

# Microbial Diseases of Skin & Wounds

CCV  
Microbiology  
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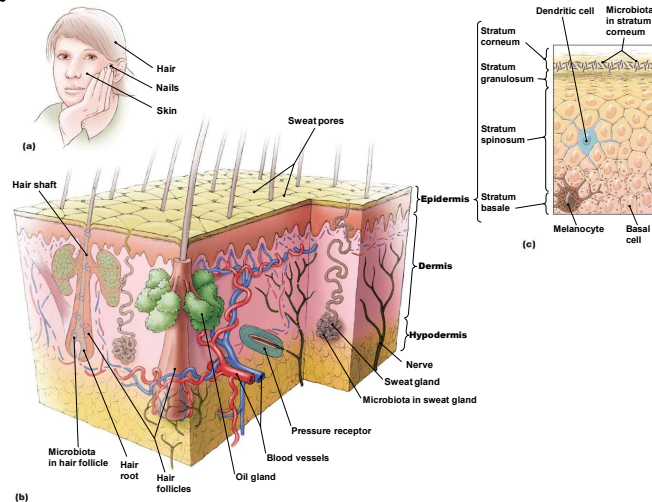
## Structure of the Skin

- Functions of the skin
  - Prevents excessive water loss
  - Regulates temperature
  - Involved in sensory phenomena
  - Assists in vitamin D formation
  - Barrier against microbial invaders
- Composed of two main layers
  - Dermis
  - Epidermis



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Figure 19.1 The skin.



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## Structure of the Skin

- Wounds
  - Trauma to any tissue of the body
    - Cuts, scrapes, surgery, burns, bites, etc.
  - Allow microbes to infect the deeper tissues of the body
    - In most cases, other body defenses eliminate infection
    - Can result in severe or fatal diseases



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### Normal Microbiota of the Skin

- Skin microbiota
  - Normally harmless microbes present on the skin
  - Compete with potential pathogens for nutrients and space
  - Cannot be completely removed through cleansing
  - Typically grow in moist areas of the skin
  - Waste products cause body odor



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### Normal Microbiota of the Skin

- Skin microbiota
  - Made up of various microbes
    - Yeast
      - *Malassezia*
    - Bacteria
      - *Staphylococcus*, *Micrococcus*, and the diphtheroids
  - May produce disease
    - If penetrate epidermis or if immune system is suppressed



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### Bacterial Diseases of the Skin and Wounds

- **Folliculitis**
  - Signs and symptoms
    - Infection of the hair follicle
    - Often called a *pimple*
    - Called a *sty* when it occurs at the eyelid base
    - Spread of infection into surrounding tissues can produce furuncles
    - Carbuncles occur when multiple furuncles grow together



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### Bacterial Diseases of the Skin and Wounds

- **Folliculitis**
  - Pathogen and virulence factors
    - Most commonly caused by *Staphylococcus*
      - Facultatively anaerobic, Gram-positive bacteria
      - Cocci typically arranged in clusters
      - Tolerant of salt and desiccation
    - Two species commonly found on the skin
      - *Staphylococcus epidermidis*
      - *Staphylococcus aureus*



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**TABLE 19.1** Comparison of Virulence Factors of Two Staphylococcal Species

Virulence Factor	<i>S. aureus</i>	<i>S. epidermidis</i>
<b>Enzymes</b>		
Coagulase	+	—
Staphylokinase	+	—
Lipase	+	+
$\beta$ -Lactamase	Present in 90% of strains	—
<b>Factors That Inhibit Phagocytosis</b>		
Polysaccharide slime layer	+	+
Protein A on cell surface	+	—
<b>Toxins</b>		
Cytolytic toxins	+	—
Leukocidin	+	—
Epidermal cell differentiation inhibitor	+	—
Exfoliative toxin	Present in some strains	—
Toxic shock syndrome toxin	Present in some strains	—



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## Bacterial Diseases of the Skin and Wounds

### • Folliculitis

- Pathogenesis
  - *Staphylococcus* transmitted via direct contact or by fomites
  - Infection can spread into the blood and move to organs beyond the skin
- Epidemiology
  - *S. epidermidis* lacks virulence factors and rarely causes disease
  - *S. aureus* transiently colonizes the skin or mucous membranes of most people



