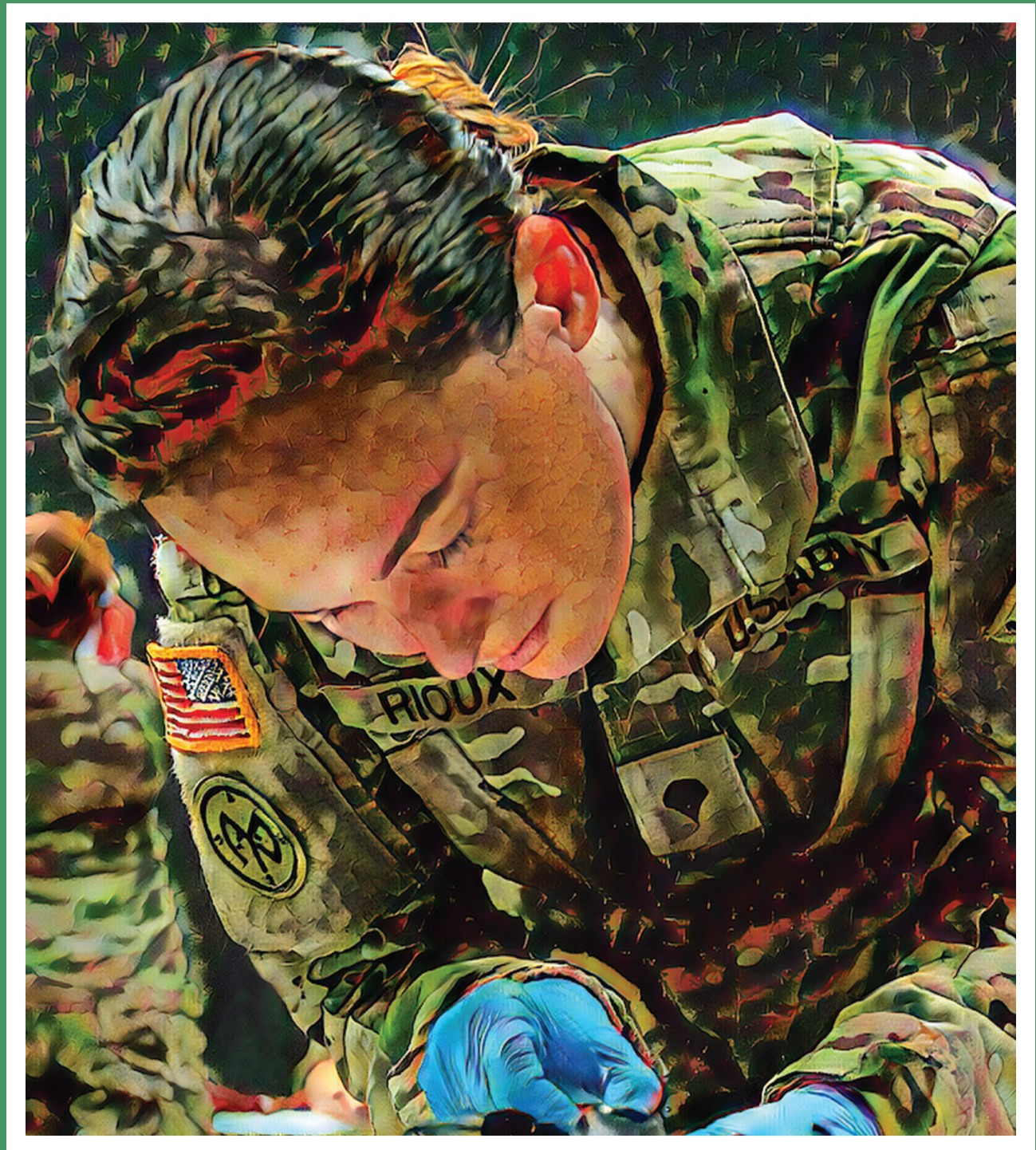


# COMBAT MEDIC SPECIALIST FIELDCRAFT

Limited Primary Care





# COMBAT MEDIC SPECIALIST FIELDCRAFT

## Limited Primary Care

PART 1 OF A 3 PART SERIES

**FIRST EDITION**

Senior Editor

Michael W. Davis, NREMTP

SFC (Ret), Texas Army National Guard



**BORDEN INSTITUTE**

US Army Medical Department Center and School  
Medical Center of Excellence  
Fort Sam Houston, Texas

**OFFICE OF THE SURGEON GENERAL**

United States Army  
Falls Church, Virginia



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## Message from the Surgeon General

COMBAT MEDICS are ubiquitous in the Army's medical footprint, providing outstanding care from sick call through tactical combat casualty care. These highly skilled and compassionate medics are deserving of the trust they earn from the service members they support. In turn, they deserve the best training available throughout their careers. The *Combat Medic Specialist Fieldcraft* textbook adds a critical tool through which the Army's second-largest Military Occupational Specialty will train to extend its lifesaving capabilities across the spectrum of conflict. Through multi-platform publishing and global availability, this textbook provides a single, comprehensive, and updatable resource for Combat Medics everywhere.



**RAYMOND S. DINGLE**

Lieutenant General, US Army

The Surgeon General and

Commanding General, USAMEDCOM



# Combat Medic Specialist Fieldcraft

IS DEDICATED TO

Sergeant First Class Benjamin L. Sebban and  
All Our Brave Combat Medics Through History

SERGEANT FIRST CLASS (SFC) BENJAMIN L. SEBBAN exemplified the combat medic ethos. He served with great honor throughout his United States Army career. During Operation Iraqi Freedom, he was the senior medic for the 73rd Cavalry Regiment (Airborne Reconnaissance). It was here that his training, love for his Soldiers, and courage all came together in a great act of heroism that cost him his life.

SFC Sebban was known for his attentiveness to the paratroopers in his unit. He constantly patrolled with them, ensuring everyone was cared for and had what they needed to succeed in combat. He roved about the patrol base, checking to make sure everyone had clean socks, caring for blistered feet, or just talking to weary paratroopers just off mission. SFC Sebban also prioritized the medics assigned to him. As a master trainer, he pushed them to be masters of their craft by providing realistic, tough, and effective training. It was common to see the medics working in the aid station with night vision goggles to practice critical skills, such as vascular access, in conditions that mirror combat environments.

On 17 March 2007, SFC Sebban was on duty in Diyala Province, Iraq, when he saw a civilian truck laden with explosives accelerating toward a combat outpost. Stepping from behind a Humvee, SFC Sebban moved toward the vehicle and warned his fellow paratroopers of the impending attack, yelling three times, until the vehicle explosion knocked him down. Although mortally wounded by shrapnel injuries to his abdomen, groin, and legs, SFC Sebban immediately moved to the aid station and treated his fellow wounded paratroopers until he collapsed and succumbed to his wounds. SFC Sebban's valiant actions safeguarded the lives of 86 paratroopers and caused enemy insurgent forces to retreat. SFC Sebban's courageous actions that day earned him the Silver Star Medal for gallantry in battle.

Medics like SFC Sebban are the reason soldiers run headlong into a gunfight to engage the enemy or to help a fellow soldier. Soldiers know that if they or their battle buddies are injured, a combat medic will be with them to provide world-class treatment at the point of injury. The US Army has the best-trained medics in the world and, just like SFC Sebban, they will give their all to treat, care for, and serve those around them with the highest dedication to duty.

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# Foreword

THE CRY “MEDIC!” may be the most emboldening sound on the battlefield. It has been screamed by thousands of Soldiers during past wars, and Combat Medics will continue to respond in future conflicts. It is the privilege of my Army career to move toward that cry and earn the title “Doc” from the Soldiers I served with, was deployed with, and fought alongside.

This text, *Combat Medic Specialist Fieldcraft*, codifies the foundational concepts every Army Combat Medic must understand and employ on demand. However, it represents a mere fraction of what is truly required to excel in this critical wartime specialty. After 11B (Infantryman), 68W is the second largest military occupational specialty (MOS) in the Army. As warfighters, we go wherever the fight takes us—by land, sea, or air. Combat Medics remain ready to shoot, move, communicate, and survive on today’s complex Multi-Domain Operations (MDO) battlefield while performing our critical medical tasks. This means that we must prioritize and practice holistic health and fitness (H2F) daily to ensure we possess the physical, mental, and moral resilience to deliver lifesaving care at the point of need. Contrary to popular belief, we rarely “rise to the occasion” when chaos ensues. Instead, we revert to our highest level of training, so we must train as we intend to fight. Combat Medics must be tactically and technically proficient. Both skill sets are perishable and require tough, realistic, and routine training to achieve the status of expert and professional.

The Army is in an era of extensive modernization. The Army of 2028 must be capable of conducting MDO and Large-Scale Combat Operations (LSCO) as part of an integrated Joint Force in a single theater, and it must be ready to do so in multiple theaters by 2035. Army Medicine plays a crucial role in the ability to deploy, fight, and win the nation’s wars across all domains. We endeavor to remain relevant by modernizing “how we fight, what we fight with, and who we are.” This means your education, as a Combat Medic, will not end when you close this textbook upon completion of Advanced Individual Training (AIT). In fact, that moment begins the next chapter of your journey and requires you to seek further knowledge in triage, damage control resuscitation, and Prolonged Casualty Care (PCC). Military medicine is a rapidly evolving discipline that requires adaptability, intellectual curiosity, and dedication.

The new generation of Combat Medics cannot expect timely casualty evacuation or rely upon the “Golden Hour” experienced in Iraq and Afghanistan during the Global War on Terrorism. Future conflicts require a robust system of ground evacuation and capable, highly trained Combat Medics with the attributes required to conserve the fighting strength for extended periods of time.

The title “Doc” comes with enormous responsibility and a legacy of courageous men and women who willingly put their lives on the line to save others. Their motivation was not for fortune, fame, or glory, but simply for the love that defines brotherhood and sisterhood — a bond that defies reason and propels Soldiers to heroic acts beyond comprehension. 68W is not only an MOS; it is a calling. You are inheriting a tradition of honor, expertise, and selfless sacrifice, and I want to thank you for answering the call.

Army Medicine is Army Strong!

**Diamond D. Hough**

Command Sergeant Major, US Army

US Army Medical Command

# Preface

DURING TRAINING, sweat and dedication save lives and reduce despair on the battlefield. Warfighters are effective because they trust in the skills and abilities of their embedded healthcare providers, Combat Medics. Army Medical professionals and pre-hospital trauma subject matter experts analyzed, updated, and packaged the most current clinical practice guidelines to best instruct the next generation of 68Ws to provide medical overmatch at the point of injury and wherever else necessary. The continuum of care reinforcing readiness begins long before kinetic operations with routine sick call and progresses through care under fire toward individual resilience and recovery. This edition covers a myriad of topics ranging from providing care, preventing infection, and handling casualties to documenting actions under the overarching principles of tactical combat casualty care. Chapters begin with key terms and core concepts, then transition to review questions and step-by-step skill drills. Combat Medics must be competent and confident in their abilities to preserve life even in the most challenging and austere conditions. Army Medicine is committed to providing world-class training for all professionals who Conserve Fighting Strength.

Army Medicine Starts Here!

**Clark J. Charpentier**

Command Sergeant Major

US Army Medical Center of Excellence

# Introduction

THIRTY YEARS AGO, my MOS 91B Combat Medic book consisted of a paper-bound, black-and-white, 400-page book with grainy, barely legible illustrations. The content mirrored books published for the National Registry Emergency Medical Technicians (NR-EMT) course, as well as treatment regimens gleaned from the Korean and Vietnam Wars. This book touched on diseases, injuries, and various treatment methods, with a medium focus on combat care. It also contained in-depth studies into the anatomy and physiology of the human body. Today's combat-focused 68W MOS is drastically different and changes every year to keep up with advances in both technology and science.

68Ws represent the second largest enlisted specialty in the US Army, with approximately 36,000 medics. Currently, a 68W student receives 10 different specialty books during training. There is no single, unified textbook that can be updated and accessed worldwide. Combat Medics cannot immediately retrieve material that is being taught at the proponency. Until now! The solution was to develop an official, approved training textbook for the 68W Combat Medics. The Borden Institute (the Medical Center of Excellence publishing arm) in collaboration with the Department of Combat Medic Training and the Department of Combat Medic Education (now the Combat Medical Specialist Training Program in the Department of Operational Medicine) energetically produced a 30-chapter text, which covers limited primary care to tactical combat casualty care.

This new 68W Combat Medic textbook will position all medics worldwide to provide the best possible care to our Warfighters, care that saves lives! Input will focus on quality, currency, and usability. This publication will be available as a spiral-bound book and online, enabling Soldiers and authorized users access everywhere the Army is located. I can also ensure that it will support initial, sustainment, and readiness training, and it will enhance overall operational readiness. The new 68W Combat Medic textbook will focus on the following areas: Tactical, Technical, and Clinical. In an effort to remain highly relevant to our Combat Medics, this text also draws material from other Combat-Medicine-centric courses such as Brigade Combat Trauma Team Training (BCT3), Joint Forces Combat Trauma Management Course (JFTCMC), and Tactical Combat Medical Care Course (TCMC). Other advantages to the publication and distribution of this book include efforts to align all 68W Combat

Medic training globally, with updates synchronized around the 68W MOS Program of Instruction cycle. In addition, it should be adaptable to all US Military services. This is especially important to our Navy Corpsmen and Air Force Medics as we attempt to move forward toward a joint medic concept. Lastly, and I think most significantly, is that this book is written by you! It is a compilation of all relevant and up-to-date 68W tasks developed by Combat Medic subject matter experts with extensive field and clinical experience. Updates will be available to accommodate the most current medical advances and ensure that the most current information is always available.

I hope that everyone out in the force is as excited as we are (at the Medical Center of Excellence) about this book. It will have a high impact on Combat Medic training effectiveness as well as operational readiness!

**James Musnicki**

Sergeant Major

US Army Medical Center of Excellence

---

Sergeant Major Musnicki currently serves as the sergeant major of academic affairs to the Office of the Commandant, US Army Medical Center of Excellence.



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**NEUTRAL LANGUAGE.** Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

# 1 SICK CALL AND MEDICAL DOCUMENTATION

## CORE CONCEPTS

- Explain documentation requirements in the clinical setting.
- Utilize the sick call process.
- Identify critically ill patients.
- Document medical care in a medical record.
- Define the SOAP method.
- Identify the documentation forms used in the clinical setting.
- Interpret HIPAA restrictions on how patient information is used or distributed.

## INTRODUCTION

Knowledge of sick call procedures and the principles of accurate patient care documentation are bed-rock concepts of military medical care. Entries written in a patient's medical record are part of a legal and permanent written document. Accurate observation and documentation of the patient's symptoms and your observations are critical to appropriate treatment and recovery. If documentation is incomplete or poorly entered into a medical record, a patient may receive improper or potentially harmful care. The information that is documented in a medical record is used by physicians, nursing personnel, and physician assistants to plan, implement, and evaluate a patient's course of treatment. This chapter will provide you with an overview of sick call concepts and procedures as well as an opportunity to learn and practice a crucial part of the medical record documentation (Figure 1-1).

### FORMS USED DURING THE SICK CALL PROCESS

The Department of Defense (DD) Form 689, Individual Sick Slip (Figure 1-2), is used when initiating the sick call process. This form is used when a soldier requests or receives medical or dental treatment at an Army medical treatment facility (MTF). In addition, the DD Form 689, Individual Sick Slip, is also used as



**Figure 1-1.** Combat medics are performing sick call procedures (SOAP note writing) during War Days Battalion Aid Station training.

a means of communication between medical personnel and the patient's commander.

Use Standard Form (SF) 600, Chronological Record of Medical Care (Figure 1-3) to document the chronological record of outpatient treatment. Include date, time of visit or entry, MTF involved, and the signature of the person making the entry.

| INDIVIDUAL SICK SLIP                                                        |                   | DATE                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> ILLNESS <input type="checkbox"/> INJURY |                   | 20140220                                                                                                                                                                                                                                                    |
| LAST NAME - FIRST NAME - MIDDLE INITIAL OF PATIENT<br>Doe - John - J.       |                   | ORGANIZATION AND STATION<br>C 3/327 Inf<br>FT Campbell, KY                                                                                                                                                                                                  |
| SERVICE NUMBER/SSN<br>123-45-6789                                           | GRADE/RATE<br>E-1 |                                                                                                                                                                                                                                                             |
| UNIT COMMANDER'S SECTION                                                    |                   | MEDICAL OFFICER'S SECTION                                                                                                                                                                                                                                   |
| IN LINE OF DUTY                                                             |                   | IN LINE OF DUTY                                                                                                                                                                                                                                             |
| REMARKS<br>Sore throat.                                                     |                   | DISPOSITION OF PATIENT <input type="checkbox"/> DUTY <input checked="" type="checkbox"/> QUARTERS<br><input type="checkbox"/> SICK BAY <input type="checkbox"/> HOSPITAL<br><input type="checkbox"/> NOT EXAMINED <input type="checkbox"/> OTHER (Specify): |
|                                                                             |                   | REMARKS<br>Quarters for 48 hours. Follow-up at 0630 on 22 February 2014.                                                                                                                                                                                    |
| SIGNATURE OF UNIT COMMANDER<br><i>John Michael Doe, Sr., 187th SDRCO</i>    |                   | SIGNATURE OF MEDICAL OFFICER<br><i>Mercedes H. PA-C</i>                                                                                                                                                                                                     |

DD FORM 689, MAR 63

PREVIOUS EDITIONS ARE OBSOLETE.

**Figure 1-2.** The Department of Defense Form 689 (Individual Sick Slip) documents patient identification, administrative data, and information about the injury or illness.

### Check on Learning

1. What is the purpose of DD Form 689?
2. What is the purpose of SF 600?

### MAKING MEDICAL ENTRIES ON STANDARD FORM 600

When documenting information on an SF 600, follow the requirements below for each entry:

- Legibly typed or handwritten in black or blue-black ink.
- Signed by the individual who made the entry (sign above printed name and title). For the military personnel signature block, sign with full payroll signature, rank, military occupational specialty, and branch of service. For the civilian personnel signature block, sign with full payroll signature, title, and grade scale level (pay grade).
- Dated in the day-month-year sequence (eg, 25 SEP 2016).
- Capitalized (the first word of each entry).
- Written with present- or past-tense verbs.
- Recorded as soon as possible.

- Written using only approved abbreviations in accordance with Army Regulation 40-66 (Figure 1-4).
- Clear, concise, and objective.

To correct an entry error, draw a single line through the information, write "error," and initial (Figure 1-5). If the documentation was completed but information must be changed, add the correct information, the reason for the change, and the date and signature block of the person making the change.

**Note:** When documenting patient care on a patient report **do not**:

- erase or use correction fluid,
- skip lines,
- write between lines,
- document information for someone else, or
- leave blank lines above the signature.

### Check on Learning

3. To save time, Specialist Fry invented several abbreviations to document patient care. Now his patient care documentation is quick, and the time saved is used to help restock shelves with supplies. Is this a good practice?

**CHRONOLOGICAL RECORD OF MEDICAL CARE**  
Medical Record  
**STANDARD FORM 600** (REV. 6-97)  
Prescribed by GSA/ICMR  
FIRMR (41 CFR) 201-9.202-1

3



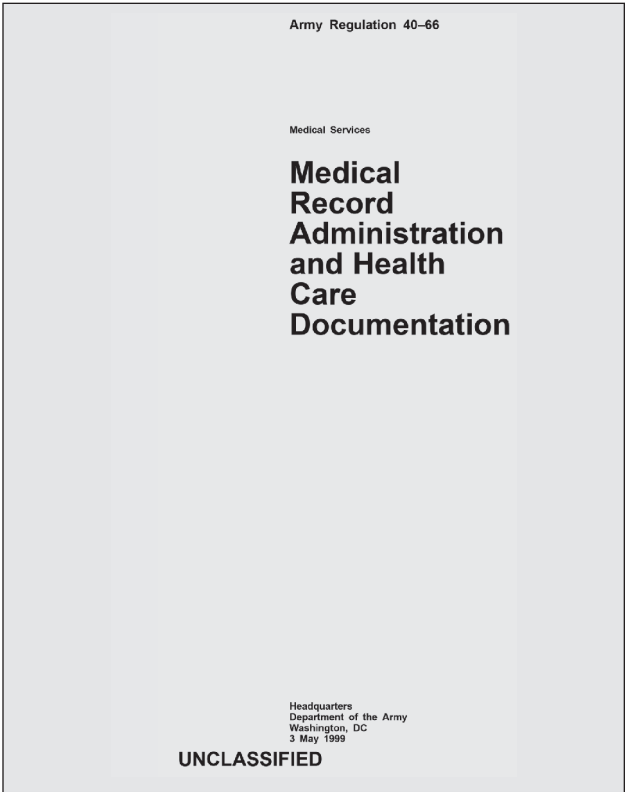


**Figure 1-4.** Army Regulation 40-66 (Medical Record Administration and Health Care Documentation) provides policies for preparation and use of medical reports and records.

### INITIATING THE SICK CALL PROCESS

The individual soldier obtains a DD Form 689 (Individual Sick Slip) from his or her first-line supervisor (section sergeant or platoon sergeant) to present to sick call. This ensures that accountability is maintained at the MTF and within the soldier's unit. Once the soldier obtains a DD 689, he or she proceeds to the MTF.

On arrival, the soldier is signed into a daily disposition log. This log is usually maintained by a combat medic. The combat medic will note the soldier's name, unit/section, time of arrival, reason for the visit, and (upon departure) disposition (return to duty or any **profile** issued). The combat medic retrieves the soldier's medical records, stored at the MTF, and initiates an entry on the SF 600 (Chronological Record of Medical Care). The soldier's vital signs, chief complaint, medical history, assessment, and treatment are also documented on the SF 600. **SOAP** is a useful acronym that represents subjective, objective, assessment, and plan. These are the four main areas that cover patient assessment and treatment. Protocol is established by the MTF's medical officer (MO) for the extent of medical history and physical examination that the combat medic will elicit prior to the soldier's evaluation by the MO (Figure 1-6).

| MEDICAL RECORD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                             | CHRONOLOGICAL RECORD OF MEDICAL CARE                                           |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--|
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| DATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                             | SYMPTOMS, DIAGNOSIS, TREATMENT, TREATING ORGANIZATION <i>(Sign each entry)</i> |  |
| 3 Mar 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | S: 24 y.O. AD male $\bar{c}$ <u>2<sup>error</sup> mws</u> 1 day hx of $\odot$ ankle pain $\bar{p}$ ruck march. No previous Trauma /surgery. |                                                                                |  |
| P 98                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $\downarrow$ strength in $\odot$ foot 2° TO pain. Patient stated                                                                            |                                                                                |  |
| BP 111/78                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | "I was ruck marching when I stepped on a rock and                                                                                           |                                                                                |  |
| R 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | rolled my ankle." /                                                                                                                         |                                                                                |  |

**Figure 1-5.** Occasionally entries on the Standard Form 600 (Chronological Record of Medical Care) may be incorrect due to transcription error, misunderstanding, or other reasons. The proper way to correct a mistake on the form is shown here.

| MEDICAL RECORD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CHRONOLOGICAL RECORD OF MEDICAL CARE                                                                                                             |                                                                                                                                                                                           |                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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| DATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | SYMPTOMS, DIAGNOSIS, TREATMENT, TREATING ORGANIZATION (Sign each entry)                                                                          |                                                                                                                                                                                           |                       |
| 3 Mar 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | S: 24 y.o. AD male $\bar{c}$ <del>2</del> <sup>error</sup> mwd 1 day hx of $\odot$ ankle pain $\bar{p}$ ruck march. No previous Trauma /surgery. |                                                                                                                                                                                           |                       |
| P 98                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | $\downarrow$ strength in $\odot$ foot 2° TO pain. Patient stated                                                                                 |                                                                                                                                                                                           |                       |
| BP 111/78                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | "I was ruck marching when I stepped on a rock and                                                                                                |                                                                                                                                                                                           |                       |
| R 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | rolled my ankle." /                                                                                                                              |                                                                                                                                                                                           |                       |
| T 98.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | O: Soldier carried into clinic by other Soldiers.                                                                                                |                                                                                                                                                                                           |                       |
| O <sub>2</sub> 97% room air                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Patient unable to walk $\bar{s}$ assistance. Marked STS                                                                                          |                                                                                                                                                                                           |                       |
| A: NKDA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | over entire ankle $\bar{c}$ bruising over $\odot$ lateral calf,                                                                                  |                                                                                                                                                                                           |                       |
| M: Motrin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ankle and foot. $\downarrow$ ROM all areas 2° TO pain.                                                                                           |                                                                                                                                                                                           |                       |
| P: None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Good pulses distal to injury. Cap refill $\leq$ 2 seconds.                                                                                       |                                                                                                                                                                                           |                       |
| L: Water & Gatoraid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | TTP over bony prominence of $\odot$ lateral malleolus.                                                                                           |                                                                                                                                                                                           |                       |
| E: Ruck march                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Positive Anterior Drawer and Inversion Talar Tilt Test. /                                                                                        |                                                                                                                                                                                           |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A: $\odot$ lateral ankle sprain R/O fx. R/O achilles tendon tear. /                                                                              |                                                                                                                                                                                           |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | P: Refer to M.D. Michael C. Davis PFC 68W                                                                                                        |                                                                                                                                                                                           |                       |
| HOSPITAL OR MEDICAL FACILITY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                  | STATUS                                                                                                                                                                                    | DEPARTMENT/SERVICE    |
| SPONSOR'S NAME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                  | SOCIAL SECURITY/ID NUMBER                                                                                                                                                                 | RECORDS MAINTAINED AT |
| PATIENT'S IDENTIFICATION: (For typed or written entries, give: Name - last, first, middle; ID NUMBER or Social Security Number; Gender; Date of Birth; Rank/Grade.)                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                  | REGISTER NUMBER                                                                                                                                                                           | WARD NUMBER           |
| Doe, John J.<br>123-45-6789<br>Male<br>19880201<br>PFC / E-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                  |                                                                                                                                                                                           |                       |
| PREVIOUS EDITION IS NOT USABLE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                  | <p align="center"><b>CHRONOLOGICAL RECORD OF MEDICAL CARE</b><br/>Medical Record<br/><b>STANDARD FORM 600</b> (REV. 11/2010)<br/>Prescribed by GSA/ICMR<br/>FIRM (41 CFR) 201-9.202-1</p> |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  | AUTHORIZED FOR LOCAL REPRODUCTION                                                                                                                                                         |                       |

**Figure 1-6.** This Standard Form 600 (Chronological Record of Medical Care) is filled out in the SOAP note format. Documentation may be subject to local standard operating procedures, so combat medics should make sure that they are following the correct format and style for their unit or medical treatment facility.

## EARLY IDENTIFICATION OF CRITICALLY SICK PATIENTS

Most patient encounters during sick call are not emergencies. However, a small number of patients will present with signs or symptoms that could indicate a serious underlying disease or injury. In the clinical setting, triage is defined as “the sorting of patients and setting priorities for treatment in urgent care settings, emergency departments, clinics, hospitals, health maintenance organizations, or in the field.”<sup>1</sup> For example, headache, nausea, and sensitivity to bright light are signs and symptoms that are experienced by patients who have migraine headaches, as well as those who have bacterial meningitis. The signs and symptoms useful for identifying bacterial meningitis are fever and the inability to touch the chin to the chest. A properly conducted triage will differentiate between the two conditions and ensure that the patient with bacterial meningitis is seen first by the MO. Look for patients with worrisome signs and symptoms to ensure they are the priority for evaluation by an MO (Figure 1-7). If a patient is suspected of being critically ill, take the following steps:

- Obtain the patient’s chief complaint (reason for reporting to sick call) on his or her arrival to the MTF. Identify any patients with signs



**Figure 1-7.** This combat medic is triaging a patient for possible meningitis during War Days Battalion Aid Station training. If the disease is suspected, the patient becomes a priority for examination by a medical officer.

and symptoms that have increased potential for complications. Examples include:

- headache,
- acute vision changes,
- neck pain or stiffness,
- chest pain,
- shortness of breath,
- abdominal pain, and
- altered mental status.
- Promptly obtain vital signs and notify the MO of these results and the signs and symptoms. If the situation permits, examine related body areas (in accordance with your skill level and training). If in a garrison environment, be familiar with the procedures for activating emergency medical services.

## HISTORY-TAKING TECHNIQUES

Use the SOAP method to ensure that the main components of the patient history are addressed. Use the following skills to gather an accurate patient history:

- **Observe.** Begin observing the soldier as soon as he or she walks through the door.
- **Listen.** Listen carefully. (This will help in determining the cause of the problem.)
- **Ask open-ended questions.** Open-ended questions help you obtain more complete and accurate information. For example, “What does the pain feel like?” is more useful than asking, “Does the pain feel like an elephant is sitting on your chest?”

Common obstacles to compiling an accurate patient history include the following:

- **Provider obstacles.** Providers’ attitudes or predeterminations may hinder their ability to make accurate judgments. A patient seen repeatedly at an aid station who rarely has identifiable problems can be a challenge. It must be assumed that every patient has a legitimate complaint at each visit. This ensures that a significant illness or injury is not missed.
- **Patient obstacles.** Patients may also have obstacles to overcome. They must have confidence in their medical care. Soldiers seeking medical evaluation and treatment have expectations that may or may not be realistic. For instance, patients without medical training will very often request spe-



cific diagnostic studies such as radiographs, blood tests, and referrals to specialists in situations where they are not warranted. Asking the right questions will get more information and the answers received will direct the physical examination. Maintain a high index of suspicion. This requires paying close attention to reported symptoms and considering all possibilities that could account for them. Any injury reported by the patient should raise or lower your index of suspicion about the potential severity of the injury. For example, a patient complaining of pain after twisting a knee while running probably has less potential for a significant injury than a patient who twisted a knee following a parachute-landing fall.

### Obtain Subjective Information from a Patient

Subjective information is provided by the patient. It is needed to obtain a relevant history of the patient's present or past related symptoms or chief complaint. This information is not necessarily found in an examination; it may be what the patient reports feeling and it is usually documented in direct quotes from the patient. Subjective information includes the following:

- age, sex, race, and first day of last menstrual period (FDLMP) for all female patients of child-bearing age;
- chief complaint (the patient's stated reason for the visit)—for example, "I twisted my ankle while running this morning";
- history of present illness (all the information relevant to the patient's chief complaint);
- past medical history (any significant medical diagnosis or disease condition the patient has, such as hypertension or diabetes);
- past surgical history (any significant surgical procedures that have been performed, such as appendectomy, tonsillectomy, or cesarean delivery);
- social history (patient's use of tobacco, alcohol, and illegal substances);
- occupation and leisure activities may be relevant and are entered as social history;
- last oral intake (the last thing the patient had to eat or drink and when it was consumed); and
- events or situation leading up to illness or injury, if known. For example, "I was driving 30 mph without a seatbelt when my car hit a car stopped in front of me."

The following are the principal components of the chief complaint. They can be remembered easily with the acronym **OPQRST**:

- **Onset.** Sudden? Gradual? Specific injury or activity?
- **Provoking or palliative factors.** What makes it worse or better?
- **Quality.** What does the pain feel like? Sharp? Dull?
- **Radiation or region.** Where is the pain? Is it localized to one area?
- **Severity.** How would you score the pain on a scale of 1 to 10 (with 10 being the worst pain the patient has ever had)? Does it limit activity?
- **Timing.** Duration? Is the pain intermittent? Constant?

Past history involves information that may contribute to understanding the present illness or injury. This information may be helpful in determining possible causes of the chief complaint or rule out other possible causes, and it may also impact your treatment decisions. The acronym **SAMPLE** provides an easy way to remember the components of past history:

- signs and symptoms;
- allergies;
- medications;
- past medical, surgical, and social history;
- last oral intake; and
- event leading up to illness or injury.

### Check on Learning

4. List four subjective information components.

### Obtain Objective Information about the Patient

Objective information is data obtained by the combat medic or medical provider through the use of the senses, such as sight, sound, touch, hearing, and smell. Use medical instruments to quantify the data. Ensure that nothing from the soldier's comments or history is recorded in this section. Collect and record the following clinical measurements and vital signs:

- height,
- weight,
- pulse,
- respiratory rate,
- blood pressure,
- temperature, and
- oxygen saturation (pulse oximetry reading).

“General impression” (GEN) is a statement of the combat medic’s initial notion of the current state of the patient’s general health. For example, the combat medic might write, “GEN-patient appears or seems to be in no acute distress (NAD),” or “GEN-patient appears to be in severe pain.”

When performing a physical exam of the patient, start with the body area that is related to the information annotated in the subjective area of the SOAP note. If a patient presents with an altered mental status or shock, conduct a complete head-to-toe assessment to rule out hemorrhage or trauma. Assess the following areas of the body to obtain information for the SF 600:

- **Orthopedic**

- Inspection. To localize pain, ask the patient to place a finger on the spot that hurts. Look for edema, ecchymosis, erythema, atrophy, deformities, and posture. Compare the affected extremity to the unaffected one. Observe the patient walk and analyze the gait and arm swing. Determine if the patient can apply weight to the extremity. An acronym to use when inspecting each body area is **DCAP-BTLS**. This acronym represents deformities, contusions, abrasions, punctures and penetrations, burns, tenderness, lacerations, and swelling.
- Palpation. Palpate the affected area for tenderness and temperature changes; assess for pulse, motor, and sensory deficit (PMS).
- Range of motion (ROM). Assess the range of motion of the affected and unaffected extremities, neck, and back. Document any decreased range of motion on the SF 600.
- Muscle strength. Note differences in muscle strength through resistance tests.
- Special tests. Observing how a patient reacts to stretching or stress on a joint and tissue may make the evaluation more efficient and provide valuable clues to the diagnosis. There are many special tests for specific anatomical injuries and disorders.

- **Skin**

- Inspection. Note the general color of the skin, vascularity, and evidence of bleeding or bruising.
- Palpation. Assess the temperature and general condition of the skin.

- Observe any lesions of the skin. Note anatomical location, distribution, grouping, type, and color.

- **Eyes, Ears, Nose, and Throat**

- Inspect and palpate external and internal (where applicable) structures of the eyes, ears, nose sinuses, and throat for DCAP-BTLS and foreign bodies.
- Special tests. Visual acuity and pupillary reaction of the eyes or other special tests may be indicated.

- **Chest (Respiratory)**

- Inspect and palpate both the anterior and posterior thorax for DCAP-BTLS.
- Note the rate, rhythm, and quality (effort) of breathing.
- Auscultate breath sounds bilaterally.

- **Abdomen**

- Ask the patient to point to the painful areas and examine those last.
- Inspect for DCAP-BTLS and **TRD-P** (tenderness, rigidity, distention, and pulsating masses).
- Auscultate each of the four abdominal quadrants for the presence of bowel sounds. The peristaltic action of the bowel produces 5 to 34 clicks or gurgles per minute in each quadrant.

## Complete an Assessment

Document the presumptive diagnosis based on the history and physical examination findings. If unsure of the diagnosis, simply restate the patient’s chief complaint. For example, “A- R knee pain” means Assessment- Right knee pain. The goal is to restate the patient’s chief complaint.

## Check on Learning

5. List four objective information components.
6. If you are unable to assess the patient’s specific problem, what should you write?

## Develop a Treatment Plan

The treatment plan should include courses of action relevant to the assessment of the patient. Treatment plans may include the following:

- medications and dosages, as prescribed by the MO or from standard operating procedures (SOPs);

- specific duty and activity restriction (profile) if applicable; and
- special actions if any, such as ice or heat, compression, elevation, splint, or crutches.

Refer all **RED FLAGS** to an MO. The entire treatment plan may be as simple as “P- Refer to MO.” The treatment plan should state when the patient should return for a follow-up evaluation. Every SOAP note should include the circumstances under which the patient should return to an MTF. For example, “Return to clinic (RTC) if symptoms persist, worsen, or new symptoms develop.”

## PROFILES

A physical profile defines, in writing, limitations to physical activity due to injury, illness, or medical condition. The authorized forms for written profiles in the Army are the DD Form 689 (Individual Sick Slip) and DA Form 3349 (Physical Profile). DA Form 3349 is preferred over DD Form 689 because it requires a much more detailed description of the soldier’s condition and the activities and exercises that he or she can perform. Soldiers may be assigned to a reconditioning program. Such soldiers include those who are on temporary medical profile, are in their recovery period after temporary profile expiration, or are on permanent medical profile with specific limitations or special fitness requirements.

Unless specifically authorized by the supervising MO and local protocol, combat medics are not authorized to issue profiles, **quarters**, or **bed rest**. Medical care providers will follow the local protocols and consult with or refer to an MO when the plan section of this medical documentation suggests a profile or quarters. Profiles should be written in nonmedical language and should be specific concerning physical limitations. Profiles should contain a specific expiration date, for example, “no running until 15 April.” Profiles that contain terms such as “x 14 hrs” or “x 3 days” may be misunderstood, particularly if the patient was seen in the afternoon or on a Friday. When writing for quarters, if the plan calls for quarters for 48 hours, write: “24 Sep 2016 to 25 Sep 2016. Return to MTF at 0630 on 26 Sep 2016.”

The term “quarters” means restriction and rest in the patient’s place of domicile. It should allow the patient freedom of movement within the living space, including common areas such as the day room. Patients on quarters may not perform military duties. Quarters will not normally exceed 72 hours. The term “bed rest” means the patient is restricted to their bed, with

allowances for necessary travel to the dining facility and latrine. Patients on bed rest may not perform any military duties. Further restriction is determined on a case-by-case basis. The term “duty” means the patient is returned to his unit for full duty without any restrictions. Army Directive 2016-07 (Redesign of Personnel Readiness and Medical Deployability) forces commanders to follow profile instructions shown in Figure 1-8.

## Check on Learning

7. What is the difference between quarters and bed rest?
8. Can a commander force a soldier to break a profile?
9. If you do not know the nature of the patient’s medical problem, what should you write for the plan?

## PATIENT CONFIDENTIALITY

On August 21, 1996, President Bill Clinton signed into law the Health Insurance Portability and Accountability Act (**HIPAA**). This federal law protects the privacy of patient-specific health care information and gives the patient control over how this information is used and distributed. The Military Command Exception allows a covered entity to disclose personal health information (PHI) of service members to their commanders. This exception does not constitute a requirement and only permits the disclosure. When PHI of a soldier is disclosed, only the minimum amount of information necessary is provided. The military command exception does not allow a commander to directly access a soldier’s medical record. Examples of activities for which PHI may be disclosed to a commander are determining a soldier’s fitness for duty, the performance of a particular assignment, and the soldier’s ability to carry out any other activity essential for the military mission. Medical confidentiality must be protected as fully as possible for all patients. Access to medical information may be given to the patient, patient care personnel, medical researchers, public health professionals, and medical educators. Do not discuss patient information within hearing range of other patients or with unauthorized personnel. Unauthorized disclosure of medical information is subject to federal law. Action can also be taken against the offender under the Uniform Code of Military Justice (UCMJ). Personnel not involved in a patient’s care or in medical research may not have access to patient information unless the following situations apply:

| PHYSICAL PROFILE                                                                                                                                                                                                                                                                                                                |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------|--|------------------------------------------------------------------|----------------------------------------|--|------------------------|--------------------------------------------------------------|-------------|--|
| For use of this form, see AR 40-501; the proponent agency is the Office of the Surgeon General.                                                                                                                                                                                                                                 |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| 1. MEDICAL CONDITION: (Description in lay terminology) <input type="checkbox"/> INJURY? Or <input checked="" type="checkbox"/> ILLNESS/DISEASE?                                                                                                                                                                                 |  |                                                              |  |                                                                  | 2. CODES (Table 7-2 AR 40-501)         |  | 3.                     |                                                              | P U L H E S |  |
|                                                                                                                                                                                                                                                                                                                                 |  |                                                              |  |                                                                  | B                                      |  | Temporary<br>Permanent |                                                              | 1 1 2 1 1 1 |  |
| 4. PROFILE TYPE                                                                                                                                                                                                                                                                                                                 |  |                                                              |  |                                                                  |                                        |  |                        | YES NO                                                       |             |  |
| a. TEMPORARY PROFILE (Expiration date YYYYMMDD) (Limited to 3 months duration)                                                                                                                                                                                                                                                  |  |                                                              |  |                                                                  |                                        |  |                        | <input type="checkbox"/> <input checked="" type="checkbox"/> |             |  |
| b. PERMANENT PROFILE (Reviewed and validated with every periodic health assessment or after 5 years from the date of issue)                                                                                                                                                                                                     |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| 5. FUNCTIONAL ACTIVITIES THAT EVERY SOLDIER REGARDLESS OF MOS MUST BE ABLE TO PERFORM. IF SOLDIER CANNOT PERFORM ANY ONE OF THESE TASKS, THEN THE PULHES MUST CONTAIN AT LEAST ONE "3" AND SOLDIER MUST BE REFERRED TO A MEB. CAN THE SOLDIER:                                                                                  |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| FUNCTIONAL ACTIVITY:                                                                                                                                                                                                                                                                                                            |  |                                                              |  |                                                                  |                                        |  |                        | YES NO                                                       |             |  |
| a. Carry and fire individual assigned weapon?                                                                                                                                                                                                                                                                                   |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| b. Evade direct and indirect fire?                                                                                                                                                                                                                                                                                              |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| c. Ride in a military vehicle for at least 12 hours per day?                                                                                                                                                                                                                                                                    |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| d. Wear a helmet for at least 12 hours per day?                                                                                                                                                                                                                                                                                 |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| e. Wear body armor for at least 12 hours per day?                                                                                                                                                                                                                                                                               |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| f. Wear load bearing equipment (LBE) for at least 12 hours per day?                                                                                                                                                                                                                                                             |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| g. Wear military boots and uniform for at least 12 hours per day?                                                                                                                                                                                                                                                               |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| h. Wear protective mask and MOPP 4 for at least 2 continuous hours per day?                                                                                                                                                                                                                                                     |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| i. Move 40lbs (for example, duffle bag) while wearing usual protective gear (helmet, weapon, body armor and LBE) at least 100 yards?                                                                                                                                                                                            |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| j. Live in an austere environment without worsening the medical condition?                                                                                                                                                                                                                                                      |  |                                                              |  |                                                                  |                                        |  |                        | <input checked="" type="checkbox"/> <input type="checkbox"/> |             |  |
| 6. APFT                                                                                                                                                                                                                                                                                                                         |  | YES NO                                                       |  | ALTERNATE APFT (Fill out if unable to do APFT run otherwise N/A) |                                        |  |                        | N/A YES NO                                                   |             |  |
| 2 MILE RUN                                                                                                                                                                                                                                                                                                                      |  | <input type="checkbox"/> <input checked="" type="checkbox"/> |  | APFT WALK                                                        |                                        |  |                        | <input type="checkbox"/> <input checked="" type="checkbox"/> |             |  |
| APFT SIT-UPS                                                                                                                                                                                                                                                                                                                    |  | <input type="checkbox"/> <input checked="" type="checkbox"/> |  | APFT SWIM                                                        |                                        |  |                        | <input type="checkbox"/> <input checked="" type="checkbox"/> |             |  |
| APFT PUSH UPS                                                                                                                                                                                                                                                                                                                   |  | <input checked="" type="checkbox"/> <input type="checkbox"/> |  | APFT BIKE                                                        |                                        |  |                        | <input type="checkbox"/> <input checked="" type="checkbox"/> |             |  |
| 7. DOES THE SOLDIER MEET RETENTION STANDARDS IAW CHAPTER 3 AR 40-501?                                                                                                                                                                                                                                                           |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| YES <input type="checkbox"/> NEEDS MMRB NO <input type="checkbox"/> NEEDS MEB                                                                                                                                                                                                                                                   |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| 8. FUNCTIONAL LIMITATIONS AND CAPABILITIES AND OTHER COMMENTS:                                                                                                                                                                                                                                                                  |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| Back pain (L2) 3-39h.                                                                                                                                                                                                                                                                                                           |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| <input type="checkbox"/> This temporary profile is an extension of a temporary profile first issued on _____                                                                                                                                                                                                                    |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| 9. NAME, GRADE & TITLE OF PROFILING OFFICER                                                                                                                                                                                                                                                                                     |  |                                                              |  |                                                                  | 10. SIGNATURE                          |  |                        | 11. DATE (YYYYMMDD)                                          |             |  |
| CIV Michael Davis, MD, -1                                                                                                                                                                                                                                                                                                       |  |                                                              |  |                                                                  | DAVIS, MICHAEL WAYNE.                  |  |                        | 20140220                                                     |             |  |
| 12. NAME & GRADE OF APPROVING AUTHORITY                                                                                                                                                                                                                                                                                         |  |                                                              |  |                                                                  | 13. SIGNATURE                          |  |                        | 14. DATE (YYYYMMDD)                                          |             |  |
| <<Approval not required>>                                                                                                                                                                                                                                                                                                       |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| 15. Commanders can access the electronic profiles of Soldiers in their unit(s) by going to <a href="http://www.mods.army.mil/">http://www.mods.army.mil/</a> and clicking on eProfile in the list of applications. Commanders will be required to register and be approved in eProfile before they can gain access to profiles. |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| 16. PATIENT'S IDENTIFICATION                                                                                                                                                                                                                                                                                                    |  |                                                              |  |                                                                  | 17. HOSPITAL OR MEDICAL FACILITY       |  |                        |                                                              |             |  |
| a. NAME: (Last, First) Doe, John J.                                                                                                                                                                                                                                                                                             |  |                                                              |  |                                                                  | Anywhere Medical Center                |  |                        |                                                              |             |  |
| b. GRADE/RANK: E-7 / SFC                                                                                                                                                                                                                                                                                                        |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| c. SSN: 123-45-6789                                                                                                                                                                                                                                                                                                             |  |                                                              |  |                                                                  |                                        |  |                        |                                                              |             |  |
| d. UNIT: C Co, 3/327th Inf, 101st ABN                                                                                                                                                                                                                                                                                           |  |                                                              |  |                                                                  | 18. PROFILING OFFICER E-MAIL           |  |                        |                                                              |             |  |
|                                                                                                                                                                                                                                                                                                                                 |  |                                                              |  |                                                                  | mdavis1234@anymilitaryinstallation.mil |  |                        |                                                              |             |  |

DA FORM 3349, SEP 2010

PREVIOUS EDITIONS ARE OBSOLETE

Page 1 of 2  
APD PE v1.00ES

**Figure 1-8.** Department of the Army Form 3349 (Physical Profile) may be used to document temporary or permanent medical conditions that limit a soldier's functional or physical fitness activities.



- access is required by law (court order),
- access is needed for hospital accreditation, or
- access is authorized by the patient.

All requests for medical information are done in writing except in emergency situations. This information is handled by patient administration personnel and is not provided by the combat medic.

### Check on Learning

10. First Sergeant Williams approaches the desk while you are conducting sick call triage. He tells you to print and provide him with all medical records for Private Shaffer. Should you provide the records? Why or why not?
11. If someone other than the patient requests copies of medical records, where should the request be directed?

### SUMMARY

Properly executing sick call procedures and medical documentation can be some of the most challenging tasks conducted by a combat medic. The general rule of thumb is if treatment was not documented then that treatment was not performed, regardless of what is said. All paper or electronic documentation must be filed in the patient's medical records.

The importance of documentation and communication cannot be overstated. The ability to identify a critically ill or injured patient early in the sick call process can save lives and speed up a soldier's return to the unit. Precise attention to detail will ensure that all assessment findings and treatment are annotated on the appropriate forms. Improper sick call procedures, as well as improper documentation, can have devastating and long-lasting effects on a soldier's future.

### KEY TERMS AND ACRONYMS

**Bed rest.** The patient is restricted to his or her bed, with allowance for necessary travel to the dining facility and latrine.

**DCAP-BTLS.** Deformity, contusion, abrasion, punctures and penetrations, burns, tenderness, lacerations, and swelling; used when performing an exam of each body part during the combat casualty assessment.

**HIPAA.** The Health Insurance Portability and Accountability Act; a federal law protecting the privacy of patient-specific health care information and providing the patient with control over how this information is used and distributed.

**MO.** Medical officer.

**OPQRST.** Onset, provoking or palliative factors, quality, radiation or region, severity, and timing; used to obtain patient history information.

**Profile.** Limitations to physical activity due to injury, illness, or medical condition.

**Quarters.** Restriction and rest in the patient's place of domicile.

**RED FLAGS.** Signs and symptoms that require immediate referral to a medical officer.

**SAMPLE.** Signs and symptoms; allergies; medications; past medical, surgical, and social history; last oral intake; and event leading up to illness or injury. Used to note past history.

**SOAP.** Subjective, objective, assessment, and plan; used help the combat medic complete the patient note.

**TRD-P.** Tenderness, rigidity, distention, and pulsating masses.

### CHECK ON LEARNING ANSWERS

1. What is the purpose of DD form 689?

*To request medical treatment and provide communication between commanders and medical personnel.*

2. What is the purpose of SF 600?

*It is a form used for medical documentation.*

3. In order to save time, Specialist Fry has invented several abbreviations to document patient care. Not only is his patient care documentation completed quickly, but the time saved is used to help restock shelves with supplies. Is this a good practice?

*No. You should only use approved abbreviations in accordance with Army Regulation 40-66.*

4. List four subjective information components.

*Any four of the following: age, sex, race, and first day of last menstrual period (FDLMP) for all female patients of child-bearing age, chief complaint, SAMPLE history, social history, and any OPQRSTI information.*

5. List four objective information components.

*Vital signs, patient's height and weight, and any physical exam findings.*

6. If you are unable to assess the patient's specific problem, what should you write?

*Restate the patient's chief complaint.*

7. What is the difference between quarters and bed rest?

*Patients on bed rest may use the dining facility.*

8. Can a commander force a soldier to break a profile?

*No. It is prohibited by Army Directive 2016-07.*

9. If you do not know the nature of the patient's medical problem, what should you write for the plan?

*P-Refer to MO.*

10. First Sergeant Williams approaches the desk while you are conducting sick call triage. He tells you to print and provide him with all medical records for Private Shaffer. Should you provide the records? Why or why not?

*No. Health Insurance Portability and Accountability Act (HIPAA) protects Private Shaffer's records. Respectfully inform First Sergeant Williams his request for patient care records must be made to the Patient Administration Office and inform your physician assistant of the conversation.*

11. If someone other than the patient requests copies of medical records, where should the request be directed?

*The request should be sent to the patient administrator.*

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This Army regulation sets policies and procedures for the preparation, disposition, and use of Army electronic and paper medical records and other health care documentation.



# 2

# INFECTION, ASEPSIS, AND STERILE TECHNIQUE

## CORE CONCEPTS

- Discuss microorganisms and their effects in health care.
- Define pathogen.
- Identify the components of the chain of infection.
- Describe the basic procedures of infection control and state why they are used.
- Define asepsis.
- State the single most effective measure in preventing the spread of disease.
- Use proper sterile technique.
- Demonstrate the procedures for patient care hand washing, donning sterile gloves, and removing gloves.

## INTRODUCTION

Preventing infection is vital to a health care facility's operation. Practicing techniques of medical and surgical **asepsis** will help protect health care workers and patients from infection. In ancient times, demons and evil spirits were thought to cause pestilence and infection. Hippocrates (460–377 BCE), the great healer of his time, irrigated wounds with wine or boiled water, foreshadowing asepsis. Galen (130–200 CE), a Greek man who practiced medicine in Rome, was the most distinguished physician after Hippocrates. He was also an early pioneer of asepsis because he boiled used surgical instruments after caring for wounded gladiators. In the early to mid-1800s, people such as Louis Pasteur introduced the world of microorganisms. Since that time, humans witnessed the invention of the steam sterilizer (1886), the practice of passive and active immunization, and the use of antibiotics.

## MICROORGANISMS

**Microorganisms** or **microbes** are minute living cells not visible to the human eye. They are so small that they can only be seen with the aid of a microscope (Figure 2-1). The vast number of species that exist are found in many locations, including those in hostile environments previously thought to be incapable of sustaining life. Many species reside in or on humans

and other animals. Some species are beneficial, others are harmful, and some are simply present (neither helpful nor harmful). Microorganisms that add the

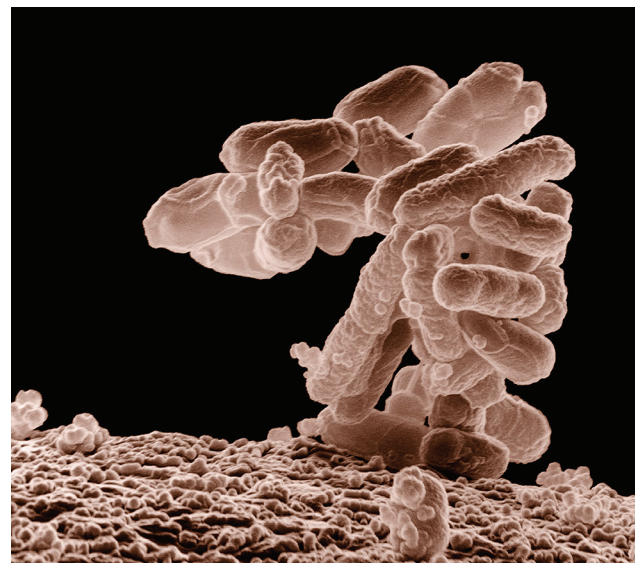


**Figure 2-1.** Electron micrograph of a cluster of *Escherichia coli* bacteria magnified 10,000 times. Each individual bacterium is oblong shaped. Photomicrograph by Eric Erb. Digital colorization by Christopher Pooley. Reproduced from US Department of Agriculture, Agricultural Research Service. <https://www.ars.usda.gov/oc/images/photos/mar05/k11077-1/>

flavor and character to cheeses and yogurt or fermenting beer are considered beneficial. Harmful microorganisms produce disease, such as bacteria that cause Lyme disease.

Most microorganisms do not cause disease under normal conditions; those that do are called **pathogens**. Understanding pathogen physiology, ecology, and disease transmission helped create technology for disease prevention, especially for health care providers caring for potentially infected patients. Many microorganisms have their own metabolism (eg, bacteria take in oxygen, burn food for energy and growth, and excrete waste). They can increase in size, divide, and mutate, as well as react in different ways to environmental changes. Many are able to move on their own and some form protective capsules. These characteristics can all be exploited to prevent disease.

At the beginning of a bacterial infection, pathogens usually invade the body in small numbers. As the bacteria reproduce, they form groups of millions of individual cells, called **colonies**. Certain environmental factors such as oxygen, nutrients, temperature, moisture, **pH**, and light affect the metabolism and growth of microorganisms. Most microorganisms grow at normal body temperature; cold temperatures often slow growth, while high temperatures usually kill most organisms. Steam sterilization and boiling water are two common techniques used to kill pathogenic microorganisms.



**Figure 2-2.** *Codium fragile*, a type of algae. Photograph by Flyingdream. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Codiumfragile.jpg>



**Figure 2-3.** Photograph of a patient with ringworm of the toes (tinea pedis), also known as athlete's foot, a fungus. Content provided by CDC/Dr. Lucille K. Georg. Reproduced from Public Health Image Library. <https://phil.cdc.gov/Details.aspx?pid=2939>

The following are the different types of microorganisms and their defining characteristics:

- **Algae**—resemble plant cells, are primarily found on sunlit water, and rarely cause human disease (Figure 2-2).
- **Fungi**—include yeasts (eg, *Candida albicans*, which causes thrush and vaginitis) and molds (eg, tinea pedis, or “athlete’s foot”) (Figure 2-3).
- **Protozoa**—single-celled microscopic microorganisms (eg, *Trichomonas vaginalis*, which causes vaginal infection in women and urinary tract infection in males) (Figure 2-4).
- **Bacteria**—single-celled organisms without nuclei. Some bacteria form **spores** that are able to survive extreme conditions of light and drying, as well as exposure to many chemicals. Spore-forming bacteria such as *Bacillus anthracis* (Figure 2-5) are the most difficult to control and destroy. Pathogenic bacteria cause diseases such as gonorrhea, pneumonia, and infectious meningitis. An increasing number of bacteria are resistant to certain antibiotic therapies (eg, methicillin-resistant *Staphylococcus aureus*) (Figure 2-6).
- **Viruses**—biological agents that reproduce inside the cells of living hosts (Figure 2-7). Immunization is the most effective means of preventing viral infections (eg, polio, measles).



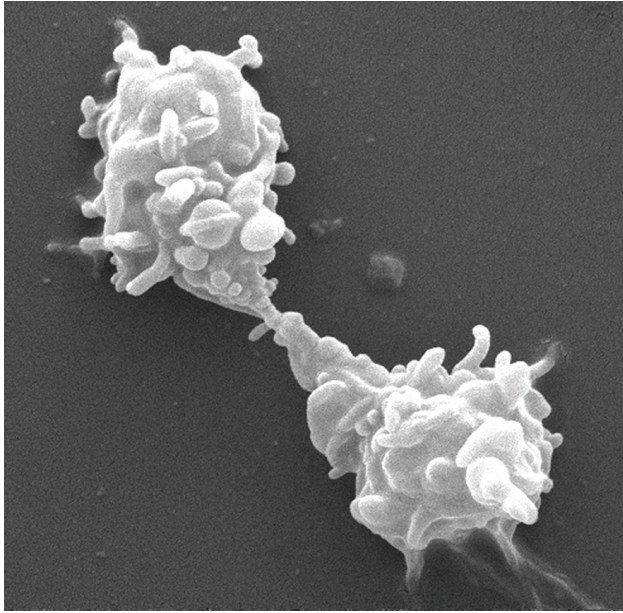


**Figure 2-4.** Scanning electron micrograph showing two protozoa interacting through their projecting pseudopodia. These pseudopodia enable the amoebae to move about and grasp objects in their environment. Photomicrograph by CDC/Janice Haney Carr. Content provided by CDC/Catherine Armbruster; Margaret Williams. Reproduced from Public Health Image Library. <https://phil.cdc.gov/Details.aspx?pid=11901>

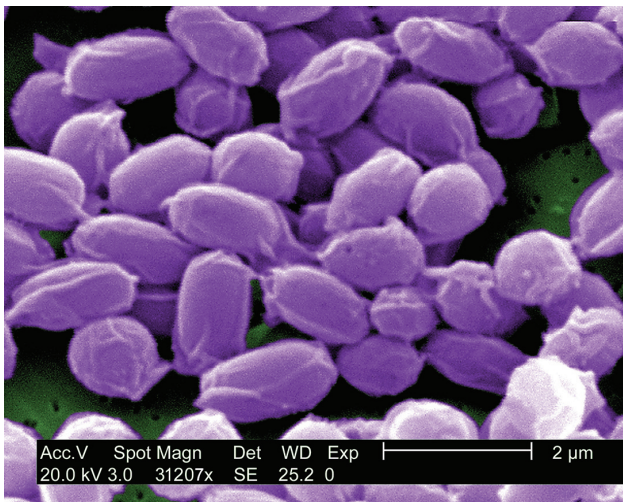


**Figure 2-5.** Digitally colorized scanning electron microscope image of endospores of *Bacillus anthracis* bacteria. Photomicrograph by Laura Rose. Content provided by CDC/Janice Haney Carr. Reproduced from Public Health Image Library. <https://phil.cdc.gov/Details.aspx?pid=10123>

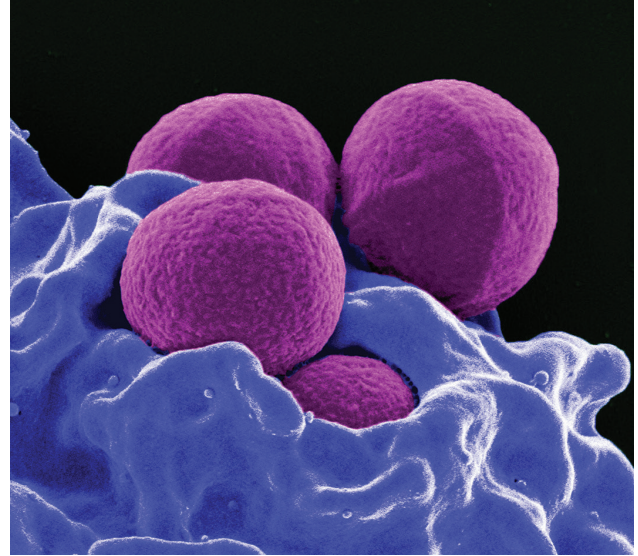


**Figure 2-6.** Digitally colorized scanning electron microscope image showing four magenta-colored spherical, methicillin-resistant *Staphylococcus aureus* (MRSA) bacteria being phagocytized by a blue-colored white blood cell called a neutrophil. Photomicrograph by the National Institute of Allergy and Infectious Diseases. Reproduced from Public Health Image Library. <https://phil.cdc.gov/Details.aspx?pid=18167>

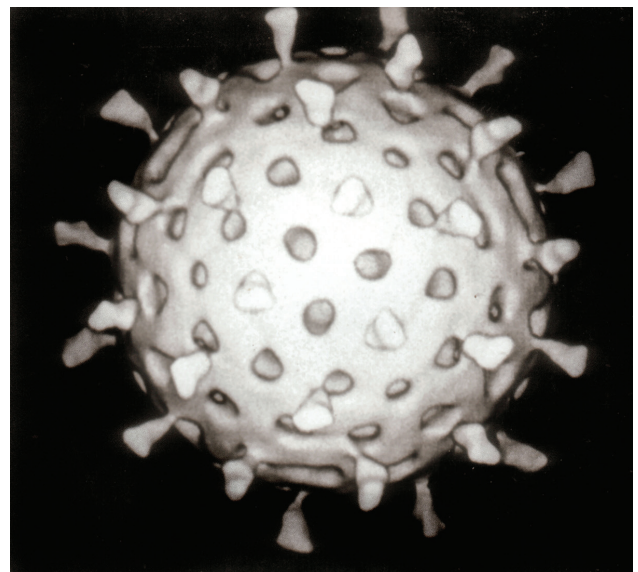


**Figure 2-7.** This illustration provides a 3D graphical representation of a rotavirus. Note the characteristic wheel-like appearance that gives the rotavirus its name. Rota means “wheel” in Latin. Illustration by Alissa Eckert. Content provided by CDC/Jessica A. Allen. Reproduced from the Centers for Disease Control and Prevention. <https://phil.cdc.gov/Details.aspx?pid=21351>

## Check on Learning

1. What is a pathogen?
2. What type of microorganism is the most difficult to control and destroy?
3. What type of microorganism reproduces inside the cells of living hosts?

## SPREADING INFECTIOUS DISEASE

### Disease Movement

Infectious diseases can be:

- **Communicable.** Spread from one person to another.
- **Contagious.** Capable of being transmitted from one individual to another.
- **Epidemic.** Occurring above the expected number in a particular geographic area; an outbreak.
- **Zoonotic.** Transmitted from animals to humans.
- **Arthropod borne.** Transmitted to humans from vectors such as ticks and mosquitoes.

### Chain of Infection

Scientists and health care workers use knowledge gained from **epidemiology** to help control diseases. For example, the use of **Standard Precautions** by all health care personnel is an important factor in controlling the spread of infection (Figure 2-8). In fact, proper hand washing is the single most useful and effective means of preventing disease transmission.

The chain of infection is another key factor in disease prevention and control, learned through the application of epidemiology. It contains the elements described in Figure 2-9.

A **reservoir** is any living thing or inanimate object in or on which microorganisms can multiply or survive before moving to a susceptible host. Microorganisms can leave an animal or human reservoir through body orifices via natural discharges such as mucus, semen, sputum, saliva, urine, feces, vomit, drainage, or blood. These are called **portals of exit**. Direct contact spreads pathogens from one person to another through touch, kissing, hand shaking, or sexual intercourse. Indirect contact implies that an intermediary object harbors the pathogens and carries them from an infected person to a new victim. Such objects include patient bedding,



**Figure 2-8.** A combat medic dons gloves prior to performing a Combat Casualty Assessment.

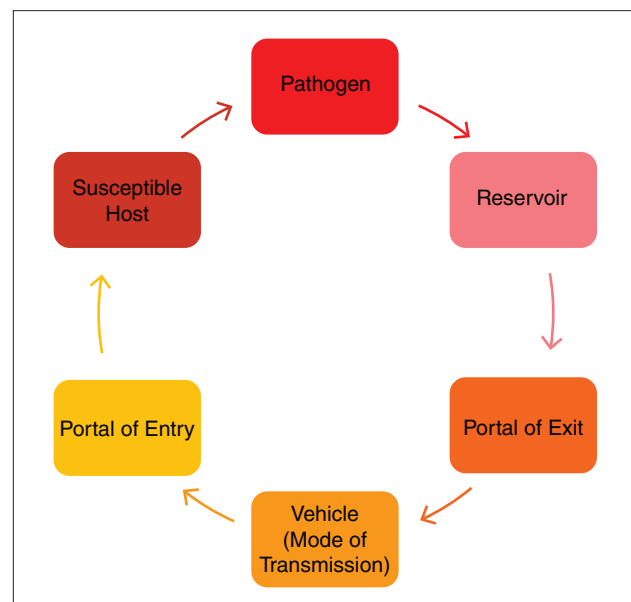


**Figure 2-9.** The chain of infection.

dressings, used syringes, and drinking cups. A human carrier is someone who does not exhibit the symptoms of a disease but carries the pathogens and transmits them to others. Vectors are animal or arthropod carriers of pathogens. Examples of vectors are rodents, mosquitoes, flies, ticks, and fleas (Figures 2-10 to 2-14). They can spread disease to humans in the following ways:

- directly from feet, wings, bodies, or mouth-parts to food that is then consumed (eg, shigellosis, salmonella);





**Figure 2-10.** This image depicts a black rat, *Rattus rattus*, which is one of the hosts associated with the spread of the “Black Death” plague. Rats infected with the plague virus, *Yersinia pestis*, host fleas, which transmitted the plague from the rats to humans. Content provided by Centers for Disease Control and Prevention. Reproduced from the Centers for Disease Control and Prevention. <https://phil.cdc.gov/Details.aspx?pid=14282>



**Figure 2-11.** This female *Aedes albopictus* mosquito is in the process of inserting its needle-like proboscis through the skin surface of its human host. This type of mosquito transmits West Nile virus and Zika virus. Photograph by CDC/James Gathany. Reproduced from the Centers for Disease Control and Prevention. <https://phil.cdc.gov/Details.aspx?pid=4487>



**Figure 2-12.** House fly. Photograph by USDA-ARS/Stephen Ausmus. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Common\\_house\\_fly,\\_Musca\\_domestica.jpg](https://commons.wikimedia.org/wiki/File:Common_house_fly,_Musca_domestica.jpg)



**Figure 2-13.** Adult deer tick. Photograph by USDA, ARS/Scott Bauer. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Adult\\_deer\\_tick\(cropped\).jpg](https://commons.wikimedia.org/wiki/File:Adult_deer_tick(cropped).jpg)





**Figure 2-14.** Electron micrograph of a flea. Photograph by CDC/Janice Haney Carr. Reproduced from Public Health Image Library. <https://phil.cdc.gov/details.aspx?pid=11436>

- through bites (eg, leishmaniasis, yellow fever); and
- from exposure to rodent saliva, urine, or feces (eg, leptospirosis, hantavirus).

Microbes and spores can blow from place to place, spreading disease through airborne transmission. For example, sneezing can spread the common cold. Public water, such as pools and lakes, can be contaminated with feces and transmit disease via waterborne transmission. Raw, undercooked, or contaminated food can be responsible for foodborne transmission. Blood-borne disease transmission can occur through contaminated medical devices during transfusions, kidney dialysis (Figure 2-15), and injections. Body orifices both natural and created (eg, by intravenous or urinary catheters) serve as **portals of entry** through which a microorganism can enter a host.

Infection is not inevitable just because a pathogen comes in contact with a host; the host must be sus-



**Figure 2-15.** Patient receiving dialysis. Photograph by Anna Frodesiak. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Patient\\_receiving\\_dialysis\\_03.jpg](https://commons.wikimedia.org/wiki/File:Patient_receiving_dialysis_03.jpg)

ceptible. Healthy people have a variety of nonspecific (skin, fever) and specific (immunity) defenses. More susceptible are people with compromised immune systems such as hospitalized patients, ill or inactive people, those with chronic fatigue or poor nutrition, infants, young children, older adults, those who are injured or have wounds, and those who sustain shock and trauma. Side effects of some medications can also compromise the immune system, as can emotional factors such as anxiety.

### Check on Learning

4. What is the single most useful and effective means of preventing disease transmission?
5. What are the six elements of the chain of infection?

## INFECTION CONTROL

Combat medics must know the meanings and infection control implications of a variety of terms. Dirty is a term for any object or person that has not been cleaned or sterilized for removal of microorganisms. A **contaminated** object was clean or sterile before it touched a dirty object. Clean implies that many or most harmful microorganisms have been removed. **Disinfectants** destroy most pathogens, but not necessarily spores. **Sterile** means that the item is free of all microorganisms and spores. Sterilization involves complete removal or destruction of microorganisms and spores in or on an object. For example, sterilization of instruments in an autoclave (a pressure steam sterilizer)



**Figure 2-16.** A combat medic demonstrates medical asepsis by cleaning the IV site with an alcohol prep pad prior to administering a saline lock.

raises their surface temperature high enough and long enough to kill all microorganisms and spores. Some medical instruments are very sensitive and would be damaged or destroyed if sterilized by standard sterilization methods such as autoclave. These types of heat-sensitive instruments should undergo **high-level disinfection** by being submerged into microbicidal fluids like glutaraldehyde, orthophthalaldehyde, or concentrated hydrogen peroxide. Each high-level disinfectant requires the instrument to be submerged for a specific period of time, such as 20 minutes for 2% glutaraldehyde, in order to achieve a high level of disinfection. High-level disinfection will rid the instruments of small levels of bacteria spores, fungi, mycobacteria, or viruses. **Asepsis** refers to practices that minimize or eliminate organisms that can cause infection and disease.

### Medical Asepsis

There are two kinds of asepsis: medical and surgical. Medical asepsis is a clean technique; surgical asepsis is a sterile technique that aims to destroy all microorganisms and is used only in certain situations. Medical asepsis is the practice of minimizing the number of microorganisms or preventing the transmission of microorganisms from one person or source to another (Figure 2-16). Because it is impossible to know which patients are carrying communicable diseases, the Centers for Disease Control and Prevention (CDC) established a set of guidelines to be used in the delivery



**Figure 2-17.** A combat medic applying exam gloves prior to treating simulated casualty.

of all health care encounters. These guidelines require standard precautions in the care of **ALL** patients. A combination of **universal precautions** (designed to reduce transmission of **blood-borne pathogens**) and **body substance isolation** (designed to reduce transmission of pathogens from moist body substances) reduce risk from both known and unknown sources of infection. CDC officials recommend that health care workers handle all blood, body fluids (including secretions, excretions, and drainage), tissues, and contact with mucous membranes and broken skin as if they contain infectious agents, regardless of the patient's diagnosis.

### Standard Precautions

Required standard precautions include wearing gloves for any known or anticipated contact with blood, body fluids, tissues, mucous membranes, or non-intact skin (Figure 2-17). If the task or procedure being performed could result in splashing or splattering of blood or body fluids to the face or body, wear a mask, goggles or face shield, and a fluid-resistant gown or apron. Additional protective clothing, such as shoe covers, may be appropriate in situations that may expose health care workers to large amounts of blood or body fluids (or both). Discard gloves after each patient contact. To prevent transfer of pathogens between patients or between patients and the environment, wash your hands and skin surfaces immediately and thoroughly after each patient contact, and after



removing gloves. Do not recap or break needles. Place needles and sharp objects into a special, puncture-resistant “sharps” container after use. When available, use a needleless system or safety syringes. Immediately notify supervisors of any exposure to blood or body fluids. Cover skin breaks and wounds that are draining and change dressings when they are wet. Disinfect tubes and ports before collecting specimens from drainage tubes or intravenous lines. When possible, provide clean, dry, wrinkle-free linen. Remove linen without shaking it or allowing it to touch your clothing. Place contaminated linen into a leak-proof bag. Avoid talking, sneezing, or coughing directly over open wounds or a sterile field. Treat a patient’s underlying condition so the patient does not become a susceptible host. Isolate patients with contagious diseases. Patients who have airborne infections may need to wear masks or receive medications that prevent coughing.

### Transmission-Based Precautions

**Transmission-based precautions** are used in addition to standard precautions during treatment of patients with a suspected or known communicable disease. They are based on the disease’s route of transmission and are intended to interrupt the chain of infection. The three types are listed below.

#### *Airborne Precautions*

Pathogens from evaporated droplets remain suspended in the air or are carried on dust particles and inhaled. Airborne precautions (Figure 2-18) help prevent the spread of diseases such as tuberculosis, measles, and chickenpox. Use a high-filtration particulate respirator such as an N95 mask (Figure 2-19) when caring for tuberculosis patients. They should also have private rooms with monitored negative air flow pressure (with air discharged outdoors or specially filtered before circulating to other areas). Doors to these rooms should remain closed.

#### *Droplet Precautions*

Pathogens are propelled through the air from an infected person who is sneezing, coughing, talking, or being suctioned and are deposited on a host’s eyes, nose, or mouth. Droplet precautions (Figure 2-20) help prevent the spread of diseases such as meningitis, pneumonia, diphtheria, streptococcal pharyngitis, influenza, mumps, and rubella. Patients with these diseases should have private rooms or share with

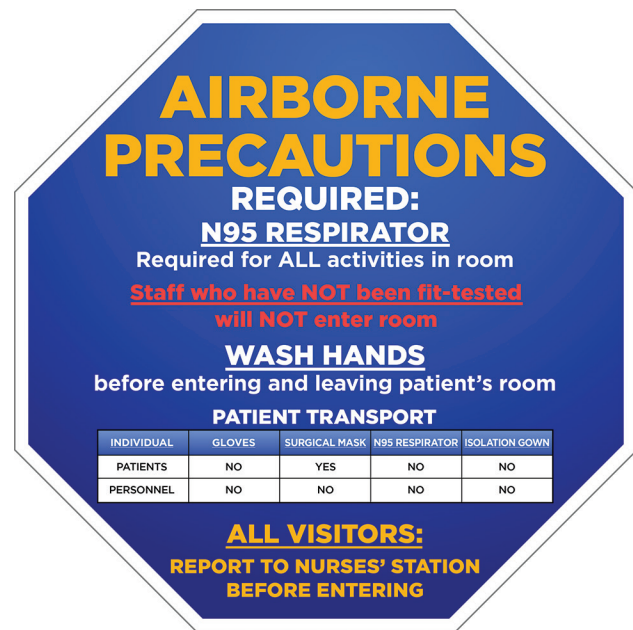


**Figure 2-18.** An airborne precaution sign placed at the doors of infectious patients’ hospital rooms.



**Figure 2-19.** A combat medic demonstrating how to wear an N95 respirator.

another patient with the same infection. Doors may remain open. Wear an N95 mask when working within 3 feet of these patients, and require the patients to wear masks if they are transported outside of the room.



**Figure 2-20.** A droplet precaution sign placed at the doors of infectious patients' hospital rooms.

### Contact Precautions

The most frequent mode of disease transmission occurs when there is direct contact between a susceptible host's body surface and an infected or colonized person (who may or may not exhibit clinical signs or symptoms). Contact precautions (Figure 2-21) help prevent the spread of drug-resistant gastrointestinal, respiratory, skin, and wound infections; hepatitis A; herpes simplex virus; and acute diarrhea. Patients with these illnesses should have private rooms or share with another patient with the same infection. The doors may remain open. Use of noncritical equipment should be restricted to one patient only. If equipment is shared, it must be disinfected before use on other patients. Wear gloves when entering the room and remove them before leaving. Wear a gown if you anticipate contact with infectious matter. Remove the gown before leaving the room and wash your hands with an antimicrobial or waterless antiseptic agent.

### Neutropenic Precautions

Unlike other types of precaution procedures, **neutropenic** (protective or **reverse isolation**) precautions guard a patient who is at increased risk for infection against contact with potential pathogens. Patients with weakened immune responses must be protected from

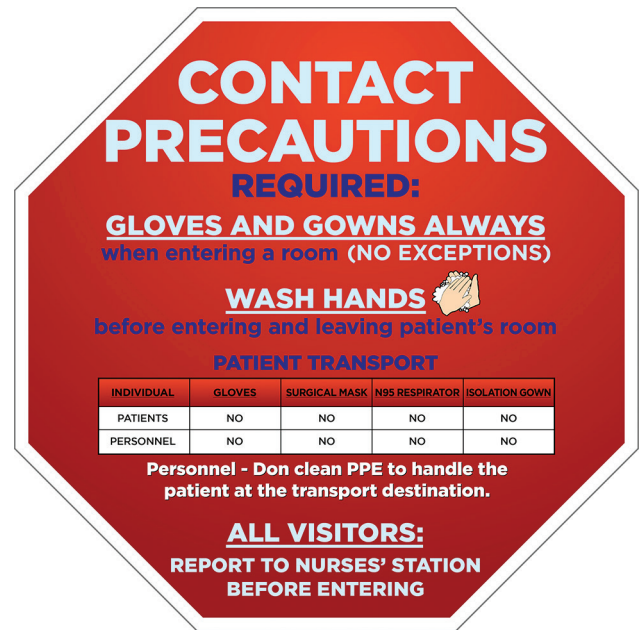


**Figure 2-21.** A contact precaution sign placed at the doors of infectious patients' hospital rooms.

the outside environment and from microorganisms that may be carried by others. This level of immunosuppression may occur with burns, bone marrow transplants, human immunodeficiency virus infection, chemotherapy, or low resistance due to other reasons. Health care workers and visitors with communicable diseases must not enter the patient's private room. No fresh fruits and vegetables, gifts, or flowers are allowed. Healthy individuals who enter the room must wear masks and wash their hands before entering.

### Surgical Asepsis

Surgical asepsis is a sterile technique used when performing dressing changes, administering **parenteral** (the introduction of substance into the body via a route other than the digestive tract) medications, and during surgery and other invasive procedures such as urinary catheterization. The technique destroys microorganisms on surfaces before they can enter the body and prevents them from being carried to the patient. Sterilized instruments and dressings are used during sterile procedures, and equipment is sterilized or discarded after use. Articles must first be sterilized, then prevented from coming into contact with any unsterile objects. When a sterile article touches an unsterile article, it becomes contaminated and is no longer sterile. Sterile-to-sterile remains sterile, yet sterile-to-clean





**Figure 2-22.** Surgical asepsis being displayed by a surgical team. Note the sterile field being displayed. Reproduced from Nessen S, Lounsbury D, Hetz S, eds. *War Surgery in Afghanistan and Iraq: A Series of Cases, 2003-2007*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2012: 114.

becomes contaminated (Figure 2-22). Think before you touch anything. Never touch sterile articles with unsterile articles. Discard an article if you contaminate it or are unsure whether it is contaminated. Do not risk using a contaminated article.

### Check on Learning

6. What are the three types of transmission-based precautions?
7. What is the most frequent mode of disease transmission?

### Patient Care Hand Wash

Correct and thorough hand washing reduces the number of resident and transient microorganisms that are transmitted from hospital environment to patient and from patient to health care provider. Wash hands before and after patient contact and after contact with dirty or contaminated materials (eg, used linens or thermometers). Proper hand washing requires running water (sink and faucets) and hand soap (usually a germicidal agent in a dispenser) in accordance with local standard operating procedure (SOP). When performing a patient care hand wash, warm water is preferable to cold because it reduces chapping skin and removes skin oils, which can retain bacteria.

### Patient Care Hand Wash Procedures

1. Stand in front of the sink and avoid leaning against it. Turn on the water and adjust the temperature.
2. Thoroughly wet your hands and forearms under running water, keeping your hands lower than your elbows.

**Note:** When performing a patient care hand wash, give particular attention to creases and folds in the skin where microorganisms are difficult to dislodge. To reduce areas that are difficult to clean, do not wear rings in any patient care area.

3. Apply soap and wash your hands, wrists, and lower forearms using a circular scrubbing motion. The duration of the patient care hand wash should be a minimum of 10 to 15 seconds and up to 2 minutes (or longer), depending on the potential for contamination with microorganisms.
4. Insert your fingernails from one hand under those of your other hand using a sweeping motion. Repeat with the other hand. Repeat the procedure if your hands are very dirty.
5. Rinse your hands, wrists, and forearms, keeping your hands and wrists lower than your elbows so that water flows from elbows to fingers. Do not touch any part of the contaminated sink or faucets.
6. Finish by drying your hands, wrists, and forearms thoroughly using clean paper towels. Once your hands are dry, turn off the water with the towel used for hand drying. Discard the towel in accordance with local SOP (usually trash container disposal is sufficient) without dropping your hands below waist level.

### Check on Learning

8. What is the purpose of the patient care hand wash?
9. When is a patient care hand wash performed?
10. How long should the patient care hand wash last?

## Donning and Removing Sterile Gloves

Sterile gloves establish a barrier to microorganisms between health care worker and patient. They maintain a sterile field during hands-on procedures such as the following:

- during invasive procedures (eg, surgery, urinary catheterization),
- when sterility must be maintained (eg, handling sterile instruments while assisting during sterile procedures),
- when changing sterile dressings, and
- when irrigating wounds.

### Donning Sterile Gloves

1. Select and obtain the proper size sterile gloves and inspect the glove package for signs of contamination and damage.
2. Perform a patient care hand wash, then open the sterile package.
3. Place the package on a flat, clean, and dry surface in the area where the gloves are to be worn. Peel the outer wrapper open to completely expose the inner package. Remove the inner package, touching only the folded side of the wrapper, and position it so the cuff end is nearest to you. Unfold the inner package by opening it to a fully flat position without touching the gloves. Expose both gloves. Grasp the lower inside corners or designated areas on the folder and pull gently to the side without touching the gloves.
4. Grasp the cuff at the folded edge and remove it from the wrapper with one hand, then step away from the table or tray.
5. Keeping both hands above your waist, insert the fingers of your other hand into the glove and pull the glove on, touching only the exposed inner surface of the glove. If it is difficult fitting your fingers fully into the glove fingers, make adjustments after donning both gloves.
6. When preparing to put on the second glove, first insert the fingertips of the gloved hand under the edge of the folded-over cuff. The gloved thumb may be kept up and away from the cuff area or may be inserted under the edge of the folded-over cuff with your fingertips. Keeping both hands above the waist, insert the fingers of your ungloved hand into the glove.

7. Pull the glove on and adjust the gloves to fit properly. Be careful not to contaminate either glove. Avoid dropping your hands below waist level once your gloves are on; anything below the waist is considered contaminated. Grasp and pick up the glove surfaces on the individual fingers to adjust them. Pick up the palm surfaces and work your fingers and hands into the gloves.
8. Interlock your gloved fingers and work your hands around until the gloves are firmly on your fingers.

### Removing Gloves

1. To remove gloves, grasp the glove at the heel of one hand with the other gloved hand and peel the glove off, retaining it in the palm of the gloved hand.
2. Reach under the cuff of the remaining glove with one or two fingers of the ungloved hand and peel the glove off over the glove being held in the palm, being careful not to contaminate yourself.
3. Discard the gloves according to local SOP and perform a patient care hand wash.

### Check on Learning

11. Why do we use sterile gloves for patient care?
12. Name four medical care procedures that require the use of sterile gloves.

## RESPONSES TO INFECTION

Whether or not a pathogen produces an active infection depends on both the organism and the host. There are four phases of normal infection. First is the incubation period, which begins when the pathogen enters the body and lasts until the first symptoms of illness appear. The second phase is the prodromal stage, which lasts from the onset of initial symptoms, such as fatigue or low-grade fever, to the beginning of more severe symptoms. The third phase is the full stage of illness, when symptoms are acute and specific to the type of infection, such as lesions covering the body or high fever (Figure 2-23). The final phase is convalescence, when acute symptoms of the infection subside and the person recovers.

When dealing with patients who suffer from infection, combat medics should realize that the severity



**Figure 2-23.** Very sick person from cholera. Note the wrinkling of the fingers indicating severe dehydration. Content provided by Centers for Disease Control and Prevention. Reproduced from Public Health Image Library. <https://phil.cdc.gov/Details.aspx?pid=1939>

of infection is determined by several factors. Factors that influence infection are the strength of the body's immune system, the specific **portal** of entry, the number of microorganisms, the pathogen's **virulence**, and host resistance.

A patient who has a weakened immune system will be more susceptible to infection when exposed to microorganisms. An example of a condition that results in a weakened immune system would be a patient who has contracted human immunodeficiency virus (HIV). This virus reduces the number of white blood cells known as T helper or CD4 white blood cells, which results in the body being more susceptible to infection.

Some disease states require that a specific microorganism enter the body through a specific portal of entry. An example of this factor of infection is the *Streptococcus pneumoniae* bacteria. In order for a patient to contract pneumococcal pneumonia, they must be exposed to *Streptococcus pneumoniae* through the respiratory portal of entry.

Another factor that can influence the development of infection in a patient is the number of microorganisms the patient is exposed to. If a patient is exposed to few microorganisms, in most cases the immune system has a better chance of fighting them off and thus preventing infection. However, if a patient is exposed to many microorganisms, the sheer number may overwhelm the patient's immune system.

Virulence is described as the pathogen's strength to cause disease. There are many factors that affect virulence. For example, some bacteria form protective capsules to defend themselves against attack from the human immune system, while other bacteria produce enzymes that destroy blood cells, stop normal blood

clotting, damage host cell membranes, or consume muscle fibers. These all may result in an increase in the pathogen's virulence.

**Note:** Ebola virus disease is caused by one of the most virulent agents to infect humans and it has a very high fatality rate. A related term is pathogenicity, or the ability of a microorganism to cause disease in a susceptible individual. These terms are commonly used interchangeably.

Finally, a host's resistance to pathogens will decrease the chance of infection. An example of host resistance is the natural body flora. Natural body flora have an antibiotic relationship with pathogens that will keep the pathogen in check. If a condition in the body reduces the normal floral bacteria or if the flora is introduced to an area of the body where it doesn't belong, then infection can occur.

**Nosocomial infections**, also known as **health care-associated infections (HCAI)**, are those that patients acquire while in a health care facility. They are a serious problem for health care facilities, which harbor a number of disease-causing microorganisms, many of which are resistant to antibiotics. Health care facilities house several potential pathogen reservoirs, including intravenous fluids, food, biological materials, and equipment. Nosocomial infections can lengthen a patient's hospital stay, increase the cost of treatment, promote further antibiotic resistance, and even cause death.

### Check on Learning

13. What is a nosocomial infection?
14. What is an example of host resistance?
15. What factors increase a pathogen's virulence?
16. What is the normal course of infection?

### SUMMARY

Throughout the ages, diseases have resulted in more casualties than actual battle injuries. Understanding the chain of infection will aid you in implementing measures that will result in the reduction of disease, ensuring that the soldier arrives at the battle, ready to fight and win. Through the use of asepsis and sterile technique, medical procedures can be performed with a greatly reduced chance of the casualty developing an infection. Proper asepsis and sterile technique will speed up a casualty's recovery, reduce complications with healing, and return them to the fight.



## PATIENT CARE HAND WASHING



STEP 1: Stand in front of the sink and avoid leaning against it. Turn on the water and adjust the temperature.



STEP 2: Thoroughly wet your hands and forearms under running water, keeping your hands lower than your elbows.



STEP 3: Apply soap and wash your hands, wrists, and lower forearms using a circular scrubbing motion for a minimum of 10–15 seconds and up to 2 minutes (or longer).



STEP 4: Insert your fingernails from one hand under those of your other hand using a sweeping motion. Repeat with the other hand.



## PATIENT CARE HAND WASHING,CONT.



STEP 5: Rinse your hands, wrists, and forearms, keeping your hands and wrists lower than your elbows so that water flows from the elbows to the fingers.



STEP 6: Finish by drying your hands, wrists, and forearms thoroughly using clean paper towels. Once dry, turn off the water with the towel used for hand drying. Discard the towel in accordance with local SOP (usually trash container disposal is sufficient) without dropping your hands below waist level.

## DONNING STERILE GLOVES



STEP 1: Select and obtain the proper size sterile gloves and inspect the glove package for signs of contamination and damage.



STEP 2: Perform a patient care hand wash, then open the sterile package.



STEP 3: Place the package on a flat surface. Peel the outer wrapper open. Remove and unfold the inner package. Grasp the lower inside corners or designated areas and pull gently to the side.



STEP 4: Grasp the cuff at the folded edge and remove it from the wrapper with one hand, then step away from the table or tray.



## DONNING STERILE GLOVES, CONT.



STEP 5: Keeping both hands above the waist, insert the fingers of your other hand into the glove and pull the glove on, touching only the exposed inner surface of the glove.



STEP 6: Insert the fingertips of the gloved hand under the edge of the folded-over cuff. Insert the fingers of the ungloved hand into the glove.



STEP 7: Pull the glove on and adjust to fit properly.



STEP 8: Interlock your gloved fingers and work your hands around until the gloves are firmly on your fingers.



## REMOVING GLOVES



STEP 1: Grasp the glove at the heel of one hand with the other gloved hand and peel the glove off, retaining it in the palm of the gloved hand.



STEP 2: Reach under the cuff of the remaining glove with one or two fingers of the ungloved hand and peel the glove off over the glove being held in the palm, being careful not to contaminate yourself.



STEP 3: Discard the gloves according to local standard operating procedure.

## KEY TERMS AND ACRONYMS

- Arthropod borne.** Disease that is transmitted by arthropods (invertebrate phylum Arthropoda), such as mosquitos, ticks, flies, fleas, and lice.
- Asepsis.** Practices that minimize or eliminate organisms that cause infections or disease.
- Bacteria.** A one-celled organism without a true nucleus or cell organelles, belonging to the kingdom Prokaryotae (Monera).
- Blood-borne pathogen.** Infectious microorganisms in human blood that can cause disease in humans.
- Body substance isolation.** Isolation practice that emphasizes avoiding contact with all moist and potentially infectious body substances.
- Colony.** A growth of microorganisms in a culture; usually considered to have grown from a single organism.
- Communicable.** Transmitted from one person to another.
- Contagious.** Capable of being transmitted from one individual to another.
- Contaminate.** To soil, stain, or pollute.
- Disinfectant.** A substance that prevents infection by killing bacteria.
- Epidemic.** Pertaining to a disease affecting an exceptionally high percentage of people in a community or larger area at one time.
- Epidemiology.** The study of the distribution and determinants of health-related states and events in populations and the application of this study to the control of health problems.
- HCAI.** Health-care-associated infection.
- High-level disinfection.** Disinfection with the use of chemical sterilants that will kill all microorganisms except large numbers of bacterial spores.
- Microbes.** A unicellular or small multicellular organism including bacteria, protozoa, some algae and fungi, viruses, and some worms.
- Microorganisms.** A living organism too small to be perceived with the naked eye.
- MRSA.** Methicillin-resistant *Staphylococcus aureus*.
- Neutropenia.** The presence of an abnormally low number of neutrophils (a type of white blood cells) in the blood.
- Neutropenic precautions.** Precautions that are taken to prevent infection when a patient has neutropenia.
- Nosocomial.** Originating in a health care facility; a nosocomial infection.
- Parenteral.** Situated or occurring outside the digestive tract; introduced or administered other than by way of the digestive tract (eg, central venous catheter).
- Pathogen.** A disease-producing agent or organism.
- Pathogenic.** Causing or capable of causing disease.
- pH.** The symbol for hydrogen ion concentration. Use of the symbol with a number denotes whether a substance is acidic (< 7.0), neutral (7.0), or basic (> 7.0).
- Portal.** An entryway.
- Portal of entry.** The pathway by which infectious organisms gain access to the body.
- Portal of exit.** The pathway by which pathogens leave the body of a host.
- Reservoir.** A place or cavity for storage.
- Reverse isolation.** Isolation in which a vulnerable patient is protected from potentially harmful microorganisms in the environment.
- Spore.** A protective capsule formed by some microorganisms to safeguard them.
- Standard precautions.** Guidelines recommended by the Centers for Disease Control and Prevention to reduce the risk of the spread of infection in hospitals.
- Sterile.** Free of living organisms, especially microorganisms.
- Transmission-based precautions.** Measures suggested by the Centers for Disease Control and Prevention to reduce the risk of airborne, droplet, and direct contact transmission of infection in hospitals.
- Universal precautions.** Guidelines designed to protect workers with occupational exposure to blood-borne pathogens (such as HIV and hepatitis B).

**Vector.** Carrier; especially of a disease organism.

**Virulence.** Ability of a microorganism to cause disease; strength, potency, or severity.

**Virus.** A pathogen composed of nucleic acid core within a protein shell, which can grow and reproduce only after infecting a host cell.

**Zoonotic.** An infection that is common in animal populations and occasionally infects humans.

### CHECK ON LEARNING ANSWERS

1. What is a pathogen?  
*A microorganism that causes disease.*
2. What type of microorganism is the most difficult to control and destroy?  
*Spore-forming bacteria.*
3. What type of microorganism reproduces inside the cells of living hosts?  
*Virus.*
4. What is the single most useful and effective means of preventing disease transmission?  
*Hand washing.*
5. What are the six elements of the chain of infection?  
*Pathogen, reservoir, portal of exit, vehicle of transmission, portal of entry, susceptible host.*
6. What are the three types of transmission-based precautions?  
*Airborne, droplet, and contact.*
7. What is the most frequent mode of disease transmission?  
*Contact (direct).*
8. What is the purpose of the patient care hand wash?  
*To reduce the number of microorganisms that can be transmitted to a patient.*
9. When is a patient care hand wash performed?  
*Before and after patient contact and after contact with dirty or contaminated materials.*
10. How long should the patient care hand wash last?  
*A minimum of 10 seconds to as long as 2 minutes (or even longer). Length depends on the potential for contamination.*
11. Why do we use sterile gloves for patient care?  
*To establish a barrier against microorganism transfer from person to person.*
12. Name four medical care procedures that require the use of sterile gloves.
  - *Invasive procedures—surgery, sterile procedures (urinary catheterization).*
  - *Handling sterile instruments while assisting during sterile procedures.*
  - *Changing sterile dressings.*
  - *Irrigating wounds.*



13. What is a nosocomial infection?

*An infection that is contracted in a health care facility.*

14. What is an example of host resistance?

*Naturally occurring body microorganisms that have antibiotic relationships with pathogens and also may contribute to an individual's health.*

15. What factors increase a pathogen's virulence?

*Some bacteria form protective capsules that increase their virulence. Other bacteria produce enzymes that destroy blood cells, stop normal blood clotting, damage host cell membranes, or consume muscle fibers.*

16. What is the normal course of infection?

*Incubation period, prodromal stage, full stage of illness, and convalescence.*

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# 3 PHARMACOLOGY

## CORE CONCEPTS

- Explain therapeutic effects, side effects, indications, and contraindications for medications.
- Differentiate between drug tolerance and drug dependence.
- Define broad-spectrum and narrow-spectrum antibiotics.
- Discuss antibiotic resistance.
- Select common conditions requiring antifungal treatment.
- Recognize properties of nonsteroidal anti-inflammatory drugs.
- Discuss usage of non-narcotic and narcotic analgesics.
- Summarize opiate overdose and antidote treatment protocols.

## INTRODUCTION

There are approximately 70 different medications in the Army's current medical equipment set kit. Combat medics must know what these medications are prescribed for and be able to reference the proper **dose** to administer. Developing a working knowledge of these medications can help ensure their safe and effective use.

## PHARMACOLOGY BASICS

Simply stated, pharmacology is the science of drugs. This broad topic includes their origin, composition, appearance, chemistry, uses, physiological effects, effectiveness, toxicology, and modes of action. Combat medics focus on the clinical uses and **therapeutic effects** of drugs in human patients.