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**TABLE 19.2** Some Diseases Caused by *Staphylococcus aureus*

Disease	Where Discussed
Skin disease: folliculitis, sty, furuncle, carbuncle	p. 560
Staphylococcal scalded skin syndrome	p. 562
Impetigo	p. 563
Staphylococcal toxic shock syndrome	Chapter 24
Bacteremia	Chapter 21
Endocarditis	Chapter 21
Pneumonia	Chapter 22
Food poisoning	Chapter 23



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## Bacterial Diseases of the Skin and Wounds

### • Folliculitis

- Diagnosis
  - Isolation of Gram-positive bacteria in grapelike clusters from pus
- Treatment
  - Dicloxacillin (semisynthetic penicillin) is the drug of choice
  - Vancomycin is used to treat resistant strains
- Prevention
  - Hand antisepsis
  - Proper procedures in hospitals to minimize MRSA infections



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## Bacterial Diseases of the Skin and Wounds

### • Staphylococcal Scalded Skin Syndrome

- Signs and symptoms
  - Skin becomes red and wrinkled and forms blisters
  - Outer epidermis peels off in sheets
- Pathogen and virulence factors
  - Some *Staphylococcus aureus* strains
  - One or two different exfoliative toxins cause SSSS
- Pathogenesis
  - No scarring because dermis is unaffected
  - Death is rare but may be due to secondary infections



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Figure 19.3 Staphylococcal scalded skin syndrome.



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## Bacterial Diseases of the Skin and Wounds

### • Staphylococcal Scalded Skin Syndrome

- Epidemiology
  - Disease occurs primarily in infants
  - Transmitted by person-to-person spread of bacteria
- Diagnosis, treatment, and prevention
  - Diagnosed by characteristic sloughing of skin
  - Treated by administration of antimicrobial drugs
  - Widespread presence of *S. aureus* makes prevention difficult



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## Bacterial Diseases of the Skin and Wounds

### • Impetigo (Pyoderma) and Erysipelas

- Signs and symptoms
  - Impetigo: red patches form on the face and limbs
  - Erysipelas: infection spreads to the lymph nodes
- Pathogens and virulence factors
  - Most cases are caused by *S. aureus*
  - Some cases caused by *Streptococcus pyogenes*
    - Gram-positive coccus, arranged in chains
    - Virulence factors contribute to impetigo
      - M protein
      - Hyaluronic acid
      - Pyrogenic toxins



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Figure 19.4 Impetigo.



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Figure 19.5 Erysipelas.



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### Bacterial Diseases of the Skin and Wounds

#### • Impetigo (Pyoderma) and Erysipelas

- Pathogenesis
  - The bacteria invade where the skin is compromised
  - Acute glomerulonephritis can result if infection spreads to the kidneys
- Epidemiology
  - Transmitted by person-to-person contact or via fomites
  - Impetigo occurs most in children
  - Erysipelas can also occur in the elderly

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### Bacterial Diseases of the Skin and Wounds

#### • Impetigo (Pyoderma) and Erysipelas

- Diagnosis, treatment, and prevention
  - The presence of vesicles is diagnostic for impetigo
  - Impetigo is treated with oral and topical antimicrobials and careful cleaning of infected areas
  - Erysipelas is treated with penicillin
  - Prevent with proper hygiene and cleanliness

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## Bacterial Diseases of the Skin and Wounds

### • Necrotizing Fasciitis

- Pathogen and virulence factors
  - Most cases are caused by *S. pyogenes*
  - Various enzymes facilitate invasion of tissues
  - Exotoxin A and streptolysin S damage cells and tissues
- Pathogenesis and epidemiology
  - *S. pyogenes* enters through breaks in the skin
  - Usually spread person-to-person
- Diagnosis, treatment, and prevention
  - Early diagnosis is difficult because symptoms are nonspecific
  - Treat with clindamycin and penicillin



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## Disease In Depth 19.1 Necrotizing fasciitis

**DISEASE IN DEPTH**

### NECROTIZING FASCIITIS

**Group A Streptococcus**

**SIGNS AND SYMPTOMS**

Necrotizing fasciitis is usually characterized by severe pain, swelling, and redness of the skin. Initially, the pain may not be severe, but it quickly becomes excruciating as the bacteria spread. The skin may become discolored, and there may be a foul odor. The patient may also experience fever, chills, and nausea.

**PATHOGEN AND VIRULENCE FACTORS**

Group A Streptococcus (GAS) is a Gram-positive, spherical bacterium. It is highly virulent and can cause a wide range of diseases, including necrotizing fasciitis. Key virulence factors include:

- Exotoxins:** These include streptolysin S (SLS), streptolysin O (SLO), and exotoxin A (EA). SLS and SLO are hemolytic toxins that damage red blood cells. EA is a potent toxin that inhibits the host's immune response.
- Enzymes:** GAS produces several enzymes that facilitate tissue invasion, including hyaluronidase, streptokinase, and streptodornase.

**PATHOGENESIS**

GAS enters the body through a break in the skin. It then spreads rapidly, invading the underlying tissues. The bacteria release toxins and enzymes that damage cells and tissues, leading to necrosis. The immune system responds by sending white blood cells to the site, but the bacteria are able to evade these defenses.

**EPIDEMIOLOGY**

Necrotizing fasciitis is a rare but serious condition. It can occur in people of all ages and ethnicities. However, it is more common in people with underlying health conditions, such as diabetes, immunosuppression, and skin ulcers. It is also more common in people who have had recent surgery or trauma.

**DIAGNOSIS, TREATMENT, AND PREVENTION**

Diagnosis is often difficult because the symptoms are nonspecific. However, a combination of clinical signs, laboratory tests, and imaging can help identify the disease. Treatment involves aggressive debridement of the infected tissue, intravenous antibiotics, and sometimes hyperbaric oxygen therapy. Prevention focuses on minimizing skin breaks and promptly treating any infections.



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## Bacterial Diseases of the Skin and Wounds

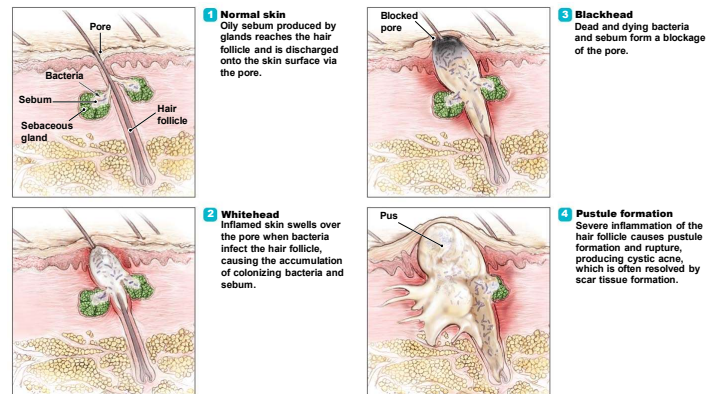
### • Acne

- Pathogen
  - Commonly caused by *Propionibacterium acnes*
  - Gram-positive, rod-shaped diphtheroids
  - Commonly found on the skin



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Figure 19.6 The development of acne.



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## Bacterial Diseases of the Skin and Wounds

### • Acne

- Epidemiology
  - Propionibacteria are normal microbiota
  - Typically begins in adolescence but can occur later in life
- Diagnosis, treatment, and prevention
  - Diagnosed by visual examination of the skin
  - Treated with antimicrobial drugs and drugs that cause exfoliation of dead skin cells
  - Accutane is used to treat severe acne
  - Ultraviolet light is also used to destroy bacteria



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## Bacterial Diseases of the Skin and Wounds

### • Cat Scratch Disease

- Signs and symptoms
  - Fever, malaise, localized swelling at infection site
- Pathogen and virulence factors
  - Caused by *Bartonella henselae* (Gram-negative bacillus)
  - Endotoxin is the primary virulence factor
- Pathogenesis and epidemiology
  - Transmitted by cat bites or scratches and by blood-sucking arthropods
- Diagnosis, treatment, and prevention
  - Diagnosed with serological testing
  - Treated with antimicrobials



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Figure 19.7 Cat scratch disease.