Every medication has at least three names: the chemical name, the **generic name**, and one or more **trade names** (brand names) given by the manufacturer. For example, ibuprofen is a generic name. Its chemical name is (RS)-2-(4-(2-methylpropyl) phenyl) propionic acid and it has 17 trade names, some of which include Advil (GlaxoSmithKline, Middlesex, UK), Caldolor (Cumberland Pharmaceuticals Inc, Nashville, TN), Ib-utab (Zee Medical Inc, Irvine, CA), and Motrin (Johnson & Johnson, New Brunswick, NJ). Usually, the generic name is preferred.

## PHARMACOLOGICAL CONSIDERATIONS

The use of a pharmaceutical product to treat a medical condition requires knowledge of the medicine, the medical condition, and the individual patient. Not all medications work equally in all people or under all conditions. Not all medications are suited for use in all patients. The prescribing medical officer (MO) must balance effectiveness and potential **side effects**. The MO must determine whether the proposed drug is appropriate for the patient and must choose the form and **dosage** of the medicine that will best achieve the desired effect. In order to achieve maximum benefit, the patient must understand the dosage instructions and be compliant with taking the drugs as directed.

### Therapeutic Effects

Medications are intended to provide cures for diseases, reduce the signs of disease, and relieve symptoms. Not all drugs are curative, but all should have positive therapeutic effects. A drug's mechanism of action is the physiologic or biochemical interaction of the drug on its target (the way the drug works at the cellular or subcellular level).

Some medications have multiple therapeutic effects. For example, aspirin (acetylsalicylic acid, or ASA) is an **analgesic** that reduces inflammation, reduces fever, and reduces blood clot formation. Other drugs have

single, very specific effects. For example, some antihypertensive medications have a sole therapeutic effect of controlling high blood pressure, and **antibiotics** only treat microbial infections.

### Indications

Medications are approved for use by the US Food and Drug Administration (FDA). These approved uses, or reasons the medications are administered, are the drug's indications. For example, acetaminophen is indicated for pain relief and fever reduction. Indications are located on the label or instructions for use.

### Contraindications

MOs must consider whether using a drug may do more harm than good, or have undesirable effects. Some factors make the use of a particular medication in a particular patient inadvisable. These factors, called contraindications, may include things like patient age (usually pediatric or geriatric), pregnancy, immune status, allergies, and other medications. Preexisting conditions commonly result in contraindications for use. For example, aspirin is contraindicated in patients with known or suspected stomach ulcers.

Contraindications can be either relative or absolute. A relative contraindication means that a drug or treatment may harm a patient, but can still be used if the benefit outweighs the risk. An absolute contraindication means the drug is never allowed because it could cause a life-threatening condition.

If the medication cannot be used for the patient, the MO may seek available alternatives. MOs must consider effectiveness, safety, and contraindications of possible alternatives as well.

Occasionally, a drug is used “off label,” or without FDA approval for a particular condition. Off-label use is not always contraindicated, but a careful risk-benefit analysis should precede such unapproved use.

### Allergies

Allergic reactions are unpredictable responses to a drug that may be mild, moderate, or severe. A true allergy to a medication, while rare, contraindicates its use. Any medication can cause an allergic reaction, but some do so more frequently than others (eg, antibiotics, aspirin and other nonsteroidal anti-inflammatory drugs, sulfa drugs, **topical** and injectable medications containing iodine, and vaccines). Always ask the

patient about allergies to medications before administering or dispensing them. Also, individuals with a known allergy to one drug, may be allergic to others.

### Mild to Moderate Reactions

A mild to moderate allergic reaction involves a generalized body response that may persist for several hours or more, but is not progressive and does not pose a threat to life (eg, a reddened area at an injection site). Signs and symptoms of a mild to moderate allergic reaction to medication include the following:

- pruritus (itching);
- reddened skin (flush);
- swelling;
- hives (urticaria);
- watery, itchy eyes; and
- increased heart rate.

### Severe Reactions

**Anaphylaxis** refers to a life-threatening hypersensitivity reaction to an **antigen**; it is the most severe of allergic reactions. Even mild initial allergic reactions may progress to anaphylaxis without warning. There are a number of common medications that cause anaphylaxis (anaphylactic shock), including antibiotics, aspirin, vaccines, and medications containing iodine (topical and injectable). Signs and symptoms include:

- airway compromise that may include hoarseness, stridor, edema, rhinorrhea, and wheezing;
- low blood pressure;
- tachycardia, chest pain, and tightness;
- nausea, vomiting, abdominal cramping, and diarrhea;
- itching, hives, swelling of the face, neck, and extremities; and
- **angioedema**.

Patients should remain in the treatment area for 20 minutes following injections because of the possibility of a severe reaction that must be treated immediately.

### Side Effects

Pharmaceutical agents often have negative effects or actions in addition to the desired actions. Every medication, over-the-counter (OTC) and prescription, has numerous potential side effects. Most drugs affect more than one system of the body, so the drug target site probably is not the only site of action. For example,



ibuprofen may relieve muscle strain, but may also upset the stomach (especially if taken without food).

Although many side effects are minor and tolerable, others may outweigh the benefits of the drug and be severe enough for the patient to discontinue the medication. Some side effects may be life threatening. The drug label describes when the patient should seek emergency medical care or medical advice for side effects. Patients must be advised of potential interactions before taking any medication.

**Note:** Do not confuse side effects with allergic reactions. Severe allergic reactions are medical emergencies. Symptoms of severe allergic reactions include hives, difficulty breathing, and swelling of the tongue, throat, lips, or face.

### Drug Interactions

Drugs may modify the action of one or more other drugs by altering, increasing, or decreasing the expected effects. Drug interactions are common and may be intentional or unintentional. The risk of unintended interactions increases with the number of different drugs a patient uses. Interactions also occur when drugs are used along with dietary supplements (eg, vitamins or herbals), foods, or alcohol. Factors such as age, gender, weight, certain disease states, and genetic predispositions also affect drug interactions.

If a patient is taking more than one drug, or is taking supplements, MOs and pharmacists should check for interactions and evaluate the safety of combining them. Advise patients of potential interactions before administering any medication.

**Note:** The responsibility of correctly and safely dispensing medications remains with the combat medic, even when administering a medication directed by a supervising health care provider.

### Drug Tolerance

Many drugs become progressively less effective over time because the patient's body reacts less to the drug. This happens at the cellular level when the drug is metabolized more quickly, the body produces fewer receptors to the drugs, or the existing receptors become

desensitized. When tolerance develops, MOs typically prescribe a higher dose (or a different medicine) to produce the original desired effect. Diphenhydramine is an example of a common medication that may result in tolerance. Drug tolerance is not the same as drug addiction; however, some drugs that produce tolerance are also potentially addictive (eg, **opioids**).

### Drug Dependence

Drug dependence occurs when a person becomes reliant on a medication to help them function or feel normal. Soldiers who are prescribed certain formulary medications (eg, **narcotics**) may be at risk of developing dependence, so caution is always required. Susceptibility, or risk of developing dependence, varies among individuals. There are two aspects of dependence: psychological and physical. Though often discussed as separate entities, they most often occur together and may not be distinguishable in practice.

Psychological dependence is characterized by persistent cravings for a substance or a strong belief that it is needed. There are many withdrawal symptoms of psychological dependence, including anxiety, mood swings, sleep disruption, and poor judgement. Many psychotropic medications (eg, some antidepressants) are associated with psychological dependence.

Physical (or physiological) dependence is a state where the body has developed a need for the substance. It is characterized by physical withdrawal symptoms such as nausea, vomiting, diarrhea, body aches, and seizures. Physical dependence commonly occurs with chronic use of a tolerance-producing drug and can occur even when drugs are taken as prescribed. Some pain-relieving drugs such as narcotics (eg, opioids) are associated primarily with physical dependence.

### Check on Learning

1. Define mechanism of action as it pertains to medications.
2. Define indications as they pertain to medications.
3. What is the difference between a relative and an absolute contraindication?
4. List seven signs and symptoms of a severe allergic reaction to a medication.

## DOSAGE FORMS

Manufacturers produce medications in a variety of forms. These dosage forms (or unit doses) contain a mixture of active ingredients and inactive additives manufactured into a form that delivers medication to sites of action in the body. Dosage forms may be configured in a variety of ways, depending on factors such as physical characteristics (eg, liquid or solid), **route** of administration (eg, oral, topical, injectable), patient characteristics (eg, infant or adult), stability requirements (shelf life), and even aesthetic considerations. Each dosage form has advantages and disadvantages, and specific drugs are often available in more than one form. Similarly, drugs may not be available for every method of administration. Dosage forms are commonly classified by their physical forms.

### Solids

Solid form drugs are administered orally. They are very common and have many benefits. They are easy to mass produce with uniform doses. Stability of the active ingredient, enveloped in a solid form, may be superior to that of other dosage forms. Although solid oral medications are convenient for consumers, they have the disadvantage of being difficult for some to swallow. There is also a lag time between taking the medication and experiencing its effects because it must be broken down in the small intestine before being absorbed into the bloodstream for transport to the target site. Common examples of solid medications taken orally are aspirin, ibuprofen, and acetaminophen.

### Pills

Pill is a common term for many solid oral medications, but more specifically, it describes a round, solid form of medication that is broken down into a solution in the stomach. For example, aspirin is commonly manufactured in pill form.

### Tablets

Tablets are the most common dosage form across all types. They come in many shapes and have diverse physical properties (Figure 3-1). They are very familiar in oblong or circular (wafer-like) forms, but may also be spherical or oddly shaped. Tablets dissolve in the stomach or small intestines. They are frequently coated and may be manufactured as caplets (elongated tablets coated for easier swallowing), or as enteric-coated tablets (tablets that pass through the stomach unchanged



**Figure 3-1.** Tablet dosage forms. Photograph by Carnfinwen. Reproduced from Pixabay. <https://pixabay.com/photos/pills-pill-pharmacy-anxieties-2397455/>

and are dissolved and absorbed in the small intestines). Enteric-coated medications should not be chewed or crushed because that will destroy the special coating that prevents them from dissolving in the stomach. Chewable or effervescent tablets are examples of uncoated tablets. Throat lozenges (or troches) are sweet, mucilaginous tablets that dissolve slowly in the mouth. Some tablets are scored (indented or marked to allow a person to break the tablet into halves or quarters).

### Capsules

Capsules are drug forms that contain a solid (eg, powder), oil, or liquid medication enclosed in a soft or hard gelatin or polymer coating (Figure 3-2). Capsules are mostly tasteless and odorless and they are relatively easy to swallow. They must be administered whole to achieve the desired result. In particular, sustained-release and timed-release capsules cannot be divided or crushed. Capsules are usually more expensive than tablets.



**Figure 3-2.** Capsule dosage form. Photograph by Heung-Soon. Reproduced from Pixabay. <https://pixabay.com/photos/pill-capsule-medicine-pharmacy-4099839/>

## Powders

Powders are dry preparations with a uniform mix of medications. They are often mixed with liquids and are mostly delivered orally; however, some powders are applied topically. Nutritional supplements, such as protein powders, are a familiar example.

## Semisolids

These semisolid dosage forms are applied to skin or mucous membranes. They may have local or systemic effects.

- Ointment—a viscous, oil-based semisolid mixture applied to the skin (eg, nitroglycerin ointment to prevent angina).
- Gel—an aqueous solution that liquefies on contact with skin, dries into a thin film, and is easily removed (eg, some OTC gels for treating muscle pain).
- Cream—a semisolid emulsion of water and oil that is easy to apply to skin (eg, lidocaine cream).
- Lotion—an aqueous or alcohol preparation for skin that dries quickly after application. Lotions can soothe, protect, cleanse skin, or act as an astringent (eg, camphor-glycerin-alcohol-water astringent lotion).
- Paste—a mixture of powder and ointment (eg, zinc oxide paste).

## Liquids

Liquid medications can come in a variety of forms, many of which must be shaken before use to ensure equal distribution of the drug throughout the formulation (Figure 3-3). Liquids are typically administered orally or by injection.



**Figure 3-3.** An oral medication formulated as a liquid. Photograph by frolicsomepl. Reproduced from Pixabay. <https://pixabay.com/photos/anxieties-medicines-syrup-pharmacy-342448/>

## Solutions

A liquid containing a dissolved medication is a solution. Sugar dissolved in water is a household example of

a solution. There are three common solutions used in medicines. An alcohol solution that is sweet, aromatic, and designed to be taken orally is an **elixir**. A solution consisting of medication dissolved in a concentrated solution of sugar and water is a **syrup**. A solution of the soluble constituents of vegetable compounds that act as drugs is a **fluid extract**.

## Suspensions

Undissolved drugs, finely divided and mixed into liquids, are **suspensions**. They may consist of one or more drugs in a single suspension. Shake suspensions before administering them to mix the liquid with the solid portions of the medication that settled at the bottom of the container. A household example of a suspension is a mixture of flour and water.



**Figure 3-4.** A suppository dosage form. Photograph by Marco Verch. Reproduced from Flickr. <https://www.flickr.com/photos/30478819@N08/49175691543>

## Suppositories

A suppository is a drug mixed with a lubricated substance and molded to insert into body cavities such as the rectum or vagina (Figure 3-4). Suppositories are solid at room temperature, but dissolve quickly and release medication when inserted and warmed by body heat. This useful dosage form can rapidly exert both local and systemic effects.

## Transdermal Patches

Transdermal patches (or topical disks) are medicated, adhesive patches placed on skin (Figure 3-5). The medication is absorbed through the skin and





**Figure 3-5.** A fentanyl transdermal patch. Photograph by Daniel Tahar. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:A\\_generic\\_fentanyl\\_transdermal\\_patch\\_with\\_a\\_release\\_rate\\_of\\_12mcg\\_per\\_hour\\_applied\\_to\\_the\\_skin\\_\(cropped\).jpg](https://commons.wikimedia.org/wiki/File:A_generic_fentanyl_transdermal_patch_with_a_release_rate_of_12mcg_per_hour_applied_to_the_skin_(cropped).jpg)

into the bloodstream, providing a slow, controlled release of therapeutic agents. They increase compliance because patients do not have to remember dosing instructions and they are particularly useful in patients who cannot take oral medications (unconscious or nauseated). Transdermal patches are used to deliver substances such as analgesics, estrogen, nicotine, and nitroglycerin.

### Gases

This group of dosage forms includes inhalers and aerosols. **Nebulizers** (Figure 3-6), pressurized metered-dose aerosols, or powder aerosols adminis-



**Figure 3-6.** A nebulizer mask. Photograph by James Heilman, MD. <https://commons.wikimedia.org/wiki/File:Nebulizer.JPG>

ter medications by the respiratory route. This route is common for management and treatment of respiratory conditions such as asthma.

## ANTIBIOTICS

An antibiotic is a chemical compound that kills, inhibits, or stops the growth of microorganisms such as bacteria, fungi, and protozoa. Most frequently they are indicated for treatment or prevention of bacterial infections. There are more than 150 antibiotics developed to help in the fight against infectious diseases and they have saved millions of lives.

### Categories and Types of Antibiotics

All antibiotics fall into one of two categories: broad spectrum or narrow spectrum. Broad-spectrum antibiotics are effective against a wide range of organisms. For example, ampicillin is a broad-spectrum antibiotic that is effective against numerous gram-negative and gram-positive bacteria. Broad-spectrum antibiotics are useful for treating infections with more than one pathogen, or for treating infections before the pathogen is identified. Narrow-spectrum antibiotics are effective against only a few microorganisms and should be used in a targeted manner for identified pathogens. Antibiotics in both categories are used to treat or prevent infections prior to surgery. Broad-spectrum antibiotics are better suited for combat environments, unless specific infectious agents are known. Narrow-spectrum antibiotics are most suited for treating known pathogens. Many different broad-spectrum and narrow-spectrum antibiotics are available. Local standard operating procedure will guide their selection and use.

Antibiotics are also grouped into classes (types), each with its own chemical composition, use, mode of action, and potential side effects. The following are common classes of antibiotics, with representatives (generic names) for each:

- beta-lactam—penicillin, amoxicillin, cephalixin;
- macrolide—erythromycin, azithromycin;
- tetracycline—tetracycline, doxycycline;
- aminoglycoside—gentamicin, neomycin; and
- fluoroquinolone—ciprofloxacin, levofloxacin.

Some patients are allergic to specific types of antibiotics (eg, penicillin allergies are common); those antibiotics are contraindicated in such patients.

## Antibiotic Dosage Forms

Antibiotics that are applied directly on the skin, the mucous membrane of the conjunctiva, or the nasopharynx are known as topical antibiotics. Uses include treatment for skin diseases, wound management, burns, and conjunctivitis. Topical antibiotics are easy to use and generally noninvasive. Absorption through mucous membranes is rapid. Examples of topical antibiotics include bacitracin (minor skin infections), mupirocin (impetigo), besifloxacin (conjunctivitis), and silver sulfadiazine (burns).

Oral antibiotics typically are taken by mouth over a course of time (usually 7–10 days). Oral antibiotics are the oldest method of administration and have a number of advantages that make them the preferred route. Oral antibiotics are easy to administer and are the safest, most convenient, and most economical route of administration. With all of their benefits, oral antibiotics also have limitations and disadvantages. Administration requires a conscious and cooperative patient. Irritation of the gastrointestinal mucosa may cause vomiting. Also, when compared to other routes, they have a much slower absorption rate. Examples of oral antibiotics include levofloxacin, streptomycin, and the combination drug sulfamethoxazole and trimethoprim.

**Note:** All medications have side effects and it is your responsibility to know the side effects for all medications you administer.

For treatment of severe illness and injury in patients who are unconscious or uncooperative, or who cannot tolerate oral antibiotics, the preferred route is intravenous (IV). IV antibiotics have a much faster and more predictable absorption rate, which makes them ideal for emergencies. The fast absorption rate can also be problematic, since allergic reactions occur more quickly and more severely than with oral administration. Intravenous access is a requirement for IV antibiotics; therefore, administration is more difficult and may induce anxiety in patients who have a fear of needles. IV antibiotics can also cause tissue necrosis if administered incorrectly. Examples of IV antibiotics include cefazolin and ertapenem.

## Antibiotic Resistance

Antibiotic-resistant bacteria appeared soon after penicillin was introduced in the 1940s. Over the years, overuse and misuse of antibiotics have caused problems with their effectiveness. Antibiotics are frequently used for conditions or infections that are not caused by bacteria (eg, viral infections). They are also heavily used in agriculture to prevent animal disease. Antibiotic resistance reduces the capability of some drugs to treat certain bacteria effectively. It is a growing concern because we rely heavily on antibiotics in modern medicine and many bacteria are now resistant to commonly used antibiotics. For example, methicillin-resistant *Staphylococcus aureus* (MRSA) was once seen only in hospitals, but now it appears in the wider community. These types of infections are relatively common in the military.

Resistance occurs when an antibiotic fails to kill all of the bacteria it targets and the surviving bacteria become resistant to that particular drug (and frequently to other antibiotics, as well). This drug-resistant bacteria is a “super bug.” Doctors may prescribe a stronger antibiotic, but the bacteria quickly evolve to withstand the more potent drug as well, perpetuating a cycle in which increasingly powerful drugs are required to treat infections. To reduce the development of resistance, the full course of antibiotics should always be completed, regardless of whether the patient feels better before finishing all the medication. Do not save antibiotics for later use or use someone else’s prescription.

## Check on Learning

5. What is an antibiotic?
6. What is the difference between broad-spectrum and narrow-spectrum antibiotics?
7. What are the advantages of oral antibiotics?

## ANTIFUNGALS

Antifungal medications are used to treat fungal infections, known as mycoses. Mycoses are generally named based on the location of the infection and they can affect superficial, cutaneous, or subcutaneous areas of the skin. The route of the medication (topical, oral, or IV) will depend largely on the location and extent of the infection. Factors that contribute to the appearance and extent of fungal infections include high humidity and hormonal or immune system abnormalities.

Prevention includes keeping skin clean and dry, proper hand washing, avoiding infected individuals, and maintaining good hygiene. Fungal infections are contagious, so it is important to wash any area that may have come in contact with contaminated surfaces or others who may be infected. Common mycoses include ringworm, scalp infection (a form ringworm), athlete's foot, and jock itch.

Tinea corporis, also known as ringworm, is a superficial fungal infection that can appear anywhere on the body. The name is derived from its appearance (a raised ring at the center of the infection). Individuals living in crowded, humid conditions are more susceptible, as are those who participate in contact sports, particularly wrestling. The extent of the infection will determine course of treatment for ringworm. Topical OTC antifungal medications include clotrimazole, ketoconazole, fluconazole, and undecylenic acid. Oral antifungals such as griseofulvin may also be used. In more severe cases, a systemic IV medication (amphotericin B) may be needed for fungal infections that show resistance to other drugs.

Tinea capitis is a fungal infection of the scalp characterized by severe itching, raised ring-like appearance, and bald patches on the affected area. Treatment for this form of fungal infection is identical to that of tinea corporis.

Tinea pedis, also known as athlete's foot, is a fungal infection that affects the feet, particularly the toes and the webbing of the toes. Treatment for athlete's foot includes topical OTC antifungals (eg, clotrimazole) or oral prescription antifungals (eg, terbinafine hydrochloride or griseofulvin). Fungal nail infections are similar to athlete's foot. These infections can be treated with topical OTC medications or an oral prescription drug (eg, itraconazole or terbinafine hydrochloride).

Tinea cruris, also known as jock itch, is a fungal infection of the groin characterized by itching, burning, and a reddish appearance. Jock itch is more common in males, but can also occur in females. Topical antifungals are the preferred course of treatment for tinea cruris in males. Treatment for fungal infection caused by *Candida albicans* (vaginal yeast infection) includes tioconazole (ointment or suppository).

### Check on Learning

8. What is the location of tinea corporis?
9. What is the location of tinea capitis?
10. What is the location of tinea pedis?

## ANTIHISTAMINES

Histamines and leukotrienes are immune system substances released by the body in response to sensitivity to certain foreign antigens. Mild to moderate allergy symptoms represent physiological overreactions to a foreign invader. Histamines are physically active substances found in plant and animal tissues. They are released from mast cells in the human body and contribute to stimulation of gastric secretions, dilation of capillaries, constriction of bronchial smooth muscles, and decrease in blood pressure. Leukotrienes are fatty molecules of the immune system that contribute to inflammation in asthma and bronchitis patients.

Antihistamines are a class of drugs that combat the histamine release during an allergic reaction by blocking the action of the histamine on the tissue. Antihistamines do not stop the formation of histamine, nor do they stop the allergic reaction between the body's antibodies and the foreign substance, but they do protect tissues from some of its effects. Side effects associated with antihistamines include drowsiness, dry mouth, urine retention in men, and increased heart rate. Newer, non-sedating antihistamines are generally thought to be less effective. Antihistamines provide only temporary relief and must be used frequently to control symptoms. Prolonged use may result in undesirable effects.

Some example of antihistamines include, fexofenadine, diphenhydramine, loratadine, and cetirizine. Antihistamines should be prescribed with great caution in a combat environment and when the patient is returned to duty (consider if the patient will drive or operate machinery). Treatment for mild to moderate allergic reactions may also include bronchodilators to relieve lung symptoms. Cortisone preparations and other anti-inflammatory agents may have cooling and antiseptic effects and reduce itching and other symptoms.

### Check on Learning

11. What are the effects of histamines on the body?
12. Do antihistamines stop the production of histamines?
13. What are some side effects associated with antihistamines?



## EPINEPHRINE

Anaphylaxis is an immediate life threat and must be addressed as soon as it is identified. Treatment for an anaphylactic reaction includes securing the airway, administering supplemental oxygen with positive pressure ventilations (if necessary), and administering epinephrine 0.3 to 0.5 mg (1:1,000 solution) intramuscular (IM) or subcutaneous (SC) for an adult. Epinephrine may be repeated every 5 to 10 minutes if symptoms continue or recur. The MO may also prescribe antihistamines (diphenhydramine 25–50 mg IM or IV), corticosteroids (methylprednisolone sodium succinate 125 mg IV), and a normal 500 cc saline bolus.

**Note:** Epinephrine is the first-line treatment for anaphylaxis.

## NONSTEROIDAL ANTI-INFLAMMATORY DRUGS

Nonsteroidal anti-inflammatory drugs (NSAIDs) are drugs with analgesic (pain-killing), antipyretic (fever-fighting), and anti-inflammatory (swelling-reducing) effects. NSAIDs are indicated for patients in mild to moderate pain, febrile patients, and patients with tissue inflammation. They are commonly prescribed to reduce inflammation of arthritis, tendinitis, bursitis, and other body tissues. To alleviate pain, they should be tried prior to using narcotics if the situation warrants. Examples include aspirin, ibuprofen, and naproxen. Acetaminophen is not an anti-inflammatory drug, so it is not considered an NSAID, even though it relieves pain and reduces fever.

Side effects of therapeutic doses of NSAIDs include:

- gastric irritation (epigastric discomfort or stomach ache),
- heartburn,
- nausea,
- lack of appetite,
- prolonged clotting time in some (eg, aspirin),
- high-pitch tinnitus,
- vertigo, and
- deafness.

Overdose and toxicity are concerns with NSAIDs. Although hearing and balance problems are generally temporary or curable, permanent damage can occur from ototoxicity. Toxic doses also greatly elevate body temperature, resulting in hyperthermia. This is in direct contrast to the effects of therapeutic doses.

Behavioral side effects of overdose may include central nervous system stimulation followed by depression, agitation, and confusion. This may be followed by stupor and coma. Respiratory stimulation may proceed to the point of hyperventilation, followed later by respiratory depression.

Hypersensitivity (an undesirable overreaction of the immune system) is a serious complication of NSAID use. Aspirin may cause hypersensitivity and exacerbate asthma symptoms. Also, aspirin and other NSAIDs are extremely hard on the stomach lining. With prolonged use, they may cause peptic ulcers with resultant gastric bleeding. NSAIDs may cause acute renal failure, so encourage patients taking them to drink adequate fluids.

**Note:** Aspirin and ibuprofen are contraindicated for military members in combat because they inhibit blood clotting.

**Warning:** Do not give aspirin to children! Aspirin may cause **Reye's syndrome**.

## Check on Learning

14. What are the signs and symptoms of NSAID toxicity?
15. Why is aspirin not recommended for military personnel in combat?
16. What are the properties of NSAIDs?

## ANALGESICS

Medications intended to relieve pain are known as analgesics. Analgesics are typically divided into two groups: narcotic and non-narcotic. Generally, the patient's pain level will determine the type of analgesic required for relief. Non-narcotic analgesics (indicated for mild to moderate pain) include meloxicam and acetaminophen. Narcotic analgesics (indicated for moderate to severe pain) include morphine, fentanyl, and ketamine.

### Non-narcotic Analgesics

For patients who are experiencing mild to moderate pain, a non-narcotic analgesic such as meloxicam or acetaminophen is recommended. These are useful in combat situations for conscious and lucid casualties.

who are still able to fight. Give meloxicam 15 mg per os (by mouth) daily. The recommended dosage for acetaminophen is two 500 mg caplets per os every 8 hours. As with any medication, patients should be monitored for adverse reactions. High doses of meloxicam can cause serious gastrointestinal issues and high doses of acetaminophen can cause liver damage if given for an extended period of time or in patients with known liver disease. Document every dose given and the time it was administered.

## Narcotic Analgesics

Severely injured patients (eg, those with operational and combat injuries, traumatic amputations, ballistic injuries, severe burns, or crush injuries) experiencing moderate to severe pain require narcotic analgesics. All opioid analgesics can be addictive, so limit use to casualties in moderate or severe pain only, as described below.

**Caution:** Respiratory depression can occur with repeated doses of narcotic analgesics, as can nausea or vomiting.

### Morphine

Morphine is indicated for severe pain. Morphine causes constriction of the pupils and inhibits pupillary reactions; therefore, using pupillary response for trauma casualty assessment is an unreliable vital sign for assessment of head injuries.

Contraindications for morphine include morphine allergies and altered mental status. Some soldiers may claim to have an allergy to morphine and will either develop a rash or experience nausea, vomiting, or pruritus (itching) when morphine is administered. In combat, these soldiers can still take morphine. The soldiers who have had a previous anaphylactic reaction to morphine must be identified early in the pre-deployment process and have other injectable pain medications supplied for their use. The specific type of alternate medication to carry and administer will depend on the area of deployment and the decision of the MO.

Morphine is administered in an initial dose of 5 mg slow IV push over 1 to 2 minutes. Dilute the 5 mg dose in 5 mL normal saline prior to IV administration. Repeated doses of morphine IV may be given every 5 minutes. Most adults will experience pain relief at a total dose of 10 to 20 mg, although higher doses may

be required. Document every dose given, including the time of administration. Monitor the casualty closely for adverse effects.

**Note:** Due to the adverse effects of morphine on the respiratory system, fentanyl is preferred over morphine in a combat environment.

### Fentanyl

Fentanyl is an opioid pain medication used for moderate to severe pain in casualties who are alert and conscious. Fentanyl “lollipops” are most commonly used in combat settings for quick pain relief. Fentanyl is also useful for patients with known morphine allergies; however, it is contraindicated in patients with altered mental status or allergies to the medication (or any of its components). Exercise caution when administering fentanyl to a patient who has already been given morphine, since this combination can increase the chances of respiratory depression and adverse narcotic side effects.

Fentanyl is administered transbuccally (absorbed through the mucosal lining of the cheeks) via an 800 µg (micrograms) lozenge. To avoid an overdose, tape the lozenge to the patient’s finger. When pain is relieved, the patient’s finger will move away from their mouth. Reassess patients every 15 minutes for early recognition of serious side effects or respiratory depression.

### Ketamine

Patients with possible cardiorespiratory depression may be given ketamine, a very potent analgesic that is mainly used as a general anesthetic. It is indicated for controlling moderate to severe pain. Ketamine can cause hallucinogenic terrors, so it is contraindicated in patients with history of schizophrenia and in patients under 3 years old. A nasal spray formulation of ketamine (10 mg) is in development for soldiers. It reportedly will not have abuse potential and will be easier to administer.

High doses ranging from 50 to 100 mg (or 0.5–1.0 mg/kg) IM or intranasal (IN) can dissociate conscious thought from sensory input (including pain). The dosage can be repeated every 20 to 30 minutes (IM or IN) or every 20 minutes (IV) as needed to control pain or until the patient develops **nystagmus**. The half-life for ketamine is 2.5 hours. Patients given a single high dose will have approximately 30 minutes duration of dissociation.

At low doses of 30 mg (or 0.3 mg/kg) slow IV or intraosseous (IO) push over one minute, ketamine relieves pain twice as fast as morphine. The dosage can be repeated every 20 minutes as necessary to control severe pain, or until the casualty develops nystagmus.

**Note:** Ketamine requires slightly more time and expertise to administer than fentanyl, but avoids the risk of cardiorespiratory depression.

### Check on Learning

17. Acetaminophen can cause damage to what organ in high dosages?
18. What are the contraindications for fentanyl?
19. What are the contraindications for ketamine?
20. What is the dose for fentanyl?

### ANTIDOTE

The potential for overdose exists in any patient who is administered a potent opiate narcotic, such as morphine. Respiratory depression is a sign of overdose and is a life threat. If overdose is suspected, the **opiate** antagonist, naloxone, is used to reverse the effects of the narcotic. Naloxone binds to the same receptors in the central nervous system that opiates normally attach to, blocking the narcotic from binding to the same receptors. Naloxone has no absolute contraindications for use and minimal side effects. It may induce narcotic withdrawal symptoms (eg, nausea, vomiting, and tachycardia). Emergency administration of the antidote outweighs the potential side effects of the medication.

Typical dosage and administration of naloxone involve slow IV push 0.4 to 2.0 mg over 1 to 2 minutes (IM or SC), which may be repeated 3 or 4 times. The recommended dosage for effective management of suspected opiate overdose is up to 10 to 20 mg. When administered via IV, an immediate positive response is usually realized within 1 to 2 minutes and the duration of action is 1 to 2 hours. Since the half-life of morphine is 2 to 4 hours and the half-life of naloxone is 1 to 2 hours, naloxone effects may wear off earlier than morphine and patients could lapse back into respiratory depression. Accordingly, naloxone should be adjusted to the patient's respiratory status rather than their level of consciousness and patients must be continually monitored for relapse.

### Check on Learning

21. Subsequent doses of naloxone should be administered with consideration to what?
22. List the side effects associated with naloxone.

### SUMMARY

Every day, combat medics use the principles of pharmacology in their patient care roles, whether consciously or subconsciously. Whether in a garrison environment with a team of health care providers, or working independently in a combat setting, knowledge of pharmacology improves patient outcomes by affecting treatment decisions. Within your scope of practice, you must use your full knowledge to provide high-quality, competent, and compassionate medical care.



## KEY TERMS AND ACRONYMS

**Analgesic.** A pain reliever that does not cause loss of consciousness.

**Anaphylaxis.** An acute allergic reaction to an antigen (eg, venom from a bee sting) to which the body has become hypersensitive.

**Angioedema.** Diffuse swelling that may start with the lips, hands, feet, or mucous membranes, and sometimes progresses to the airway, causing difficulty breathing.

**Antibiotics.** Chemical compounds that inhibit or kill the growth of microorganisms, such as bacteria, fungi, and protozoa.

**Antigen.** A foreign substance that produces an immune response in the body. Examples include viral and bacterial components or products, some food proteins, venom, and pollen.

**Astringent.** A substance that causes tightening of soft tissues, such as skin.

**Dosage.** The calculation or administration of the proper amount, number, and frequency of doses. Often used interchangeably with dose.

**Dose.** The amount (quantity) of medication administered. Often used interchangeably with dosage.

**Emulsion.** A blend of liquids that do not mix together, but where one component is dispersed in fine droplets in another. For example, oil and vinegar dressing after thorough shaking.

**Elixir.** An alcohol solution that is sweet and aromatic.

**Fluid extract.** A solution of the soluble constituents of vegetable compounds that act as medications. Each milliliter of the drug represents 1 gram of medication.

**Generic name.** The official chemical name for a drug.

**Mechanism of action.** A predictable chemical reaction that determines how a drug works at the cellular or subcellular level. This is observed as expected responses in the body that indicate the drug is working.

**Narcotic.** A sleep-inducing drug that relieves pain. The term is usually associated with opiates.

**Nebulizer.** A medical device that dispenses liquid respiratory medication by dispersing it with pressurized oxygen. The patient breathes the resulting fine spray or mist into the lungs.

**NSAID.** Nonsteroidal anti-inflammatory drug.

**Nystagmus.** A condition where eyes move rapidly and uncontrollably. Movements may be side to side, up and down, or circular. Vertical nystagmus might be a sign of serious brain injury.

**Opiate.** A drug derived from alkaloids produced by the opium poppy. The major biologically active opiates found in opium are morphine and codeine.

**Opioid.** Specifically refers to synthetic narcotics that are similar to opiates, such as heroin and hydrocodone. However, the term is often used to include opiates and synthetic narcotics.

**Reye's syndrome.** A rare, but serious condition that damages the brain and liver. It was seen more often in the past, when children were given aspirin to alleviate symptoms of a viral illness.

**Route.** The means of access for medication delivery, or how the medication is administered.

**Side effects.** Negative effects or actions other than the desired actions.

**Suspension.** One or more drugs finely divided and mixed into a liquid without dissolving.

**Syrup.** Medication dissolved in a concentrated solution of sugar and water.

**Therapeutic effects.** The expected positive effect of a drug.

**Topical.** A medication designed to be applied to the body surface (eg, skin or eyes).

**Trade name.** The official brand name of a drug produced by a specific company.

**CHECK ON LEARNING ANSWERS**

1. Define mechanism of action as it pertains to medications.  
*How the drug works. Certain responses are expected in the body and can also be described as predictable chemical reactions.*
2. Define indications as they pertain to medications.  
*The reason the medication is administered.*
3. What is the difference between a relative and an absolute contraindication?  
*A relative contraindication is when the medication or treatment may harm the patient but can still be administered if the benefit outweighs the risk. An absolute contraindication means that the drug or treatment could cause a life-threatening condition and is never allowed.*
4. List seven signs and symptoms of a severe allergic reaction to a medication.  
*Any seven of the following: airway compromise that may include hoarseness, stridor, edema, rhinorrhea, and wheezing; low blood pressure; tachycardia; chest pain and tightness; nausea; vomiting; abdominal cramping; diarrhea; itching; hives; and angioedema.*
5. What is an antibiotic?  
*A chemical compound that inhibits or kills the growth of microorganisms, such as bacteria, fungi, or protozoa.*
6. What is the difference between broad-spectrum and narrow-spectrum antibiotics?  
*Broad-spectrum antibiotics are effective against a wide range of microorganisms, whereas narrow-spectrum antibiotics are effective against only a few or specific microorganisms. Broad-spectrum antibiotics are better suited for combat environments unless the specific infection is known.*
7. What are the advantages of oral antibiotics?  
*They are generally safe, convenient, economical, and are easy to administer.*
8. What is the location of tinea corporis?  
*The body.*
9. What is the location of tinea capitis?  
*The head.*
10. What is the location of tinea pedis?  
*The feet.*
11. What are the effects of histamines on the body?  
*Stimulate gastric secretions, dilate capillaries, constrict bronchial smooth muscles, and decrease blood pressure.*
12. Do antihistamines stop the production of histamines?  
*No. They block the action of histamines on tissues.*

13. What are some side effects associated with antihistamines?  
*Drowsiness, dry mouth, urine retention in men, and increased heart rate.*
14. What are the signs and symptoms of NSAID toxicity?  
*Hyperthermia, behavioral effects, respiratory stimulation, and high-pitch tinnitus.*
15. Why is aspirin not recommended for military personnel in combat?  
*It contributes to prolonged clotting times, which may cause excessive bleeding.*
16. What are the properties of NSAIDs?  
*Analgesic, anti-inflammatory, and antipyretic.*
17. Acetaminophen can cause damage to what organ in high dosages?  
*The liver.*
18. What are the contraindications for fentanyl?  
*Altered mental status or allergy to the medication or its components.*
19. What are the contraindications for ketamine?  
*Children under 3 and patients with a history of schizophrenia.*
20. What is the dose for fentanyl?  
*800 µg.*
21. Subsequent doses of naloxone should be administered with consideration to what?  
*The patient's respiratory level.*
22. List the side effects associated with naloxone.  
*Nausea, vomiting, and tachycardia.*

## SOURCES

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# 4

# MEDICATION ADMINISTRATION

## CORE CONCEPTS

- Discuss the combat medic's scope of practice to administer medication.
- Administer medications.
- State the 6 Rights of medication administration.
- Describe how to treat mild to moderate allergic reactions after medication administration.
- Describe how to treat severe allergic reactions after medication administration.
- Calculate drug dosages.

## INTRODUCTION

Medications (also called pharmaceuticals or drugs) prevent and treat disease and control pain. Combat medics administer various types of medications, from vaccines to powerful pain medications. Medication administration is an exact science and one error could cause severe injury or death to a patient. To properly administer medications and prevent accidental injuries, combat medics must understand how certain drugs affect the body. They must also be able to calculate and administer the correct drug **dose** every time.

The Centers for Disease Control and Prevention (CDC) estimates that mistakes made by health care providers administering medications within health care facilities injure or kill thousands of people each year. The administration of medication is a vital combat medic skill.

## SCOPE OF PRACTICE

Combat medics practice under supervision of a licensed health care provider (doctor, nurse practitioner, registered nurse, or physician assistant). In the clinical setting, you may dispense prescriptions and over-the-counter medications ordered or directed by a licensed health care provider. In the field, you may be responsible for the safe and appropriate delivery of medication in accordance with (IAW) unit standard operating procedures (SOP) or the approved formulary (off-line medical control). You are responsible for knowing all medications within their authority to dispense IAW unit SOP.

You must also understand how to treat medication allergies. Although rare, a severe hypersensitivity (**anaphylaxis**) is a life-threatening emergency that may progress suddenly from mild initial reactions.

**Note:** The supervising MO and the combat medic carry the same burden of responsibility for administering medications correctly and safely.

## ENTERAL ROUTES OF MEDICATION ADMINISTRATION

Enteral **routes** of drug administration are those in which medications are absorbed through the gastrointestinal tract. Enteral routes include medications given by mouth (the most common way to give medications), by any tube inserted into the gastrointestinal tract (nasogastric, gastrostomy, or jejunostomy tubes), by **suppository** (rectum), or by **enema** (rectum). Medications administered via the enteral route come in many forms, such as powders, **pills**, **tablets**, **lozenges** (troches), liquids, and suppositories. Common examples of medications given by mouth include aspirin, acetaminophen, and ibuprofen.

Some medications are delivered orally, but are absorbed through mucous membranes (**transmucosal**) before reaching the intestine. Nevertheless, these are often classified as enteral medications. Sublingual medications are placed under the tongue and are absorbed through the blood vessels there (eg, nitro-

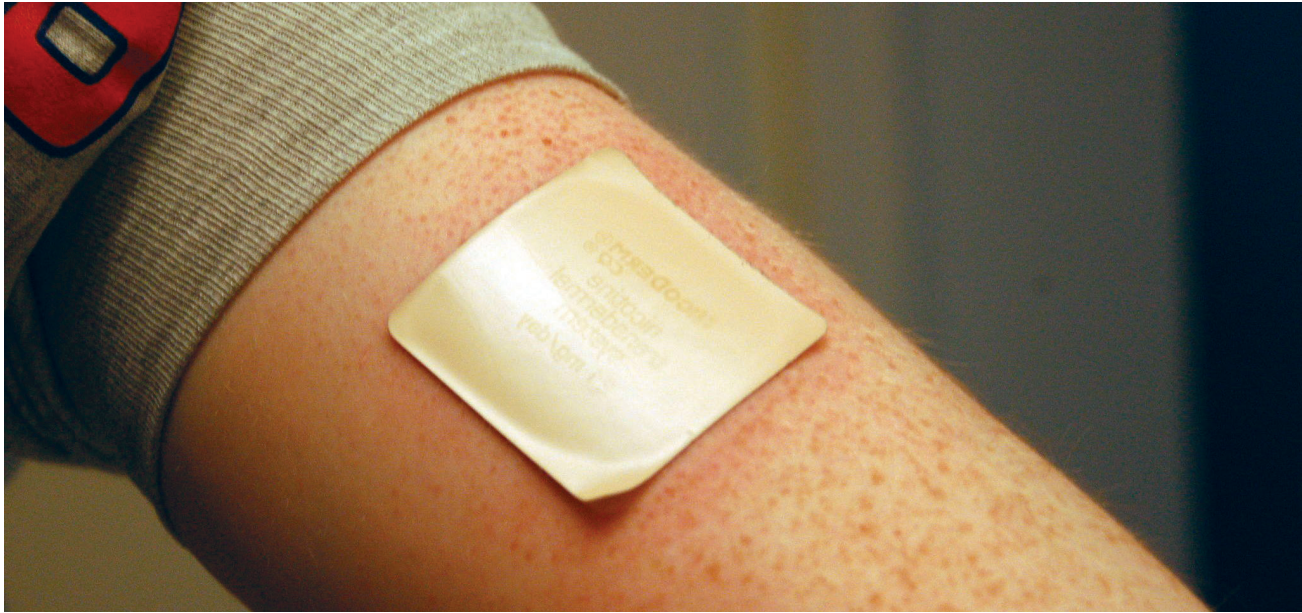


**Figure 4-1.** A nicotine transdermal patch. Photograph by RegBarc. Reproduced from Wikimedia Creative Commons. <https://commons.wikimedia.org/wiki/File:Nicoderm.JPG>

glycerin). Buccal medications are placed alongside the cheek and are absorbed through the blood vessels in the mouth (eg, oral glucose).

### Advantages

The main advantages of administering a medication via the enteral route are safety and low cost. Administration is very convenient and easy, and most medications are available in forms approved for enteral administration. Furthermore, if a patient overdoses while taking medication via the enteral route, the medication can be removed through a procedure called **gastric lavage** or by having the patient vomit.

### Disadvantages

The onset of action depends on absorption rates in the gastrointestinal (GI) tract, which vary. Unconscious patients, or those experiencing nausea or vomiting, cannot receive enteral medications that dissolve in the stomach and are absorbed in the small intestines. Some medications lose their effectiveness if mixed with gastric secretions. Some enteral medications may have an objectionable odor or taste, or may be too bulky for some patients to swallow.

## PARENTERAL ROUTES OF MEDICATION ADMINISTRATION

Parenteral routes are any drug administration routes other than the mouth and alimentary canal (the passage in which food passes through the body from mouth to anus). Parenteral routes include percutaneous, subcutaneous, intradermal, intramuscular, and intravenous (IV) push.

### Percutaneous Route

The percutaneous route refers to the absorption of medication through the skin or mucous membranes. Topical application is common and familiar, but inhalation and instillation (including intranasal delivery) are extremely useful for percutaneous medicine administration.

### Topical

In the topical method of percutaneous medication administration, medication is applied to body surfaces such as the skin or mucous membranes (eg, with a paste or patch) and is absorbed through the surface. Topical medications may come in forms such as **ointments** (eg, **antibiotic ointments**), **creams**, **lotions**, **pastes**, and **transdermal patches (topical disks)**.



Nicotine, analgesics, nitroglycerin, and estrogen all can be delivered systemically via transdermal patches (Figure 4-1).

The main advantage of applying medication through a topical percutaneous route is localization of the drug at the site of application, which reduces possible systemic **side effects**. However, lotions, ointments, creams, powders, and topical disks (transdermal patches) can be messy and difficult to apply. To avoid accidental poisoning, gloves are required for handling or applying percutaneous medication. For example, if you handle a transdermal patch without gloves, you may absorb the medication through your skin.

The following factors affect the amount of drug absorbed through topical administration:

- drug concentration,
- skin contact time,
- application area (size),
- skin thickness,
- skin tissue hydration, and
- degree of skin disruption.

### **Inhalation**

Inhalation is the method of medication administration that delivers aerosolized liquids and gases into the lungs. Inhaled medication is absorbed through the lower airway. The lungs, with their rich supply of blood vessels, have a large surface area over which medications are absorbed. The smaller the particles in inhaled medications, the lower in the respiratory tract the medication tends to travel. Due to the large surface area of the lung tissue and the large number of blood vessels, drug dosing can be difficult to establish. Devices such as metered-dose inhalers help deliver a consistent dose of medication during inhalation. Examples of inhalation medications include bronchodilators (eg, albuterol and ipratropium bromide) and steroids (eg, fluticasone and budesonide) used to control and reduce symptoms of asthma and chronic obstructive pulmonary disease.

### **Instillation**

The instillation method administers medication by absorption through the mucous membranes of the mouth, eyes (ophthalmic), ears (otic), nose (nasal), rectum, and vagina.

### **Ophthalmic**

There are many reasons to apply medications through the ophthalmic route such as to remove foreign bodies or irrigate the eye, to dilate the pupil for medical procedures, and to administer antibiotics for eye infections. Some eye medications may be absorbed systemically. Most eye medications are eye drops or ointments (eg, Visine [Johnson & Johnson, New Brunswick, NJ]), which treat many eye conditions (Figure 4-2).



**Figure 4-2.** A person applying medicated eye drops. Photograph courtesy of Mike Davis; Medical Center of Excellence, Joint Base San Antonio, TX.

### **Otic**

The otic route refers to medication applied in the external auditory canal of the ear. This route is used to treat ear infections, irrigate to remove foreign objects, or remove excessive cerumen (earwax). Most ear medications are eardrops.

### **Rectal**

In this route of administration, medications are inserted into the rectum and absorbed through mucous membranes. They are typically administered with an enema or a suppository.

### **Vaginal**

Vaginal instillation medications are absorbed through the mucous membranes of the vagina to treat medical disorders ranging from infection to pain relief. They typically are administered with suppositories, creams, gels, or foams.



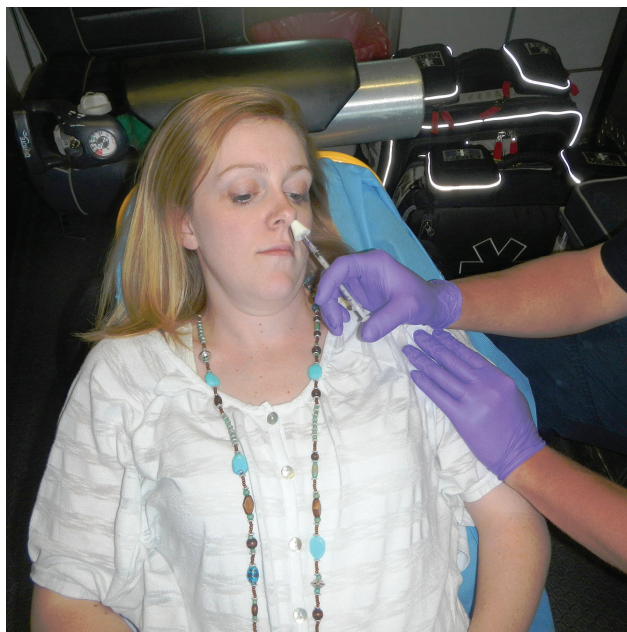


**Figure 4-3.** A patient being treated with an intranasal medication delivered through a 1 mL syringe and a mucosal atomization device. Photograph courtesy of Mike Davis; Medical Center of Excellence, Joint Base San Antonio, TX.

### *Intranasal*

Intranasal (IN) delivery of medications is a relatively new transmucosal (percutaneous, instillation) route of delivery (Figure 4-3). IN refers to medicine applied to the mucous membranes of the nasal passages. The nasal cavity is large and possesses a dense vascular network providing a direct route into the bloodstream for medications that easily cross mucous membranes. Nasal cavities can absorb about 20 mL of medication.

The IN route of administration is rapidly gaining popularity among health care providers. This instillation route is especially important for emergencies, since medications are rapidly absorbed. Nasal decongestants are common IN medications.

**Advantages of the Intranasal Route.** The direct, transmucosal route avoids gastrointestinal destruction and **hepatic first-pass metabolism** of drugs, effectively increasing **bioavailability** (for small drug molecules) and decreasing time of onset. It is also a cost-effective way to deliver medications.

The proximity of the nose to the brain leads to a more rapid equilibration between the blood and the cerebrospinal fluid, leading to a more rapid onset than with conventional routes. The rates of absorption and time to peak plasma concentrations are comparable to IV administration and are generally superior to subcutaneous or intramuscular routes.

Medications administered through the GI tract pass through the liver, which metabolizes a portion of the drug. This hepatic first-pass metabolism reduces the amount of usable medication. IN delivery (just as any parenteral route) bypasses the liver, and therefore maintains the drug's strength. The nasal passage enables better bioavailability for smaller drug molecules. With an absorption enhancer added to medications with larger molecules, those drugs also have good bioavailability when administered IN.

The IN drug administration route is painless and may reduce the patient's anxiety during treatment. In addition, since IN drugs do not require needles, there is no risk of an accidental needle stick. This safety feature is particularly valuable in low visibility and kinetic environments.

**Disadvantages of the Intranasal Route.** A limited number of medications can be administered via the IN route because many medications are not adequately concentrated to achieve the desired effect. The effectiveness of an IN-approved medication also will depend on the condition of the patient's nasal mucosa.

### **Subcutaneous Route**

Medications delivered by the subcutaneous (SC, SQ, or subq) route are injected under the epidermis and dermis, into the fatty subcutaneous layer of the skin. SC injections are useful for delivering medications that cannot be absorbed in the intestines (eg, insulin) or are destroyed by digestive acids and enzymes. Their effects are produced more slowly than medications delivered by the intravenous (IV) route. SC injections generally have less pain and risk of infection than other forms of injections. Other common examples of medications delivered by SC injections are heparin, epinephrine, and allergy medications.

### **Intradermal Route**

Intramuscular (IM) injections deliver medications into the muscle tissue. Medications are absorbed more quickly than in ID or SC routes of administration. IM injections are commonly used for antibiotics (eg, penicillin G and streptomycin) and biologicals (eg, immunoglobulins and toxoids).

### **Intravenous Push Medication Administration**

When ordered by a medical officer (MO), IV push medications are administered directly into a vein through a saline lock or through the injection port of IV tubing attached to an IV catheter inserted into the vein (Figure 4-4). This route is most useful for emergencies



**Figure 4-4.** Medication delivered into a vein by intravenous push.

because the medications are rapidly absorbed. Some medications are delivered very rapidly, while others must be administered slowly over several minutes. However, in all cases, medication delivery is faster than through an IV drip.

#### *Advantages of IV Push Medication Route*

IV push medications have faster onsets of action than most delivered through other parenteral and enteral routes. Since IV push medications bypass the liver and go straight to the cardiovascular system, they do not undergo hepatic first-pass metabolism, and have no reduction in volume or concentration. Full-strength drugs reach the target site. Functionally, a smaller medication dose is needed for IV push than for other routes of administration.

IV push is a viable alternative if the patient is unable or unwilling to swallow a medication. It is also a good choice if digestive juices in the GI tract would alter the drug's effects.

#### *Disadvantages of IV Push Medication Route*

When administering an IV push, use aseptic technique to avoid infection. Infection risk is elevated because of the direct line into the cardiovascular system. In addition, any drug given through an IV can leak into the extravascular spaces and cause **lipodystrophy**, tissue necrosis or abscess, skin sloughing, nerve injuries, prolonged pain, and **periostitis**.

There is no margin of error when calculating dosages for IV push. The intravascular route, rapid absorption, and lack of hepatic first-pass metabolism eliminate any buffer to reduce the amount or concentration of the drug. A miscalculation results in too little or too much drug administered. While an insufficient dose may reduce the drug's efficacy, an overdose can have severe medical consequences.

Intravenous medications can be more expensive than the same drug prepared for other administration routes, such as by mouth.

The rate of injection of an IV push medication can sometimes be difficult, especially if the volume of fluid to be administered is very small (a drug volume less than 1 mL that must be pushed over several minutes).

#### **Check on Learning**

1. What are two advantages and two disadvantages of enteral medication administration?
2. Which of the following is not considered a parenteral route?
  - a. Percutaneous administration.
  - b. IN administration.
  - c. IV push administration.
  - d. Oral administration.

### **THE 6 RIGHTS OF MEDICATION ADMINISTRATION**

The 6 Rights of medication administration decrease human error and increase patient safety. They are the right patient, the right medication, the right time, the right route, the right dose, and the right documentation.

#### **Right Patient**

To prevent errors, confirm the identity of the patient before you dispense medication. In particular, misidentification of patients with common last names is possible if you fail to confirm their first names and dates of birth. Additionally, verify the patient's DOD ID number.

**Note:** Check patient identification every time you administer any medication, even if this is not the first time you have managed the patient in a day.

Verify inpatient identification by checking the patient's name on the medical record. Verify the patient's name on the MO's orders, such as those found on an SF 600, Chronological Record of Medical Care, or DA Form 4678, Medication Administration Record. Additionally, ask the patient to state their name and check the identification wristband provided by the hospital.

Verify outpatient (Troop Medical Clinic, Battalion Aid Station) identification. Ask the patient to state their name and confirm that this matches their ID card or ID tags.

## Right Medication

If an MO provides a verbal medication order, repeat it back to confirm. Verify the medication a minimum of three times. The first verification occurs when removing the medication or container from the storage area. The next verification occurs when preparing the medication dose. If the medication is an IV push or injection medication, perform the second check prior to drawing the drug from the vial. Check for the third time before administering the medication to the patient. Verify and prepare the correct dose. Check again, just before administration.

Be familiar with formulary medications: **brand name**, **generic name**, usual dosages, **indications**, contraindications, common side effects, and other considerations. For example, the MO ordered Motrin (Johnson and Johnson, New Brunswick, NJ) 800 mg tablets, but you have no brand name product on hand. Verify that ibuprofen is the generic equivalent of Motrin and obtain it from the storage area. Have resources available to answer your medication questions when your MO is not available. Verify all information needed for safe and effective use of the drug.

When dispensing a medication ordered by an MO, do not assume the MO has ensured that the medication is right for the patient. You have the same responsibility as the ordering health care provider to prevent medication errors. Ensure the patient is not allergic to the medication. When a patient states they are allergic to a medication, document their description of the reaction. A patient with a known allergy to one medication is commonly allergic to others. A patient who is allergic to ibuprofen, for example, may be allergic to most, if not all, other anti-inflammatory medications, including aspirin.

## Right Time

In a field or combat environment, most medications that you administer will be in urgent or emergent situations. However, during sick call (limited primary care), you may be required to give medications on a scheduled basis. Giving a medication too early could lead to an overdose with undesired effects such as toxicity, sedation, and even death. Giving a medication too late could result in other undesired effects, such as loss of pain control or infection control. Proper medical record documentation helps maintain correct intervals between doses.

## Right Route

A medication's onset of action can vary widely, and depends largely on its route of administration. Many medications come in multiple dosage forms so you must ensure that the form of medication on hand is approved for the route of administration intended. Not all medications are available in every method of administration.

All medications, regardless of route administered, eventually enter the bloodstream. The time it takes a medication to enter the bloodstream is its absorption rate. The more quickly a medication enters the bloodstream, the more quickly it will act; however, quick action is not appropriate in all situations.

## Right Dose

Familiarity with common medication dosages can enhance safety. For example, 800 mg doses of ibuprofen are common, but patients usually should not take more than 2,400 mg in 24 hours. Combat medics should have enough knowledge to question a written order, such as "administer 800 mg of ibuprofen every 8 hours by mouth for pain." Failure to question could inadvertently cause an overdose.

Medications are prescribed and dispensed based on concentration (amount of medication in a given volume). Medications are never ordered by volume alone (eg, milliliters or number of tablets), because various concentrations can exist for any drug. An order that calls only for milliliters of a medication does not give a dose, but only a volume of fluid. The fluid form of medications is produced by dissolving a drug (**solute**) in a sterile fluid (**solution**) for dispensing. Most injectable medications come in various concentrations, as the number of micrograms (or milligrams) per milliliter (eg, morphine is available in either 10 or 20 mg/mL). An order that calls only for 1 mL of morphine can result in two different possible dosages, depending on which concentration is on hand. There are many solid forms of medications with more than one concentration as well. For example, ibuprofen is available in 200 or 800 mg tablets.

## Right Documentation

Thorough medication documentation is vital in the continuity of patient care. The most commonly used forms are SF 600, Chronological Record of Medical



Care; DA 4678, Medication Administration Record; and DD 1380, Tactical Combat Casualty Care (TCCC) Card. All medication documentation should become a part of the patient's permanent medical records. Professional language should be used, but if necessary, describe the patient's reaction to medication in clear, concise, and simple terms. Before administering any drug, document the following:

- vital signs,
- pain levels,
- anatomic location of pain, and
- all signs and symptoms that indicate the need for medication (eg, lung sounds prior to giving an inhaler).

When administering any drug, document the following:

- name of the medication,
- time of administration,
- reason for the medication,
- a description of the location of the application (for topical medication),
- the condition of the skin at the time of application (for topical medication), and
- follow-up action taken (if applicable).

After administering any drug, document the vital signs and all effects of the medication. For example, document the patient's lung sounds after administering medication through an inhaler. Record the omission of any scheduled medication administration, whether by accident or on purpose. If a patient refuses a medication, offer it again in 5 minutes. If it is refused a second time, record the omission and the reason for the omission in the patient's medical record and notify your supervisor.

## PREGNANCY CONSIDERATIONS

Many medications, both prescription and over-the-counter, are either **contraindicated** in pregnancy or should be used only in limited circumstances. To prevent accidental administration of medications that could harm a fetus, obtain the First Day of Last Menstrual Period (FDLMP) for female patients. This date raises or lowers the index of suspicion for pregnancy. If there are any doubts about the patient's pregnancy status, check with the supervising MO before administering medication. A good rule of thumb is to assume that *all* female patients are pregnant until reasonably proven otherwise.

## Check on Learning

3. An MO orders you to administer a specific medication to a pregnant patient, which is contraindicated. Are you, as a combat medic who is following orders, potentially liable for causing injury to the fetus?
4. List the 6 Rights of medication administration.
5. How many times should you verify medications?
6. Restate the times a medication should be verified.

## ALLERGIC REACTIONS

Always ask the patient about allergies to medications before administering or dispensing any medication. Ask what happens when they take the medication. For example, if a patient states they are allergic to penicillin, ask them to describe the reaction. Check unconscious patients for a medical alert bracelet or a medal indicating a medication allergy before administering medications. If the patient informs you of a medication allergy, do not administer the medication. Discuss the issue with an MO. After the patient receives the injection, direct them to remain in the treatment area for 20 minutes and monitor them for a severe reaction. See Chapter 3, Pharmacology, for more information on drug allergies.

**Caution:** An allergic reaction may progress rapidly to anaphylaxis without warning.

## Mild to Moderate Allergic Reactions

These are localized or generalized self-limiting reactions such as itching or swelling. They are not life threatening. Bronchodilators (eg, albuterol) may relieve mild to moderate lung symptoms, such as wheezing or coughing. These are short-acting medications, delivered through a nebulizer or inhaler.

Anti-inflammatory agents, such as corticosteroids, are useful for mild or moderate symptoms. They have cooling and antiseptic effects and reduce itching and other symptoms. They are manufactured in many forms, such as pills, nose or eye drops, creams, injections, and as liquids for inhalation.

Antihistamines effectively reduce mild symptoms by inhibiting histamine action within the body. They

provide only temporary relief, so patients must use them frequently for continuous effect. Prolonged use has undesirable effects, such as an increasing tolerance to the medication (most commonly seen in first-generation antihistamines). First-generation antihistamines (eg, diphenhydramine) may cause drowsiness. Use great caution in prescribing antihistamines in a combat environment. Be cautious when the patient is returned to duty as well (consider if the patient will be operating machinery or driving).

### Severe Allergic Reactions

Anaphylaxis is a life-threatening emergency that can affect more than one organ system. Anaphylaxis refers to a hypersensitivity reaction to an antigen and is the most severe form of an allergic reaction. Even someone experiencing a mild allergic reaction may progress into anaphylaxis. Signs include **angioedema**, difficulty breathing, hives, vomiting, and dangerously low blood pressure (see Chapter 3, Pharmacology, for more information). Immediate medical intervention is required. Treatment of anaphylaxis starts with securing the patient's airway. Give supplemental oxygen and perform positive pressure ventilations if necessary. Administer epinephrine 0.3 to 0.5 mg (of 1:1,000 solution) IM or SC for an adult. Repeat epinephrine every 5 to 10 minutes if symptoms continue or recur. The administration of epinephrine and a 500 mL fluid bolus will aid in combatting hypotension caused by the anaphylaxis. Other medications may be prescribed by an MO as needed, including antihistamines (diphenhydramine: 25–50 mg IM or IV) and corticosteroids (methylprednisolone sodium succinate or methylprednisolone acetate: 125 mg IV).

## DOSAGE CALCULATION MATH

### Fractions

The concentration of a drug (amount of drug in solution) appears as a fraction (eg, 1 mg/10 mL). This concentration fraction is always constructed with the drug weight (eg, 1 mg) per ("/") the solution (eg, 10 mL). An easy way to remember the numerator (the number on top) and the denominator (the number on the bottom) is to use a boat analogy, where the boat (numerator) is the weight of the drug and the boat is always on top of the water (denominator).

When calculating medication dosages, reduce (convert) the concentration to the amount of drug mixed in 1 mL of solution by dividing the drug weight by the water volume (solution).

### Example

Reduce a 5 mg/20 mL concentration of a drug. First, identify the weight (5 mg) and water volume (20 mL). Next, divide the weight by the volume:

$$5 \text{ mg} \div 20 \text{ mL} = 0.25 \text{ mg/mL}$$

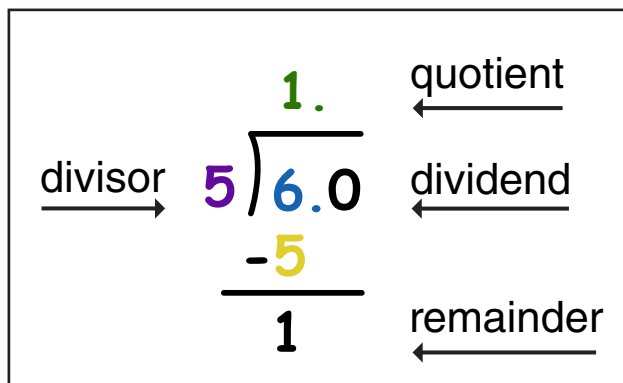


Figure 4-5. Terminology used for numbers in a long division formula.

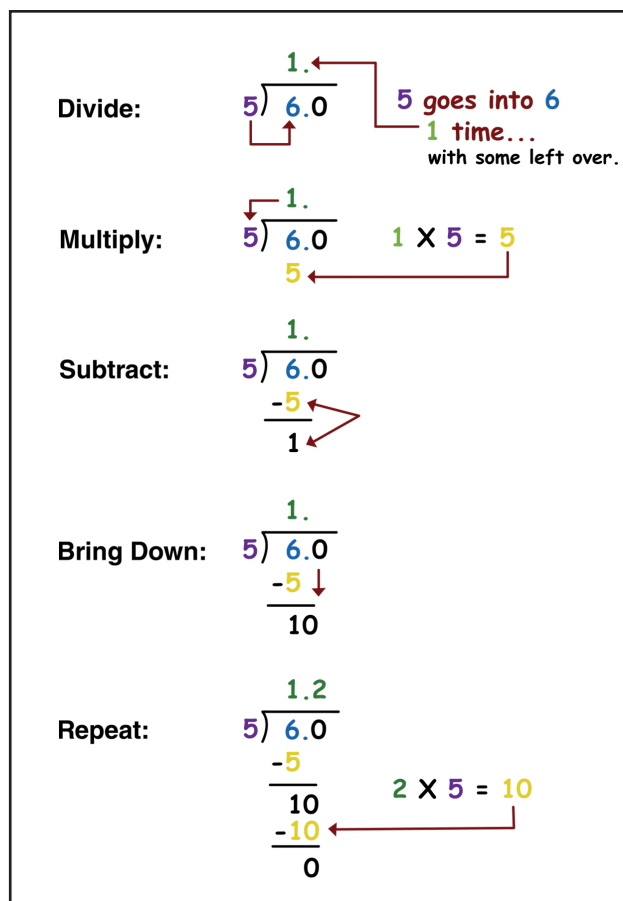


Figure 4-6. A guide to completing math problems using long division.

In division with fractions, the **divisor** is also in the denominator position, following the slash ("/") symbol (eg, the divisor is 6 in the fraction  $5/6$ ). In traditional long division, the divisor is placed outside the division box and the **dividend** (the number to be divided) inside the box. The result or answer of the division is also called the **quotient**. Figure 4-5 shows the terminology in a traditional long division problem. Figure 4-6 shows how to calculate a quotient using long division.

### Proper Fractions

In proper fractions, the number is less than one and the numerator is less than the denominator (eg,  $3/4$ ,  $1/2$ ,  $7/8$ ). Use the following steps to reduce (simplify) a proper fraction to its lowest terms:

1. Identify the numerator and denominator.
2. Find the **greatest common factor** of both numbers.
3. Divide both the numerator and denominator by the greatest common factor.
4. Write the simplified fraction as the new numerator over the new denominator.

*Example 1:* Reduce  $5/10$  to its lowest terms.

- Step 1. The numerator is 5 and the denominator is 10.
- Step 2. The greatest common factor is 5 (5 is the largest number that divides into both the numerator and denominator).
- Step 3. Divide both the numerator (5) and the denominator (10) by the greatest common factor (5):

$$5 \div 5 = 1 \text{ and } 10 \div 5 = 2.$$

- Step 4. Write the reduced fraction as the new numerator (1) over the new denominator (2).

$$1 \text{ over } 2 \text{ is } 1/2.$$

*Example 2:* Reduce  $9/27$  to its lowest terms.

- Step 1. The numerator is 9 and the denominator is 27.
- Step 2. The greatest common factor is 9.
- Step 3.  $9 \div 9 = 1$  and  $27 \div 9 = 3$ .
- Step 4. 1 over 3 is  $1/3$ .

*Example 3:* Reduce  $7/8$  to its lowest terms.

- Step 1. The numerator is 7 and the denominator is 8.
- Step 2. The greatest common factor is 1.
- Step 3.  $7 \div 1 = 7$  and  $8 \div 1 = 8$ .
- Step 4.  $7/8$ . This fraction cannot be reduced.

*Example 4:* Reduce  $8/12$  to its lowest terms.

- Step 1. The numerator is 8 and the denominator is 12.
- Step 2. The greatest common factor is 4.
- Step 3.  $8 \div 4 = 2$  and  $12 \div 4 = 3$ .
- Step 4. 2 over 3 is  $2/3$ .

### Improper Fractions

In improper fractions, the numerator is greater than the denominator (eg,  $4/3$ ,  $11/5$ ). Use the following three steps to convert an improper fraction into a mixed number (one with a combination of a whole number and a fraction [eg,  $1 \frac{1}{3}$ ]):

1. Divide the numerator by the denominator.
2. Write down the whole number.
3. After the whole number, write down any remainder over the original denominator.

*Example 1:* Convert  $25/3$  into a mixed number.

- Step 1.  $25 \div 3 = 8$ , with remainder 1.
- Step 2. 8 (whole number).
- Step 3.  $8 \frac{1}{3}$  (whole number [8] and remainder [1] over the original denominator [3]).

*Example 2:* Convert  $11/5$  into a mixed number.

- Step 1.  $11 \div 5 = 2$ , with remainder 1
- Step 2. Write down the whole number 2.
- Step 3.  $2 \frac{1}{5}$  (whole number [2] and remainder [1] over the original denominator [5]).

### Mixed Numbers

Mixed Numbers are a combination of a whole number and a fraction (eg,  $1 \frac{1}{2}$ ,  $5 \frac{7}{8}$ ). Use the following four steps to convert a mixed fraction into a decimal:

- Step 1. Multiply the whole number by the denominator.
- Step 2. Add the result from step 1 to the numerator. This sum is the new numerator.
- Step 3. Place the new numerator over the denominator.
- Step 4. Divide the numerator by the denominator.

*Example 1:* Convert  $3 \frac{5}{6}$  to its decimal form.

- Step 1.  $3$  (whole number)  $\times 6$  (denominator) = 18.
- Step 2.  $18 + 5$  (numerator) = 23 (new numerator).
- Step 3.  $23$  (new numerator)  $\div 6$  (denominator).
- Step 4.  $23 \div 6 = 3.833$ .

**Note:** The formula is  $(3 \times 6 + 5) \div 6$ .



*Example 2:* Convert  $4\frac{7}{8}$  to its decimal form.

Step 1.  $4 \times 8 = 32$ .

Step 2.  $32 + 7 = 39$ .

Step 3.  $39/8$ .

Step 4.  $39 \div 8 = 4.875$ .

**Note:** The formula is  $(4 \times 8 + 7) \div 8$ .

### Check on Learning

7. Reduce the fraction 5 mg/10 mL to its lowest terms.
8. Reduce the fraction 500 µg/5 mL to its lowest terms.
9. Convert the improper fraction 1,000 mg/250 mL into a mixed number.
10. Convert the concentration 25 mg/10 mL into a decimal form.

### Decimal Fractions

A decimal is a real number expressed in base 10. A decimal fraction is a fraction or mixed number in which the denominator is expressed as a power of 10. The decimal point (a dot) identifies the beginning of a decimal fraction. All numbers to the left of the decimal are whole numbers. All numbers to the right of the decimal point are fractions of a base 10 number. The first number to the right of a decimal point represents tenths, the second represents hundredths, and the third represents thousandths. Read the number 5.125 as, "five point one two five." The numeric places are 5 (whole number), point, 1 (tenths), 2 (hundredths), 5 (thousandths). If a decimal answer does not contain a whole number, place a zero to the left of the decimal (eg, 0.75, 0.2). A zero at the end of a decimal number does not add value, so in many cases, it can be dropped (eg, 2.0 becomes 2).

In some cases, you may round a number up or down. Round up if the number is 5 or greater and round down if the number is less than 5. For example, 5.5 and 5.6 are both rounded up to 6, but 5.4 is rounded down to 5.

### Metric System

The metric system, also known as the International System of Units (SI), is a globally accepted, decimal standard of measure. The metric system of weights and volume is used to calculate medication dosages. It is simpler and more widely used around the world than the US Customary System of Measurement. Metric units of length or distance are based on the meter. From small to large, the most common units are millimeter (mm), centimeter (cm), meter (m), and kilometer (km). Metric units of weight are based on the kilogram. From small to large, the most common units are microgram (µg or mcg), milligram (mg), gram (g), and kilogram (kg). Most drug doses are measured in grams (g), milligrams (mg), and micrograms (mcg or µg). Metric units of volume are based on the liter. From small to large, the most common units are microliter (µL), milliliter (mL), and liter (L). Table 4-1 shows the relationships between metric units of measure.

### Converting Common Medication Weights

Dosage calculations often require conversion from one medication weight to another, using the metric system and decimals. In the metric system, simply move the decimal point either right or left. For example, a combat medic plans to administer an IV microdrip drug at 600 µg/min. However, the drug comes in a 200 mg vial. The first step of calculating medication doses is to convert the dosage on hand to the same metric multiple as ordered. In this example, the dosage on hand is 200 mg, but the dose ordered is 600 µg/min. Simply move the decimal point three places to the right to convert milligrams to micrograms. The dosage on hand is now 200,000 µg. Use Table 4-1 to convert between multiples of a weight or volume.

### Check on Learning

11. Convert 1 g to mg.
12. Convert 1 mg to µg.
13. Convert 1,000 mg to g.
14. Convert 1.5 L to mL.
15. Convert 70.000 g to kg.
16. Convert 0.0017 g to µg.
17. Convert 5 mg to g.
18. Convert 0.04 L to mL.
19. Convert 400 µg to g.
20. Convert 1,500 mL to L.

**Table 4-1.** Metric System Units of Measure and Nomenclature with the Most Common Measures Shaded.

| Prefix names | Weight prefix symbols | Volume prefix symbols | Multiples and submultiples                                    |
|--------------|-----------------------|-----------------------|---------------------------------------------------------------|
| tera         | Tg                    | TL                    | 1,000,000,000,000 (12 zeros)                                  |
| giga         | Gg                    | GL                    | 1,000,000,000 (9 zeros)                                       |
| mega         | Mg                    | ML                    | 1,000,000 (6 zeros)                                           |
| kilo         | Kg                    | kL                    | 1,000 (3 zeros)                                               |
| hecto        | hg                    | hL                    | 100 (2 zeros)                                                 |
| deka         | dag                   | daL                   | 10 (1 zero)                                                   |
| N/A          | g                     | L                     | 1 (base [decimal point goes to the right of this number])     |
| deci         | dg                    | dL                    | 0.1 (one place to the right of the decimal)                   |
| centi        | cg                    | cL                    | 0.01 (two places to the right of the decimal)                 |
| milli        | mg                    | mL                    | 0.001 (three places to the right of the decimal)              |
| micro        | µg                    | µL                    | 0.000 001 (six places to the right of the decimal)            |
| nano         | ng                    | nL                    | 0.000 000 001 (nine places to the right of the decimal)       |
| pico         | pg                    | pL                    | 0.000 000 000 001 (twelve places to the right of the decimal) |

### CALCULATE DRUG DOSAGE USING THE 4-STEP METHOD

#### Required Information

The following information is required to calculate drug dosages:

- The amount of medication the doctor ordered (may be weight based).
- The concentration of the medication on hand.
- The unit of measure needed (how much the doctor ordered).
- The formula for calculating drug dosage.
- The patient's weight (for weight-based drug dosages).

#### How to Use the 4-Step Method

Use the 4-Step Method to calculate medication dosage<sup>1</sup>:

1. Identify the required dose (the amount the doctor ordered). If the dose is not weight based (eg, the doctor orders 25 mg), go to step 2. If the dose is weight based (eg, the doctor orders a dose of 2 mg/kg), follow steps a and b.

- a. Convert the patient's weight from pounds to kilograms: divide the patient's weight (lb) by 2.2 (conversion factor).
  - b. Multiply the required dose by the patient's weight (kg).
2. Determine the concentration of the drug on hand. If the unit of the required dose differs from the unit of the medication on hand (eg, the drug on hand is in milligrams, but the required dose is in micrograms), convert the drug on hand to the same unit as the required dose.
    - a. Follow Table 4-1 to convert the weight of the drug on hand to the weight of the required dose.
    - b. Is the concentration reduced to the amount of drug mixed in 1 mL? If not, divide the weight by the amount of solution to get the reduced concentration of drug in 1 mL
  3. Calculate the amount of fluid to draw into the syringe from the medication vial by dividing the required dose by the concentration.

**Note:** Stop here for IV push or injection drugs. Continue to step 4 for IV infusions.

4. If the drug is an IV drip medication, perform this step in addition to the previous three steps to calculate how many drops per minute over a specified time will deliver the correct dosage of medication.

Amount to be infused  $\times$  gtts/mL infusion tubing/time of infusion.

**Note:** If providing only IV fluid (eg, fluid resuscitation) over a specified duration, calculate only step 4. Skip steps 1 through 3.

*Example 1:* A patient experiencing anaphylaxis needs 25 mg of diphenhydramine. The combat medic has a prefilled syringe containing 100 mg/5 mL. How many mL of fluid will the combat medic administer?

- Step 1. What is the required dose? It is 25 mg of diphenhydramine. The medication is not weight based, so go to step 2.
- Step 2. Is the required dose in the same metric weight units as the medication on hand? Yes, the required dose (25 mg) is in milligrams as is the drug on hand (100 mg), so there is no need to convert units.
- Step 2, continued. Is the concentration reduced to its simplest form (amount of drug mixed in 1 mL)? No, the concentration given is 100 mg mixed in 5 mL of fluid. Reduce the concentration by dividing the weight of the drug (100 mg) by the amount of solution (5 mL). The result is 20 mg/mL.
- Step 3. Divide the required dose by the concentration (25 mg  $\div$  20 mg/mL = 1.25 mL). Withdraw 1.25 mL of diphenhydramine from the medication vial.

**Note:** Step 3 always calculates the amount of fluid to draw up into the syringe.

Step 4. **STOP HERE.**

*Example 2:* A combat casualty suffered burns over 30% of her body surface area. She weighs 170 lbs (77 kg). By applying the **Rule of Ten** fluid resuscitation calculation for treating burn casualties, the combat medic calculated that the casualty needs 300 mL of Ringer solution per hour. A 1,000 mL bag of Ringer IV solution is attached to a 10 gtts/mL macro IV tubing set. How many drops per minute will deliver 300 mL of Ringer solution in 1 hour?

Steps 1–3 do not apply. Step 4 is the only step used to calculate the amount of IV fluid to be infused over a stated duration.

- Step 4. The amount to be infused is  
 $300 \text{ mL} \times 10 \text{ gtts/mL} = 3,000 \text{ mL}$ .

Divide 3,000 by the time of infusion in minutes (1 hour = 60 min, so divide by 60 min, which results in 50 gtts/min. Adjust the flow rate of the IV tubing until you see 50 drops of fluid from the IV solution enter the IV tubing through the drip chamber.

*Example 3:* The MO orders 2 mg of a drug to be given IM. You have a vial with 10 mg of medication dissolved in 5 mL of fluid. How many milliliters of medication do you administer?

- Step 1. Identify the required dose: 2 mg.
- Step 2. Reduce the given concentration of the drug on hand:  $10 \text{ mg}/5 \text{ mL} = 2 \text{ mg/mL}$ .
- Step 3. Calculate the amount of medication to administer:  $2 \text{ mg/mL (concentration)} \div 2 \text{ mg (required dose)} = 1 \text{ mL}$ .

### Check on Learning

21. A patient experiencing anaphylaxis needs 50 mg of diphenhydramine. The combat medic has a prefilled syringe containing 100 mg/5 mL. How many milliliters of fluid will the combat medic administer?
22. The same patient in Check on Learning 21 must now receive 0.3 mg of 1:1,000 epinephrine through a subcutaneous injection. The epinephrine that the medical clinic has on hand is 1 mg of 1:1,000 epinephrine mixed in 1 mL of solution contained in an ampule. How much fluid must be drawn from the ampule to administer 0.3 mg of 1:1,000 epinephrine?
23. A combat medic is treating a combat casualty who is in severe pain and is developing hemorrhagic shock. The combat medic selects TCCC option 3 to administer ketamine to the casualty. The protocol directs the combat medic to administer 30 mg of ketamine slow IV/IO push. The combat medic has a vial of ketamine with 500 mg of ketamine in 10 mL of fluid. How much fluid must be withdrawn from the vial to administer 30 mg?
24. A combat casualty has suffered severe burns to his body with 50% body surface area burned. The casualty weighs 210 lbs, which is calculated to be 95 kg. The casualty needs 700 mL of Ringer solution per hour (fluid resuscitation calculated using the Rule of Ten). A 1,000 mL bag of Ringer IV solution is attached to a 10 gtts/mL macro IV tubing set. How many drops per minute will deliver 700 mL of Ringer solution in 1 hour?



25. A combat medic is treating a combat casualty who was wounded about 30 minutes prior and has severe internal bleeding. The combat medic must administer tranexamic acid (TXA). Per protocol, the combat medic mixed 1 g of TXA in a 100 mL bag of normal saline for administration over 10 minutes. The IV tubing is 15 gtts/mL. How many drops per minute will deliver the drug over 10 minutes?

## ADMINISTER MEDICATIONS

### Administer Solid Medications Through the Oral Route

There are many common forms of solid medications, such as tablets, capsules, soft gels, liquids, chewable forms, and powders. To administer any medication by mouth, the patient must be able to protect the airway, have an intact gag reflex, and be alert.

Solid medications are not manufactured in every conceivable dose. Sometimes splitting tablets in half is the best way to get a required dose. Many tablets are scored across the middle to make splitting easier. Capsules are great for patients who have trouble swallowing tablets. Capsules can be opened and the medicine added to water or juice.

**Note:** Do not crush enteric-coated tablets. Crushing them destroys the special coating that prevents drugs from being released too soon.

Use the following steps to administer a solid medication by mouth:

1. After receiving the MO's order to administer an oral medication, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients. Always verify medication, check the 6 Rights, check for allergies, and document appropriately.

**Caution:** If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

**Caution:** Always check allergies prior to the administration of any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate the administration of the medication.

2. Don personal protective equipment (PPE). Gloves and eye protection are minimum PPE for administering an oral medication.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and dose (or concentration) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (medication specific).
  - b. Obtain the equipment.
    - i. Selected medication.
    - ii. Medication dispensing cup.
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.
  - d. If there is any evidence of medicine or packaging contamination or damage, or if the medication is outdated, discard the product into the appropriate receptacle and obtain new medication.
4. Read and follow the medication instructions. For example, some oral liquid medications require shaking prior to dispensing them.
5. Place the tablet, pill, or capsule in a small, disposable dispensing cup so that the patient can see the medication.

**Caution:** When giving different oral medications, place each medication in its own labeled dispensing cup and administer the medications one at a time. Also, if giving medications to different patients, label each dispensing cup.

**Caution:** Do not pass pills, capsules, or other solid medications from your hand to the patient's hand. Put them into a medication dispensing cup to reduce contamination. Patients expect cleanliness when asked to swallow a medication.

6. Recheck to ensure that the medication is the correct medication ordered by the MO.
7. Perform a final check to ensure that the proper medication is about to be administered to the patient.
8. Administer the medication and watch to ensure that the patient swallows all of the medication.

**Note:** If the patient has difficulty swallowing large capsules, open the capsule and mix the medication in juice or water.

**Caution:** When dispensing more than three units of the same solid medication at one time, pour the medication onto a clean surface (pill counting tray), count one by one, and place the medication into a dispensing cup.

9. Monitor the patient for any adverse reaction to the medication.
10. Document the following information into the patient's medical records: medication administration, the patient's condition prior to administering the medication, and any effects after the medication administration.

### Check on Learning

26. How do you ensure that oral medication has been administered to the patient?
27. What must you assess to ensure the patient may accept medication orally?
28. What is the advantage of a capsule over a tablet?

### Administer Medications Through the Respiratory Route

Combat medics may encounter and treat patients who require respiratory medications. Place patients with a respiratory complaint in a comfortable position that also facilitates a thorough examination. The proper approach to treating a patient with a respiratory complaint is to perform a primary assessment to rule out all life threats first and then perform a focused physical exam. Assess the patient's respiratory status and communicate any unexpected findings to the MO.

The two most common delivery methods for respiratory medications are meter-dosed inhalers (MDI) and small-volume nebulizers. As with any medication, combat medics must read the manufacturer's insert for administration guidelines for an MDI or small-volume

nebulizer. Explain the treatment procedure to the patient before attempting to administer medication.

If the patient will operate an MDI or nebulizer, ensure that they have the knowledge and ability to operate the equipment. Certain disabilities can hinder self-administered respiratory treatment, such as patients being unable to make an airtight seal between their mouths and the equipment, having insufficient strength to sit up, or being unable to hold the equipment. Other disabilities, such as blindness, may also affect their ability to self-treat.

### Metered-Dose Inhaler

MDI respiratory medications are portable and are self administered by the patient. An MDI provides a consistent, measured dose of medication dispensed under pressure. MDIs are more effective when used with an attachment called a spacer (a holding chamber with a valve). The spacer retains the dispensed medication in a chamber, which allows the patient to breathe most of the medication into the lungs (Figure 4-7). The spacer is most beneficial for patients who have severe shortness of breath and cannot take long deep breaths.

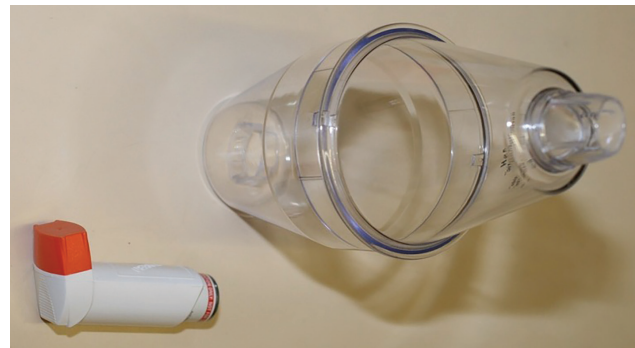


**Figure 4-7.** A metered-dose inhaler and spacer. Photograph by Tradimus. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Asthma\\_spacer\\_adult.JPG](https://commons.wikimedia.org/wiki/File:Asthma_spacer_adult.JPG)

Use the following steps to administer medications with a metered-dose inhaler:

1. After receiving the MO's order to administer an MDI respiratory medication, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

**Caution:** If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering respiratory medication from an MDI.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored.
  - b. Obtain the equipment.
    - i. MDI actuator.
    - ii. MDI spacer (a valved holding chamber).
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container. If there is any evidence of medicine or packaging contamination or damage, or if the medication canister is outdated, discard the product into the appropriate receptacle and obtain new medication.
  - d. If separated, place the medication canister into the MDI actuator.
4. Recheck to ensure that the medication is the correct medication ordered by the MO.
5. Shake the assembled MDI vigorously.
6. Attach the MDI spacer.
7. Perform a final check to make sure the proper medication is about to be administered to the patient.
8. Remove the oxygen mask from the patient's face if supplemental oxygen is in use.
9. Have the patient exhale forcefully.
10. Have the patient make a good seal with their mouth on the mouthpiece of the MDI spacer.
11. Depress the medication canister on the MDI and encourage the patient to inhale deeply. Give the patient plenty of time to inhale the medication from the MDI spacer.
12. Monitor the patient's respiratory status to ensure that the medication is working.

- a. Observe the patient's oxygen saturation (94% or greater).
- b. Observe the patient's end tidal CO<sub>2</sub> status if able (35–45 mmHg).

### *Small-Volume Nebulizer*

A small-volume nebulizer dispenses liquid respiratory medication by dispersing it with pressurized oxygen. The patient breathes the resulting fine spray or mist into the lungs. Nebulizers come in two configurations. One configuration is a pipe with a reservoir that temporarily holds the nebulized medication until it is breathed into the lungs (Figure 4-8). Another configuration is a nebulizer attached to a mask strapped to the patient's face, eliminating the need for the patient to hold it in place (Figure 4-9). Medication for a small-volume nebulizer comes prepared as a liquid, in a single-use, low-density, polyethylene (LDPE) vial (Figure 4-10).

Assemble the items listed below for dispensing medications with a small-volume nebulizer:

- blue chux pad
- two oxygen sources with regulators
- nebulizer
- oxygen tubing
- oxygen mask



**Figure 4-8.** Pipe configuration of a small-volume nebulizer. Photograph by James Heilman, MD. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Nebulizerpipe.JPG>





**Figure 4-9.** Face mask configuration of a small-volume nebulizer. Photograph by Marco Verch. Reproduced from flickr. <https://www.flickr.com/photos/30478819@N08/49918283661>

Use the following steps to administer medications with a small-volume nebulizer:

1. After receiving the MO's order to administer a nebulized respiratory medication, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

**Caution:** If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering respiratory medication via a nebulizer.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if



**Figure 4-10.** A single-use medication vial for a nebulizer.

applicable) are exactly what was ordered by the MO.

- ii. Verify that the medication was properly stored (eg, in aluminum foil for some respiratory medications).

**Caution:** The different types of respiratory medications packaged in single-use LDPE vials look very similar to each other. Read the LDPE vial carefully.

- b. Obtain the equipment.
- c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.
- d. If possible, check the medication for floating particles and changes in color and consistency by holding the single-use LDPE vial to the light.
- e. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the appropriate receptacle and obtain new medication.
- f. Ensure that the oxygen source has plenty of oxygen to complete the treatment.
4. Place respiratory medication into the nebulizer.
  - a. Unscrew the medication chamber of the nebulizer.
  - b. Twist off the top of the respiratory medication LDPE vial.
  - c. Squeeze the entire LDPE vial contents into the medication chamber of the nebulizer.
  - d. Screw and close the medication chamber of the nebulizer.

**Note:** Ensure that the nebulizer does not tilt more than 90 degrees after placing medication into the medication chamber or the medication may spill out of the chamber.

5. Recheck to ensure that the medication placed in the nebulizer is the correct medication ordered by the MO.
6. Attach the mouthpiece and reservoir extension tubing to the nebulizer (if a pipe-style nebulizer is being used).
7. Attach the oxygen tubing to the oxygen source.
8. Turn on the oxygen and verify that the medication is misting from the mouthpiece of the nebulizer.
  - a. Attach the oxygen tubing to oxygen source and turn on oxygen (8–10 L/min).
  - b. Verify that medication is misting from the mouthpiece.
9. Perform a final check to make sure the proper medication is about to be administered to the patient.
10. Remove the oxygen mask from the patient and have patient hold the nebulizer.
11. Have patient place the mouthpiece into their mouth and make a seal with their lips.
12. Coach the patient to breathe the medication into their lungs.
13. Monitor the patient's respiratory status to verify that the medication is working.
  - a. Observe the patient's oxygen saturation (94% or greater).
  - b. Observe the patient's end tidal CO<sub>2</sub> status if capable (35–45 mmHg).

### Check on Learning

29. After administering an inhaler, you should document the patient's condition. Specifically what should you assess and document, and why?
30. What types of patients benefit most from an inhaler with a spacing device?

### Administer Medications Through the Intranasal Route

Assemble the items listed below for dispensing medications through the IN route:

- blue chux pad
- syringe—appropriate size for the type of medication being given

- 18 G or blunt needle used for drawing the medication from the vial
- mucosal atomization device (MAD)
- alcohol prep pad

Use the following steps to administer IN medications:

1. After receiving the MO's order to administer an IN drug, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

**Caution:** If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

**Caution:** Always check allergies prior to the administration of any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate the administration of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering a medication via the IN route.
3. Check and assemble required equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (medication specific).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Obtain the equipment.
    - i. blue chux pad.
    - ii. syringe—appropriate size for the type of medication being given.
    - iii. 18 G or blunt needle used for drawing the medication from the vial.
    - iv. mucosal atomization device (MAD).
    - v. alcohol prep pad.
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.

**Note:** The protective cap should be in place on single-dose vials. If the protective cap has been removed, discard the vial and select a new one from the medication storage area.

- d. If possible, check the medication for floating particles and changes in color and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, conduct this check when drawing up the medication into the syringe.
- e. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
- f. Open the packaging of the 18 G or blunt needle, MAD, alcohol prep pad, and syringe.
- g. Connect the hub of the 18 G or blunt needle to the needle adapter on the syringe.
4. Remove the cap from the medication vial and cleanse the vial with the alcohol prep pad.
5. Remove the protective cap from the needle safely and pull the needle cover straight off without bending or touching the needle.
6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
  - a. The amount of air to draw up equals the amount of fluid to be administered.
  - b. Follow the directions on the medication vial, if provided.
  - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
7. Insert the 18 G or blunt needle into the medication vial on the table.
  - a. Place the medication vial on a table, standing up, and insert the 18 G or blunt-needled syringe through the rubber stopper, ensuring that the needle tip passes completely through. Make sure the hub of the needle does not touch the rubber stopper.
  - b. Pick up the syringe and vial and turn them upside down.
  - c. Hold the syringe and vial at eye level.
8. Push the plunger forward injecting air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.

9. Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.
10. Remove the needle from the vial and recap the needle using the scoop method.
11. Attach the MAD.
  - a. After the medication is drawn up and ready to be administered, conduct a final recheck to make sure the medication and concentration are exact to what was ordered by the MO. This is the third and final recheck prior to administration.
  - b. Pull back on the plunger slightly to move any fluid from the 18 G or blunt withdraw needle into the syringe.
  - c. Detach the 18 G or blunt withdraw needle by twisting it counterclockwise and discard it into a sharps container.
  - d. Attach the MAD by connecting the leuer lock mechanism with a twisting motion.
12. While using your free hand to hold the crown of the patient's head to stabilize it, place the tip of the atomizer snugly against either nostril. Aim slightly up and outward (toward the top of the ipsilateral ear).
  - a. Briskly compress the syringe plunger to deliver approximately half of the medication into the nostril (not to exceed 1 mL per nostril).
  - b. Move the MAD to the opposite nostril and administer the remaining medication (not to exceed 1 mL).
  - c. If more than 1 mL per nostril is needed, wait 2 to 3 minutes and administer the remaining medication.

### Administer Medications Through Intravenous Push

IV push medications are delivered rapidly or slowly through an IV fluid administration set, by way of a syringe. Each medication is different and you must understand the specific requirements before administering a drug. For example, ketamine sedates patients and treats severe pain. Rapid administration of ketamine may cause respiratory depression, so slow delivery is standard.

It is easier to deliver a small-volume, slow IV push drug after diluting it in a larger volume of solution. For example, ketamine may come prepared with 500 mg of ketamine mixed in 10 mL of sterile saline solution. The reduced concentration is 50 mg/mL. TCCC



guidelines recommend 30 mg slow IV or IO push. If 50 mg of ketamine is in 1 mL of saline and the required dose is 30 mg, the amount of fluid to administer is 0.6 mL. This is a very small volume to administer slowly (over 60 seconds). To make administration easier, mix the syringe contents of 0.6 mL (of ketamine) with more sterile saline solution, such as 0.4 mL, or more. The 0.6 mL of ketamine combined with 0.4 mL of normal saline provides 1 mL of fluid. Slowly depress the 1 mL syringe containing the dilution over a 60-second interval. A mix of 0.6 mL of ketamine with 4.4 mL of fluid yields 5 mL of fluid, and requires a larger syringe. In this case, administer approximately 1.2 mL every 10 seconds to deliver the entire 5 mL (with the 30 mg of ketamine) within 1 minute. Dilution in a larger volume of solution reduces the chance of accidentally pushing the drug too fast.

**Note:** IV push may be easier to accomplish for some small-volume doses by adding a diluent to increase the overall volume. For example, ketamine 30 mg comes in a vial that is 100 mg/10 cc. A clinician will dilute the 30 mg (equivalent to 0.3 mL) with another 0.7 mL to make it easier to push 1 mL of fluid over 2 minutes.

Assemble the items listed below for dispensing IV push medications through an IV fluid administration set:

- blue chux pad
- syringe—appropriate size for the type of medication being given
- 18 G or blunt needle used for drawing the medication from the vial
- 18 G needle for administering the IV push medication
- two alcohol prep pads

Use the following steps for preparing and administering an IV push medication through an IV fluid administration set:

1. After receiving the MO's order to administer a drug by IV push, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

**Caution:** If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

**Caution:** Always check allergies prior to the administration of any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate the administration of the medication.

2. Don PPE. Gloves and eye protection are minimum PPE for administering an IV push medication.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (medication specific).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Gather the supplies and equipment.
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container. Check the rubber stopper for defects, such as small holes or torn plugs, if it is an open multi-dose vial.

**Note:** The protective cap should be in place on single-dose vials. If the protective cap was previously removed, discard the vial and select a new one from the medication storage area.

- d. Check the date the multidose vial was opened and check the expiration date of the medication.
  - i. Multidose vials should have the following information written on the label once opened—time, date, and initials detailing first use.
  - ii. Multidose vials are good for 28 days from the date of first use, unless specified differently by the manufacturer.

- e. If possible, check the medication for floating particles and changes in color and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, conduct this check when drawing up the medication into the syringe.
  - f. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
  - g. Open the packaging of the 18 G or blunt needle, administration needle (depending on type of injection), and syringe.
  - h. Connect the hub of the 18 G or blunt needle to the needle adapter on the syringe.
  - i. Open the alcohol prep pad.
4. Remove the cap from the medication vial and cleanse the rubber stopper with the alcohol prep pad.
  5. Remove the protective cap from the needle safely and pull the needle cover straight off without bending or touching the needle.
  6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
    - a. The amount of air to draw up equals the amount of fluid to be administered.
    - b. Follow the directions on the medication vial, if provided.
    - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
  7. Insert the 18 G or blunt needle into the medication vial on the table.
    - a. Place the medication vial on a table, standing up, and insert the 18 G or blunt-needled syringe through the rubber stopper, ensuring that the needle tip passes completely through. Make sure the hub of the needle does not touch the rubber stopper.
    - b. Pick up the syringe and vial and turn them upside down.
    - c. Hold the syringe and vial at eye level.
  8. Push the plunger forward injecting air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.
  9. Withdraw the prescribed medication into the syringe by pulling back on the syringe to the desired milliliter mark.
  10. Remove the needle from the vial and recap the needle using the scoop method (see Chapter 5, Injections).
  11. Attach the appropriate needle to the syringe.
    - a. After the medication is drawn up and ready to be administered, conduct a final recheck to ensure that the medication and concentration (if applicable) are exactly what was ordered by the MO. This is the third and final recheck prior to administration.
    - b. Pull back on the plunger slightly to move any fluid from the 18 G or blunt withdraw needle into the syringe.
    - c. Detach the 18 G or blunt withdraw needle by twisting it counterclockwise and discard it into a sharps container.
    - d. Attach the administration needle.

**Note:** Some medication Y-ports or hubs do not require a needle to attach and administer medications.

- e. Slowly advance the plunger of the syringe to expel the air bubble from the top of the syringe and the new administration needle. Place the syringe at eye level and position the plunger exactly on the prescribed milliliter mark.
12. Cleanse the medication Y-port or hub on the IV tubing administration set with the second alcohol prep pad.
13. Stop IV flow (either shut off IV flow with a roller clamp on tubing or pinch the tubing).
14. Connect the syringe to the medication Y-port or hub and administer at the proper push rate (fast IV push versus slow IV push).
15. Remove the syringe and dispose of it into a sharps container.
16. Flush the administration tubing by opening up the roller clamp or unpinching the tubing and allow it to flow wide open for a short period of time (5–10 sec).
17. Adjust the IV drip to the rate ordered by the MO.
18. Document the medication given (time, place, route, and strength) on the patient's medical records.
19. Assess the patient for desired effects of the medication and take full vital signs.



**Figure 4-11.** Piggyback intravenous medication administration.

### Administer Medications Though Intermittent Infusion

Intermittent infusion (IV piggyback) medication administration is a convenient way to administer IV infusion medications through a patent IV drip set because there is no need to obtain a new IV access site (Figure 4-11). The IV piggyback prevents repetitive disconnections of IV lines from the primary infusion to attach a second infusion to the inserted IV catheter. This is important because repeated line disconnections and exchanges increase the risk of infections or other complications.

Recall that the IV push technique (via syringe injection) requires you to deliver medication quickly, or over 1 to 2 minutes, depending on label or MO instructions. An IV intermittent infusion medication requires you to inject a medication into an IV bag and slowly administer the bag contents over a longer time. Some medications require a very slow administration that would be impractical or impossible to administer via IV push.

The type of IV tubing to use, when administering an IV intermittent infusion, will also depend on the time needed to infuse the medication. IV tubing usually

comes in two forms, macrodrip (10, 15, 20 gtts/mL) and microdrip (60 gtts/mL). The more drops needed to equal 1 mL of fluid, the longer it will take to administer the fluid (and the medication in that fluid). For example, a rapid IV infusion of TXA over 10 minutes requires macrodrip tubing. This tubing is large enough to deliver 1 mL of fluid in 10, 15, or 20 drops. Therefore, macrodrip tubing will deliver the medication at a faster rate than microdrip tubing, which requires 60 drops to equal 1 mL of fluid. Some medications (eg, IV antibiotics and some cardiac medications) are infused slowly over many minutes (more than 10) to hours. To deliver medication this slowly, microdrip tubing is required. Medication delivered through microdrip tubing is measured in units as small as micrograms ( $\mu\text{g}$  or mcg).

Primary IV infusion bags are usually 250 mL or larger. For IV piggyback infusions, the smaller IV bags (50–100 mL) are normally used.

Assemble the items listed below for dispensing medications through intermittent infusion (IV piggyback):

- primary infusion bag
- secondary (piggyback) IV bag
- appropriate primary infusion tubing
- IV piggyback tubing
- three alcohol prep pads
- two 18 G or blunt needles
- two appropriate size IV catheters
- constricting band
- clear dressing

Use the following steps to administer medication through intermittent infusion (IV piggyback):

1. After receiving the MO's order to administer a drug by IV infusion (via piggyback), ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients.

**Caution:** If a female patient thinks she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the medication without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.



2. Don PPE. Gloves and eye protection are minimum PPE for administering an IV infusion medication.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (medication specific).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.

**Warning:** Some medications cannot be given with certain IV fluids. Always ensure that the medication is compatible with the fluid in the primary infusion bag, as well as in the piggyback infusion bag.

- b. Gather the supplies and equipment.
- c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container.

**Note:** The protective cap should be in place on single-dose vials. If the protective cap has been removed, discard the vial and select a new one from the medication storage area.

- d. If possible, check the medication for floating particles and changes in color and consistency by holding the vial to the light. If it is a dark, light-obscuring vial, conduct this check when drawing up the medication into the syringe.
- e. If there is any evidence of medicine or packaging contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
- f. Open the packaging of both the 18 G or blunt needle and the syringe.
- g. Connect the hub of the 18 G or blunt needle to the needle adapter on the syringe.
- h. Open the alcohol prep pads.

4. Remove the cap from the medication vial and cleanse the rubber stopper with the alcohol prep pad.
5. Remove the protective cap from the needle safely and pull the needle cover straight off without bending or touching the needle.
6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
  - a. The amount of air to draw up equals the amount of fluid to be administered.
  - b. Follow the directions on the medication vial, if provided.
  - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
7. Insert the 18 G or blunt needle into the medication vial on the table.
  - a. Place the medication vial on a table, standing up, and insert the 18 G or blunt needled syringe through the rubber stopper, ensuring that the needle tip passes completely through. Make sure the hub of the needle does not touch the rubber stopper.
  - b. Pick up the syringe and vial and turn them upside down.
  - c. Hold the syringe and vial at eye level.
8. Push the plunger forward injecting air from the syringe into the vial. The amount of air injected should equal the amount of fluid to be withdrawn.
9. Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.
10. Remove the needle from the vial and recap the needle using the scoop method.
11. Attach the appropriate administration needle to the syringe.
  - a. After the medication is drawn up and ready to be injected into the infusion bag, conduct a final recheck to make sure the medication and concentration (if applicable) are exactly what was ordered by the MO. This is the third and final recheck prior to administration.
  - b. Pull back on the plunger slightly to move any fluid from the 18 G or blunt withdraw needle into the syringe.
  - c. Detach the 18 G or blunt withdraw needle by twisting counterclockwise and discard it into sharps container.

- d. Attach a new 18 G or blunt needle onto the syringe.
- e. Slowly advance the plunger of the syringe to expel the air bubble from the top of the syringe and the new administration needle. Place the syringe at eye level and position the plunger exactly on the prescribed milliliter mark.
12. Open a second alcohol prep pad and cleanse the medication injection port on the piggyback infusion bag.
13. Insert the needled syringe into the medication infusion bag and inject the medication.
14. Remove the needled syringe from the medication infusion bag and discard it into a sharps container.
15. Gently shake the medication infusion bag to mix the medication in the fluid.
16. Spike the medication infusion bag with the appropriate size IV tubing.
17. Prime the medication infusion bag's IV tubing with fluid and shut off flow with the roller clamp. Prime in a manner where fluid is not lost, which will result in lost medication.
18. If not completed already, have a trained person start a primary IV infusion.
19. Stop the flow of fluid from the primary IV by closing the roller clamp.
20. Clean the Y-port or hub of the primary infusion tubing with an alcohol prep pad.
21. Connect the piggyback medication infusion's IV tubing to the primary infusion's Y-port or hub.
  - a. Connect needle-less systems by screwing the end of the medication IV tubing into the medication port of the IV infusion tubing.
  - b. If the system requires a needle, insert an 18 G IV catheter through the rubber medication port of the IV infusion tubing and then connect the medication IV tubing to the 18 G IV catheter.
22. Hang the piggyback medication infusion bag higher than the primary IV infusion bag.
23. Open the roller clamp on the primary IV infusion tubing and set it at the proper drip rate for the type of fluid being administered.
24. Open the roller clamp on the piggyback medication infusion tubing and set the drip rate.
25. Once the piggyback medication has been completely administered, close the roller clamp on the piggyback medication's IV tubing and disconnect the piggyback's tubing from the primary IV infusion tubing.
26. Assess the patient for desired effects of the medication and take full vital signs.
27. Document the medication given (time, place, route, strength) on the patient's medical records.

### Check on Learning

31. If a patient tells you they are allergic to a certain medication, what additional information do you need to obtain from them?
32. How long should you observe the patient after administering immunizations, IV, or IM medication?
33. What is the treatment for anaphylaxis?

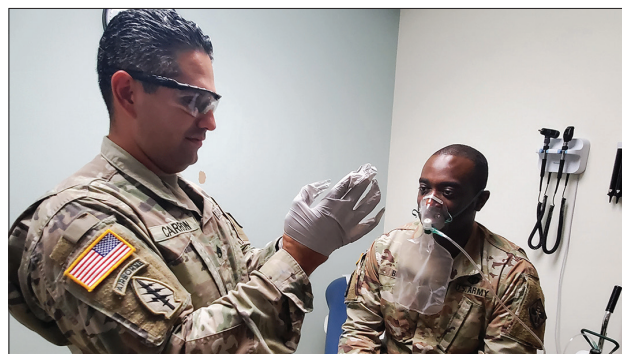
### SUMMARY

Proper medication administration can greatly help patients recover from illness or injury and maintain health. All health care professionals must mitigate risks and potential harm to patients. By knowing and applying the 6 Rights, therapeutic effects, contraindications, side effects, treatments for allergic reactions, and how to calculate drug dosages, you can greatly increase the chance of recovery for your patients. Proper medication administration improves overall health readiness by facilitating soldier recovery and return to duty.

## ADMINISTERING METERED DOSE INHALER MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



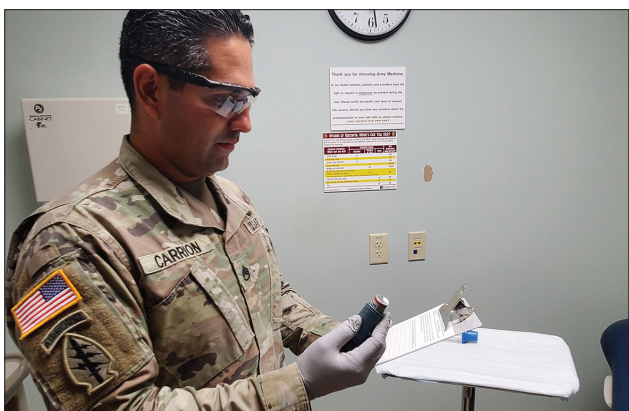
STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If separated, place the medication canister into the MDI actuator.



STEP 4: Recheck to ensure that the medication is exactly what the MO ordered.



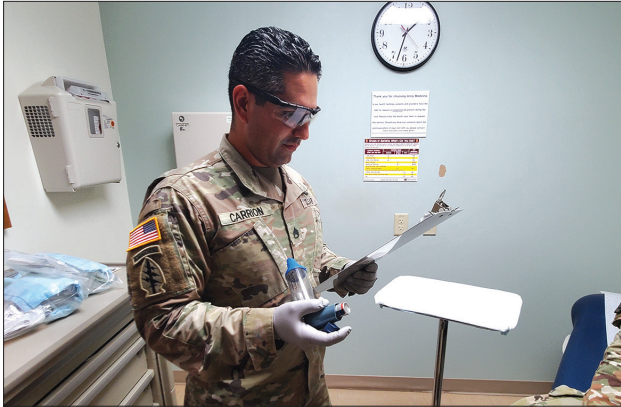
STEP 5: Shake the assembled MDI vigorously.



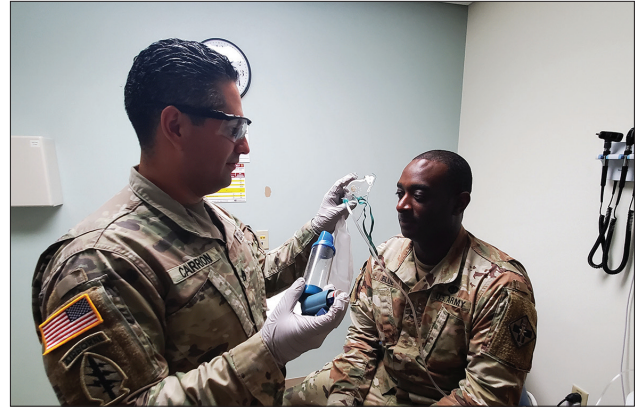
STEP 6: Attach the MDI spacer to the actuator.



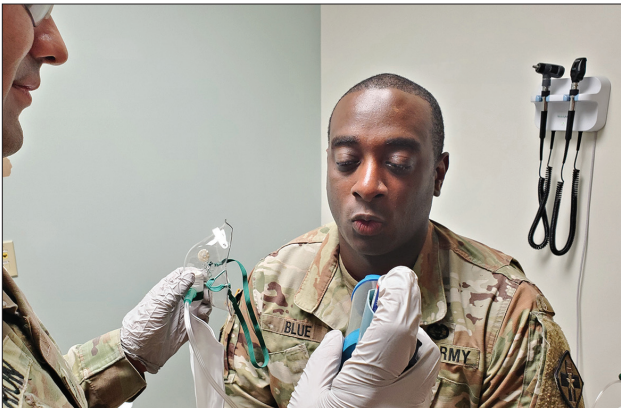
## ADMINISTERING METERED DOSE INHALER MEDICATION, CONT.



STEP 7: Conduct a final recheck to ensure that the medication is exactly what the MO ordered.



STEP 8: If the patient is receiving supplemental oxygen, remove their mask.



STEP 9: Ask the patient to exhale forcefully.



STEP 10: Have the patient make a good seal with their mouth on the mouthpiece of the MDI spacer.



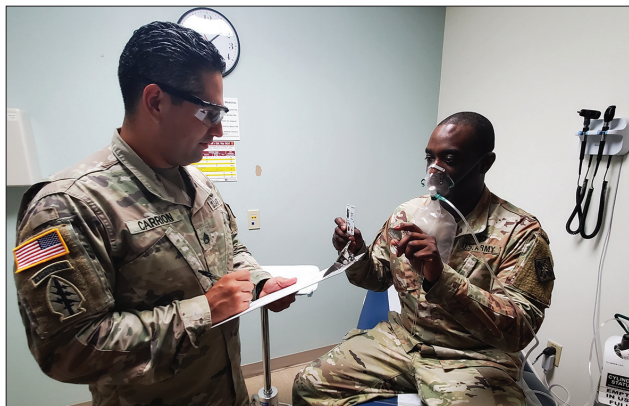
STEP 11: Depress the medication canister on the MDI and encourage the patient to inhale deeply.



STEP 12: Monitor the patient's respiratory status to ensure that the medication is working.



## ADMINISTERING SMALL VOLUME NEBULIZER MEDICATION



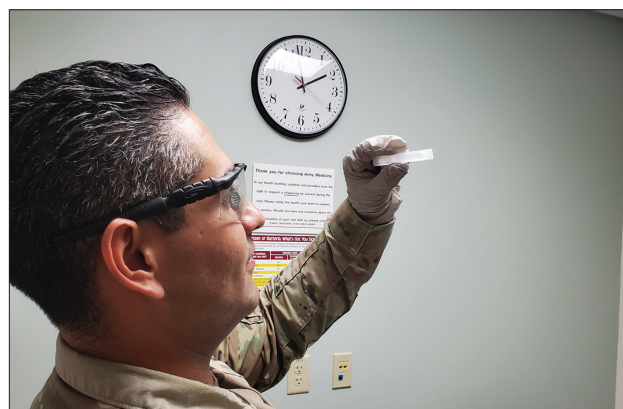
STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: Check the medication for floating particles or changes in color. Ensure that the oxygen source has plenty of oxygen to complete the treatment.



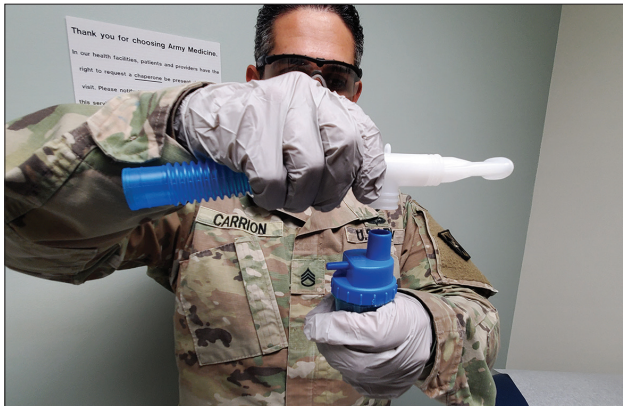
STEP 4: Place the respiratory medication into the nebulizer and close the medication chamber by screwing the medication chamber and nebulizer together.



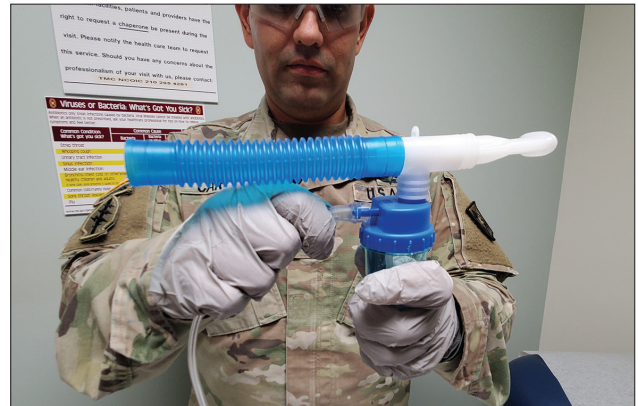
STEP 5: Recheck to ensure that the medication placed in the nebulizer is exactly what the MO ordered.



## ADMINISTERING SMALL VOLUME NEBULIZER MEDICATION, CONT.



STEP 6: Attach the mouthpiece and extension tubing to the nebulizer (if using a pipe-style nebulizer).



STEP 7a: Attach the oxygen tubing to the nebulizer.



STEP 7b: Attach the oxygen tubing to the oxygen source.



STEP 8: Turn on the oxygen at a flow rate of 8–10 L/min. Make sure the medication is misting from the mouthpiece of the nebulizer.



STEP 9: Perform a final check to verify that you are using the correct medication.



STEP 10: If the patient is wearing an oxygen mask, remove it and have the patient hold the nebulizer.



## ADMINISTERING SMALL VOLUME NEBULIZER MEDICATION, CONT.



STEP 11: Ask the patient to place the mouthpiece into their mouth and make a seal with their lips.

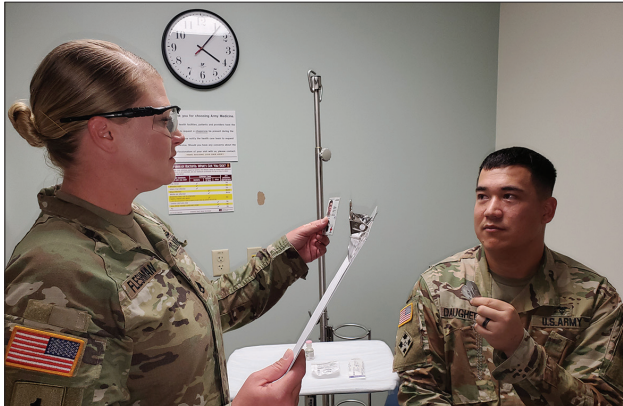


STEP 12: Coach the patient to breathe the medication into their lungs.



STEP 13: Monitor the patient's respiratory status to ensure that the medication is working.

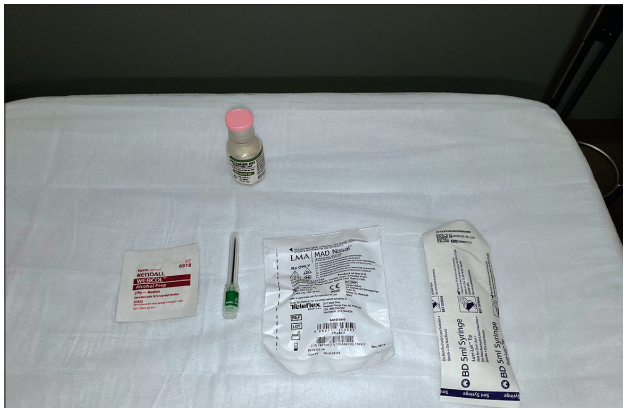
## ADMINISTERING INTRANASAL MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



STEP 2: Don PPE.



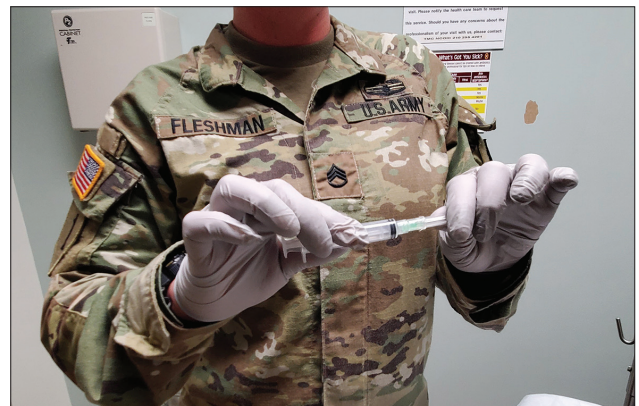
STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If possible, check the medication for floating particles or changes in color.



STEP 3c: Open the packaging on the 18 G or blunt needle, MAD, alcohol prep pad, and syringe.



STEP 3d: Connect the hub of the 18 G or blunt needle to the syringe.



## ADMINISTERING INTRANASAL MEDICATION, CONT.



STEP 4: Remove the cap from the medication vial and cleanse the vial with alcohol.



STEP 5: Safely remove the protective cap from the needle.



STEP 6a: Pull back the plunger to draw air into the syringe for injection into the medication vial.



STEP 6b: Recheck to verify that the medication and concentration (if applicable) are exactly what the MO ordered. This is the second check for accuracy.



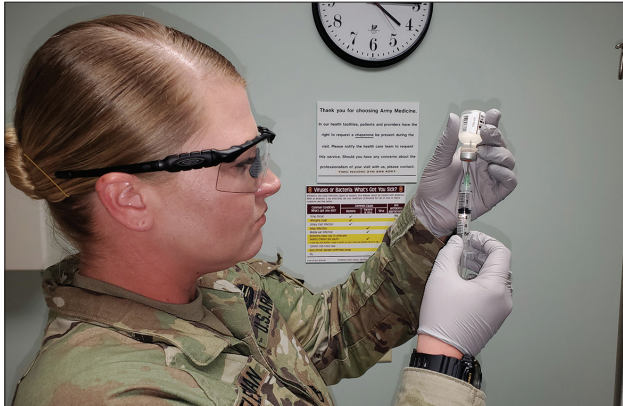
STEP 7: Insert the 18 G or blunt needle into the medication vial on the table. Pick up the syringe and vial and turn them upside down. Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward to inject air from the syringe into the vial. The amount of air injected equals the amount of fluid to withdraw.



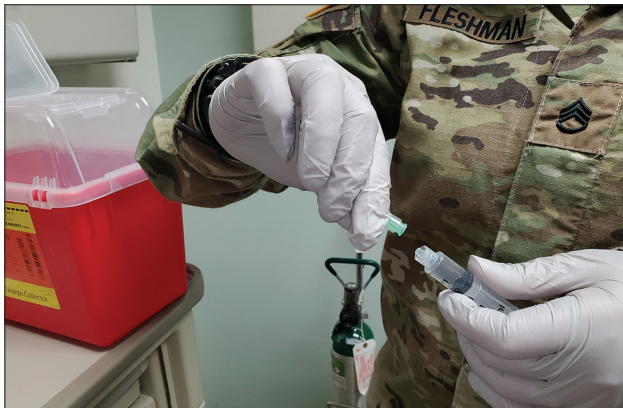
## ADMINISTERING INTRANASAL MEDICATION, CONT.



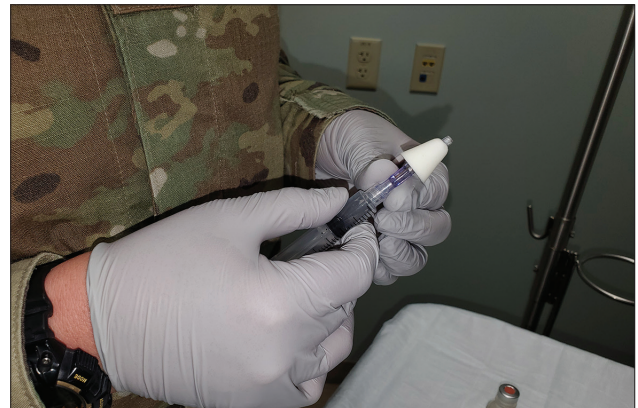
STEP 9: Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.



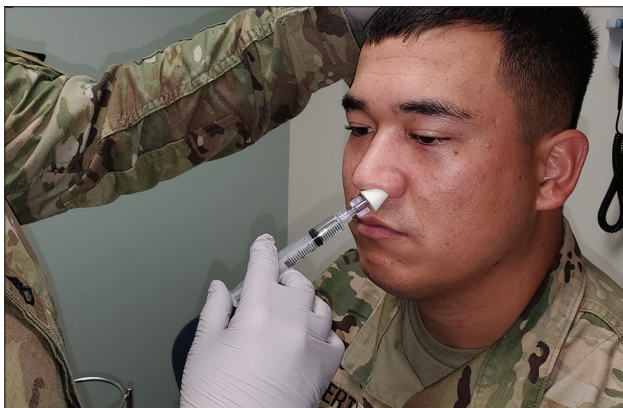
STEP 10: Remove the needle from the vial and recap the needle using the scoop method.



STEP 11a: Attach the MAD. Conduct a final recheck to ensure that the medication and concentration (if applicable) are exactly what the MO ordered.



STEP 11b: Pull back on the plunger to withdraw the medication from the needle into the syringe. Detach the needle and attach the MAD.



STEP 12: Use your free hand to hold the crown of the patient's head. Place the tip of the atomizer snugly against either nostril. Aim slightly up and outward and briskly compress the syringe plunger to deliver the medication.



## ADMINISTERING IV PUSH MEDICATION



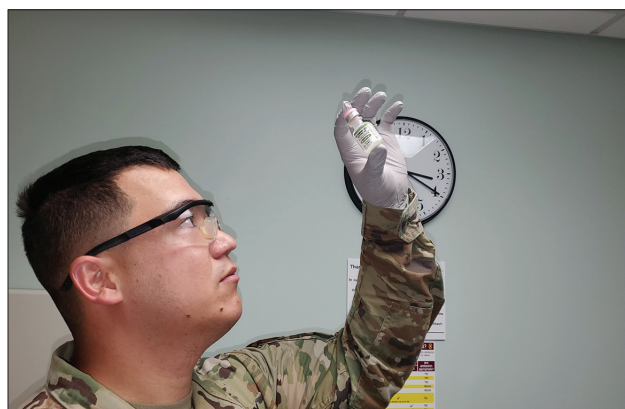
STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



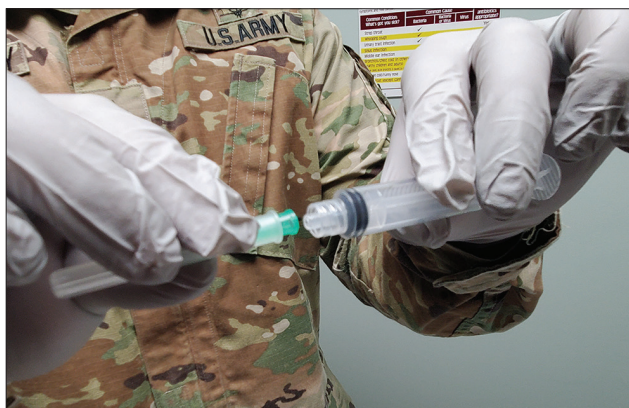
STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If possible, check the medication for floating particles or changes in color.



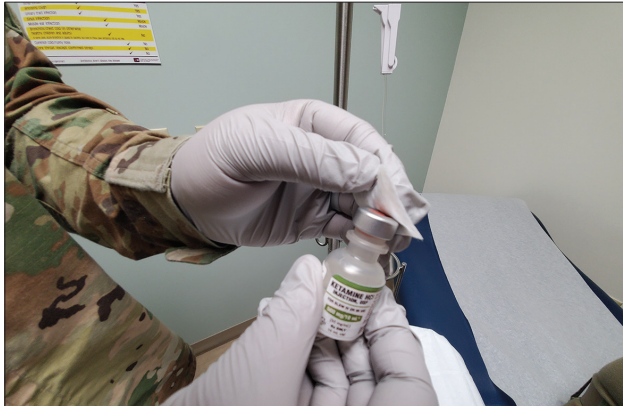
STEP 3c: Attach the medication withdraw needle to the syringe with a twisting motion.



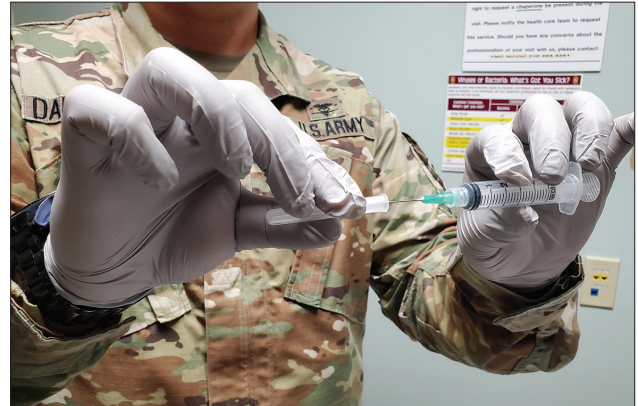
STEP 4a: Remove the cap from the medication.



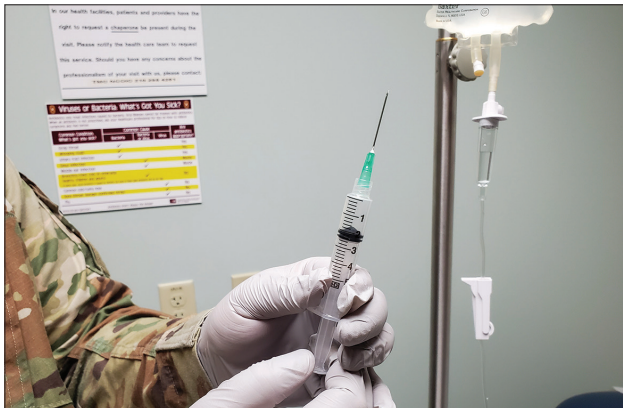
## ADMINISTERING IV PUSH MEDICATION, CONT.



STEP 4b: Clean the rubber stopper with an alcohol prep pad.



STEP 5: Remove the protective cap from the needle safely.



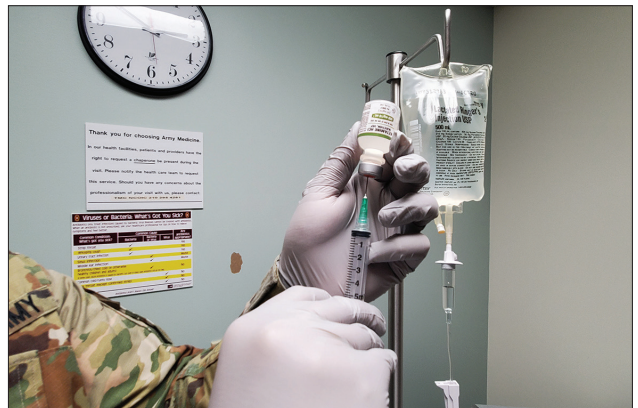
STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe (follow the directions on the medication vial). Recheck the medication to make sure it is exactly what the MO ordered.



STEP 6b: Recheck to verify that the medication and concentration (if applicable) are exactly what the MO ordered. This is the second check for accuracy.



STEP 7: Insert the 18 G or blunt needle into the medication vial on the table. Pick up the syringe and vial and turn them upside down. Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward to inject air from the syringe into the vial. The amount of air injected equals the amount of fluid to withdraw.



## ADMINISTERING IV PUSH MEDICATION, CONT.



STEP 9: Withdraw the prescribed amount of medication from the vial.



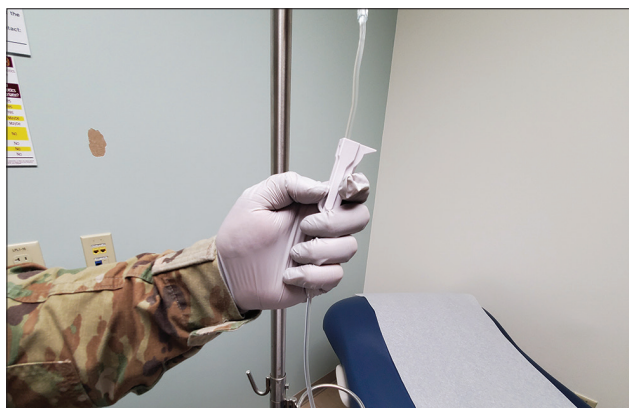
STEP 10: Remove the needle from the vial and recap it using the scoop method.



STEP 11: Detach the medication withdraw needle and discard it into a sharps container. Attach the appropriate administration needle (if required by the administration set medication Y-port or hub). Conduct a final medication recheck.



STEP 12: Cleanse the medication Y-port or hub with an alcohol prep pad.



STEP 13: Stop IV flow by closing the roller clamp or pinching the tubing.



STEP 14: Connect the syringe to the medication Y-port or hub and administer the medication at the proper push rate.

## ADMINISTERING IV PUSH MEDICATION, CONT.



STEP 15: Remove the syringe and dispose of it into a sharps container.



STEP 16: Flush the administration tubing by opening up the roller clamp or unpinching the tubing and allowing wide-open flow for 5–10 seconds.



STEP 17: Adjust the IV drip to the rate ordered by the MO.



STEP 18: Document the medication given (time, place, route, and strength) on the patient's medical records.



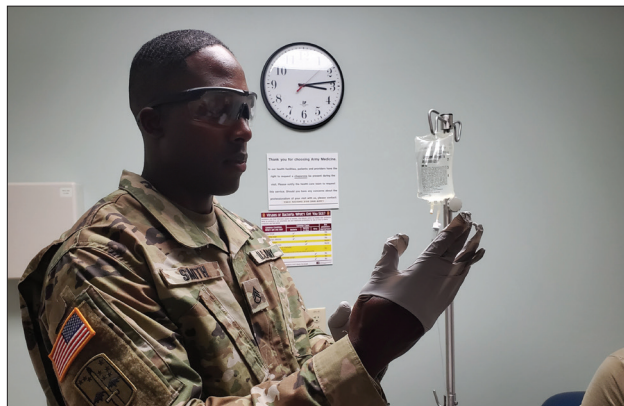
STEP 19: Stop IV flow by closing the roller clamp or pinching the tubing.



## ADMINISTERING IV PIGGYBACK MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant. Check for known medication allergies.



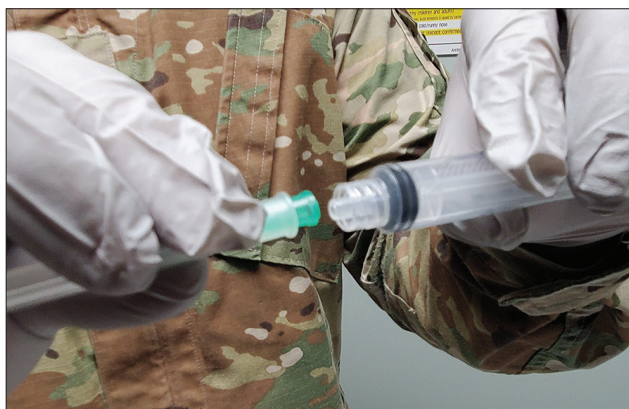
STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the correct medication. Ensure that all packaging is properly sealed, undamaged, and unexpired.



STEP 3b: If possible, check the medication for floating particles or changes in color.



STEP 3c: Attach the medication withdraw needle to the syringe with a twisting motion.



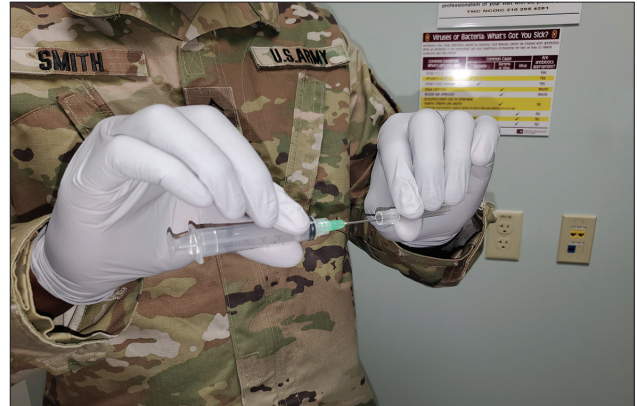
STEP 4a: Remove the cap from the medication.



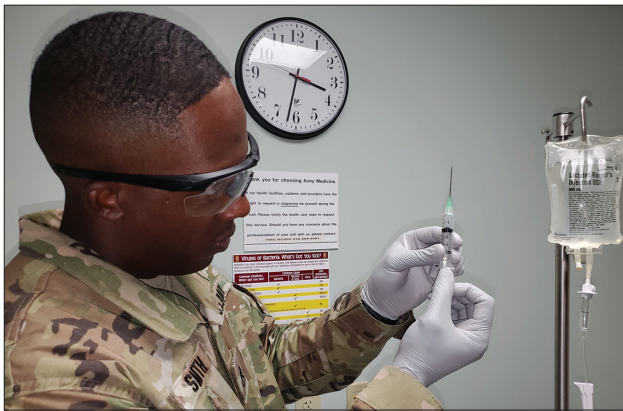
## ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 4b: Clean the rubber stopper with an alcohol prep pad.



STEP 5: Remove the protective cap from the needle safely.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe (follow the directions on the medication vial). Recheck to verify that the medication is exactly what the MO ordered.



STEP 7: Insert the 18 G or blunt needle into the medication vial on the table, pick up the needle and vial, and turn them upside down. Elevate the syringe and vial to eye level.



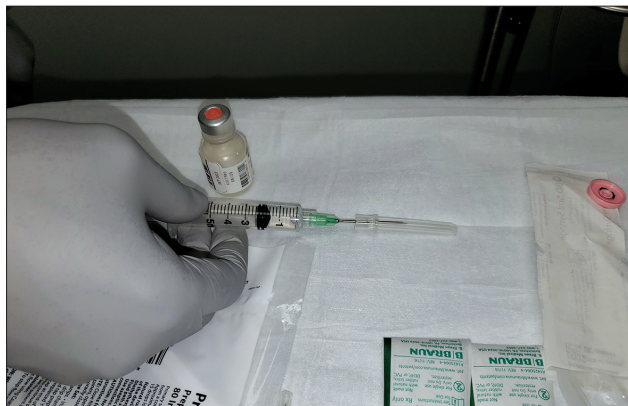
STEP 8: Push the plunger forward so air is pushed into the vial (see directions on insert of medication).



STEP 9: Withdraw the prescribed amount of medication from the vial.



## ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



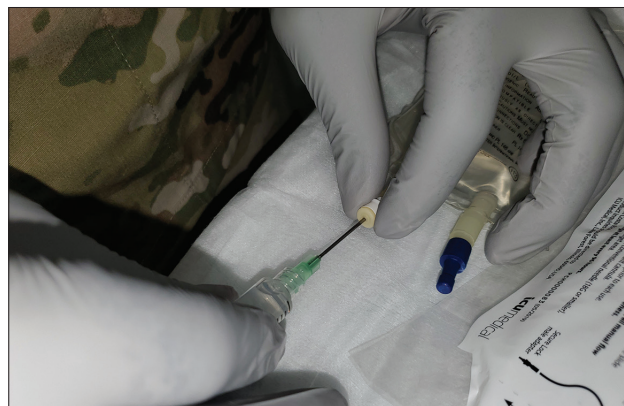
STEP 10: Remove the needle from the vial and recap it using the scoop method.



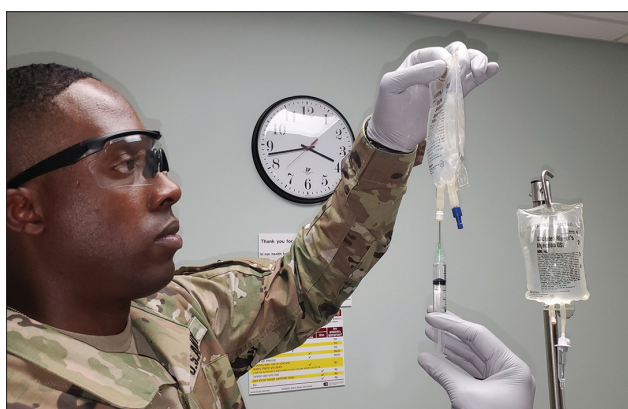
STEP 11: Detach the medication withdraw needle and discard it into a sharps container. Attach the appropriate administration needle. Recheck the medication for the final time.



STEP 12: Open the second alcohol prep pad and cleanse the medication injection port on the piggyback infusion bag.



STEP 13a: Insert the needled syringe into the medication infusion bag.



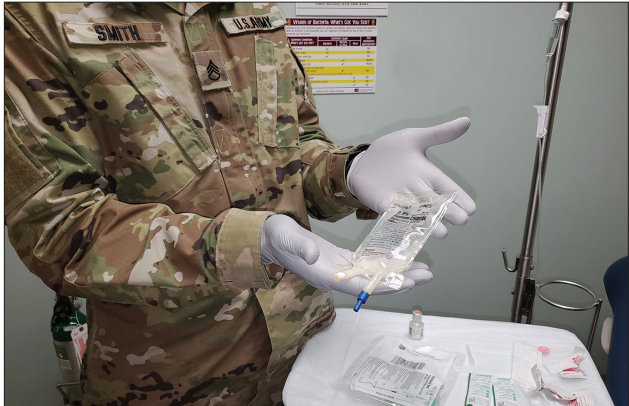
STEP 13b: Inject the medication into the infusion bag.



STEP 14: Remove the needled syringe from the medication infusion bag and discard it into a sharps container.



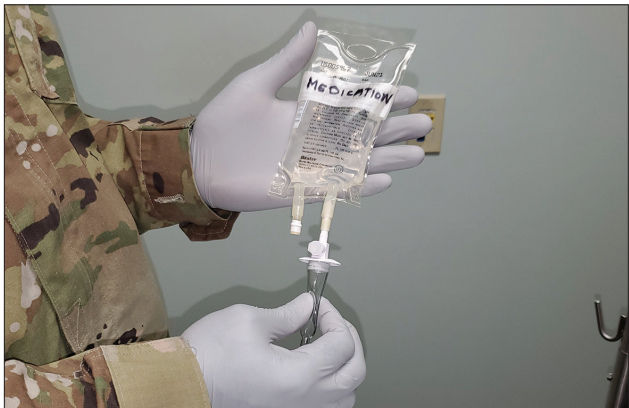
## ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 15: Gently shake the medication infusion bag to mix the medication in the fluid.



STEP 16: Spike the medication infusion bag with the appropriate size IV tubing.



STEP 17: Prime the medication infusion bag's IV tubing with fluid and shut off flow with the roller clamp.



STEP 18: If not completed already, have a trained person start a primary IV infusion.



STEP 19: Stop fluid flow from the primary IV by closing the roller clamp.



STEP 20: Clean the Y-port or hub of the primary infusion tubing with an alcohol prep pad.



## ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



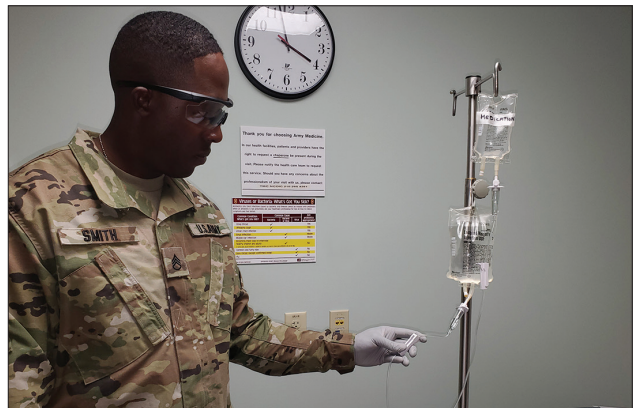
STEP 21a: Connect the piggyback medication infusion's IV tubing to the primary infusion's Y-port or hub. If the system requires a needle, insert an 18 G IV catheter through the rubber medication port of the IV infusion tubing.



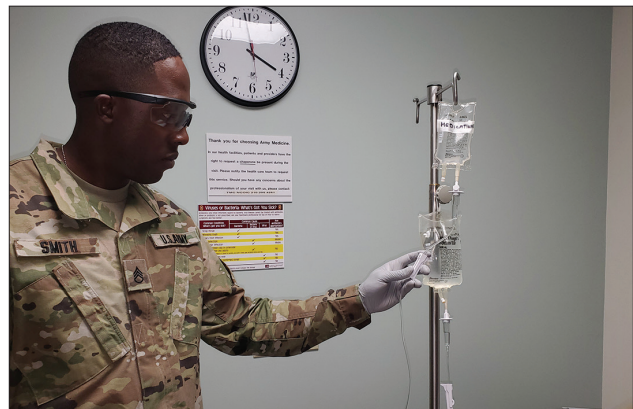
STEP 21b: Connect the medication IV tubing to the 18 G IV catheter. Secure the medication IV tubing to the patient with medical tape.



STEP 22: Hang the piggyback medication infusion bag higher than the primary IV infusion bag.

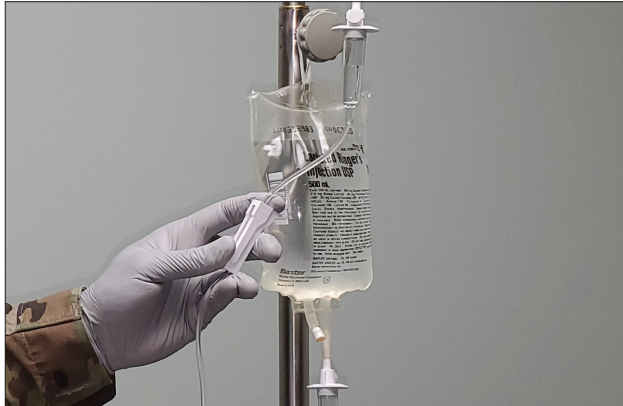


STEP 23: Open the roller clamp on the primary IV infusion tubing and set it at the proper drip rate, depending on type of fluid being administered.



STEP 24: Open the roller clamp on the piggyback medication infusion tubing and set the drip rate.

## ADMINISTERING IV PIGGYBACK MEDICATION, CONT.



STEP 25: Once the piggyback medication has been completely administered, close the roller clamp on the piggyback medication's IV tubing and disconnect the piggyback's tubing from the primary IV infusion tubing.



STEP 26: Assess the patient for desired effects of the medication and record full vital signs.



STEP 27: Document the medication given (time, place, route, strength) on the patient's medical records.

## KEY TERMS AND ACRONYMS

**Anaphylaxis.** An acute allergic reaction to an antigen (eg, venom from a bee sting) to which the body has become hypersensitive.

**Angioedema.** Diffuse swelling that may start with the lips, hands, feet, or mucous membranes, and sometimes progresses to the airway, causing difficulty breathing.

**Antibiotic.** A medication used to treat microbial (eg, bacterial) infections; abbreviated as ABX.

**Bioavailability.** The amount of drug absorbed into the circulatory system.

**Brand name.** Trade name. The name by which a company markets a particular drug. Brand names are usually capitalized. There may be several trade names for a single generic named drug.

**Capsule.** A form of medication that contains a powder, liquid, or oil enclosed in a hard or soft gelatin outer shell. Some capsules (sustained release, extended release, controlled release, or timed release) release medication over time and they may not be divided or crushed.

**Contraindication.** A situation or condition where you would not administer the medication because it may do more harm than good.

**Cream.** A semisolid emulsion of oil and water used as a topical medication.

**Dividend.** A number that is being divided.

**Divisor.** A number that the dividend is divided by.

**Dosage.** The calculation or administration of the proper amount, number, and frequency of doses.

**Dose.** The amount (quantity) of medication administered.

**Enema.** Injection of a fluid into the lower bowels via the rectum. Enemas are frequently used to administer medications.

**Gastric lavage.** The medical procedure to wash stomach contents out of the body.

**Generic name.** The official chemical name for a drug. Generic names are not capitalized.

**Greatest common factor.** The highest number (factor) that divides exactly into two or more numbers. For example, 9 and 36 both share the factors 1, 3, and 9. The number 9 is the greatest common factor.

**Gtts.** Drops. From the Latin “guttae.”

**Hepatic first-pass metabolism.** When a drug is absorbed through the enteral route (GI tract), it first passes through the liver where a portion of the drug is metabolized reducing the amount of drug in the circulatory system to be used in the body.

**Indications.** The reason the medication is administered (approved uses). Indications are guided by the conditions being treated.

**Lipodystrophy.** Defective fat metabolism.

**Lotion.** A liquid medicinal preparation applied to the skin. Lotions can act as a soothing agent and provide skin protection. Some lotions can cleanse the skin or act as astringents.

**Lozenge (troche).** A sweet, mucilage-type tablet that dissolves in the mouth and releases medication.

**Ointment.** A semisolid medicinal preparation applied to the skin.

**Paste.** A semisolid medicinal preparation applied to the skin. It has a firmer consistency than creams, lotions, or ointments.

**Periostitis.** Inflammation of the bone.

**Pill.** A round, solid form of medication that is either swallowed or chewed and is broken down in the stomach or small intestines.

**Quotient.** The answer resulting from the division of one number by another.

**Route.** The means of access for medication delivery.

**Rule of Ten.** An adult burn fluid resuscitation protocol created by the US Army Institute of Surgical Research that rounds up the casualty's total body surface area to the nearest ten and then uses the casualty's body weight in calculating the amount of fluid to be administered.

**Side effects.** Negative effects or actions other than the desired actions.



**Solute.** A substance that is dissolved in a solution.

**Solution.** A liquid containing a dissolved medication.

**Suppository.** A medication prepared as a dissolvable solid form that is designed for insertion into the rectum.

**Tablet.** A round, spherical, or oddly shaped form that dissolves in the stomach or small intestines.

**Topical disk.** Another name for transdermal patch.

**Transdermal.** Transfer through unbroken skin and into the bloodstream.

**Transdermal patch.** An adhesive patch placed on unbroken skin to deliver medication through the skin and into the bloodstream for systemic effects.

**Transmucosal.** Transfer through mucosal tissue directly into the bloodstream.

### CHECK ON LEARNING ANSWERS

1. What are two advantages and two disadvantages of enteral medication administration?

*Two advantages of enteral medication administration are safety and low cost. Two disadvantages are varying absorption rates in the GI tract and the ability of the patient to swallow the medication.*

2. Which of the following is not considered a parenteral route?

- a. Percutaneous administration.
- b. IN administration.
- c. IV push administration.
- d. Oral administration. *(The correct answer.)*

3. An MO orders you to administer a specific medication to a pregnant patient, which is contraindicated. Are you, as a combat medic who is following orders, potentially liable for causing injury to the fetus?

*Yes. Combat medics carry the same burden of responsibility as MOs for administering a medication correctly and safely.*

4. List the 6 Rights of medication administration.

*Right patient, medication, dose, route, time, and documentation.*

5. How many times should you verify medications?

*Three times at a minimum.*

6. Restate the times the medication should be verified.

1. *After retrieving the medication from the storage area.*
2. *When preparing the medication dose prior to removing it from its storage container or drawing it from the vial or ampule.*
3. *Just prior to administering the medication.*

7. Reduce the fraction 5 mg/10 mL to its lowest terms.

*0.5 mg/mL.*

8. Reduce the fraction 500 µg/5 mL to its lowest terms.

*100 µg/mL.*

9. Convert the improper fraction 1,000 mg/250 mL into a mixed number.

*4 mg/mL.*

10. Convert the concentration 25 mg/10 mL into a decimal form.  
*2.5 mg/mL.*
11. Convert 1 g to mg.  
*1,000 mg.*
12. Convert 1 mg to  $\mu$ g.  
*1,000  $\mu$ g.*
13. Convert 1,000 mg to g.  
*1 g.*
14. Convert 1.5 L to mL.  
*1,500 mL.*
15. Convert 70.000 g to kg.  
*0.070 kg.*
16. Convert 0.0017 g to  $\mu$ g.  
*1,700  $\mu$ g.*
17. Convert 5 mg to g.  
*0.005 g.*
18. Convert 0.04 L to mL.  
*40 mL.*
19. Convert 400  $\mu$ g to g.  
*0.0004 g.*
20. Convert 1,500 mL to L.  
*1.5 L.*
21. A patient is experiencing mild anaphylaxis and needs 50 mg of diphenhydramine. The combat medic has on hand a prefilled syringe that contains 100 mg/5 mL. How many milliliters of fluid will the combat medic administer?  
*2.5 mL.*
22. The same patient in Check on Learning question 21 must now receive 0.3 mg of 1:1,000 epinephrine through a subcutaneous injection. The epinephrine that the medical clinic has on hand is 1 mg of 1:1,000 epinephrine mixed in 1 mL of solution contained in an ampule. How much fluid must be drawn from the ampule to administer 0.3 mg of 1:1,000 epinephrine?  
*0.3 mL.*
23. A combat medic is treating a combat casualty who is in severe pain and is developing hemorrhagic shock. The combat medic selects TCCC option 3 to administer ketamine to the casualty. The protocol directs the combat medic to administer 30 mg of ketamine slow IV/IO push. The combat medic has a vial of ketamine with 500 mg of ketamine in 10 mL of fluid. How much fluid must be withdrawn from the vial to administer 30 mg?  
*0.6 mL.*

24. A combat casualty has suffered severe burns to his body with 50% body surface area burned. The casualty weighs 210 lbs, which is calculated to be 95 kg. The casualty needs 700 mL of Ringer solution per hour (fluid resuscitation is calculated using the Rule of Ten). A 1,000 mL bag of Ringer IV solution is attached to a 10 gtts/mL macro IV tubing set. How many drops per minute will deliver 700 mL of Ringer solution in 1 hour?

*116.6 gtts/min.*

25. A combat medic is treating a combat casualty who was wounded about 30 minutes prior and has severe internal bleeding. The combat medic must administer TXA. Per protocol, the combat medic mixed 1 g of TXA in a 100 mL bag of normal saline for administration over 10 minutes. The IV tubing is 15 gtts/mL. How many drops per minute will deliver the drug over 10 minutes?

*150 gtts/min.*

26. How do you ensure oral medication has been administered to the patient?

*Observe the patient swallowing the prescribed medication.*

27. What must you assess to ensure the patient may accept medication orally?

*The patient must be able to protect their airway, have an intact gag reflex, and be alert.*

28. What is the advantage of a capsule over a tablet?

*Capsules are easier to administer to a patient with problems swallowing because the capsule can be opened and the medication poured into water or juice and then administered.*

29. After administering an inhaler you should document the patient's conditions. Specifically what should you assess and document, and why?

*Rate, rhythm, and quality of breathing to ensure a lessening of the patient's respiratory effort.*

30. What types of patients benefit most from an inhaler with a spacing device?

*A patient who is unable to depress an inhaler canister while simultaneously breathing in deeply would benefit from using a spacer.*

31. If a patient tells you they are allergic to a certain medication, what additional information do you need to obtain from them?

*Inquire specifically what happens when the patient takes the medication.*

32. How long should you observe patients after administering immunizations, IV, or IM medication?

*Observe patients for at least 20 minutes to make sure they do not experience an allergic reaction.*

33. What is the treatment for anaphylaxis?

*Secure the airway, provide supplemental oxygen and positive pressure ventilations, administer epinephrine (0.3 mg of 1:1,000 solution IM or SC for an adult, repeated every 5–10 minutes), administer diphenhydramine (25–50 mg IM or IV), and administer corticosteroids (methylprednisolone sodium succinate or methylprednisolone acetate).*



## REFERENCES

1. Foust SD. *Easy 4-Step Method to Drug Calculations*. 1st ed. Pearson/Prentice Hall; 2004.

## SOURCES

*Taber's Cyclopedic Medical Dictionary*. 22nd ed. F.A. Davis Co; 2013.



# 5 INJECTIONS

## CORE CONCEPTS

- Select an appropriate needle and syringe for an injection.
- Assemble a needle and syringe for an injection using sterile technique.
- Select medication for injection using physicians' orders.
- Draw medication from a vial and an ampule.
- Reconstitute medication with a diluent.
- Prepare an intradermal, subcutaneous, and intramuscular injection.
- Provide treatment for an allergic reaction and anaphylactic shock.

## INTRODUCTION

Combat medics are required to administer injections. **Injection** is a method of delivering liquid medications into the body. The term **parenteral** can be used for any method of getting medication into the body other than through the gastrointestinal tract (**enteral**). The parenteral routes include **intramuscular** (IM), **subcutaneous** (SQ), and **intra**dermal (ID) injections. Enteral routes include oral, mucosal, intranasal, or per rectum. The administration routes affect the onset of a medication's action.

## INJECTIONS

Combat medics may give injections by various routes. The following general principles apply for each method:

- Before administering any medication, compare the drug name on the **vial** with the drug name on the doctor's order.
- Validate the medicine when taking it from storage, while preparing and drawing up the medication, and prior to administering the medication to the patient.
- Check the patient's chart (or dog tags) for allergies to medications.
- Ask the patient to verbally confirm any known medication allergies prior to administration.

A basic knowledge of which medication is being prescribed, and why, can also help prevent medication injection errors. Many medications have very similar spellings or similar words, but have very different indications and usages. Extreme caution must be taken when comparing the prescription and the actual medication to be given. After administering the medication, monitor the patient for the prescribed amount of time (defined by either a drug reference or the medical officer [**MO**]). During this time, monitor for adverse reactions both locally at the site of injection and systemically. Systemic reactions affect the entire body and include fevers, vomiting, sweating, redness, generalized swelling, and difficulty breathing. Adverse reactions can lead to **anaphylaxis**, shock, or death if not recognized and treated. Report all reactions to the MO and add them to the patient's medical records.

Sterile techniques are paramount to preventing the introduction of pathogens into the body during the administration of an injection. Pathogens in this situation are usually bacteria that are normally found on the skin surface. These bacteria can be resistant to various antibiotics and it is becoming more common to have patients with a history of skin infections, boils, and abscesses. If the skin is not cleansed appropriately, bacteria will be pushed into the tissue by the needle. Cleaning and proper preparation of the skin before an injection will help keep infection rates low.



**Figure 5-1.** A combat medic using proper technique to administer an injection.

There are many advantages to administering a medication via injection. Advantages and benefits of injections that should be considered include the following:

- The majority of medications are most effective when given by injection.
- The medication cannot be provided in any other form.
- The patient's condition requires a quicker onset of the desired action (through rapid absorption) than is typically achieved with enteral medications.
- The entire dose of the medication must be obtained to achieve the desired effect.
- Due to nausea, vomiting, or other reasons like altered mental status or injury to the mouth, the oral route is not available.
- The drug cannot be absorbed through the digestive system.

Combat medics must know the locations of common administration sites, the type of injection to be administered, and the mechanism of action of the medication being injected. When providing an injection (Figure 5-1), follow procedures exactly to prevent an adverse outcome. An accidental injection into a nerve could result in injury and paralysis. An unintended injection directly into a blood vessel could cause the medication to be absorbed too rapidly, possibly resulting in injury or death of a patient. Some medications, such as injectable steroids, must be injected into deep muscle tissue, and failure to do so could result in deformity due to tissue **atrophy**.

## PREPARING AND USING SUPPLIES FOR INJECTIONS

### Needles

All parts of the needle are sterile. Be careful not to touch the **hub**. This would contaminate the needle and possibly pass an infection to the patient. Only the outside of the needle cover may be touched. A needle consists of the following parts (Figure 5-2):

- lumen—hollow cavity inside of needle,
- bevel—cutting edge of needle (slanted),
- hub—point of attachment to syringe,
- cannula (shaft)—elongated part of the needle, and
- protective cover (not shown).

Needles are sharp and made of stainless steel. Standard needle lengths are from 1/2 to 5 in. The length is determined from the tip of the point to the junction of the shaft and hub. The **gauge** (diameter) of the needle varies from 14 to 28; the larger the gauge number (**G**), the smaller the diameter (Figure 5-3). For example, a 14 G needle has a larger lumen in the bevel and can administer larger amounts of fluid at a faster rate than a 22 G needle, which has a smaller lumen and administers smaller amounts of fluid at a slower rate.

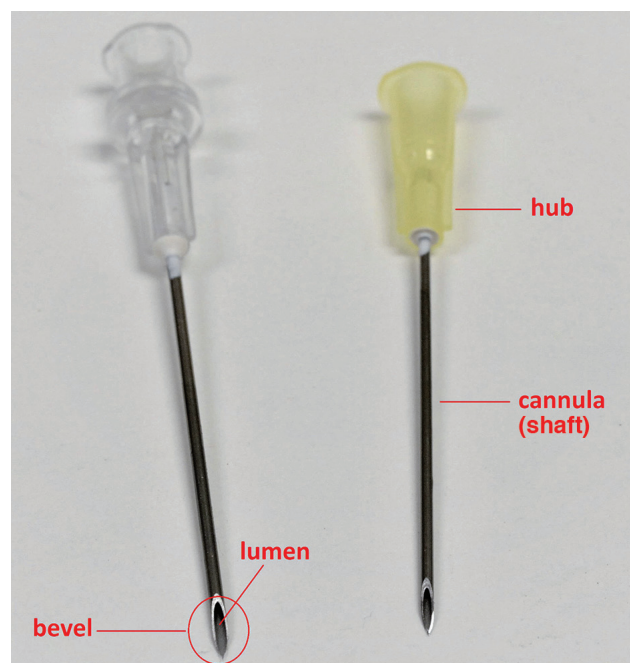


**Figure 5-2.** The parts of a needle.





**Figure 5-3.** Different sizes of needles. From top to bottom, needle gauge decreases as needle diameter increases.

It is important to select the appropriate needle when administering an injection. Choose one with the proper length based on the following factors:

- type of injection—SQ, IM, or ID;
- the size of the patient—eg, thin or obese; and
- the injection site—eg, 1 in. needle length for an IM injection into the deltoid muscle versus 1.5 in. length for an IM injection into the gluteus maximus muscle.

Select the needle with the proper gauge (most commonly from 18 to 25 G). The larger the number, the smaller the bore (diameter). For example, a 25 G needle has a very small opening and may be used for SQ or ID injections, whereas a 23 G needle has a larger bore and may be used for an IM injection. Also, small-gauge needles are indicated for watery medications, and large-gauge needles are indicated for viscous (thick) medications.

Blunt-tip needles and needleless systems are becoming more common for administration of medications through an intravenous (IV) port attached to IV tubing. A blunt-tip needle is a rigid, unbeveled needle that significantly reduces accidental **needlesticks** because the point of the needle is not sharp like standard needles. Some IV tubing companies make tubing with integrated needleless and IV medication ports. This allows combat medics to attach a syringe without a needle, for safer medication administration.

Another type of needle a combat medic may use is a “filter needle.” Filter needles are used only to draw up medications from glass **ampules**, and are NEVER

used to administer an injection. Filter needles contain a filter to prevent glass particles from being drawn up into a syringe and accidentally injected into the patient.

**Caution:** All parts of the needle are sterile. **Do not touch the hub** because contamination could cause patient infection. Only the outside of the needle cover may be touched.

## Syringes

A syringe is an instrument that is attached to a needle and used for injecting fluids into cavities or vessels. Hypodermic syringes are the most common type used by combat medics. They are attached to hypodermic needles and are used to inject fluid through the skin. Syringes come in many different sizes depending on the type of medication and amount of fluid to be administered. Most syringes possess units of measurement in milliliters. A cubic centimeter (cc) is equal to a milliliter (mL); however, the cc unit of measurement is no longer used. An example of syringes that measure in different units are those used by people with diabetes. These syringes are used to administer insulin, and their measurements are not in milliliters, but in units.

Most syringes have similar parts, as shown in Figure 5-4. They include the following:

- Barrel—a clear plastic or glass tube marked with calibrated scales. The inside of the barrel is sterile.
- Plunger—the movable portion inside the barrel. The rubber portion and the shaft are sterile.
- Needle adapter—the sterile portion of the syringe where the needle attaches.
- Calibrated scales—measurement markings on the barrel that vary depending on the overall size of the syringe.

Select an appropriate syringe by first checking the drug manufacturer’s specifications. Determine whether a glass or plastic syringe should be used for the medication since some medications deteriorate in a plastic syringe. Drug manufacturers’ specifications provide guidance. Ensure that the total capacity of the syringe is appropriate for the amount of medication to be administered. The syringe should be large enough to hold the entire dose and small enough to draw up an accurate dose. Check the intervals of the calibration marks on the syringe to ensure they are appropriate for the dose of medication to be administered.

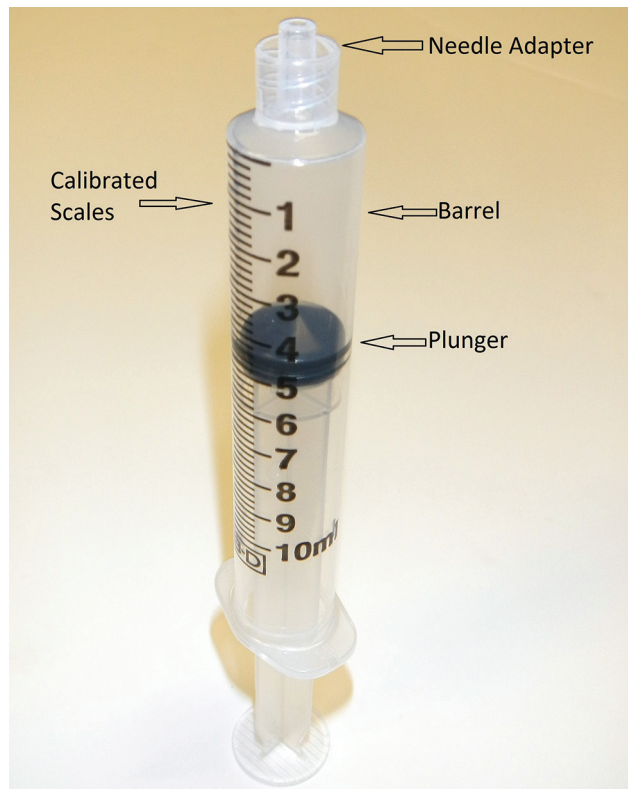


**Figure 5-4.** The parts of a syringe.

The plunger fits inside the tube or barrel of the syringe. It creates a tight seal inside the syringe, usually with the assistance of a small rubber or plastic gasket. This prevents the contents from escaping out the rear of the syringe, keeping dosages consistent. When depressed, the plunger forces fluid or gas out of the opening of the syringe. When pulled back, a vacuum is created inside the barrel that will suck up any fluids or gases in contact with the syringe. If the plunger is not the right size, or is defective, it can be difficult to pull back or push forward, which can interfere with medication administration.

**Caution:** The needle adapter and the shaft of the plunger are sterile. **Do not touch the adapter or the shaft of the plunger** because contamination could cause patient infection.

### Safety Syringes

Most syringe and needle combinations comprise some type of safety syringe. In syringe-based safety

devices, the safety mechanism is built into the syringe. The needle on a syringe-based safety device can be detachable or permanently attached. Typically, the needle has a standard or conventional design. Safety syringes help prevent needlesticks.

### Check on Learning

1. What parts of the needle are sterile?
2. Put these needles in order from the largest to smallest diameters: 25 G, 18 G, and 22 G.
3. What factors influence the length of the needle that should be used for a particular injection?
4. What parts of the syringe are sterile?
5. How do you know which syringe to select?

### Assembling the Needle and Syringe

During needle and syringe assembly, you are responsible for maintaining the sterility and security of the equipment. First, inspect the needle and syringe packaging for defects, such as openings, holes, and water spotting. Discard the equipment into a **sharps container** if any defect is found.

Use the following steps for assembling a needle and syringe:

1. Don personal protective equipment (PPE). The minimum PPE for administering injections is gloves and eye protection.
2. Select and inspect equipment.
  - a. Ensure that all necessary equipment is retrieved.
  - b. Select the appropriate size needle and syringe for the type of injection being performed.
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired.
3. Unpack the syringe.
  - a. Peel the sides of the wrapper apart to expose the rear end of the syringe barrel.
  - b. Grasp the syringe by the barrel. Be careful not to touch the adapter or shaft of the plunger.
  - c. Pull the syringe from the packaging.

**Note:** The outside of the syringe barrel does not have to be kept sterile.

4. Inspect the syringe.
  - a. Pull on the plunger. When pulling on the plunger, a distinct “pop” should be felt; if it is not, the seal was previously broken and the equipment must be discarded.
  - b. Grasp the flared end of the syringe and move the plunger back and forth to test for smooth, easy movement.
  - c. Visually check the rubber stopper (inside the syringe) to ensure that it is attached securely to the top end of the plunger, forming a seal. If the plunger is stuck or does not move smoothly, discard the syringe.
  - d. Push the plunger fully into the barrel until you are ready to fill the syringe with medication.
5. Unpack the needle.
  - a. Peel the sides of the flexible wrapper apart to expose the needle hub. **Do not touch the hub**; only touch the outside of the needle cover.
  - b. If the needle is packaged in a hard plastic tube, twist the cap of the tube until a “pop” is felt and remove the cap to expose the needle hub.
6. Assemble the syringe.
  - a. Join together the syringe and needle by inserting the needle adapter of the syringe into the needle hub.
  - b. Tighten the needle and syringe by twisting the needle clockwise one-quarter turn to ensure that the needle is securely attached to the syringe.
7. Place the assembled needle and syringe on the work surface; leave the protective cover on the needle.
  - a. Leave the plunger pushed fully into the barrel.
  - b. Keep the assembled needle and syringe within sight to ensure safety and prevent contamination.

## Check on Learning

6. While preparing to administer an injection, the needle is removed from the flexible wrapper. Inadvertently, you drop the needle on the floor. The protective cap was in place when the needle touched the floor. Can the needle still be used? Why or why not?

## Recapping a Needle

Recapping needles is not recommended because it increases needlestick risk. Sometimes it may be necessary to recap a needle, such as after withdrawing medication from a vial or ampule. If you must recap a needle, use the following scoop technique while holding the assembled needle and syringe in your dominant hand. Follow these steps:

1. Drape a blue chux pad over a hard, flat surface that has been cleared of any other equipment. Place the protective cap on the chux pad.
2. Insert the needle into the open end of the protective cap and lift the protective cap, causing it to slide down on the needle.
3. Cover the needle with the protective cap, ensuring that the cap is secured to the needle hub.

**WARNING:** Never recap a dirty (used) needle. Always use extreme caution when recapping a clean needle. Never hold the sheath (the protective needle cover) in your nondominant hand and attempt to recap the needle. Use the scoop method when recapping a clean needle.

## PREPARING MEDICATIONS FOR ADMINISTRATION

### Drawing and Administering Medication from a Vial

Liquid medications are packaged in different containers such as vials, ampules, and **prefilled syringes**. A vial is a small glass bottle that contains a liquid medication. It differs from an ampule by its distinct rubber stopper. The rubber stopper allows insertion





**Figure 5-5.** A combat medic using proper technique to draw medication from a vial. The vial is inverted and the rubber stopper prevents medicine from leaking out.

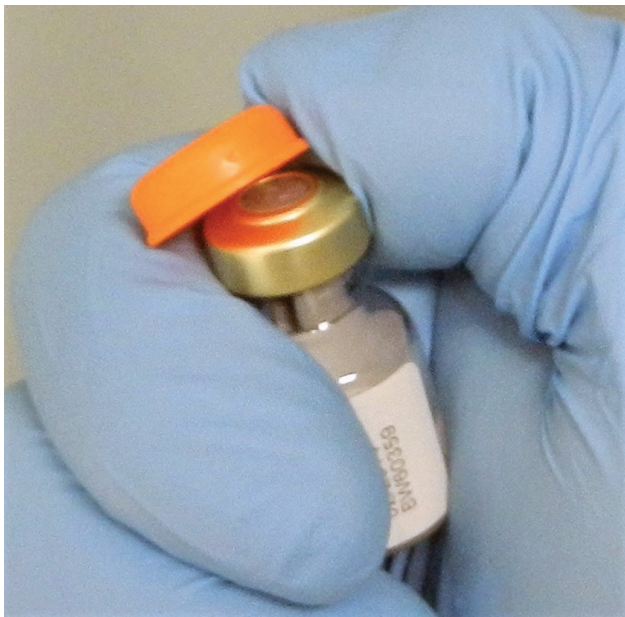


**Figure 5-6.** Removal of the protective cap of a single-dose vial. The rubber stopper can be seen just below the protective cap.

of a needle and withdrawal of medication from the vial without spilling if the bottle is tilted or inverted (Figure 5-5). The characteristic rubber stopper of a vial is protected from damage by a protective cap, typically made out of plastic or metal (Figure 5-6). Once the protective cap is removed from the vial, it cannot be replaced. Vials come prepared as single- or multi-dose bottles.

Use the items listed below for drawing medication from a vial:

- blue chux pad
- syringe—appropriate size for the type of medication being given
- 18 G or blunt needle used for drawing the medication from the vial
- needle of the appropriate size for administering the medication via the desired type of injection
- alcohol prep pad
- 2 in. × 2 in. (2 × 2) gauze pad

Use the following steps for drawing medication from a vial:

1. After receiving the MO's order to administer a drug from a vial, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients. Verifying the 6 Rights ensures that the combat medic has the correct:
  - a. patient—confirm the patient's identity using two patient identifiers in accordance with (IAW) your local MTF standard operating procedures (SOP)—usually by asking them to state their name and date of birth (DOB),
  - b. medication,
  - c. dosage,
  - d. route,
  - e. time, and
  - f. documentation.

**Caution:** If a female patient believes there is a chance she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the injection without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. The minimum PPE for drawing medication from a vial is gloves and eye protection.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (eg, refrigerated).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Obtain the required equipment.
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired. Examine the container. If it is a multi-dose vial that has been opened, check the rubber stopper for defects, such as small holes or torn plugs.

**Note:** The protective cap should be in place on single-dose vials. If the protective cap has been removed, discard the vial and select a new one from the medication storage area.

- d. Check the date the multi-dose vial was opened and check the expiration date of the medication.
  - i. Multi-dose vials should have the following information written on the label once opened—time, date, and initials detailing first use.
  - ii. Multi-dose vials are good for 28 days from the date of first use, unless the manufacturer specifies otherwise.
- e. If possible, check the medication for floating particles and changes in color

and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, this check must be done when drawing up the medication into the syringe.

- f. If there is any evidence of medicine or package contamination or damage, or if the vial is outdated, discard the product IAW local SOPs and obtain a new vial.
  - g. Open the packaging on both the 18 G (or blunt) and administration needles, as well as the syringe. Connect the hub of the 18 G (or blunt) needle to the needle adapter on the syringe.
  - h. Open the alcohol prep pad.
4. Remove the cap from the medication vial and cleanse the vial with the alcohol prep pad.
  5. Remove the protective cap from the needle safely. Pull the needle cover straight off without bending or touching the needle.
  6. Pull back on the plunger to draw air into the syringe for injection into the medication vial.
    - a. The amount of air to draw up equals the amount of fluid to be administered.
    - b. Follow the directions on the medication vial, if provided.
    - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
  7. Insert the 18 G (or blunt) needle into the medication vial on the table.
    - a. Place the medication vial upright on a table. Insert the 18 G (or blunt) needled syringe through the rubber stopper, ensuring the needle tip passes completely through. Ensure the hub of the needle does not touch the rubber stopper.
    - b. Pick up the syringe and vial and turn them upside down.
    - c. Elevate the syringe and vial to eye level.
  8. Push the plunger forward to inject air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.

9. Pull the plunger back to the desired milliliter mark, withdrawing the prescribed medication into the syringe.
10. Remove the needle from the vial and recap the needle using the scoop method.
11. Attach the appropriate needle to the syringe and administer the medication.
  - a. After the medication has been drawn up and is ready to be administered, conduct a final recheck to ensure that the medication and concentration (if applicable) are exactly what was ordered by the MO. This is the third and final check prior to administration.
  - b. Pull back on the plunger slightly to withdraw any fluid that may be in the 18 G (or blunt) withdraw needle. This moves all fluid into the syringe.
  - c. Detach the 18 G (or blunt) withdraw needle by twisting counter clockwise and discard it into a sharps container.
  - d. Attach the administration needle.
  - e. Slowly advance the plunger of the syringe to expel the air bubble from the top of the syringe and the new administration needle. Place the syringe at eye level and ensure the plunger is positioned exactly on the prescribed milliliter mark once the air bubble has been expelled from the syringe and administration needle.
  - f. Administer the injection.
12. Discard the needle and syringe into the sharps container.

Once the medication has been administered, return the vial to the proper storage area. If it is a multi-dose vial, verify that the date and the time the vial was opened are recorded on the vial label (Figure 5-7), then place it back into storage. Discard single-dose vials and multi-dose vials if they are empty or expired, in accordance with local SOP.

### Check on Learning

7. How are clean needles recapped?
8. How do you determine that the correct amount of medication has been drawn?

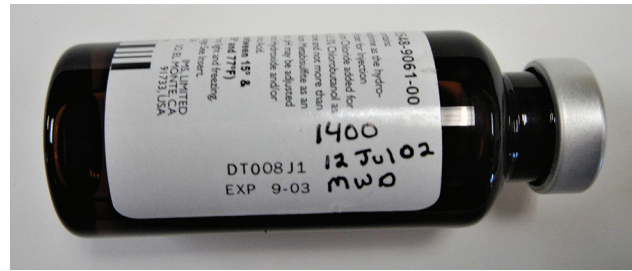


**Figure 5-7.** A multi-dose vial properly labeled with the date and time of opening.



**Figure 5-8.** Glucagon is an emergency reconstituted medication used to release sugar stores in the liver during a hypoglycemic event. The Bedford Laboratories (Bedford, OH) glucagon product shown here has two vials; the diluent is on the left and the powdered medication is on the right.

### Reconstituting Medicines

Some medications come in a powdered form that must be turned into a solution prior to administration. Normally, the powdered medication is packaged in a vial, and another vial that contains a liquid **diluent** is included. If no diluent is included, check the powdered medication label for instructions on what diluent should be used (Figure 5-8). Once the contents of both vials are mixed together and the medication is dissolved, it is now in its proper form for administration.

**Warning:** The **reconstituted** powder shown in the skill drills (at the back of the chapter) is Practi-Powder White, by Wallcur (San Diego, CA). Wallcur Practi-Products are NOT medicines and are NOT for human or animal use. They are for training purposes only.



Use the items listed below for reconstituting medicine:

- two 3 to 5 mL syringes
- 18 G or blunt needle used for reconstituting the medication
- appropriate size needle for desired type of injection, used for administering the medication
- two alcohol prep pads
- diluent and medication vials

Use the following steps for reconstituting a medication:

1. After receiving the MO's order to administer a drug that requires reconstitution, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights for all patients. Verifying the 6 Rights ensures that the combat medic has the correct:
  - a. patient—confirm the patient's identity using two patient identifiers IAW your local MTF SOP—usually by asking them to state their name and DOB,
  - b. medication,
  - c. dosage,
  - d. route,
  - e. time, and
  - f. documentation.

**Caution:** If a female patient believes there is a chance she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the injection without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. The minimum PPE for reconstituting a drug is exam gloves and eye protection.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.

- i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
  - ii. Normally, powdered medication is packaged with its diluent in the same box. If no diluent is included, check the powdered medication label for instructions on what diluent should be used.
- b. Obtain the required equipment.
- c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired.
- d. If possible, check the diluent vial for floating particles and changes in color and consistency by holding the vial up to light.
- e. If there is any evidence of medicine or package contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain a new vial.
- f. Open the packaging on both the 18 G (or blunt) and administration (depending on type of injection) needles, as well as both syringes. Connect the hub of the needles to the needle adapters on the syringes.
- g. Open the alcohol prep pads.
4. Remove the cap from the diluent and medication vials and cleanse both with an alcohol prep pad.
5. Safely remove the protective cap from the 18 G (or blunt) needle and syringe unit by pulling it straight off without bending or touching the needle.
6. Pull back on the plunger to draw air into the syringe for injection into the diluent vial.
  - a. The amount of air to draw up equals the amount of fluid in the diluent vial.
  - b. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.

7. Insert the 18 G (or blunt) needle into the diluent vial on the table.
  - a. Place the diluent vial upright on a table. Insert the 18 G (or blunt) needled syringe through the rubber stopper, ensuring the needle tip passes completely through.
  - b. Pick up the 18 G (or blunt) needle and syringe and diluent vial and turn them upside down.
  - c. Elevate the syringe and vial to eye level.
8. Push the plunger forward to inject air from the syringe into the diluent vial. The amount of air injected should be equal to the total amount of fluid in the diluent vial. All fluid must be withdrawn.
9. Pull back on the plunger, drawing up the correct amount of diluent fluid from its vial.
10. Withdraw the 18 G (or blunt) needle from the diluent vial and insert it into the medication vial on the table.
11. Inject the diluent into the medication vial. If the vial with powdered medication contains air, the diluent may be difficult to inject; air may have to be withdrawn to allow injection.
12. Withdraw the needle and syringe from the medication vial and discard it into a sharps container.
13. Mix the medication well.
  - a. Check the medication vial label or package because some medications should only be inverted gently, while others require vigorous mixing. Mix the contents IAW package instructions until all the power is dissolved.
  - b. Visually inspect the solution to ensure it is well mixed.
    - i. Check the medication for abnormalities such as undissolved crystals.
    - ii. Refer to the enclosed manufacturer's insert for acceptable variations in medication. If the insert is unavailable or if you have any questions, stop the process and check with your MO or noncommissioned officer in charge (NCOIC) prior to injecting the patient with the medication.

14. After conducting the third medication check, withdraw the prescribed amount (using the 21 G needle-syringe unit), verify the correct dosage, and administer properly.
  - a. Remove the protective cap from the 21 G needle-syringe unit safely. Pull the needle cover safely off without bending or touching the needle.
  - b. Place the medication vial onto the table and insert the 21 G needle into the vial. Pick up the syringe and medication vial and turn them upside down. Elevate the syringe and vial to eye level.

**Note:** Cleanse the rubber stopper again with an alcohol prep pad if it is touched by anything unsterile during the preparation (mixing) of the medication.

- c. Pull back on the plunger of the syringe, drawing up the correct amount of medication from the medication vial.
- d. If any air bubbles are visible in the syringe, point the needle up and tap the syringe to move the air bubbles to the needle. Slightly depress the plunger to expel the air from the needle-syringe.
- e. Verify the correct dosage.

### Check on Learning

9. While attempting to dilute powdered medication, the diluent is difficult to inject. What should you do?
10. How do you determine whether to mix reconstituted medication gently or vigorously?

### Drawing Medication from an Ampule

An ampule is a glass container of medication that resembles a small bottle. The neck of an ampule consists of a break line, which is the spot where the glass ampule is broken to access the medication inside (Figure 5-9). A filter needle is normally used when drawing medications from ampules. This prevents small glass particles, which may be in the ampule after opening, from being drawn up into the syringe and injected into the patient. When filter needles are used to draw up medication, the needle must be changed before the medication is given to the patient.

Use the items listed below for drawing medication from an ampule:

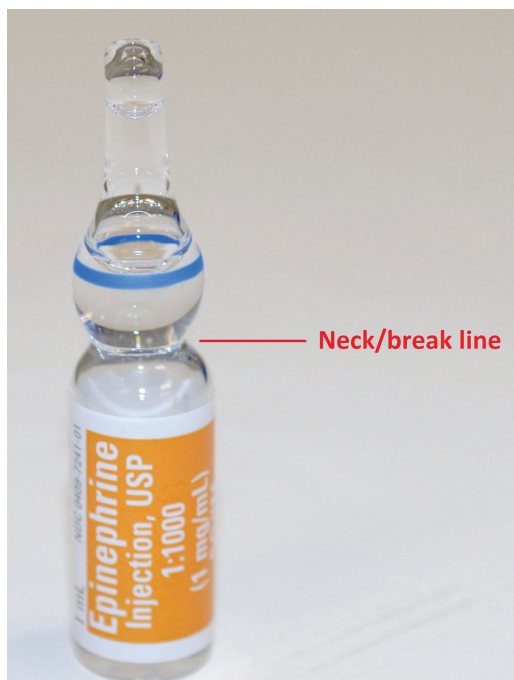


**Figure 5-9.** An ampule of 1:1,000 epinephrine.

- blue chux pad
- filter needle
- appropriate size needle for desired type of injection
- alcohol prep pad
- 2 × 2 gauze pad
- 3 to 5 mL syringe

Use the following steps for drawing up medication from an ampule:

1. After receiving the MO's order to administer a drug from an ampule, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights. Verifying the 6 Rights ensures that the combat medic has the correct:
  - a. patient—confirm the patient's identity using two patient identifiers IAW your local MTF SOP—usually by asking them to state their name and DOB,
  - b. medication,
  - c. dosage,
  - d. route,
  - e. time, and
  - f. documentation.

**Caution:** If a female patient believes there is a chance she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the injection without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE. The minimum PPE required for drawing medication from an ampule is exam gloves and eye protection.
3. Check and assemble the equipment.
  - a. Select the correct medication from the storage area and conduct the first verification that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - i. Verify that the medication was properly stored (eg, refrigerated).
    - ii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Obtain the required equipment.
  - c. Ensure that all packaging is properly sealed and undamaged. Verify that nothing is expired.
  - d. If possible, check the medication for floating particles and changes in color and consistency by holding the ampule up to light. If it is a dark, light-obscuring ampule, this check must be done when drawing up the medication into the syringe. Discard any ampules with contents that appear corrupted or deteriorated into a sharps container.
  - e. Open and place a blue chux pad on the table.
  - f. Open the needle packaging on both the filter and administration needles, as well as the 3 to 5 mL syringe. Connect the hub of the filter needle to the needle adapter on the syringe.
  - g. Open the alcohol prep pad.



4. Cleanse the neck of the ampule with the alcohol prep pad.
  - a. Place the ampule upright and lightly tap to force any trapped medication out of the top of the ampule.
  - b. Remove the alcohol prep pad from the open package and place it on the break line of the ampule.
  - c. Clean the entire circumference of the ampule's neck and break line.
5. Using your nondominant hand, pick up the ampule, and with your dominant hand, place the 2 × 2 gauze pad on the ampule, covering the neck and break line.
  - a. The 2 × 2 gauze pad should be on the side of the ampule facing you, and held in place by the thumbs of both hands. The 2 × 2 gauze pad protects you from any small glass pieces.
6. Break the neck of the ampule, directing the breaking away from your body.
7. Inspect the ampule for glass.
  - a. Raise the broken ampule to eye level, toward a light source, and look for any small shards of glass that may have fallen into the ampule accidentally.
  - b. If any small shards of glass are visible inside of the ampule, discard it into a sharps container, obtain another ampule of the same medication, and repeat steps 1 through 7.
8. Using the syringe with the attached filter needle, withdraw the prescribed amount of verified medication from the ampule.
  - a. Pick up the assembled needle and syringe with your dominant hand. Safely remove the protective cover with your free hand by pulling it straight off without bending or touching the needle.
  - b. Do **not** pull the plunger back and draw air into the syringe in preparation for drawing medication.
  - c. Hold the ampule vertically with your nondominant hand or place the ampule upright on a flat surface, insert the filter needle and syringe, and withdraw the prescribed dose of medication. Be careful

not to touch the outside edge or bottom of the ampule with the needle while drawing up the medication.

- d. Withdraw the needle from the ampule and verify the dosage. Check the syringe for air bubbles.
  - e. Hold the syringe with the filter needle pointing up and pull back on the plunger slightly to clear all the medication from the needle shaft.
  - f. Tap the barrel lightly to force bubbles to the top.
  - g. Pull slightly back on the plunger to remove any medication in the filter needle.
9. Recap the needle (using the correct technique) to prevent an accidental needlestick. Then twist the filter needle to remove it from the syringe and put the needle into a sharps container.

**Caution:** The needle recapping technique is only performed on clean needles. Never recap a dirty needle.

10. Attach the appropriate size needle and administer the medication properly.
  - a. Once the administration needle has been connected to the needle adapter of the syringe, advance the plunger slightly forward to expel any air bubbles and fill the administration needle with the medication.
  - b. Verify the medication and dosage again, then cover the needle with the protective cover if not administering the medication immediately. Recap the administration needle if the cap had been removed.
11. Discard the needle and attached syringe into the sharps container immediately after administering the medication.

### Check on Learning

11. You snapped the neck of the ampule and are inspecting the ampule. What are you looking for?
12. What should you do if you find something in the ampule?

## Prefilled Syringe

A prefilled syringe provides a single medication dose or unit dose medication prepared by a manufacturer or pharmacy. Prefilled syringes are convenient and easy to use. They improve health care by minimizing microbial contamination and reducing medication dosing errors.

Despite their advantages, prefilled syringes are not widely used. There are no prefilled syringes with integrated safety features, and some medications cannot be packaged in a prefilled syringe.

If the entire amount of medication in a prefilled syringe is not needed, the excess should be discarded into a designated receptacle before administration. This is done by pushing the plunger until the correct quantity is obtained.

## TYPES OF INJECTIONS

### Intradermal Injections

ID injections are used to test for exposure to diseases (eg, tuberculosis or mumps), and for sensitivity to environmental allergens and medications. Because little systemic absorption of intradermally injected agents takes place, this type of injection is used primarily to produce a localized effect.

ID injections are administered in small volumes, usually 0.5 mL or less, into the outer layers of the skin. Intradermal injections require a 1/4 to 1/2 in. needle, from 25 to 27 G. A **tuberculin syringe** or other 1 mL syringe will also be necessary. Ensure the injection site is free of hair, tattoos, and scars. Do not inject over a vein or bony area. Place medication just below the epidermis.

The primary injection site for ID injection is the ventral forearm (on the inner, flat portion). This site is most commonly used because it is easily accessible and lacks hair (Figure 5-10). Other appropriate sites include the back of the upper arm and on the back below the shoulder blades.

### Preparing and Administering an Intradermal Injection

Use the items listed below for administering an ID injection:

- blue chux pad
- tuberculin or other 1 mL syringe

- 18 G or blunt needle used for drawing the medication from the vial
- 25 to 27 G needle, 1/4 to 1/2 in.
- two alcohol prep pads



**Figure 5-10.** An example of a proper intradermal injection with wheal formation. The needle is inserted at a 5° to 15° angle.

Use the following steps for administering an ID injection:

1. After receiving the MO's order to administer a drug as an ID injection, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights. Verifying the 6 Rights ensures that the combat medic has the correct:
  - a. patient—confirm the patient's identity using two patient identifiers IAW your local MTF SOP—usually by asking them to state their name and DOB,
  - b. medication,
  - c. dosage,
  - d. route,
  - e. time, and
  - f. documentation.

**Caution:** If a female patient believes there is a chance she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the injection without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. Check with the MO to see if the patient described an allergy that would contraindicate use of the medication.

2. Don PPE and perform a patient care hand wash. The minimum PPE for administering an ID injection is exam gloves and eye protection.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication vial was stored properly (eg, refrigerated).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Obtain the required equipment.
  - c. Ensure that the packaging of all items is properly sealed, not damaged, and not expired.
    - i. Examine the medication container. If it is a multi-dose vial that has been opened, check the rubber stopper for defects, such as small holes or torn plugs.

**Note:** If the vial being used is not a multi-dose vial, the protective cap should be in place and not removed. If the protective cap has been removed, discard the vial and select a new one from the medication storage area.

- ii. Check the date the multi-dose vial was opened and check the expiration date of the medication. Multi-dose vials should have the following information written on the label once opened: time, date, and initials detailing first use. Multi-dose vials are good for 28 days from the date of first use unless the manufacturer specifies otherwise.

- d. Inspect the vial by holding it up to light to check for foreign particles and changes in color and consistency. If it is a dark, light-obscuring vial, this check must be done when drawing up the medication into the syringe.

**Note:** If there is any evidence of medicine or package contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain another.

- e. Open the packaging on the 18 G (or blunt) needle and syringe. Some 1 mL syringes come with the appropriate 25 G needle already attached. If this is the case, separate the 25 G needle from the 1 mL syringe and attach the 18 G (or blunt) needle.
- f. Open the alcohol prep pad.
4. Remove the cap from the medication and cleanse the vial with an alcohol prep pad.
5. Remove the cap from the needle safely by pulling it straight off without bending or touching the needle.
6. Pull back on the plunger of the syringe to draw in air for injection into the vial.
  - a. The amount of air to draw up equals the amount of fluid to be administered.
  - b. Follow the directions on the medication vial, if provided.
  - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
7. Insert the 18 G (or blunt) needle into the medication vial on the table.
  - a. Place the medication vial upright on a table. Insert the needled syringe through the rubber stopper, ensuring the needle tip passes completely through, and that the hub of the needle does not touch the rubber stopper.
  - b. Pick up the syringe and vial and turn them upside down.
  - c. Elevate the syringe and vial to eye level.