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## Bacterial Diseases of the Skin and Wounds

### • *Pseudomonas* Infection

- Signs and symptoms
  - Blood infection causes fever, chills, and shock
  - Blue-green color from the bacterial pigment, pyocyanin, occurs in massive infections
- Pathogen and virulence factors
  - *Pseudomonas aeruginosa* is the causative agent
    - Gram-negative bacillus
    - Found in soil, decaying matter, moist environments
- Numerous virulence factors
  - Fimbriae, adhesins, capsule, toxins, enzymes
  - Rarely causes disease despite virulence factors



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Figure 19.8 *Pseudomonas aeruginosa* infection.

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## Bacterial Diseases of the Skin and Wounds

### • *Pseudomonas* Infection

- Pathogenesis
  - Infection can occur in burn victims
    - Bacteria grow under the surface of the burn
  - The bacteria kills cells, destroys tissue, and triggers shock
  - Debridement of burn is required for topical antimicrobials to be effective
- Epidemiology
  - *P. aeruginosa* is inhabitant of water and soil
  - Bacterium rarely part of the human microbiota
    - Can infect almost any organ or system once in body

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## Bacterial Diseases of the Skin and Wounds

### • *Pseudomonas* Infection

- Diagnosis, treatment, and prevention
  - Diagnosis can be difficult
    - Pyocyanin discoloration indicates massive infection
  - Infections are treated with combination of antimicrobials
    - Treatment is difficult because of multi-drug resistance of *P. aeruginosa*
  - *P. aeruginosa* is widespread, but infections typically don't occur in healthy individuals

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## Bacterial Diseases of the Skin and Wounds

### • Spotted Fever Rickettsiosis

- Arthropod-borne rickettsias
  - Rocky Mountain spotted fever is most severe
- Signs and symptoms
  - Nonitchy spotted rash on trunk and appendages
  - Organ failure can occur in severe cases
- Pathogen and virulence factors
  - Caused by *Rickettsia rickettsii*
    - Gram-negative intracellular parasite
    - Rickettsias do not use glucose as a nutrient
  - Pathogen avoids digestion in phagosome

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## Bacterial Diseases of the Skin and Wounds

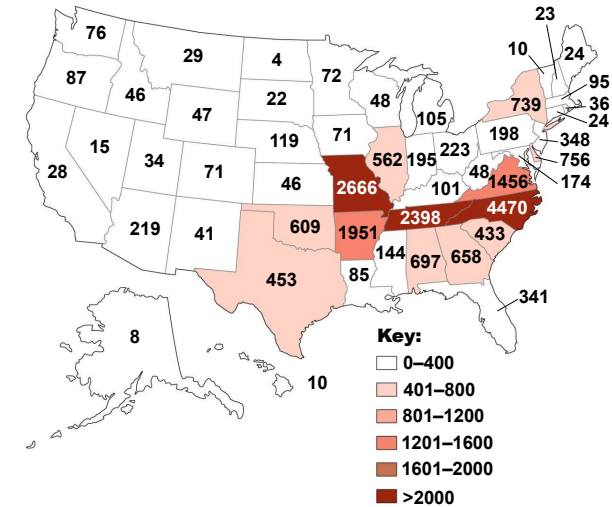
### • Rocky Mountain Spotted Fever

- Pathogenesis
  - *R. rickettsii* does not secrete any toxins
  - Disease occurs from damage to blood vessels
- Epidemiology
  - Transmitted via bite of infected tick
- Diagnosis, treatment, and prevention
  - Diagnosed with serological testing
  - Treated with various antimicrobials
  - Prevented with the use of tick repellents and avoidance of tick-infested areas



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Figure 19.9 Number of cases of Rocky Mountain spotted fever in the United States, 2002–2012.