8. Push the plunger forward to inject air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.
9. Withdraw the prescribed amount of medication from the vial. Pull back on the plunger to the desired milliliter mark, withdrawing the correct amount of medication.
10. Remove the 18 G (or blunt) needle and recap the needle using the scoop method. Replace the 18 G (or blunt) needle with the administration needle.
  - a. Withdraw the plunger slightly to remove any medication in the 18 G (or blunt) needle.
  - b. Discard the needle used to withdraw the medication into the sharps container.
  - c. Connect the administration needle (25 G) to the medicine-filled syringe and slightly push on the plunger to fill the administration needle with medication.
  - d. Perform a final recheck prior to administration. Ensure that the medication and concentration (if applicable) match the MO's order. This is the third and final check prior to administration.
11. Ensure that the proposed injection area (forearm) is completely exposed and the muscle is relaxed. Have the patient sit down and place the forearm on a table with the anterior side facing up.
12. Identify the injection site (anterior mid-forearm). Ensure that the injection site is free of hair, tattoos, and scars.
13. Clean the injection site with an alcohol prep pad.
  - a. Clean in a spiral motion outward to 3 in. from the injection site.
  - b. Allow the skin to dry completely before administering the injection.
14. Remove the cap from the needle safely by pulling it straight off without bending or touching the needle.
15. Using your nondominant hand, pull the skin taut toward the patient's hand.
16. Advise the patient of the stick, then insert the needle at a 5° to 15° angle.
  - a. With your dominant hand, position the syringe, with the needle bevel up, at a 5° to 15° angle to the skin surface.
  - b. Advance until the bevel is under the skin surface.
    - i. Insert the needle just until the bevel disappears under the skin's surface, about 1/8 in. (0.3 cm) below the epidermis.
    - ii. If more than one ID injection is required, ensure that the injections are 2 in. (5 cm) apart.
17. With the thumb of your nondominant hand, push the plunger forward slowly until all the medication has been injected and a **wheal** appears at the injection site. Remove the needle-syringe and place it into a sharps container.

**Note:** Do not **aspirate** when performing an intradermal injection.

- a. The appearance of a wheal indicates the medication has entered the area between the epidermis and the dermis.
- b. If a wheal does not appear, withdraw the needle completely from the arm at the angle of insertion, and discard the needle and syringe into a sharps container. Prepare a new set, and repeat the procedure at another site at least 2 in. away from the initial test site.
- c. If the injection is successful and a wheal does appear, finish injecting the remaining medication. When finished, quickly withdraw the needle at the same angle in which it was inserted.
- d. Without applying pressure to the skin's surface, cover the injection site with dry, sterile gauze.

**Caution:** Instruct the patient not to rub, scratch, or wash the injection site. Scratching could irritate the area and cause the injected material to be absorbed systemically, as well as give a false positive or negative reading.

18. Monitor the patient for 20 minutes; watch for signs and symptoms of a developing allergic reaction.

- a. Check the site for bleeding, then circle the test with a marking pen, and label the skin according to the test given.
- b. Document the injection in the patient's medical record. On the appropriate forms, record the date, time the injection was given, amount of medication given, site of administration, patient's response to the injection, and any adverse reactions to the injection.
- c. Instruct the patient when and where to have the test read IAW the local SOP.

**Warning:** Have an emergency tray available for the immediate treatment of serious reactions. Include a syringe containing a 1:1,000 solution of epinephrine.

### Check on Learning

13. What are the recommended sites for intradermal injections?
14. At what angle should the needle be inserted to deliver an intradermal injection?
15. If a wheal does not appear, what is your next course of action?
16. Do intradermal injections require aspiration?

### Subcutaneous Injections

SQ injections place the medication within the tissue under the skin (Figure 5-11). They are used when the desired absorption rate is slower than that achieved via the IM route. SQ injections also cause minimal tissue trauma and carry little risk of striking large blood vessels and nerves. Absorbed mainly through the capillaries, drugs recommended for SQ injection include nonirritating aqueous solutions and suspensions in small amounts (up to 2 mL) of fluid (eg, heparin and insulin). SQ medications must be soluble and of sufficient strength to be effective, yet safe for surrounding tissues. The absorption rate for SQ injection is 15 to 30 minutes. The duration is hours to weeks (comparable to that of the IM route). Drugs and solutions for SQ injection are injected through a relatively short needle, using sterile technique. SQ injections are given in areas where bones and blood vessels are not near the skin's surface. Injection is contraindicated in sites that are inflamed, edematous, scarred, or covered by a mole, birthmark, or other lesion. It may also be contraindicated in patients with impaired coagulation mechanisms.



**Figure 5-11.** A combat medic preparing to administer a subcutaneous injection.

When administering SQ injections, use needles that range from 25 to 27 G, with a length of 5/8 to 1/2 in., or an insulin syringe. Needle length and gauge will vary depending on the amount of SQ tissue and the patient's age, size, and condition. It is important to have a needle that is short enough to just reach the SQ tissue.

**Note:** Injection at the correct angle is important. The usual rule is a 45° angle for a 5/8 in. needle. Always check your local SOP.

SQ injections are usually given in the rear lateral aspect of the upper arm, halfway between the shoulder and the elbow and one-third of the way around laterally (see Figure 5-11). Medication volume should not exceed 0.5 mL. Take care not to inject the medication too close to the skin's surface because doing so may cause faster absorption and onset of action of the medication, possibly causing local irritation. Tell the patient where you will be giving the injection and position them sitting or standing, with the area completely exposed, muscle relaxed, and arm at the side.

The **vastus lateralis** is another appropriate site for an SQ injection (Figure 5-12). This injection site extends from the middle of the anterior thigh to the middle of

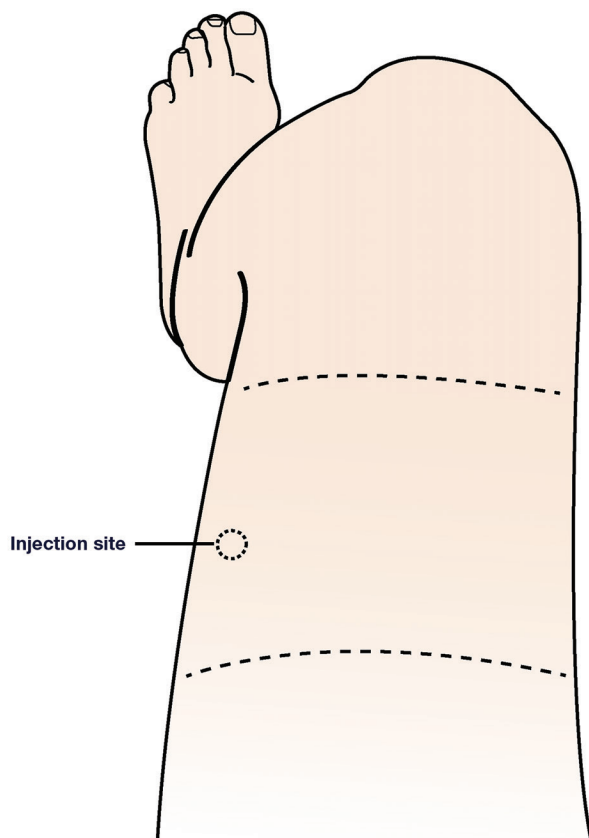


**Figure 5-12.** The vastus lateralis injection site, appropriate for subcutaneous and intramuscular injections.

the lateral thigh, and from one hand's width below the hip joint to one hand's width above the knee. Medication volume at this site should not exceed 2 mL. Tell the patient where you will be administering the injection and position them lying face up or seated.

SQ injections of medications such as insulin and heparin can be administered in the abdomen. Tell the patient where you will be administering the injection and position them lying face up.

**Note:** The amount of medication given will vary according to the needs of the patient; a physician will prescribe the dosage.

**Caution:** Seated or lying positions are preferred for injections. Although it is permissible to use a standing position, some patients (even young, healthy soldiers), may experience a vasovagal response to an injection. A **vasovagal** response can lead to dizziness or syncope (loss of consciousness).

**Note:** Do not administer an injection within 2 in. of a scar, a bruise, or the umbilicus. Do not aspirate to check for blood return because this can cause bleeding into the tissues at the site. Do not rub or massage the site after injection. Rubbing can cause localized small hemorrhages or bruising.

### Preparing and Administering Subcutaneous Injections

Use the items listed below for administering an SQ injection:

- blue chux pad
- 3 to 5 mL syringe—appropriate size for type of medication
- 18 G or blunt needle used for drawing the medication
- 25 G or 27 G needle, 5/8 to 1/2 in.
- two alcohol prep pads
- 2 × 2 gauze pad

Use the following steps for administering an SQ injection:

1. After receiving the MO's order to administer a drug as an SQ injection, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights. Verifying the 6 Rights ensures that the combat medic has the correct:
  - a. patient—confirm the patient's identity using two patient identifiers IAW your local MTF SOP—usually by asking them to state their name and DOB,
  - b. medication,
  - c. dosage,
  - d. route,
  - e. time, and
  - f. documentation.

**Caution:** If a female patient believes there is a chance she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the injection without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. If there is a known allergy, do not administer the medication; contact your supervisor or the prescribing MO.



2. Don PPE and perform a patient care hand wash. The minimum PPE for SQ injection is exam gloves and eye protection.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (eg, refrigerated).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Ensure that all items are properly packaged and sealed, not damaged, and not expired.
    - i. Examine the medication container. If it is a multi-dose vial that has been opened, check the rubber stopper for defects, such as small holes or torn plugs.

**Note:** If the vial being used is not a multi-dose vial, the protective cap should be in place and not removed. If the protective cap has been removed, discard the vial and select a new vial from the medication storage area.

- ii. Check the date the multi-dose vial was opened and check the expiration date of the medication. Multi-dose vials should have the following information written on the label once opened—time, date, and initials detailing first use. Multi-dose vials are good for 28 days from the date of first use unless the manufacturer specifies otherwise
- iii. If possible, check the medication for floating particles and changes in color and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, this check must be done when drawing up the medication into the syringe.

- iv. If there is any evidence of medicine or package contamination or damage, or if the vial is outdated, discard the product into the sharps container and obtain another.
- c. Open the packaging on the needle and syringe. If the needle and syringe are packaged separately, open both and attach the needle to the syringe.
- d. Open the alcohol prep pad.
4. Remove the cap from the medication and cleanse the vial with alcohol prep pad.
5. Remove the cap from the needle safely by pulling it straight off without bending or touching the needle.
6. Pull back on the plunger of the syringe to draw in air for injection into the vial.
  - a. The amount of air to draw up equals the amount of fluid to be administered.
  - b. Follow the directions on the medication vial, if provided.
  - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check.
7. Insert the 18 G (or blunt) needle into the medication vial on the table.
  - a. Place the medication vial upright on a table. Insert the 18 G (or blunt) needled syringe through the rubber stopper, ensuring the needle tip passes completely through and that the hub of the needle does not touch the rubber stopper.
  - b. Pick up the syringe and vial and turn them upside down.
  - c. Elevate the syringe and vial to eye level.
8. Push the plunger forward to inject air from the syringe into the vial. The amount of air injected should equal the amount of fluid that must be withdrawn.
9. Withdraw the prescribed amount of medication from the vial. Pull back on the plunger to the desired milliliter mark, withdrawing the correct amount of medication.

10. Remove the 18 G (or blunt) needle and recap the needle using the scoop method. Replace the 18 G (or blunt) needle with the administration needle.
  - a. Withdraw the plunger slightly to remove any medication in the 18 G (or blunt) needle.
  - b. Discard the needle used to withdraw the medication into the sharps container.
  - c. Connect the administration needle (23 G) to a medicine-filled syringe and slightly push on the plunger to fill the administration needle with medication.
  - d. Perform a final check prior to administration. Ensure that the medication and concentration (if applicable) match the MO's order. This is the third and final check prior to administration.
11. Ensure that the proposed injection site (lateral aspect of the upper arm or the vastus lateralis of the anterior thigh) is completely exposed and the muscle is relaxed. Have the patient sit in a manner that will allow easy access to either injection site. Remember that sitting is the preferred position.
12. Identify the injection site—lateral aspect of the upper arm (halfway between the shoulder and the elbow and one-third of the way around laterally) or the vastus lateralis of the anterior thigh.
  - a. Ensure that the injection site is free of hair, tattoos, and scars.
  - b. If the patient requires SQ injections routinely, always rotate the injection sites, which will prevent injury to the subcutaneous tissue due to multiple SQ injections at the same site.
13. Clean the injection site with an alcohol prep pad.
  - a. Clean in a spiral motion outward 3 in. from the injection site.
  - b. Allow the skin to dry completely before administering the injection.
14. Remove the cap from the needle safely by pulling it straight off without bending or touching the needle.
15. Using your nondominant hand, reach over the top of the site, placing the index finger and thumb on each side of the injection location. Squeeze the fingers and thumb together, slightly pinching the skin. This technique will elevate the subcutaneous tissue, forming a 1 in. (2.5 cm) fat fold.
16. Advise the patient of the stick, then insert the needle, in an upward motion at a 45° angle.
  - a. With your dominant hand, position the syringe 1/2 in. from the skin surface with the needle bevel up at a 45° angle to the skin surface.
  - b. Plunge the needle firmly and quickly through the skin and into the subcutaneous tissue.
  - c. Using a slow, continuous movement, completely depress the plunger and inject the medication.

**Caution:** Do not administer the injection if an air bubble is in the syringe. Syringes are calibrated to administer the correct dose of medication, which will be altered if an air bubble exists.

- d. Place either an alcohol pad or sterile gauze pad lightly over the injection site and withdraw the needle at the same angle in which it was inserted.
- e. Discard the used needle into a sharps container.

**Warning:** Never attempt to recap a dirty needle.

17. Rub the area in a circular motion using the 2 × 2 gauze to disperse the medication into the tissue.
  - a. Ensure that this is not contraindicated for the type of medication injected.
  - b. Remove the gauze and check the injection site for bleeding or bruising.
  - c. Place an adhesive bandage over the site.
18. Monitor the patient for 20 minutes; watch for signs and symptoms of a developing allergic reaction. Document the injection in the patient's medical record. On the appropriate forms, record the date, time the injection was given, amount of medication given, site of administration, patient's response to injection, and any adverse reactions to the injection.

**Warning:** Have an emergency tray available for the immediate treatment of serious reactions. Include a syringe containing a 1:1,000 solution of epinephrine.

### Check on Learning

17. When should SQ injections be used rather than ID or IM injections?
18. What are possible sites for SQ injections?
19. At what angle should the needle be inserted for SQ injections?
20. Into what type of tissue is the medication being delivered in SQ injections?

### Intramuscular Injections

IM injections (Figure 5-13) are used when rapid absorption rate (10–20 min) and long duration (hours to weeks) are desired. They are preferred when administering viscous or irritating medications and when a large volume of medication is needed for a stronger effect.

**Caution:** Because absorption of medications administered by the IM route relies on adequate blood flow to the muscles, IM injections should not be used in individuals with poor circulation or symptoms of shock.



**Figure 5-13.** A combat medic administering an intramuscular injection.

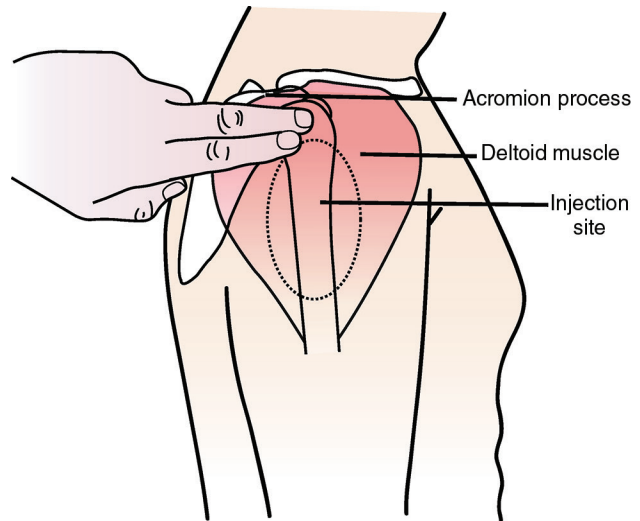


**Figure 5-14.** The deltoid intramuscular injection site.

For IM injections, choose a needle that is no less than 1 in. long for an adult (unless the patient is thin, in which case you may use a smaller size). For obese patients, needles up to 2 in. may be needed. Selecting a needle long enough to reach the muscle is essential; using a needle that is too short will cause the medication to be injected into SQ tissue, potentially reducing absorption and effectiveness. Needle bore diameter should range from 20 to 22 G. The exact length and gauge selected will vary depending on the patient's amount of muscle mass, age, size, and overall condition.

Primary IM injection sites include the deltoid, vastus lateralis, **ventrogluteal**, and **dorsogluteal** muscles. The deltoid muscle, located in the outer one-third of the arm between the shoulder bone (acromion process) and axilla, is used for medication volumes from 0.5 to 1 mL in adults and allows for faster absorption than other IM sites. The injection site is approximately two or three finger widths below the shoulder bone, in the middle of the deltoid muscle mass (Figure 5-14). When administering the injection, position the patient standing or sitting with the area completely exposed, muscle relaxed, and the arm at the side.

The safest site to perform an IM injection is the vastus lateralis. This site is the muscle mass located on the lateral thigh, extending from the middle of the anterior thigh to the middle of the lateral thigh, and from one hand's width below the hip joint to one hand's width above the knee (see Figure 5-12). This site is considered the safest because there are no major nerves or blood vessels. An injection up to 5 mL of fluid can be



given at this site. This IM injection site may be more painful than the other sites due to a larger number of small nerve endings located there. Although it is permissible to use a standing position for injections, seated or lying positions may be preferable to avoid a vasovagal response.

The ventrogluteal site is used for larger medication volumes (up to 5 mL) and may require a long needle (2 in. or longer in large adults). The ventrogluteal site is preferred for IM injections in anyone over the age of 7 months. This site provides the greatest thickness of gluteal muscle, does not have nerves and blood vessels, and has the most consistent and thinnest layer of adipose tissue. Because of these characteristics, injuries from IM injections at the ventrogluteal site are rare. An injection given in an area outside this site could cause damage to the sciatic nerve or puncture the superior gluteal artery, causing either paralysis or severe bleeding.

When administering an IM injection, position the patient in a ventrogluteal position. The patient can be placed in the prone position with the toes pointing inward. This will help relax the gluteal muscle. Another form of the ventrogluteal position is to have the patient lying on their side and flexing the upper legs.

Identify the ventrogluteal area by placing the patient in the prone or side position. If identifying an injection site on the patient's right hip, use your left hand. If identifying the injection site on the patient's left hip, use your right hand. With the heel of your hand on the lateral portion of the greater trochanter of the patient's hip, point your thumb toward the patient's groin. Point your index finger toward the anterior iliac spine, and extend your middle finger along the iliac crest (toward the buttocks as far as possible). This hand position will create a V shape with the index and middle fingers. The injection site is directly in the middle of the V shape (Figure 5-15).

### Preparing and Administering Intramuscular Injections

Use the items listed below for administering an IM injection:

- blue chux pad
- 3 to 5 mL syringe—appropriate size for type of medication
- 18 G or blunt needle
- 20 to 22 G needle, 1 1/2 to 2 in.
- two alcohol prep pads
- 2 × 2 gauze pad

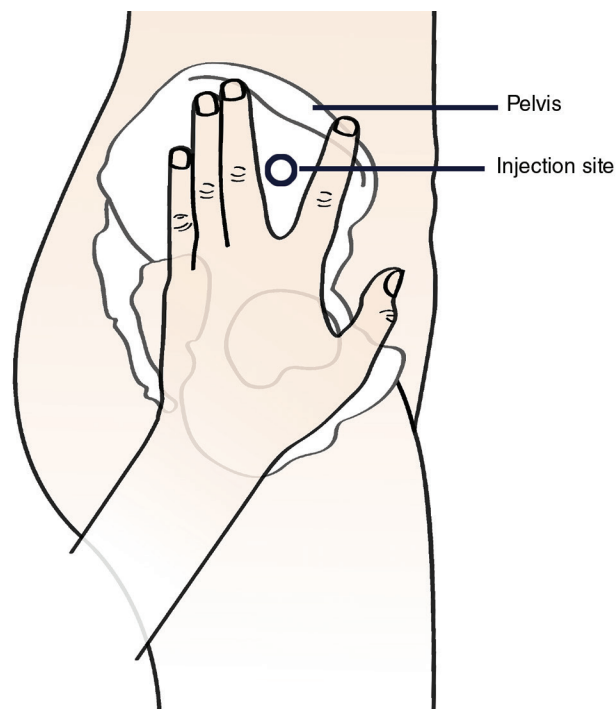


**Figure 5-15.** The ventrogluteal intramuscular injection site.

Use the following steps for administering an IM injection:

1. After receiving the MO's order to administer a drug as an IM injection, ask the patient if they have known allergies, ask female patients if they could be pregnant (some medications can harm the fetus), and verify the 6 Rights. Verifying the 6 Rights ensures that the combat medic has the correct:
  - a. patient—confirm the patient's identity using two patient identifiers IAW your local MTF SOP—usually by asking them to state their name and DOB,
  - b. medication,
  - c. dosage,
  - d. route,
  - e. time, and
  - f. documentation.

**Caution:** If a female patient believes there is a chance she could be pregnant, contact your supervisor or the prescribing MO. Do not administer the injection without written authorization.

**Caution:** Always check allergies before administering any medication. Have the patient describe the reactions in their own words. If there is a known allergy, do not administer the medication; contact your supervisor or the prescribing MO.

2. Don PPE and perform a patient care hand wash. The minimum PPE for IM injection is exam gloves and eye protection.
3. Check and assemble equipment.
  - a. Select the correct medication from the storage area.
    - i. Conduct the first verification by ensuring that the medication and concentration (if applicable) are exactly what was ordered by the MO.
    - ii. Verify that the medication was properly stored (eg, refrigerated).
    - iii. Premixed medications may have to be shaken or rolled in your hands to ensure that the medication is resuspended in the solution; always check the medication label for instructions.
  - b. Obtain the required equipment.
  - c. Ensure that the packaging of all items is properly sealed, not damaged, and not expired.
    - i. Examine the medication container. If it is a multi-dose vial that has been opened, check the rubber stopper for defects, such as small holes or torn plugs.

**Note:** If the vial being used is not a multi-dose vial, the protective cap should be in place and not removed. If the protective cap has been removed, discard the vial and select a new vial from the medication storage area.

- ii. Check the date the multi-dose vial was opened and check the expiration date of the medication. Multi-dose vials should have the following information written on the label once opened—time, date, and initials detailing first use. Multi-dose vials are good for 28 days from the date of first use unless the manufacturer specifies otherwise.

- iii. If there is any evidence of medicine or package contamination or damage, or if the vial is outdated, discard the product into a sharps container and obtain a new vial.
  - d. If possible, check the medication for floating particles and changes in color and consistency by holding the vial up to light. If it is a dark, light-obscuring vial, this check must be done when drawing up the medication into the syringe.
  - e. Open the packaging on the needle and syringe. If the needle and syringe are packaged separately, open both and attach the needle to the syringe.
  - f. Open the alcohol prep pad.
4. Remove the cap from the medication vial and cleanse with the alcohol prep pad.
  5. Remove the protective cap from the needle safely by pulling it straight off without bending or touching the needle.
  6. Pull back on the plunger of the syringe to draw in air for injection into the vial.
    - a. The amount of air to draw up equals the amount of fluid to be administered.
    - b. Follow the directions on the medication vial, if provided.
    - c. Recheck to ensure that the medication being drawn up into the syringe is the correct medication and concentration (if applicable) ordered by the MO. This is the second check for accuracy.
  7. Insert the 18 G (or blunt) needle into the medication vial on the table.
    - a. Place the medication vial upright on a table. Insert the 18 G (or blunt) needled syringe through the rubber stopper, ensuring the needle tip passes completely through and that the hub of the needle does not touch the rubber stopper.
    - b. Pick up the syringe and vial and turn them upside down.
    - c. Elevate the syringe and vial to eye level.
  8. Push the plunger forward to inject air from the syringe into the vial.

9. Withdraw the prescribed amount of medication from the vial. Pull back on the plunger to the desired milliliter mark, withdrawing the correct amount of medication.
10. Remove the 18 G (or blunt) needle and recap the needle using the scoop method. Replace the 18 G (or blunt) needle with the administration needle.
  - a. Withdraw the plunger slightly to remove any medication in the 18 G (or blunt) needle.
  - b. Discard the needle used to withdraw the medication into a sharps container.
  - c. Connect the administration needle (23 G) to the medicine-filled syringe and slightly push on the plunger to fill the administration needle with medication.
  - d. Perform a final recheck prior to administration. Ensure that the medication and concentration (if applicable) matches the MO's order. This is the third and final check prior to administration.
11. Ensure that the proposed injection area (deltoid, ventrogluteal, or the vastus lateralis) is completely exposed and the muscle relaxed.
  - a. Remove all clothing at the injection site.
  - b. Place the patient in the proper position to receive the specific type of IM injection.
    - i. For an IM injection into the deltoid muscle, the patient can either stand or sit.
    - ii. For an IM injection into the vastus lateralis muscle, the patient should sit or lie in the supine position.
    - iii. For an IM injection into the ventrogluteal muscles, the patient should lie straight on their side.
12. Identify the injection site.
  - a. Deltoid muscle IM injection site (see Figure 5-14):
    - i. Locate the acromion process located on the lateral, superior aspect of the shoulder.
    - ii. Place two or three fingers below the acromion process and in the middle of the deltoid muscle mass.
  - b. Vastus lateralis IM injection site (see Figure 5-12):
    - i. Locate the anterior thigh and place one hand just below the hip to identify one hand's width below the hip (this identifies the superior landmark border). Place one hand above the knee to identify one hand's width above the knee (this identifies the inferior landmark border).
    - ii. After locating the superior and inferior landmarks, draw an imaginary vertical line down the center of the anterior thigh, and an imaginary vertical line down the center of the lateral thigh.
    - iii. The space between the superior and inferior landmarks, as well as between the anterior and lateral vertical lines, indicates the vastus lateralis IM injection site.
  - c. Ventrogluteal IM injection site (see Figure 5-15):
    - i. If providing an IM injection into the patient's right hip, identify the injection site with your left hand. If providing an IM injection into the patient's left hip, identify the injection site with your right hand.
    - ii. Identify the greater trochanter of the hip, and place the heel of your opposite hand on the lateral portion of the greater trochanter with your fingers pointing toward the patient's head.
    - iii. Your middle finger should point directly vertical along the lateral midline of the patient.
    - iv. Spread your index finger from the middle finger toward the patient's anterior iliac spine and spread your thumb from your index finger toward the patient's groin. The V shape formed between your middle and index finger identifies the IM injection site (directly in the middle of the V).
13. Clean the injection site with an alcohol prep pad in a spiral motion outward 3 in.



14. Remove the cap from the needle safely. Pull the needle cover straight off without bending or touching the needle.
15. Using your nondominant hand, stabilize the site.
  - a. If providing an IM injection into the deltoid muscle or vastus lateralis, take your nondominant hand and reach over the top of the site with your index finger and thumb on each side of the injection location. Squeeze your thumb and index finger together, slightly pinching the skin and underlying muscle.
  - b. If providing an IM injection into the ventrogluteal site, use your non-dominant hand to identify proper landmarks before inserting the needle.
16. Advise the patient of the stick, then insert the needle at a 90° angle.
  - a. Hold the syringe in your dominant hand between your thumb and index finger, and position the needle bevel up, at a 90° angle to the skin surface and about 1/2 in. from the skin's surface.
  - b. Plunge the needle firmly and quickly into the muscle.

**Note:** Always encourage the patient to relax the muscle you will be injecting because injections into tense muscles are more painful and may bleed more readily.

**Caution:** Do not administer the injection if an air bubble is in the syringe. Syringes are calibrated to administer the correct dose of medication, which will be altered if an air bubble exists.

17. Using your nondominant hand, grasp the plunger and slowly aspirate. Look for blood in the syringe. Release your hold on the skin with the nondominant hand and use it to support the syringe while you aspirate by pulling back slightly on the plunger of the syringe with your dominant hand.
18. If there is no blood in the syringe, inject the medication, remove the needle-syringe, hold pressure, and discard the needle and syringe into a sharps container.

**Warning:** The presence of blood indicates that you have entered a blood vessel. If blood is present, remove the needle, hold pressure on the injection site, discard the needle and syringe into a sharps container, and identify a new injection site.

**Warning:** Never inject medication into a sensitive muscle, especially a muscle that may be twitching or trembling when assessed. An injection into a sensitive, twitching muscle may cause sharp or referred pain; such as the pain caused by nerve trauma.

- a. Using a slow, continuous movement, completely depress the plunger and inject the medication.
- b. Place either an alcohol pad or sterile gauze pad lightly over the injection site and withdraw the needle at the same angle in which it was inserted.
- c. Discard the used needle into a sharps container.

**Warning:** Never attempt to recap a dirty needle.

19. Rub the area in a circular motion using the 2 × 2 gauze to disperse the medication into the tissue.
  - a. Ensure that this is not contraindicated for the type of medication injected.
  - b. Remove the gauze and check the injection site for bleeding or bruising.
  - c. Place an adhesive bandage over the site.
20. Monitor the patient for 20 minutes; watch for signs and symptoms of a developing allergic reaction. Document the injection in the patient's medical record. On the appropriate forms, record the date, time the injection was given, amount of medication given, site of administration, patient's response to injection, and any adverse reactions to the injection.

**Warning:** Have an emergency tray available for the immediate treatment of serious reactions. Include a syringe containing a 1:1,000 solution of epinephrine.

## Check on Learning

21. When administering an IM injection, should you aspirate? Why or why not?
22. At what angle should the needle be inserted for IM injections?
23. When should IM injections be used rather than SQ or ID injections?
24. What are the preferred IM injection sites?

## ALLERGIC REACTIONS

Allergic reactions (Figure 5-16), including anaphylaxis (the most extreme form of an allergic reaction), are always possible when administering an injection to a patient. Patients who suffer an anaphylactic allergic reaction are experiencing a life-threatening event that if untreated may quickly lead to death. Definitive signs of anaphylaxis are **stridor**, **bronchospasms**, and **hypotension**. Symptoms of an allergic reaction may begin within seconds or up to one hour; however, typical allergic reactions begin within minutes of exposure and may affect the skin, cardiovascular, and respiratory systems.



**Figure 5-16.** A patient displaying urticaria, an allergic reaction. Photograph by James Heilman, MD. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:EMminor2010.JPG>

## Standard Approach to Anaphylactic Treatment

When treating a patient experiencing anaphylaxis, perform or provide the following:

- A primary assessment addressing all immediate life threats.
- High-flow oxygen (15 L/min) via a non-rebreather (NRB) or bag valve mask (if the patient requires manual ventilation).
- Baseline vital signs (blood pressure, pulse, and respirations).
- Albuterol at 2.5 mg nebulized for minor dyspnea or wheezing.
- Cardiac monitoring if capable.
- If systolic blood pressure is greater than 90 mmHg, establish an IV with normal saline at “to keep open” (TKO).

**Note:** If systolic blood pressure is lower than 90 mmHg, administer a 10 to 20 mL/kg fluid bolus to maintain a systolic blood pressure greater than 90 mmHg.

**Note:** Patients suffering true anaphylaxis rarely present with normal blood pressure.

- Diphenhydramine. For adults with moderate allergic reactions, administer 25 mg IM or IV push. For adults with severe allergic reactions or anaphylaxis, administer 50 mg IM or IV push.
- Epinephrine. For adults with respiratory distress indicators (eg, wheezing or stridor), administer an adult dose of epinephrine or 0.3 mg (1:1,000 concentration) SQ or IM.

**Note:** If treating a pediatric patient, consult the MO for dosages.

**Note:** For patients suffering severe allergic reactions, subcutaneous injections are absorbed very slowly and may not provide the needed medication fast enough to help the patient. Slow absorption is made worse when the patient is hypotensive. These patients should have medication administered via intramuscular injection.

## Check on Learning

25. What are definitive signs of anaphylaxis?
26. Symptoms of an allergic reaction may begin within (time) \_\_\_\_\_ or up to \_\_\_\_\_.
27. What concentration of epinephrine is used to treat a patient suffering from anaphylaxis, through SQ or IM injection?
28. What is the dose of epinephrine to administer through SQ or IM injection to a patient suffering from anaphylaxis?
29. What is the dose of diphenhydramine to administer to a patient suffering from anaphylaxis?

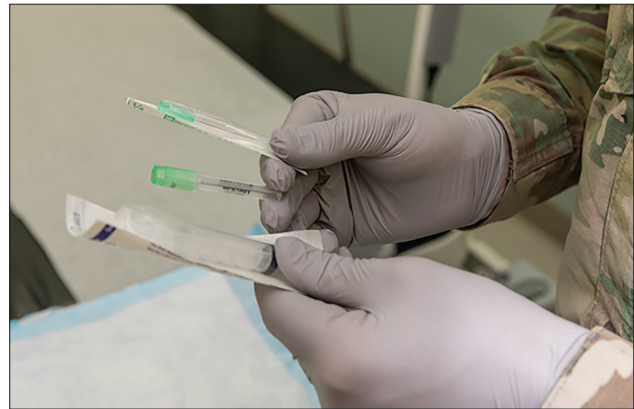
## SUMMARY

The ability to provide an injection is a basic skill for a combat medic. Proficiency in performing injections is paramount to ensuring that medication is provided properly and no harm is caused. Because significant harm can be caused by improper technique, standardization in preparation and administration is critical for patient protection. Proper selection of equipment, proper preparation of the patient, sterile technique during administration, proper disposal of contaminated equipment, and proper documentation will minimize risk of injury to both patients and combat medics.

## ASSEMBLING THE NEEDLE AND SYRINGE



STEP 1: Don PPE.



STEP 2: Select and inspect equipment. Ensure that all packaging is properly sealed, not damaged, and not expired.



STEP 3: Unpack the syringe. Peel the sides of the wrapper and expose the rear end of the syringe.



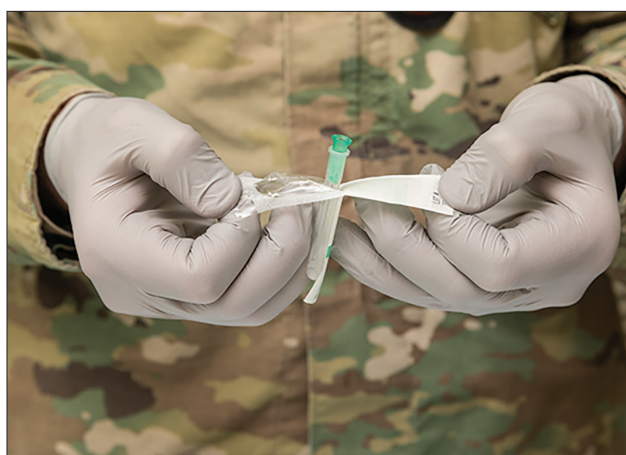
STEP 4a: Inspect the syringe. Pull on the plunger and feel for the distinct "pop."



## ASSEMBLING THE NEEDLE AND SYRINGE, CONT.



STEP 4b: Grasp the flared end of the syringe and move the plunger back and forth to test for smooth, easy movement. Visually check the rubber stopper (inside the syringe) to ensure that it is attached securely to the top end of the plunger, forming a seal.



STEP 5a: Unpack the needle. Peel the sides of the flexible wrapper apart to expose the needle hub.



STEP 5b: If it is packaged in a hard plastic tube, twist the cap of the tube until a "pop" is felt and remove the cap to expose the needle hub.



STEP 6: To assemble the needle and syringe, first join them together by inserting the needle adapter of the syringe into the hub of the needle. Tighten the needle by turning it 1/4 of a turn to ensure that it is securely attached.



STEP 7: Place the assembled needle and syringe on the work surface, leaving the protective cover on the needle. Leave the plunger pushed fully into the barrel. Keep the assembled needle and syringe within sight.

## RECAPPING THE NEEDLE



STEP 1: Prepare to slide the needle into the cap by placing the cap on a hard, cleared surface.



STEP 2: Insert the needle into the open end of the cap and lift the cap up, causing it to slide onto the needle.



STEP 3: Cover the needle with the cap, ensuring that the cap is secured to the needle hub.



## DRAWING AND ADMINISTERING MEDICATION FROM A VIAL



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the proper medication. Ensure that all packaging is properly sealed, not damaged, and not expired.



STEP 3b: Examine the vial. Inspect and ensure that the medication is not discolored and does not contain floating particles.



STEP 4a: Remove the cap from the medication.



STEP 4b: Clean the rubber stopper with an alcohol prep pad.



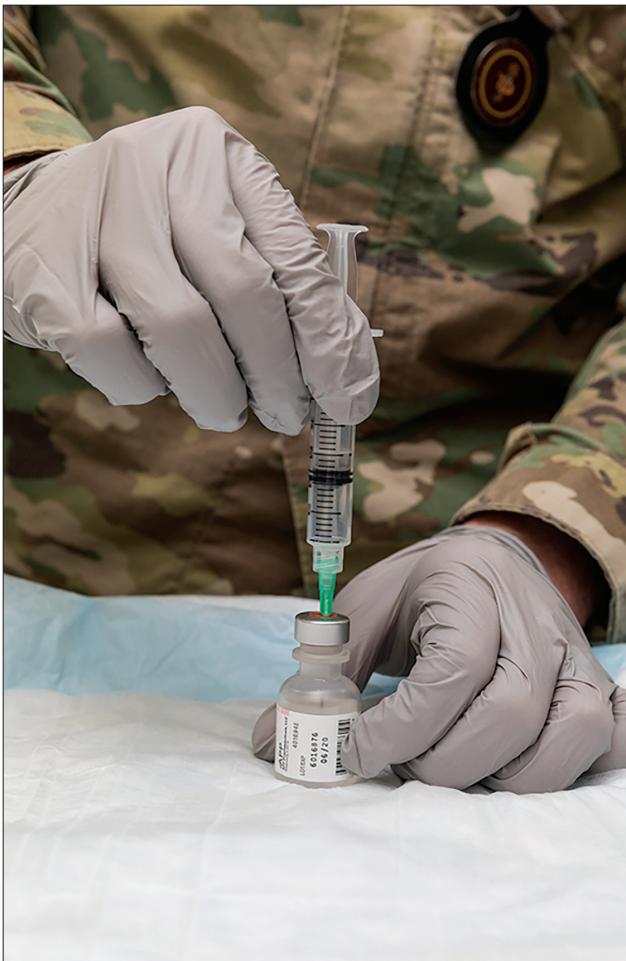
## DRAWING AND ADMINISTERING MEDICATION FROM A VIAL, CONT.



STEP 5: Remove the cap from the needle safely.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe. Follow the directions on the vial, if provided.



STEP 7: Insert the needle into the medication vial on the table, pick up the needle and vial, and turn them upside down. Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward so air is pushed into the vial (see directions on insert of medication).



STEP 9: Withdraw the prescribed amount of medication from the vial.

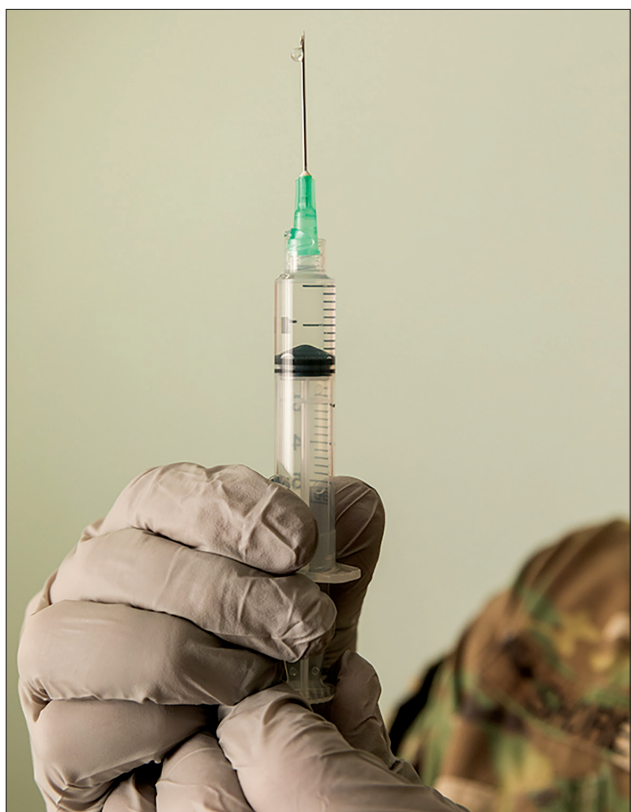
## DRAWING AND ADMINISTERING MEDICATION FROM A VIAL, CONT.



STEP 10: Remove the needle from the vial and recap it using the scoop method.



STEP 11a: Detach the 18 G needle and discard it into a sharps container. Attach the administration needle.



STEP 11b: Slowly advance the plunger of the syringe to expel the air bubble from the new administration needle prior to injecting the medication.



STEP 11c: Administer the injection.



STEP 12: Discard both the needle and the attached syringe; place them into a sharps container.



## RECONSTITUTING MEDICATION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant.



STEP 2: Don PPE.



STEP 3a: Check and assemble equipment. Select the proper medication from the storage area. Ensure that all packaging is properly sealed, not damaged, and not expired.



STEP 3b: Open the packaging on both the needle-syringe units and connect the hubs of the needles to the needle adapters on the syringes.



STEP 4a: Remove the caps from the diluent and medication vials.



STEP 4b: Cleanse both vials with alcohol prep pads.



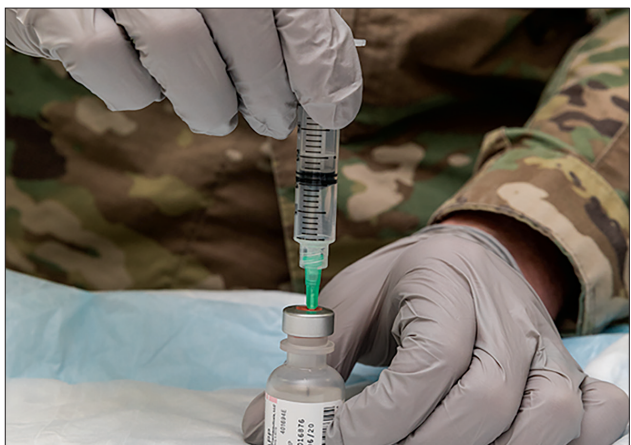
## RECONSTITUTING MEDICATION, CONT.



STEP 5: Remove the protective cap from the 18 G needle-syringe unit safely.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe. Follow the directions on the vial, if provided.



STEP 7a: Insert the 18 G (or blunt) needle into the diluent vial on the table.



STEP 7b: Pick up the syringe and vial and turn them upside down. Elevate the syringe and vial to eye level.

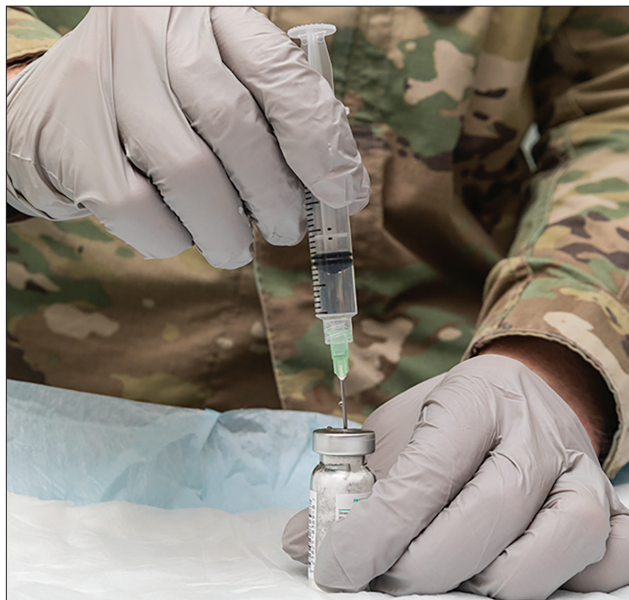


STEP 8: Push the plunger forward so air is pushed into the diluent vial.



STEP 9: Pull back on the plunger, drawing up the correct amount of diluent from the vial.

## RECONSTITUTING MEDICATION, CONT.



STEP 10: Withdraw the needle from the diluent vial and insert it into the medication vial on the table.



STEP 11: Inject the diluent into the medication vial.



STEP 12: Withdraw the needle and syringe from the medication vial and discard it into a sharps container.



STEP 13: Mix the medication well.



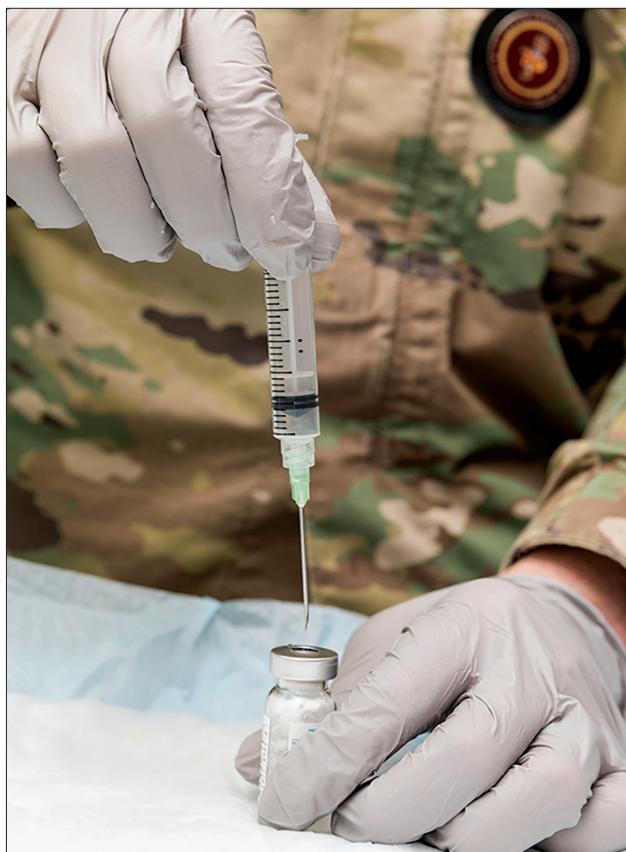
## RECONSTITUTING MEDICATION, CONT.



STEP 14a: Safely remove the protective cap from the unused needle-syringe unit.



STEP 14c: Pick up the syringe and medication vial and turn them upside down. Elevate them to eye level. Pull back on the plunger and draw up the correct amount of medication from the vial.



STEP 14b: Place the medication vial on the table and insert the unused needle-syringe unit into vial.



STEP 14d: Verify the correct dosage.



## DRAWING MEDICATION FROM AN AMPULE



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant.



STEP 2: Don PPE.



STEP 3: Check and assemble equipment. Select the correct medication from the storage area. Ensure that all packaging is properly sealed, not damaged, and not expired. Inspect and ensure that the medication is not discolored and does not contain floating particles.



STEP 4: Cleanse the neck of the ampule with an alcohol prep pad.



STEP 5: Using your nondominant hand, pick up the ampule. With your dominant hand, place the 2 × 2 gauze pad on the ampule, covering the neck and break line.



STEP 6: Break the neck of the ampule away from your body.

## DRAWING MEDICATION FROM AN AMPULE, CONT.



STEP 7: Inspect the ampule for glass particles.



STEP 8: Using a syringe with an attached filter needle, withdraw the prescribed amount of medication from the ampule.



STEP 9: Remove the filter needle from the syringe and place it into a sharps container.



STEP 10: Attach the appropriate size administration needle to the syringe and administer the medication properly.



STEP 11: Directly after medication administration, discard the needle and attached syringe into a sharps container.



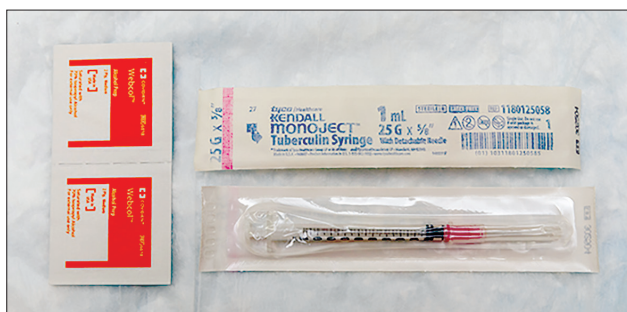
## INTRADERMAL INJECTION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant.



STEP 2: Don PPE.



STEP 3: Check and assemble equipment. Select the correct medication from the storage area. Ensure that all packaging is properly sealed, not damaged, and not expired. Inspect and ensure that the medication is not discolored and does not contain floating particles.



STEP 4: Remove the cap from the medication and cleanse the vial with an alcohol prep pad.



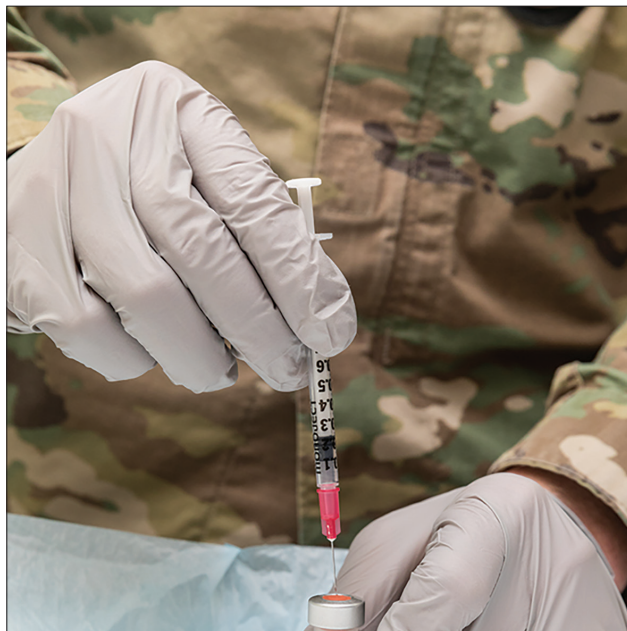
STEP 5: Remove the cap from the needle safely.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air in the syringe.



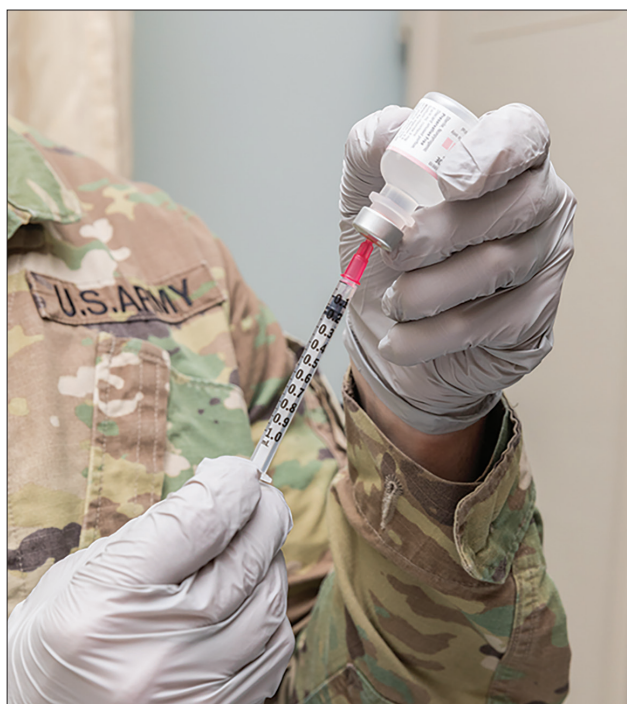
## INTRADERMAL INJECTION, CONT.



STEP 7a: Insert the needle into the vial on the table, pick up the syringe and vial, and turn them upside down.



STEP 7b: Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward so air is pushed into the vial.



STEP 9: Withdraw the prescribed amount of medication from the vial by pulling back on the plunger to the desired milliliter mark.

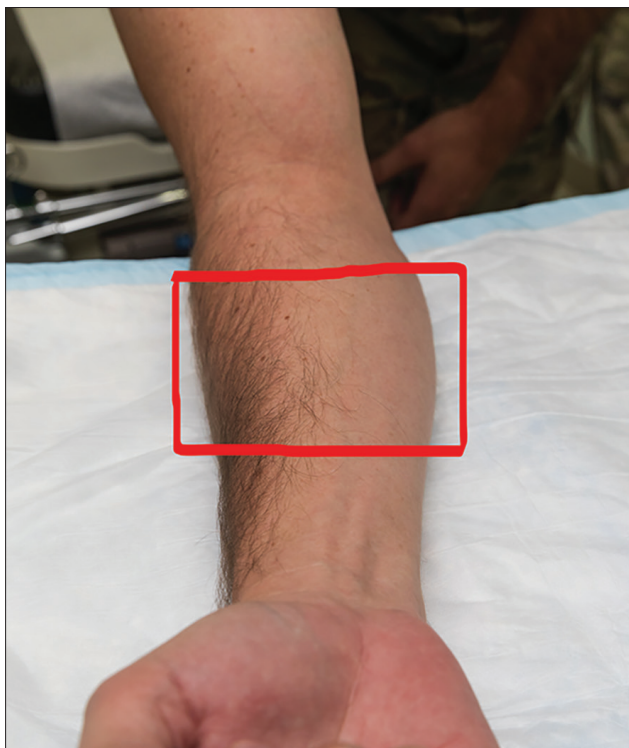
## INTRADERMAL INJECTION, CONT.



STEP 10: Remove the needle and recap it using the scoop method. Replace the 18 G (or blunt) needle with the administration needle.



STEP 11: Ensure the proposed injection area (forearm) is completely exposed with the muscle relaxed.



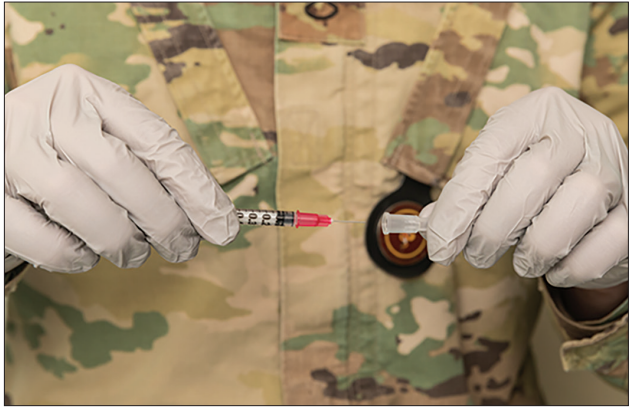
STEP 12: Identify the injection site (anterior mid-forearm). Ensure the site is free of hair, tattoos, and scars.



STEP 13: Clean the injection site with an alcohol prep pad in a spiral motion outward 3 inches.



## INTRADERMAL INJECTION, CONT.



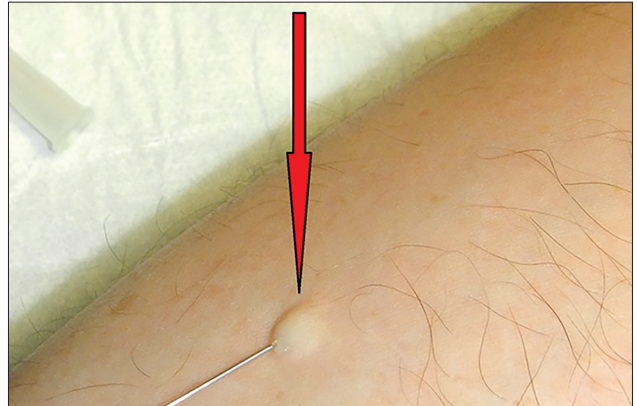
STEP 14: Remove the cap from the needle safely.



STEP 15: Using your nondominant hand, pull the skin taut toward the patient's hand.



STEP 16: Advise the patient of the stick, then insert the needle at a 5°–15° angle. Advance until the bevel is under the skin surface.



STEP 17: Inject the medication, ensuring the presence of a wheal. **Do not aspirate.** Remove the needle-syringe and place it into a sharps container. Do not rub the site.



STEP 18: Monitor the patient for 20 minutes and document the injection in the patient's medical record.



## SUBCUTANEOUS INJECTION



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant.



STEP 2: Don PPE.



STEP 3: Check and assemble equipment. Select the correct medication from the storage area. Ensure that all packaging is properly sealed, not damaged, and not expired. Inspect and ensure that the medication is not discolored and does not contain floating particles.



STEP 4a: Remove the cap from the medication.



STEP 4b: Cleanse the vial with an alcohol prep pad.

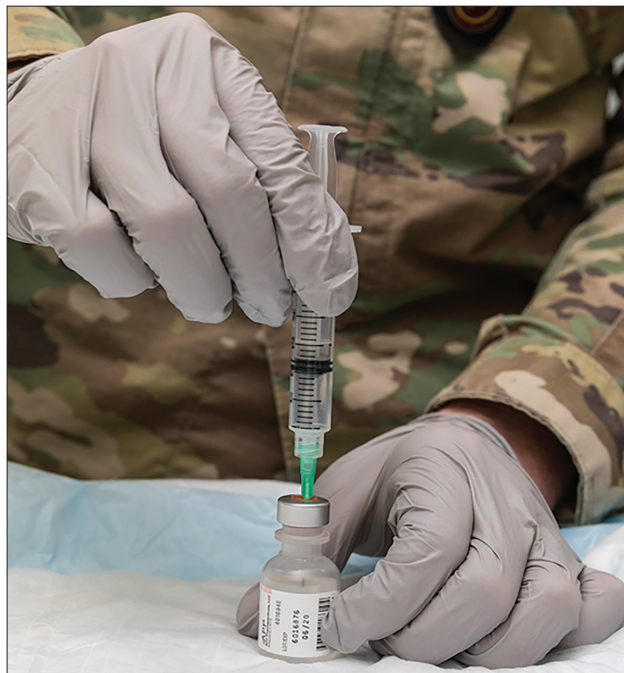


STEP 5: Remove the cap from the needle safely.

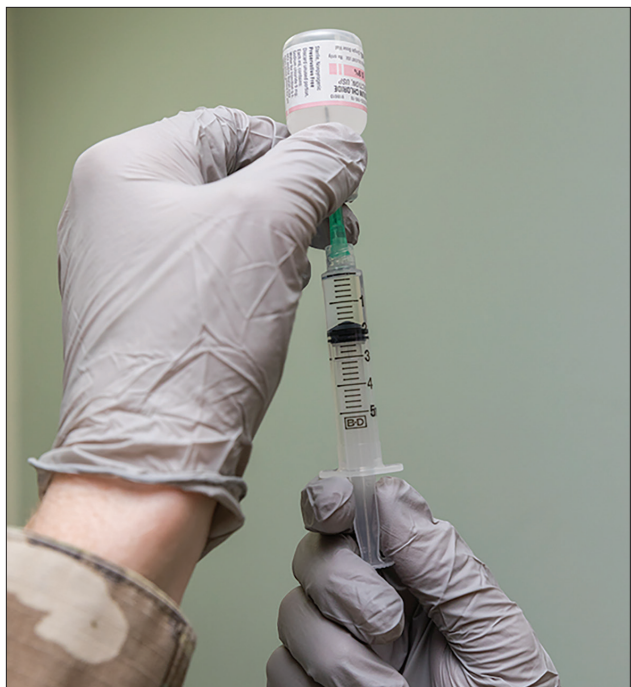
## SUBCUTANEOUS INJECTION, CONT.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air. Follow the directions on the vial, if provided.



STEP 7a: Insert the needle into the vial, pick up the syringe and vial, and turn them upside down.



STEP 7b: Elevate the syringe and vial to eye level.



STEP 8: Push the plunger forward so air is pushed into the vial.



## SUBCUTANEOUS INJECTION, CONT.



STEP 9: Pull back on the plunger, drawing up the correct amount of medication.



STEP 10: Remove the 18 G (or blunt) needle and recap it using the scoop method. Replace the 18 G (or blunt) needle with the administration needle.



STEP 11: Ensure the proposed injection area is completely exposed, with the muscle relaxed.



STEP 12: Identify the injection site (halfway between the shoulder and the elbow, 1/3 of the way around laterally). The vastus lateralis of the anterior thigh is an alternate site.



## SUBCUTANEOUS INJECTION, CONT.



STEP 13: Clean the injection site with an alcohol prep pad in a spiral motion outward 3 inches.



STEP 15: Using your nondominant hand, reach over the top of the site, placing your index finger and thumb on each side of the injection location. Squeeze your fingers together, slightly pinching the skin.



Step 14: Remove the cap from the needle safely.



STEP 16a: Advise the patient of the stick, then insert the needle in an upward motion at a 45° angle.



## SUBCUTANEOUS INJECTION, CONT.



STEP 16b: Inject the medication.



STEP 16c: Remove the needle-syringe and place it into a sharps container.



STEP 17: Rub the area in a circular motion, using the 2 × 2 gauze to disperse the medication into the tissue.



STEP 18: Monitor the patient for 20 minutes and document the injection in the patient's medical record.



## INTRAMUSCULAR INJECTIONS



STEP 1: Verify the 6 Rights. If the patient is female, ask if she could be pregnant.



STEP 2: Don PPE.



STEP 3: Check and assemble equipment. Select the correct medication from the storage area. Ensure that all packaging is properly sealed, not damaged, and not expired. Inspect and ensure that the medication is not discolored and does not contain floating particles.



STEP 4a: Remove the cap from the medication.



STEP 4b: Cleanse the vial with an alcohol prep pad.



STEP 5: Remove the cap from the needle safely.



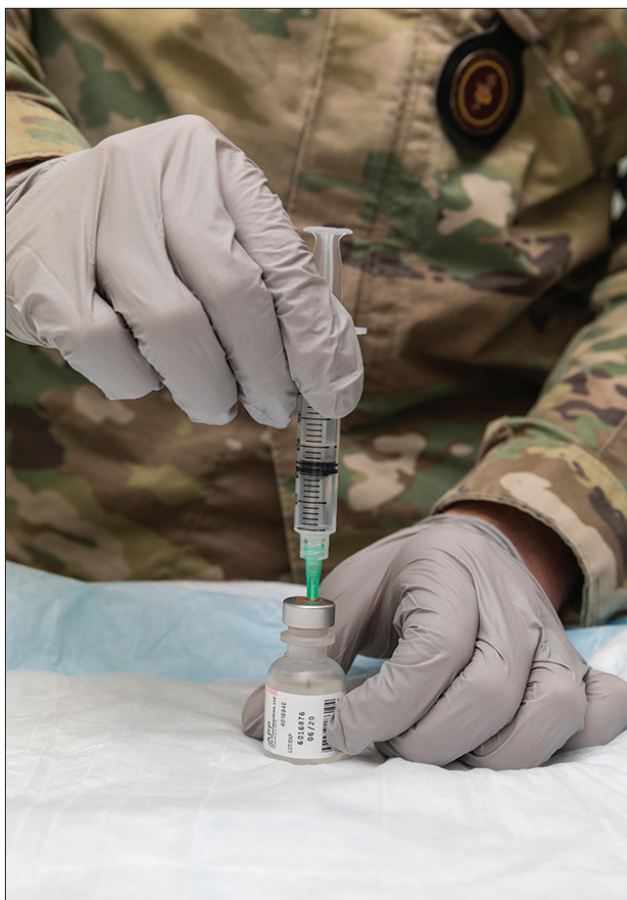
## INTRAMUSCULAR INJECTION, CONT.



STEP 6: Pull back on the plunger of the syringe, drawing up the correct amount of air into the syringe.



STEP 8: Push the plunger forward so air is pushed into the vial.



STEP 7: Insert the 18 G (or blunt) needle into the vial on the table, pick up the needle and vial, and turn them upside down. Elevate the syringe and vial to eye level.



STEP 9: Pull back on the plunger, drawing up the correct amount of medication.



STEP 10: Remove the 18 G (or blunt) needle and recap it using the scoop method. Discard the needle into a sharps container and replace it with the administration needle.

## INTRAMUSCULAR INJECTION, CONT.



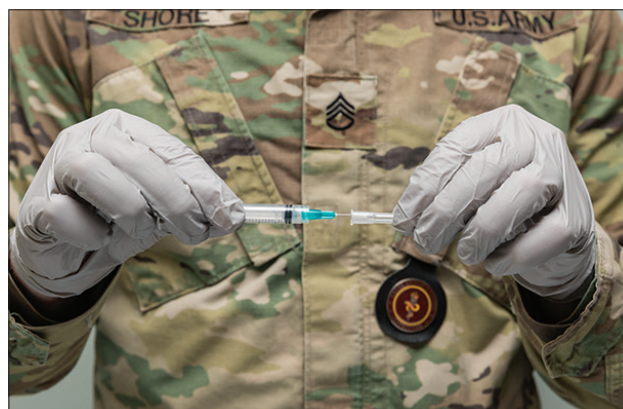
STEP 11: Ensure the proposed injection area is completely exposed, with the muscle relaxed.



STEP 12: Identify the injection site.



STEP 13: Clean the injection site with an alcohol prep pad in a spiral motion outward 3 inches.



STEP 14: Remove the cap from the needle safely.



STEP 15: Using your nondominant hand, reach over the top of the site with your index finger and thumb on each side of the injection location. Squeeze your finger and thumb together, slightly pinching the skin and underlying muscle.



STEP 16: Advise the patient of the stick, then insert the needle at a 90° angle.



## INTRAMUSCULAR INJECTION, CONT.



STEP 17: Using your nondominant hand, grasp the plunger and slowly aspirate, observing for blood in the syringe.



STEP 18: If there is no blood in the syringe, inject the medication, remove the needle-syringe, hold pressure, and discard it into a sharps container.



STEP 19: Rub the area in a circular motion using the 2 × 2 gauze pad to disperse the medication into the tissue.



STEP 20: Monitor the patient for 20 minutes and document the injection in the patient's medical record.



## KEY TERMS AND ACRONYMS

- Ampule.** A small glass container that can be sealed and its contents sterilized. This is a French invention for containing hypodermic solutions; it holds a premeasured, single medication dose.
- Anaphylaxis.** A systemic hypersensitivity reaction to an antigen, which can be life threatening if not treated quickly.
- Aspirate.** To draw in or out by suction.
- Atrophy.** A decrease in size or wasting away of a body part or tissue.
- Bronchospasms.** Contractions of smooth muscles in the airways that line the lungs. This narrows the airways.
- Diluent.** An agent that dilutes the substance or solution when mixed together.
- DOB.** Date of birth.
- Dorsogluteal.** Pertaining to the buttocks; the anatomic area just behind the back of hip.
- Enteral.** Through the gastrointestinal tract.
- G.** Gauge.
- Gauge.** The needle's inner diameter (also known as the bore), through which medication is administered. The gauge is stated using numbers; the larger the number, the smaller the bore or hole of the bevel.
- Hub.** The sterile piece that attaches to the tip of the syringe, also known as the hilt.
- Hypotension.** Abnormally low blood pressure.
- IAW.** In accordance with.
- Injection.** The forcing of a fluid into a vessel, tissue, or cavity.
- Intracutaneous.** Injection into the skin; used in giving serums and vaccines when a local reaction is desired.
- Intradermal.** Intracutaneous, or more specifically, within the dermis (ID); often used for diagnostic testing (skin tests). ID injections are shallow, given just beneath the epidermis. The inner aspect of the forearm is the most common injection site.
- Intramuscular.** Injection into muscle tissue (IM); usually the anterior thigh, deltoid, or buttocks. IM injection is used primarily in the administration of vaccines, immune globulins, corticosteroids, some antibiotics, some hormones, and sedatives.
- MO.** Medical officer.
- MTF.** Military treatment facility.
- Needlestick.** Accidental puncturing of the skin with an unsterilized needle; health care workers are especially at risk for injury while handling needles. Prevention of needlestick injury is essential because of the danger of exposure of those involved to infection from diseases transmitted by blood (eg, HIV, hepatitis B or C).
- Parenteral.** Medication administration through any other route other than the mouth and gastrointestinal tract.
- Prefilled syringe.** A single medication dose prepared by a manufacturer or pharmacy. If the entire amount of medication is not needed, the excess is discarded into a designated receptacle before dose administration.
- Reconstituted.** To restore to a former condition by adding liquid.
- Sharps container.** A container for disposal of needles, syringes, vials, ampules, and prefilled syringes according to local protocols.
- SOP.** Standard operating procedures.
- Stridor.** A harsh, high-pitched breath sound that occurs when there is obstruction of the airways.
- Subcutaneous.** An injection beneath the skin, into the adipose (fatty) tissues located below the dermis (SQ); typical sites include the abdomen, upper or outer arm, or the thigh.
- Syringe.** An instrument for injecting fluids into the body or its cavities.

**Tuberculin syringe.** A syringe commonly used for intradermal (ID) injections. The tuberculin syringe has a very small diameter and can measure in hundredths of a milliliter, resulting in a very accurate measurement of very small amounts of liquid medication.

**Vasovagal.** Concerning the action of stimuli from the vagus nerve on blood vessels.

**Vastus lateralis.** One of the three large muscles of the thigh.

**Ventrogluteal.** An anatomic area of the upper lateral thigh.

**Vial.** A glass container equipped with a self-sealing rubber stopper; it may contain a single premeasured medication dose, or it may be a multi-dose vial.

**Wheal.** An elongated mark or ridge, such as a ridge produced by an intradermal injection.

### CHECK ON LEARNING ANSWERS

1. What parts of the needle are sterile?

*All parts of the needle (except the protective cover).*

2. Put these needles in order from the largest to smallest diameters: 25 G, 18 G, 22 G.

*18 G > 22 G > 25 G.*

3. What factors influence the length of the needle that should be used for a particular injection?

*Type of injection, size of the patient, injection site.*

4. What parts of the syringe are sterile?

*Needle adapter, inside the barrel, plunger.*

5. How do you know which syringe to select?

*The syringe should be large enough to hold the entire dose and the calibration small enough to draw up an accurate dose.*

6. While preparing to administer an injection, the needle is removed from the flexible wrapper. Inadvertently, you drop the needle on the floor. The protective cap was in place when the needle touched the floor. Can the needle still be used? Why or why not?

*No, the needle should not be used. All parts of the needle are considered sterile, including the hub. If the sterile hub touches the floor, it is no longer sterile. The contaminated hub could cause an infection.*

7. How are clean needles recapped?

*Place protective cover on work surface. With your dominant hand holding the syringe, scoop the needle into the cover. DO NOT hold the protective cover with your nondominant hand.*

8. How do you determine that the correct amount of medication has been drawn?

*Ensure the forward edge of the plunger is on the prescribed milliliter mark.*

9. While attempting to dilute powdered medication, the diluent is difficult to inject. What should you do?

*If the vial with the powdered medication contains air, some air may have to be withdrawn to allow the diluent to be injected.*

10. How do you determine whether to mix reconstituted medication gently or vigorously?

*Check the medication label or package insert.*

11. You snapped the neck of the ampule and are inspecting the ampule. What are you looking for?  
*Small glass particles.*
12. What should you do if you find something in the ampule?  
*Discard the ampule and get a new one.*
13. What are the recommended sites for intradermal injections?  
*The ventral forearm (most common), the back of the upper arm, and on the back below the shoulder blade.*
14. At what angle should the needle be inserted to deliver an intradermal injection?  
*A 5° to 15° angle.*
15. If a wheal does not appear, what is your next course of action?  
*If a wheal does not appear, withdraw the needle completely from the arm at the angle of insertion and discard the needle and syringe into a sharps container. Prepare a new set, and repeat the procedure at another site at least 2 in. away from the initial test site.*
16. Do intradermal injections require aspiration?  
*No.*
17. When should SQ injections be used rather than ID or IM injections?  
*SQ injections should be used when an absorption rate slower than that of IM injections is desired. SQ absorption rate is slower than that achieved via the IM route.*
18. What are possible sites for SQ injections?  
*SQ injections are usually given in the rear lateral aspect of the upper arm, halfway between the shoulder and the elbow and one-third of the way around laterally; in the vastus lateralis muscle; and in the abdomen.*
19. At what angle should the needle be inserted for SQ injections?  
*Bevel up, at a 45° angle to the skin surface.*
20. Into what type of tissue is the medication being delivered in SQ injections?  
*Subcutaneous tissue.*
21. When administering an IM injection, should you aspirate? Why or why not?  
*Yes. Aspiration of the syringe will determine if the needle unintentionally entered a blood vessel, which could harm the patient if the drug or vaccine is directly injected into the blood vessel.*
22. At what angle should the needle be inserted for IM injections?  
*A 90° angle.*
23. When should IM injections be used rather than SQ or ID injections?  
*IM injections are used when rapid absorption rate (10–20 minutes) and long duration (hours to weeks) are desired. They are also preferred when administering viscous or irritating medications and when a large volume of medication is needed for a stronger effect.*
24. What are the preferred IM injection sites?  
*Deltoid, vastus lateralis, and ventrogluteal muscles.*



25. What are definitive signs of anaphylaxis?  
*Stridor, bronchospasm, and hypotension.*
26. Symptoms of an allergic reaction may begin within (time) \_\_\_\_\_ or up to \_\_\_\_\_.  
*Seconds or up to 1 hour.*
27. What concentration of epinephrine is used to treat a patient suffering from anaphylaxis, through SQ or IM injection?  
*1:1,000.*
28. What is the dose of epinephrine to administer through SQ or IM injection to a patient suffering from anaphylaxis?  
*0.3 mg of 1:1,000 epinephrine.*
29. What is the dose of diphenhydramine to administer to a patient suffering from anaphylaxis?  
*50 mg IV/IM.*

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# 6

# VENIPUNCTURE

## CORE CONCEPTS

- Describe the purpose for obtaining a blood specimen.
- Select a vein (site) for the collection of a blood specimen.
- Use equipment in the collection of a blood specimen.

## INTRODUCTION

**Venipuncture** is the technique used to gain vascular access, usually to obtain a blood specimen or initiate an intravenous infusion. This chapter focuses on venipuncture, specifically for drawing blood samples for laboratory analysis. Information from the laboratory analysis is used in diagnosing and treating diseases and disorders. Critical tasks include selecting an appropriate venipuncture site; preparing to obtain a specimen; and following procedures for inserting the needle, collecting the specimen, and removing the needle. The initial steps of performing venipuncture for blood collection are the same as those used for acquiring vascular access to administer medications and fluids.

## PURPOSE OF VENIPUNCTURE

Venipuncture gives the medical provider the ability to obtain a blood specimen. Usually, a specimen is taken to assess the blood's cells and other components and to determine the presence of abnormalities or disease. The number and shape of the red blood cells give information about disease states such as sickle cell anemia. The number and characteristics of the white blood cells give information about infection or disease states such as leukemia. Your role is to collect the blood specimen so that it can be analyzed at the laboratory and interpreted by a medical officer.

## SELECTING THE APPROPRIATE VEIN

The **antecubital fossa** is the recommended site for conducting venipuncture (Figure 6-1). The veins in this area are near the surface of the skin and are easy to see

and feel. The **median cubital vein** is the first choice; it is well supported and least apt to roll. The **cephalic vein** is the second choice; it is located along the lateral aspect of the elbow. The third choice, the **basilic vein**, may be the most prominent vein. However, this vein tends to roll easily, making venipuncture difficult. Avoid veins that are infected or irritated or have an intravenous (IV) line running **distal** to the proposed venipuncture site. Do not attempt to draw blood from small or fragile veins; this can cause the vein to collapse.

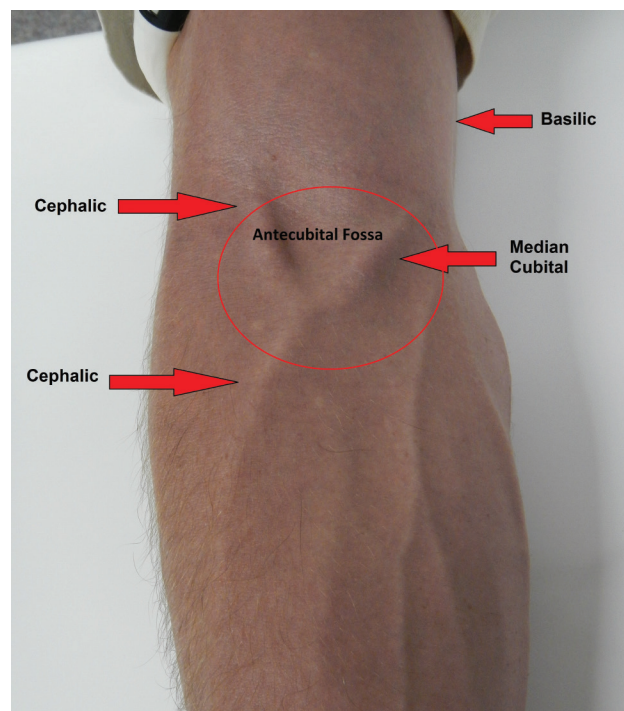


**Figure 6-1.** Antecubital fossa area showing the median cubital, cephalic, and basilic veins.



## PREPARATION FOR VENIPUNCTURE

Before performing venipuncture, the combat medic should conduct specific preparations to ensure a smooth procedure. These may include reviewing the procedure and gathering the required supplies. Use the following items to obtain a blood specimen via venipuncture (Figure 6-2):

- sharps container
- gloves
- eye protection
- constricting band
- alcohol or povidone iodine wipes
- protective pad (chux)
- sterile 2 inch × 2 inch (2 × 2) gauze pads (sponges)
- evacuated blood collection tube needle assembly
- evacuated blood collection tube sleeve (holder)
- blood specimen tubes
- patient identification label

The evacuated blood collection tube and needle assembly consists of a sterile, disposable, double-ended needle and an evacuated blood collection tube sleeve (holder). The needle may consist of a single-specimen needle or a multiple-specimen needle. A multiple-specimen needle has a rubber sheath that covers the shaft of the needle and is pushed up when a blood tube (eg, Vacutainer [BD, Franklin Lakes, NJ] or Vacuette [Greiner Bio-One North America, Inc, Monroe, NC]) is inserted. It then slips back over the needle to prevent blood leakage while the tubes are being changed.

Be careful when selecting blood specimen tubes. The type of blood tube needed depends on the specific test to be performed. The rubber stoppers of the tubes are color coded for different tests. For example, whole blood for a complete blood count (CBC) is collected in a lavender-top tube, while a drug monitoring test is collected in a plain red-top tube. For some tests, **anticoagulants** or other additives may be present in the tube. All specimen tubes are manufactured with decreased pressure inside the tube, creating a vacuum. Ideally, the vacuum will be replaced with blood during the specimen collection.

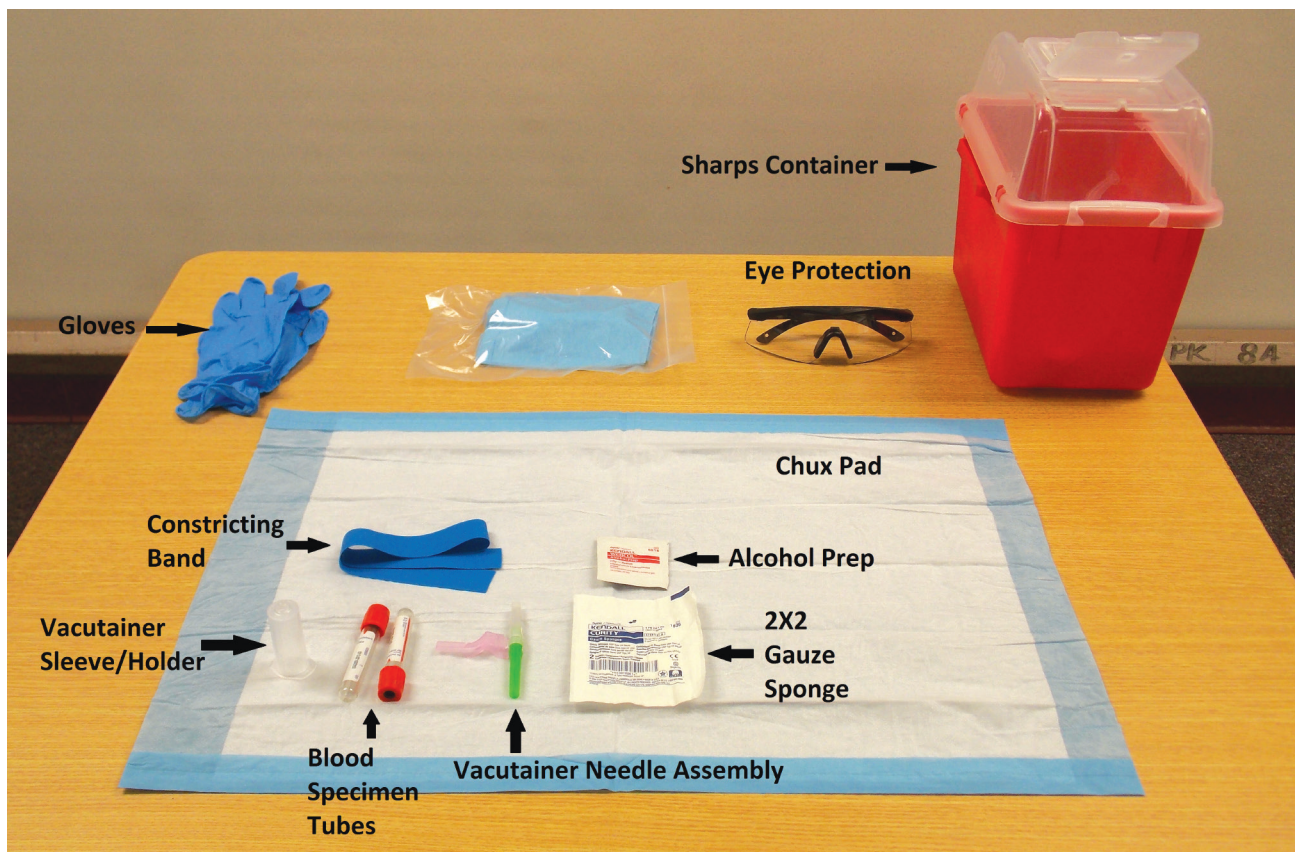


Figure 6-2. Selected equipment used to perform venipuncture and obtain a blood specimen.



Meticulous use of patient identification labels is critically important to ensure there are no mislabeled specimens. Stamp each label with the patient's addressograph plate. If there is no plate, write the patient's name, organization, Social Security number, prefix code, ward or clinic, facility, and date on a label. Apply labels to each specimen tube drawn.

### Check on Learning

1. List the veins in order of preference for obtaining a blood specimen.
2. What are the parts of the evacuated blood collection tube needle assembly?

### OBTAIN THE SPECIMEN

Once the equipment has been gathered, inspected, and assembled, the specimen collection process is ready to begin. Before starting, verify that the information on the identification label is correct and that the appropriate blood specimen tubes have been selected for the tests requested by the medical officer. Take appropriate standard precautions to protect both yourself and your patient.

**Note:** Standard precautions for this task include hand washing, gloves, and goggles or eye shields.

**Caution:** Combat medics must strictly adhere to the local sharps policy and use sharps containers when performing venipuncture.

### Venipuncture Preparation

1. Gather and inspect the equipment.
  - a. Check the local laboratory standard operating procedure (SOP) for tube selection.
  - b. Select and label the proper blood specimen tubes for the tests to be performed.

**Note:** Always inspect the needle for nicks and barbs before use and replace the needle if it is flawed.

2. Perform a patient care hand wash and don personal protective equipment. See Chapter 2, Infection, Asepsis, and Sterile Technique, to review these tasks.

3. Prepare the equipment.
  - a. Prepare the evacuated blood collection tube needle assembly by inserting the shortened end of the needle into the threaded hole in the evacuated blood collection tube sleeve (holder) and screw it in tightly using a clockwise motion.
  - b. Ready the evacuated blood collection tube needle assembly by inserting the rubber stoppered end of the specimen tube into the evacuated blood collection tube sleeve (holder) and advance the tube until it is even with the guideline.
  - c. Prepare gauze pads (sponges) for use.
    - i. Open the povidone iodine or alcohol wipes and 2 × 2 gauze pad packages.
    - ii. Place them within easy reach.
4. Identify the patient and prepare them for the procedure.
  - a. Verbally identify the patient by name and at least two additional patient identifiers and compare this information to the name and additional identifiers on the laboratory request.
  - b. Explain the procedure and purpose of the specimen to the patient.
  - c. Position the patient either sitting or lying down.

**Caution:** Never attempt to draw blood from a standing patient.

- d. Extend the patient's arm with the palm up; stabilize it using a pillow, table, or other flat surface. Position a protective pad (chux) under the patient's extended elbow and forearm.
  - e. Expose the area to be used to conduct the venipuncture and select a vein.
5. Apply the constricting band.

Apply the constricting band with enough pressure to stop venous return without stopping the arterial flow. A radial pulse should be felt. Wrap the constricting band around the limb approximately 2 inches above the venipuncture site. Stretch the tubing slightly and hold it with one end longer than the other. Loop the longer end and draw it under the shorter end so that the tails are away from the site.

**Note:** If a commercial band is used, wrap it around the limb and secure it by overlapping the hook and loop ends.

6. Select and cleanse the venipuncture site.
  - a. Instruct the patient to clench and unclench their fist several times and then hold the fist clenched. This traps blood in the veins and causes them to distend.
  - b. Palpate along the length of the vein with your index finger 1 to 2 inches from the selected site in both directions to determine the size and track of the vein. The vein should feel like a spongy tube.
  - c. Cleanse the site with an alcohol or povidone iodine pad to prevent infection. Wipe in a circular motion, moving outward from the venipuncture site.

**Caution:** Always ask the patient if he or she has an allergy to povidone iodine before use. If the patient is allergic to povidone iodine, use alcohol to clean the site.

**Caution:** Do not palpate the vein again after cleansing the skin.

### Use Venipuncture to Gather a Blood Sample

7. Remove the protective cover from the needle.
8. Position the needle in line with the vein and grasp the patient's arm below the entry point with your free hand.
9. Place your thumb one inch below the entry site and pull the skin taut.
10. Puncture the vein.
  - a. Align the needle, bevel up, in line with the vein, and pierce the skin at a 15 to 30 degree angle.
  - b. Decrease the angle until almost parallel to the skin surface, then pierce the vein wall.
  - c. A faint "give" will be felt when the needle enters the vein, and blood will appear in the needle.
  - d. If you do not feel the give and blood does not appear, the venipuncture is unsuccessful. Pull the needle back slightly (not above the skin surface), redirect the needle toward the vein, and try again.

**Caution:** If the needle is withdrawn above the skin surface, do not attempt venipuncture again with the same needle.

- e. If still unsuccessful:
    - i. Release the constricting band.
    - ii. Place a 2 × 2 gauze pad over the site.
    - iii. Quickly withdraw the needle. Instruct the patient to slightly elevate the arm, keeping it fully extended while simultaneously applying pressure to the site for 2 to 3 minutes.
    - iv. Notify your supervisor before attempting another venipuncture.
11. Collect the specimen.
  - a. Hold the evacuated blood collection tube sleeve (holder) and needle assembly steady with your dominant hand, ensuring that the collection tube is positioned against, but not through, the needle.
  - b. Place the index and middle fingers of your nondominant hand behind the flange of the evacuated blood collection tube sleeve (holder).
  - c. Push the specimen tube as far forward as possible with the thumb of your nondominant hand without causing excessive movement.
  - d. Instruct the patient to relax and unclench their fist after blood has started flowing into the tube.
  - e. When the specimen tube is two-thirds full or blood stops flowing, remove it, leaving the needle and evacuated blood collection tube sleeve (holder) in place. Do not dislodge the needle from the vein.
  - f. If a single specimen is all that is needed, go to step 12.
  - g. If multiple specimens are needed, insert a second tube into the evacuated blood collection tube sleeve (holder). Push the blood specimen tube as far forward as possible without causing excessive movement.
  - h. Repeat these procedures until the desired number of tubes are filled or blood stops flowing.

**Note:** If the tube was pushed beyond the guideline, the vacuum may release and blood will not be pulled into the tube.

12. After the last specimen tube is approximately two-thirds full of blood or blood stops flowing, release the constricting band by pulling on the long end of looped tubing or releasing the hook and loop fastener with your nondominant hand and remove the blood specimen tube from the evacuated blood collection tube sleeve/holder.

**Caution:** Remember to remove the blood specimen tube from the evacuated blood collection tube needle assembly **AND** release the constricting band **BEFORE** removing the needle from the vein.

13. Withdraw the needle smoothly and quickly. Immediately apply pressure to the site with a 2 × 2 gauze pad, keeping the patient's arm fully extended.
14. Place the evacuated blood collection tube sleeve (holder) and needle assembly into a sharps container.

**Note:** If the specimen tube contains an anticoagulant or other additive, gently invert the tube several times to mix with the blood.

15. Instruct the patient to elevate their arm slightly, keep it fully extended, and apply firm manual pressure with a folded 2 × 2 gauze pad for 2 to 3 minutes. This prevents or reduces hematoma formation by reducing the amount of bleeding out of the vein into the **interstitial** space of the arm. If the patient is unable to do this, you must complete this task for them.
16. Secure the 2 × 2 gauze pad or adhesive bandage in place and instruct the patient that this dressing can be removed in approximately 30 minutes.

## Post-Venipuncture Actions

1. Remove the protective chux pad.
2. Dispose of all single-use supplies in an appropriate manner; dispose of the needle in accordance with the local SOP.

**Caution:** Discard the needle into a sharps container as soon as possible or in accordance with local protocol. **DO NOT** unscrew the needle from the sleeve with your hands. **DO NOT** recap the needle.

3. Remove all of the venipuncture equipment from the area.
4. Store reusable equipment in accordance with the local SOP.
5. Remove your gloves and wash your hands.
6. Complete administrative duties.
  - a. Check and complete the laboratory form in accordance with the local SOP.
  - b. Apply prepared labels to specimen tubes.
  - c. Document the procedure in accordance with the local SOP.

## Check on Learning

3. Put the following steps in the correct order:
  - a. Remove the needle from the vein.
  - b. Remove the specimen tube from the evacuated blood collection tube needle assembly.
  - c. Release the constricting band.
4. At what angle should the needle pierce the skin?
5. What is the purpose of obtaining a blood specimen?
6. What veins should be avoided when collecting a blood specimen?

## SUMMARY

All combat medics must be proficient and confident in performing venipuncture to obtain blood samples. This is a common procedure in the clinical setting; however, blood samples are not collected in a tactical setting. The information obtained from blood specimens will be used by the medical team to diagnose and treat patients.



## VENIPUNCTURE



STEP 1: Gather and inspect the equipment.



STEP 2: Perform a patient care hand wash and don personal protective equipment.



STEP 3: Prepare the equipment. Screw the needle assembly into the evacuated blood collection tube sleeve (holder), ready the evacuated blood collection tube needle assembly, and prepare alcohol or povidone wipes. This is a Vacuette blood collection tube (Greiner Bio-One North America, Inc, Monroe, NC; used with permission).



STEP 4: Identify and prepare the patient for the procedure.



STEP 5: Apply the constricting band.



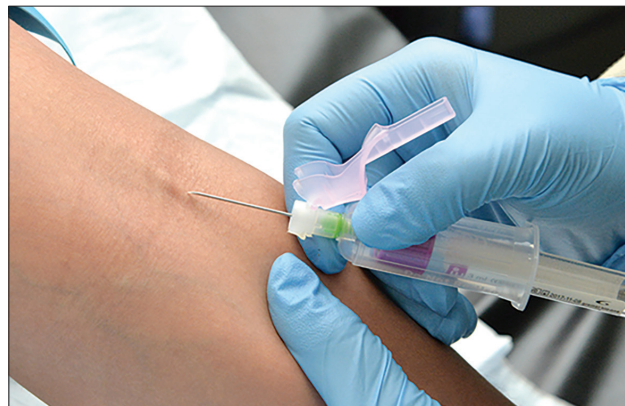
STEP 6: Select and cleanse the venipuncture site.



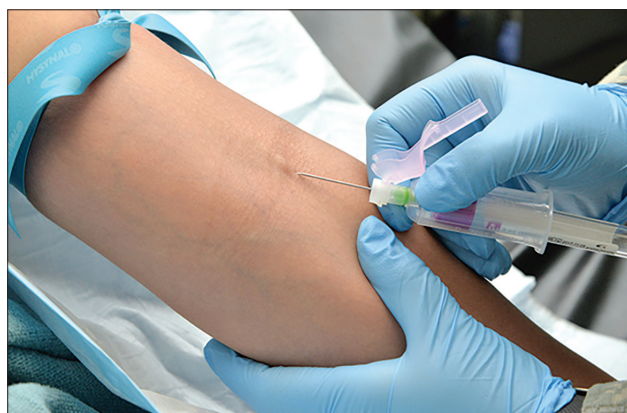
## VENIPUNCTURE, CONT.



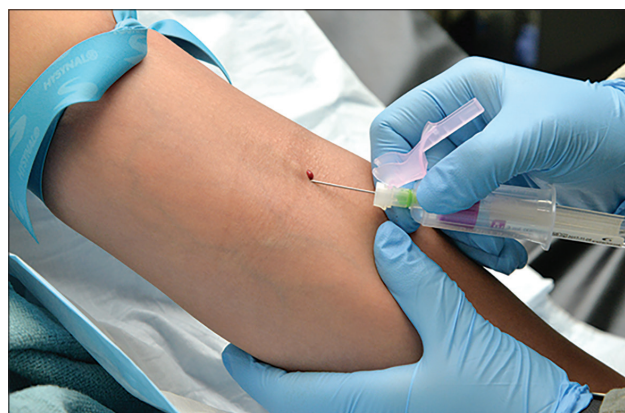
STEP 7: Remove the protective cover from the needle.



STEP 8: Position the needle in line with the vein and grasp the patient's arm below the entry point with your free hand.



STEP 9: Place the thumb of your free hand 1 inch below the entry site and pull the skin taut.



STEP 10: Puncture the vein. Align the needle, bevel up, in line with the vein, and pierce the skin at a 15 to 30 degree angle. Decrease the angle until almost parallel with the skin surface, then pierce the vein wall.



STEP 11a: Collect the specimen. Hold the evacuated blood collection tube sleeve (holder) and needle assembly steady with your dominant hand and place the index and middle fingers of your nondominant hand behind the flange on the evacuated blood collection tube sleeve (holder).



STEP 11b: Push the specimen tube as far forward as possible with the thumb of your nondominant hand and instruct the patient to relax and unclench their fist once blood starts to flow in the specimen tube.



## VENIPUNCTURE, CONT.



STEP 11c: When the specimen tube is two-thirds full or blood stops flowing, remove the specimen tube without dislodging the needle from the vein. Leave the needle and evacuated blood collection tube sleeve (holder) in place. Repeat until the desired number of specimen tubes are full. If a single specimen is all that is needed, proceed to step 12.



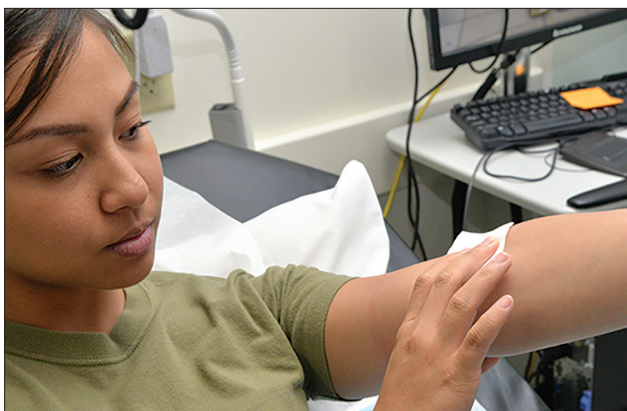
STEP 12: After the last specimen tube is two-thirds full or blood stops flowing, release the constricting band with your nondominant hand. (For this photograph, a second specimen had been obtained.)



STEP 13: Withdraw the needle smoothly and quickly.



STEP 14: Place the evacuated blood collection tube sleeve and needle assembly into the sharps container.



STEP 15: Instruct the patient to elevate their arm slightly, keep it fully extended, and apply firm pressure with a folded 2 x 2 gauze pad for 2 to 3 minutes.



STEP 16: Secure the 2 x 2 gauze in place and instruct the patient that the dressing can be removed in approximately 30 minutes.



## KEY TERMS

**Antecubital fossa.** The hollow or depressed area at the bend of the elbow.

**Anticoagulants.** Substances that prevent or delay clotting of the blood.

**Basilic vein.** The third vein choice. It may be prominent, but it tends to roll easily, making venipuncture difficult.

**Cephalic vein.** The second vein choice. It is located along the lateral aspect of the elbow.

**Distal.** Farthest from the center, from a medial line, or from the trunk.

**Interstitial.** Pertaining to the interstices or spaces within an organ or tissue.

**Median cubital vein.** The first vein choice. It is well supported and the least apt to roll.

**Venipuncture.** The transcutaneous puncture of a vein to withdraw a specimen of blood, provide fluids, or administer a medication.

## CHECK ON LEARNING ANSWERS

1. List the veins in order of preference for obtaining a blood specimen.

*Median cubital vein, first choice; cephalic vein, second choice; and basilic vein, third choice.*

2. What are the parts of the evacuated blood collection tube needle assembly?

*Sterile, disposable, double-ended needle; blood specimen tubes; and evacuated blood collection tube sleeve (holder).*

3. Put the following steps in the correct order:

- a. Remove the needle from the vein.
- b. Remove the specimen tube from the evacuated blood collection tube needle assembly.
- c. Release the constricting band.

*Release the constricting band, remove the specimen tube from the evacuated blood collection tube needle assembly, and remove the needle from the vein.*

4. At what angle should the needle pierce the skin?

*15 to 30 degrees.*

5. What is the purpose of obtaining a blood specimen?

*Usually a specimen is taken to assess the blood's cells and other components as well as to determine the presence of abnormalities or disease. The number and shape of the red blood cells give information about anemia and other disease states. The number and characteristics of the white blood cells give information about infection.*

6. What veins must be avoided when collecting a blood specimen?

*Veins that are infected, irritated, or injured, or have an IV running distal to the venipuncture site.*

## SOURCES

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# 7

# EYES, EARS, NOSE, AND THROAT PRIMARY CARE

## CORE CONCEPTS

- Label the anatomy of eyes, ears, nose, and throat.
- Identify the most common EENT complaints.
- Explain the differences among illnesses with similar symptoms.
- Use diagnostic tools and procedures to perform an EENT assessment.

## INTRODUCTION

In clinical or field environments, combat medics will examine patients with eye, ear, nose, and throat (EENT) complaints. These complaints are common, but it's important for combat medics to recognize RED FLAGS. Assessment of EENT conditions requires obtaining accurate vital signs, conducting thorough clinical observation, and taking appropriate patient histories. These actions may prevent a minor medical complaint from becoming a far more debilitating condition.

## THE EYE

### Anatomy and Physiology of the Eye

The eye consists of the numerous external and internal structures used for eye movement, vision, and protection (Figure 7-1). The conjunctiva is a mucous membrane that lines the eyelid and extends from the eyelid to the front of the eyeball, covering the anterior portion of the sclera. Lacrimal glands are located in the upper-outer aspect of each upper eyelid. Secretions from these glands prevent infections, moisten the eye, and drain through ducts located in the eyelids. Surface structures of the anterior portion of the eye protect and gather light. The sclera (white of the eye) is the tough layer that protects the inner structure of the eye and helps maintain its shape. It is connected to six muscles that allow the eye to look up, down, and side to side. The cornea is the tough, transparent, and colorless window that covers the pupil and iris. Injuries to the cornea may cause opacity and stop light rays from entering the eye.

Behind the external structures of the eye are the iris, pupil, lens, and retina. The iris is the colored circular muscle that lies between the cornea and the lens. The iris can constrict and dilate to control the amount of light that goes through the pupil to be refracted by the lens onto the retina. The pupil is the circular opening through the iris that allows light to pass to the lens and the retina. The lens is a circular structure filled with a jelly-like substance that is held in position by very small muscles known as ciliary muscles. Contraction of these muscles changes the shape of the lens, thus changing the amount of light refracting onto the retina. This results in the ability to see near and far objects. The retina is in the inner, posterior portion of the eye that contains photoreceptor cells called rods and cones (the vision receptors that allow us to see images). The retina is a continuation of the optic nerve, which transmits visual information to the brain.

### Assessing Ocular Complaints

Ocular injuries are classified as penetrating or non-penetrating and are common, despite protection from the bony orbit. An accurate history often helps the combat medic establish a possible cause for the eye problem. The following information should be gathered:

- If there is a history of injury, what was the mechanism of injury?
- Is the injury blunt or penetrating?
- Is there a foreign body injury (eg, glass from a motor vehicle accident)?
- Is there a thermal, chemical, or laser burn?
- Does the patient wear glasses or contact lenses?



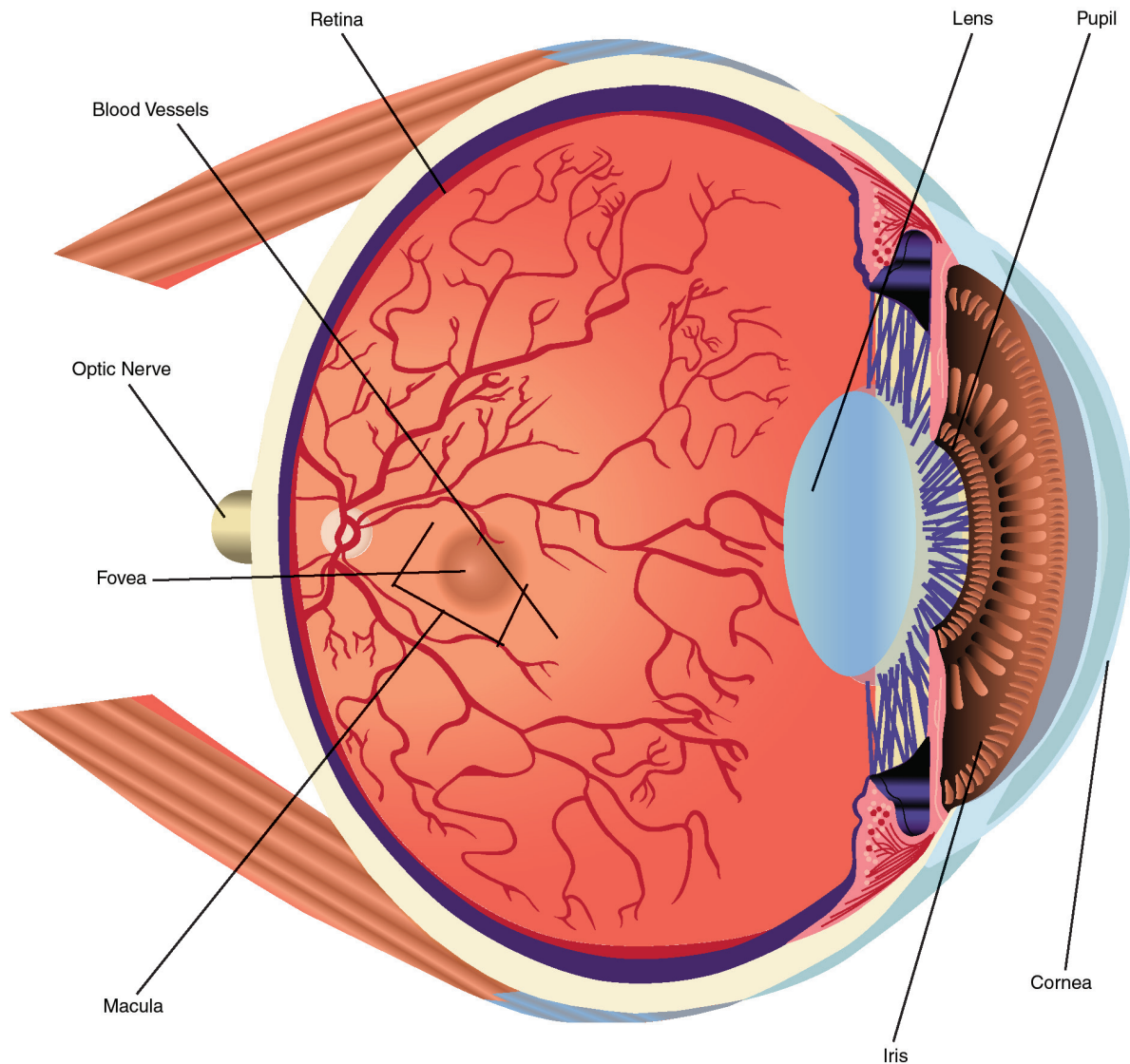


**Figure 7-1.** Anatomy of the eye.

**Note:** “Contact lenses will not be worn during basic training, field exercises, gas chamber exercises, deployments, or combat.”<sup>1</sup>

**Warning:** Contact lenses will worsen chemical exposures of the eye and corneal injuries, such as corneal foreign bodies, laceration, ulcers, and infections.

- Is there a history of eye disease or previous eye trauma or surgery?
- Is there eye pain or vision loss? If there is vision loss, is it in one eye or both?

**Warning:** Vision loss, foreign body, photophobia, severe eye pain, or a history of trauma are RED FLAGS that demand immediate attention and action!

**Exhibit 7-1.** Patient History Information

| Subjective assessments                                                                                                                                                  | Objective assessments                                                                                                              | Additional vital signs (as needed)                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Age</li> <li>• Sex</li> <li>• Race</li> <li>• FDLMP</li> <li>• Chief complaint</li> <li>• OPQRSTI</li> <li>• SAMPLE</li> </ul> | <ul style="list-style-type: none"> <li>• Pulse</li> <li>• Respirations</li> <li>• Blood pressure</li> <li>• Temperature</li> </ul> | <ul style="list-style-type: none"> <li>• Pulse oximetry</li> <li>• End tidal CO<sub>2</sub></li> <li>• Blood glucose monitoring</li> </ul> |

FDLMP: first day of last menstrual period  
OPQRSTI: onset, provoking and palliative factors, quality, radiation and region, severity, timing, intervention  
SAMPLE: signs and symptoms, allergies, medications, pertinent past medical and social history, last oral intake, events preceding the onset of the illness or injury

**Physical Examination of the Eye**

All physical exams begin with obtaining a history of the patient. Exhibit 7-1 identifies the data.

Assessing visual acuity is the most important step in evaluating ocular problems. The way you screen visual acuity will depend on the setting. All patients with eye complaints should undergo some type of visual acuity test. In the case of ocular burns, first flush the eyes. Once the mechanism of the burn has been eliminated, the visual acuity screening can take place. If you are in a clinic, use a standard Snellen eye chart (Figure 7-2). The Snellen visual acuity test measures distant vision by asking the patient to state the smallest readable letters from a standardized chart at a distance of 20 feet. Perform this test initially on all patients presenting with eye complaints (except for ocular burns). In children and the elderly, this test may be routinely performed to screen for any vision problems.

A gross vision examination is recommended when equipment, light, or space does not permit a standard screening. Test each eye individually by covering one with the patient's hand, being careful to avoid applying pressure to the eye. Complete the following four examinations in descending order based on the patient's ability:

1. Ask the patient to read or identify information on a near card. If a near card is not available, use any printed material you have available.
2. Ask the patient to count how many fingers you are holding up and record the farthest distance at which the fingers can be counted correctly (eg, 4 ft).

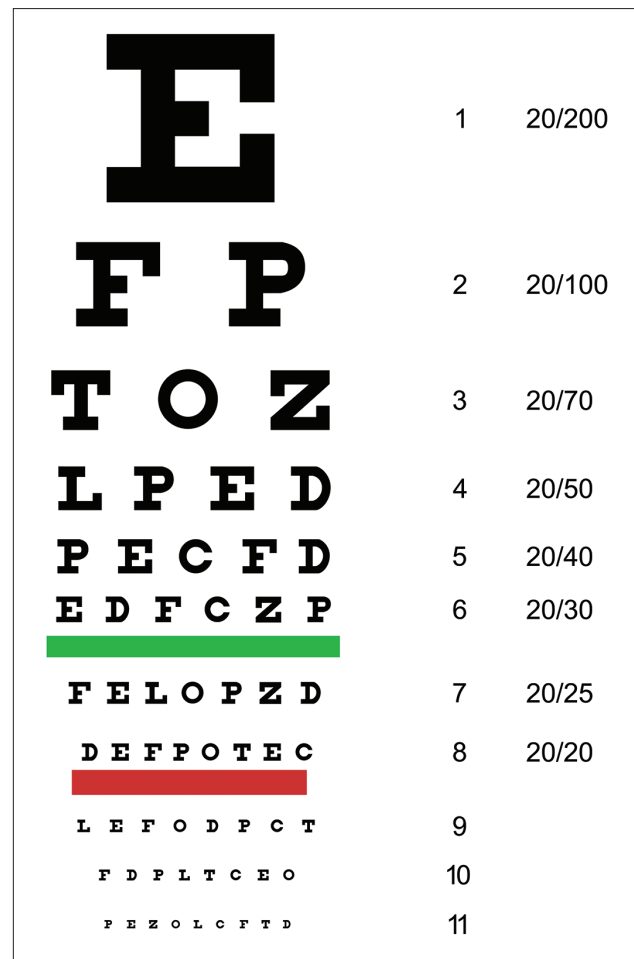


**Figure 7-2.** A Snellen chart—used to assess a person's visual acuity. Reproduced from Cho RI, Savitsky E. Ocular trauma. In: Savitsky E, Eastridge B, eds. *Combat Casualty Care, Lessons Learned from OEF and OIF*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2012: 214, fig 9.

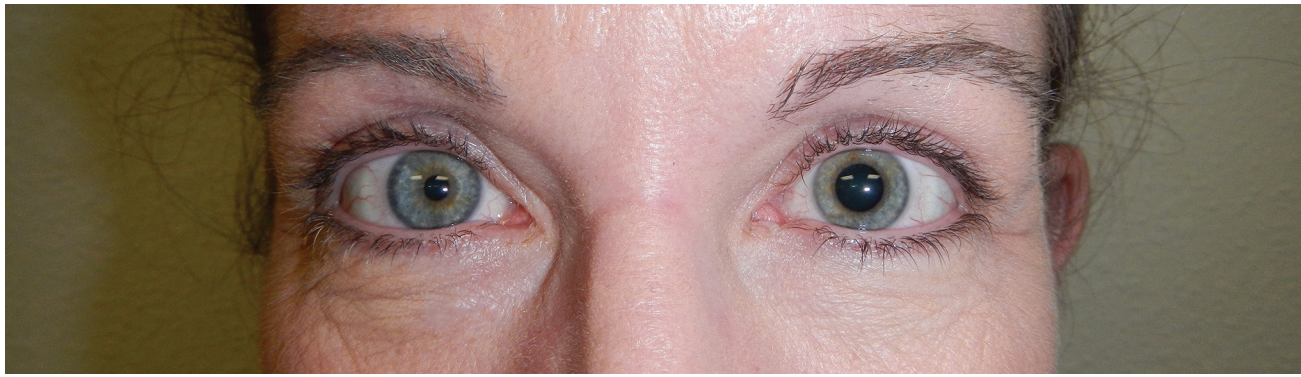


**Figure 7-3.** Anisocoria (unequal pupils).

3. If the patient is unable to count fingers, assess the patient's ability to detect hand motion 1 to 2 inches in front of the eye.
4. If the patient is unable to detect hand motion, turn off all the lights in the room, fully cover one of the patient's eyes, and test for light perception.

Distant vision visual acuity is recorded as a fraction in which the numerator indicates the distance from the chart (eg, 20 ft) and the denominator indicates the distance at which the normal eye can read the line. Thus, 20/200 means that a patient can read at 20 feet what the average person can read at 200 feet. Normal vision is considered 20/20. Most states require 20/40 vision to pass a driver's license test. Most printed materials are formatted at 20/40. The ability to read alarm clock numbers from 10 feet or headlines on a newspaper is equivalent to 20/80 vision. If a person can barely read the letters on a stop sign, they have 20/200 vision and are considered legally blind.

Abbreviate the left eye as OS (oculus sinister) and abbreviate the right eye as OD (oculus dexter). For example, to record visual acuity (V/A) in each eye separately, you might write, "V/A 20/20 OS, 20/40 OD uncorrected" (no corrective lenses). The abbreviation for both eyes is OU (oculus uterque). To report the same acuity in both eyes, you might write, "V/A 20/20 OU uncorrected." If a patient has corrective lenses, initially test acuity uncorrected, and then with the lenses. Remember that the patient may be wearing contact lenses. In that case, either have the patient remove the lenses or document that the visual acuity obtained is "corrected."

General examination techniques are used in the physical examination, including inspecting and palpat-

ing in adequate lighting. Avoid applying pressure to the globe during the examination. The objective portion of the examination will include use of the Snellen chart (if possible). To perform this test, position the patient 20 feet away from the chart, in a well-lit area. Test each eye individually by covering one eye with an opaque card or gauze. Do not apply pressure to the eye. Ask the patient to identify all of the letters beginning at the 20/20 vision level; if the patient can read that line, no further distance vision testing is required for that eye. If the patient cannot read the 20/20 line, determine the smallest line where the patient can identify more than half of the letters.

After testing the eyes individually, have the patient uncover both eyes and read the smallest line possible. If the patient has corrective lenses, either have the patient remove them or document that the visual acuity obtained is corrected. If the patient can remove the lenses, test without them initially, and then with them. Record the visual acuity.

Perform a physical examination of the eye, noting any drainage or bleeding. Then inspect the following:

- The eyelid's ability to open wide and close completely. Inspect lids for edema, discoloration, and foreign bodies. Observe the position of the lids in relationship to the eyeballs.
- Ask the patient to look upward as you pull the lower lid downward, then look down as you pull the upper lid upward. Observe the conjunctiva for erythema or **exudates**. A pink to dark pink color is normal. Note the color of the sclera (white is normal). Patients who have darker pigmented skin may have scattered areas of brown pigment as a normal finding, but note this observation.



- Note any irregularity in the shape of the pupils. Pupils should be equal, round, regular, and reactive to light (**PERRL**). Assess extra-ocular movement.

**Note:** Unequal pupil size (**anisocoria**) may be congenital or caused by local eye medication (Figure 7-3). Approximately 20% of people have minor or noticeable differences in pupil size, with normal reflexes.

### Common Eye Complaints

Eye complaints must always be taken seriously because of the possibility of permanent effects on vision. All patients complaining of ocular issues must receive a consultation from a medical officer (MO).

**Warning:** Any patient presenting with severe eye pain or decreased visual acuity should be considered emergent and must see an MO immediately.

### Conjunctivitis

The condition conjunctivitis, commonly referred to as “pink eye,” is inflammation that is limited to the conjunctiva and may affect one or both eyes (Figure 7-4). Common causes of conjunctivitis are bacterial or viral infections, allergies, or chemical irritation. Most common signs and symptoms include the following:

- erythema,
- edema,
- a gritty sensation,



**Figure 7-4.** Allergic conjunctivitis. Photograph courtesy of Dr. David E. O'Brien, IV.

- burning,
- pain,
- itching, and
- a **purulent** discharge. The discharge can sometimes be severe enough to cause the eyelids to stick together and is commonly associated with a bacterial infection.

**Exam for Conjunctivitis.** All patients presenting with possible conjunctivitis must have a visual acuity test performed and be referred to an MO.

**Treatment for Conjunctivitis.** Treatment is based on patient history and presentation. Bacterial conjunctivitis is treated with antibiotic eye drops or ointments. Viral conjunctivitis may be treated with antiviral medication or symptomatically. Allergic conjunctivitis may have associated sneezing and watery discharge from the eyes. It may be treated with antihistamine medications to reduce symptoms. An MO may recommend the use of either a warm or cold compress (a moist washcloth or hand towel) to closed eyelids three or four times a day for swelling reduction and pain relief. Tell patients to avoid environmental allergens and not wear contact lenses, if possible.

### Stye

A **hordeolum** (stye) is an inflammation of oil or sweat glands on the eyelid (Figure 7-5). Symptoms include erythema, edema, and pain. They are similar to a pimple, as they are raised and contain pus.

**Exam for a Hordeolum.** All patients presenting with a possible hordeolum must have a visual acuity test performed and be referred to an MO.

**Treatment for a Hordeolum.** Treatment includes warm wet compresses until the hordeolum drains,



**Figure 7-5.** Hordeolum (stye). Photograph by Andre Reimann. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Stye02.jpg>

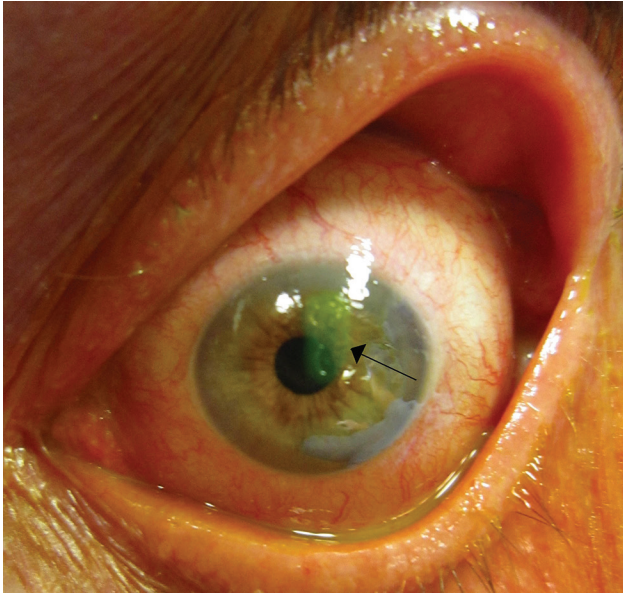


**Figure 7-6.** A corneal abrasion stained with fluorescein. Photograph by James Heilman, MD. Reproduced with permission from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Human\\_cornea\\_with\\_abrasion\\_highlighted\\_by\\_fluorescein\\_staining.jpg](https://commons.wikimedia.org/wiki/File:Human_cornea_with_abrasion_highlighted_by_fluorescein_staining.jpg)

which generally reduces pain and swelling and allows healing to start. Topical antibacterial ointment may also be used. In severe cases the hordeolum will be incised and drained. Instruct patients to never squeeze a hordeolum, as it can spread infection and cause reoccurrences.

### **Corneal Abrasion**

Corneal abrasions (Figure 7-6) are common eye trauma injuries caused by foreign bodies in the eye, scratches from fingernails or other objects, and improperly fitted or maintained contact lenses. Symptoms of a corneal abrasion include the following:

- sensation of a foreign body in the eye,
- light sensitivity,
- severe pain, and
- erythema.

Corneal abrasions are generally diagnosed with fluorescein dye and a Wood's lamp. The fluorescein dye settles in the scratches and causes them to glow green when exposed to the Wood's lamp black light (used in a military treatment facility) or a cobalt blue light (a small light used in a battalion aid station).

**Exam for a Corneal Abrasion.** All patients presenting with a possible corneal abrasion must have a visual acuity test performed and be referred to an MO. An MO may order a fluorescein stain exam.

**Treatment for a Corneal Abrasion.** Treatment includes antibiotic eye drops or ointment. This usually results in the abrasion healing within 24 to 48 hours. If healing has not occurred within 48 hours, refer the patient to an ophthalmologist to prevent complications. If an abrasion becomes infected, there will be white fluid at the wound site. Any abrasion with an infectious fluid is called a corneal ulcer. Depending on the size and location of an ulcer, a culture may be recommended so antibiotic coverage can be tailored accordingly.

### **Check on Learning**

1. What medical condition is described as an inflammation of oil or sweat glands on the eyelid?
2. Is 20/15 vision better or worse than 20/20 vision?
3. Which structure in the eye has cone and rod cells?

## **THE EAR**

### **Anatomy and Physiology of the Ear**

The ear consists of numerous structures that function for hearing, balance, and spatial orientation. Figure 7-7 shows ear anatomy.

The external ear is composed of the auricle (or pinna), tragus, external auditory **meatus**, and external auditory canal (EAC). The auricle is shaped to collect sound waves and direct them toward the external auditory meatus (the opening to the EAC). The tragus is a nodule eminence that points backwards over the entrance to the external auditory canal. The external auditory canal extends from the external auditory meatus to the tympanic membrane. The EAC is the only skin-lined cul-de-sac in the body. It is warm, dark, and prone to being moist, making it an excellent environment for bacterial and fungal growth.

The middle ear is an air-filled cavity within the temporal bone of the skull. The middle ear is separated from the external ear by a thin, translucent membrane called the tympanic membrane (TM), or "eardrum." A healthy TM may be pearly gray to amber in color; redness usually indicates an infectious process. The TM contains three **ossicles** (small bones): the malleus (hammer), incus (anvil), and stapes (stirrup). Sound vibrations from the environment travel down the

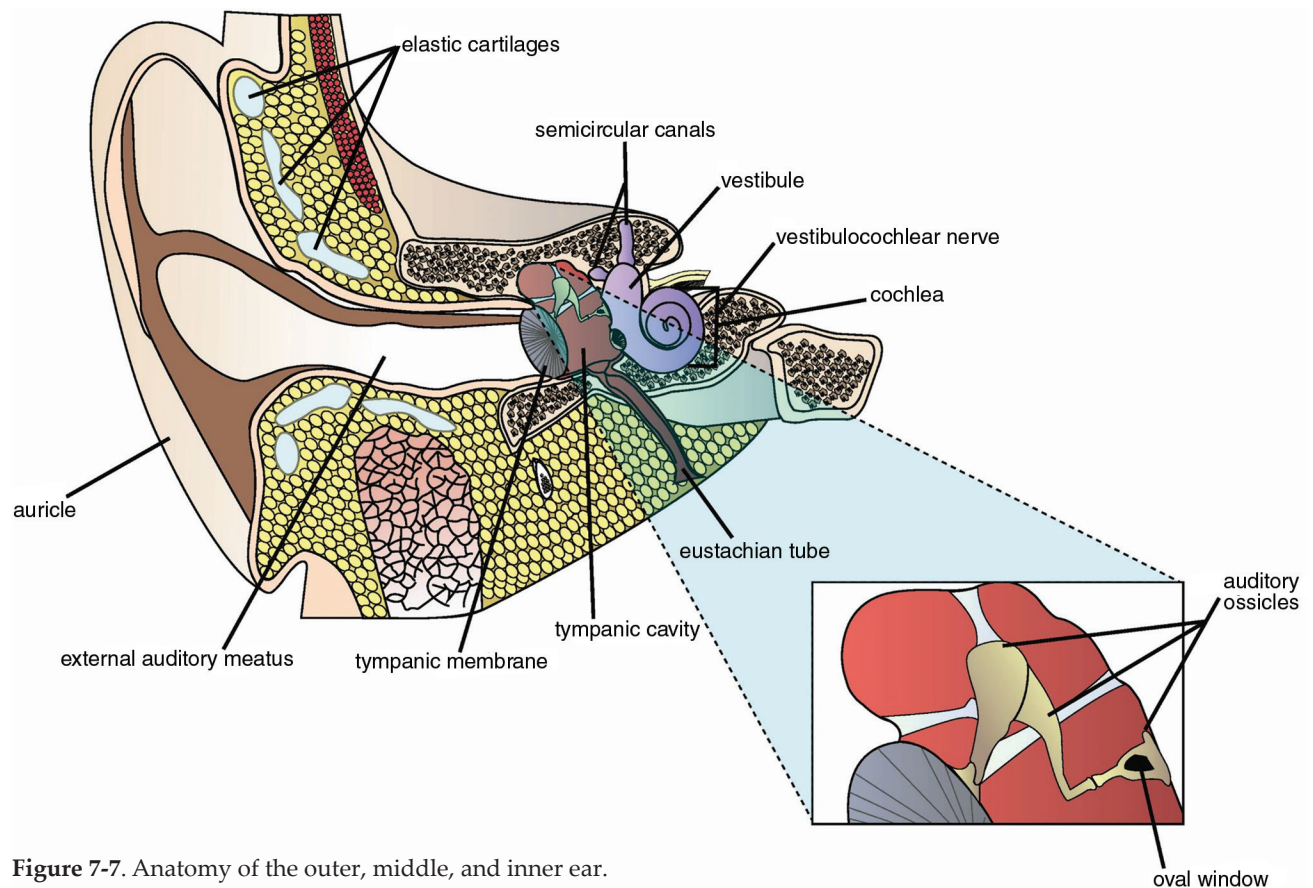


**Figure 7-7.** Anatomy of the outer, middle, and inner ear.

EAC, causing movement of the TM, and in turn, movement of the ossicles, continuing sound transfer to the semicircular canals and cochlea. Those vibrations are converted to electrical signals that are interpreted by the brain as sound.

The eustachian tube (middle ear tube) drains the middle ear to the nasal part of the pharynx (nasopharynx). It protects the eardrum from rupture by allowing air pressure in the middle ear to equalize with the air pressure outside of the ear. Upper respiratory infections commonly result in mucous buildup in the eustachian tube, as well as inflammation, which may cause hearing loss during the course of the infection and prevent the patient from being able to equalize pressure in their ears.

The inner ear is the membranous curved cavity inside the bony labyrinth that is involved in hearing and balance. The inner ear consists of the cochlea, which is the actual receptor for hearing. It is a coiled, cone-shaped structure that contains the organ of Corti (an organ with hair-like cells that move with sound waves). The vestibular nerve sends information for equilibrium from the semicircular canals and **otolith**

**organs** to the brain. The semicircular canals send information in pitch, roll, and yaw; the otolith organs send information on linear acceleration.

### Physical Examination of the Ear

All physical exams begin with obtaining a history of the patient. See Exhibit 7-1 for the required data.

Physical examination of the ear consists of inspection, palpation, and an otoscopic examination. Begin the examination by observing the outer ear for abnormalities such as edema, erythema, ecchymosis, rash, nodules, and **lesions**. Inspect the ear's size, shape, symmetry, landmarks, color, and position on the head. Palpate the auricle for tenderness and swelling. Perform an otoscopic examination as described in the following five steps:

1. Stabilize your examining hand against patient's head to prevent injury.
2. In adults, pull the auricle back and out. Consult with an MO before completing an otoscopic examination on a child.





**Figure 7-8.** Cerumen (earwax).

3. Hold the otoscope handle between your thumb and fingers while bracing that hand against the patient's face to stabilize the instrument. This technique will prevent any injury to the patient during unexpected movements.
4. Insert the speculum and observe the EAC.
  - a. Examine the unaffected ear first.
  - b. Use the largest speculum the ear canal will accommodate.
  - c. Look for edema, erythema, lesions, narrowing of the EAC, discharge, foreign bodies, or presence of **cerumen** (earwax) (Figure 7-8).
5. Observe the TM.
  - a. A normal TM should be translucent and pearly gray to amber in color.
  - b. Look for perforations, air bubbles, scarring, fluid, erythema, exudate, bulging appearance, and the "**cone of light**."

**Caution:** If the TM is obscured by cerumen, if you suspect perforation, or if the auditory canal is filled with blood or discharge, **DO NOT** irrigate. Consult with an MO.

The **Valsalva maneuver** can be used on some patients to help raise or lower suspicion of fluid behind the tympanic membrane. An MO must train you on how and when to perform the Valsalva maneuver. The Valsalva maneuver is contraindicated for patients with any of the following conditions:

- severe coronary artery disease,
- recent heart attack,
- moderate to severe reduction in blood volume,
- chest wounds, and
- inability to hold their breath for the time needed to complete the maneuver (the Valsalva maneuver raises intrathoracic pressure).

To perform the maneuver, the patient should try to exhale air while keeping their mouth closed and nose pinched. This action forces air into the eustachian tube, which then travels to the middle ear and causes the TM to move. An examiner using an otoscope should see the TM move when the maneuver is performed. Movement of the TM is normal, whereas lack of movement could indicate a middle ear infection (otitis media), **eustachian tube dysfunction**, or defect of the ossicles.

Test the inner ear by evaluating the patient's hearing. Gross hearing testing begins when the patient responds or fails to respond to your questions. Complete hearing evaluations are performed by audiology services.

### Common Complaints of the Ear

**Warning:** Fever of  $\geq 100.4$  °F and severe ear pain, any embedded foreign objects, history of trauma to the ear, or hearing loss are **RED FLAGS**. The patient must see an MO immediately!

**Note:** About 50% of earaches in adults are caused by dental problems.

### Cerumen Impaction

Cerumen is a naturally occurring product of the EAC. Impaction is usually asymptomatic, but it can cause hearing loss, dizziness, and pain. Hearing loss is a primary symptom of impaction.

**Exam for Cerumen Impaction.** When cerumen is impacted, the TM cannot be seen during otoscopic examination. Refer patients with cerumen impaction to an MO.

**Treatment for Cerumen Impaction.** Irrigating the ear or using eardrops that will dissolve the earwax are effective ways to manage cerumen impaction. A combat medic, trained at the unit level by an MO, may perform an ear irrigation.

### Otitis Externa

**Note:** If the patient has a temperature  $\geq 100.4$  °F, look for another cause of fever.

Otitis externa (OE), or "swimmer's ear," is inflammation or infection of the external auditory canal (Figure 7-9), commonly caused by bacteria, viruses, or in rare cases, fungi. Otitis externa can be precipitated by excessive moisture resulting from swimming, use of ear-



**Figure 7-9.** A severe case of otitis externa. Photograph by James Heilman, MD. Reproduced with permission from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:OtitisExterna10.JPG>

plugs or hearing aids, and trauma to the ear canal. Signs and symptoms of OE include the following:

- ear pain;
- canal swelling;
- foul smelling drainage;
- increasing pain on movement of the auricle and tragus, which may be severe; and
- low-grade fever.

**Exam for Otitis Externa.** Conduct an examination of the ear and obtain a thorough patient history. Patients with suspected OE must be referred to an MO for treatment.

**Treatment for Otitis Externa.** Management primarily involves administration of antibiotic and steroid eardrops. Irrigation of the ear canal is not recommended. A nonsteroidal anti-inflammatory drug, such as ibuprofen, will usually relieve pain.

### *Otitis Media*

Otitis media (OM) (Figure 7-10) is a middle ear infection commonly caused by a virus or bacteria. A patient's chief complaints will be the following:

- ear pain,
- fever,
- congestion,
- cough, and
- hearing loss in the affected ear.

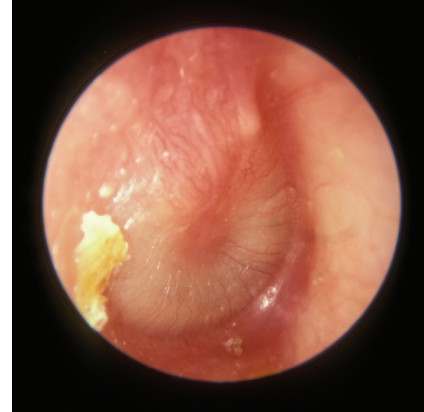


**Figure 7-10.** Otitis media with fluid behind the tympanic membrane. Photograph by Michael Hawke, MD. Reproduced with permission from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Acute\\_Otitis\\_Media\\_Stage\\_of\\_Resolution.jpg](https://commons.wikimedia.org/wiki/File:Acute_Otitis_Media_Stage_of_Resolution.jpg)

Acute otitis media is usually viral and self-limited. It normally accompanies an upper respiratory infection (URI). The patient will have ear congestion, and perhaps mild discomfort and popping. Symptoms resolve with resolution of the underlying URI.

If the middle ear (which is normally sterile) becomes contaminated with bacteria, infection can result in purulent exudate and increased pressure. An individual with bacterial acute OM has classic earache pain that is severe, continuous, and often accompanied by fever of 102 °F or more. Viral acute otitis media presents with less severe symptoms, but secondary bacterial OM often follows quickly.

**Exam for Otitis Media.** On otoscopy, the TM will be bulging and may look red. The “cone of light” will commonly be absent. This condition is typically unilateral (occurs in one ear). Refer patients with suspected OM to an MO for treatment.

**Treatment for Otitis Media.** Manage viral otitis media symptomatically. Bacterial infections require oral antibiotics and decongestants.

### **Common Trauma Complaints of the Ear**

#### *Tympanic Membrane Perforations*

Tympanic membrane perforations (Figure 7-11) commonly occur secondary to blast injuries, especially when hearing protection is not being used. The vast majority of ruptured TMs will heal on their own, but refer all patients presenting with a TM rupture to an MO for evaluation and treatment.

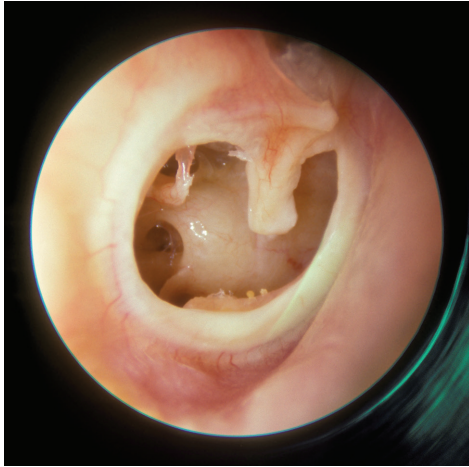


**Figure 7-11.** Subtotal perforation of the right tympanic membrane from a previous severe acute otitis media. Photograph by Michael Hawke, MD. Reproduced with permission from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Subtotal\\_Perforation\\_of\\_the\\_right\\_tympanic\\_membrane.tif](https://commons.wikimedia.org/wiki/File:Subtotal_Perforation_of_the_right_tympanic_membrane.tif)

### *Skull Fractures and Soft Tissue Injuries*

Skull fractures and soft tissue injuries of the auricle, tragus, or earlobe make up most other complaints of ear pain in trauma. One type of skull fracture that affects the ear is the basilar skull fracture. This type of skull fracture may present with “**Battle’s sign**” (bruising behind the ear) (Figure 7-12) and raccoon eyes (bruising around the eyes). Patients who exhibit signs and symptoms of a possible basilar skull fracture should have the auditory canal inspected externally. These patients may also suffer from dizziness and **vertigo** (feeling off balance as though high in the air looking down) as well as **tinnitus** (ringing in the ears).

**Warning:** Placement of unsterile instruments inside the EAC can introduce bacteria into the cerebral spinal fluid, possibly resulting in a life-threatening infection.

### **Check on Learning**

4. Valsalva maneuver is contraindicated in which patients or casualties?
5. What does TM stand for?
6. The eustachian tube runs from the back of the ear to the back of the \_\_\_\_\_.



**Figure 7-12.** A casualty displaying Battle’s sign.

## **THE NOSE AND SINUSES**

### **Anatomy and Physiology of the Nose and Sinuses**

The nose is formed by bone and cartilage and covered with skin. The structures of the nose (Figure 7-13) facilitate respiration, moisten inhaled air, filter dust, and contribute to olfaction.

Nares are bilateral anterior openings of the nose. External and internal nares are lined with vascular mucous membranes thickly covered with small hairs, known as **cilia**, and mucous secretions.

The nasal bridge is formed by the frontal and maxillary bones. The nasal turbinates, also called nasal concha or conchae (plural), are shell-shaped networks of bones, vessels, and tissue within the nasal passageways. Their function is to increase surface contact time of inhaled air, resulting in humidification and warming. Paranasal sinuses are air-filled, paired extensions of the nasal cavity within the bones of the skull. These include the frontal, ethmoid, sphenoid, and maxillary sinuses (Figure 7-14).

### **Examination of the Nose and Sinuses**

All physical exams begin with obtaining a history of the patient. See Exhibit 7-1 for the required data.

Once a subjective history has been obtained, inspect the external structure of the nose, observing the shape, size, symmetry, color, and presence of deformities or lesions. Palpate the external nose for tenderness, swelling, or masses. Inspect the frontal and maxillary sinus area for swelling and palpate the frontal and maxillary sinuses for tenderness. Only the maxillary and frontal sinuses are accessible to physical examination.



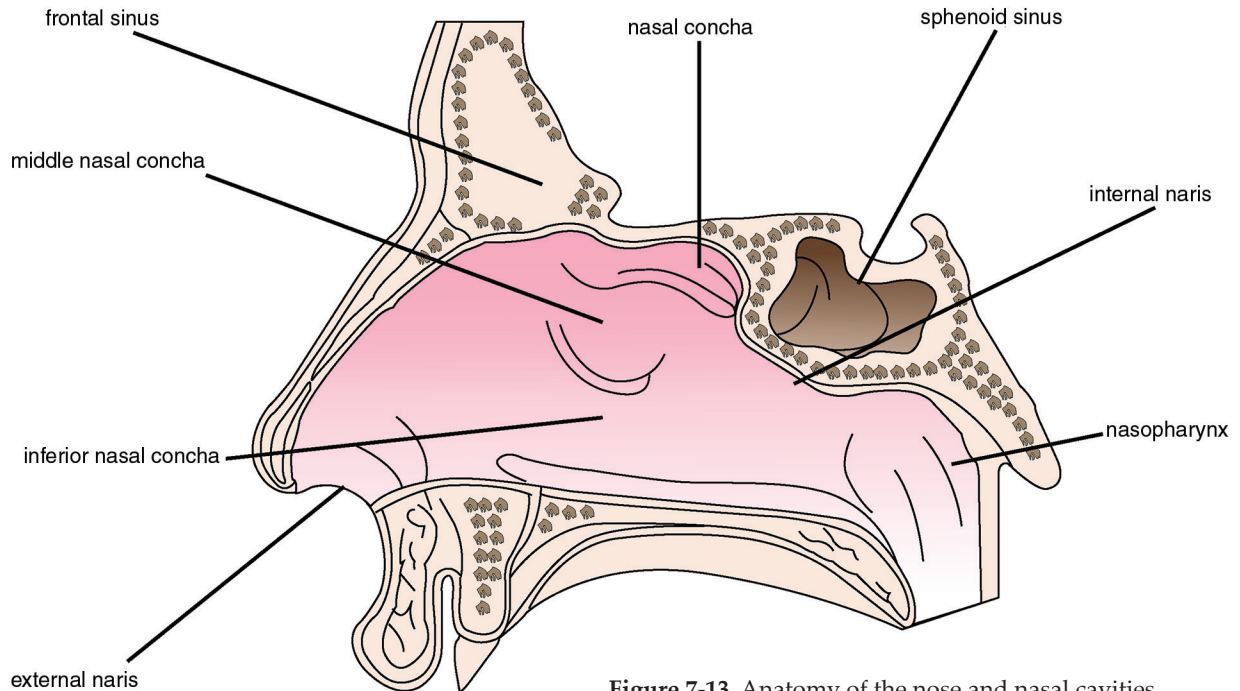


Figure 7-13. Anatomy of the nose and nasal cavities.

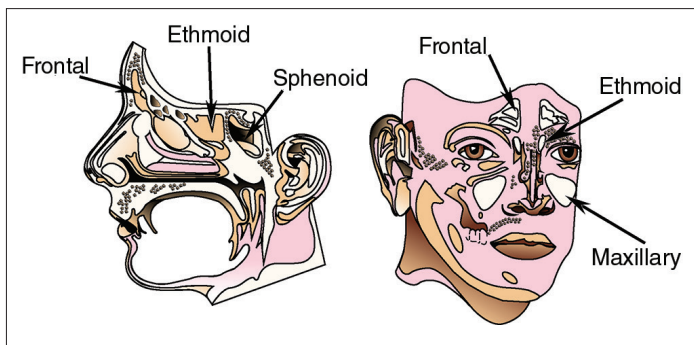


Figure 7-14. The sinuses. Note that frontal and sphenoid sinuses are not well developed in young children.

**Warning:** Fever of  $\geq 100.4$  °F, severe pain, visual changes, and mental or cognitive changes are sinus complaint RED FLAGS. The patient must see an MO immediately!

### Common Complaints of the Nose and Sinuses

#### Epistaxis

A common complaint of the nose is **epistaxis** (nosebleed). Most nosebleeds occur in the front nasal passages. Some common causes of epistaxis include

external trauma, nose picking, nasal infection from plucking nose hairs, vigorous nose blowing, and nasal mucosa drying. Epistaxis may be an early sign of a more significant illness, such as hypertension (high blood pressure) or a blood clotting disorder.

**Management of Epistaxis.** Controlling bleeding takes priority when treating epistaxis. The patient should sit up and lean forward. Direct the patient to tilt their head forward and pinch their entire nose firmly for 10 to 15 minutes. If this does not control the bleeding, a vasoconstrictive nasal spray, such as oxymetazoline nasal spray, or phenylephrine may also be used for periods not to exceed 3 days. To prevent recurrence when the cause is a dry nasal mucosa, the patient may be given antibiotic ointment to use as a protective coating for the nasal mucosa, or a saline nasal spray.

**Exam for Epistaxis.** Once the bleeding is stopped, gather a patient history (See Exhibit 7-1) and check the patient's blood pressure. If the patient has a history of multiple nosebleeds or a nosebleed that cannot be controlled, refer to an MO and gather information about family history of bleeding problems, patient medications (eg, aspirin or other nonsteroidal anti-inflammatory drugs), and any history of chronic illnesses that predispose the patient to nosebleeds (hypertension or blood clotting disorder).

## Allergic Rhinitis

**Rhinitis** is an inflammation of the nasal membranes. Patients with rhinitis often have family histories of multiple allergic disorders, including hay fever (seasonal allergies or allergic rhinitis), asthma, and eczema. Allergens such as dust, dander, and pollen can cause the sensitized immune system to produce antibodies, which in turn cause chemicals called **histamines** to be released into the bloodstream. Histamines play a major role in many allergic reactions and cause numerous physiological events including dilation of blood vessels, increased vessel permeability, increased secretion of acid by the stomach, smooth muscle constriction, mucus production, tissue swelling, and itching.

**Exam for Allergic Rhinitis.** A patient with seasonal allergies may complain of congestion, fatigue, and an overall feeling of being unwell. Signs and symptoms manifest predominantly in the nose and eyes and vary in severity from person to person, but may include the following:

- sneezing,
- **pruritis** (swelling and itching of the affected tissue),
- **rhinorrhea**,
- nasal congestion,
- hives, and
- rashes.

Refer these patients to an MO.

**Treatment for Allergic Rhinitis.** Treatment is aimed at identifying and avoiding the allergen, if possible. If avoidance is not possible, treat according to the symptoms. Treat itching and sneezing symptomatically with an antihistamine. However, antihistamines can worsen nasal congestion because they dry out the nasal mucosa. Nasal saline will keep the inside of the nose moist. If eye irritation is significant, add an antihistamine eye drop (eg, tetrahydrozoline).

Decongestants can be used to treat nasal congestion. If nasal congestion is severe, a nasal decongestant spray may also be used for periods not to exceed 3 days.

**Caution:** Sedating antihistamines should be used cautiously. Any soldier who must operate heavy equipment or drive must not be under the influence of any drug that has a sedative effect.

**Note:** Antihistamines increase the risk of heat injury.

## Sinusitis

Sinusitis (sinus infection) may be caused by anything interfering with airflow into the sinuses and drainage of mucus out of the sinuses. The sinus openings may be obstructed by swelling of the tissue lining and adjacent nasal passage tissue. The mucus-producing cells have small, hair-like fibers (cilia) that move back and forth to help the mucus move out of the sinuses. Cilia may be damaged by many irritants, especially smoke, which prevent them from helping mucus drain from the sinuses. Examples of causes for sinus pain or fullness include the following:

- common colds;
- allergies;
- tissue irritants (eg, cigarette smoke);
- obstruction by tumors or growths in the proximity of the sinus ostia;
- thickening of mucous secretions by decrease in the water content of the mucus, brought on by disease (ie, cystic fibrosis);
- drying medications (antihistamines); and
- lack of sufficient humidity in the air.

Inflammation or infection of the paranasal sinuses is known as acute sinusitis. Common causes of acute sinusitis include infection by a pathogenic microorganism (bacterial or viral) or an allergen. Patients may present with the following signs and symptoms:

- headache that will not go away or intensity that changes with head position,
- facial tenderness or pain,
- fever,
- cloudy or discolored nasal drainage,
- nasal stuffiness,
- sore throat,
- tooth pain,
- cough,
- increased sensitivity or headache when leaning forward, and
- fever in up to 25% of patients.

**Exam for Acute Sinusitis.** Physical examination shows tenderness to percussion over the frontal or maxillary sinuses. Allergic sinusitis or other associated allergy symptoms (eg, itchy eyes and sneezing) may be common. Tooth pain occurs because the sinuses are in close proximity to the tooth roots and nerves of the upper jaw. Sinus infection should be ruled out before referring the patient to dental. Patients with suspected sinusitis should be referred to an MO.

**Treatment for Acute Sinusitis.** Antibiotics and decongestants are prescribed to manage bacterial acute sinusitis, but antihistamines should be avoided because they dry the eustachian tubes and nasal mucosa and prevent proper drainage. Decongestants are recommended for viral sinusitis.

### Check on Learning

7. What are the RED FLAGS when dealing with sinus complaints?
8. Which way should the head be tipped when treating epistaxis?
9. Hay fever is considered what type of rhinitis?

## MOUTH AND THROAT

### Anatomy and Physiology of the Mouth and Throat

The tongue, teeth, mouth, and gums are located in the anterior portion of the oropharynx (the whitish, hard, dome-shaped palate; the pinker soft palate should be **contiguous** with the hard palate). Figure

7-15 shows the anatomy of the mouth and throat. The vestibule is the space between the **buccal mucosa** and the outer surface of the teeth and gums. Mucous membranes should look pinkish-red, smooth, and moist. Gums should have a slightly pink appearance with a clearly defined, tight margin at each tooth. The tongue should appear dull red, moist, and glistening; it should be smooth with increasing roughness as it moves back into the throat. The back of the tongue is covered with **papillae**, giving it a roughened surface. Taste buds contain taste receptor cells known as gustatory cells and are located around the small structures known as papillae. Papillae are scattered over the upper surface of the tongue, soft palate, upper esophagus, cheek, and epiglottis.

### Examination of the Mouth and Throat

All physical exams begin with obtaining a history of the patient. See Exhibit 7-1 for the required data.

When conducting an exam of the mouth or throat, the patient should remove any dental appliances. Inspect and palpate the lips for symmetry, color, edema,

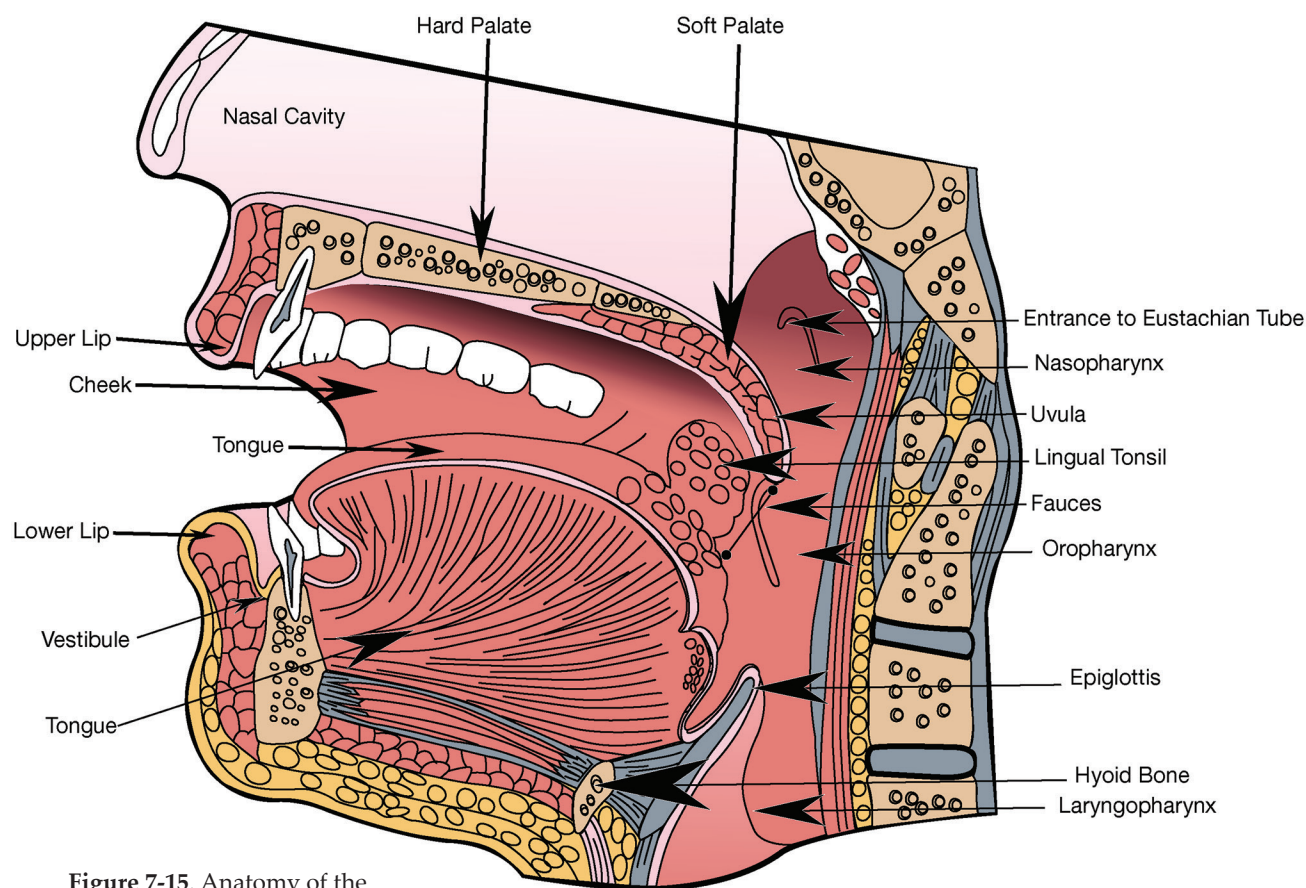


**Figure 7-15.** Anatomy of the mouth and oral cavity.



and surface abnormalities. Ask them to open their mouth, stick out their tongue, and say, “ahh.” Use a tongue blade and bright light to inspect the mucous membranes, the entire mouth, teeth, posterior pharynx, and tonsils. Examine the mucosal membranes and tongue (which are normally pink and moist) for any ecchymosis, erythema, or lesions. Examine the posterior pharynx (consisting of the tonsils and uvula) for exudates, erythema, and lesions. Finally, inspect the uvula to ensure it is midline.

**Warning:** Difficulty breathing, difficulty swallowing, fever of  $\geq 101^\circ\text{F}$ , tonsillar exudates, and midline deviation of uvula are RED FLAGS. The patient must see an MO immediately!

## Common Complaints of the Mouth and Throat

### Upper Respiratory Infection

A URI is an acute infection of the upper airway usually caused by viruses, and less frequently by bacteria. Patients may complain of the following:

- sore throat,
- congestion,
- discharge,
- sinus pressure,
- productive or nonproductive cough (if productive, sputum may be clear or purulent), and
- low-grade fever.

**Exam for Upper Respiratory Infection.** The pharynx may appear slightly reddened with mucous streaking. If the infection is contained in the upper respiratory tract, the lungs are clear to auscultation. Options for patient referral are based on the preferences of the MO and local SOP.

**Treatment for Upper Respiratory Infections.** Manage URI symptoms with cough suppressants, decongestants, and throat lozenges or sprays. Analgesics can be used for fever and body aches. Antibiotics are not indicated for most URIs because they are viral infections.

### Streptococcal Pharyngitis

Streptococcal pharyngitis (strep throat) is an infection of the posterior pharynx or tonsils (Figure 7-16), typically caused by **group A streptococci (GAS) bacteria**. It is most common in the late fall, winter, and early spring. It is spread by person-to-person contact



**Figure 7-16.** A patient exhibiting tonsillar exudates who tested positive for streptococcal pharyngitis. Photograph by James Heilman, MD. Reproduced with permission from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Pos\\_strep.JPG](https://commons.wikimedia.org/wiki/File:Pos_strep.JPG)

with nasal secretions or saliva, often among family or household members. There are many strains of group A streptococcus bacteria. Some produce toxins that can lead to a deadly complication known as scarlet fever (thought to be an allergic reaction to the toxins), with a fatality rate up to 25% if untreated.

In some people, strep throat is very mild and manifests with only a few symptoms. In others, the infection is severe. Signs and symptoms begin 2 to 5 days after exposure, usually with a sudden onset, of fever that peaks on the second day, erythema, edema and/or exudates of the tonsils, **palatal petechiae**, pain, **odynophagia**, and cervical **lymphadenopathy**. Chief complaints of strep throat are listed in Exhibit 7-2.

**Exam for Streptococcal Pharyngitis.** Obtain a history. Refer patients with the previously listed signs and symptoms to an MO for treatment.

**Treatment for Streptococcal Pharyngitis.** Diagnosis is confirmed with a throat culture, but the MO may treat for this condition based on symptoms alone. Treatment requires antibiotics (penicillin has traditionally been recommended and is still very effective). Even though the sore throat usually gets better on its own, people who have strep throat take antibiotics to prevent more serious complications of the infection, including **rheumatic fever**, which can be fatal.

**Exhibit 7-2.** Strep Throat vs Mononucleosis**Strep Throat (bacterial)**

- Mild to severe illness; few to all symptoms; sudden onset
- Treat with antibiotics (eg, penicillin)
- Severe sore throat
- Fever (peaking on 2nd day)
- Tender, swollen neck glands
- **Scarlet fever rash**
- **Malaise**
- Exudate (pus) and/or edema common on reddened tonsils and pharynx
- Headache
- Chills
- Nausea
- Erythema
- Palatal petechiae and pain
- Odynophagia (difficulty swallowing)

**Mononucleosis (viral)**

- Symptoms develop slowly
- Do not treat with penicillin or other antibiotics; treat symptoms
- Sore throat
- Fever
- Significant posterior lymph node enlargement of the neck
- Exhaustion
- Shaggy white-purple tonsillar exudate
- Common significant enlargement of lymph nodes and neck
- Abdominal pain may indicate inflammation of spleen

**Infectious Mononucleosis**

Infectious mononucleosis (mono) is a viral infection that presents as a sore throat. It is usually spread by person-to-person contact via saliva, and is commonly called “the kissing disease” from this prevalent form of transmission among teenagers. Mononucleosis is caused by the Epstein-Barr virus. This virus is spread by coughing or sneezing small droplets of infected saliva or mucus.

**Exam for Infectious Mononucleosis.** Signs and symptoms are listed in Exhibit 7-2 and include: sore throat; fatigue; significant posterior lymph node (gland) enlargement of the neck (Figure 7-17); shaggy, white-purple tonsillar exudates; and possibly abdominal pain (indicative of spleen inflammation). Patients with suspected infectious mononucleosis must be referred to an MO for treatment.

**Treatment for Infectious Mononucleosis.** A blood test (mononucleosis spot test) may be ordered, along with a throat culture to rule out streptococcal pharyngitis and confirm mononucleosis. See Exhibit 7-2 for a comparison of signs and symptoms of these two infections.

**Note:** Mono and strep throat have similar symptoms, but there is no abdominal pain with strep throat.

Treatment is symptomatic and may include use of throat lozenges, acetaminophen, decongestants,



**Figure 7-17.** Lymphadenopathy in a patient with mononucleosis. Photograph by James Heilman, MD. Reproduced with permission from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Lymphadenopathy.JPG>

and sometimes short courses of oral steroids. Mono is a virus, so antibiotics are not indicated. Patients are advised to avoid excessive physical activity for at least 30 days after diagnosis due to the increased risk of splenic rupture, which causes fatal hemorrhage if not identified and treated. Most patients will be given a short convalescent leave to avoid spreading the disease and to reduce risk of potential complications.

### Peritonsillar Abscess

Peritonsillar abscess (**PTA**) is a bacterial infection of the tonsils that spreads into a cellulitis and **abscess** in the throat tissues next to one of the tonsils. The abscess can cause pain and swelling and may occlude the airway. PTA usually results as a complication of streptococcal pharyngitis.

**Exam for Peritonsillar Abscess.** Signs and symptoms of PTA include the following:

- difficulty swallowing,
- muffled voice (often described as a “hot potato” voice that sounds as if the speaker has a mouthful of hot potato),
- severe sore throat that is isolated to one side (the abscess usually affects one side of the mouth, resulting in a tonsil deviating toward the midline) (Figure 7-18),
- fever,
- chills,
- ear pain on the same side as the abscess, and
- spasm in the muscles of the jaw or **trismus** (difficulty opening the mouth).

**Treatment for Peritonsillar Abscess.** PTA is a surgical emergency that commonly requires urgent surgical drainage and antibiotic therapy. All patients exhibiting signs and symptoms of a PTA require immediate referral to an MO.

### Check on Learning

10. What illness that manifests in the throat can cause an enlarged spleen?
11. Strep throat can progress to what fatal disease if left untreated?

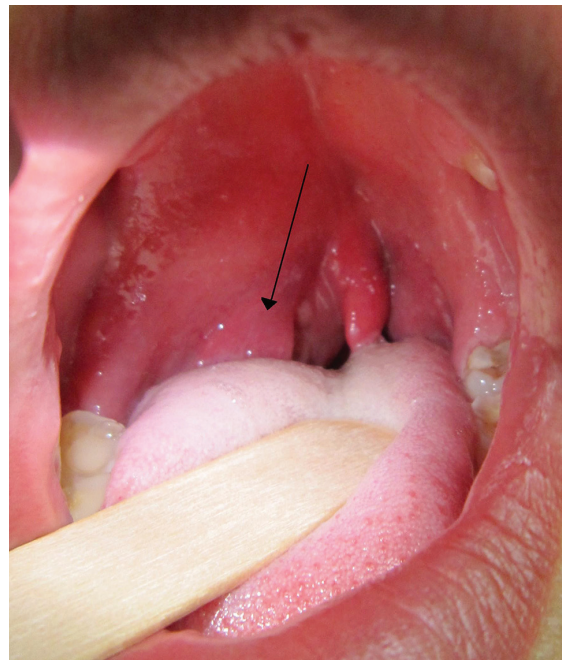


**Figure 7-18.** Right-sided peritonsillar abscess. Photograph by James Heilman, MD. Reproduced with permission from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:PeritonsilarAbsess.jpg>

### SUMMARY

Primary care of the eyes, ears, nose, and throat begins with knowledge of their structures and functions. To recognize and accurately assess, treat, or refer these patients to an MO, clinical observation, accurate vital signs, and appropriate history taking are essential. Early assessment and treatment will reduce the amount of time soldiers are unable to perform their duties due to debilitating illness.

### KEY TERMS AND ACRONYMS

**Abscess.** A local accumulation of pus anywhere in the body.

**Anisocoria.** Unequal pupils.

**Battle's sign.** The sign is named after William Henry Battle. It is an indication of a fracture of the middle cranial fossa of the skull, and may suggest underlying brain trauma. Battle's sign consists of bruising over the rounded protrusion of bone just behind the ear, as a result of leakage of blood along the path of the small artery between the cartilage of the ear and the mastoid process of the temporal bone along the lateral side of the head.

**Buccal mucosa.** The mucous membrane lining the inner surface of the lips and cheeks.

**Cerumen.** A substance secreted by glands at the outer third of the ear canal; earwax.



- Cilia.** Threadlike projections from the free surface of certain epithelial cells such as those lining the trachea, bronchi, and some reproductive ducts that propel or sweep materials, such as mucus or dust, across a surface.
- Cone of light.** Reflection of light from the otoscope, resembling a cone shape, which is visualized on a healthy tympanic membrane during otoscopic exam.
- Contiguous.** In contact; touching along the side or boundary.
- Epistaxis.** A nosebleed.
- Eustachian tube dysfunction.** Any condition that prevents the eustachian tube from equalizing middle ear pressure with outer ear pressure.
- Exudate.** Any fluid released from the body with a high concentration of protein, cells, or solid debris; usually the result of inflammation.
- Group A streptococci (GAS).** Gram-positive coccal-shaped bacteria that appear usually as a chain of two or more bacteria, with molecules on their surface known as Lancefield group A antigens. Organisms are normally spread by direct human-to-human contact; however, they can occasionally be spread by droplets or by contact with items recently handled by an infected individual.
- Histamine.** A compound stored in mast cells that plays a major role in many allergic reactions. Histamine release is part of the natural allergic response that allows for greater capillary permeability to aid in phagocytosis.
- Hordeolum (stye).** A localized, inflamed bump that forms on or in the eyelid as the result of a blocked gland.
- Lesion.** Any abnormal change involving any tissue or organ due to disease or injury. Lesions vary in severity from harmless to serious.
- Lymphadenopathy.** Enlargement of lymph nodes greater than 1.5 cm.
- Malaise.** A subjective sense of discomfort, weakness, fatigue, or feeling run down that may occur alone or accompany other symptoms and illnesses.
- Meatus.** The opening to the external auditory canal.
- Odynophagia.** Pain on swallowing.
- Ossicles.** Any small bone, such as the tiny bones within the human ear.
- Otolith organs.** Sensory organs in the ear that detect linear acceleration.
- Palatal petechiae.** Small red or purple spots on the palate (less than 3 mm in size), caused by tiny minor bleeding from broken capillary beds.
- Papillae.** Tiny bumps that give the tongue its rough texture.
- PERRL.** Pupils equal, round, regular, and reactive to light.
- Pruritus.** Itching.
- PTA.** Peritonsillar abscess.
- Purulent.** A pus-like fluid.
- Rheumatic fever.** A multisystem, febrile inflammatory disease that is a delayed complication of untreated group A streptococcal pharyngitis.
- Rhinorrhea.** A runny nose.
- Scarlet fever rash.** A rash that starts on the trunk and spreads to the arms and legs. It looks like sunburn, but it feels rough like sandpaper. The rash may be redder in skin folds. As the rash starts to go away, the skin may peel.
- Tinnitus.** A subjective ringing, buzzing, tinkling, or hissing sound in the ear that can range from minor irritation to debilitating noise.
- Trismus.** The tonic contraction of the muscles of the jaw, which can be caused by trauma, diseases such as tetanus, mouth infections, encephalitis, and salivary gland inflammation.
- URI.** Upper respiratory infection; infection of the air passages of the nose, throat, or bronchial tubes.
- Valsalva maneuver.** A movement or procedure in which one tries with force to exhale with the windpipe closed, impeding the return of venous blood to the heart.
- Vertigo.** A feeling of spinning movement, sometimes accompanied by nausea and vomiting; usually described by patients as dizziness or lightheadedness.

### CHECK ON LEARNING ANSWERS

1. What medical condition is described as an inflammation of oil or sweat glands on the eyelid?  
*Stye or hordeolum.*
2. Is 20/15 vision better or worse than 20/20?  
*Better.*
3. Which structure in the eye has cone and rod cells?  
*Retina.*
4. Valsalva maneuver is contraindicated in which patients or casualties?  
*Cardiac or respiratory.*
5. What does TM stand for?  
*Tympanic membrane.*
6. The eustachian tube runs from the back of the ear to the back of the \_\_\_\_\_.  
*Nasopharynx.*
7. What are the RED FLAGS when dealing with sinus complaints?  
*Fever  $\geq 100.4$  °F.*
8. Which way should the head be tipped when treating epistaxis?  
*Down.*
9. Hay fever is considered what type of rhinitis?  
*Allergic.*
10. What illness that manifests in the throat can cause an enlarged spleen?  
*Mononucleosis.*
11. Strep throat can progress to what fatal disease if left untreated?  
*Rheumatic fever.*

### REFERENCE

1. Department of the Army. *The Army Vision Conservation and Readiness Program*. DA; 2009.  
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# 8 RESPIRATORY PRIMARY CARE

## CORE CONCEPTS

- Recognize signs and symptoms related to common respiratory disorders.
- Assess patient history and make correlations relative to respiratory disorders.
- Initiate treatment for patients presenting with acute respiratory disorders.

## INTRODUCTION

Respiratory system illnesses are common complaints among soldiers reporting to sick call. Combat medics must be able to recognize the signs and symptoms suggestive of respiratory disorders. Coughing, shortness of breath, and difficulty breathing are common symptoms. Therefore, you should have a basic knowledge of the anatomy and function of the respiratory system to enable treatment of common respiratory disorders within your scope of practice.

### ANATOMY AND PHYSIOLOGY OF THE RESPIRATORY SYSTEM

The respiratory system is made up of several structures that allow us to take in oxygen, transfer it to the body, and release carbon dioxide through the process of breathing (Figure 8-1). The structure of the airway is divided into upper and lower regions. The upper airway consists of the nose, mouth, throat (pharynx), and epiglottis. The epiglottis is the leaf-like doorway that ends the upper airway and is mainly responsible for directing food and water away from the airways and into the digestive tract. The lower airway begins with the glottis (vocal cords) and ends with the alveoli, where oxygen is transferred to the circulatory system. Between these two structures are the trachea, bronchi, and bronchioles, which are tubes that channel air to the lungs. This system enables the body to exchange oxygen and carbon dioxide through a process called **diffusion** (Figure 8-2).

## ASSESSING A PATIENT WITH A RESPIRATORY COMPLAINT

Assessment of patients with respiratory complaints follows the **SOAP** note format.

### Subjective and Objective Information

When assessing a patient with respiratory complaints, gather the following subjective information:

- age, sex, and race;
- first day of last menstrual period (in females);
- chief complaint;
- history of present illness;
- **OPQRST**;
- past history; and
- **SAMPLE** history.

Document the following objective information:

- general impression;
- vital signs (blood pressure, temperature, pulse, respiratory rate, and pulse oximetry); and
- chest physical examination findings. Inspect and palpate both the anterior and posterior thorax for **DCAP-BTLS**. Note rate, rhythm, and effort of breathing. **Auscultate** breath sounds bilaterally.



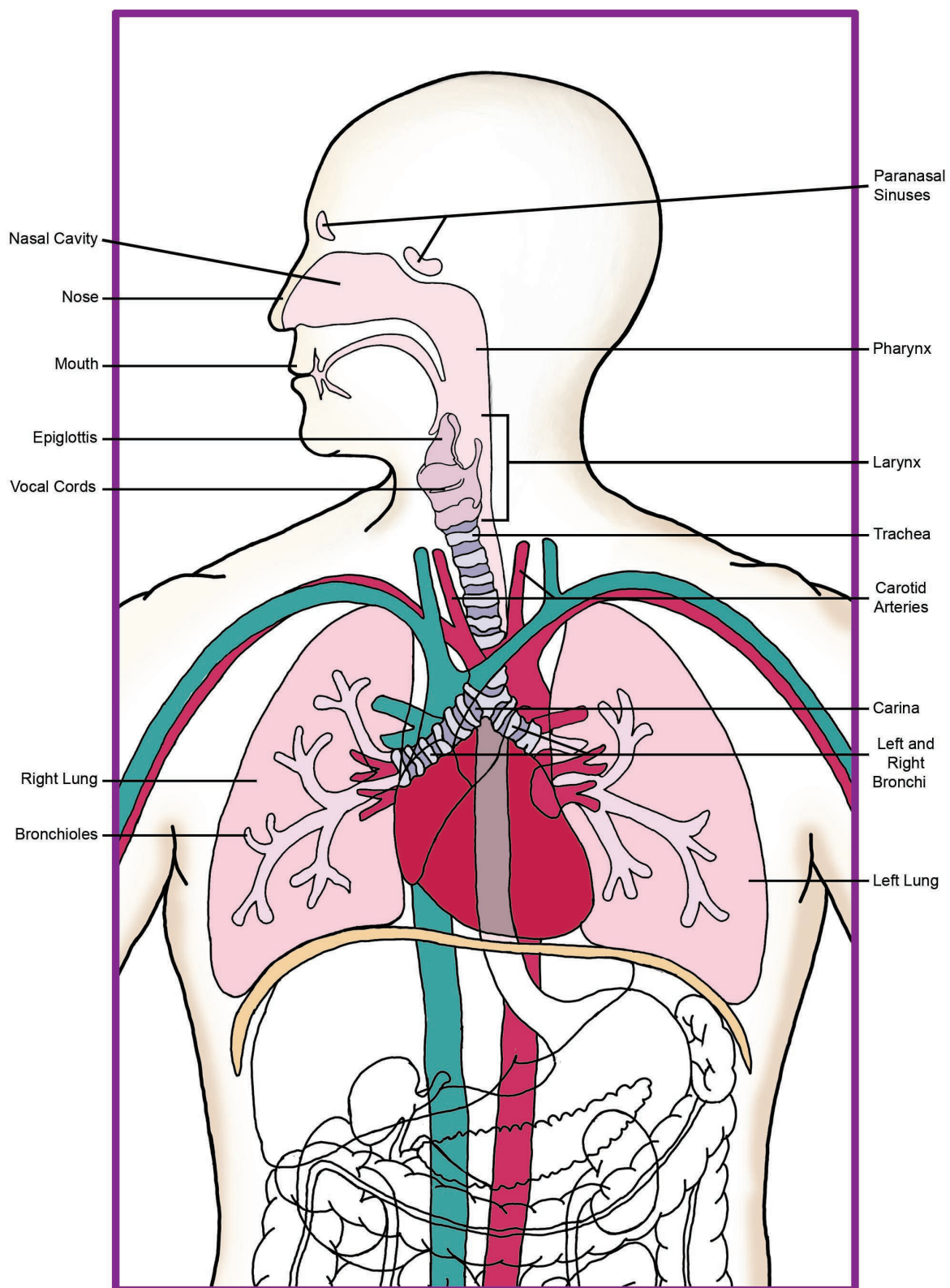


Figure 8-1. Anatomy of the upper and lower airway.

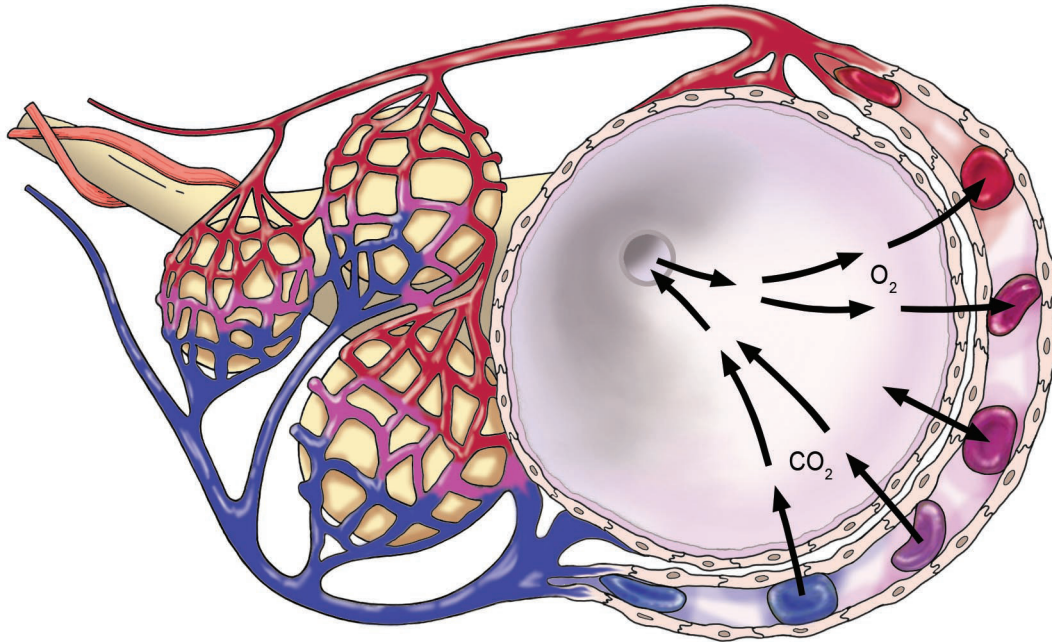


**Figure 8-2.** Oxygen diffuses across the alveolar membrane and binds to the hemoglobin of red blood cells, while carbon dioxide diffuses from the hemoglobin into the alveoli.

### RED FLAGS of Respiratory Complaints

The following respiratory symptoms warrant immediate attention:

- fever higher than 100.4 °F,
- shortness of breath,
- abnormal breath sounds (**rhonchi**, **rales**, and **wheezing**),
- abnormal pulse oximetry (<95% oxygen saturation),
- **accessory muscle** use, and
- productive cough with chest pain.

### Check on Learning

1. List the six RED FLAGS of respiratory complaints.

### COMMON RESPIRATORY COMPLAINTS

#### Upper Respiratory Infection

An upper respiratory infection (**URI**) can be defined as an acute infection of the upper airway usually caused by viruses. URIs are typically afebrile with

inflammation in any or all areas including the nasal cavity, paranasal sinuses, throat, larynx, epiglottis, and most often the trachea and bronchi.

Although upper respiratory infections can occur at any time, they are most common during the fall and winter months. URIs are prevalent during this time because viruses that affect the upper respiratory tract thrive in the low humidity of the winter. Signs and symptoms may include the following:

- nasal congestion,
- sore throat,
- cough (productive or nonproductive),
- hoarseness,
- breathing difficulties,
- sinus pressure,
- **malaise**, and
- fatigue.

The pharynx may appear slightly reddened with mucous streaking. If the infection is contained in the upper respiratory tract, the lungs can be clear to auscultation.

In the military, upper respiratory infection (especially the common cold or influenza) is one of the most common reasons for sick call visits. Appropriate assessment is vital to identifying the illness and



returning the soldier to duty. The medical officer (MO) will discuss referral options and medical intervention goals you should consider while screening patients. Patients presenting with symptoms of a URI should be treated symptomatically with cough suppressants, decongestants, throat lozenges, **analgesics** for fever and body aches, increased fluids, and rest. The use of a face mask should be considered to prevent the spread of disease. Antibiotics are not indicated for viral URIs.

### Common Cold and Influenza (Flu)

The flu and the common cold are both respiratory illnesses caused by different viruses (Figure 8-3). They are both highly contagious respiratory infections that can affect the soldier's ability to complete the mission. Most are seasonal and thrive in environments with relatively low humidity. People with a common cold or flu can spread it to others through droplets

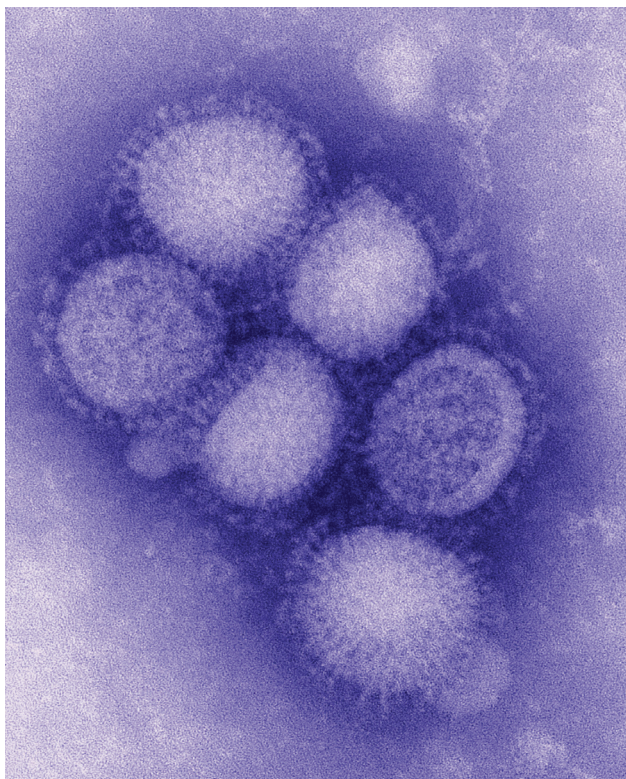


**Figure 8-3.** H1N1 Influenza virus. This virus is a subtype of type A influenza and has been responsible for several pandemics in history. Photograph by CDC/Dr. Lucille K. Georg. Reproduced from Public Health Image Library, Centers for Disease Control and Prevention. [http://www.cdc.gov/h1n1flu/images.htm?s\\_cid=cs\\_001](http://www.cdc.gov/h1n1flu/images.htm?s_cid=cs_001)



**Figure 8-4.** A combat medic administers the influenza vaccine at the troop medical clinic at Contingency Operating Base Q-West. Photo by Sergeant Keith Anderson. Reproduced from Defense Visual Imagery Distribution System. <https://www.dvidshub.net/image/130163/medics-fast-with-hands-slow-with-minds>

deposited in the air from coughing, sneezing, or talking. The viruses can be acquired from inhalation or by touching the eyes, nose, or mouth after touching infected surfaces. The single most effective preventive measure to stop the spread of the common cold or flu is appropriate hand washing. All soldiers must be vaccinated against seasonal flu every year (Figure 8-4). However, vaccination may not completely protect the recipient and some circulating virus strains may not be included in the vaccine. Give face masks to all patients suspected of having the flu and refer them to the MO.

Signs and symptoms of the common cold and flu are similar, which makes it difficult to diagnose if you are focused on symptoms alone. Symptoms of the common cold can be as mild as having a runny or stuffy nose. In more severe cases, symptoms can include the following:

- sore throat,
- sneezing,
- slight fever,
- cough,
- fatigue,
- headache, and
- body ache.

When considering the possibility of the patient having the flu, it is important to remember that influenza patients experience a higher pain intensity. The most recognizable symptoms for the flu are extreme tiredness, fever, and nausea. A person infected with a



flu virus typically suffers from the illness for approximately 7 to 10 days. Treatment consists of 5 to 6 days of limited activity and about 3 days of bed rest. The common cold usually does not cause such debilitation.

## Pneumonia

Pneumonia is inflammation of the lungs caused by a reaction to an invading pathogen or noxious substance (toxins or chemicals). It usually results in fluid consolidation, whereby fluid accumulates in surrounding lung tissue (Figure 8-5), separating the alveoli from the capillaries. When assessing a patient for pneumonia, always consider where and how the patient acquired the illness, as well as any other preexisting medical problems. Many different types of infectious agents cause pneumonia. Bacterial causes are common in young adults, whereas viruses are the common culprits in infants and young children (Figure 8-6).

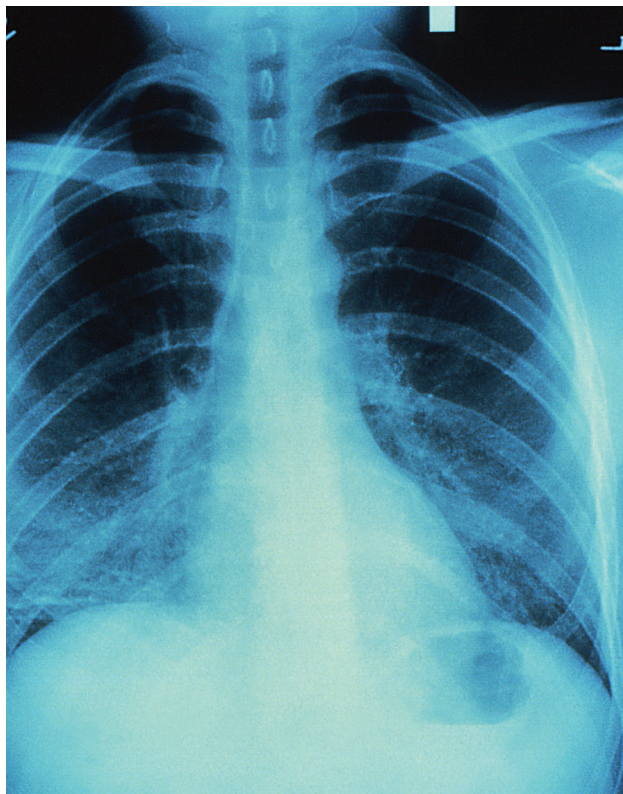


**Figure 8-5.** An anteroposterior (AP) chest x-ray showing bilateral pneumocystis (fungal) pneumonia. Photograph by CDC/Jonathan W.M. Gold, MD. Reproduced from Public Health Image Library, Centers for Disease Control and Prevention. <https://phil.cdc.gov/Details.aspx?pid=14372>

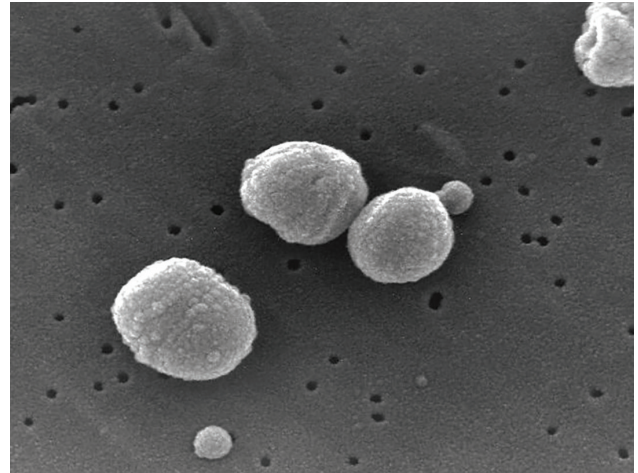


**Figure 8-6.** *Streptococcus pneumoniae* infections can cause serious illnesses such as pneumonia, bacterial meningitis, peritonitis, and endocarditis. Photograph by CDC/Janice Carr and Dr. Richard Facklam. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Streptococcus\\_pneumoniae.jpg](https://commons.wikimedia.org/wiki/File:Streptococcus_pneumoniae.jpg)

The following are signs and symptoms of pneumonia:

- cough (usually productive with green, brown, or rust-colored **purulent** sputum);
- chest pain;
- **pleurisy** (worse with cough or deep breath);
- shortness of breath at rest;
- malaise;
- lethargy;
- poor appetite;
- fever (occasionally with shaking chills);
- **tachycardia**;
- **tachypnea**; and
- rhonchi and rales (may be heard on auscultation).

If pneumonia is suspected, symptoms may be treated with nonsteroidal anti-inflammatory drugs (NSAIDs) or acetaminophen for fever, decongestants, cough suppressants (if cough results in trouble sleeping), and bronchodilators (eg, an albuterol inhaler). Patients should increase their fluid intake to avoid dehydration. Consider putting the patient on profile and bed rest. If in a field environment, patients with pneumonia should be evacuated to the nearest medical treatment facility. Patients with pneumonia usually require antibiotics; therefore, refer them to the MO for evaluation.

**Note:** Pneumonia is a leading medical cause of death in the United States.

### Check On Learning

2. What are the signs and symptoms of pneumonia?
3. What is the single most effective way to stop the spread of colds and flu?
4. In obtaining a patient history, what are signs and symptoms indicating URI?

### Asthma

Asthma is a disorder of the tracheobronchial tree characterized by mild to severe obstruction of airflow. It is caused by an exaggerated **bronchoconstriction** response to many different stimuli. Hyperactivity or hyper-responsiveness of the airway triggers the obstructive elements of asthma. The degree of hyper-responsiveness is closely linked to the extent of inflammation and severity of the disease. Precipitating factors may include the following:

- stress;
- physical exertion (usually beginning within 3 minutes after the end of exercise);
- cold weather;
- upper respiratory infection;
- allergens (eg, pollen, mold, house dust, animal dander, and cigarette smoke);
- certain drugs (eg, NSAIDs such as ibuprofen and aspirin); and
- other environmental agents such as outdoor pollutants.

Signs and symptoms may vary widely from mild to life-threatening. Acute symptoms are caused by spasm of the bronchial smooth muscle, narrowing of large and small airways, edema and inflammation of the bronchial mucosa, and excessive production of mucus. (Figure 8-7).

**Note:** The clinical hallmark of asthma is wheezing.

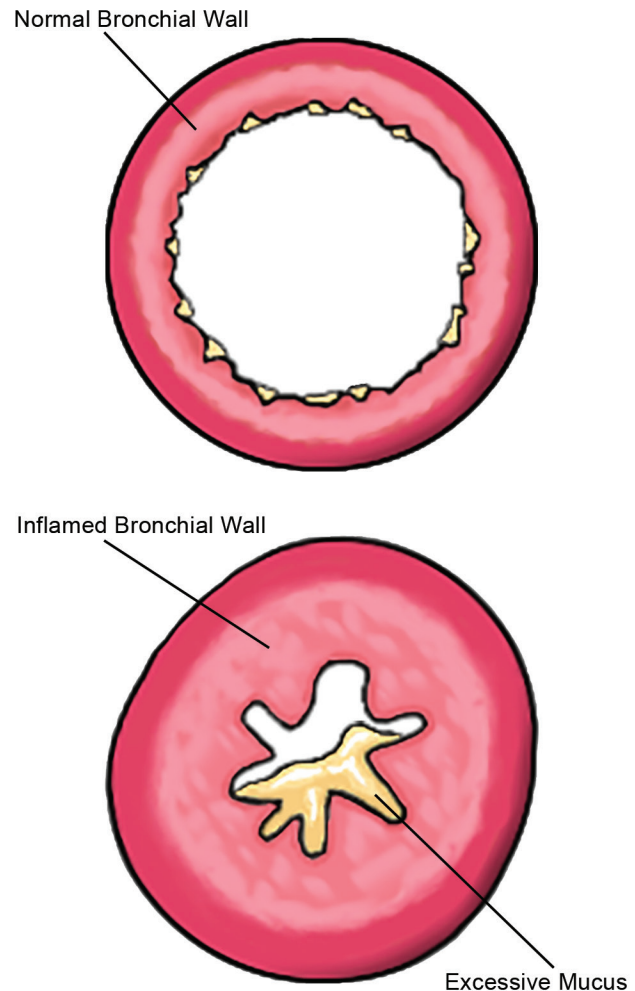


**Figure 8-7.** The pathophysiology of an asthma attack depicting the bronchoconstriction and mucous plugging that occurs when a patient experiences an asthma attack.

Symptoms include the following:

- prolonged expiratory phase,
- accessory muscle use with retractions,
- tachycardia, and
- decreased blood oxygenation (check with a pulse oximeter).

Signs and symptoms of asthma can be episodic, **paroxysmal**, or persistent.



**Figure 8-8.** An asthma patient receiving a nebulizer treatment of a bronchodilator medication. Photograph courtesy of Schertz Emergency Medical Services, Schertz, Texas.

The affected individual may have shortness of breath after exercise or upon awakening, a history of wheezing, chronic cough (usually nonproductive), nocturnal attacks, and chest tightness. Refer patients with these symptoms to the MO immediately.

Treatment for acute asthma attacks includes inhaled bronchodilators, such as a metered-dose inhaler or nebulizer (Figure 8-8), intravenous fluids, and supplemental oxygen. Patients in a field environment require immediate evacuation.

### Check on Learning

5. What are five precipitating factors of asthma?

### SUMMARY

Respiratory disorders are common and the ability to accurately assess and recognize them is crucial. In the field, identification of respiratory disorders can become even more significant due to possible environmental aggravations. Moreover, a combat medic who knows how to properly assess patient history plays a critical role in treating common symptoms and identifying RED FLAGS that may warrant immediate attention. Respiratory disorders can affect the mission; however, early diagnosis and treatment will reduce the amount of time soldiers are unable to perform their duties.

### KEY TERMS AND ACRONYMS

**Accessory muscle.** One of several muscles that assist the primary muscles used in breathing by contributing to expansion and contraction of the thoracic cavity when needed. For example, you can often observe patients having an asthma attack using their abdominal muscles to help them move air.

**Analgesics.** Medications that provide pain relief.

**Auscultate.** Listening to sounds that originate from inside the body.

**Bronchoconstriction.** Constriction of the bronchial tubes.

**DCAP-BTLS.** Deformities, contusions, abrasions, punctures, burns, tenderness, lacerations, and swelling.

**Diffusion.** A passive process in which molecules move from an area of higher concentration to an area of lower concentration.

**Hyper-responsiveness.** Reacting quickly to a stimulus.

**Malaise.** A subjective sense of discomfort, weakness, fatigue, or feeling run down that may occur alone or accompany other symptoms and illnesses.

**NSAID.** Nonsteroidal anti-inflammatory drug.

**OPQRST.** Onset, provoking or palliative factors, quality, radiation or region, severity, and timing.

**Paroxysmal.** A sudden attack or recurrence.

**Pleurisy.** Inflammation of the pleura, with or without a liquid emission or discharge in the pleural cavity, characterized by a dry cough and pain in the affected side.

**Purulent.** Relating to or containing pus.

**Rales.** An abnormal crackling or rattling sound heard upon auscultation of the chest, caused by disease or congestion of the lungs.

**Rhonchi.** A wheezing or snoring noise heard upon auscultation of the chest, caused by an accumulation of mucus or other material.



**SAMPLE.** Signs and symptoms; allergies; medications; past medical, surgical, and social history; last oral intake; and events leading up to illness or injury.

**SOAP.** Subjective, objective, assessment, plan.

**Tachycardia.** Rapid heart rhythm, more than 100 beats per minute (bpm).

**Tachypnea.** Rapid respirations.

**URI.** Upper respiratory infection.

**Wheezing.** A rough, high-pitched breath sound that occurs when there is an airway obstruction.

### CHECK ON LEARNING ANSWERS

1. List the six RED FLAGS of respiratory complaints.

*Fever higher than 100.4 °F; shortness of breath, abnormal breath sounds (rhonchi, rales, severe wheezing), abnormal pulse oximetry (< 95% oxygen saturation), accessory muscle use, and productive cough with chest pain.*

2. What are the signs and symptoms of pneumonia?

*Cough, chest pain, pleurisy (worse with cough or deep breath), shortness of breath at rest, malaise, lethargy, poor appetite, fever (occasionally with shaking chills), and tachycardia.*

3. What is the single most effective way to stop the spread of colds and flu?

*Appropriate hand washing techniques.*

4. In obtaining a patient history, what signs and symptoms indicate URI?

*Nasal congestion, sore throat, cough, hoarseness, malaise, fatigue, and headache.*

5. What are five precipitating factors of asthma?

*Any five of the following: emotional upset, physical exertion, cold weather, upper respiratory infection, allergic components (eg, pollen, mold, house dust, animal dander, and cigarette smoke), certain drugs (eg, NSAIDs such as ibuprofen and aspirin), and other environmental agents such as outdoor pollutants.*

### SOURCES

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# 9 ABDOMINAL PRIMARY CARE

## CORE CONCEPTS

- Identify the four abdominal quadrants and the organs contained in each.
- Summarize the physiology of each abdominal organ.
- Recall the RED FLAG signs and symptoms associated with life-threatening abdominal conditions.
- Demonstrate the proper steps in an abdominal assessment.
- Recognize common epidemiological factors in acute abdominal pain.
- Describe treatment modalities for patients with acute abdominal pain.

## INTRODUCTION

During combat operations, medics may have to assess and treat patients with signs and symptoms of various types of abdominal disorders, including nausea, vomiting, diarrhea, constipation, and pain. These signs and symptoms could indicate a minor abdominal condition or a significant underlying life threat. Some causes of abdominal distress require surgical intervention. If a combat medic fails to identify signs and symptoms of an abdominal condition requiring surgical intervention, the patient could die. Always obtain a thorough medical history, compile accurate vital signs, and conduct a systematic assessment. Evaluating this information greatly reduces the likelihood of overlooking an abdominal life threat.

## ANATOMY AND PHYSIOLOGY OF THE ABDOMINAL ORGANS

### Gastrointestinal Tract

The gastrointestinal tract (also called the GI tract or digestive tract) is composed of the oral pharynx (mouth), esophagus, stomach, small intestine, large intestine, rectum, and anus. It is a long tube that converts food into absorbable nutrients and removes residual waste products.

### Abdomen

The abdominal cavity boundaries are the diaphragm (superior boundary), the anterior abdominal wall, the pelvic bones (inferior boundary), the abdominal muscles (anterior boundary) and flanks, as well as the spinal column and back muscles (posterior boundary). The **peritoneum** is a serous membrane that covers the abdominal cavity and its organs. The **parietal peritoneum** lines the abdominal cavity and the **visceral peritoneum** lines most intra-abdominal organs. The organs are suspended in the abdominal cavity by a double layer of peritoneum known as **mesentery**. Four quadrants make up the abdominal cavity: (1) the right upper quadrant (RUQ), (2) the left upper quadrant (LUQ), (3) the right lower quadrant (RLQ), and (4) the left lower quadrant (LLQ). Figure 9-1 shows the abdominal cavity quadrants and internal organs.

### *Right Upper Quadrant*

The RUQ includes the following organs:

- liver;
- gallbladder;
- head of the pancreas (**retroperitoneal**);
- part of the colon (hepatic flexure and part of transverse colon);
- a portion of the small intestine composed of **duodenum, jejunum, and ileum**;
- abdominal aorta along the line separating RUQ from LUQ;
- right kidney (retroperitoneal); and
- right renal artery.