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## Bacterial Diseases of the Skin and Wounds

### • Cutaneous Anthrax

- Caused by *Bacillus anthracis*
- Characterized by an eschar
  - Black, painless ulcer
- Treated with antimicrobial drugs
- Prevention requires control of the disease in animals



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## Bacterial Diseases of the Skin and Wounds

### • Gas Gangrene

- Signs and symptoms
  - Death of muscle and connective tissue
    - Blackening of infected muscle and skin
    - Presence of gas bubbles
- Pathogens and virulence factors
  - Caused by several *Clostridium* species
    - Gram-negative endospore-forming bacilli
    - *C. perfringens* is most often isolated
  - Bacterial endospores survive harsh conditions
  - Vegetative cells secrete 11 toxins



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## Bacterial Diseases of the Skin and Wounds

- **Gas Gangrene**
  - Pathogenesis and epidemiology
    - Traumatic event must introduce endospores into dead tissue
    - Mortality rate exceeds 40%
  - Diagnosis, treatment, and prevention
    - Appearance is usually diagnostic
    - Rapid treatment is crucial
      - Surgical removal of dead tissue
      - Administration of antitoxin and antimicrobials
    - Prevented with proper cleaning of wounds



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## Viral Diseases of the Skin and Wounds

- Many viral diseases are systemic
  - These diseases can result in signs and symptoms in the skin



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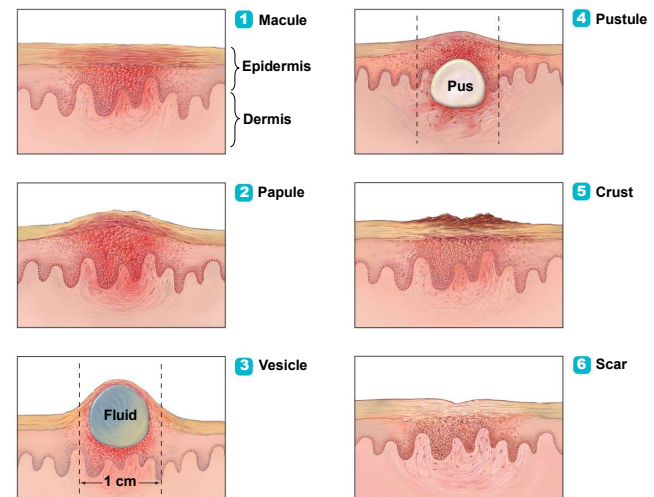
## Viral Diseases of the Skin and Wounds

- **Diseases of Poxviruses**
  - Poxviruses that cause human diseases
    - Smallpox
    - Orf, cowpox, and monkeypox (rare in humans)
  - Smallpox is the first human disease to be eradicated
  - Signs and symptoms
    - Diseases progress through a series of stages



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Figure 19.10 The stages of lesions of poxviral skin infections.



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## Viral Diseases of the Skin and Wounds

### • Diseases of Poxviruses

- Pathogens and virulence factors
  - Poxviruses are DNA viruses
    - Produce various proteins that interfere with the immune response
    - *Orthopoxvirus* (variola virus) causes smallpox
- Pathogenesis
  - Smallpox infection occurs by inhalation of virus
    - Viruses spread from the respiratory tract throughout the body
  - Other poxviruses are spread by direct contact



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## Viral Diseases of the Skin and Wounds

### • Diseases of Poxviruses

- Epidemiology
  - Variola virus stocks are maintained in U.S. and Russian labs for research
  - Monkeypox cases have increased over the past decade
- Diagnosis, treatment, and prevention
  - Treatment requires immediate vaccination
  - Vaccination discontinued in 1980s



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## Viral Diseases of the Skin and Wounds

### • Herpes Infections

- Signs and symptoms
  - Slow-spreading skin lesions
    - Herpetic gingivostomatitis, whitlow, herpes gladiatorum
  - Recurrence of lesions is common
- Pathogens and virulence factors
  - Caused by human herpesviruses 1 and 2
  - Produce various proteins that act as virulence factors
- Pathogenesis
  - Painful lesions caused by inflammation and cell death
  - Fusion of infected cells forms syncytia



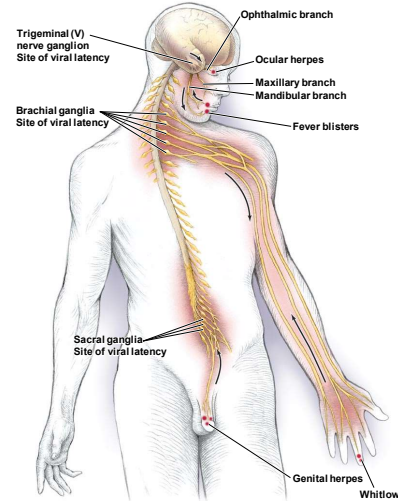
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Figure 19.11 Oral herpes lesions.



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Figure 19.12 Sites of events in herpesvirus infections.



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TABLE 19.3 Comparative Epidemiology and Pathology of Human Herpesvirus Infections

	HHV-1	HHV-2
Usual diseases	90% of cold sores/fever blisters; whitlow	85% of genital herpes cases
Mode of transmission	Close contact	Sexual intercourse
Site of latency	Trigeminal and brachial ganglia	Sacral ganglia
Locations of lesions	Face, mouth, and rarely trunk	External genitalia, and less commonly thighs, buttocks, and anus
Other complications	15% of genital herpes cases; pharyngitis; gingivostomatitis, ocular/ophthalmic herpes; herpes gladiatorum; 30% of neonatal herpes cases	10% of oral herpes cases; 70% of neonatal herpes cases

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## Viral Diseases of the Skin and Wounds

### • Herpes Infections

- Epidemiology
  - Spread between mucous membranes of mouth and genitals
  - Herpes infections in adults are not life threatening
  - Neonatal infections can be fatal
- Diagnosis, treatment, and prevention
  - Diagnosis is made by presence of characteristic lesions
  - Immunoassay reveals presence of viral antigens
  - Chemotherapeutic drugs help control the disease but do not cure it
  - Health care workers can wear gloves to limit exposure

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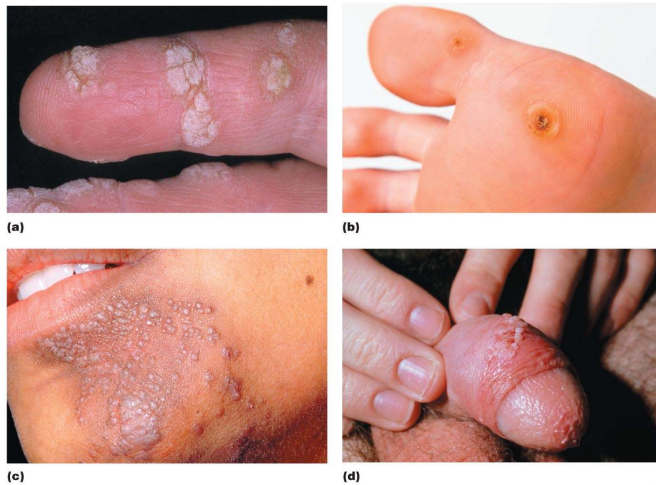
## Viral Diseases of the Skin and Wounds

### • Warts

- Signs and symptoms
  - Benign epithelial growths on the skin or mucous membranes
  - Can form on many body surfaces
- Pathogens and virulence factors
  - Various papillomaviruses cause warts
  - Some strains trigger oncogenes in host chromosome
- Pathogenesis
  - Warts develop several month after infection
  - Most warts are harmless
  - Papillomaviruses may precipitate some cancers

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Figure 19.13 Various kinds of warts—lesions caused by papillomaviruses.



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## Viral Diseases of the Skin and Wounds

### • Warts

- Epidemiology
  - Transmitted via direct contact and fomites
  - Individuals can spread viruses among locations on their own body
- Diagnosis, treatment, and prevention
  - Diagnosed by observation
  - Various techniques to remove warts
    - New warts can develop as a result of latent viruses

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## Viral Diseases of the Skin and Wounds

### • Chickenpox and Shingles

- Signs and symptoms
  - Chickenpox
    - Highly contagious infectious disease
    - Characterized by lesions on the back and trunk that spread across body
    - Virus becomes latent within sensory nerves
  - Shingles
    - Occurs following reactivation of the virus
    - Lesions are localized to skin along an infected nerve
    - Pain may last after lesions have healed

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## Viral Diseases of the Skin and Wounds

### • Chickenpox and Shingles

- Pathogen
  - Varicella-zoster virus (VZV) causes both diseases
- Pathogenesis
  - Infection spreads from the respiratory tract to the skin via blood and lymph
  - Infected dermal cells cause characteristic rash of chickenpox
  - Chickenpox is usually a mild disease
  - Virus becomes latent in nerve ganglia
    - Reactivated VZV causes shingles