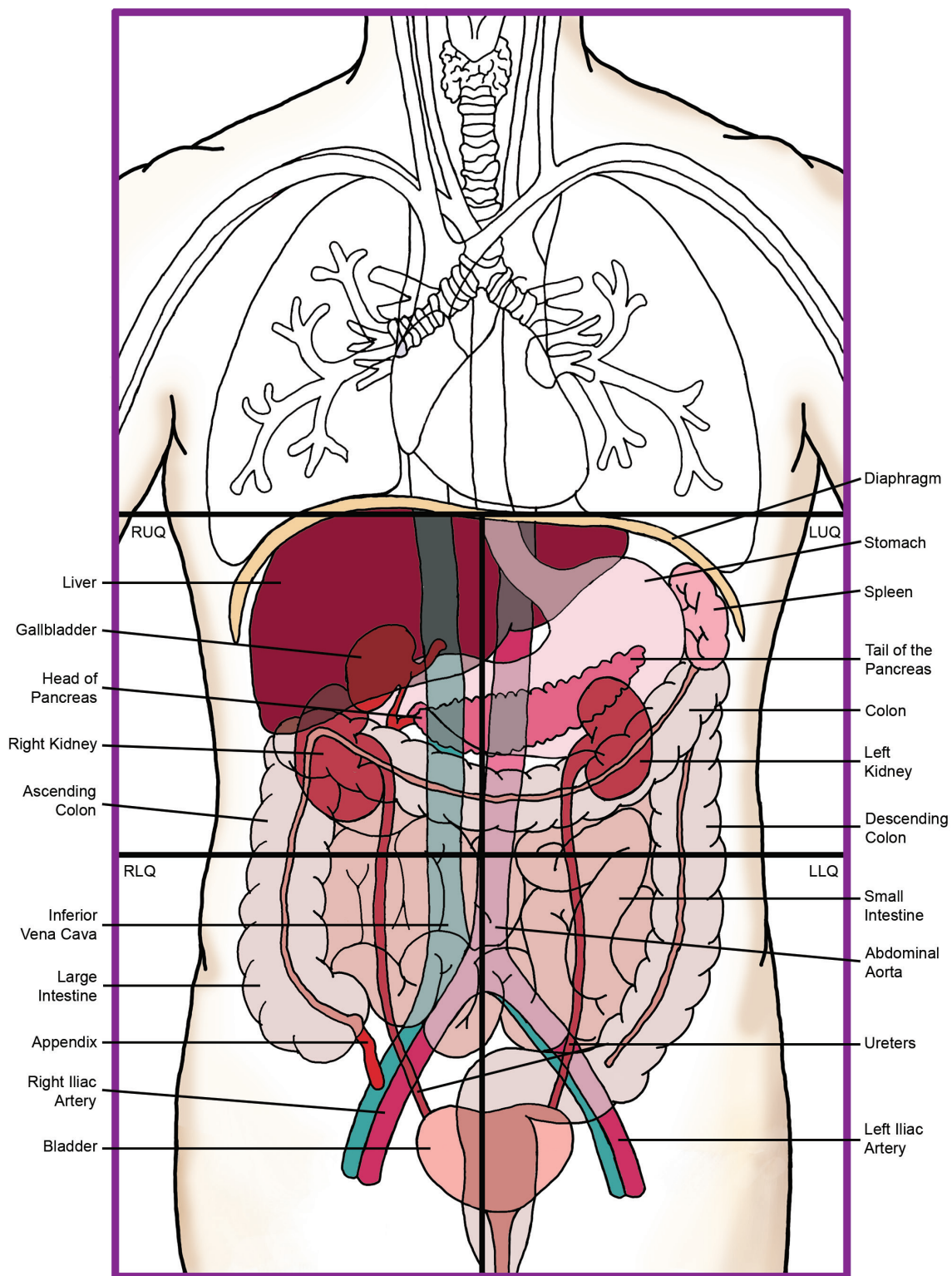


**Figure 9-1.** The abdominal organs. Abdominal quadrants are a common way to describe organ location.



### Left Upper Quadrant

The LUQ includes the following organs:

- stomach,
- spleen,
- tail of the pancreas (retroperitoneal),
- part of the colon (**splenic flexure** and portion of the **transverse colon**),
- a portion of the small intestine,
- abdominal aorta (along the line separating the RUQ from the LUQ),
- left kidney (retroperitoneal), and
- left renal artery.

### Right Lower Quadrant

The organs found in the RLQ are:

- part of the colon (ascending colon including **cecum**),
- appendix (attached to cecum),
- a portion of the small intestine,
- part of the bladder and uterus,
- right fallopian tube,
- right ovary, and
- right iliac artery.

### Left Lower Quadrant

The LLQ includes the following organs:

- a portion of the small intestine,
- part of the colon (descending and **sigmoid** colon),
- part of the bladder and uterus,
- left fallopian tube,
- left ovary, and
- left iliac artery

## Abdominal Organ Physiology

### Liver

The liver (Figure 9-2) stores about 10% of an individual's total blood volume; metabolizes carbohydrates, fat, and protein; stores vitamins and iron; forms various blood clotting factors; and detoxifies, excretes, and metabolizes many different drugs. The liver also forms bile, which breaks down fat for digestion and serves as a means for excreting certain waste products from the blood.

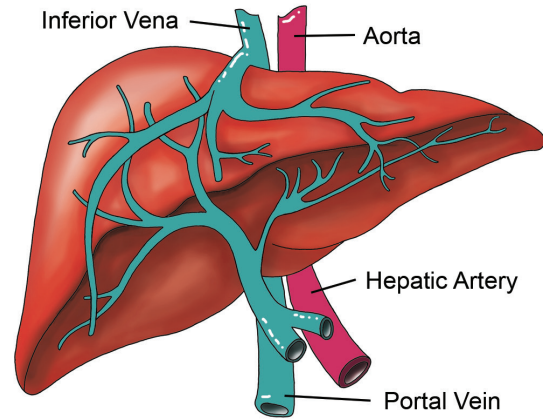


Figure 9-2. Liver anatomy.

### Gallbladder

The gallbladder (Figure 9-3) stores bile formed by the liver. It empties bile into the first part of the small intestine (duodenum) when an individual consumes a meal high in fat. If “stones” form in the gallbladder, they may obstruct the drainage system (bile duct) to the small intestine.

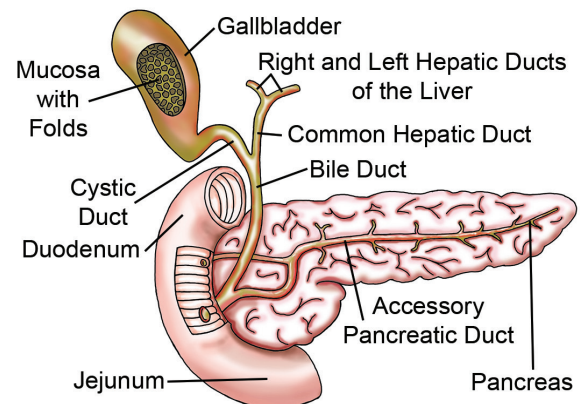


Figure 9-3. Pancreas and gallbladder anatomy.

### Pancreas

The pancreas (see Figure 9-3) produces and secretes digestive juices into the duodenum via the pancreatic duct. It also produces and secretes hormones (insulin and **glucagon**) into the blood that regulate blood sugar (glucose). Insulin promotes glucose entry into most cells of the body, decreasing blood glucose levels in the blood. Glucagon increases glucose release from the liver into the circulating body fluids, increasing blood glucose levels.

### Small Intestine

The small intestine (see Figure 9-1) absorbs carbohydrates, proteins, fats, electrolytes (sodium, chloride, bicarbonate, calcium, iron, potassium), and the water that accompanies them. Most of the water is absorbed in the colon (large intestine).

### Colon

The colon, or large intestine (see Figure 9-1), absorbs water and electrolytes (as much as 5–7 L per day) and stores fecal matter until it can be expelled.

### Stomach

The stomach (Figure 9-4) stores ingested food as it converts into a soupy mixture (chyme) and empties into the duodenum (first portion of the small intestine). It secretes digestive juices and enzymes. Most absorption occurs in the small intestine, but the stomach absorbs highly **lipid-soluble** substances, such as alcohol and some medications (eg, aspirin).

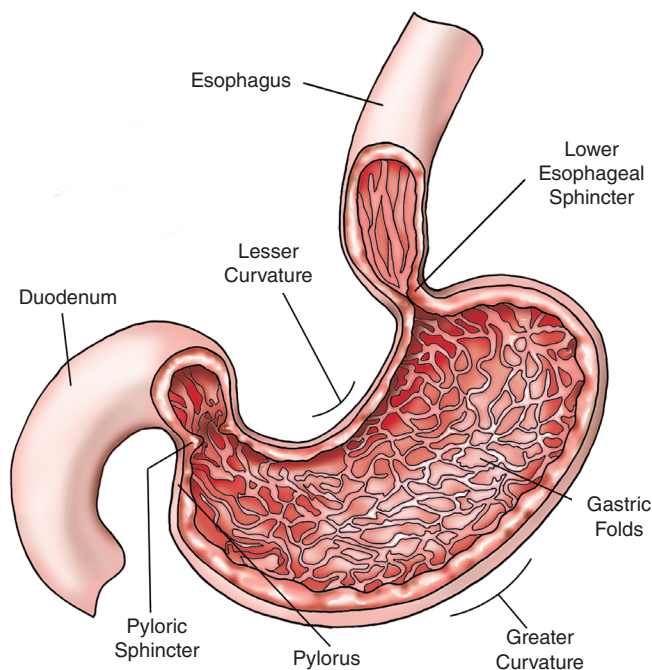


Figure 9-4. Stomach anatomy.

### Spleen

The spleen (Figure 9-5) is the lymphatic system organ that contains the largest amount of lymphatic tissue in the body. It stores red blood cells and plate-

lets and removes those that are worn out or defective. The spleen carries out immune functions and contains cells involved in fighting infections. It is a highly vascular organ that may result in massive hemorrhage if injured.

**Warning:** Patients with infectious mononucleosis may have inflamed and enlarged spleens. Advise these patients to avoid contact sports for up to 4 weeks after diagnosis to prevent splenic rupture. Although ruptures are rare, they may cause internal bleeding. Refer to an MO.

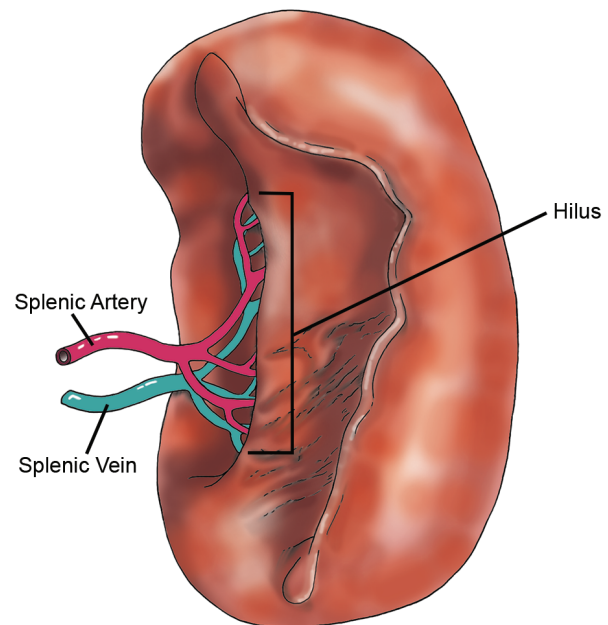


Figure 9-5. Spleen anatomy.

### Kidneys

The kidneys (Figure 9-6) excrete most of the end products of metabolism through blood filtration and urine formation. They regulate the water, electrolytes, and acid-base content of the blood.

### Ovaries

Ovaries are two almond-shaped female reproductive organs located on both sides of the pelvic cavity, next to the opening of the fallopian tubes (called the fimbria) (Figure 9-7). They attach to the uterus by the utero-ovarian ligament. Ovaries produce hormones (estrogen and progesterone) and eggs. An egg fertilized by a male spermatozoon develops sequentially into a zygote, embryo, fetus, and baby.

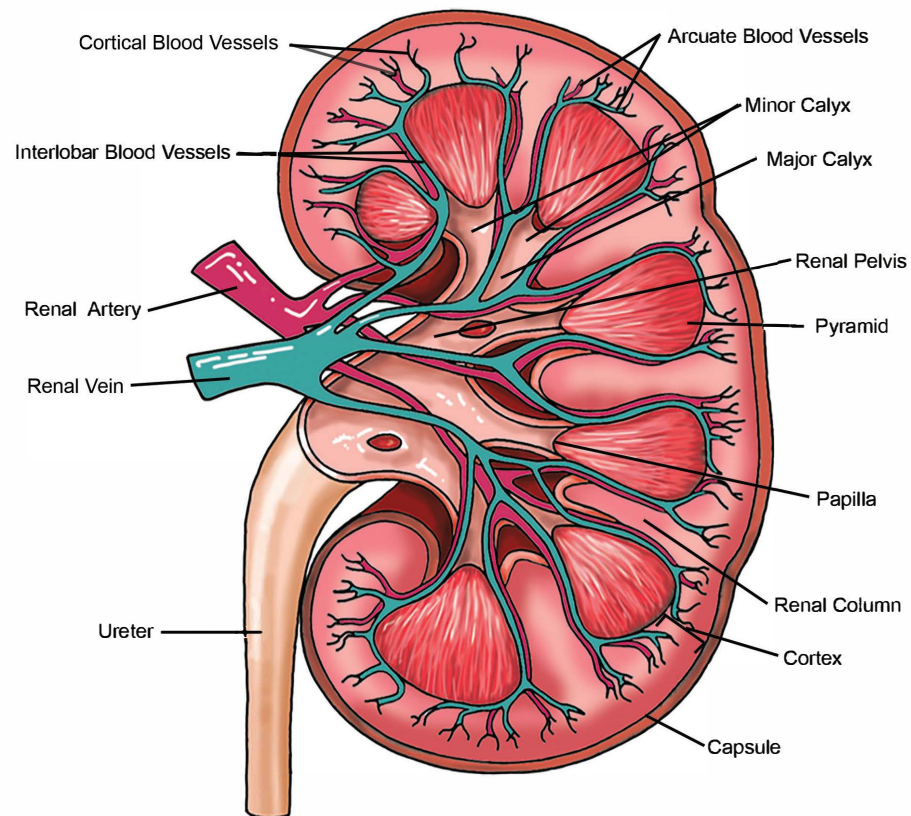


Figure 9-6. Kidney anatomy.

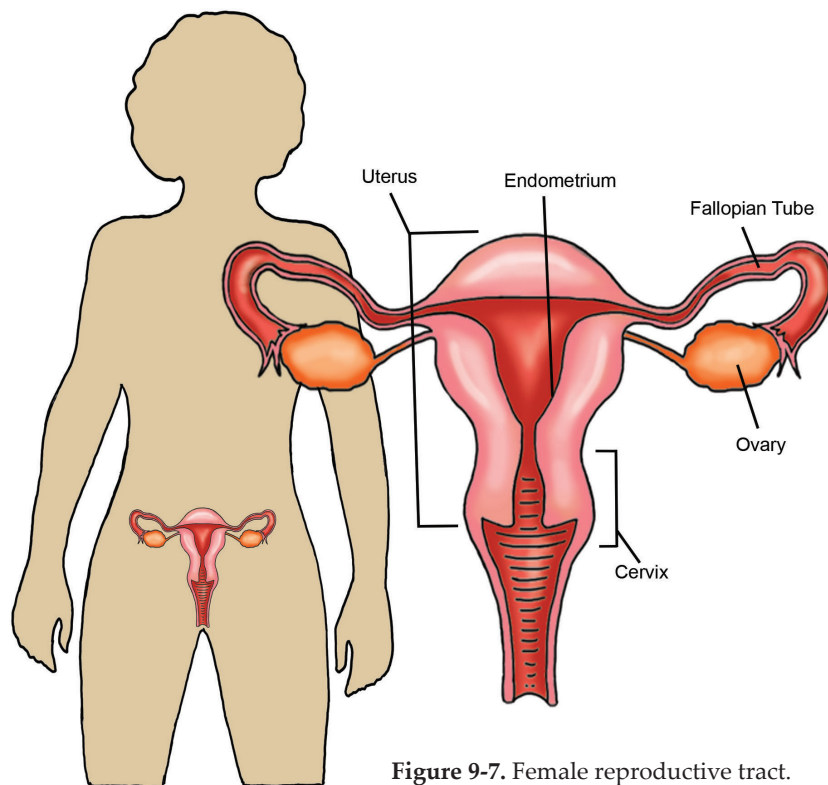


Figure 9-7. Female reproductive tract.



## Fallopian Tubes

The fallopian tubes are hollow, round tubes that lie in close proximity to the ovaries and extend to the uterus (see Figure 9-7). Fallopian tubes facilitate movement of the ovum (egg) from the ovaries to the uterus and facilitate movement of the spermatozoa from the uterus to the ovaries.

## Uterus

The uterus is a muscular, pear-shaped reproductive organ in the middle of the pelvis (between the sacrum and the pubis symphysis) (see Figure 9-7). The uterus provides a stable environment to nourish and grow an embryo (see Figure 9-7).

## Check on Learning

1. List the eight organs located in the left upper quadrant (LUQ).
2. The \_\_\_\_\_ absorbs water and electrolytes (as much as 5–7 L/day) and stores fecal matter until it is expelled.

## ABDOMINAL ASSESSMENT

All examinations begin with initiating SOAP (subjective, objective, assessment, and plan) note patient documentation on a Standard Form 600, Chronological Record of Medical Care (see Chapter 1, Sick Call and Medical Documentation). During the objective portion of the SOAP note, conduct a proper physical exam.

## Visual Inspection

Expose the patient from the xyphoid process to the symphysis pubis, making sure to keep the patient warm and comfortable. With the patient lying supine with arms at the sides, ask the patient to bend their knees, or support them with a pillow to help relax the abdominal muscles (Figure 9-8). Ask the patient to point to the site of any pain (remember to palpate that area last).

Begin assessing from the patient's right. First, inspect the patient's skin, noting the color (eg, pale, flushed, or yellow). Next, look for lesions. If present, describe their location, shape, size, and color (eg, scars, stretch marks, or rashes). Continue the assessment by examining the abdomen contour and symmetry. This may help identify any underlying issues. To make contour changes more obvious, have the patient take

and hold a deep breath. Look for a flat or distended abdomen, bulges, masses, swelling, muscle spasms, visible peristalsis, or pulsations. The following are the basic abdomen variations seen on examination:

- flat—common in thin patients with good muscle tone;
- **navicular (scaphoid) abdomen**—a condition in which the anterior abdominal wall is sunken;
- distention or bulging—normal (eg, pregnancy or obesity) or abnormal (eg, infection or internal bleeding) distortion that may be caused by air, fluid, or tissue; and
- **asymmetrical distention** or protrusion—may be caused by a hernia, tumor, cyst, bowel obstruction, or enlargement of abdominal organs.

## Auscultation of Bowel Sounds

Once the visual inspection is complete, warm the stethoscope diaphragm then **auscultate** the patient (Figure 9-9). Listen to all four quadrants (RLQ, LLQ, RUQ, and LUQ). Do not touch the abdomen before completing auscultation, as palpation can alter **bowel sounds**. Note if sounds are present or absent. Remember that the stage of digestion affects their characteristics. Check and categorize bowel sounds as one of the following:

- hypoactive—quiet, slow, sluggish sounds; associated with an acute abdomen or constipation.
- active—frequent clicks and gurgles. Describe as “active” (5–35 times per minute). Do not describe as “normal.”
- hyperactive—loud, prolonged gurgles normally associated with hunger. Increased bowel sounds may occur with **gastroenteritis** or early obstruction.
- absent—established only after 5 minutes of continuous listening in each quadrant (it is rare for a combat medic to auscultate the abdomen for this length of time). Auscultate all four quadrants to avoid missing sounds.
- vascular sounds—a bruit (pronounced “broo-ee”) is a harsh, blowing sound heard with auscultation that results from turbulent blood flow through an artery. This could be caused by narrowing of an artery or weakening of the artery wall, as in the case of an aneurysm. If you think you hear any other sound besides bowel sounds, alert the medical officer (MO) immediately.

## Palpation

Perform palpation at the end of an abdominal examination. A patient with abdominal pain may experience abdominal wall muscle spasms during palpation in an effort to guard against pain. The patient may also attempt to block the examiner from assessing a painful area. Sometimes, during deep palpation of the abdomen, the patient experiences greater pain upon quick release of the examiner's hands than during the actual palpation. This is rebound tenderness and suggests inflammation of the parietal peritoneum. Potential causes of rebound tenderness include **perforated** viscera, such as a ruptured appendix or bowel.

**Note:** A positive response during a check for rebound tenderness interferes with any subsequent examination.

If the patient is experiencing pain, have them point to the pain site. Palpate that area last. Palpate all quadrants using light, deep, or bimanual palpation (one hand atop the other), beginning with light palpation (Figure 9-10). Lightly depress the abdomen about 1 cm with your fingers to detect **guarding** and tenderness that may be caused by peritonitis. Deeply palpate by pressing into the abdominal wall with the distal half of your fingers. This assesses deeper structures within the abdomen. Use bimanual palpation if deep palpation is difficult because of obesity or muscular resistance. To perform this technique, place one hand atop the other (some examiners prefer this method with all patients).

The five steps of an abdominal physical exam are as follows:

1. Prepare and position the patient.
2. If the patient is experiencing any abdominal pain, have them point to the location of the pain.
3. Perform an inspection of the abdomen.
  - a. Utilize the **DCAP-BTLS** acronym when performing a visual and physical inspection of the abdomen.
  - b. Inspect the skin.
  - c. Inspect contour and symmetry (have the patient take in and hold a deep breath).
4. Auscultate bowel sounds in all four abdominal quadrants. Auscultate the quadrant the patient identified as being painful last.



**Figure 9-8.** A combat medic flexing a patient's legs to relieve pain during an abdominal examination.



**Figure 9-9.** A combat medic auscultating abdominal quadrants during an abdominal exam.



**Figure 9-10.** A combat medic performing bimanual palpation of the patient's abdominal quadrants.

5. Palpate all four abdominal quadrants.
  - a. Palpate the painful quadrant (as identified by the patient) last.
  - b. Perform light and deep palpation.
  - c. Feel for abdominal masses.
  - d. Observe for rebound tenderness.
  - e. Observe any guarding of the abdomen by the patient.

**Note:** In a field or combat environment, extensive examination is not warranted because it is urgent to move the patient to a treatment facility, where the examination will likely be repeated. However, do make a brief assessment, as the situation allows.

## RED FLAGS

When taking a patient history and performing an abdominal assessment, if any RED FLAG signs and symptoms present, refer the patient to an MO immediately. The following signs and symptoms are RED FLAGS:

- progressive, severe pain that persists without improvement over 6 hours;
- severe abdominal pain with guarding or rebound tenderness, especially in the RLQ;
- history of abdominal surgery within the past 6 months;
- abdominal pain with associated fever;
- abdominal pain with associated tachycardia;
- patient reporting blood in stool (black or tar-like stool);
- vomitus containing blood or having a coffee-ground appearance;
- abdominal pain with dehydration;
- abdominal pain in a pregnant patient; and
- abdominal pain in a female who is late having her menstrual period.

## Check on Learning

3. List 4 of the 10 abdominal assessment RED FLAGS that require immediate referral to an MO.
4. Name the condition in which the anterior abdominal wall is sunken.
5. Auscultate each abdominal quadrant for at least \_\_\_\_ minutes in each quadrant.

6. \_\_\_\_ is a harsh, blowing sound heard with auscultation that results from turbulent blood flow through an artery.
7. What type of palpation technique should you use if deep palpation is difficult because the patient is obese or very muscular?

## ABDOMINAL DISORDERS

### Abdominal Masses

Note the abdomen's consistency, mobility, and movement with respiration. Take care not to confuse normal abdominal structures for abdominal masses. Evaluate rebound tenderness at the end of the examination. Refer the patient to an MO if you detect any abdominal masses.

### Gastroenteritis

Gastrointestinal disorders are one major source of abdominal discomfort, and gastroenteritis is chief among these conditions. Gastroenteritis occurs when the stomach or intestines become inflamed. It is usually caused by infection (commonly viral), has rapid onset, and is self-limited to a few days. In severe cases, gastroenteritis is complicated by dehydration.

Gastroenteritis is commonly spread through contaminated food or water. Improper hand washing can spread bacteria or virus from person to person. Common signs and symptoms include:

- cramping,
- abdominal pain,
- nausea,
- vomiting,
- diarrhea, and
- fever ( $\geq 100.4^{\circ}\text{F}$ ).

In serious cases, a physical examination may reveal a swollen abdomen.

Treatment of gastroenteritis is limited to treating the symptoms (no antibiotics). Use bismuth subsalicylate (eg, Pepto-Bismol [The Procter & Gamble Company, Cincinnati, OH] or Kaopectate [Chattem, Inc, Chattanooga, TN]) to help bind up and remove bowel contaminants. Antispasmodic medications, such as dicyclomine, in conjunction with bismuth subsalicylate, can alleviate cramping pain. The patient should avoid foods and beverages likely to upset the gastrointestinal tract (fried, fatty, greasy, and spicy



foods; alcoholic beverages). A BRAT (bananas, rice, applesauce, and toast) diet may be recommended. Encourage increased liquid intake once the patient is able to tolerate oral intake.

**Note:** Bismuth subsalicylate may cause the stool to appear black and tarry and may be confused with a gastrointestinal bleed.

## Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) occurs when pressure is greater in the stomach than in the lower esophagus, causing stomach contents, including destructive acidic gastric juices, to reflux into the esophagus. The lower esophageal sphincter (a band of smooth muscle tissue where the esophagus meets the stomach) normally prevents gastric contents from moving up the esophagus. It controls the gradient of air pressure in the lower esophagus relative to the air pressure in the stomach. Usually air pressure in the lower esophagus is greater than the pressure in the stomach, creating the tendency for stomach contents to remain in the stomach.

Diagnosis is usually made based on symptoms and the absence of findings that would suggest other causes. The most common symptom of GERD is a burning sensation, or heartburn, so named because of the proximity of the esophagus to the heart. GERD affects about 20% of adults, who report at least weekly episodes of heartburn, and up to 10% complain of daily symptoms. Patients with GERD may have a history of heartburn aggravated by meals, bending, or lying down. Patients may report relief after taking antacids.

**Note:** These symptoms could also be the result of a stomach ulcer, gallstones, or angina pectoris (chest pain due to coronary artery disease).

Physical examination is usually normal in uncomplicated cases. Examine the heart and lungs, as with other patients. Special diagnostic tests may be necessary. Although most patients have mild disease, up to 50% develop esophageal mucosal damage (**reflux esophagitis**) and a few develop more serious complications. Refer patients to an MO for diagnosis and treatment. Consult with an MO for previously diagnosed patients who require symptomatic treatment.

GERD is a lifelong disease, managed by lifestyle modifications. Recommendations include the following:

- avoid lying down within 3 hours of eating a meal,
- lose weight,
- quit smoking,
- avoid foods and beverages known to precipitate symptoms, and
- avoid activities known to precipitate symptoms.

Over-the-counter antacids usually provide rapid, though short-term, symptomatic relief. These antacids include aluminum hydroxide/magnesium hydroxide (eg, Maalox [Novartis Corporation, Parsippany, NJ]), aluminum hydroxide/magnesium hydroxide/simethicone (eg, Mylanta [McNeil Consumer Pharmaceuticals Co, Ft Washington, PA]), milk of magnesia, and the H<sub>2</sub> receptor agonist, cimetidine (eg, Tagamet [GlaxoSmith-Kline, London, UK]). The over-the-counter version of Tagamet is half the dose strength of the prescription form. Prescription acid-blocking medications are typically required on a daily basis to minimize the severity and reduce the frequency of GERD symptoms.

## Peptic Ulcer Disease

Peptic ulcer disease (PUD) is a gastrointestinal disorder caused by a break in the mucosa (lining) of the stomach or first part of the small intestine (duodenum). It usually presents with pain or aching and burning in the middle upper abdomen (**dyspepsia**). PUD occurs more commonly in smokers and patients taking anti-inflammatory medications, such as ibuprofen or aspirin, for prolonged periods. Increased use of alcohol can aggravate PUD. *Helicobacter pylori* bacteria also cause PUD.

Before an ulcer develops, patients may experience dyspepsia for an extended period. Pain may or may not be associated with eating or drinking.

The physical examination of the abdomen will reveal tenderness to palpation in the middle upper abdomen (mid-epigastric area). A rectal examination may reveal blood in the stool and the patient may report black, tarry-looking stools (melena). A fecal occult blood test may reveal hidden blood in the stool. Refer PUD cases to an MO. Advise patients who smoke to quit. Avoid foods, alcoholic beverages, and medications that aggravate symptoms.

## Hepatitis

Another common gastrointestinal ailment is liver inflammation (hepatitis A, B, and C). A variety of agents, including viruses, bacteria, and physical or chemical agents (drugs and alcohol), cause hepatitis. Among soldiers, viral and alcoholic hepatitis are most common.

Signs and symptoms of hepatitis include:

- jaundice (yellowing of skin, nails, and sclera),
- anorexia (loss of appetite),
- nausea and vomiting,
- **malaise**, and
- fever.

Physical examination of the abdomen will reveal pain when palpating the liver, which may be enlarged and tender.

**Note:** Some patients may state they have chronic hepatitis, which is mild inflammation from the same causes, but usually without the obvious signs and symptoms listed above.

**Note:** Patients with hepatitis may experience serious complications. Refer them to an MO.

## Appendicitis

Another common cause for gastrointestinal complaint occurs when the appendix is obstructed by a fecalith (hardened feces), inflammation, intestinal worms, foreign body, swollen lymph nodes, or neoplasm (cancerous process) (Figure 9-11). The obstruction leads to increased pressure within the appendix, congestion of venous blood, infection, and thrombosis (clotting) of blood within the appendix wall. If untreated, gangrene and perforation can develop within 36 hours.

Signs and symptoms of appendicitis include:

- pain (early in the course) around the navel region,
- pain that migrates to the RLQ,
- loss of appetite,
- nausea,
- vomiting,
- extreme constipation,
- low-grade fever, and
- elevated white blood cell count.

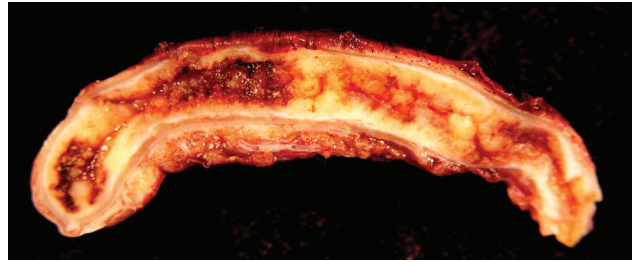


**Figure 9-11.** Acute appendicitis in a 10-year-old boy. This patient's appendix was removed before it could rupture and cause further complications. Photograph by Ed Uthman. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Acute\\_Appendicitis.jpg](https://commons.wikimedia.org/wiki/File:Acute_Appendicitis.jpg).

Physical examination of the abdomen will reveal pain that localizes to the RLQ, frequently with guarding and rebound tenderness. Refer appendicitis patients to an MO. The appendix typically is surgically removed (appendectomy).

## Constipation

Constipation is a common abdominal complaint caused most frequently in the service member population by inadequate fluid and dietary fiber intake. Normal frequency of bowel movements varies. "Normal" is defined as 3 per week by some and 12 per week by others. The following patient complaints are common:

- cannot move bowels when they feel the urge to do so;
- cramping pain due to peristalsis;
- tearing pain or straining during bowel movements that produce firm, hard stools;
- abdominal pain (uncommon unless the constipation is severe); and
- slight blood noticed on the toilet tissue after passing a hard stool.

Physical examination of the abdomen is usually unremarkable unless there is severe constipation, in which case the examiner may palpate a firm mass in the LLQ.

To reduce the likelihood of future constipation, advise patients to increase fluid and dietary fiber intake (eg, whole grain cereals) and encourage daily exercise. Fiber supplements like psyllium (eg, Metamucil [Procter & Gamble Company, Cincinnati, OH]), methylcellulose (eg, Citrucel [GlaxoSmithKline, London, UK]), or polycarbophil (eg, FiberCon [Pfizer Inc, New York, NY]) taken on a daily basis will help the patient maintain regular bowel habits. Stool softeners,

such as docusate sodium (eg, Colace [Avrio Health LP, Stamford CT]) taken by mouth for several days, and short-term use of a stimulant laxative such as bisacodyl (eg, Dulcolax [Boehringer Ingelheim Pharmaceuticals, Inc, Ridgefield, CT]) are beneficial. Refer patients with persistent constipation or significant abdominal pain or discomfort to an MO.

## Diarrhea

Diarrhea is the frequent passage of unformed, watery stool. It can range in severity from an acute, self-limiting episode to a life-threatening illness. It is helpful to distinguish acute from chronic diarrheas because treatments differ.

### Acute Diarrhea

Viruses, bacteria, bacterial toxins, and parasites commonly cause acute diarrhea. Infection frequently results from consuming unpurified water or improperly stored or prepared food. Noninfectious causes include medications (such as antibiotics) and food allergies. Signs and symptoms of diarrhea (infectious or noninfectious) include the following:

- acute onset;
- persists for up to 3 weeks;
- frequent loose or watery stools that may contain blood, mucus, or pus;
- fever;
- abdominal pain, tenderness, cramping;
- history of travel outside the continental United States (because of the possibility of consuming water from an unapproved source);
- history of field exercise;
- orthostatic hypotension (tilts); and
- weight loss (especially if symptoms are chronic).

**Note:** Orthostatic hypotension (tilts) is a drop in blood pressure when a patient changes position from lying to sitting ( $\geq 10$  mm Hg after 1–3 min) or from lying to standing ( $\geq 20$  mm Hg after 1–3 min). A patient feeling dizzy or lightheaded upon standing may indicate a fluid volume deficit (dehydration).

**Note:** Do not give antidiarrheal medication if the patient is experiencing fever or bloody stool.

Some viral illnesses that present with diarrhea also have head, eyes, ears, nose, and throat (HEENT) signs and symptoms. Conduct a physical HEENT examination. Physical examination of the abdomen will reveal tenderness to palpation. Treatment includes fluid resuscitation (intravenous or oral fluid and electrolyte replacement) and antidiarrheal medications. For simple or minimal diarrhea, treat with loperamide (eg, Imodium [McNeil Consumer Pharmaceuticals Co, Ft Washington, PA]) or bismuth subsalicylate (eg, Pepto-Bismol or Kaopectate [Chattem, Inc, Chattanooga, TN]).

Antibiotic therapy is recommended for moderate to severe bacterial diarrhea with fever or with bloody stools (eg, “traveler’s diarrhea” when deployed). Consult with an MO. Put the patient on a liquid diet at first, and progress to a bland diet (avoiding caffeine, dairy products, and raw fruits and vegetables). The patient should only consume food and water from approved sources. Refer the patient to an MO if the diarrhea does not resolve with the above treatment.

### Chronic Diarrhea

Chronic diarrhea persists longer than 3 weeks. It may be bacterial, viral, or parasitic. Diarrhea not caused by infections could be attributed to a number of motility, secretory, inflammatory, or **malabsorption** disorders. Some chronic infections, systemic conditions, or medications may cause chronic diarrhea. Sometimes the cause of chronic diarrhea remains unknown. Refer all patients with chronic diarrhea to an MO for diagnosis and treatment.

### Hemorrhoids

Hemorrhoids are varicose (blood engorged) veins in the lower rectum or anus that are caused by straining during a bowel movement, constipation, prolonged sitting, pregnancy, and a diet low in fiber. Signs and symptoms of hemorrhoids include:

- itching,
- irritation,
- pain with bowel movement, and
- blood in the toilet or on toilet paper (typically bright red).

Ensure vital signs do not indicate the presence of severe hemorrhaging. Physical examination will reveal an obvious external hemorrhoid, or internal hemorrhoids on rectum inspection. If there is no obvious source of bleeding, refer the patient to an MO for further examination. Otherwise, encourage the patient to consume a



diet high in fiber (vegetables, fruits, grains) and increase water intake to promote soft, formed, regular bowel movements. Soaking in a sitz bath for 15 minutes 3 times per day reduces pain and swelling. Medications may include daily stool softener (eg, docusate sodium) by mouth and a bulk-forming laxative. Pain can be controlled with nonsteroidal anti-inflammatory drugs (eg, ibuprofen) or other analgesics (eg, acetaminophen), and topical anesthetics (eg, dibucaine). Patients with hemorrhoids should avoid straining (eg, performing sit-ups or heavy-lifting tasks).

### **Female Reproductive Tract Disorders**

Since female reproductive organs are located in the RLQ and LLQ (see Figure 9-7), be aware that some abdominal complaints may be related to reproductive tract disorders.

#### ***Premenstrual Syndrome***

Premenstrual syndrome has a variety of symptoms, but abdominal pain is common. Use nonsteroidal anti-inflammatory drugs (eg, ibuprofen) or other over-the-counter medications specifically for premenstrual syndrome to alleviate pain.

#### ***Endometriosis***

Another common disorder is endometriosis, which occurs when endometrial cells that normally line the uterus grow outside of the uterus. The most common signs and symptoms are:

- severe (even debilitating) premenstrual cramps,
- very long or heavy periods,
- migraines, and
- lower back pain.

Several symptoms are similar to those of other abdominal disorders. They include:

- nausea,
- diarrhea,
- constipation,
- bloody urine,
- rectal bleeding, and
- bloating.

Refer to an MO for diagnosis (imaging or lab tests) and treatment.

### ***Pelvic Inflammatory Disease***

Sexually transmitted bacteria that spread from the vagina to other reproductive organs typically cause pelvic inflammatory disease (PID). Symptoms may include:

- lower abdominal pain,
- irregular vaginal discharge,
- abnormal uterine bleeding,
- painful urination, and
- fever.

PID may be asymptomatic in some cases. Prevention includes practicing safe sex and treating sexually transmitted infections early. Refer to an MO if you suspect PID.

#### ***Uterine Fibroids***

Uterine fibroids are noncancerous growths in the uterus. Symptoms may include:

- pelvic pain,
- heavy bleeding,
- long menstrual periods,
- frequent urination,
- difficulty emptying the bladder, and
- constipation.

Some cases are asymptomatic. If suspicious of uterine fibroids, refer to an MO for diagnosis and treatment.

#### ***Ectopic Pregnancy***

An ectopic pregnancy is any pregnancy where the fertilized ovum implants outside of the uterus. The ectopic pregnancy can occur in the peritoneum; however, it mostly occurs in the fallopian tubes. Ectopic pregnancy signs and symptoms include abdominal pain, a delay in the menstrual cycle, and vaginal bleeding (usually a spotting type of bleeding). An ectopic pregnancy may start as a dull pain that worsens into sharp, stabbing pain as the fallopian tube stretches. If the tube ruptures, excruciating pain will be present throughout the abdomen.<sup>1</sup>

## URINARY DISORDERS

### Cystitis

Cystitis (also known as a urinary tract infection or UTI) is caused by an infection of the urinary bladder. It is more common in women than in men and often occurs after sexual intercourse. It is also more common in soldiers in a field environment because of dehydration (infrequent urination prevents contaminant washout). Signs and symptoms of cystitis include:

- painful urination (dysuria),
- frequent urination,
- urinary urgency,
- discomfort in the suprapubic area, and
- obvious blood in the urine (gross hematuria).

Physical examination is usually unremarkable, with the possible exception of tenderness to palpation of the suprapubic area. Urinalysis commonly reveals the presence of blood and bacteria. If treatment is delayed, pathogens can migrate up the ureters and cause a kidney infection.

Refer all patients with cystitis to an MO for antibiotic therapy. Patients can benefit from increasing oral fluid intake. To prevent recurrence, encourage patients to urinate after sexual intercourse, which will flush any bacteria introduced into the urethra. Advise females to wipe from front to back after urinating to prevent wiping bacteria toward the urethra.

### Pyelonephritis

Delayed treatment for cystitis can allow the infection to migrate to the kidneys, causing **pyelonephritis** (kidney infection). It may occur in males, though it is uncommon.

Signs and symptoms of pyelonephritis include the following:

- back pain in the region of the affected kidney (flank pain),
- **costovertebral angle** tenderness that is elicited when the examiner taps a fist over the location of the patient's kidney,
- nausea and vomiting,
- fever with tachycardia,
- shaking (tremors) and chills,
- pain with urination (dysuria),
- frequent urination (polyuria), and
- urine that appears bloody (gross hematuria).

Refer any patient with a suspected kidney infection to an MO. Patients usually need antibiotic therapy and sometimes must be hospitalized.

### Nephrolithiasis

Nephrolithiasis (kidney stones) occurs three times more often in men than women and tends to occur more often during hot, summer months. Kidney stones (Figure 9-12) are common in hot, desert environments.

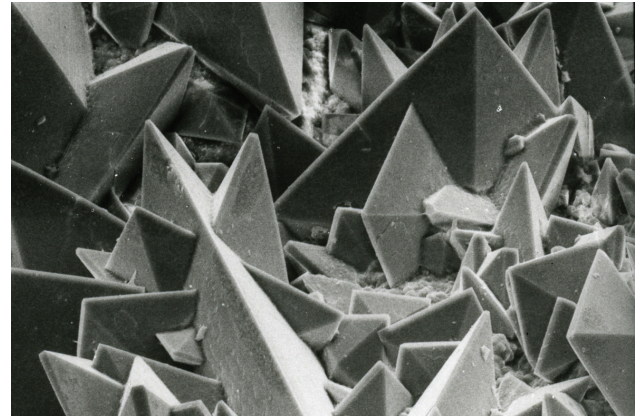


**Figure 9-12.** Electron micrograph of the surface of a kidney stone. Photograph by Kempf, EK. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Surface\\_of\\_a\\_kidney\\_stone.jpg](https://commons.wikimedia.org/wiki/File:Surface_of_a_kidney_stone.jpg)

The patient usually presents with obvious cramping and intermittent pain, and will often be restless and constantly moving. Constant movement is unique and contrasts with those patients presenting with surgical problems such as peritonitis or appendicitis. The pain is typically severe and colicky (comes and goes or varies in intensity in a rhythmic nature) and usually develops suddenly, sometimes awakening the patient from sleep. Pain onset is usually in the flank and migrates as the stone makes its way through the urinary tract. Pain may be referred to the testicles. Other signs and symptoms include gross hematuria, fever (common), and tenderness to palpation near the stone. Always refer the patient to an MO for treatment. A narcotic pain medication, antibiotics, and close observation are required.

Most kidney stones will pass through the urinary tract on their own. Provide the patient with increased fluid (sometimes intravenously) and appropriate pain control medications until the stone passes. Prevention centers on ensuring adequate fluid intake, especially in hot climates.

## Check on Learning

8. What is the treatment consideration for acute diarrhea?
9. What information from the patient indicates a possible hemorrhoid problem?
10. Explain how cystitis (urinary tract infection) can develop into pyelonephritis (kidney infection).
11. Why would urinating after sexual intercourse help reduce the chances of developing cystitis?
12. How does a patient experiencing nephrolithiasis (kidney stones) present differently than patients with other abdominal problems, such as appendicitis?

## SUMMARY

Combat medics may assess and treat patients with abdominal complaints ranging from minor illnesses to immediate life threats. The ability to identify RED FLAGS, requiring immediate referral to an MO, could mean the difference between life and death.

## KEY TERMS AND ACRONYMS

**Asymmetrical distention.** Uneven distention.

**Auscultate.** To examine by listening to sounds emitting from the body.

**Bowel sounds.** The normal sounds associated with movement of the intestinal tract.

**Cecum.** A blind pouch or cul-de-sac that forms the first portion of the large intestine, located below the entrance of the ileum at the ileocecal valve.

**Costovertebral angle.** An angle at the base of the rib cage (12th rib) and the top of the lumbar vertebrae, in the area of the kidneys.

**DCAP-BTLS.** Deformities, contusions, abrasions, punctures, burns, tenderness, lacerations, and swelling.

**Duodenum.** The first part of the small intestine, between the pylorus and the jejunum.

**Dyspepsia.** Upper abdominal discomfort, often chronic or persistent, generically referred to as indigestion.

**Gastroenteritis.** Inflammation of the stomach and intestinal tract.

**Glucagon.** A hormone secreted by the pancreas that causes an increase in blood glucose levels by stimulating the liver to release stored glucose, known as glycogen.

**Guarding.** The body's defense method to prevent movement of an injured part.

**Ilium.** The last (third) part of the small intestine, extending from the jejunum to the opening of the large intestine

**Jejunum.** The second portion of the small intestine, extending from the duodenum to the ileum.

**Lipid-soluble.** The characteristic of dissolving in fats.

**Malabsorption.** Inadequate absorption of nutrients in the small intestines.

**Malaise.** A subjective feeling of discomfort, fatigue, and weakness.

**Mesentery.** The peritoneal fold that encircles the small intestine and connects to the posterior abdominal wall.

**Navicular (scaphoid) abdomen.** A condition in which the anterior abdominal wall is sunken, having a concave rather than a convex contour. Also called scaphoid abdomen.

**Parietal peritoneum.** The serous peritoneal membrane that lines the abdominal cavity.

**Perforated.** Pierced or punctured.

**Peritoneum.** The serous membrane lining the abdominal cavity and reflecting over the viscera.

**Pyelonephritis.** Infection of the kidneys, which usually results from a migrating bladder infection (cystitis).

**Reflux esophagitis.** Inflammation of the esophagus due to acid reflux.

**Retroperitoneal.** Behind and outside the peritoneal cavity.

**Sigmoid.** An "s" shape. The sigmoid colon bends medially at the left iliac crest.

**Splenic flexure.** The junction of transverse and descending colon. It bends on the left side, near the spleen.

**Transverse colon.** The middle part of the large intestine that extends from right to left below the stomach.

**Visceral peritoneum.** The serous peritoneal membrane that lines the organs in the abdominal cavity.



## CHECK ON LEARNING ANSWERS

1. List the eight organs located in the left upper quadrant (LUQ).  
*Stomach, spleen, tail of the pancreas (retroperitoneal), part of the colon (splenic flexure and portion of the transverse colon), a portion of the small intestine, abdominal aorta (along the line separating the RUQ from the LUQ), left kidney (retroperitoneal), and left renal artery.*
2. The \_\_\_\_\_ absorbs water and electrolytes (as much as 5–7 L/day) and stores fecal matter until it is expelled.  
*Colon (large intestine).*
3. List 4 of the 10 abdominal assessment RED FLAGS that require immediate referral to an MO.  
*Any four of the following:*
  - *Progressive, severe pain that persists without improvement for more than 6 hours.*
  - *Severe abdominal pain with guarding or rebound tenderness, especially in the RLQ.*
  - *History of abdominal surgery within the past 6 months.*
  - *Abdominal pain with associated fever.*
  - *Abdominal pain with associated tachycardia.*
  - *Patient reporting blood in stool, black or tar-like stool.*
  - *Emesis (vomitus) containing blood or having a coffee-ground appearance.*
  - *Abdominal pain with dehydration.*
  - *Abdominal pain in a pregnant patient.*
  - *Abdominal pain in a female who is late having her menstrual period.*
4. Name the condition in which the anterior abdominal wall is sunken.  
*Navicular abdomen (scaphoid abdomen).*
5. Auscultate each abdominal quadrant for at least \_\_\_\_\_ minutes in each quadrant.  
*Five.*
6. \_\_\_\_\_ is a harsh, blowing sound heard with auscultation that results from turbulent blood flow through an artery.  
*Bruit.*
7. What type of palpation technique should you use if deep palpation is difficult because the patient is obese or very muscular?  
*Bimanual palpation.*
8. What is the treatment consideration for acute diarrhea?  
*Antibiotics; bland diet; and avoidance of caffeine, dairy products, raw fruits, and raw vegetables.*
9. What information provided by the patient indicates a possible hemorrhoid problem?  
*Itching, irritation, pain with bowel movements, and blood on toilet paper or in toilet.*
10. Explain how cystitis (urinary tract infection) can develop into pyelonephritis (kidney infection).  
*Delayed treatment for cystitis (UTI) can result in the infection migrating up into the kidneys.*

11. Why would urinating after sexual intercourse help reduce the chance of developing cystitis?  
*It will flush any bacteria that was introduced into the urethra.*
12. How does a patient experiencing nephrolithiasis (kidney stones) present differently than patients with other abdominal problems, such as appendicitis?  
*Patients with nephrolithiasis will be restless and constantly moving; patients with medical conditions such as appendicitis will not want to move at all.*

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# 10 ORTHOPEDICS PRIMARY CARE

## CORE CONCEPTS

- Discuss anatomy and physiology of musculoskeletal components.
- Recognize common musculoskeletal injuries.
- Assess a musculoskeletal injury or disorder.
- Perform specialized tests on a musculoskeletal patient when required.
- Treat common musculoskeletal disorders.

## INTRODUCTION

Combat medics are required to assist or personally examine individuals who have orthopedic (musculoskeletal) injuries or disorders. Because physical exertion and strenuous activity are a part of the everyday job required of most soldiers, it is no surprise that musculoskeletal problems are extremely common. Often there are no obvious findings on a physical exam. Whether in a field environment or in a medical treatment facility, you must know what questions to ask and which examinations to conduct. You then must select an appropriate treatment plan to provide the best quality medical care, ensure a speedy recovery, prevent further injury, and even prevent permanent disability.

## BONES

Bones have a variety of functions, and together, form the skeletal structure (Figure 10-1). They give the body its shape, provide structural support (in conjunction with muscles and adipose tissue), and protect vital organs. For example, the skull protects the brain and the rib cage protects the heart, lungs, liver, and kidneys. Bones assist in movement, serving as points of attachment for the muscles of the limbs. These attachments of muscle to bone allow us to do many things, such as stand erect, sit, jump, lift, and run. In addition to their structural and movement roles, bones produce blood cells, store minerals, and store chemical energy. There are five types of bones in the human body and they are the hardest and least flexible of the musculoskeletal tissues (Figure 10-2).

### Flat Bones

Flat bones primarily function to protect internal organs. They also provide structural support and surfaces for muscle attachment. They are usually flat and thin. Examples include the skull, ribs, sternum, scapula, and coccyx.

### Long Bones

The bones of the limbs, such as the humerus and femur, are long bones. They are longer than they are broad. Long bones support the weight of the body and facilitate movement. Long bone fractures may become a life-threatening injury due to the possibility of the jagged ends of the bone severing the arteries (eg, brachial or femoral) within the corresponding limb.

### Short Bones

These roughly cube-shaped bones help provide stability and movement. They are located in the wrists and ankles.

### Irregular Bones

Irregular bones protect internal organs. They have complex, varied shapes. For example, vertebrae are irregular bones that protect the spinal column. Other irregular bones include pelvic bones and facial bones. Irregular bones like the pelvic bones may also pose life-threatening risks when fractured. These bones, like long bones, can sever the major vessels and cause massive blood loss.





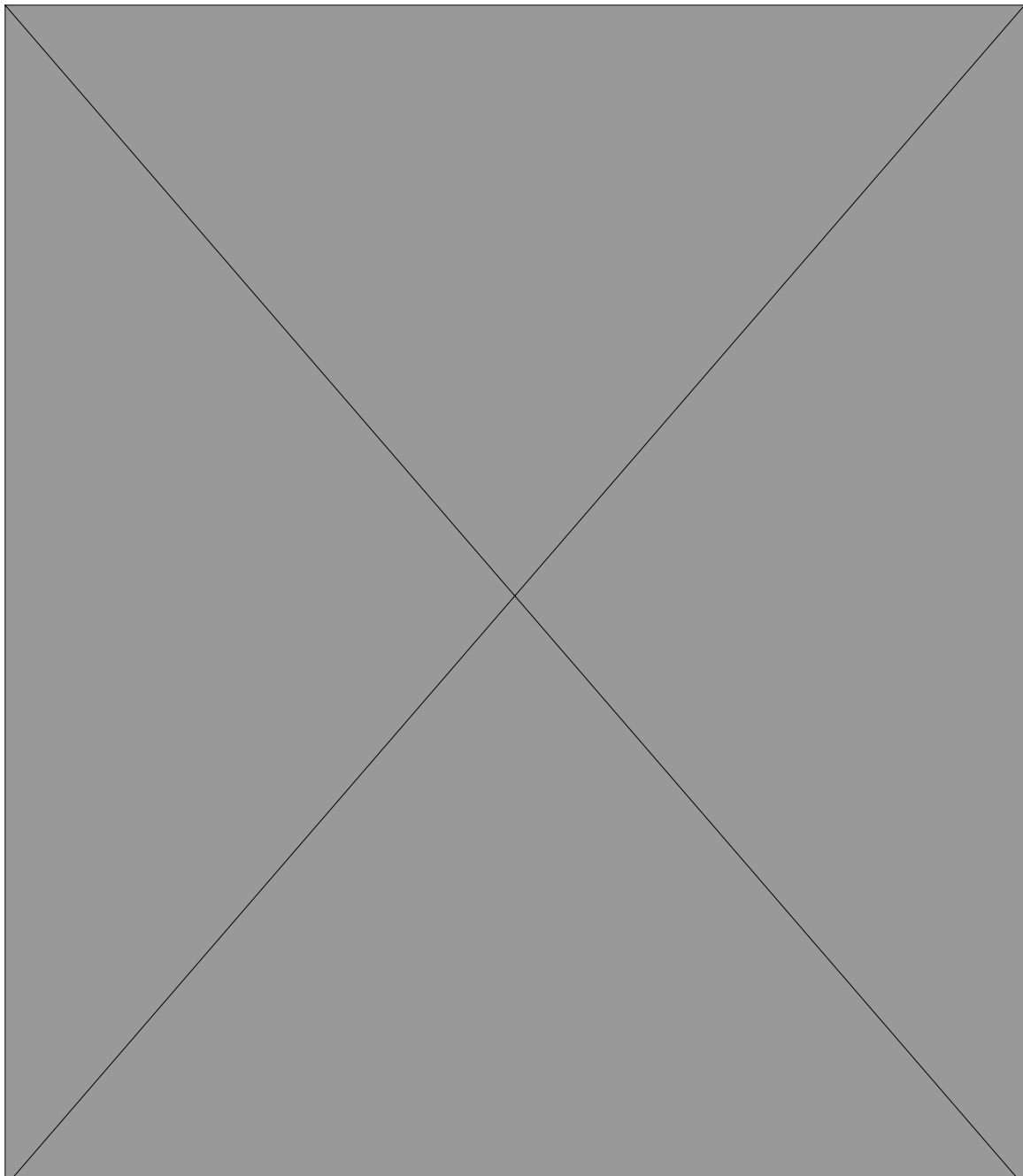


**Figure 10-2.** The five types of bones. Reproduced from OpenStax College. Provided by Rice University. Access for free at <https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>. License at <https://creativecommons.org/licenses/by/4.0/legalcode> <https://openstax.org/books/anatomy-and-physiology/pages/6-2-bone-classification#0y>

## Sesamoid Bones

The small, roundish sesamoid bones are embedded in **tendons** and help reinforce and protect them. The largest sesamoid bone in the human body is the knee (patella), but most are in the hands and feet.

### Check on Learning

1. List five functions of bones.
2. How many types of bones are there?
3. What is the largest sesamoid bone in the body?
4. What are long bones and why could a fracture of these bones become life threatening?

## JOINTS

A joint is a structure of bones connected to other bones by ligaments. The six different types of joints enable movement and provide stability. The joints with the most movement provide the least stability and the joints with the least movement have the most stability. Most joints of the extremities are synovial joints, which allow the greatest amount of motion (Figure 10-3). A bursa is a fluid filled sac typically found near a joint that helps reduce friction between bones and tendons or between tendons and ligaments.

### Ball-and-Socket Joints

The shoulder and hip have ball-and-socket joints, the type of joint with the greatest range of motion. Their movements include anterior and posterior, lateral and medial, and they can rotate around the long axis. Structurally, a ball at the end of one bone rotates in a round, concave socket in another bone. The typical injuries that affect ball-and-socket joints like the shoulder are **dislocation** and **subluxation**. Dislocation occurs when the articular surfaces of the bones that make up the joint completely separate and no longer contact one another. Subluxation occurs when there is an incomplete dislocation of a joint.

### Hinge Joints

Hinge joints can only bend and straighten. The convex end of one bone articulates with the concave end of another bone. Hinge joints include the elbow, knee, ankle, and joints between finger and toe bones.

### Pivot Joints

The pivot joints rotate on a single axis. Structurally, a rounded portion of one bone is held in place at the **articulation** point of another bone and ligament ring. The joint between the atlas and axis allows the head to turn from side to side. The joint between the radius and ulna allows the forearm to rotate.

### Condyloid Joints

These joints allow movement in two planes at right angles, bending, straightening, and moving side to side. They have an elliptical structure at the end of one bone that rests in a shallow depression at the end of another. Examples include the joint between the radius and carpus, and the knuckle joints.

### Saddle Joints

These joints allow movement in two planes at right angles, without any axial rotation. The ends of both adjoining bones are saddle shaped and fit together like a rider in a saddle. The joint at the base of the thumb gives us the function of opposable thumbs. Saddle joints also occur in the shoulder (sternoclavicular joint) and inner ear (between the malleus and incus).

### Gliding Joints

Gliding joints (plane joints) may allow limited movement in several directions, but the movement is constrained by surrounding ligaments. The surfaces at the end of articulating bones are flat (or mildly curved), so they can slide against one another. These joints are located between vertebrae, carpal bones of the wrist, tarsal bones of the foot, and between the clavicle and scapula of the shoulder.

## TENDONS, LIGAMENTS, AND CARTILAGE

### Tendons

Tendons connect muscle to bone to facilitate movement. The fibrous structures connect voluntary muscles to bones, cartilage, or ligaments. Tendons enable muscles to produce motion in the joint or body area to which they attach. They modulate forces from muscle contraction and provide stability.



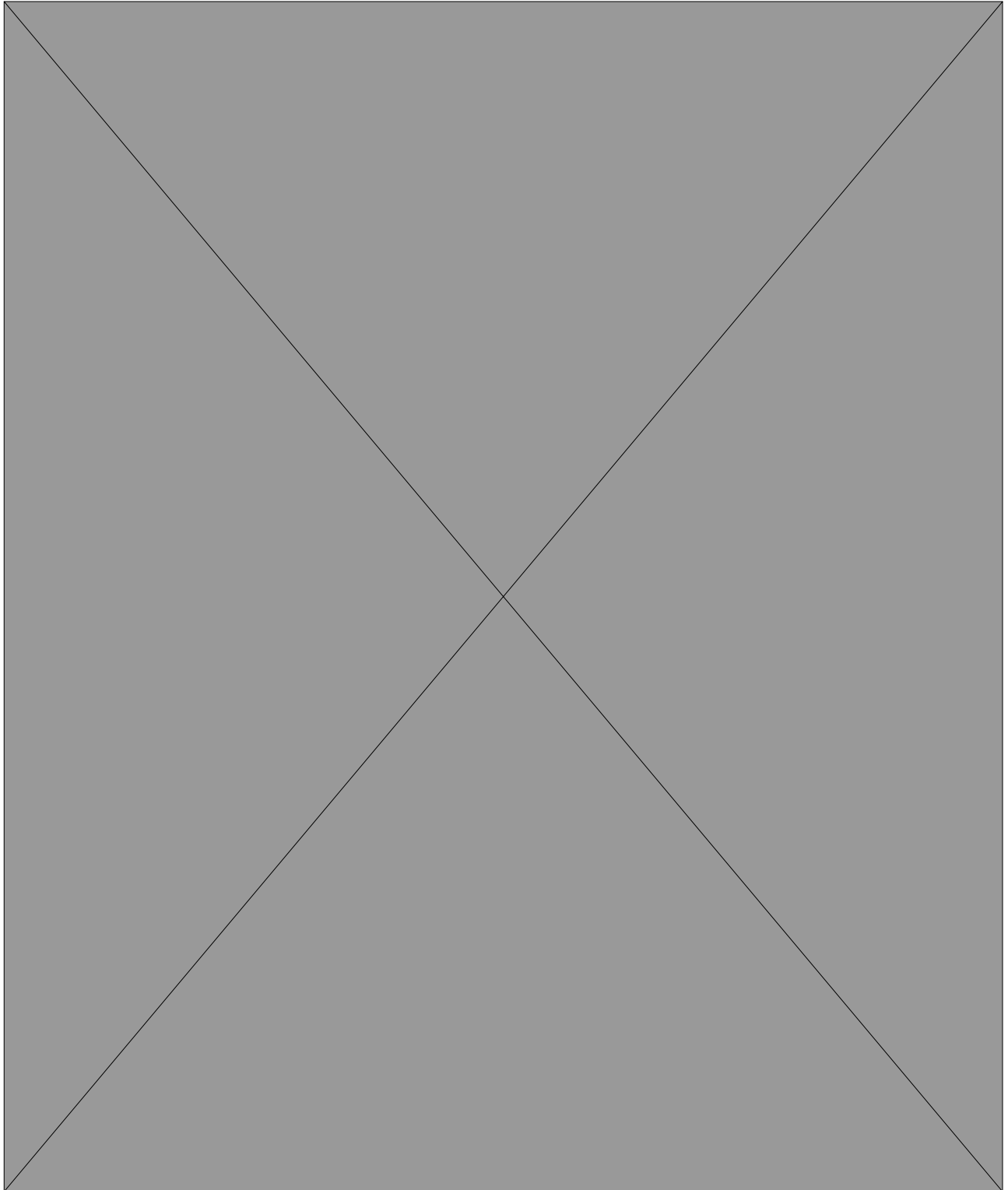


**Figure 10-3.** The types of synovial joints. Reproduced from OpenStax College. Provided by Rice University. Access for free at <https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>. License at <https://creativecommons.org/licenses/by/4.0/legalcode> <https://openstax.org/books/anatomy-and-physiology/pages/9-4-synovial-joints>

## Ligaments

Ligaments connect bone to bone at joints to provide stability. Ligaments are bundles of flexible connective tissue that form part of the fibrous capsule surrounding and attaching to a joint. Two or more ligaments reinforce all extremity joints. Ligaments stabilize and support the joint through its normal range of motion by confining its movement to specific planes and preventing **hyperextension** or **hyperflexion**. Ligaments within the ankle region are frequent sites of **sprains** in service members.

## Cartilage

Cartilage is tissue that acts as padding and protects the ends of bones at the joint. Cartilage is also present in the rib cage, nose, spine, and various other locations. Cartilage is a semi-rigid, fibrous connective tissue with a smooth surface. It is **avascular** and derives its nourishment from the synovial fluid and the underlying vascular bone. Cartilage has many functions in adults, including the following:

- support soft-tissue structure (eg, keep trachea open, maintain shape of ear and nose);
- provide strength and elasticity;
- reduce friction between bones within joints;
- cushion vertebrae and resist compression;
- prevent abrasion, wear of bones, and ultimately, bone-to-bone contact in joints; and
- allow the rib cage to move during breathing.

## MUSCLES

Muscles produce movement (voluntary and involuntary) and heat. Skeletal muscles contribute to voluntary and involuntary muscle movement through the somatic nervous system (SNS) and autonomic nervous system (ANS). Your ability to exert enough force to complete a 3-repetition maximum deadlift during the Army Combat Fitness Test is the result of the SNS acting on your skeletal muscles. In contrast, the ANS is responsible for involuntary muscle contractions, such as those that occur when your body is cold, cardiac contractions, and peristalsis.

Muscles are composed of contractile tissues. Their functions include the following:

- produce voluntary and involuntary movement,
- stabilize body position,

- move substances through the body,
- regulate temperature, and
- protect organs.

The different types of muscles have different functions.

## Skeletal Muscles

Skeletal muscles allow for voluntary movement throughout the body (Figure 10-4). They also help with posture and stability, protect organs, and regulate body temperature. Familiar examples include muscles such as biceps, quadriceps, and gluteals. A muscle **strain** is a common injury among soldiers. It can occur in many locations (eg, calf, lower back, and groin).

## Smooth Muscles

Smooth muscles are located in the walls of blood vessels, the digestive tract, and the reproductive tract. The muscle contractions within smooth muscle are involuntary. They help move food and urine and regulate diameter of blood vessels.

## Cardiac Muscles

Cardiac muscles continuously contract to pump blood throughout the body and maintain blood pressure. Special pacemaker cells regulate the involuntary contractions of cardiac muscles.

## Check on Learning

5. What are the functions of a joint?
6. Where are ball-and-socket joints located in the body?
7. Where are hinge joints located in the body?
8. Tendons connect bone to \_\_\_\_\_.
9. What are the functions of ligaments?
10. What is the main difference between skeletal and smooth muscle?

## SKELETAL STRUCTURE

In an adult, the skeleton comprises 206 bones, divided into two distinct portions: the axial skeleton and the appendicular skeleton (see Figure 10-1).

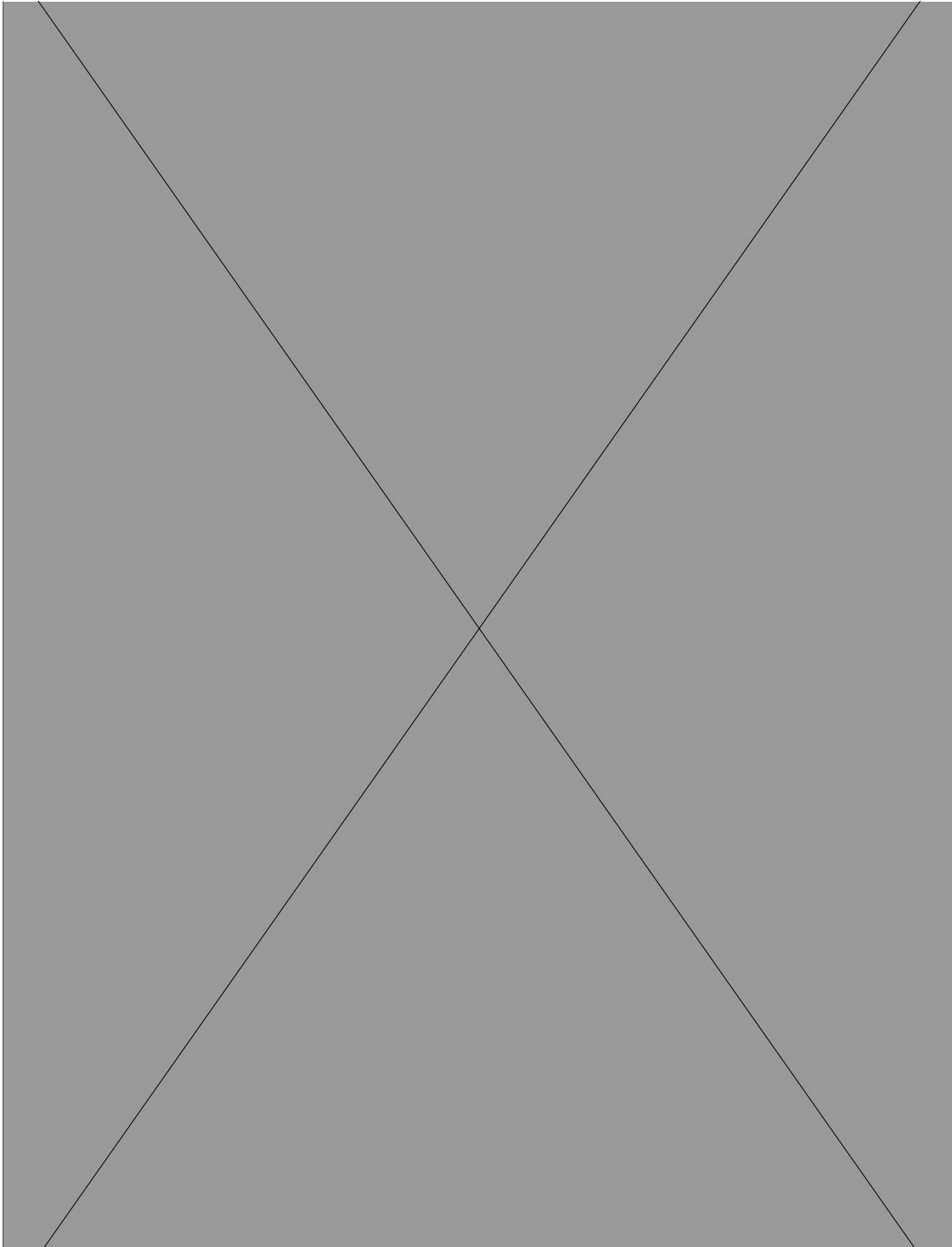


**Figure 10-4.** The major skeletal muscles of the body. Skeletal muscles are under voluntary control and are required for movement.



## Axial Skeleton

The word “axial” refers to bones that are close to the medial axis of the body. The axial skeleton provides midline support above the pelvis, and protects the vital organs. The axial skeleton, with approximately 80 bones, consists of the skull, vertebral column, ribs, and sternum.

### Head

The head consists of the skull and the facial bones. The skull includes the cranium and mandible. Several fused flat bones make up the cranium, which is the dome that protects and encloses the brain. Cranial sutures are the visible lines of fusion in the skull. The mandible is the lower portion of the mouth and jaw, which forms the chin. The facial bones (14 in total) include the nasal bones, cheekbones, and the upper mouth.

### Spine

The spinal (vertebral) column is a curved structure that consists of 33 spinal vertebrae, divided into sections from top to bottom as follows (Figure 10-5):

- cervical (7 vertebrae),
- thoracic (12 vertebrae),
- lumbar (5 vertebrae), and
- sacrococcygeal (5 fused vertebrae in the sacrum and 4 fused vertebrae in the coccyx).

The cervical spine includes the atlas and axis (specialty vertebrae). The atlas allows you to move your head vertically, as in a “yes” nod, and the axis allows you to move your head laterally, as in a “no” movement. The cervical spine (neck region) supports the head and is vulnerable to whiplash-type injuries. The thoracic region provides attachment points for the ribs. The lumbar region is where the spine naturally curves back inward to the body and is a common site of injury and pain. The sacrum (5 fused vertebrae) helps stabilize the hips and supports the base of the spinal column. The coccyx (3–5 fused vertebrae) forms the “tailbone.”

Each vertebra has an opening through the middle called the spinal canal. The spinal cord runs down the spinal canal, starting at the foramen magnum. The spinal cord only extends as far as the second lumbar vertebra. Below that point, only nerve roots pass through the spinal canal. The spinal column protects

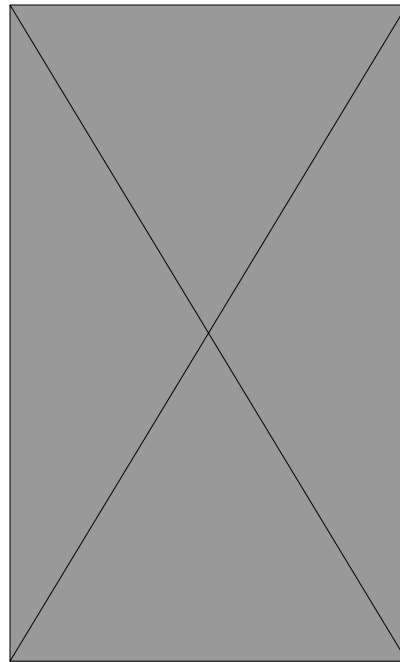


**Figure 10-5.** The segments of the spinal column. Image by Jmarchn, CC BY-SA 3.0, via Wikimedia Commons. Adapted from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Spinal\\_column\\_curvature\\_ca.svg](https://commons.wikimedia.org/wiki/File:Spinal_column_curvature_ca.svg)

the spinal cord, which has nerve roots exiting between each of the vertebrae.

There is an intervertebral disc on the anterior side of each vertebra. This rubber-like disc acts as a cushion between the stacked vertebrae. The posterior portion of each vertebra has a bony projection called the spinous process, which connects with adjacent vertebra to create facet joints. These facets limit the movement of the spine. The concave and convex curves of the spine help distribute upper body weight and cushion the impact of walking and running.

From the spine, 12 pairs of ribs and the sternum form the thorax anteriorly (Figure 10-6). The thorax helps protect many vital organs and great vessels. There are 12 ribs, 1 attached to each of the 12 thoracic vertebrae of the spinal column and curving anteriorly toward the sternum. The 2 ribs not attached to the sternum are “floating ribs.” Intercostal muscles between the ribs have 3 layers of muscle. They help expand the chest outward as you breathe.

The back comprises bones, discs, facet joints, ligaments, and muscles. The deep, paraspinal muscles are also called intrinsic muscles. They extend from the base of the skull to the sacrum and are responsible for back movements such as extending, arching, bending, twisting, or leaning to the side. The erector spinae act to flex

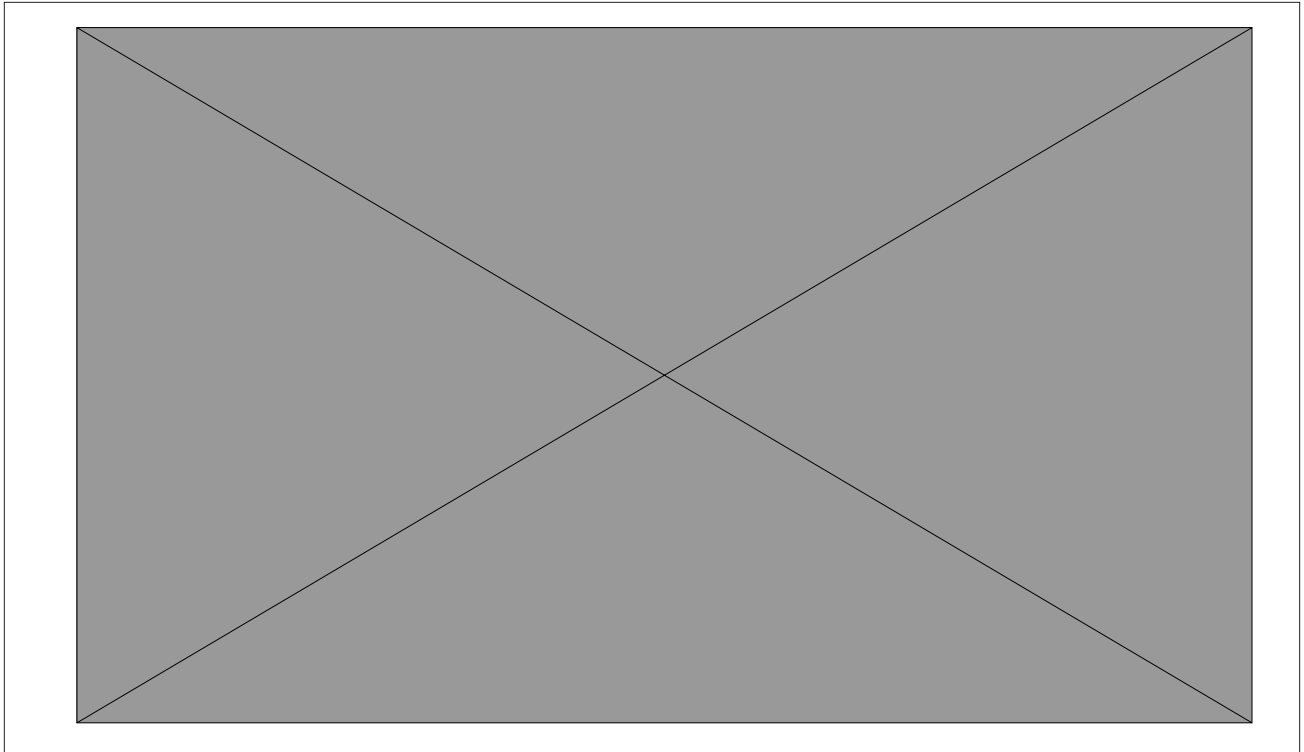


**Figure 10-6.** The ribs and sternum. Reproduced from OpenStax College. Provided by Rice University. Access for free at <https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>. License at <https://creativecommons.org/licenses/by/4.0/legalcode> <https://openstax.org/books/anatomy-and-physiology/pages/7-4-the-thoracic-cage>

and extend the back. The transversospinales extend, rotate, and stabilize the vertebral column.

### ***Appendicular Skeleton***

The term “appendicular” derives from the word “appendage.” The appendicular skeleton supports body movement. It comprises 126 bones divided into four sections: (1) shoulder girdle (or pectoral girdle), (2) upper extremities, (3) pelvic girdle, and (4) lower extremities (see Figure 10-1).

### ***Shoulder Girdle***

The shoulder (Figure 10-7) permits a wide range of movement in all directions through the action of four joints, three bones, and muscle groups. Together, these make up the shoulder girdle. Unlike other joints, there are no major ligaments to hold the bones together. The shoulder includes the clavicle (collarbone), scapula (shoulder blade), and head (ball) of the humerus. The

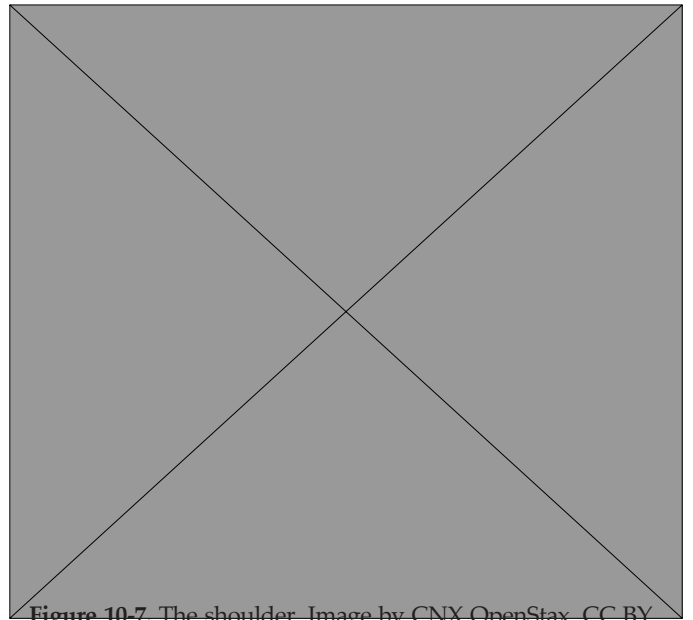


**Figure 10-7.** The shoulder. Image by CNX OpenStax, CC BY 4.0. Adapted from Wikimedia Commons (added labels). [https://commons.wikimedia.org/wiki/File:Figure\\_38\\_03\\_10.jpg](https://commons.wikimedia.org/wiki/File:Figure_38_03_10.jpg)

clavicle is anterior and serves as support between the sternum and the scapula. The scapula is posterior and forms a part of the shoulder girdle, connecting the humerus laterally. The humerus hangs from the scapula, suspended from the shallow glenoid fossa (a socket or depression) by the joint capsule, ligaments, the glenoid labrum (a ring of tissue that increases the depth of the fossa), and a mesh of muscles and tendons. The acromion process of the scapula is the highest portion of the shoulder. It forms the acromioclavicular joint with the clavicle and is a frequent area of shoulder injury (acromioclavicular separation).

### Upper Extremities

The upper arm and forearm (see Figure 10-1) include three main bones and many muscles. The humerus is the bone between the shoulder and elbow. The radius is the lateral bone of the forearm that joins with carpals (thumb side). When aligned with the thumb, the radius articulates with the humerus. The ulna is the medial forearm bone (little finger side). The elbow joint helps position the hand in space and stabilizes the lever action of the forearm. The humerus and the two bones of the forearm form the elbow.

The wrist consists of eight carpal bones. The hands include 5 metacarpals and the 14 finger bones, known as phalanges. The wrist and hand form a complex unit of small, highly active joints. These have little protection from overlying soft tissue and are vulnerable to trauma and disability.

### Pelvic Girdle

The pelvic girdle consists of three fused bones (Figure 10-8). Together they form the hipbone. The ilium is the largest and most superior bone that makes up the hip joint. The superior aspect of the ilium is the iliac crest. Place your hands on your hips near your waist to feel this wide, bony wing. The ilium provides numerous attachment points for muscles and ligaments of the torso and hip.

The ischium is the lower and posterior portion of the pelvis. We sit on this bone. The joining of the bones of the anterior pubis forms the ischium.

The pubis (or pubic bone) makes up the anterior position of the pelvis. The pubis symphysis is a cartilaginous joint at the midline, where the left and right pubic bones join. It is in front of the bladder and is palpable above the genitalia.

The pelvis joins posteriorly to the sacral spine at the sacroiliac joint. The ball-and-socket hip joint is deeply

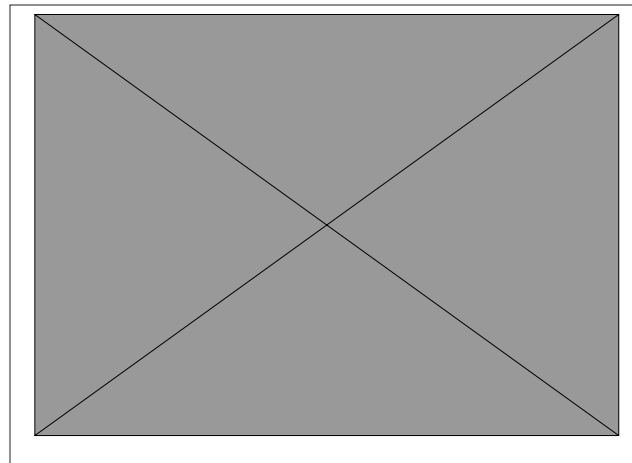


**Figure 10-8.** The pelvic girdle. Image by Fred the Oyster. Original by U.S. National Cancer Institute. Vectorization by Fred the Oyster, German translation kopiersperre/Rothwild, CC BY-SA 4.0. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Pelvic\\_girdle\\_illustration.svg](https://commons.wikimedia.org/wiki/File:Pelvic_girdle_illustration.svg)

embedded in the pelvis and is the only moveable joint in the pelvis. It consists of the acetabulum (socket of the hip joint) and the ball at the proximal end of the femur (femoral head). The hip joint is stable and strong and has a wide range of motion (**ROM**).

### Lower Extremities

See Figure 10-1. The femur (thighbone), tibia, and fibula are the long bones in the leg. The femur is the longest and largest single bone of the body. The proximal end (head) of the femur is seated into the acetabulum (socket of the pelvis) to create a ball-and-socket joint. The distal end articulates with the tibia to create a hinge joint (the knee).

The tibia (shinbone) is the anterior bone of the lower leg and it forms the inferior portion of the knee joint. The smaller bone of the lower leg, the fibula, is lateral. The patella (kneecap) is the largest sesamoid bone in the body. The patella is incorporated into the quadriceps tendon and is anterior to the knee joint.

The knee joint is a hinge joint that involves the femur, tibia, and patella (Figure 10-9). It has three articulating surfaces: two between the femur and the tibia, and one between the femur and patella. Internal ligaments and cartilage of the knee include the anterior and posterior cruciate ligaments, **meniscus**, and the medial and lateral collateral ligaments. The stability of the knee is dependent on ligaments to hold the joint in place. The dependency of ligaments and the lack of



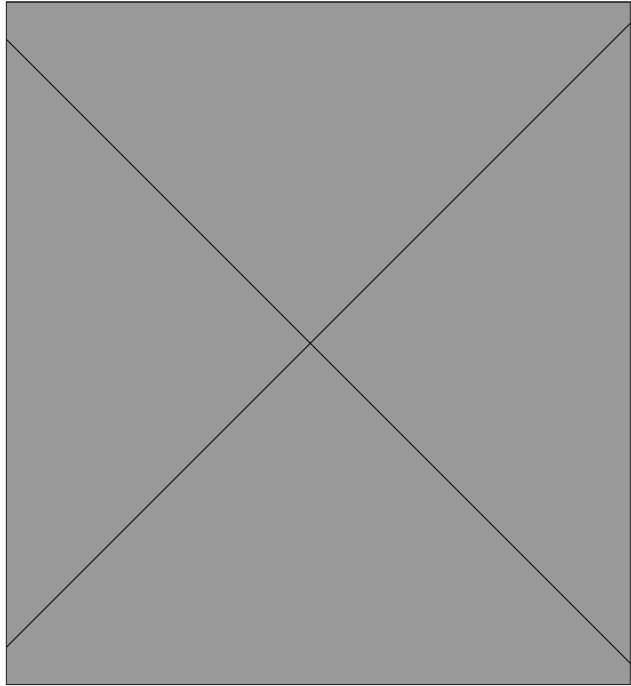


**Figure 10-9.** An anterior view of the knee. Image by DataBase Center for Life Science (DBCLS). Adapted from Wikimedia Commons (added labels). [https://commons.wikimedia.org/wiki/File:202108\\_Anterior\\_view\\_of\\_knee\\_joint.svg](https://commons.wikimedia.org/wiki/File:202108_Anterior_view_of_knee_joint.svg)

padding from fat or muscle make the knee joint highly vulnerable to injury.

The ankle is a hinge joint, located where the tibia and fibula connect with the talus (the most superior bone of the foot). There are two distinct protrusions (principal landmarks) on the lateral and medial aspects of ankles, the lateral malleolus (lower end of the fibula) and the medial malleolus (lower end of tibia). The tibia and fibula sit on the talus like an inverted cup.

The midfoot consists of seven bones called tarsals. The more distal foot bones (5) are metatarsals, and the calcaneus is the heel bone. The 14 toe bones are the phalanges. The total weight of the body transmits through the ankle to the foot. The ankle and foot balance the body and absorb the impact of the heel strike and **gait**. The ankle and foot are vulnerable to tendon, ligament, and bone injuries.

### Check on Learning

11. What are the two major skeletal regions?
12. Name the five subsections of the spinal column.
13. Approximately how far does the spinal cord extend down the spinal column?

## ASSESSMENT OF ORTHOPEDIC COMPLAINTS

Collect and document the subjective and objective data (see Chapter 1, Sick Call and Medical Documentation). All physical exams begin with obtaining a thorough history of the patient. Gather information from direct observation, witnesses, and others who can provide patient history related to the injury. When assessing any patient with orthopedic complaints, it is imperative to ask applicable questions based on the mechanism of injury (MOI) and available evidence. Note: Skull injury identification and treatment are not included here.

Direct observation can begin before a patient gets to an examination room. For example, an assessment of the spine can begin with watching a patient walk to the room. For a quick general impression, observe the patient's need for assistance (eg, litter, wheelchair, carry), the appearance of obvious pain, and their gait (the way they walk). Some patients may try to understate their symptoms so they do not appear weak, whereas others may exaggerate their injuries to receive a desired treatment. The legitimate extent of the injury may become more evident when the patient believes no medical professional is observing. Maintain an index of suspicion for orthopedic injury.

### Physical Examination

The physical examination consists of inspection, palpation, ROM, and special tests. Document these in the order they are performed.

#### *Inspection, Palpation, and Range of Motion*

Inspection will include identifying any abnormalities such as trauma, deformities, redness, bruising, and swelling. Palpate the affected area for tenderness, abnormal masses, crepitus, and temperature changes. Observe the patient walking or moving and analyze ROM. ROM may be full or impaired. Measure ROM in degrees of angle from the affected area's normal, extended position. Ask the patient to complete specific ROM movements that pertain to the affected area, but neither you nor the patient should physically force a motion. For active ROM, instruct the patient to complete the test. If the patient has trouble completing the active test, conduct passive testing (if appropriate) by assisting movement, until you meet resistance or the patient complains of pain. Document ROM deficiencies and pain reported by the patient. Compare ROM in both the affected and unaffected extremities. Assess the patient's muscle strength and document as full or

limited. Muscle strength tests determine the ability of the muscle to perform against examiner resistance.

### **Special Tests**

Your medical officer (MO) will train you on any special tests you may need to perform.

### **Documentation**

Base the suspected diagnosis on the patient's history and your physical examination findings. List all findings, including those within normal limits. Document all physical examination findings in your SOAP (subjective, objective, assessment, plan) notes.

### **RED FLAGS**

RED FLAGS are certain situations and complaints that call for special consideration. Refer these conditions to an MO immediately.

### **Check on Learning**

14. When does assessment of the patient begin?
15. What are the three components of the physical exam for an orthopedic complaint?

## **ASSESSMENT OF THE NECK AND BACK**

### **Subjective**

Gather subjective information by asking the patient questions pertaining to their current spinal or back issue. Follow the directions given in Chapter 1, Sick Call and Medical Documentation. Specific details for subjective assessment of neck and back complaints follow.

Thoroughly investigate the quality of pain reported in neck and back injuries. Ask questions to determine if the patient is experiencing numbness or tingling anywhere in the body. Ask if they have localized, regional, or radiating pain. Ask for descriptions of their pain (eg, sharp, dull, throbbing).

**Note:** Patients may have difficulty describing their type of pain.

Investigate the severity and timing of the pain. Ask the patient to score their pain severity on a scale from

1 to 10, with 10 being the most severe pain imaginable. Ask if the pain limits or prevents activity. Determine if the pain is constant or intermittent. If it is intermittent, ask them if certain movements or activities trigger the pain.

The history of the complaint also provides important diagnostic information. Be sure to ask if they have painful or frequent urination. Determine if the issue is chronic or if a specific event caused the pain. Be sure to ask about previous injuries to their neck or back as well as how they were treated (eg, surgery, medication, rest).

### **Objective**

#### **Inspection**

When conducting the physical examination of the neck and back, evaluate both anterior and posterior positions. The head should be midline with the shoulders; note any abnormalities from this position. If possible, have the patient point to where it hurts the most.

#### **Palpation**

Sweep the spine descending from the base of the skull, along the spinal column, all the way to the top of the pelvis to rule out misalignment and to locate any other abnormalities. If the patient has radiating pain, note how far it radiates from the point of origin. Tuning forks are an additional tool to assess for fractures when radiographs may not be immediately available. The high-frequency vibrations of the tuning fork pass through bone and elicit pain in a fractured bone. Certain locations may require auscultation while using a tuning fork in order to determine the pitch of a fracture in a patient. A fractured bone has a diminished pitch compared with a bone that is uninjured.

#### **Range of Motion of the Neck**

ROM assessments for the neck include flexion, extension, lateral bending, and rotation. Perform the following assessments:

- Flexion—have the patient bend their head forward and touch their chin to their chest (Figure 10-10).
- Extension—have the patient tilt their head back (Figure 10-11).



Figure 10-10. Neck flexion.



Figure 10-11. Neck extension.



Figure 10-12. Neck lateral bend.



Figure 10-13. Neck rotation.

- Lateral bending—have the patient tilt their head to the side as if attempting to touch the ear to the shoulder (Figure 10-12). Repeat in the opposite direction.
- Rotation—have the patient turn their head to the right and then to the left as far as they can without straining, while keeping their torso facing forward (Figure 10-13).

Examine the cervical muscles, using resistance to determine stability.

**Caution:** Do not force patients beyond pain threshold; this may cause permanent damage.

### *Range of Motion of the Back*

ROM assessments for the back include flexion, extension, lateral bending, and rotation. Expose the patient's back during the examination to note smoothness and symmetry during flexion. Perform the following assessments:

- Flexion—have the patient bend forward at the waist as if attempting to touch their toes while keeping their knees locked (Figure 10-14). Once the patient is in the flexed position (about 75°–90°), check for curvature and other abnormalities (eg, deformity of the thorax) indicating scoliosis or muscle spasm.





**Figure 10-14.** Back flexion.

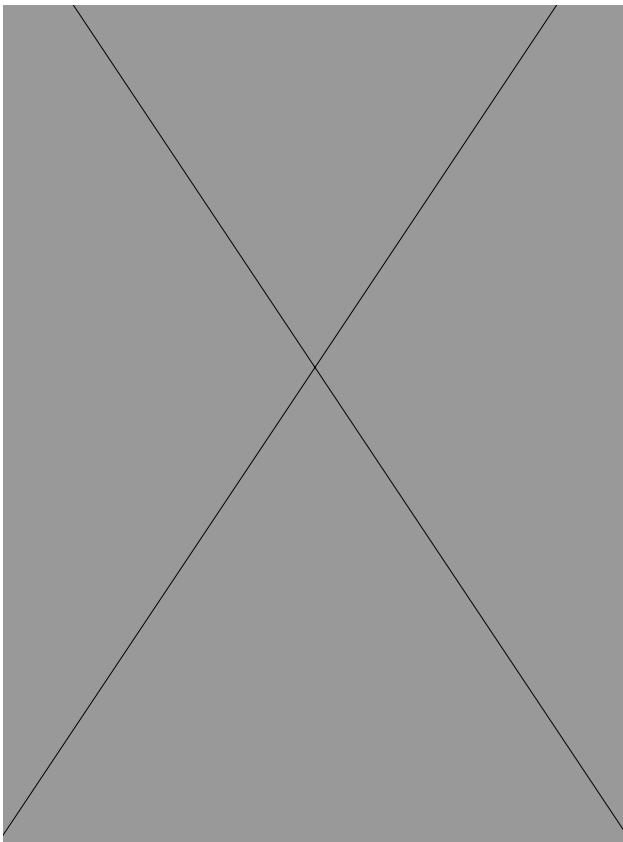


**Figure 10-15.** Back extension.

**Note:** Not all patients will be able to touch their toes, and the inability to do so does not necessarily indicate a limited ROM.

- Extension—have the patient arch their back posteriorly (Figure 10-15). This movement is very limited in comparison to back flexion in the average person. When conducting the extension movement (about 30°), support the patient by placing your hand in the position of the posterior pelvis or have them lean against the examination table, then tell the patient to lean back as far as possible. This movement helps evaluate the deep intrinsic muscles of the back.
- Lateral bending (about 35° on each side) uses the intrinsic muscles of the back and abdominal muscles. Assess lateral bending by having the patient bend at the waist laterally to the right and then left (Figure 10-16). Allow the arms to hang freely. Stabilize the patient by placing your hand laterally on the patient's pelvis as the patient bends side to side.
- Rotation (about 30° on each side) also evaluates the abdominal muscles and the intrinsic muscles of the back. Assess rotation by having the patient twist at the waist to the right and the left while keeping the hips facing forward (Figure 10-17). If you help the patient with stability, do not interfere with movement.
- Document any limited ROM as LIMITED or IMPAIRED; otherwise document ROM as FULL. Be sure to document any pain associated with the movements. Many patients can have full ROM yet have some pain in doing so.
- Assess quality of pain during flexion. Note signs and symptoms of an existing condition related to the chief complaint or any other underlying issue causing pain or stiffness. ROM may be limited, but this is a common complaint and a neurological exam may be normal.