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## Viral Diseases of the Skin and Wounds

### • Chickenpox and Shingles

- Epidemiology
  - Chickenpox occurs mostly in children
  - VZV infected 90% of children prior to immunization
  - Disease is more severe in adults
  - ~20% of people who have had chickenpox develop shingles
  - Risk of shingles increases with age
- Diagnosis, treatment, and prevention
  - Diagnosis based on characteristic lesions
  - Treatment based on relief of symptoms
  - Vaccine available against chickenpox



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## Viral Diseases of the Skin and Wounds

### • Rubella

- Signs and symptoms
  - Children develop a mild rash
  - Adults may develop arthritis and encephalitis
  - Congenital infection can result in birth defects or death of fetus
- Pathogen and pathogenesis
  - Caused by rubella virus (RNA virus)
  - Infection spreads from the respiratory tract throughout the body via the blood
  - The immune response to infected cells contributes to the disease severity in adults



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## Viral Diseases of the Skin and Wounds

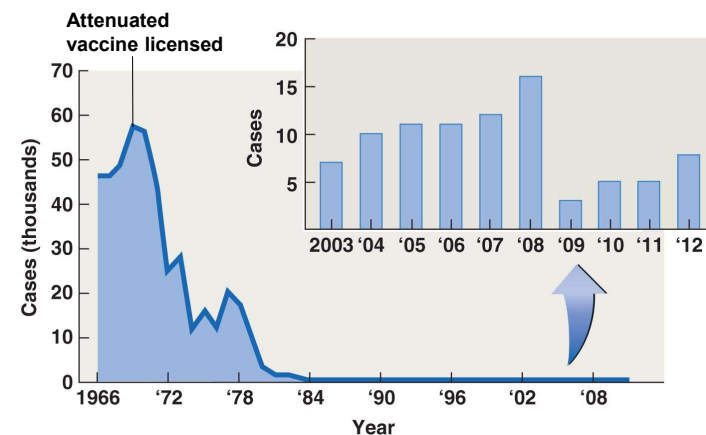
### • Rubella

- Epidemiology
  - Spread by respiratory secretions
  - Infects only humans
- Diagnosis, treatment, and prevention
  - Diagnosis made by observation of rash and serological testing
  - Vaccine is available
    - Aimed at preventing rubella infections in pregnant women



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Figure 19.14 The efficacy of immunization against rubella.



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## Viral Diseases of the Skin and Wounds

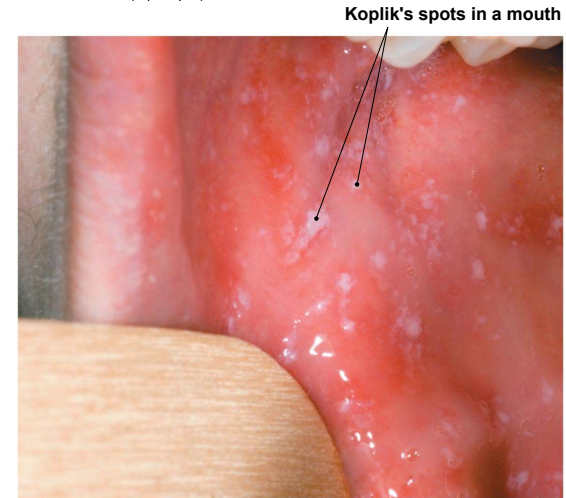
### • Measles (Rubeola)

- Signs and symptoms
  - Characterized by Koplik's spots
  - Subacute sclerosing panencephalitis is rare complication
- Pathogen and virulence factors
  - Caused by measles virus
  - Adhesion and fusion proteins help virus avoid immune recognition
- Pathogenesis
  - Immune response to infected cells causes most symptoms
  - Disease can be fatal in children



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Figure 19.15 Oral lesions of measles (Koplik's spots).