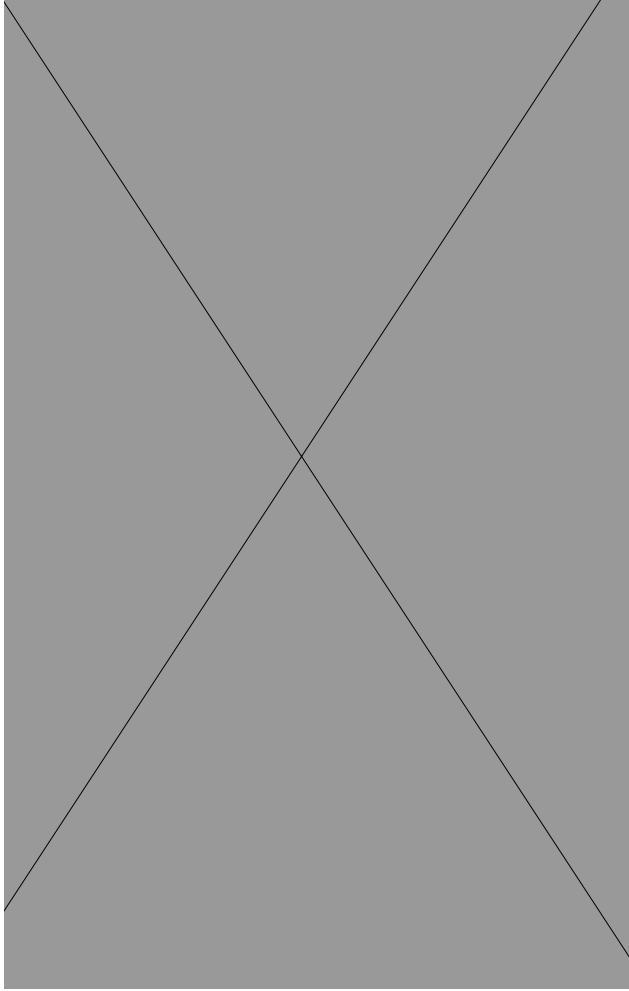


**Figure 10-16.** Back lateral bend.

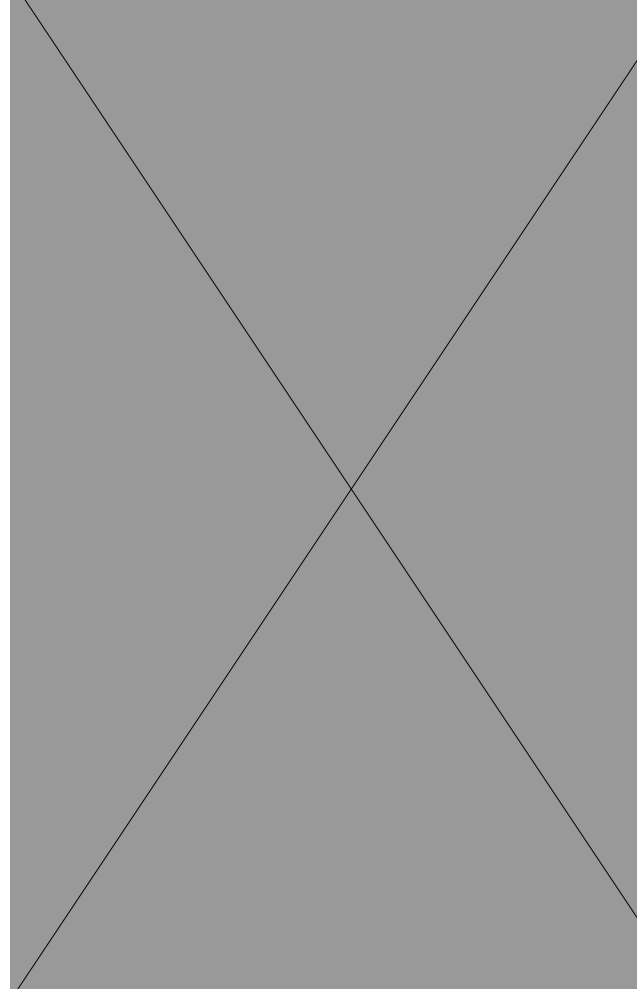


**Figure 10-17.** Back rotation.

**Muscle Strength.** There are many ways to assess muscle strength, including the following:

- The hamstring muscle test. Instruct the patient to sit on the edge of the exam table with their legs hanging freely at the knee. Ask the patient to flex the hamstring by bending one leg at the knee. Hold the ankle of the patient's flexed leg. Ask the patient to attempt to touch their foot to their buttocks while you apply gentle resistance against their motion (Figure 10-18).
- The quadriceps muscle test. Ask the patient to sit on the edge of the exam table with their legs hanging freely at the knee. Gently hold the ankle and instruct the patient to extend their leg against your resistance (Figure 10-19). Repeat with the other leg, and document any differences in strength.
- The calf muscle and anterior leg strength test can also be an indicator of lower back injury. Instruct the patient to sit on the edge of the exam table and let their legs hang freely. Since knees are bent, the gastrocnemius (calf muscle) is relaxed (its origin and insertion are closer together) and eliminated as a possible restriction of dorsiflexion. Now as you grip the forefoot, push as one unit into the plantar flexion (Figure 10-20) and dorsiflexion (Figure 10-21). The patient should be able to resist these motions. Document any differences in strength.

**Special Tests.** Additional specialized exams for cervical or spinal conditions may be required. MOs will train you on any additional special tests you may be required to perform.

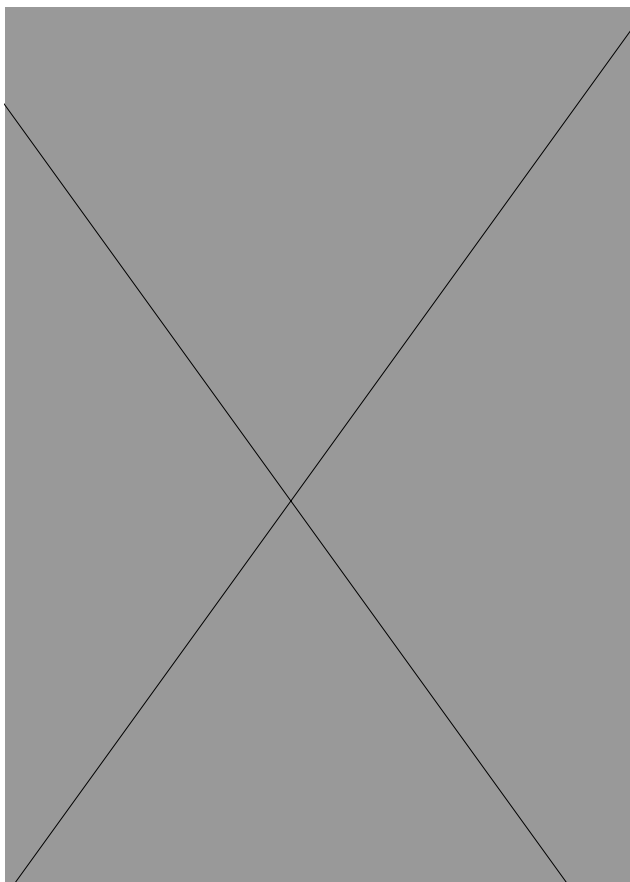


**Figure 10-18.** The hamstring muscle-strength test.

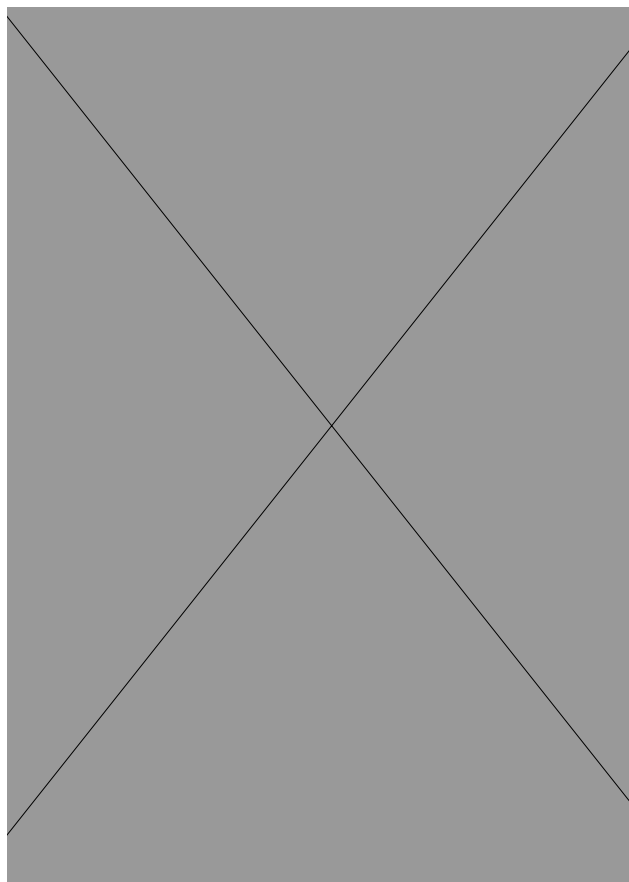


**Figure 10-19.** The quadriceps muscle-strength test.

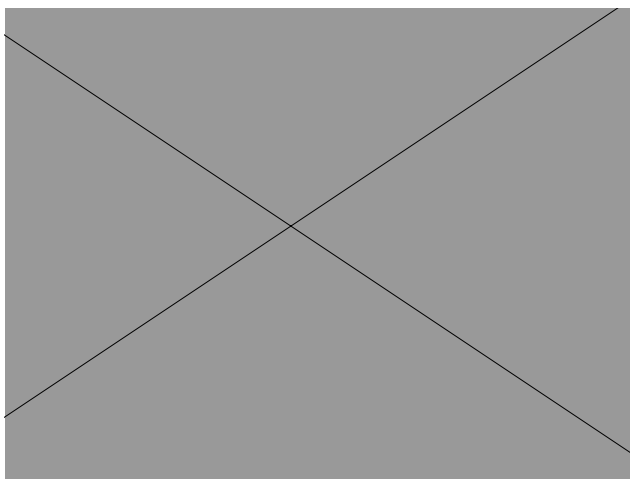


**Figure 10-20.** An assessment of calf muscle strength.

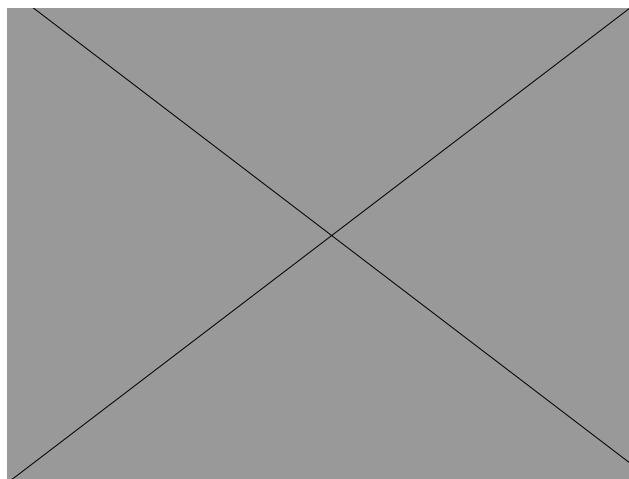


**Figure 10-21.** An assessment of anterior leg strength.



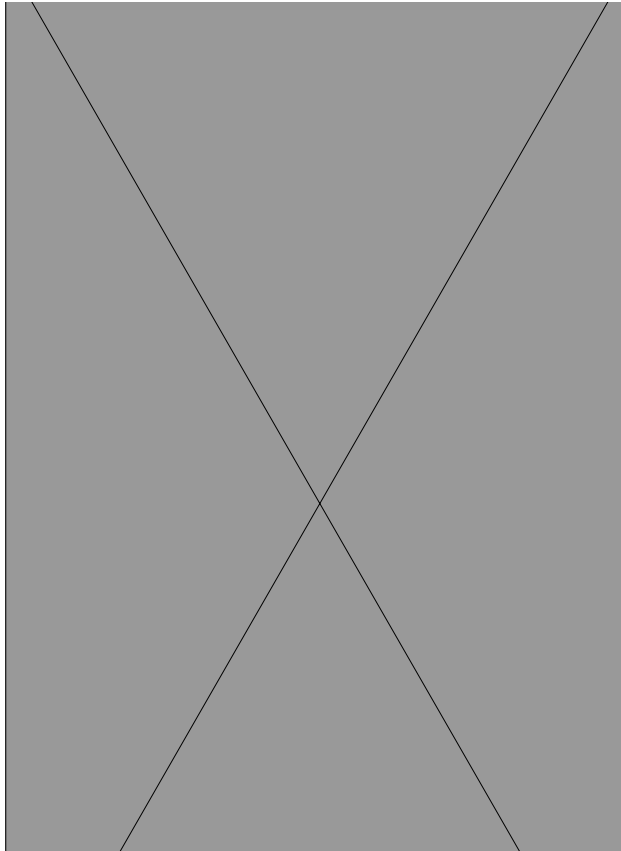


**Figure 10-22.** A cervical compression fracture. The reduced height of the vertebra in relation to the other vertebrae is a sign of compression fracture (arrow). Radiograph by Dr. Henry Knipe, CC BY NC SA 3.0. Reproduced from Store Medisinske Leksikon. <https://sml.snl.no/ryggs%C3%B8ylebrudd>

### RED FLAGS of Spinal Complaints

RED FLAGS indicate immediate referral to the MO. RED FLAGS of spinal complaints include any of the following:

- unbearable pain that does not respond to treatment;
- repeated visits for the same complaint;
- numbness, tingling, or weakness in the extremities;
- bony deformities, step-offs, or crepitus;
- trauma with neurological changes or a deteriorating examination (alert, verbal, pain, unresponsive [AVPU] or Glasgow Coma Scale [GCS]);
- fever, weight loss, night sweats, night pain (and/or narcotic use);

- loss of bowel or bladder control;
- statements such as “I can’t pee”;
- inability to bear weight due to pain in the lower back; and
- significant decrease in ROM of the back.

**Note:** Recurrent or chronic pain can be a sign of cancer or fracture. An MO MUST evaluate the condition. Imaging is likely.

### Check on Learning

16. Why should you avoid forcing patients to move beyond their point of pain?
17. List five RED FLAGS of spinal complaints.

### COMMON COMPLAINTS OF THE NECK AND BACK

Neck and lower back pain are common complaints in a clinical and field setting. You must be able to evaluate the patient properly and refer to the MO as needed for further evaluation and treatment.

#### Cervical Fracture

Cervical fractures (Figure 10-22) are associated with significant MOIs supporting the diagnosis, such as trauma to the head and neck from a fall, motor vehicle collision, diving accident, or deceleration injuries. The location, persistence, distribution, and quality of pain are all important considerations in assessing cervical spine patients.

Signs and symptoms of cervical fracture include severe neck pain, radiating pain, and loss of movement to one or multiple extremities. Physical examination shows reduced or absent ROM, muscle strength, and sensory function. The patient may also display edema, erythema, ecchymosis, deformity, Battle’s sign, neurological changes, crepitus, and step-off. Examine the patient. If they are clear of trauma, carefully evaluate their cervical spine ROM. Pain or stiffness can cause limited ROM of the neck.

Treatment of suspected cervical fractures includes immobilization and evaluation by the MO as soon as possible. Monitor the patient en route if transport or evacuation is necessary.

**Warning:** If the MOI is significant, immediately immobilize the cervical spine.

## Cervical Strain

Cervical strain correlates with a history of whiplash injury and results when the soft tissues of the neck have sustained a hyperflexion injury.

Signs and symptoms include cervical pain and muscle stiffness, pain that increases with motion, and muscle spasms. Physical exam may reveal tenderness to palpation (**TTP**) or a limited ROM. A neurological examination is usually normal.

Treatment of suspected cervical strain is to refer patients with significant trauma to the MO to order radiographs and prescribe medications. Soft cervical collars, nonsteroidal anti-inflammatory drugs (NSAIDs), and muscle relaxants (for spasms) can all be useful, as well as profiles. Have the patient follow up in 24 hrs with the MO to determine if the signs and symptoms are worsening.

## Lumbar Fractures

Lumbar fractures (Figure 10-23) are associated with high-energy trauma or minimal trauma in patients with osteoporosis, tumors, infections, or long-term steroid use.

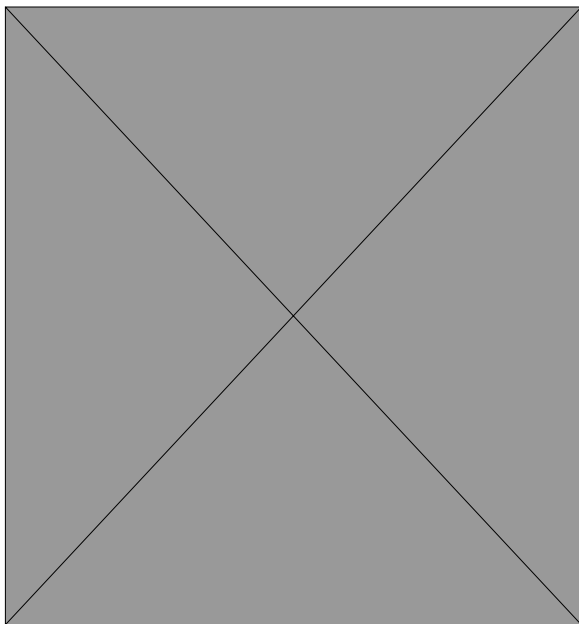


**Figure 10-23.** A burst fracture of L4 as seen on computed tomography. Image by James Heilman, MD, CC BY-SA 4.0. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:BurstCoL4LCT.png>

Signs and symptoms include moderate to severe back pain that increases with motion. Numbness, tingling, weakness, or bowel and bladder dysfunction can suggest nerve root or spinal cord injury. Physical examination will reveal TTP at the point of injury, with edema, ecchymosis, hematoma, step-off, or a gap between the spinous processes (the portion of the spine that projects posteriorly and serves as the attachment of ligaments and muscles).

Treatment involves full spinal immobilization and evaluation in an emergency room.

## Lower Back Pain

Lower back pain is a common complaint among soldiers. The cause of back pain varies, but usually occurs after poor lifting and twisting techniques, bad posture, and other repetitive movements over several years. The most likely cause of back pain is from injury to one of the three muscle groups (collectively called the paravertebral muscles) that help support the spinal column.

The extensor muscles attach to the back of the spine and help support the spinal column in standing and lifting heavy objects. Strenuous, repetitive, or sudden activity without sufficient preparation causes damage. If this activity damages the disc, compression could cause nerve damage.

The flexor muscles attach to the front of the spine and support forward bending and lifting of the lower back. Because the hip flexors attach the thigh to the spine and run through the pelvis, they are at risk of hyperextension and overexertion from improper lifting and supporting heavy and awkward-shaped weights. They can also become tight from sitting at a computer desk for long periods, resulting in lower back pain.

The oblique muscles attach to the lateral aspect of the spine and assist with twisting and good posture. Weak oblique and abdominal muscles can lead to bad posture over time, which will in turn cause tightening and shortening of paravertebral muscles that may eventually manifest as lower back pain. Axial loading can cause twisting injuries to the lateral spinous muscles. Sacral and coccyx injuries occur among soldiers who fall while carrying full gear.

Lower back strain is an injury to the paravertebral spinal muscles, whereas a sprain is an injury involving the ligaments. The patient may have strained the paravertebral spinal muscles due to a history of repeated or improper lifting or twisting motion. A trauma pa-

tient with back pain may also complain of numbness, tingling, weakness, or bowel or bladder dysfunction, which could indicate a spinal cord injury.

A limited ROM due to stiff and painful bending is a key indicator for common complaints such as arthritis, spinal stenosis (narrowing of the spinal column, which causes pressure on the spinal cord), and herniated or bulging discs. Pain may radiate and ROM may be limited, especially during flexion. Lower extremity motor and sensory functions are usually normal, although severe muscle spasms could cause pain or numbness in the lower extremities.

**Note:** Do not confuse lack of limberness with a limited ROM.

Make sure there are no underlying causes for pain. Other causes may not be related to orthopedic complaints, such as kidney or gallbladder infections. Severity of pain should also take into account the patient's pain threshold, which varies among patients.

Symptomatic treatment includes activity modification, use of acetaminophen or NSAIDs for pain, heat application, and education on proper lifting and bending techniques. Lower back pain resolves quickly and the patient should return to duty in a few days. Refer the patient to an MO after repeated visits or if the patient has decreased or absent motor or sensory function.

### Check on Learning

18. Which common spinal complaint is usually associated with a history of whiplash injury?
19. What is the common treatment for lower back strain?

## ASSESSMENT OF THE SHOULDER AND UPPER EXTREMITIES

### Subjective

Gather subjective information, as directed in Chapter 1, Sick Call and Medical Documentation. Ask the patient questions pertaining to their upper extremity complaint.

### Objective

#### Inspection

For all patients, obtain a thorough history and maintain an index of suspicion. Consider the MOI and gather information obtained from the patient, witnesses, or associates (statements may reveal RED FLAGS, such as “my hand is numb,” or “I cut my knuckle in a fight”). If a patient complains of joint symptoms, evaluate the joint above and below the area of complaint. Inspect the extremity for abnormalities. Have the patient place one finger on the most painful spot to localize the pain. Compare the affected extremity to the unaffected one. Observe the patient walking to evaluate the evenness and symmetry of the motion and make sure arms swing together with the opposite lower extremity.

#### Palpation

Palpate the affected area for tenderness, abnormal masses, crepitus, and temperature changes. Evaluate pulse and motor and sensory function at the affected area.

#### ROM of the Shoulder

Evaluate ROM of the patient's shoulder with flexion, extension, abduction, adduction, and rotation movements. Perform the following assessments on each shoulder:

- Forward flexion—instruct the patient to sit or stand with their arms at their sides. Have the patient slowly raise one or both arms anteriorly, continuing until they are pointing above the head (typically 180°) (Figure 10-24).
- Hyperextension—ask the patient to stand with the arm at their side, palms facing forward. Have the patient slowly raise the arm rearward (typically 50°) (Figure 10-25).
- External rotation and abduction (scratch test)—direct the patient to reach behind their head and attempt to touch the opposite shoulder blade (Figure 10-26).
- Internal rotation and adduction (scratch test)—direct the patient to reach behind their back and attempt to touch the opposite shoulder blade (Figure 10-27).



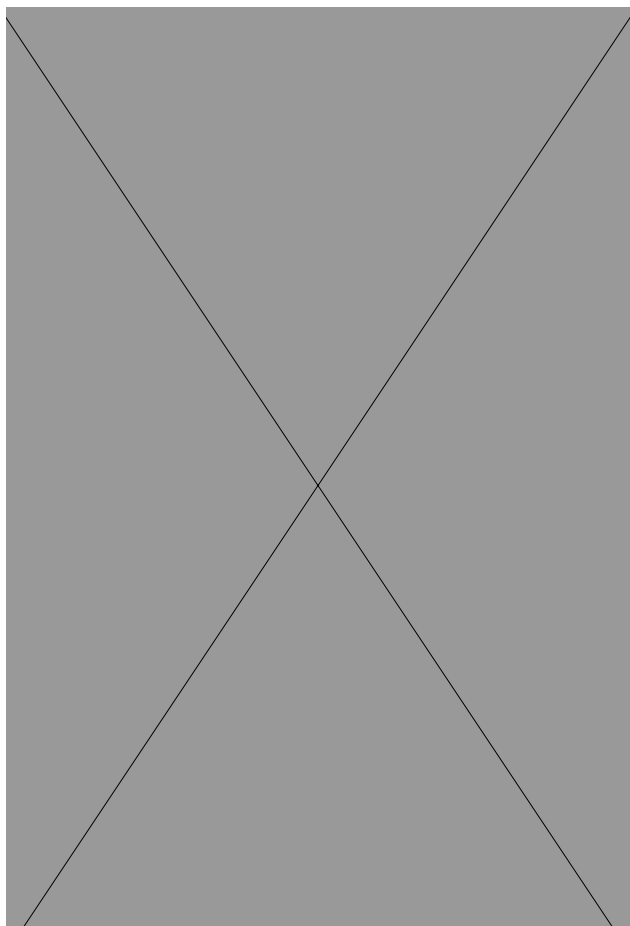


**Figure 10-24.** Shoulder forward flexion.

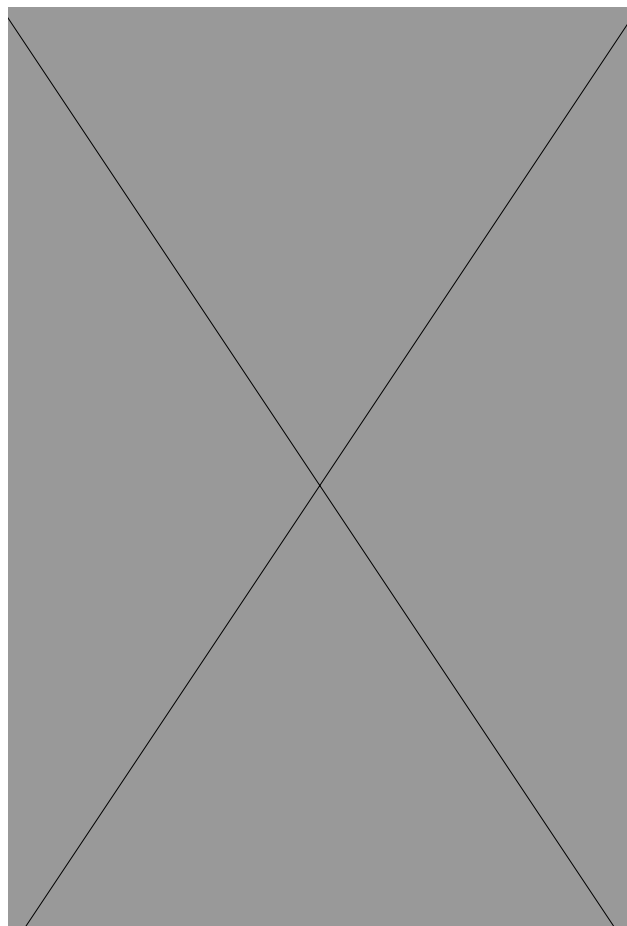


**Figure 10-25.** Shoulder hyperextension.

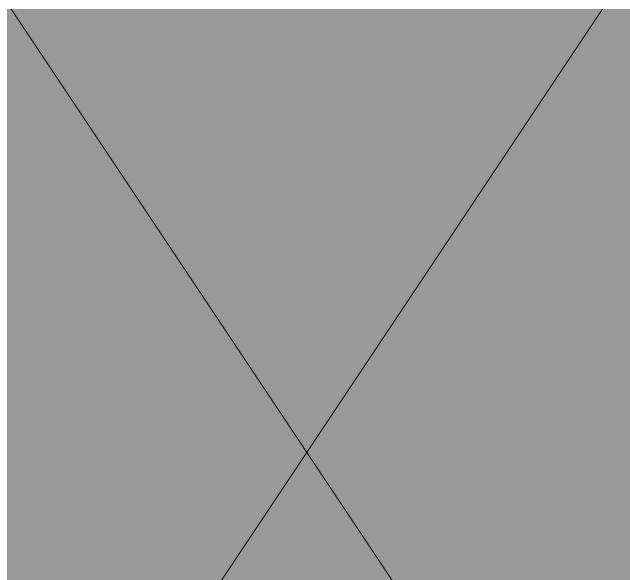


**Figure 10-26.** Right shoulder external rotation.

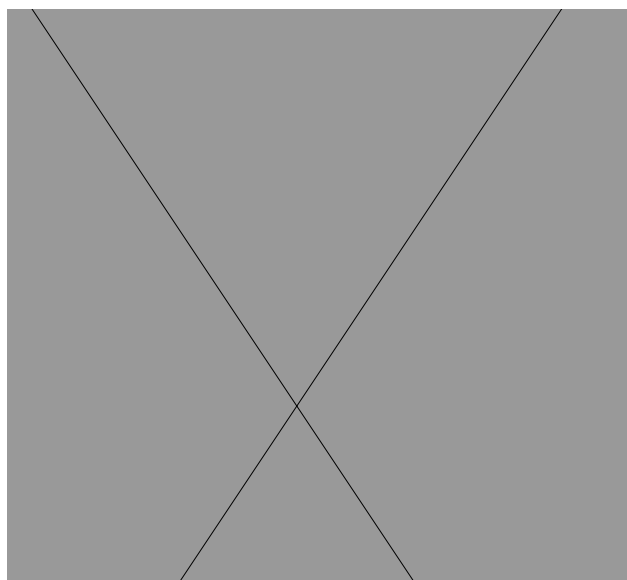


**Figure 10-27.** Right shoulder internal rotation.

### ROM of the Elbow

Evaluate ROM of the elbow with extension, flexion, supination, and pronation. MOs will provide additional training as needed. Perform the following assessments on each elbow:

- Flexion—have the patient hold the arm extended, palm up, at shoulder height in front of the body. Ask the patient to bend the arm at the elbow, bringing their palm toward the shoulder (typically 140°) (Figure 10-28).
- Extension—evaluate when arm is returned to the fully extended position, palm up (Figure 10-29).

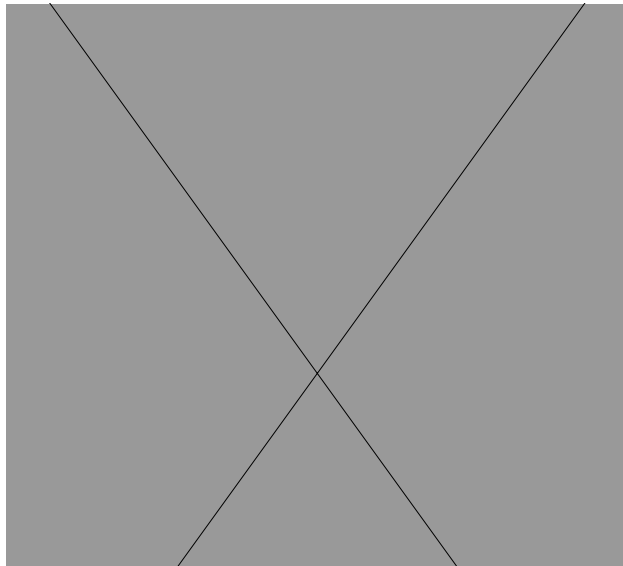


Figure 10-28. Elbow flexion.

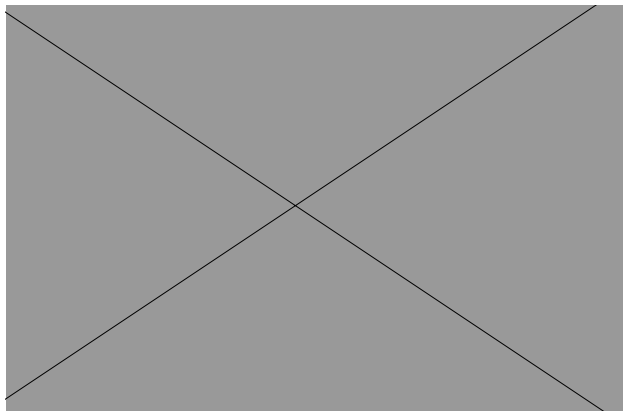


Figure 10-29. Elbow extension.

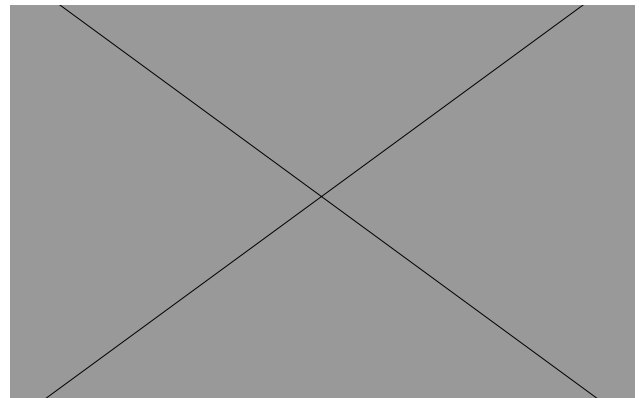


Figure 10-30. Elbow supination.

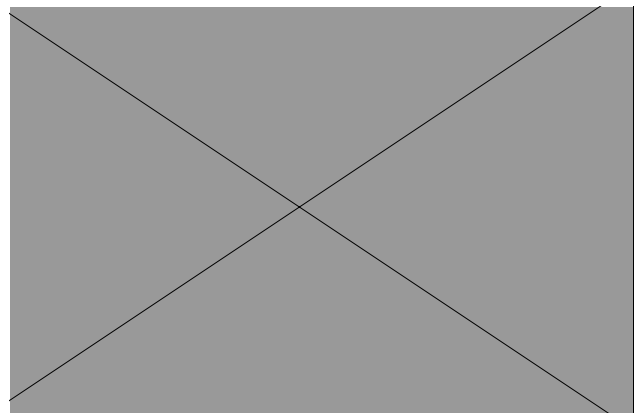


Figure 10-31. Elbow pronation.

- Supination—with the arm at the patient's side and elbows bent to a 90° angle in front of the body, instruct the patient to rotate the palms face up (in an outward direction) as far as they can (Figure 10-30).
- Pronation—ask the patient to rotate the palms to face down (in an inward direction) as far as they can (Figure 10-31).
- Additional specialized exams may be required for associated shoulder conditions.

### ROM of the Wrist

Evaluate ROM of the wrist with extension, flexion, radial flexion, and ulnar flexion. Perform the following assessments on each wrist:

- Flexion—ask the patient to move the hand downward at the wrist (typically 60°) (Figure 10-32).

- Extension—ask the patient to move the hand upward at the wrist (typically 60°) (Figure 10-33).
- Radial flexion—ask the patient to move the hand laterally (toward the thumb) at the wrist (typically 20°) (Figure 10-34).
- Ulnar flexion—ask the patient to move the hand medially (towards the 5th metacarpal) at the wrist (typically 30°) (Figure 10-35).

### ***Muscle Strength***

Have that patient complete the following, while the provider applies a minimal amount of resistance.

- flexion,
- extension,
- abduction,
- adduction,
- external rotation, and
- internal rotation.

Ask the patient to shrug their shoulders.

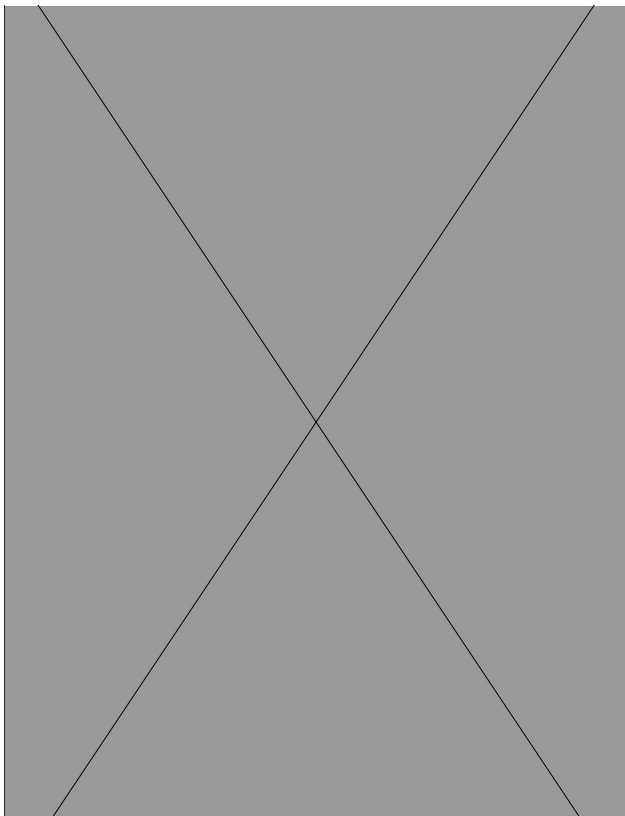


**Figure 10-32.** Wrist flexion.

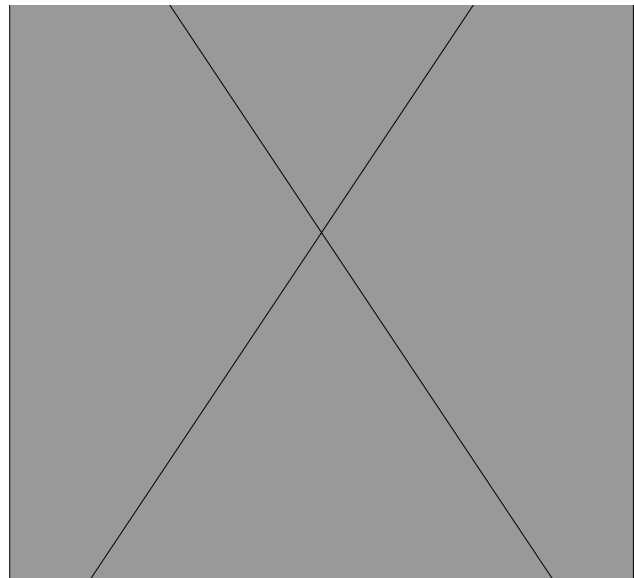


**Figure 10-33.** Wrist extension.

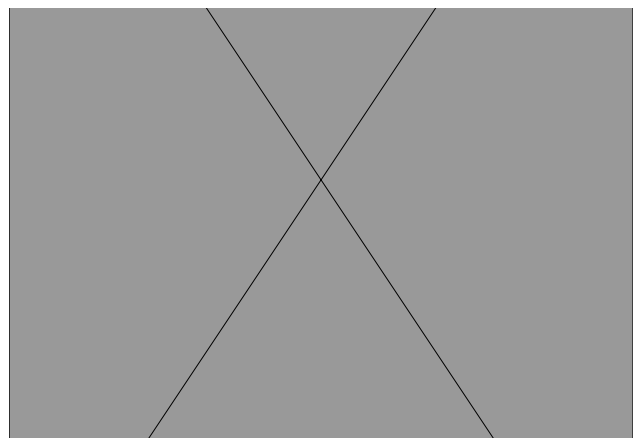


**Figure 10-34.** Radial flexion.

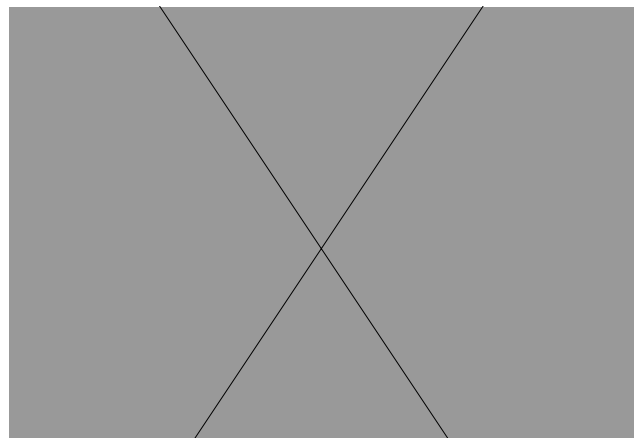


**Figure 10-35.** Ulnar flexion.



### Special Tests

Additional specialized exams for upper extremities may be required. MOs will train you on any additional special tests you may be required to perform

### RED FLAGS of Upper Extremity Complaints

RED FLAGS indicate immediate referral to an MO. RED FLAGS of upper extremity complaints consist of any of the following:

- unbearable pain that does not respond to treatment;
- repeated visits for the same complaint;
- open fractures or deformities;
- neurovascular compromised extremities;
- hot, swollen joint;
- inability to fully extend or flex (decreased ROM);
- trauma with neurological changes, muscle weakness, or a deteriorating exam in the affected extremities; and
- any suspected fracture.

**Note:** Recurrent or chronic pain can be a sign of cancer, fracture, or other serious injury and **MUST** be evaluated by a medical provider. Imaging is likely.

### COMMON COMPLAINTS OF THE SHOULDER AND UPPER EXTREMITIES

#### Shoulder Disorders

A careful history, physical examination, and radiographs are used to diagnose most shoulder disorders.

#### Dislocated Shoulder

The shoulder joint has great mobility and is susceptible to subluxation and dislocation (most commonly from trauma). A dislocated shoulder (Figure 10-36) occurs when the humeral head partially slips out of socket. Dislocations may be anterior (>90%), posterior (<10%), or inferior (1%–2%). Anterior dislocation is the most common because there is no bone in front to stop the movement. Posterior dislocations are the second most common. Inferior dislocations are very rare but come with severe associated injury to the arteries,

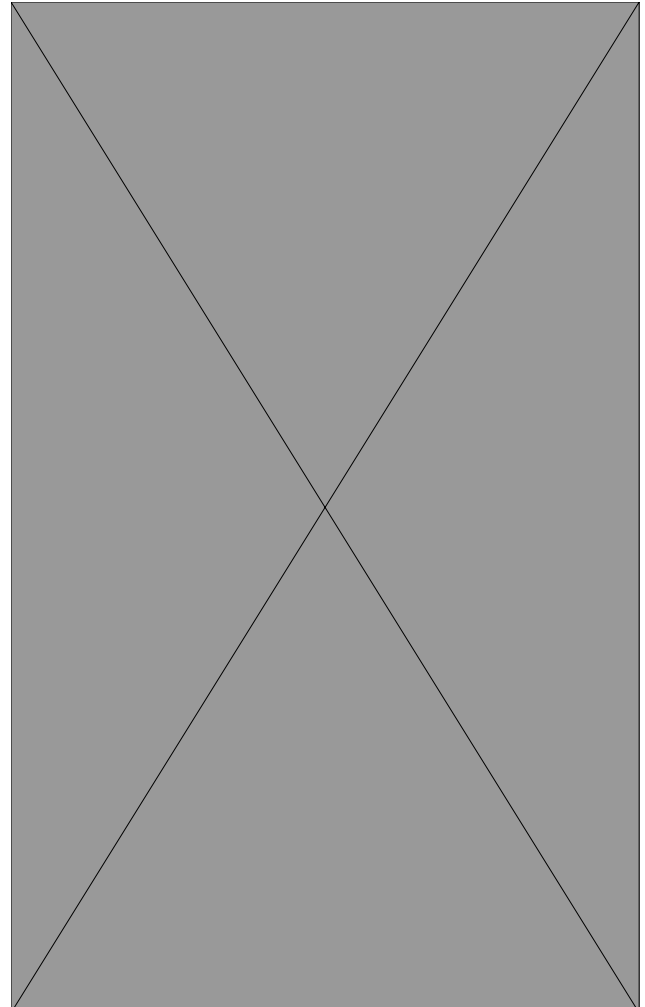


**Figure 10-36.** An anteroposterior projection showing a shoulder dislocation. Radiograph by Mikael Häggström. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Shoulder\\_dislocation,\\_anteroposterior\\_before\\_reduction.jpg](https://commons.wikimedia.org/wiki/File:Shoulder_dislocation,_anteroposterior_before_reduction.jpg)

brachial plexus, and other structures in the axilla. The patient may describe a feeling of the shoulder slipping out of joint when the arm is abducted and externally rotated. Initial dislocations are associated with significant trauma, while subsequent dislocations require less force.

Movement causes considerable pain; the patient will usually self-splint (support arm on side of injury) to a neutral position. There is a loss of the rounded contour of the shoulder and the acromion is prominent, resulting in a squared-off appearance. Check neurovascular function before and after any treatment and document your observations.

Refer the patient to the MO for reduction (actively reseating the humeral head) of the dislocation. Treatment after successful reduction is shoulder immobilization with a sling and swath or shoulder immobilizer. The typical immobilization time is 1 to 3 weeks, but an MO should follow up each week. In some cases, the patient may require referral to an orthopedic surgeon.

Advise the patient to use NSAIDs for shoulder pain and inflammation. Tell the patient to modify physical activities based on pain level. The patient should allow the pain to dictate the activity. The patient WILL be referred to physical therapy for continued care and management. Physical therapy or specified exercises may be required to rehabilitate the shoulder.

### **Clavicle Fracture**

The most common bony injury of the shoulder is a clavicle fracture (Figure 10-37). Eighty percent of fractures occur in the middle third of the clavicle. The MOI is often a fall on the shoulder or a strike over the clavicle with a heavy object.

The patient is usually unable to lift the arm due to pain and may complain of pain at the site. Physical examination will reveal TTP, edema, ecchymosis, erythema, tenting of the skin, and deformity at the fracture site. ROM will be decreased and crepitus may be present. Assess neurovascular function in the affected extremity. Refer the patient to the MO for evaluation.

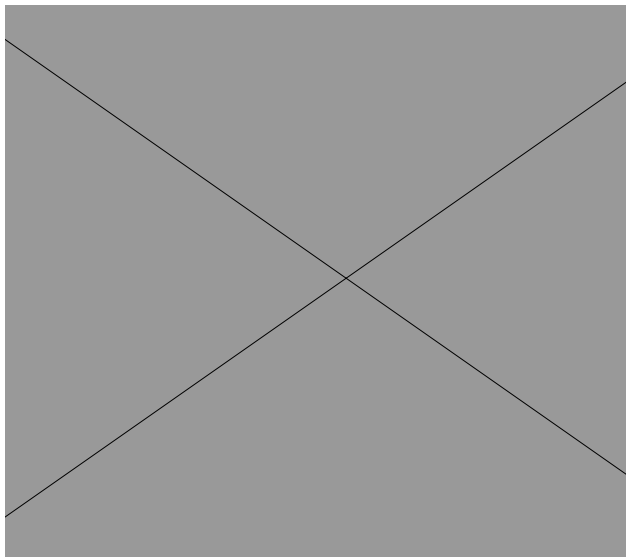


**Figure 10-37.** A clavicle fracture. Radiograph by Majorkev at English Wikipedia, CC BY 3.0. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Clavicle\\_Fracture\\_Left.jpg](https://commons.wikimedia.org/wiki/File:Clavicle_Fracture_Left.jpg)

Most clavicle fractures are treated without surgery with an arm sling for 4 to 6 weeks, use of NSAIDs, activity modification, and shoulder rehabilitation. Surgery may be indicated for more severe fractures and those associated with neurovascular impairment.

### **Acromioclavicular (AC) Separation**

An acromioclavicular (AC) separation (shoulder separation) (Figure 10-38) commonly results from trauma to the AC joint ligaments such as a fall onto the tip of the shoulder. When the acromion is driven into a hard surface, variable degrees of ligamentous disruption occur, from grade I (minor) to grade VI (severe).

Patients will report pain over the AC joint and pain on lifting the arm. With grade III or higher injuries, there is an obvious deformity. Physical examination reveals TTP, edema, ecchymosis, and erythema at the AC joint. The patient will support the arm in an adducted position with little movement or ROM. Assess neurovascular function. Refer the patient to the MO for evaluation.

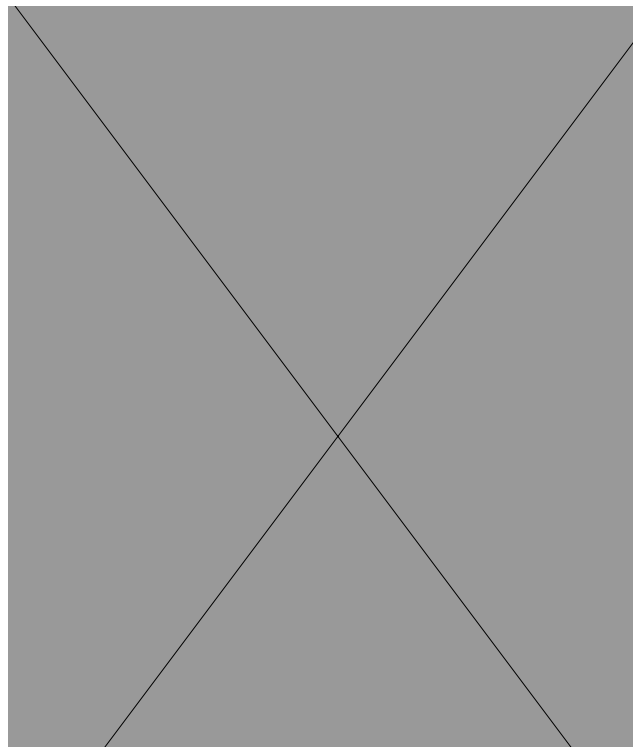


**Figure 10-38.** An acromioclavicular separation. Photograph by Lee Down, CC BY-SA 2.0. Reproduced from flickr.com. <https://www.flickr.com/photos/leedman/1399799871/>

Treatment includes use of a sling, NSAIDs, and ice, as well as shoulder rehabilitation. Surgery becomes an option for separations in grades III and above.

## Arm and Hand Disorders

### *Humerus, Radius, and Ulna Fractures*

Fractures of the humerus (Figure 10-39) are uncommon, while distal radius fractures are the most common in adults. The MOI for ulna and radius fractures (Figure 10-40) is falling on an outstretched hand (FOOSH). The two most common types of distal radial fractures are the Colles (most common) and Smith

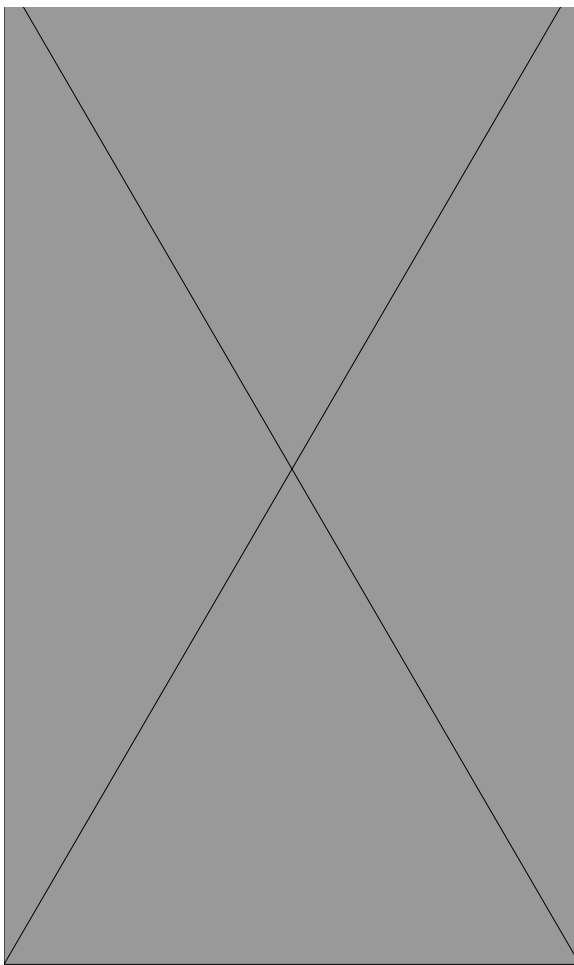


**Figure 10-39.** This radiograph of a right humerus bone (including elbow joint and a portion of the shoulder joint) shows a badly displaced fracture of the humerus. It was broken on 6 Aug 2007, during an arm wrestling match. Photo by Chris Norlin. <https://commons.wikimedia.org/wiki/File:Arm-Wrestle-Xray.jpg>

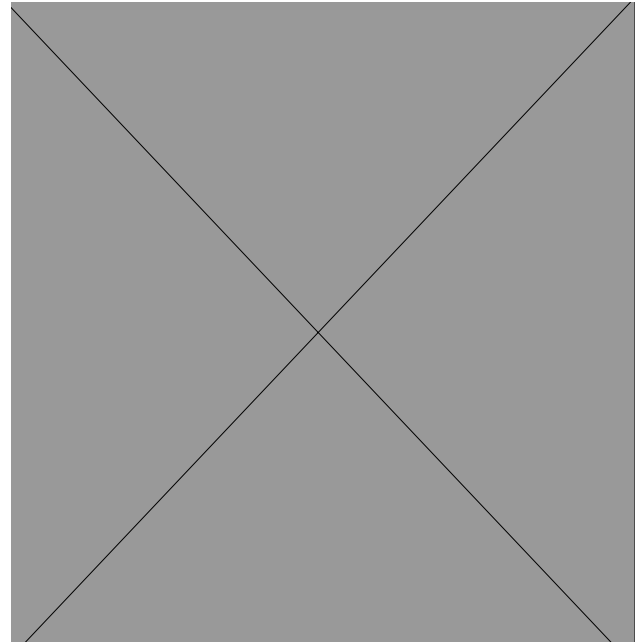


**Figure 10-40.** A midshaft fracture of the radius and ulna. Radiograph by James Heilman, MD, CC BY-SA 4.0. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:FracRadUlnaMark.png>

(less common) fractures. A Colles fracture typically occurs when falling onto wrists in extension, causing fragmentation dorsally. A Smith fracture occurs when falling onto wrists in flexion, causing fragmentation ventrally.

Signs and symptoms include acute pain following injury and pain with movement. Physical examination will reveal TTP at the site, edema, ecchymosis, deformity, and decreased ROM. It is imperative to assess for signs of shock and the pulse, motor, and sensory status of the extremity distal to the fracture. Refer patients to the MO for evaluation.

Treatment includes use of a splint and sling; NSAIDs; and rest, ice, compression, and elevation (**RICE**) for acute treatment of suspected fractures.

### *Medial and Lateral Epicondylitis*

An injury such as a fracture, dislocation, or tendon or ligament rupture causes acute pain and swelling. Chronic pain can be indicative of arthritis or overuse injuries from work or sport.

Medial and lateral epicondylitis are common complaints of the elbow. The epicondyle is the protrusion on top of the condyle where muscles can attach. The



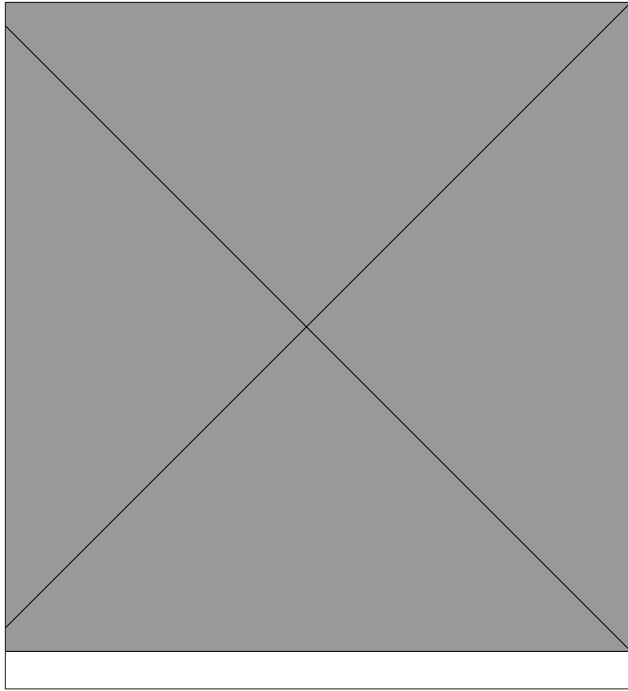


**Figure 10-41.** Epicondylitis (tennis elbow). Image by BruceBlaus, CC BY-SA 4.0. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Tennis\\_Elbow.png](https://commons.wikimedia.org/wiki/File:Tennis_Elbow.png)

condyle is the rounded end of a long bone that articulates with another bone at a joint. These two epicondyles are the anchoring points for the large muscles groups of our forearm.

Lateral epicondylitis (tennis elbow) (Figure 10-41) is more common than medial epicondylitis (golfer's elbow). The MOIs are possible overuse, sudden maximal muscle contraction, or a direct blow to the site. Signs and symptoms include gradual onset of pain in the lateral or medial elbow. Note that the patient may have no history of participating in either tennis or golf and still present with the complaint.

For lateral epicondylitis, the patient will report pain in the lateral elbow and forearm during activities involving wrist extension, such as lifting or hitting a backhand in tennis. Over time, pain becomes more severe and may occur at rest or with minimal activities. Patients will report pain at the site when lifting objects with their palms down. In the case of medial epicondylitis, pain occurs with active wrist flexion, such as with a golf swing or weight lifting. Patients will report pain at the site when lifting objects with their palms up. Physical examination for lateral epicondylitis will reveal localized TTP 1 cm distal to the lateral epicon-

dyle and pain at that site with resisted extension of the wrist. Physical examination for medial epicondylitis will reveal localized TTP 1 cm distal to the medial epicondyle and pain at same site with resisted flexion of the wrist. Refer the patient to the MO for treatment.

The most important step in treatment is to modify or eliminate activities causing symptoms. Other treatment measures include RICE, use of NSAIDs, an elbow strap, and physical therapy. Corticosteroid injections may alleviate pain from persistent problems, but injections can be avoided with proper rehabilitation of the injury.

### **Wrist and Hand Fractures**

Careful assessment and proper treatment are essential for fractures of the wrist (carpal), hand (metacarpal), and fingers (phalanges) to avoid serious complications and poor outcomes following injury. Signs and symptoms of wrist and hand injury include pain, ecchymosis, edema, erythema, or deformity at the injury site and an associated MOI.

**Carpal Fractures.** The most commonly fractured carpal bone is the scaphoid, usually resulting from a fall on an outstretched hand (forced extension of the wrist). The scaphoid is a wrist bone on the radial side that is important for stability and motion of the wrist. Pain occurs at the anatomical snuffbox. This is the deepened or hollowed area on the radial, dorsal aspect of the hand at the carpal level when the thumb is extended. The scaphoid is at the base of the anatomical snuffbox and is where the patient most commonly complains of pain or tenderness.

**Metacarpal Fractures.** Commonly, fractures in the hand are at the fourth or fifth metacarpal (Figure 10-42). The MOI for a fourth or fifth metacarpal fracture is a closed fist striking an object. Physical assessment may reveal a depressed knuckle, TTP, ecchymosis, and edema. Tenting of the skin may be present with metacarpal fractures.

**Phalangeal Fractures.** The distal phalanx is the most common site for a finger fracture. Physical examination will reveal localized TTP, edema, ecchymosis, erythema, deformity, and a break in the skin. ROM is decreased. Evaluate the affected digit for rotation or shortening. Distal phalangeal fractures may present with a fingernail that is avulsed, missing, or with a subungual hematoma. Treat amputated phalanges as any other amputation.

**Treatment.** Treatment includes referring all hand and wrist complaints to the MO for evaluation. Splint and place the affected arm in a sling to prevent further

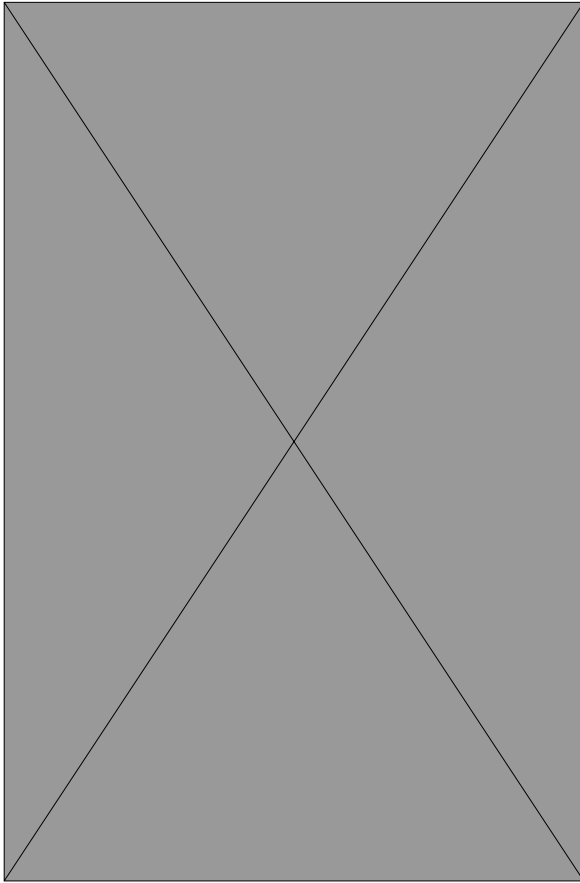


**Figure 10-42.** A neck fracture of the fourth metacarpal bone, commonly known as a boxer's fracture. Radiograph by Louis Philippe Lessard, CC BY-SA 3.0. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Neck\\_Fracture\\_of\\_the\\_Fourth\\_Metacarpal\\_Bone.png](https://commons.wikimedia.org/wiki/File:Neck_Fracture_of_the_Fourth_Metacarpal_Bone.png)

injury; splint finger injuries with a finger splint or by taping the injured finger to an uninjured finger (buddy taping). Advise the patient to use RICE and NSAIDs, and put the patient on profile.

### Check on Learning

20. List five RED FLAGS of upper extremity complaints.
21. What are the common MOIs for medial and lateral epicondylitis? What is the most common onset?
22. Your patient states he was upset so he hit a wall with his fist. What is the most common injury associated with this MOI?

## ASSESSMENT OF THE PELVIS AND LOWER EXTREMITIES

### Examination of the Lower Extremities

#### Subjective

Gather subjective information, as directed in Chapter 1, Sick Call and Medical Documentation. Ask the patient questions pertaining to their lower extremity complaint. During questioning, patients may reveal RED FLAGS from statements such as "I can't extend my knee," "I can't walk or bear weight on my leg," "My knee gives out," or "My knee locks up."

#### Objective

**Inspection.** If a patient complains of joint symptoms, evaluate the joint above and below the area of complaint. Inspect the extremity for abnormalities. Have the patient place one finger on the most painful spot to localize the pain. Compare the affected extremity to the unaffected one. Observe the patient walking to analyze gait and arm swing. Does the patient bear weight on the affected extremity?

**Palpation.** Palpate the affected area for tenderness, abnormal masses, crepitus, and temperature changes. Evaluate pulse and motor and sensory function at the affected area.

**ROM of the Hip.** Include flexion and extension motions to evaluate ROM of the patient's hip. Perform the following assessments on each hip:

- Hip flexion—position the patient in a supine position on the exam table and instruct them to bring one knee up toward their body (typically 110°) (Figure 10-43).
- Hip extension—with the patient standing and facing the edge of the exam table, direct them to bend over onto the exam table to support their upper body. Then have them raise one leg posteriorly as high as they can without arching their back (typically 30°) (Figure 10-44).

**ROM of the Knee.** Include flexion and extension motions to evaluate ROM of the patient's knee. Perform the following assessments on each knee:

- Flexion—with the patient positioned supine on the exam table, have them bend a knee, place the foot flat on the exam table, and slide the heel as far back as possible toward the buttocks as possible (Figure 10-45).

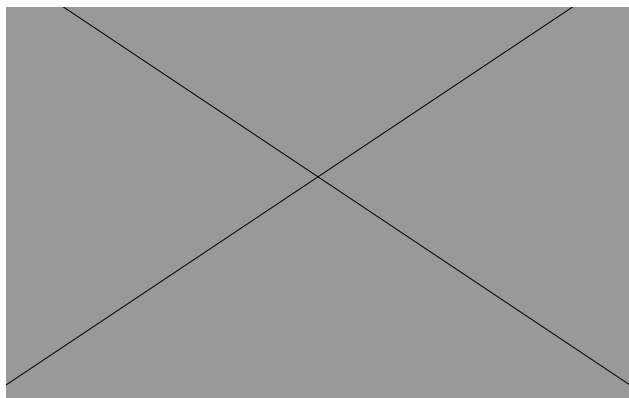


**Figure 10-43.** Hip flexion.

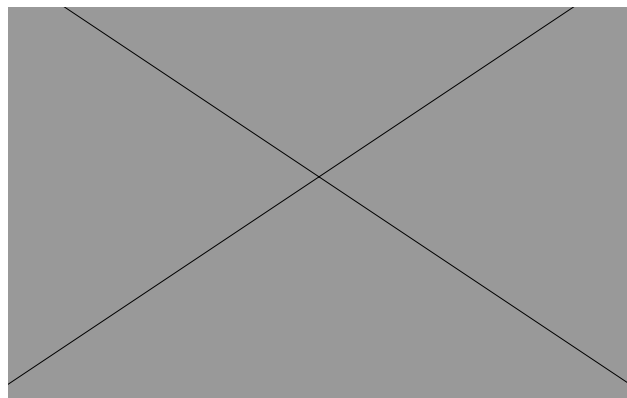


**Figure 10-44.** Hip extension.

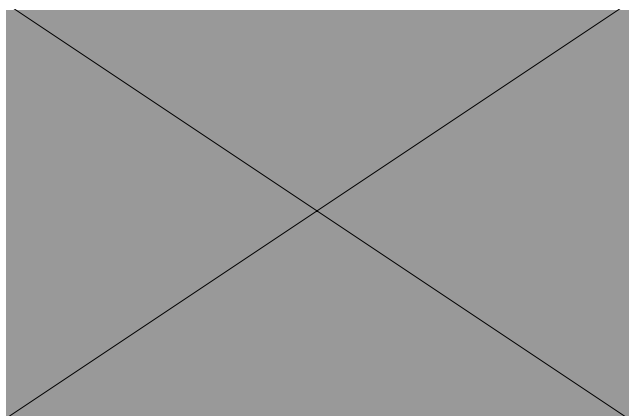


**Figure 10-45.** Knee flexion.

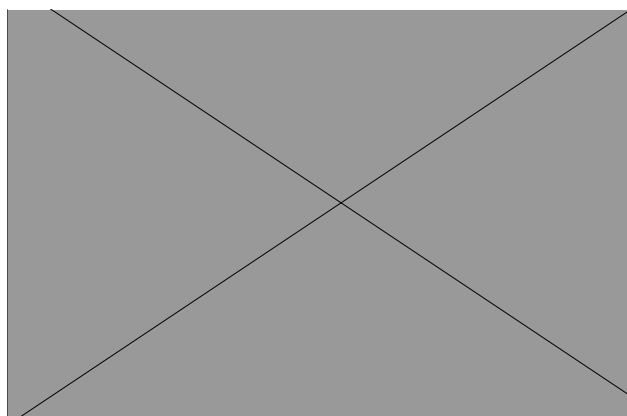


**Figure 10-46.** Knee extension.

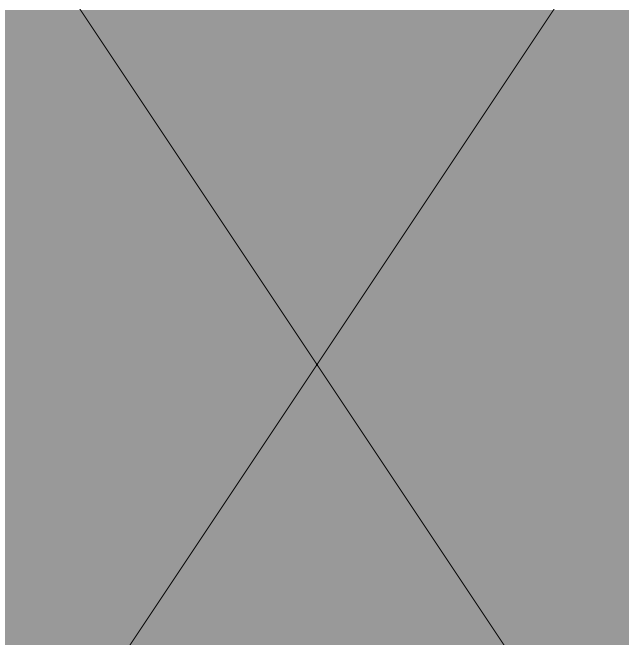


**Figure 10-47.** Ankle dorsiflexion.

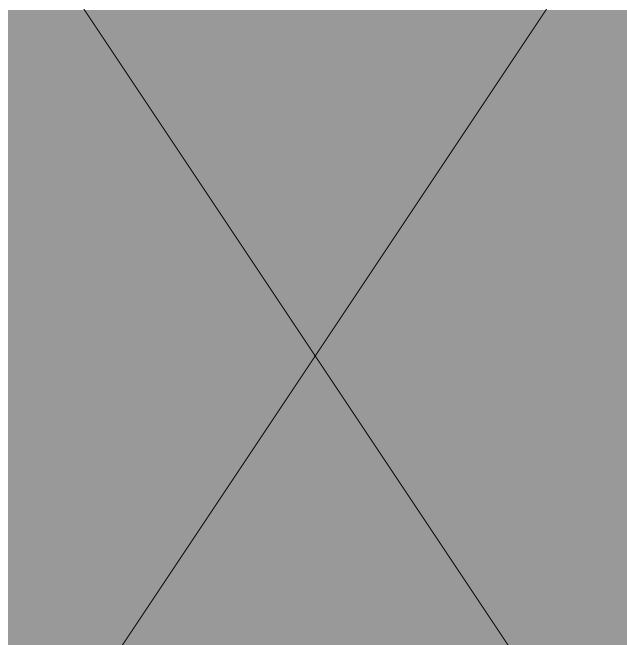


**Figure 10-48.** Ankle extension.



- Extension—with the patient positioned supine on the exam table, have them straighten their lower leg as far as possible (Figure 10-46).

**ROM of the Ankle.** Include dorsiflexion and plantar flexion motions to evaluate ROM of the patient's ankle. Perform the following assessments on each ankle:

- Dorsiflexion—with the patient seated on the edge of the exam table, instruct them to raise the balls of their feet upward by movement of the ankle. Alternately, have the patient stand on their heels and raise the balls of their feet off the ground (Figure 10-47).
- Plantar flexion (extension)—with the patient seated on the edge of the exam table, ask them to point their toes towards the ground (Figure 10-48). Alternately, extension can be assessed by having the patient stand on their toes (Figure 10-49).

**Special Tests.** Additional specialized exams for lower extremities may be required. MOs will train you on any additional special tests you may be required to perform.

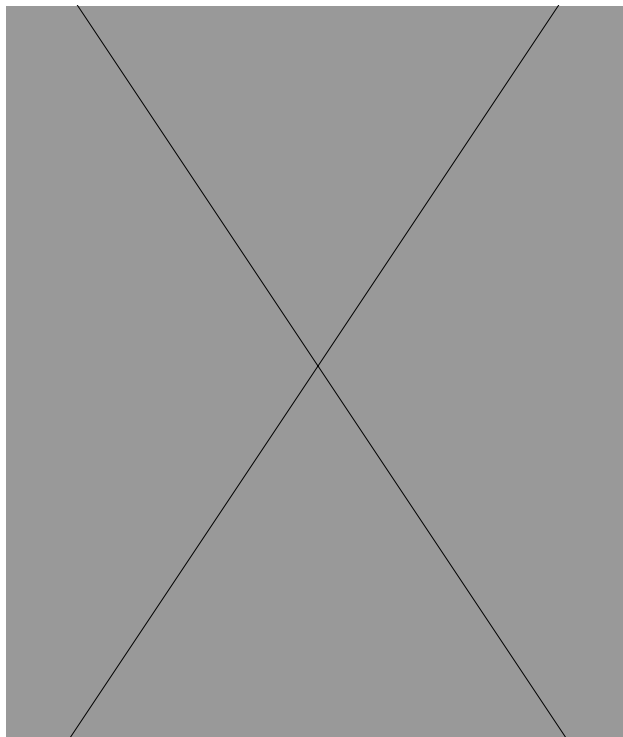


**Figure 10-49.** Standing ankle extension.

## RED FLAGS of Lower Extremity Complaints

RED FLAGS of lower extremity complaints that require immediate referral to an MO include:

- intolerable pain;
- pain that is not responsive to treatment;
- repeated visits for the same complaint;
- open fractures, deformities, or neurovascular compromised extremities;
- trauma with neurological changes, muscle weakness, or a deteriorating exam in the affected extremity;
- inability to bear weight, repeated giving way (instability), or locking;
- any hot, swollen joint;
- inability to fully extend or flex the extremity (decreased ROM); and
- any suspected fracture.

**Note:** Recurrent or chronic pain can be a sign of cancer, fracture, or other serious injury. An MO MUST evaluate the condition. Imaging is likely.

## COMMON COMPLAINTS OF THE LOWER EXTREMITIES

### Hip and Thigh Disorders

#### *Pelvic Fracture*

Pelvic fractures among soldiers usually result from high impact MOIs (eg, motor vehicle accidents, falls from heights, and IEDs). Unstable fractures cause loss of pelvic structural integrity and may be life threatening. In unstable fractures, bones are displaced or the ends of bones are moved apart (Figure 10-50). These fractures can cause significant bleeding and may damage internal organs. Stable fractures (Figure 10-51) are those in which the pelvis retains its structure. They are usually less serious than unstable fractures.

In the primary care setting, you are most likely to see stress fractures or avulsion fractures related to sports activities or physical training. Stress fractures are small cracks in bone caused by overuse or repetitive use. In an avulsion fracture, an injured tendon pulls away from the bone, taking with it a small piece of bone. Patients may complain of pain in the hip or

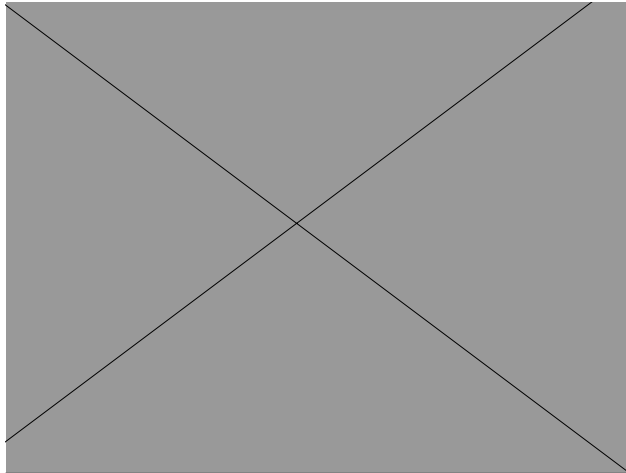


**Figure 10-50.** A traumatic open book pelvis fracture and significant diastasis in the symphysis pubis. Radiograph by Nevit Dilmen, CC BY-SA 3.0. Adapted from Wikimedia Commons (added a pointer). [https://commons.wikimedia.org/wiki/File:Diastasis\\_symphysis\\_pubis\\_1300500.JPG](https://commons.wikimedia.org/wiki/File:Diastasis_symphysis_pubis_1300500.JPG)

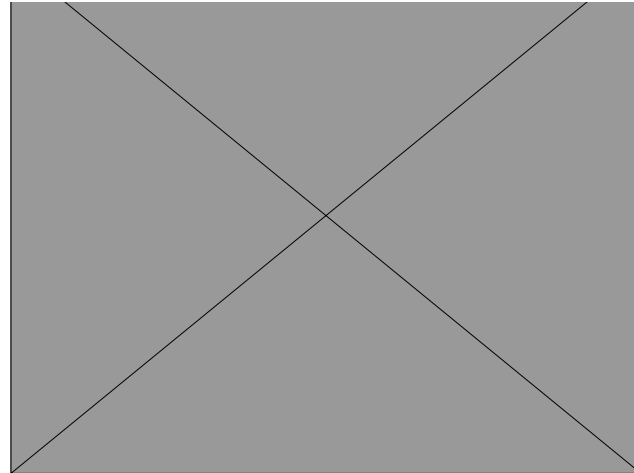


**Figure 10-51.** A pelvic acetabulum fracture as seen on plain radiograph. Radiograph by James Heilman, MD, CC BY-SA 3.0. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:AcetabularfracX.png>

groin that gets worse with activity. There may be visible bruising or swelling in the affected area. Check for numbness or tingling. Refer patients with suspected pelvic fracture to an MO.

### *Hip Strain and Sprain*

Hip pain is a common complaint in new soldiers who are not used to running frequently or walking great distances while bearing heavy loads. Their bodies may not have endured the harsh treatment and conditioning some athletes are used to and can find the training to be punishing. The most common sites of hip pain are in the groin and lateral hip.

Extra-articular (outside of the joint) injuries are the largest source of hip and groin pain in active adults. Tendinitis, tendon tears, **bursitis**, and muscle injuries cause lateral hip pain. Among runners and athletes involved in running-based sports, acute muscle strains and tendinopathies are the most common injuries. Intra-articular (in the joint) disorders are in part caused by overuse or trauma, which may result in stress fractures or sprained ligaments. Intra-articular hip pain is most notably felt in the groin, hip, and buttocks. Hip strain is a broad term related to overuse caused by strenuous muscular contraction.

Weight bearing, flexion, and excessive standing induce most of the problems that correlate with hip complaints. The hip is the center of the body and it

endures loads and stress from running and jumping. Conduct hip assessment tests with the patient positioned standing, sitting, lateral decubitus (lying on one side), prone, and supine. For the following special tests consider alignment, focus on differences in leg length, and note pain induced by bearing weight and with any movement:

- Trendelenburg's test for hip stability. The patient stands on one leg and alternates legs when instructed (Figure 10-52). In a negative test, the pelvis will be level or greater on the side of the raised leg. In a positive test, the pelvis will be lower on the side of the raised leg.
- Thomas test for ROM of the hip flexors. It helps identify early signs and symptoms of arthritis, and patellofemoral pain syndrome. Ask the patient to lie supine on exam table. Stabilize the patient's pelvis by placing your hand under the patient's lumbar spine and flexing their hip (Figure 10-53). As the patient flexes the hip, the lumbar spine flattens and the pelvis is stabilized. Normally, a person should be able to bring their knee to their chest without flexing their thoracic spine or arching their lumbar spine. If the patient compensates in either of these ways, there may be hip flexion pathology.

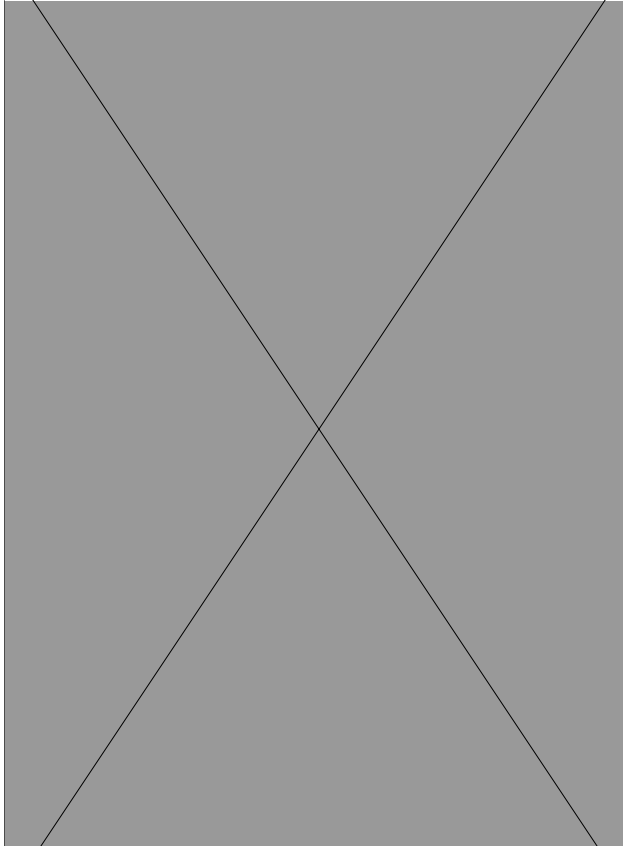


**Figure 10-52.** Trendelenburg's test for hip stability.

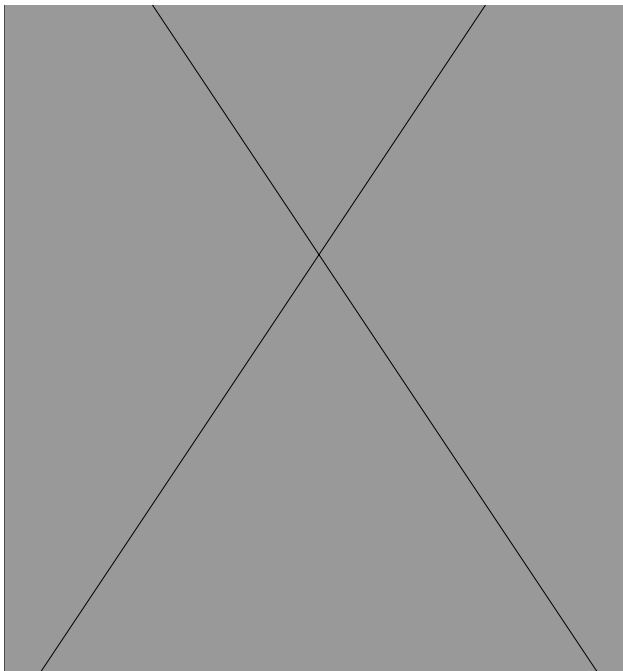


**Figure 10-53.** The Thomas test for hip flexor range of motion.

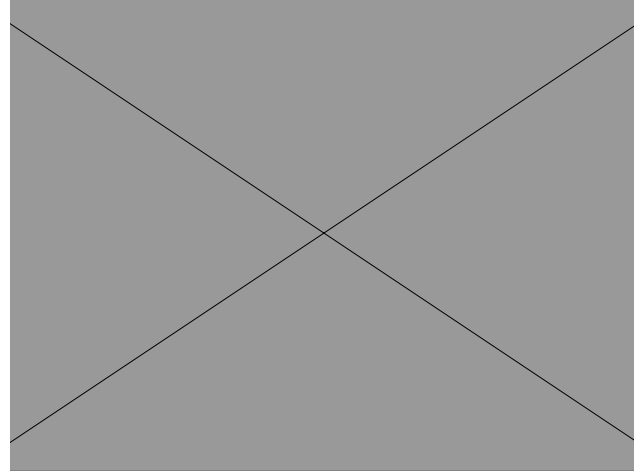


**Figure 10-54.** The FABER test for sacroiliac joint injury.

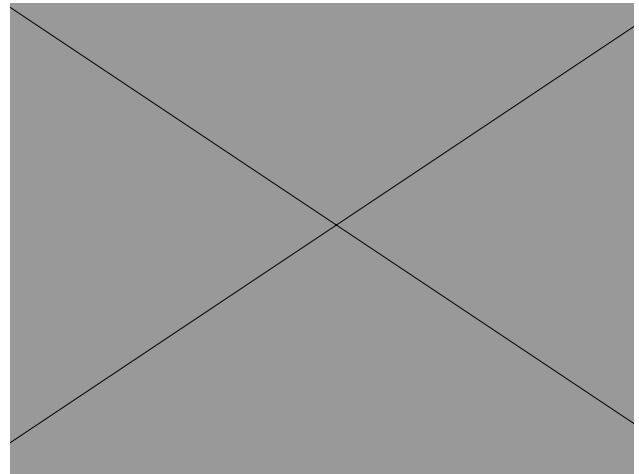


**Figure 10-55.** The Ely test for lumbosacral or hip injury.

- **FABER** test (Patrick's test) for the sacroiliac joint injury. The patient's hip is flexed to a 90° angle, abducted, and externally rotated (Figure 10-54). If a patient has hip, groin, or back pain, the test will be positive. This can suggest iliopsoas pain or pathology within the sacroiliac joint.
- Ely test for muscle tightness caused by a lumbosacral or hip injury. Ask the patient to lie in a prone position. Instruct the patient to flex their leg until the heel touches the buttocks (Figure 10-55). A positive test occurs when the patient cannot touch the heel to the buttocks without pain or the hip of the tested side rising off the table. A positive test may also be indicative of a bulging disc.



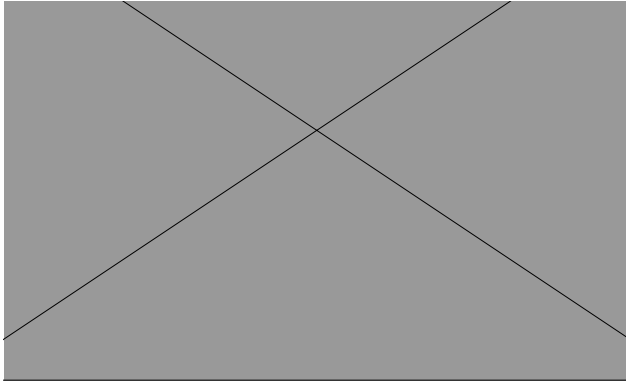


**Figure 10-56.** The Scour test, medial rotation, for hip pain of unknown origin.

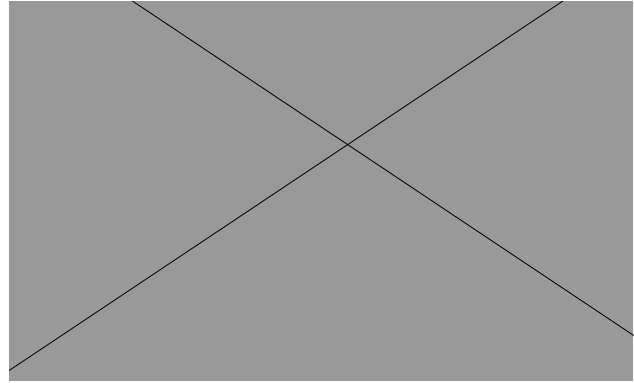


**Figure 10-57.** The Scour test, lateral rotation, for hip pain of unknown origin.

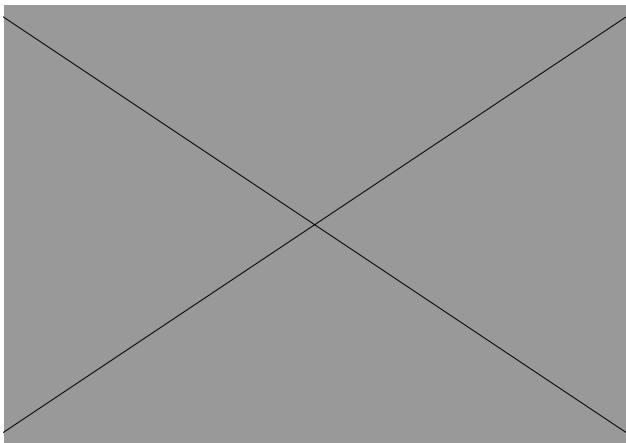


**Figure 10-58.** The McMurray test for knee meniscus injury.

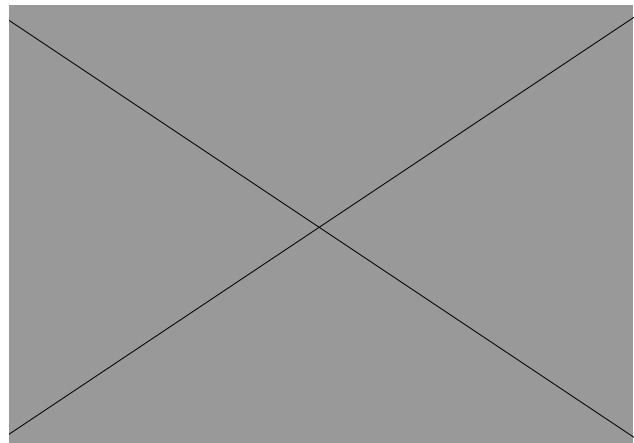


**Figure 10-59.** The valgus test for medial collateral ligament injury.

- Scour test to assess for hip pain of unknown origin. Ask the patient to lie in a supine position. Flex and rotate the knee to check ROM (Figures 10-56 and 10-57). Any irregularities including patient apprehension, pain, clicking, or grinding indicate a positive test.

Physical examination will affirm TTP (although it may be difficult to pinpoint the exact location of the injured muscle due to hip muscle depth). A patient may complain of pain over the injured muscle area that continues during strenuous activity. Refer patients to an MO.

Ice, NSAIDs, activity modification, and physical therapy are the pillars of treatment.

### ***Femur Fracture***

High-energy trauma (eg, from a motor vehicle collision) causes most fractures of the femoral shaft in

adults. Pathologic fractures from low-energy trauma (falls) are less common and often occur in bone weakened by disease.

A patient may present with severe pain in the thigh along with an obvious deformity. They will be unable to move or bear weight on that extremity. Examination may reveal TTP, edema, ecchymosis, deformity, and/or an open wound at the site. The injured extremity may present shorter than the unaffected extremity or rotated. ROM may be reduced and the patient will not tolerate placing weight on the injured leg. It is imperative to assess for signs of shock and the PMS status of the extremity distal to the fracture.

Treatment should begin with immediate referral to an MO. Splint using a traction splint if available to prevent further injury and decrease pain associated with the fracture. Evaluate for and treat associated life-threatening injuries. Consider optional pain management.

### ***Femoral Stress Fracture***

A femoral stress fracture usually results from overuse and repetitive processes rather than from a single acute traumatic event. Femur stress fractures occur most commonly in military recruits and athletes.

Signs and symptoms include vague pain in the groin or anterior thigh associated with activity or weight bearing that subsides after cessation of activity. The patient will also likely have a history of increased or repetitive physical activity preceding the symptoms. Physical examination will reveal vague TTP at the proximal thigh due to soft-tissue irritation. The patient will have pain at extreme ROM that increases with internal rotation. An early radiograph will usually be normal. Refer these patients to an MO.

Treat nondisplaced stress fractures by directing the patient to cease activities that stress the leg and to use crutches to prevent weight bearing until the injury is healed (usually 6–8 w). NSAIDs and activity modification may also be helpful. Displaced fractures will require surgery.

### ***Thigh Strain***

A thigh strain can be temporarily painful and can seriously impair an athlete. The posterior thigh muscle (hamstring) is injured more often than the anterior thigh (quadriceps). Patients will report sudden onset of posterior thigh pain that occurred during rapid movement (eg, running). The onset of pain may have been accompanied by a “pop” feeling.

Physical examination will reveal local tenderness at the site of the injured muscle. There may be ecchymosis at the posterior thigh. Refer the patient to an MO. Treatment consists of RICE and physical therapy.

### **Check on Learning**

23. What should you do if you suspect a pelvis fracture?
24. Repetitive overloading and increased workloads can result in which injury?

### **Knee Pain and Disorders**

#### ***Internal Derangement of the Knee***

Internal derangement of the knee includes damage to the ligaments or cartilage of the knee. Injuries to the knee occur most commonly from twisting, hyperexten-

sion, or medial or lateral force (as seen in sports-related activities, explosions, or motor vehicle accidents). Most patients will report an activity associated with sudden knee pain. Some will report an audible “pop” (eg, with a tear of the anterior cruciate ligament), and the patient will not be able to continue the activity due to pain. Following the acute injury, the patient may report pain, stiffness, swelling, giving out, locking, and popping. When assessing the knee, do not force the patient to bear weight or manipulate the knee in any way that causes pain, as this may cause further injury to the underlying ligaments. Use the following specialty tests to examine the knee in more detail:

- McMurray test for meniscus injury. Ask the patient to lie in a supine position. Hold their heel with one hand and flex their knee. Cup your other hand over their knee, with your fingers and thumb placed along the medial joint line. Using pressure on the patient’s heel, rotate the patient’s lower leg externally, then push on the lateral side of the knee to put a valgus stress on the medial side of the joint at the same time (Figure 10-58). Maintain pressure and slowly extend the patient’s lower leg, while keeping it in external rotation. Use the same manipulation, but with internal rotation of the foot, to stress the lateral meniscus. Consider the test positive if a click is felt or heard at the joint line during flexion and extension of the knee, or if tenderness is noted along the joint line.
- Valgus and varus tests for medial and lateral collateral ligament injuries. To test the medial collateral ligament, hold the patient’s ankle with one hand and place your other hand on the lateral aspect of the patient’s knee. Then push medially against the knee and attempt to open the knee joint on the inside (valgus stress) (Figure 10-59). To test the lateral collateral ligament, reverse the position of your hands and push laterally against the knee and medially against the ankle to open the knee joint on the lateral side (varus stress) (Figure 10-60). Consider the test positive if you feel a gap, instability, or pain.
- Anterior and posterior drawer tests for anterior and posterior cruciate ligament injuries. Have the patient lie supine with flexed knees and feet flat on the table. With your thumbs on the medial and lateral joint and your fingers clasping the hamstring muscle, pull forward

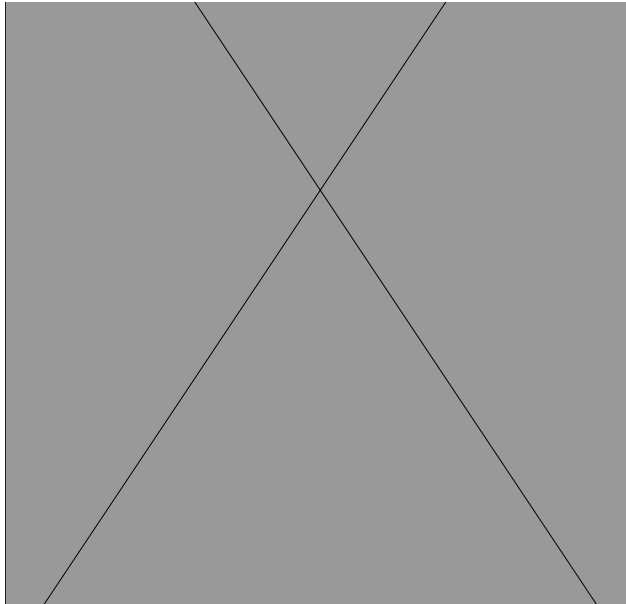


**Figure 10-60.** The varus test for lateral collateral ligament injury.

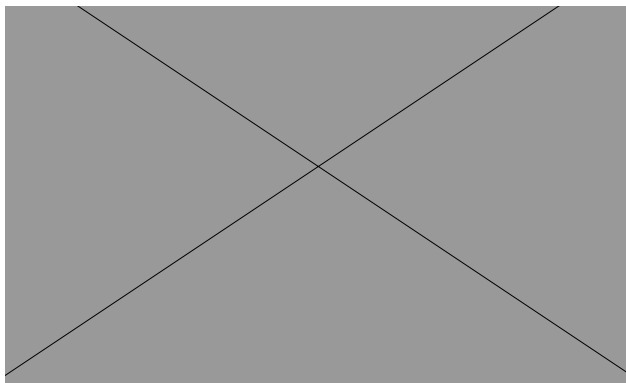


**Figure 10-61.** The anterior drawer test for anterior cruciate ligament injury.

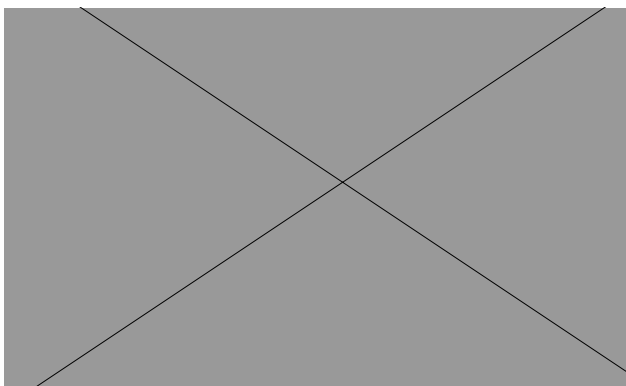


**Figure 10-62.** The posterior drawer test for posterior cruciate ligament injury.

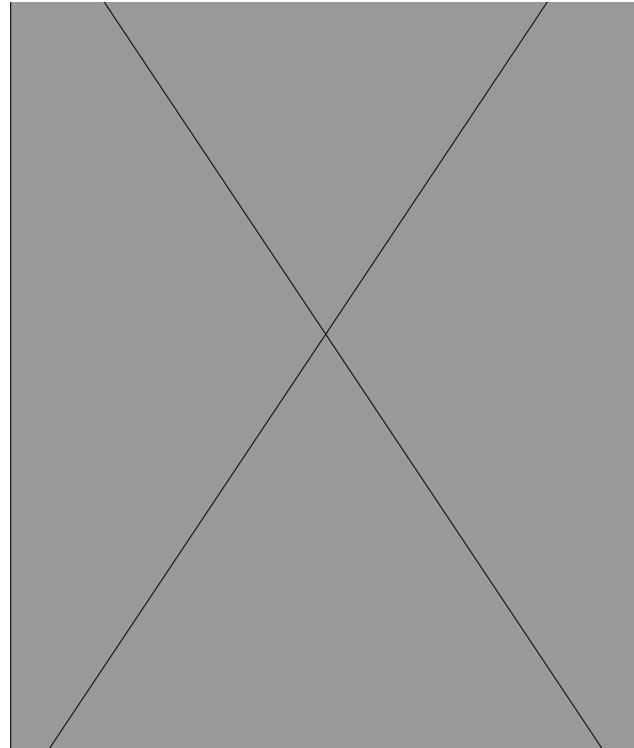


**Figure 10-63.** The Lachman test to assess integrity of the anterior cruciate ligament.

(Figure 10-61) and push backward (Figure 10-62) to see if the tibia will slide out like a drawer from the femur. There is slight movement in a normal test, as long as you feel it on both sides. If you feel movement and see some shape of the patient's upper tibia, the test is positive.

- Lachman test for anterior cruciate ligament injury. Hold the leg so the patient's joint is between your hands. Place your thumb on the medial or lateral joint line. Twist the patient's femur and tibia in opposite directions. Check for forward deviation (Figure 10-63).

Physical examination will reveal TTP of the knee. The exact location of the tenderness will be helpful to make the diagnosis. Edema and decreased ROM may develop because of bleeding into the joint (hemarthrosis). Refer patients to an MO for evaluation and possible aspiration of the hemarthrosis.

Treatment will include RICE, use of crutches and acetaminophen, followed by NSAIDs during rehabilitation. Knee braces provide additional support. Surgery may be indicated for ligament and meniscus tears, followed by intensive physical therapy.



### ***Patellofemoral Pain Syndrome***

Patellofemoral pain syndrome (runner's knee) is related to overuse and overloading of the knee joint. Patients have diffuse, aching anterior knee pain that increases with activities that place additional loads across the knee joint (such as running, climbing up or down stairs, kneeling, and squatting).

Signs and symptoms include a diffuse, aching anterior knee pain that is worse after prolonged sitting, climbing stairs, jumping, or squatting. Physical examination may be completely normal. Observe the patient's gait. Check for crepitus during ROM examination of the knee. Refer the patient to an MO for evaluation.

Treatment involves activity modification (biking and swimming are good alternatives), use of NSAIDs, weight loss for obese patients, and quadriceps strengthening.

### ***Patellar Tendinitis***

Patellar tendinitis (jumper's knee) is an overuse or overload syndrome of the quadriceps tendon or the patella tendon.

Anterior knee pain, especially at the inferior pole of the patella, is the hallmark symptom of this condition. Patients can point to a tender spot on the tendon and generally report a history of pain immediately after exercise that sometimes resolves after warming up. The physical examination commonly reveals no swelling. Palpation of the knee reveals focal tenderness to the inferior pole of the patella or patellar tendon. Patients will have full ROM and strength, but with pain. Refer the patient to an MO for evaluation.

Treatment consists of ice and heat, use of NSAIDs, knee sleeves, activity modification, and physical therapy.

## **Lower Leg and Foot Disorders**

### ***Tibia and Fibula Fractures***

**Fractures.** High-energy trauma can cause tibia and fibula fractures. A patient may present with severe pain in the thigh along with an obvious deformity. They will be unable to move or bear weight on that extremity. Examination may reveal TTP, edema, ecchymosis, deformity, and/or an open wound at the site. The injured extremity may present shorter than the unaffected extremity or rotated. ROM may be reduced and the patient will not tolerate placing weight

on the injured leg. It is imperative to assess for signs of shock and the pulse, motor, and sensory status of the extremity distal to the fracture.

**Stress Fractures.** A stress fracture is a nontraumatic microscopic break in a bone. Stress fractures of the tibia and fibula typically follow a rapid increase in exercise intensity. Military recruits and high-performance athletes are susceptible to these injuries from overuse.

Pain from a stress fracture initially occurs only with exercise, but with continued activity, the patient feels pain while walking or at rest. Patients are usually able to locate an extremely painful area on the tibia. Physical examination will reveal TTP localized to the affected area of bone. Impact and stress on the bone will cause pain. Six or more weeks after the onset of symptoms, swelling secondary to the bony callus may be palpable. Refer the patient to an MO for evaluation, leg splints, and radiographs.

Treatment consists of RICE, use of NSAIDs, and a profile for activity modification.

### ***Medial Tibial Stress Syndrome***

Medial tibial stress syndrome (also known as shin splints) is a condition characterized by the gradual onset of pain in the anteromedial aspect of the distal third of the leg. This condition develops in response to increased exercise or activity level. The increased exercise or activity level causes stress on the tibia (shinbone) and connective tissue that attaches muscles to the bone. Other common causes are flat feet, poorly fitting shoes, and working out without warm-up or cool-down exercises.

The patient's chief complaint will be a gradual onset of pain with exercise with pain localized to the distal third of the medial tibia or distal third of the leg. During examination, the posterior medial crest of the tibia will be tender to palpation. Refer the patient to an MO for evaluation, leg splints, and radiographs.

Treatment consists of RICE, NSAIDs, and a profile for activity modification.

### ***Ankle Sprains***

Ankle sprains are common. They are not always simple injuries and residual symptoms may occur. Ankle sprains lead to recurrent sprains. Most ankle sprains result from ankle inversion (an inward turning of the foot, also known as an inversion roll), which injures lateral ligaments.

Signs and symptoms include pain over the injured ligaments, swelling, and loss of function. Some patients

will report an audible “pop.” Physical examination reveals TTP and decreased ROM. Edema and ecchymosis around the entire joint are common. Compare the affected to the unaffected side.

Treatment consists of RICE, use of NSAIDs or acetaminophen, activity modification, use of a splint or brace, and rehabilitation. If you suspect a fracture, treat it as a fracture. Issue crutches and refer the patient to an MO for evaluation.

### *Ankle, Metatarsal, and Phalangeal Fractures*

Ankle, metatarsal, and phalangeal fractures occur frequently among military personnel. Traumatic force usually causes acute fractures, whereas repetitive overloading and increased activity levels usually cause stress fractures.

Following trauma, patients with ankle, metatarsal, and phalangeal fractures (Figure 10-64) usually report acute pain, swelling, and inability to bear weight on the affected appendage. Stress fractures will present with pain that increases with weight bearing and is relieved by rest (without a history of trauma). Edema,

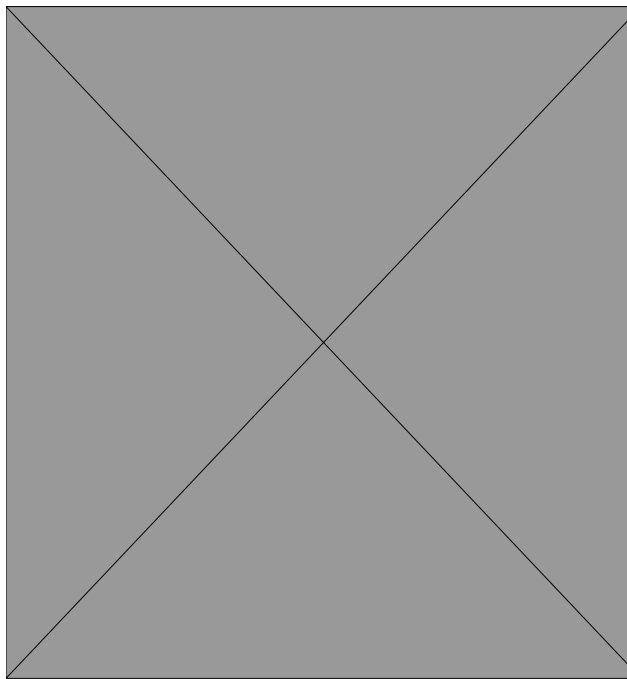


**Figure 10-64.** A left lateral malleolus avulsion fracture. Radiograph by Timdwilliamson, CC BY-SA 4.0. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Left\\_lateral\\_malleolus\\_avulsion\\_fracture\\_detail.jpg](https://commons.wikimedia.org/wiki/File:Left_lateral_malleolus_avulsion_fracture_detail.jpg)

erythema, and ecchymosis may accompany an acute fracture, with TTP evident at the fracture site.

If the chief complaint is ankle pain, with any of the above signs or symptoms, you may consider Ottawa Ankle Criteria. These rules were developed, tested, and validated in adult patients and may inform the need for a radiograph or evacuation. Positive Ottawa Ankle Criteria tests comprise the following indicators during examination:

- bone tenderness at the posterior edge of the distal 6 cm of the patient’s medial or lateral malleolus,
- bone tenderness at the tip of the patient’s medial or lateral malleolus, or
- bone tenderness not present, but the following criteria must all be present in the patient:
  - unable to bear weight immediately after the injury,
  - unable to bear weight after four steps in the clinic, and
  - tenderness along the lateral edge of the tarsal/metatarsal region.

The MO may still recommend radiographs at their discretion if two out of the three signs are present.

**Note:** Some sources include tenderness over the fifth metatarsal as another indicator of ankle sprain. This tenderness could be due to an avulsion fracture, which commonly occurs during ankle inversion.

Second metatarsal fractures are the most common metatarsal injuries in soldiers. They are caused by recurrent stress from activities like running or marching. In the Army, a second metatarsal fracture commonly is called a “march fracture.”

Lacerations or skin tears may indicate an open fracture. For any suspected fracture, refer the patient to an MO. Radiographs may be requested for definitive diagnosis of a fracture.

Treatment consists of RICE, use of acetaminophen or NSAIDs, use of a splint or crutches, and a profile to protect from further injury. Treat non-angulated toe fractures with RICE and buddy taping the toe. Stress fractures require a stiff-soled shoe and activity modification. Displaced or angulated fractures may require reduction or casting.

**Plantar Fasciitis**

Plantar fasciitis is the most common cause of heel pain in adults. It occurs as a degenerative tear of part of the fascia on the bottom of the foot and is more common in women and those who are overweight.

Patients will complain of pain at the heel or the sole of the foot that is greatest upon rising from a resting position, especially in the morning, and sitting often relieves symptoms. Symptom onset is not normally related to trauma. Physical examination will reveal TTP at the calcaneus and plantar fascia. No edema, ecchymosis, or erythema will be present. Pain with weight bearing on the heel will be evident. Refer patients to an MO for further evaluation.

Greater than 95% will heal within 6 to 12 months. Over-the-counter heel pads, ice, NSAIDs, and night splints are the mainstays of treatment, along with stretching and alternative exercise programs.

**Check on Learning**

25. Vague pain in the groin or anterior thigh associated with activity or weight bearing that subsides after cessation of activity could be associated with what complaint?
26. List five RED FLAGS of lower extremity complaints.
27. Patellofemoral pain syndrome also is called \_\_\_\_\_.
28. Patellar tendinitis also is called \_\_\_\_\_.
29. What is the hallmark symptom of patellar/quadriceps tendinitis?
30. The lateral ligaments of the ankle are injured mostly as the result of \_\_\_\_\_.
31. Ankle inversions also are called \_\_\_\_\_.
32. Which injury results from recurrent stress activities like running or marching? What is the common name for this injury?
33. Degenerative tears of part of the fascia on the bottom of the foot are the most common cause of heel pain in adults. This condition is called \_\_\_\_\_.
34. 95% of patients with plantar fasciitis will heal in how much time?

**SUMMARY**

Musculoskeletal injuries are frequently encountered complaints that may have few obvious findings on the physical examination. Your ability to apply these appropriate principles and techniques of assessment and management may mean the difference in reducing recovery time, preventing further painful injury, and preventing permanent disability.



## KEY TERMS AND ACRONYMS

**Articulation.** The place of union or junction between two or more bones of the skeleton.

**Avascular.** A lack of blood vessels.

**AVPU.** Alert, verbal, pain, unresponsive.

**Bursitis.** Inflammation of a bursa (a fluid-filled sac).

**Dislocation.** A bone that has been displaced from its usual articulation with another bone.

**Ecchymosis.** Passage of blood from ruptured blood vessels into subcutaneous tissue, marked by a purple discoloration of the skin.

**Erythema.** Redness of the skin, caused by dilation of the capillaries.

**FABER.** Flexion, abduction, and external rotation.

**Gait.** A particular way or manner of walking, described as a normal gait or an antalgic (abnormal) gait.

**GCS.** Glasgow Coma Scale.

**Hemarthrosis.** Blood in a joint.

**Hyperextension.** A joint or muscle straightened beyond its normal ROM.

**Hyperflexion.** A joint bent or muscle contracted beyond its normal ROM.

**Inversion.** Elevation of the medial border of the foot (the sole of the foot or ankle turns inward).

**Meniscus.** A semilunar, fibrocartilaginous wedge that rims and cushions each tibiofemoral articulation (the superior aspect of each tibia).

**RICE.** Rest, ice, compression, and elevation.

**ROM.** Range of motion.

**Sprain.** The stretching, wrenching, or laceration of a ligament, usually characterized by pain, swelling, and disablement of the joint. Sprains result from a joint being forced beyond the limits of its normal plane of motion. This can occur even during common activities such as walking over uneven terrain in a field environment.

**Strain.** An overstretching or tearing injury to muscle fibers resulting from excessive tension or overuse. Strains can occur due to improper warm-up procedures prior to a strenuous exercise event (eg, sprinting or power lifting).

**Subluxation.** An incomplete or partial dislocation.

**Synovial joints.** Joints located between bones that move against each other, such as the joints of the limbs (shoulder, knee, hip, and elbow). These joints have a cavity filled with fluid (synovial fluid) that reduces friction.

**Tendinitis.** Inflammation of a tendon.

**Tendons.** Bands of tough, inelastic, fibrous tissue connecting muscles with their bony attachments.

**TTP.** Tenderness to palpation.

## CHECK ON LEARNING ANSWERS

1. List five functions of bones.

*Any five of the following: give the body its shape and structural support, protect vital organs, assist in movement, produce blood cells, store minerals, and store chemical energy.*

2. How many types of bones are there?

*Five.*

3. What is the largest sesamoid bone in the body?

*Knee (patella).*

4. What are long bones and why could a fracture of these bones become life threatening?

*Long bones are longer than they are broad (eg, humerus and femur). Long bone fractures may become life threatening if the jagged ends of the bone sever the arteries within the corresponding limb.*

5. What are the functions of a joint?

*To enable movement and provide stability.*

6. Where are ball-and-socket joints located in the body?

*In the shoulder and hip.*

7. Where are hinge joints located in the body?

*In the elbow, knee, ankle, and joints between finger and toe bones.*

8. Tendons connect bone to \_\_\_\_\_.

*Muscle.*

9. What are the functions of ligaments?

*Ligaments stabilize and support the joint through its normal ROM by confining its movement to specific planes and preventing hyperextension or hyperflexion.*

10. What is the main difference between skeletal and smooth muscle?

*Skeletal muscles (eg, biceps) allow for voluntary movement, and smooth muscles (eg, intestinal wall muscles) contract involuntarily.*

11. What are the two major skeletal regions?

*Axial and appendicular skeleton.*

12. Name the five subsections of the spinal column.

*Cervical, thoracic, lumbar, sacral, and coccyx.*

13. Approximately how far does the spinal cord extend down the spinal column?

*To the second lumbar vertebra.*

14. When does assessment of the patient begin?

*As the patient walks toward the exam room.*

15. What are the three components of the physical exam for an orthopedic complaint?

*Inspection, palpation, and ROM assessment.*

16. Why should you avoid forcing patients to move beyond their point of pain?

*Forcing movement could exacerbate injury or cause additional injury.*

17. List five RED FLAGS of spinal complaints.

*Any five of the following:*

- *unbearable pain that does not respond to treatment;*
- *repeated visits for the same complaint;*
- *numbness, tingling, or weakness in the extremities;*
- *bony deformities, step-offs, or crepitus;*
- *trauma with neurological changes or a deteriorating examination (AVPU or GCS);*
- *fever, weight loss, night sweats, night pain;*
- *loss of bowel or bladder control or statements such as, "I can't pee";*
- *inability to bear weight, due to pain in the lower back; and*
- *significant decrease of ROM in the back.*

18. Which common spinal complaint is usually associated with a history of whiplash injury?

*Cervical strain.*

19. What is the common treatment for lower back strain?

*Symptomatic treatment includes activity modification, use of acetaminophen or NSAIDs for pain, heat application, and education on proper lifting and bending techniques.*

20. List five RED FLAGS of upper extremity complaints.

*Any five of the following:*

- *unbearable pain that does not respond to treatment;*
- *repeated visits for the same complaint;*
- *open fractures or deformities;*
- *neurovascular compromised extremities;*
- *hot, swollen joint;*
- *inability to fully extend or flex (decreased ROM);*
- *trauma with neurological changes, muscle weakness, or a deteriorating exam in the affected extremities; and*
- *any suspected fracture.*

21. What are the common MOIs for medial and lateral epicondylitis? What is the most common onset?

*Medial epicondylitis MOIs are possible overuse, sudden maximal muscle contraction, or a direct blow to the site. Lateral epicondylitis MOIs are activities involving wrist extension, such as lifting or hitting a backhand in tennis.*

22. Your patient states he was upset so he hit a wall with his fist. What is the most common injury associated with this MOI?

*Metacarpal fracture (boxer's fracture).*



23. What should you do if you suspect a pelvis fracture?

*Immediately refer the patient to an MO.*

24. Repetitive overloading and increased workloads can result in which injury?

*Stress fracture.*

25. Vague pain in the groin or anterior thigh associated with activity or weight bearing that subsides after cessation of activity could be associated with what complaint?

*Femoral stress fracture.*

26. List five RED FLAGS of lower extremity complaints.

*Any five of the following:*

- *intolerable pain;*
- *pain that is not responsive to treatment;*
- *repeated visits for the same complaint;*
- *open fractures, deformities, or neurovascular compromised extremities;*
- *trauma with neurological changes, muscle weakness, or a deteriorating exam in the affected extremity;*
- *inability to bear weight, repeated giving way (instability), or locking;*
- *any hot, swollen joint;*
- *inability to fully extend or flex the extremity (decreased ROM); and*
- *any suspected fracture*

27. Patellofemoral pain syndrome also is called \_\_\_\_\_.

*Runner's knee.*

28. Patellar tendinitis also is called \_\_\_\_\_.

*Jumper's knee.*

29. What is the hallmark symptom of patellar/quadriceps tendinitis?

*Anterior knee pain.*

30. The lateral ligaments of the ankle are injured mostly as the result of \_\_\_\_\_.

*Ankle inversion.*

31. Ankle inversions also are called \_\_\_\_\_.

*Inversion rolls.*

32. Which injury results from recurrent stress activities like running or marching? What is the common name for this injury?

*Second metatarsal fracture.*

*March fracture.*

33. Degenerative tears of part of the fascia on the bottom of the foot are the most common cause of heel pain in adults. This condition is called \_\_\_\_\_.  
*Plantar fasciitis.*
34. 95% of patients with plantar fasciitis will heal in how much time?  
*6 to 12 months.*

### SOURCES

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# 11 BASIC WOUND CARE

## CORE CONCEPTS

- Identify the types of wound injuries.
- Explain the stages of wound healing.
- Describe emergency treatment of specific wound types.
- Identify drainage systems used in wound management.
- Document care provided to wound injuries.

## INTRODUCTION

The skin is the largest organ of the body. It acts as a barrier to protect the body from the potentially harmful external environment. It can also help control temperature and retain or release fluids. When the skin's integrity is broken, the body's internal environment is open to microorganisms that may cause **infection**. Any abnormal opening or break in the skin is a wound. Wounds are not restricted to the three layers of the skin (**epidermis**, **dermis**, and **subcutaneous layer**) (Figure 11-1); they may affect other tissues and organs as well.

You will likely encounter patients needing wound care. Understanding the wound healing process and proper wound care management for a variety of wounds is essential in any health care setting.

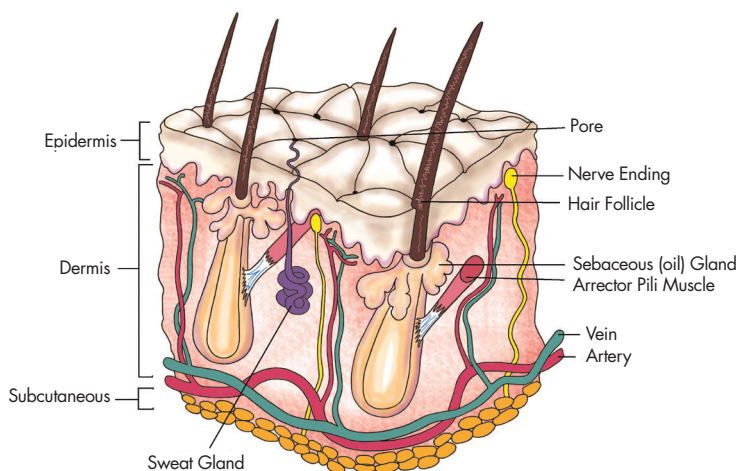


Figure 11-1. Anatomy of the skin.

## TYPES OF WOUNDS

Soft-tissue injuries involve the skin and underlying subcutaneous tissue and muscles. They are classified as closed or open wounds.

### Closed Wound

A closed wound is an injury to the soft tissue (damaged dermis), without a break in the skin. Closed wounds usually occur from forceful contact with a hard object. They include hematomas and crush injuries.



Figure 11-2. Intramuscular hematoma development and progression over an 86-hour period. Photograph by Whoisjohngalt, CC BY-SA 4.0. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Hematoma\\_development.png](https://commons.wikimedia.org/wiki/File:Hematoma_development.png)

Hematomas often appear as well-defined pockets of **extravasated** blood and fluid beneath the skin caused by leakage from a break in a blood vessel (Figure 11-2). Hematomas consist of a mass of blood (usually clotted) confined to an organ, tissue, or internal space. A contusion (bruise) is a type of hematoma caused by bleeding



beneath the skin into the soft tissue. The bleeding can be minor or extensive. Extensive bleeding can cause severe pain and edema, leading to a compromise of vital structures.

In crush injuries, force transmitted from the body's exterior to its internal structures compresses and damages tissue. There are systemic effects of prolonged traumatic muscle compression, including **rhabdomyolysis** and **hyperkalemia**.

## Open Wound

An open wound is an injury to soft tissue with a break in the skin. Generally, they are more serious than closed injuries due to the potential for blood loss and infection. There are numerous types of open wounds:



**Figure 11-3.** An abrasion. Photograph by Paul Sullivan, CC BY-ND 2.0. Reproduced from [https://www.flicker.com/photos/pfsullivan\\_1056/8253117196](https://www.flicker.com/photos/pfsullivan_1056/8253117196)

- **Abrasion.** A superficial loss of skin (the epidermis and possibly the dermis) resulting from rubbing or scraping the skin over a rough or uneven surface (Figure 11-3).
- **Laceration.** Wounds caused by shear forces that produce a tear in tissues (Figure 11-4). The partial- or full-thickness separation of skin and underlying tissue can be irregular (jagged) or sharp (incisional).
- **Puncture.** Penetration of the skin by a pointed object (Figure 11-5). It can be penetrating (an entrance wound only) or perforating (both an entrance and an exit wound). Generally, puncture wounds do not cause serious external bleeding, but there may be significant internal bleeding and damage to vital organs.



**Figure 11-4.** A laceration. Photograph courtesy of Captain Steven M. Self.



**Figure 11-5.** A patient whose knee was punctured by a dart. Photograph by Dr. James Heilman, MD. Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Knee\\_puncture.jpg](https://commons.wikimedia.org/wiki/File:Knee_puncture.jpg)

- **Avulsion.** A torn or lost flap of skin (Figure 11-6). A portion of tissue separated from its base. It is either lost or left with a narrow base of attachment.
- **Amputation.** A traumatic cutting or tearing injury in which an appendage (eg, finger, toe, arm, or leg) is either partially or completely severed (Figure 11-7).
- **Burn.** A tissue injury caused by thermal, chemical, electrical, or radiation energy. First-degree burns involve only the epidermis (Figure 11-8), second-degree burns involve the epidermis and dermis (Figure 11-9), and third-degree burns involve all three layers of skin (Figure 11-10).
- **Bite.** An abrasion, puncture, or lacerated wound from the teeth or jaw inflicted by an insect, human, or animal (Figure 11-11). Consider all bites contaminated.

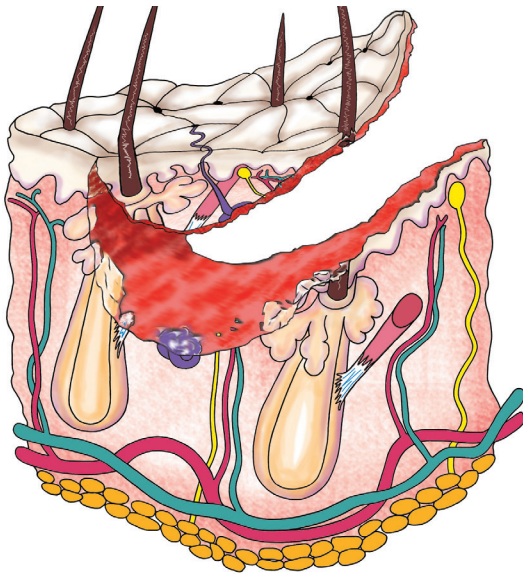


**Figure 11-6.** An avulsion, showing a flap of skin.



**Figure 11-8.** A first-degree burn (a sunburn). Photograph by QuinnHK. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/wiki/File:Sunburn.jpg>



**Figure 11-7.** A patient who suffered bilateral traumatic amputations. Reproduced from Nessen SC, Lounsbury DE, Hetz SP, eds. *War Surgery in Afghanistan and Iraq: A Series of Cases, 2003-2007*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2008: 289.



**Figure 11-9.** A severe second-degree burn to a patient's right hand. Photograph by Westchaser. Reproduced from <https://commons.wikimedia.org/wiki/File:Major-2nd-degree-burn.jpg>



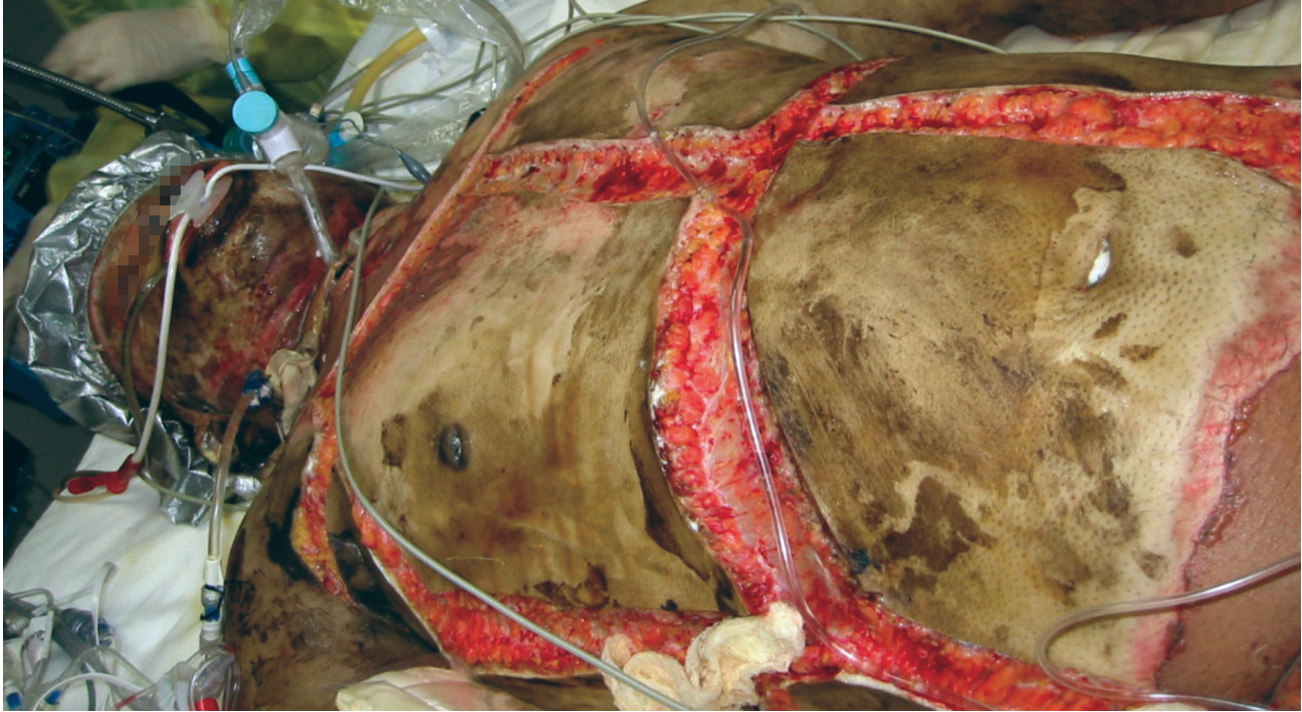


**Figure 11-10.** Third-degree burns. Reproduced from Renz E, Cancio L. Acute Burn Care. In: *Combat Casualty Care: Lessons Learned from OEF and OIF*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2012: 599, fig 5.



**Figure 11-11.** A child who suffered a dog bite to the face. Photograph by Tanner Ford, TRFPhotography, Reproduced from Wikimedia Commons. [https://commons.wikimedia.org/wiki/File:Hundebiss\\_Kind\\_export.jpg](https://commons.wikimedia.org/wiki/File:Hundebiss_Kind_export.jpg)

**Note:** Crush injuries may be closed or open.

#### Check on Learning

1. What are the two broad classifications of wound injuries?
2. List four examples of open wound injuries.
3. Name one example of a closed wound injury.



## WOUND HEALING

### Types of Wound Healing

Wound healing differs depending on the extent of tissue damage. Wound healing occurs by first, second, and third intention. In all cases, wound healing requires adequate circulation to assist with the healing process, by aiding in decreasing infections and increasing tissue perfusion with oxygenated blood.

#### *First-Intention Healing*

The period of wound closure immediately following the injury and prior to the formation of **granulation** tissue is first-intention healing or healing by primary intention. First-intention healing occurs when there is minimal tissue loss (eg, in surgical incisions or minor accidental cuts). In this phase, the wound edges are clean and aligned directly next to one another. The wound edges are well-approximated (brought into alignment, with edges touching) and usually closed with sutures, staples, or adhesives at the time of initial evaluation. There is little to no tissue loss and minimal scarring. Infection rates with first-intention healing are low. Most surgical incisions heal by primary intention.

#### *Second-Intention Healing*

Second-intention healing, also known as healing by secondary intention, occurs when the wound edges are widely separated due to tissue loss. The wounds heal without surgical closure. Second-intention healing occurs in injuries such as deep lacerations, burns, and pressure ulcers. Since the edges in these wounds do not approximate, openings slowly fill with granulation tissue. Granulation is the part of the healing process in which rough, pink tissue containing new connective tissue and capillaries form around the edges of the wound. Granulation tissue must extend from the edges inside the wound toward the center. Granulation is both normal and desirable, and it prevents **abscess** formation. As the wound gradually fills in, **epithelialization** will occur, completing the skin healing process.

Second-intention healing is slow. Drainage from infection or other wound debris prolongs healing. Broad scarring often occurs and the risk of infection is greater than that for first-intention healing. Wound care includes cleaning and minimal debridement. Daily care is imperative to ensure wound debris removal and to allow for granulation tissue formation.

### *Third-Intention Healing*

Third-intention healing is also known as delayed primary closure or tertiary intention. It occurs when there is a delay in the time between the injury and the closure of the wound. For example, leaving a wound open temporarily after surgery facilitates drainage or removal of infectious materials. When there is infection, or a large open wound, the wound is closed later. In the meantime, wound surfaces start to granulate. Deep scarring almost always occurs.

Sometimes, wound management combines first and secondary intentions to promote healing. To use this strategy, clean, debride, irrigate, and observe the wound for a period of time (typically 4 or 5 days) before closure. Place dressing material inside the wound to keep the edges apart.

### Factors That Complicate Wound Healing

The following factors complicate the wound healing process:

- **Extent of the injury.** Depth, width, and length affect healing.
- **Type of injury.** Animal bites, burns, and fractures commonly complicate healing.
- **Infection.** A disease caused by microorganisms (especially those that release toxins or invade and multiply in body tissues) that limit healthy tissue formation and may cause other adverse reactions.
- **Patient's nutritional status.** Malnutrition affects all phases of wound healing by impeding normal healing processes. Some conditions that may occur in malnourished patients are pressure ulcers and infections. Physiological stress from burns or severe trauma increases nutritional requirements and complicates healing. The patient's diet should include protein, carbohydrates, lipids, vitamins A and C, and minerals.
- **Patient's age.** Starting at about age 30, our organ systems lose about 1% of their function each year.<sup>1</sup> Most military personnel will not be severely affected by the degradation of wound healing based on age. Vascular changes impair circulation to the wound site. Reduced liver function alters synthesis of clotting factors. Reduced antibody and lymphocyte production impairs the body's ability to fight infection. **Collagen** tissue becomes less pliable as individuals age, which slows new tissue growth.

- **Obesity.** Fatty tissue lacks an adequate blood supply to aid in decreasing infection, placing the patient at risk for complications. Watch obese patients (of any age) closely for signs of wound infection, **dehiscence**, and evisceration.
- **Impaired oxygenation.** If local circulating blood flow is poor, due to factors such as swelling or tissue damage, tissues do not receive sufficient oxygen. Decreased hemoglobin (eg, in hemorrhagic shock or anemia) reduces arterial oxygen levels in capillaries and interferes with tissue repair.
- **Smoking.** Tobacco cigarettes, electronic cigarettes, and vapors with nicotine can reduce the amount of functional hemoglobin in blood, decreasing tissue oxygenation and interfering with normal cellular mechanisms that promote the release of oxygen to tissue. Nicotine is a vasoconstrictor that can result in tissue ischemia from inadequate blood flow.
- **Drugs.**
  - Anti-inflammatory drugs (eg, steroids and NSAIDs) suppress **protein synthesis**, epithelialization, and the inflammatory response. Inflammation is a normal part of the wound healing process. It is important for removal of contaminating microorganisms.
  - Prolonged antibiotic use increases the risk of resistance. **Antibiotic resistance** makes some infections difficult to treat and slows wound healing. This could lead to complications, some of which require multiple surgical interventions. In addition, a medical officer (MO) may prescribe stronger antibiotics in response to resistance. These stronger antibiotics are also subject to resistance, perpetuating a cycle of increasingly powerful drugs required to treat infections.
  - Chemotherapeutic drugs can depress bone marrow function (blood cell production), leukocyte (white blood cell) number, and inflammatory response.
- **Diabetes mellitus.** Diabetes causes small blood vessel disease, which impairs tissue perfusion. It causes hemoglobin to have greater affinity for oxygen, so it fails to release oxygen to tissues. It alters the ability of leukocytes to perform **phagocytosis**.

## Check on Learning

4. What are the three types of wound healing?
5. Name eight factors that complicate the wound healing process.
6. Why is it important to have adequate circulation to a wound?

## WOUND ASSESSMENT

The following steps detail wound assessment.

### History

1. Obtain a history of the wound injury utilizing the **OPQRST** method. How did the wound occur? How long ago did the injury occur? What type of object caused the injury?
2. Assess for pain level. Is there numbness or tingling distal to the injury? Assess pulse, motor, and sensory function.

### Inspection

3. Examine the skin color surrounding the wound.
4. Observe the color of the wound bed tissue.
  - a. Pink tissue usually indicates healthy, granulating, viable tissue.
  - b. Black tissue indicates necrotic tissue.
  - c. White or yellow tissue can indicate an infectious process.
5. Determine the wound size (length × width × depth). Depth can be described by stating the visible tissue (eg, wound extends to subcutaneous tissue, to muscle, or to bone). Document the measurements in inches (eg, 1 × 3 × 2 in.) or by using a commonly known object, such as a dime (eg, a “dime-sized” wound).
6. Observe the wound boundaries. Are the edges of the wound smooth or irregular?
7. Examine the wound for drainage. If the wound is draining, note the color (**sanguineous**, **serosanguineous**, **serous**, **purulent**), amount (small, moderate, copious), and odor (a foul smell can indicate infection; wounds with an unpleasant smell are described as **malodorous**).

## Palpation

8. Palpate the wound for temperature around the area.
9. Assess the neurovascular status of the affected extremity distal to the injury. Do not treat wounds before completing this assessment.
  - a. Check the pulse quality, location, and rate distal to the wound. If a pulse site is not available distal to the wound, attempt to use capillary refill. Loss of a pulse or coldness of the extremity distal to the injury indicates pressure on an artery and may require immediate medical intervention.
  - b. Check the sensation and motor function of the affected extremity distal to the wound. This helps identify peripheral nerve insult (damage to nerve) from an event possibly caused by direct injury, compression, or edema.

**Note:** Assess and document tetanus immunization status for any patient with an open wound.

**Note:** Always remember to manage life-threatening massive hemorrhage, airway, respiration, circulation, and hypothermia problems prior to treating wounds.

- neurologic assessment of the injured extremity;
- history of the injury to include when and how the wound occurred;
- abnormal wound healing processes;
- wound infection; and
- appropriate dressing for the wound.

Use the information in evaluation to develop the best wound management plan for each patient.

## Guide to Tetanus Prophylaxis in Wound Management

Tetanus is an acute, often fatal disease (Figure 11-12). Although it occurs worldwide, it is rare in developed countries due to widespread immunization. Document tetanus immunization status for any patient with an open wound. Recruits lacking a reliable history of previous immunization receive a primary series of tetanus-diphtheria toxoid. Recruits with a tetanus immunization history receive a booster dose of toxoid upon entering active duty. All adults should receive booster doses of toxoid every 10 years. In tetanus-prone wounds (dirty wounds), administer 0.5 mL of tetanus-diphtheria toxoid intramuscularly if more than 5 years have elapsed since the patient's last dose. If medical records are not available and the patient cannot remember the date of his or her last toxoid booster, administer a booster dose.

## WOUND MANAGEMENT

Proper wound management contributes to the healing process by preventing infection and other complications. Wound healing is a normal biological process in the human body, which takes place in four stages: hemostasis, inflammation, proliferation, and remodeling. Influencing collagen maturation through proper wound management speeds up healing and minimizes scarring.

Good wound management starts with evaluating the following factors:

- the patient's current nutritional status;
- vascular status distal to the injury (compared to the uninjured extremity), if applicable;
- color of the injured extremity;
- capillary refill;
- pulses distal to the injury;



**Figure 11-12.** A patient infected with the *Clostridium tetani* exotoxin (tetanus) experiencing extreme muscle spasms in the neck and back, which result in the posturing of the body known as opisthotonos. Content provided by CDC. Reproduced from Public Health Image Library (PHIL). <https://phil.cdc.gov/Details.aspx?pid=6373>



**Note:** The bacteria that cause tetanus exist as spores in soil. The spore gains access through a cut or wound and then germinates, and the tetanus bacteria begin producing a toxin that affects the nervous system and causes painful muscle contractions. The disease is also called lockjaw, because stiffness and pain in the muscles of the neck and jaw are common early symptoms.

### Check on Learning

7. When assessing a wound, what four things do you observe?
8. Why is it important to check the neurovascular status of the affected extremity prior to wound treatment?

### Treatment of Specific Wound Types

**Note:** Always remember to manage the patient's massive external hemorrhage, airway, breathing, circulation, and hypothermia or head injury (MARCH) prior to performing wound care.

#### Hematoma

To assess a hematoma or contusion, first inspect the skin for visible changes such as discoloration and swelling due to damage to underlying vessels, nerves, and bony structures. Next, evaluate peripheral pulses, sensation, motor function, strength, and the need for pain control. Elevate the contused area or extremity and apply ice packs within the first 24 hours.

#### Abrasion

Assess for dirt and other substances in the wound bed tissue and assess the need for tetanus prophylaxis. Evaluate functional capabilities. To treat an abrasion, clean the wound surface by manually removing large pieces of foreign matter. Do not scrub the wound bed tissue. Irrigate debris from the wound using a 30 to 60 mL syringe filled with normal saline or sterile water. Control bleeding, then apply a sterile dressing to the wound.

#### Laceration

Assess the wound depth. Control bleeding and check for associated injuries. Evaluate the neurovascular status of the affected extremity (as appropriate), checking pulse quality, location, and rate. Observe capillary refill. Note the patient's skin color, temperature, sensation, and motor function. Determine the need for pain control and tetanus prophylaxis. If the wound involves an extremity, treat by first controlling bleeding with direct pressure and elevation. Next, thoroughly cleanse and irrigate the wound using a 30 to 60 mL syringe filled with normal saline or sterile water. For a minor laceration, use a butterfly bandage and cover it with a gauze dressing. For a major laceration, consider the need for sutures, staples, or surgery. Consult the MO about the appropriate closure technique.

#### Crush Injury

In crush injuries, prolonged traumatic muscle compression causes tissue damage, often followed by systemic effects. If there is an open wound, first control bleeding by applying direct pressure or a pressure dressing. Manage all crush injuries as if there is internal bleeding and treat for shock if you believe there is any possibility of internal injuries. Evaluate the neurovascular status of the extremities, checking pulse quality, location, and rate (capillary refill is not a reliable perfusion indicator in adults). Observe the patient's skin color (eg, pale, flushed, jaundiced). Determine the need for pain control and tetanus prophylaxis. Apply a dry, sterile dressing and elevate the extremity. Splint extremities that are painful, swollen, or deformed. Crush injuries can develop into **compartment syndrome**, muscle necrosis, and leakage of muscle cell contents into systemic circulation, especially after restoration of blood to damaged tissues. In addition, the compressive forces of crush injury can break bones and damage muscles, nerves, and other tissues, as well as rupture organs, leading to internal hemorrhage. Refer the patient to an MO as soon as possible.

**Caution:** Crush injury is a limb-threatening event. If suspected, do not elevate the affected limb above the level of the heart. This may decrease perfusion to the compromised extremity.

## Avulsion

The first step in treating an avulsion is to assess the amount of tissue loss. Next, observe the depth of the injury. Determine the need for pain control and tetanus prophylaxis. Control bleeding and clean the wound surface. For attached skin, clean the wound and fold the skin back to its normal position. Dress the wound using a bulky pressure dressing. For detached skin, dress the wound using a bulky pressure dressing. Save the avulsed part by wrapping it in dry, sterile gauze and placing it in a plastic bag, if available. Keep the avulsed part as cool as possible, but do not immerse it in cooled water or saline.

## Punctures and Penetrations

Assess the wound for foreign bodies or materials and impaled objects, check the depth of the penetration for possible underlying structural damage, and evaluate the type and degree of contamination. Determine the need for pain control and tetanus prophylaxis. Do not remove any impaled object. Removing the object may cause further injury to nerves, muscles, and other soft tissues and also cause severe hemorrhage. Expose the wound and control profuse bleeding by applying pressure on either side of the impaled object and pushing downward. Stabilize the impaled object with a bulky dressing.

**Warning:** DO remove an impaled object to the cheek if there is airway compromise.

## Amputation

Assess and control bleeding first, then evaluate neurovascular status (pulse quality, location, and rate), capillary refill, skin color and temperature, sensation, and motor function (in partially amputated limbs). Determine the need for pain control and tetanus prophylaxis. Rinse the amputated part with saline; wrap it in a moist, sterile gauze pad or towel; and put it in a plastic bag or plastic container. Place that plastic bag or container in an ice-filled container, if available.

## Check on Learning

9. Name three types of wounds and describe the treatment for each.
10. Why is it important to leave an impaled object in place? What is the exception?

## Types of Dressings

### Gauze

Gauze dressings are highly absorbent and ideal for wounds that are fresh and likely to bleed or drain significantly. However, unless moist, these dressings can remove granulation tissue.

### Transparent Dressings

The chief advantage of transparent dressings is that wound assessment may not require dressing removal. They are less bulky than gauze dressings and do not require tape to secure them. However, transparent dressings are not absorbent. Do not use them on wounds that are bleeding or draining significantly.

### Hydrocolloid Dressings

Hydrocolloid dressings are self-adhesive, opaque, air- and water-occlusive wound coverings that reduce pain from air exposure. These products interact with moisture on the skin to produce a gel, which provides a moist healing environment. This allows for fewer dressing changes and provides better protection from bacteria. Use hydrocolloid dressings in shallow to moderate depth wounds and when drainage is minimal.

## Changing a Gauze Dressing

Change dressings when ordered by the MO, when the wound requires assessment or care, or when the dressing becomes loose or saturated with drainage.

Use the following supplies and equipment for a gauze dressing change:

- clean gloves
- individually packaged gauze dressings
- adhesive tape
- small basin or container
- normal saline or sterile water
- 30 to 60 mL syringe for irrigation
- waterproof pad

## Prepare to Change Dressing

To change the dressing, follow the steps below.

1. Perform a patient care hand wash (see Chapter 2, Infection, Asepsis, and Sterile Technique).
2. Explain the procedure to the patient.

3. Don appropriate PPE (minimum gloves and eye protection).
4. Position the patient and expose the areas to be re-dressed.
5. Place the underpad (chux pad) under the patient, below the wound to be re-dressed.
6. Remove the dressing.
  - a. Gently loosen the tape toward the wound while supporting the skin around the wound.
  - b. Remove the dressing. Be careful not to tear the wound or dislodge any drains.
  - c. Use sterile saline to moisten the dressing if it is sticking to the wound. This prevents discomfort to the patient, and maintains the integrity of any sutures.
7. Assess the amount, color, odor, and consistency of drainage on the old dressing.
8. Dispose of the old dressing in a red biohazard bag.
9. Inspect and assess the wound bed tissue.

**Warning:** During combat conditions, do not remove an existing dressing. Reinforce it with additional dressings instead.

### *Irrigate and Clean the Wound*

10. Pour a small amount of irrigation liquid (normal saline or sterile water) into a waste receptacle to prevent contamination and to clean the bottle rim. If the seal of the bottle is intact, this step is not necessary. Pour irrigation liquid into a sterile basin and fill the 30 to 60 mL syringe with liquid from the basin.
11. Hold the tip of the syringe just above the top end of the wound and force fluid into the wound slowly and continuously. Use enough force to flush out debris, but do not squirt or splash the fluid. Irrigate all portions of the wound, but do not force solution into wound pockets. Continue irrigating until the solution draining from the bottom end of the wound is clear.
12. Gently, pat dry the wound tissue and edges with sterile gauze. Work from the cleanest to the most contaminated areas.

### *Apply a New Dressing*

13. Place the inner dressing over the wound, ensuring the dressing extends past the edges of the wound. All other dressings will overlap each other to cover the entire wound.
14. Cover all inner dressings with a larger outer dressing.
15. Apply tape to secure the dressing.
16. Remove gloves and place them in a red biohazard bag.
17. Reposition and cover the patient.
18. Wash your hands.

**Caution:** Wounds that must be kept moist (eg, abdominal evisceration) require “wet-to-dry” dressings. Dampen the inner dressings with a solution (usually normal saline) before application. Apply dry outer dressings.

**Caution:** Tape should not form a constricting band around the wound or extremity.

### *Document*

19. Document wound care and wound assessment on the patient’s SF 600, Chronological Record of Medical Care. Enter the date and time of the procedure and a description of the wound’s color, dimensions, odor, consistency, and amount of drainage.

### *Check on Learning*

11. Name three types of dressings used to cover a wound.
12. What is the procedure for changing a gauze dressing?

### *Drainage and Drainage Systems*

Drainage is an important part of wound healing. Drainage results from inflammation and the type of fluid provides information about the healing process. Exudate is fluid that has leaked out from blood vessels into surrounding tissues. The types of exudates are:

- **serous**—clear, watery fluid seen during healing of most types of wounds;
- **sanguineous**—bright red, bloody fluid, usually from deep wounds;



- **serosanguineous**—a mixture of serous fluid and blood, often seen where there is some skin loss; and
- **purulent**—a milky, pus-filled fluid that indicates infection.

When the patient first ambulates after **drain** insertion, drainage may increase slightly. Continuous sanguineous drainage may indicate that small blood vessels are oozing. Minor draining from a wound is a normal process that assists with healing.

**Note:** Not all surgical wounds drain.

The color, amount, and odor of the drainage are important characteristics to document when assessing healing or identifying signs of infection.

**Note:** Exudate or drainage greater than 300 mL in the first 24 hours is abnormal.



**Figure 11-13.** A casualty with a drain tube inserted after surgery to repair the left elbow. Reproduced from Nessen SC, Lounsbury DE, Hetz SP, eds. *War Surgery in Afghanistan and Iraq: A Series of Cases, 2003-2007*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2008: 230.

Wound drainage systems use a device to remove excess fluid from a wound or body part. Open drains are those that pass through an open-ended tube into a receptacle or out onto the dressing (Figure 11-13). For example, a Penrose drain is a soft tube that is inserted and then pulled out in stages as the wound heals from the inside out. Closed (suction) drains are self-

contained suction units that connect to drainage tubes within the wound. Closed drains are more effective than open drains because they pull fluid by creating a vacuum via negative pressure. They also prevent environmental contaminants from entering the wound or cavity. There are two types of portable devices that provide constant, low-pressure suction to remove drainage without wall suction. Use a Jackson-Pratt drain when expecting small amounts (100–200 mL) of drainage. Use a larger-capacity negative pressure drain for amounts up to 500 mL, such as a Hemovac drainage system (Zimmer Inc, Warsaw, IN).

### Check on Learning

13. Give two examples of a closed drainage system.
14. Name the three types of drainage from uninfected wounds and provide an example of each.

### Assisting With Ongoing Wound Management

Evaluate wounds after the following events:

- dressing change,
- application of heat and cold therapies,
- irrigation,
- stress to the wound site, and
- when the patient reports increased pain at the wound site.

Assess the condition of the wound and dressing. Ask whether the patient notes any discomfort during dressing changes and inspect the condition of dressings at least every shift. Proper documentation includes the wound location, size (length × width × depth), drainage type and amount, odor, and neurovascular status. Monitor vital signs; distal peripheral pulses; skin color, sensation, and temperature; and motor function. Provide pain control as needed.

### Wound Complications

Watch closely for complications such as any impaired wound healing. Some wound complications can be life threatening.

Wound bleeding may indicate a slipped suture, dislodged clot, coagulation problem, or trauma placed on blood vessels or tissues. Inspect the wound and dressing to help detect drainage increases and color changes. If bleeding occurs internally, the dressing may remain dry, while the abdominal or thoracic cavity collects blood. Signs of internal bleeding include:

- increased thirst;
- restlessness;
- rapid, thready pulse;
- decreased blood pressure;
- decreased urinary output;
- cool, clammy skin; and
- rigid, distended abdomen.

**Warning:** If not detected, hypovolemic shock can cause circulatory system collapse and death.

**Warning:** Evisceration is a true surgical emergency. Notify the MO immediately.

Dehiscence may result after periods of sneezing, coughing, or vomiting. The patient may say that something has “given way.” Evidence of new or increased serosanguineous drainage on the dressing is an important sign. In the case of dehiscence, the patient should remain in bed and take in nothing by mouth. Advise the patient to refrain from coughing. Reassure the patient. Place a sterile dressing over the area until the MO evaluates the site.

In the case of evisceration, the patient should remain in bed. Cover the wound and its contents with warm, sterile saline dressings and notify the MO immediately.

A patient with an infected wound displays the following:

- fever,
- tenderness,
- increased pain at the wound site,
- edema, and
- elevated white blood cell count.

According to the Centers for Disease Control and Prevention, infected wounds contain purulent (pus) drainage. Purulent drainage has a foul odor and is brown, yellow, green, or white depending on the associated pathogen.

Other wound complications of concern include compartment syndrome, cellulitis, and abscess. In some cases, you can manage compartment syndrome by loosening constrictive bandaging, and stretching or massaging the affected area. However, it may require surgical intervention. Cellulitis is a bacterial skin infection characterized by heat, pain, redness, and edema that requires antibiotic treatment. Abscess management varies depending on its type and size.

### Check on Learning

15. How do you evaluate wound healing?
16. Name four types of possible wound complications.
17. Which wound complication is a surgical emergency?

### SUMMARY

Wounds range from abrasions to amputations. Early assessment and management of wounds can change recovery outcomes for patients and improve their quality of life. Combat medics must understand how wound injuries occur, the various types of wounds, and the importance of providing the proper emergency care to help prevent infection, which could slow healing. A common cause of skin breakdown is pressure against tissues that cause ischemia and tissue death. Wound healing can be complex and there are many products available to ensure an optimal outcome. Follow the manufacturer’s instructions, the MO’s orders, and local standard operating procedures. Finally, in documenting a basic wound, note appearance and any abnormalities, pertinent history, and **pertinent negatives**.



## GAUZE DRESSING CHANGE



STEP 1: Perform a patient care hand wash (see Chapter 2; Infection, Asepsis, and Sterile Technique).



STEP 2: Explain the procedure to the patient.



STEP 3: Don PPE.



STEP 4: Position the patient and expose the areas to be re-dressed.



STEP 5: Place the underpad (chux pad) under the patient, below the wound.



STEP 6: Remove the dressing. Gently loosen the tape toward the wound while supporting the skin around the wound. Do not tear the wound or dislodge drains. Use sterile saline to moisten the dressing if it is sticking to the wound.



## GAUZE DRESSING CHANGE, CONT.



STEP 7: Assess for the amount, color, odor, and consistency of drainage on the old dressing.



STEP 8: Dispose of the old dressing in a biohazard bag.



STEP 9: Inspect and assess the wound bed tissue.



STEP 10a: Pour irrigation liquid into a sterile basin.



STEP 10b: Fill the 30 to 60 mL syringe with liquid from the basin.



STEP 11: Hold the tip of the syringe just above the top end of the wound and force fluid into the wound slowly and continuously. Use enough force to flush out debris, but do not squirt or splash the fluid. Irrigate all portions of the wound, but do not force solution into wound pockets. Continue irrigating until the solution draining from the bottom of the wound is clear.



## GAUZE DRESSING CHANGE, CONT.



STEP 12: Gently pat dry the wound tissue and edges with sterile gauze. Work from the cleanest to the most contaminated areas.



STEP 13: Place the inner dressing over the wound, ensuring it extends past the edges of the wound. All other dressings will overlap each other to cover the entire wound.



STEP 14: Cover all inner dressings with a larger outer dressing.



STEP 15: Apply tape to secure the dressing. Tape should not form a constricting band around the wound or extremity.

## GAUZE DRESSING CHANGE, CONT.



STEP 16: Remove your gloves and place them in a trash receptacle.



STEP 17: Reposition and cover the patient.



STEP 18: Wash your hands



STEP 19: Document the wound care and assessment on the patient's SF 600, Chronological Record of Medical Care.



## KEY TERMS AND ACRONYMS

**Abscess.** A cavity surrounded by inflamed tissue and containing purulent discharge, formed because of a localized infection.

**Antibiotic resistance.** Antibiotics no longer work against disease-causing bacteria (eg, methicillin-resistant *Staphylococcus aureus* [MRSA]). When an antibiotic fails to kill all of the bacteria it targets, the surviving bacteria become resistant to that particular drug and frequently to other antibiotics as well.

**Collagen.** A white, fibrous, structural protein found in tendons, bone, cartilage, skin, and other connective tissues.

**Compartment syndrome.** A progressive degeneration of tissue and muscle that results from a severe interruption of blood flow when blood vessels and nerves are constricted within a space (eg, from swelling or from a tight dressing or cast). Signs and symptoms include pain with pressure over the compartment area, with diminished sensation distal to the compartment area. Diminished to absent extremity pulses distal to the injury are a late symptom.

**Dehiscence.** The separation of a surgical incision or rupture of a wound closure.

**Dermis.** The second layer of skin, which contains structures such as glands, nerves, and vessels that affect cooling, sensation, and nutrient circulation.

**Drain.** A device used to remove excess fluid from a wound or body part.

**Epidermis.** The superficial or outer layer that protects the dermis from infection and drying. It does not contain blood vessels or nerves.

**Epithelialization.** The regrowth of skin over a wound.

**Extravasated.** Blood, serum, or lymph passed or escaped into the tissues.

**Granulation.** The part of the healing process in which rough, pink tissue containing new connective tissue and capillaries form around the edges of the wound. Granulation is normal and desirable.

**Hyperkalemia.** A higher than normal blood potassium level.

**Infection.** The invasion and multiplication of infective agents in body tissues with a resultant reaction to their presence and their toxins.

**Malodorous.** Having an unpleasant smell.

**OPQRST.** Onset, provoking or palliative factors, quality, radiation or region, severity, and timing; used to obtain patient history information.

**Pertinent negatives.** The absence of certain signs and symptoms that enable the care provider to rule out some medical conditions. Use them as an aid in diagnosis.

**Phagocytosis.** A three-stage process by which neutrophils, monocytes, and macrophages engulf and destroy microorganisms, other foreign antigens, and cell debris.

**Protein synthesis.** The process all cells use to make proteins, which are responsible for all cell structure and function.

**Purulent.** Consisting of or containing pus. The color may be yellow, green, brown, or white.

**Rhabdomyolysis.** A skeletal muscle injury that results in cellular death with resultant leakage of intracellular contents.

**Sanguineous.** Bloody. The color is bright red or pink.

**Serosanguineous.** Composed of serum and blood. The color is pale red, pale pink, or clear with pink or red swirls.

**Serous.** A clear, watery drainage.

**Subcutaneous layer.** The third layer of skin insulates, adds shape to the body (adipose and connective tissue), and stores energy. It varies in thickness depending on its location.

## CHECK ON LEARNING ANSWERS

1. What are the two broad classifications of wound injuries?

*Open and closed.*

2. List four examples of open wound injuries.

*Any four of the following: crush, abrasion, laceration, avulsion, amputation, puncture, or bite.*

3. Name an example of a closed wound injury.

*Crush or hematoma.*

4. What are the three types of wound healing?

*Primary intention, secondary intention, and delayed primary closure.*

5. Name eight factors that complicate the wound healing process.

*Any eight of the following: extent of injury, type of injury, infection, patient's nutritional status, age of the patient, obesity, impaired oxygenation, smoking, drugs, diabetes mellitus, poor local blood circulation, and decreased hemoglobin (anemia).*

6. Why is it important to have adequate circulation to a wound?

*If local circulating blood flow is poor (swelling or tissue damage), tissues fail to receive needed oxygen. Decreased hemoglobin (in hemorrhagic shock or anemia) reduces arterial oxygen levels in capillaries and interferes with tissue repair.*

7. When assessing a wound, what four things do you observe?

*Color, size, boundaries, and drainage.*

8. Why is it important to check the neurovascular status of the affected extremity prior to wound treatment?

*To determine peripheral nerve insult possibly caused by direct injury, compression, or edema. To determine the need for immediate medical intervention if there is loss of the pulse or coldness of the extremity distal to the injury, indicating pressure on an artery.*

9. Name three types of wounds and describe the treatment for each.

*Any three of the following:*

*Contusion. Elevate the contused area or extremity. Apply ice packs within the first 24 hours.*

*Crush injury. Control bleeding if an open wound, using direct pressure or a pressure dressing. Apply a dry sterile dressing. Elevate the extremity if possible. Splint extremities that are painful, swollen, or deformed. Refer to an MO as soon as possible.*

*Abrasion. Clean the wound surface by manually removing large pieces of foreign matter; do not scrub the wound bed tissue. Irrigate debris from the wound using a 30 to 60 mL syringe filled with normal saline or sterile water. Control bleeding and apply a sterile dressing to the wound.*

*Laceration. Control bleeding with direct pressure. Elevate lacerated extremities. Cleanse and irrigate the wound thoroughly using a 30 to 60 mL syringe filled with normal saline or sterile water. For minor lacerations use a butterfly bandage and cover with a gauze dressing. For major lacerations, consider the need for sutures, staples, or surgery. Consult with your MO about the appropriate closure technique.*

*Avulsion. Control bleeding. Clean the wound surface. For attached skin, fold the skin back to its normal position after cleaning the wound and dress the wound using a bulky pressure dressing. For detached skin, dress the wound using a bulky pressure. Save the avulsed part by wrapping it in a dry, sterile gauze dressing and placing it in a plastic bag if available. Keep the avulsed part as cool as possible. Do not immerse the avulsed part in cooled water or saline.*

*Amputation. Control bleeding. Rinse the amputated part with saline; wrap it in a moist, sterile gauze or towel; and place it in a plastic bag or plastic container. Place this bag or container in another container containing ice.*

*Punctures and penetrations. Do not remove any impaled object. Expose the wound. Control profuse bleeding by applying pressure on either side of the impaled object and pushing downward. Stabilize the impaled object with a bulky dressing.*

10. Why is it important to leave an impaled object in place? What is the exception?

*Removal of the object may cause further injury to nerves, muscles, and other soft tissues, and may cause severe hemorrhage. However, DO remove an impaled object to the cheek if there is airway compromise.*

11. Name three types of dressings used to cover a wound.

*Gauze dressing, transparent dressing, and hydrocolloid dressing.*

12. What is the procedure for changing a gauze dressing?

*Determine the need for a dressing change. Gather supplies and equipment. Prepare to change the dressing. Irrigate the wound. Apply the new dressing. Complete and document the procedure.*

13. Give two examples of a closed drainage system.

*Jackson-Pratt drain and Hemovac.*

14. Name the three types of drainage from uninfected wounds and provide an example of each

*Serous—clear, watery drainage (eg, blister).*

*Sanguineous—bloody (eg, laceration).*

*Serosanguineous—composed of serum and blood (eg, abscess).*

15. How do you evaluate wound healing?

*Assess the condition of the wound and dressing and ask whether the patient notes any discomfort during the dressing change procedure.*

16. Name four types of possible wound complications.

*Any four of the following: cellulitis, dehiscence, impaired wound healing, internal and external bleeding, compartment syndrome, abscess, evisceration, and wound infections.*

17. Which wound complication is a surgical emergency?

*Evisceration.*



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# 12 SKIN DISEASES PRIMARY CARE

## CORE CONCEPTS

- Recognize the location and roles of the three layers of skin.
- Identify and treat common skin diseases.
- Discuss conditions that may affect a soldier's duty performance.

## INTRODUCTION

The skin is the largest organ of the body; if laid out flat it would cover approximately 20 square feet. The skin is a multipurpose organ that protects us from the elements by helping to regulate body temperature and gives us the sensation of touch, heat, and cold. It also provides a barrier that helps keep pathogens, chemicals, and other undesirable substances from entering the body.

## ANATOMY AND PHYSIOLOGY OF THE SKIN

The skin incorporates three layers (Figure 12-1). The **epidermis** is the thin outer layer, consisting mostly of dying and dead cells that shed constantly and are replaced from beneath by new cells. The epidermis has no blood vessels, so the dermis must supply its nutrition. The **dermis** is a thick layer of connective tissue below the epidermis. Rich in blood supply and nerve endings, it contains hair follicles and sebaceous glands that secrete oil to lubricate the epidermis. The **subcutaneous** tissue is beneath the dermis and contains fat, sweat glands, and hair follicles. The subcutaneous tissue provides insulation, cushioning, and a reserve energy source.

**Note:** Elevations and depressions in the epidermis and dermis form fingerprints. These patterns of ridges and grooves are hereditary and unique to each individual.

The skin protects underlying tissues from dehydration and injury. It regulates body temperature by controlling heat loss. In cold weather, blood vessels in the skin constrict to help conserve heat. In hot weather, they dilate and bring more blood to the skin surface, allowing the release of heat into the air. The skin is the site of many nerve endings, and it provides a place for the temporary storage of fat, glucose, water, and salts. Its properties allow it to absorb certain drugs and other chemicals.

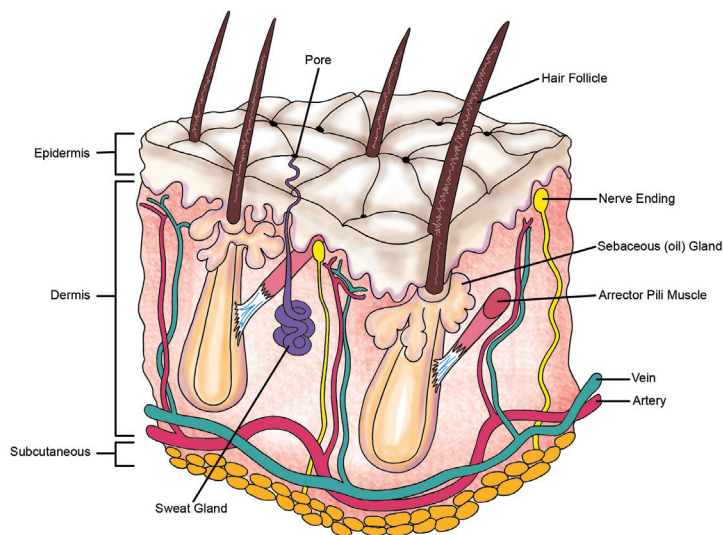


Figure 12-1. Anatomy of the skin.

## PHYSICAL EXAMINATION OF THE SKIN

To examine the skin, first expose the area to be inspected. If the skin condition is on an extremity,



Figure 12-2. Step 1. Expose the affected area.



Figure 12-3. Step 2. Compare the affected arm to unaffected arm for symmetry or visible differences.



Figure 12-4. Step 3. Palpate the skin, noting moisture, temperature, and turgor.

inspect both extremities for symmetry or differences (Figure 12-2). Inspect the skin for any change in appearance such as color, uniformity, thickness, and lesions (Figure 12-3). Next, palpate the skin (Figure 12-4).

Note moisture, temperature, and **turgor** (also known as skin elasticity and hydration). When checking for turgor, the skin should move easily when pinched and should immediately return to its original position when released. If the tent from pinching remains in the skin, evaluate the patient for dehydration. A common mistake is to test turgor on the back of a patient's hand; the looseness and thinness of the skin in that area make the results unreliable.

Note the anatomical location, distribution, grouping, size, shape, type, color, and drainage of any skin lesions. Identify skin lesions as follows:

- **Macule.** A small (<1 cm), flat lesion colored white, brown, red, or purple. A patch is a large macule greater than 1 cm (Figure 12-5). Common examples include freckles, flat moles, and tattoos.
- **Papule.** A solid, raised lesion smaller than 1 cm (Figure 12-6). A plaque is a papule or group of papules larger than 1 cm. Examples include warts, some moles (nevi), and some types of skin cancer.
- **Nodule.** A solid, raised lesion larger than 1 to 2 cm, situated deeper in the dermis (Figure 12-7). Skin can be moved over the lesion. Larger nodules (> 2 cm) are called tumors. Examples include cysts and lipomas.
- **Vesicle.** An elevated lesion containing serous fluid that is smaller than 1 cm (Figure 12-8). Examples include **contact dermatitis**, physical trauma, and sunburn.
- **Bulla.** An elevated lesion containing serous fluid that is larger than 1 cm (Figure 12-9). Examples include contact dermatitis, physical trauma, frostbite, and sunburn.
- **Pustule.** A superficial and elevated lesion that is larger than 1 cm and contains pus (Figure 12-10). Pustules result from infection. Examples include **impetigo**, acne, and **folliculitis**.
- **Wheal.** A transient, elevated lesion caused by localized **edema** (swelling) (Figure 12-11). Allergic reactions to certain drugs; insect stings and bites; and sensitivity to cold, heat, pressure, or sunlight commonly cause wheals. They are also called hives.
- **Crust.** A lesion (scab) consisting of dried serum, blood, or pus (Figure 12-12). Crusting occurs in many inflammatory and infectious diseases, such as impetigo.





**Figure 12-5.** A macule is circled in this photograph. The macules coalesced into larger lesions. Reproduced from Gentry RH. Bacterial skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:307, Fig 13-12.



**Figure 12-7.** These scalp nodules are caused by parasitic roundworms. Reproduced from Keeling JH III. Tropical parasitic infections. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:278, Fig 12-33.



**Figure 12-9.** These bullae formed after significant radiation exposure. Reproduced from Bennion SD, David-Bajar K. Cutaneous reactions to nuclear, biological, and chemical warfare. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:79, Fig 5-10.



**Figure 12-11.** Wheals, also known as hives, are caused by localized edema. Reproduced from Sperling L. Skin diseases associated with excessive heat, humidity, and sunlight. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:45, Fig 3-4.

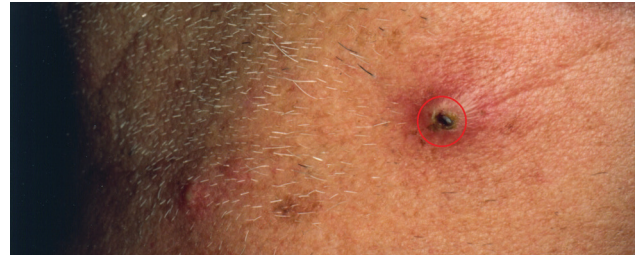


**Figure 12-6.** An erythematous (reddened) papule. Adapted from Gentry RH. Bacterial skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:294, Fig 13-5.



**Figure 12-8.** Vesicles are characteristic lesions of herpes simplex. Adapted from Becker LE, James WD. Historical overview and principles of diagnosis. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:12, Fig 1-18.



**Figure 12-10.** This pustule contains pus and blood cells. Reproduced from Gentry RH. Bacterial skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:303, Fig 13-10.



**Figure 12-12.** Crusted candidiasis caused by an opportunistic *Candida* organism. Reproduced from Fitzpatrick JE. Superficial fungal skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:439, Fig 17-26.



## VIRAL SKIN DISEASES

### Herpes Simplex

Herpes simplex is an infection caused by the herpes simplex virus (HSV). It has one or many clusters of small vesicles filled with clear fluid on slightly raised (inflamed) and **erythematous** (reddened) bases (Figure 12-13). The fluid inside the vesicles is extremely contagious. The lesions may appear anywhere on the skin or mucosa, but are most common around the mouth, on the lips (“fever blisters”), and in the genital area. Two different viral types, HSV 1 and HSV 2, cause herpes simplex infections. Both types produce identical patterns of infection. Asymptomatic carriers shed the virus and spread the disease.



**Figure 12-13.** Herpes simplex lesions. Reproduced from Benson PM. Sexually transmitted diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:526, Fig 19-26b.

Symptoms include tingling, discomfort, and itching followed by the appearance of small, tense vesicles as described above. Single clusters of vesicles vary in size. The vesicles persist for a few days and then begin to dry, forming a thin, yellowish crust or ulcer. Primary (initial) infection is generally the most severe, with fever, **lymphadenopathy**, and urinary symptoms (if the outbreak is genital). Recurrent infection is common. Local skin trauma or systemic stressors (eg, fatigue, illness) may reactivate the virus. It is common to see HSV recurrences in a field or combat environment. A herpetic whitlow is an HSV infection of the fingers,

resulting in the inoculation of HSV through a skin break. These are more common in healthcare workers. Symptoms include swelling and pain over the lesions on the finger.

Healing generally occurs 8 to 12 days following onset of symptoms. Individual herpetic lesions usually heal completely, but recurrent lesions at the same site may cause atrophy and scarring.

Patients should avoid sexual intercourse while genital lesions are present; however, viral shedding may occur even if the patient is symptom free. Discuss condom usage with all genital herpes patients. Use antiviral medications (eg, acyclovir) for initial outbreaks, recurrent infections, and suppressive therapy. Treat secondary bacterial infections with systemic antibiotics. Medications reduce the symptoms of the infection, but do not destroy the virus. HSV is a recurrent illness without a cure at this time. Refer patients with herpes simplex infections to a medical officer (MO) for treatment.

### Herpes Zoster (Shingles)

Herpes zoster is an infection caused by the chickenpox virus (varicella-zoster virus). Signs and symptoms include pain, tenderness, and itching along the site of the future rash. This usually precedes the rash by 2 to 3 days. Crops of vesicles then characteristically appear on an erythematous base. The patient may also experience headache, fever, and chills. Pain may be severe and narcotic analgesics may be required. The rash occurs most often in the thoracic or lumbar region and is usually unilateral (only on one side). Lesions typically continue to form for about 3 to 5 days. Crusting occurs by days 7 to 10 (Figure 12-14), and lesions resolve by days 14 to 21.



**Figure 12-14.** Herpes zoster is commonly known as shingles. Reproduced from O'Neill PE. Common skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:578, Fig 20-30b.

Treat herpes zoster with antiviral medications. Patients may find locally applied wet compresses soothing. Refer herpes zoster patients to an MO.

## Warts

Different viruses cause different types of warts, which commonly occur in children and young adults. Most warts resolve spontaneously; others may last a lifetime, if untreated. At least 55 strains of human papillomavirus cause warts. At least three types of human papillomavirus cause venereal warts and cervical cancer.

Warts are transmitted by contact and commonly appear at the site of minor trauma, on the hands, around the fingernails (from nail biting), on the bottom of the feet, and on genitals (Figure 12-15). The virus may also penetrate normal, intact skin. Some types of warts respond to a single treatment, while others may be resistant. Be sure to explain to patients that most warts require several treatments. Topical wart medications and liquid nitrogen freezing are the best methods for initial treatment.



**Figure 12-15.** Warts. Reproduced from Benson PM. Sexually transmitted diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:534, Fig 19-35.

## Check on Learning

1. What are the signs and symptoms of the herpes simplex virus? How do they differ from the signs and symptoms of herpes zoster?

## BACTERIAL SKIN DISEASES

Everyone has bacteria on their skin that do not cause disease. The number and type of bacteria vary in rela-

tion to the anatomic site, environmental factors (eg, heat, humidity), general hygiene, and the individual's underlying health. Combat medics likely will see many bacterial skin infections at sick call because they are among the most common disabling skin infections that occur during wartime and field exercises. Reasons for this include crowded living conditions, irregular bathing habits, skin irritation from rough clothing and equipment, and minor trauma from abrasions and insect bites. Treat bacterial skin infections aggressively. They can spread rapidly, particularly in a field or combat environment.

**Note:** Most superficial skin infections merely produce discomfort and are responsible for large numbers of outpatient visits. However, complications of secondary bacterial infections may require hospitalization. Approximately 10% of medical evacuations out of Vietnam were due to serious dermatological disorders.

## Cellulitis

Cellulitis is an acute bacterial infection of the dermis and subcutaneous tissues (Figure 12-16). It may arise from the entry of bacteria through the skin (eg, via a laceration or puncture wound) or as an extension from an abscess. Cellulitis causes serious concern because the infection can spread to the lymphatic and blood systems, which can result in **sepsis** (systemic infection) and **bacteremia** (blood infection).



**Figure 12-16.** Cellulitis is usually inflamed and without palpable edges. There may be skin scaling on the surface in severe cases. Reproduced from Gentry RH. Bacterial skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:294, Fig 13-6.



Cellulitis is more common in the lower extremities. The major findings are local redness, tenderness, and enlarged regional lymph nodes. The skin around the infected site is hot, red, and edematous. Cellulitis with chills or fever suggests that bacteremia is present. Occasionally, local abscesses form, requiring incision and drainage.

Refer patients with cellulitis to an MO for treatment. If an MO is not present, evacuate the patient on a priority basis. Oral antibiotic therapy to cover streptococci and staphylococci is required as first-line outpatient therapy. For severe infections (eg, head and neck cellulitis, cellulitis with fever or chills, or large areas of infection) that require hospitalization, intravenous antibiotics are used. Immobilizing and elevating the affected area will help reduce edema. One way to monitor the infection and see whether it is resolving is to circle the red area; when the patient returns on a follow-up visit, check that the redness is still inside the lines. Document your findings on each follow-up visit.

### Impetigo

Impetigo is a superficial bacterial skin infection that occurs most frequently on exposed parts of the body, especially on the face, hands, neck, and extremities (Figure 12-17). Risk factors include crowded living conditions, neglected minor wounds, and poor hygiene. Impetigo consists of pea-sized papules that become vesicular and rupture, leaving honey-colored crusts. The majority of cases have regional lymphadenopathy. Constitutional symptoms (eg, fever, chills) are absent.

Refer patients with impetigo to an MO for antibiotic treatment. Impetigo is extremely contagious. Avoid contact with the patient's towels, clothing, and linen to prevent spread of infection.



**Figure 12-17.** This thick, yellow crust is typical of impetigo. Reproduced from Gentry RH. Bacterial skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:293, Fig 13-1.

### Cutaneous Abscesses

Because the skin provides a strong barrier against pathogenic bacteria, skin infections and abscesses often occur in an area of injured skin. Most patients with cutaneous abscesses complain of a localized area of pain and swelling. The abscess begins as a deep, tender, red papule that becomes **fluctuant** (movable or compressible) (Figure 12-18). The patient may or may not have cellulitis, but usually will not have a fever.



**Figure 12-18.** A cutaneous abscess, caused in this case by leishmaniasis. Reproduced from Keeling JH III. Tropical parasitic infections. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:259, Fig 12-5.

The primary treatment for an abscess is incision and drainage. An abscess is not ready for drainage until the overlying skin has thinned and the mass is fluctuant. Warm compresses will help localize the infection. Under aseptic conditions, an MO will incise the fluctuant area and thoroughly drain the pus. Then loosely pack the abscess cavity with a gauze wick and remove it 24 to 48 hours later. Continue follow-up wound care on the drained abscess cavity until the wound closes. Local heat helps resolve tissue inflammation. Consider giving antibiotics following incision and drainage.

**Note:** Wet-to-dry dressings require moist packing that “dries” between dressing changes. Dead cells stick to the packing when it is removed, thus debriding the wound. The packing should not dry completely; if it does, change dressings more often. During dressing changes, remove the packing, irrigate the wound, and replace the packing. Continue this process until the wound closes (usually 1–3 weeks).

## Folliculitis

Folliculitis is the inflammation of a hair follicle caused by infection, chemical irritation, or minor physical injury (eg, shaving, abrasions). Signs and symptoms include a superficial pustule or inflammatory nodule surrounding a hair follicle (Figure 12-19). The condition may follow or accompany other skin infections. Chronic, low-grade irritation or inflammation without significant infection may occur when stiff hairs emerge from the follicle, curve, and reenter the skin. This is called pseudofolliculitis barbae, or “razor bumps.”

Refer patients to an MO for treatment. Use topical or oral antibiotics to treat folliculitis. If necessary, use a laser to remove hair permanently.



**Figure 12-19.** Folliculitis may have numerous causes such as infection or minor injury. Reproduced from Fitzpatrick JE. Superficial fungal skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:445, Fig 17-40.

## Bites

One million to three million humans sustain animal bites annually in the United States. Dog bites represent 70% to 90% of all bites; cat bites represent 7% to 20%

and have a higher incidence of infection. Human and rodent sources make up the remainder of bites.

**Note:** Dog bites cause a crushing injury. Their rounded teeth and strong jaws create pressure that can damage deeper structures such as bones, vessels, muscles, and nerves. Cat bites usually cause puncture wounds that allow bacteria to penetrate into deeper tissues. A cat tooth often ends up as a foreign body within the wound.

The extremities are involved in 75% of bite cases, often occurring when victims handle or attempt to avoid an animal. Head and neck injuries are the next most common. Bites on the hands have a higher risk of infection because of poor blood supply and because hand anatomy makes adequate wound cleansing more difficult. In general, the better the blood supply, the easier the wound is to clean, thus lowering the risk of infection.

Describe wounds in terms of size, location, and type. Include diagrams of the wound in the patient's chart (objective section of the **SOAP** note) for follow-up visits. If the wound is infected, describe lymph node enlargement and diagram the extent of the cellulitis (if present).

All bite injuries are potentially dangerous and can cause significant infection. To treat a bite wound, first wash the area with warm, soapy water. Irrigate the wound with soapy water using a needle catheter and syringe (preferably a large syringe) to provide adequate pressure. Flush punctures with a minimum of 200 mL of soapy water. All animal bites are tetanus prone; provide tetanus prophylaxis as indicated. Use systemic antibiotics to treat bite wounds. Bacteria that normally infect bite wounds are resistant to many antibiotics, but are generally sensitive to penicillin. The type of antibiotic given depends on the type of animal involved and how long it has been since the bite occurred.

Review postexposure prophylaxis guidelines for rabies. Rabies is a rare but fatal viral disease. Rabies exposure is defined as an open bite or wound that has contacted the body fluids of a wild or rabid animal. Among wild animals, skunks, raccoons, foxes, and bats are common rabies transmitters. Rabies rarely infects rabbits and rodents. Unprovoked attacks by any animal should raise suspicion for rabies exposure. This has been a common threat to deployed soldiers due to the large number of feral cats and dogs found in Iraq and Afghanistan.



In human bite cases, check for transmission of human immunodeficiency virus, hepatitis B, and hepatitis C. Commonly, soldiers receive cuts on the knuckles after an altercation, which may be overlooked or assessed as a minor injury. Human bite injuries mandate immediate referral to a medical provider to avoid misdiagnosis that can have catastrophic consequences.

Refer all bite wounds to an MO for assessment and treatment. Closely monitor all bite wounds.

### Check on Learning

2. Why are bacterial infections common in a military environment?
3. Cellulitis most commonly occurs on what part of the body?
4. What is the treatment for cellulitis?
5. What information should be included when describing bite wounds?

## CONTACT DERMATITIS

Contact dermatitis is skin inflammation caused by exposure to irritants or allergens. One of the most frequent disorders requiring both inpatient and outpatient therapy during military conflicts is dermatitis caused by contact with environmental or work-related materials. Under wartime conditions, inadequate facilities may limit personal hygiene and exposure to common chemical irritants and allergens may be prolonged. Contact dermatitis may be caused by exposure to topical medications; plants (eg, poison oak, ivy, or sumac); chemicals used in manufacturing shoes and clothing, metal compounds, dyes, and cosmetics; and rubber and latex in gloves or condoms. Photodermatitis occurs after a patient using photosensitizers (eg, aftershave lotions, sunscreens, and antibiotics) is exposed to sunlight. Perfumes, personal hygiene products, and jewelry metals (eg, copper, silver, and nickel) can also cause contact dermatitis.

The signs and symptoms of contact dermatitis range from transient redness to severe swelling with bullae. Poison oak, ivy, or sumac exposure shows characteristic linear streaks. The fluid inside the vesicle or bulla is not infectious. Pruritus (intense itching) and vesiculation are common. Dermatitis is typically limited to the site of contact but may later spread. Vesicles and bullae may rupture, ooze, and crust, and secondary bacterial infections may occur. As inflammation subsides, scaling and some temporary skin thickening may occur. Continued exposure to the

causative agent, such as irritation from or allergy to a topical drug, excoriation (tearing or wearing away skin through scratching), or a bacterial infection may perpetuate the dermatitis.

When gathering the history, note the patient's occupation, hobbies, household duties, vacations, clothing, topical drug use, current medications, cosmetics, hygiene products, and spouse's activities. The site of the initial lesion is often an important clue about the cause of the dermatitis; for example, hand dermatitis may result from lotions, jewelry, soaps, detergents, or rubber or latex gloves. Unless the causative agent is identified and removed, treatment will be ineffective. Refer patients who have allergies to medications such as sulfa drugs or other antibiotics to an MO. They will stop or change the patient's medication. Patients with photodermatitis should avoid photosensitizing chemicals and exposure to sunlight.

Administer an oral corticosteroid for 7 to 14 days in extensive cases of dermatitis, in limited cases involving facial inflammation, or as the mission dictates. Topical corticosteroids are not helpful in the blistering phase, but once the dermatitis is less acute, apply topical corticosteroid creams, ointments, or sprays.

Antihistamines are ineffective in suppressing allergic contact dermatitis but help with itchiness. Antihistamines for soldiers in the field may not be appropriate, since they make most people drowsy and increase risk for heat injury. Counsel patients to avoid scratching the rash because of the risk of spreading it, and refer them to an MO for treatment.

**Note:** Prior to deployment, educate soldiers on the flora, fauna, and chemical and industrial irritants that are common to the area of operations.

### Check on Learning

6. State four likely causes of contact dermatitis.
7. What types of questions would be helpful to ask to determine if a patient has contact dermatitis?

## FUNGAL SKIN DISEASES

Fungal infections are common on the feet and body. They may be pruritic (itchy) or asymptomatic, and occasionally, tenderness and inflammation occur. Humans usually transmit superficial fungal infections, but



exposure to fungi that inhabit the soil and infest local wild animals is more common in combat operations.

Superficial skin infections are named according to their anatomical location. Common infections include:

- **tinea corporis** (body), also known as “ringworm”;
- **tinea pedis** (feet), also known as “athlete’s foot”;
- **tinea capitis** (scalp), also known as “ringworm of the scalp”; and
- **tinea cruris** (groin), also known as “jock itch.”

Tinea corporis is a fungal infection that has an erythematous plaque with central clearing and well-defined, usually raised margins (Figure 12-20). These typically appear on the body in a ring shape that looks as though a worm is under the skin, hence the common name “ringworm.” Intense inflammation with or without pustules may be present.



**Figure 12-20.** Tinea corporis is most commonly seen on the neck, trunk, and buttocks. Reproduced from Fitzpatrick JE. Superficial fungal skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:429, Fig 17-7.

Most skin infections respond well to topical antifungal preparations. Cases that do not clear with topical therapy or those with widespread involvement require 2 weeks of oral antifungal therapy. Keep affected areas clean and dry.

Tinea pedis is the most common superficial fungal infection. Infections typically begin in the web spaces of the toes and may later involve the bottom surface of the foot (Figure 12-21). Toe web lesions are often macerated (softened) and have scaling borders. They may be vesicular or they may become dry and scaly, eventually cracking and bleeding. Acute flare-ups, manifesting with many vesicles and bullae, are common during warm weather. Tinea pedis commonly recurs. Secondary bacterial infection, cellulitis, and lymphangitis are complications of tinea pedis.



**Figure 12-21.** Tinea pedis, or athlete’s foot, is an intensely itchy fungal infection commonly seen in military members. Reproduced from Fitzpatrick JE. Superficial fungal skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:431, Fig 17-11.

Treat minor foot infections with topical agents. Good foot hygiene is essential. Toes and feet must be dried after bathing; macerated skin gently debrided; and a bland, drying, antifungal powder such as miconazole applied. Taking boots off and letting feet dry out several times a day are helpful, as are frequent sock changes.

Tinea capitis mainly affects children. It is contagious and may become epidemic. Signs and symptoms include persistent, low-grade inflammation. Alopecia



**Figure 12-22.** Tinea capitis is sometimes seen in military dependent children, but it may occur in individuals of all ages. Reproduced from Fitzpatrick JE. Superficial fungal skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:427, Fig 17-1.



**Figure 12-23.** Tinea cruris, or jock itch, usually has a ringlike border. Reproduced from Fitzpatrick JE. Superficial fungal skin diseases. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:430, Fig 17-9.

(hair loss) may occur, with characteristic black dots on the scalp that result from broken hairs (Figure 12-22). Use oral antifungal therapy rather than topical treatment. Refer patients with alopecia or scalp infections to an MO for treatment.

Tinea cruris fungal infection occurs almost exclusively in men. Typically, a ringed lesion extends from the skin fold between the scrotum and upper thigh (Figure 12-23). One or both sides may be affected. The infection may be extremely itchy and may produce pain (due to friction) on walking or running. Recurrence is common because fungi may repeatedly infect susceptible individuals. Flare-ups occur more often during summer, due to heat and humidity of the skin area. Tight clothing and obesity tend to favor growth of the organisms. Cotton briefs often stay damp, which can also encourage organism growth.

As in tinea corporis, topical therapy with a cream or lotion is often effective. Instruct patients to keep the area as clean and dry as possible. They should switch to boxer-style underwear or stop wearing underwear until the infection is under control.

## BLISTERS, CORNS, AND CALLUSES

### Blisters

Heat, moisture, and friction on skin may cause blisters. Less commonly, exposure to certain chemicals may cause blisters as well (Figure 12-24). Blister formation requires a thick and immobile epidermis. First, a tear occurs within the epidermis, forming a space between the layers while leaving the surface intact. Then fluid seeps into the space. The soles of the feet and the palms of the hands are the most common areas affected because they rub against shoes and equipment and the epidermis is thick. Blisters form more easily in warm conditions and on moist skin rather than on dry or soaked skin.

Blisters on the feet may be a minor medical problem, but for soldiers, blisters are not trivial. Blister treatment occupies a great deal of sick call time for both combat medics and the individual soldiers engaged in self aid.

**Note:** Cellulitis is a complication associated with friction blisters. One study found that 84% of cellulitis cases in a recruit population were caused by friction blisters, with an average loss of 8 duty days per patient.<sup>1</sup>

To prevent blisters, minimize friction. For the feet, this begins with proper boot selection. Socks can decrease friction between the feet and boots. Choose socks made of a material that helps move moisture away from the foot, such as wick-away fabrics. Layer socks to minimize friction forces. Counsel patients to change socks frequently and allow their feet, socks, and boots to dry before donning. Small, intact blisters that do not cause discomfort do not require treatment. To protect the blister roof, cover it with a small bandage. Drain intact large or painful blisters without removing the roof. To do this, first clean the blistered area with soap and water, then lance the bottom of the blister with a sterile needle or scalpel and allow the blister to drain. Treat blisters with small tears the same as those that were intentionally punctured. Use fine





**Figure 12-24.** Blisters shown here were caused by chemical mustard exposure. Reproduced from Bennion SD, David-Bajar K. Cutaneous reactions to nuclear, biological, and chemical warfare. In: James WD, ed. *Military Dermatology*. Borden Institute; 1994:96, Fig 5-27.



**Figure 12-25.** A corn, often seen on the dorsal surface of fingers or toes. Photograph by Marionette. Reproduced from Wikimedia Commons. <https://commons.wikimedia.org/w/index.php?curid=6101151>



**Figure 12-26.** A callus on the hand.

scissors and carefully unroof blisters with larger tears. Clean the base with soap and water. Apply antibiotic ointment and cover the blister with a bandage. For added protection, surround the unroofed blister with doughnut-shaped moleskin and a bandage.

**Note:** If possible, do not remove the skin from a blister. The skin acts as a natural dressing to protect underlying tissue.

### Corns and Calluses

Corns and calluses differ primarily in where they occur. Corns appear on the bony areas on top of toes or on the skin between the toes (Figure 12-25). They feel hard to the touch, are tender, and have a roundish appearance. Calluses commonly appear on the ball or heel of the foot or on the big toe, but can appear any place on the body that sustains continued pressure or irritation (Figure 12-26).

To prevent corns and calluses, make certain boots and shoes fit properly. Treat small corns with extra padding. Doughnut-shaped moleskin is very effective for relieving pressure. An MO may shave off the upper layers of corns and calluses.

### Check on Learning

8. Describe the treatment for friction blisters.
9. What type of preventive medicine counseling can minimize blister occurrence in a unit?
10. When inspecting the skin, what types of findings are you looking for?
11. What is a vesicle?
12. What are some common causes of pustules?

### SUMMARY

The skin is the largest and one of the most vital organs of the body. It helps regulate body temperature and keep bacteria out. Skin is subject to damage, injury, and infection. Many viruses, fungi, and bacteria can cause problems requiring medical intervention. What could appear to be a minor skin irritation can quickly turn into cellulitis, which can range from minor irritation to a fatal condition, if not properly treated.



## KEY TERMS AND ACRONYMS

**Bacteremia.** Bacteria circulating in the blood.

**Cellulitis.** An acute bacterial infection of the dermis and subcutaneous tissues.

**Contact dermatitis.** A skin inflammation caused by exposure to irritants (eg, poison oak) or allergens (eg, medications).

**Dermis.** The layer of skin lying immediately under the epidermis.

**Edema.** Swelling due to extra fluid in cells or intercellular spaces.

**Epidermis.** The outermost layer of the skin.

**Erythematous.** Redness of the skin caused by dilatation and congestion of the capillaries. It is often a sign of inflammation or infection.

**Fluctuant.** Movable or compressible.

**Folliculitis.** Inflammation of a hair follicle caused by infection, chemical irritation, or minor physical injury (eg, shaving, abrasions).

**HSV.** Herpes simplex virus.

**Impetigo.** A superficial bacterial skin infection that occurs most frequently on exposed parts of the body, especially on the face, hands, neck, and extremities.

**Lymphadenopathy.** Enlarged lymph nodes or any disease process involving the lymphatic system.

**Sepsis.** A systemic inflammatory response to pathogens or toxins in the blood.

**SOAP.** Subjective, objective, assessment, and plan.

**Subcutaneous.** Beneath the skin.

**Turgor.** Flexibility of the skin.

## CHECK ON LEARNING ANSWERS

1. What are the signs and symptoms of the herpes simplex virus? How do they differ from the signs and symptoms of herpes zoster?

*Herpes simplex starts with tingling, discomfort, and itching that occur prior to breakout. During the initial breakout, fever, lymphadenopathy, and urinary symptoms occur (genital breakouts only). Herpes zoster can cause severe pain, tenderness, and itching prior to the breakout and fever, chills, and headache can occur.*

2. Why are bacterial infections common in a military environment?

*Mission or training demands may result in irregular bathing habits, irritation from rough clothing and equipment, minor trauma from abrasions and insect bites, and crowded living conditions.*

3. Cellulitis most commonly occurs on what part of the body?

*The lower extremities.*

4. What is the treatment for cellulitis?

*Must be referred to an MO. Treat with oral antibiotics. For severe cases, IV antibiotics may be required.*

5. What information should be included when describing bite wounds?

*Size, location, and type.*

6. State four likely causes of contact dermatitis.

*Any four of the following: common chemical irritants and allergens, topical medications, plants (eg, poison oak, ivy, or sumac), chemicals used in manual compounds, dyes, cosmetics, and rubber and latex in gloves or condoms.*

7. What types of questions would be helpful to ask to determine if a patient has contact dermatitis?

*Have they been exposed to something out of the ordinary? Did they change soap, laundry detergents, etc?*

8. Describe the treatment for friction blisters.

*Clean with soap and water, lance the bottom of the blister with a sterile needle or scalpel, and allow the blister to drain. Surround the unroofed blister with moleskin for added protection.*

9. What type of preventive medicine counseling can minimize blister occurrence in a unit?

*Make certain boots fit properly and counsel soldiers to change socks frequently and keep their feet clean.*

10. When inspecting the skin, what types of findings are you looking for?

*Color, uniform appearance, thickness, symmetry, and presence of any lesions.*

11. What is a vesicle?

*An elevated lesion containing serous fluid that is smaller than 1 cm. Vesicles are commonly caused by contact dermatitis.*

12. What are some common causes of pustules?

*Impetigo, acne, and folliculitis.*

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# Abbreviations and Acronyms

## A

AC. Acromioclavicular  
ANS. Autonomic nervous system  
ASA. Acetylsalicylic acid  
AVPU. Alert, verbal, pain, unresponsive

## B

BCE. Before the common era  
BRAT. Bananas, rice, applesauce, toast  
BVM. Bag valve mask

## C

CBC. Complete blood count  
cc. Cubic centimeter  
CDC. Centers for Disease Control and Prevention  
CE. Common era  
cm. Centimeter

## D

DA. Department of the Army  
DCAP-BTLS. Deformity, contusion, abrasion, penetrations/punctures, burns, tenderness, laceration, and swelling  
DD. Department of Defense  
DOB. Date of birth  
DOD. Department of Defense

## E

EAC. External auditory canal  
EENT. Eyes, ears, nose, and throat

## F

FDA. United States Food and Drug Administration  
FDLMP. First day of last menstrual period  
FOOSH. Falling on an outstretched hand  
Ft. Foot or feet

## G

G. Gauge  
g. Gram  
GAS. Group A Streptococci  
GCS. Glasgow Coma Scale  
GEN. General impression  
GERD. Gastroesophageal reflux disease  
GI. Gastrointestinal  
Gtts. Drops. From the Latin “guttae.”

## H

HCAI. Healthcare-associated infections.  
HEENT. Head, eyes, ears, nose, and throat  
HIPAA. Health Insurance Portability and Accountability Act  
HIV. Human immunodeficiency virus  
Hr. Hour  
HSV. Herpes simplex virus  
Hx. History

## I

IAW. In accordance with  
ID. Identification, intradermal  
IED. Improvised explosive device  
IM. Intramuscular  
IN. Intranasal  
In. Inch (in.)  
IO. Intraosseous  
IV. Intravenous

## K

kg. Kilogram  
km. Kilometer

## L

L. Liter  
Lb. Pound  
LDPE. Low-density polyethylene  
LLQ. Left lower quadrant  
LUQ. Left upper quadrant

## M

m. Meter  
MAD. Mucosal atomization device  
MARCH. Massive external hemorrhage, airway, breathing, circulation, and hypothermia or head injury  
mcg. Microgram  
MDI. Metered-dose inhaler  
mg. Milligram  
Min. Minute  
mL. Milliliter  
mm. Millimeter  
mm HG. Millimeters of mercury  
MO. Medical officer  
MOI. Mechanism of injury  
MRSA. Methicillin-resistant *Staphylococcus aureus*  
MTF. Medical treatment facility

## N

NAD. No acute distress  
NCOIC. Noncommissioned officer in charge  
NRB. Non-rebreather  
NSAID. Nonsteroidal anti-inflammatory drug

## O

OD. Oculus dexter (right eye)  
OE. Otitis externa  
OM. Otitis media  
OPQRST. Onset, provoking or palliative factors, quality, radiation or region, severity, and timing  
OS. Oculus sinister (left eye)  
OTC. Over-the-counter  
OU. Oculus uterque (both eyes)

## P

PERRL. Pupils equal, round, regular, and reactive to light  
pH. Hydrogen ion concentration: acidic (<7.0), neutral (7.0), or basic (>7.0)  
PHI. Personal health information  
PID. Pelvic inflammatory disease  
PMS. Pulse, motor, and sensory  
PPE. Personal protective equipment  
PTA. Peritonsillar abscess  
PUD. Peptic ulcer disease  
PULHES. Physical capacity or stamina, upper extremities, lower extremities, hearing and ears, eyes, and psychiatric

## R

RICE. Rest, ice, compression, and elevation  
RLQ. Right lower quadrant  
ROM. Range of motion  
RTC. Return to clinic  
RTD. Return to duty  
RUQ. Right upper quadrant

## S

SAMPLE. Signs and symptoms; allergies; medications; past medical, surgical and social history; last oral intake; event leading up to illness or injury  
SC. Subcutaneous  
SF. Standard Form  
SH. Social history  
SI. International System of Units  
SNS. Somatic nervous system  
So Hx. Social history  
SOAP. Subjective, objective, assessment, and plan  
SOP. Standard operating procedure  
SQ. Subcutaneous

## T

TBSA. Total body surface area  
TCCC. Tactical combat casualty care  
TKO. To keep open  
TM. Tympanic membrane  
TRD P. Tenderness, rigidity, distention, and pulsating masses  
TTP. Tenderness to palpation  
TXA. Tranexamic acid

## U

µg. Microgram  
µL. Microliter  
URI. Upper respiratory infection

## V

V/A. Visual acuity

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