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TABLE 19.4 A Comparison of Measles and Rubella

Disease	Causative Agent	Primary Patient(s)	Complications	Skin Rash	Koplik's Spots
<b>Rubella</b> (also known as German measles, rubeola, or three-day measles)	Togaviridae: Rubivirus	Child, fetus	Birth defects	Mild	Absent
<b>Measles</b> (also known as rubeola or red measles)	Paramyxoviridae: Morbillivirus	Child	Pneumonia, encephalitis, subacute sclerosing panencephalitis	Extensive	Present



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## Viral Diseases of the Skin and Wounds

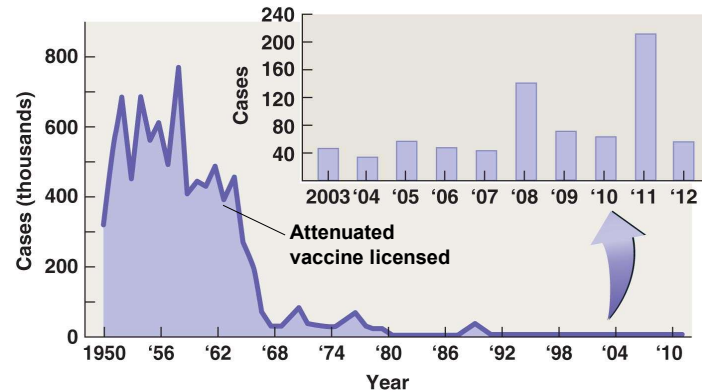
### • Measles (Rubeola)

- Epidemiology
  - Measles is highly contagious
  - Spread via respiratory droplets
  - Humans are the only host
  - Vaccination has reduced spread of the disease
- Diagnosis, treatment, and prevention
  - Diagnosis is based on signs of measles
  - Treatment involves administration of vitamin A, antibodies against measles, and ribavirin
  - MMR vaccine protects against measles



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Figure 19.16 Measles cases in the United States since 1950.



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## Viral Diseases of the Skin and Wounds

### • Other Viral Rashes

- Erythema infectiosum
  - Also referred to as *fifth disease*
  - Caused by B19 virus
  - Respiratory disease that manifests as a rash
  - Adults may also develop anemia and joint pain
- Roseola
  - Endemic disease of children
  - Caused by human herpesvirus 6 (HHV-6)
  - Characterized by a rose-colored rash

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Figure 19.17 A case of erythema infectiosum (fifth disease).



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## Mycoses of the Hair, Nails, and Skin

- Mycoses are diseases caused by fungi
- Most are opportunistic pathogens
- Mycoses are classified by infection location
  - Superficial
    - Occur on the outer surfaces
  - Cutaneous
    - Occur in the skin
  - Subcutaneous
    - In the hypodermis and muscles
  - Systemic
    - Affect numerous systems

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## Mycoses of the Hair, Nails, and Skin

### • Superficial Mycoses

- Most common fungal infections
- Occur on the hair, nails, and outer skin layers
- Signs and symptoms
  - Pityriasis versicolor
    - Hypo- or hyperpigmented patches of scaly skin
- Pathogens and virulence factors
  - Caused by *Malassezia furfur*
  - Normal inhabitant of human skin



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Figure 19.18 Pityriasis versicolor.



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## Mycoses of the Hair, Nails, and Skin

### • Superficial Mycoses

- Pathogenesis and epidemiology
  - Fungi produce keratinase, which dissolves keratin
  - Fungi are often transmitted via shared hair brushes and combs
  - Disease occurs most often in adolescents
- Diagnosis, treatment, and prevention
  - Infected skin is pale green under ultraviolet light
  - Definitive diagnosis requires microscopic examination
  - Treated with topical or oral drugs



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## Mycoses of the Hair, Nails, and Skin

### • Cutaneous Mycoses

- Dermatophytoses
  - Cutaneous lesions caused by some fungi that grow in the skin
  - Caused by dermatophytes
- Cell-mediated immune responses damage deeper tissues



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Figure 19.19 Dermatophytosis (ringworm).



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Figure 19.20 Athlete's foot.



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TABLE 19.5 Common Dermatophytoses

Disease	Agents	Common Signs	Source
Tinea pedis ("athlete's foot")	<i>Trichophyton rubrum</i> ; <i>T. mentagrophytes</i> var. <i>interdigitale</i> ; <i>Epidermophyton floccosum</i>	Red, raised lesions on and around the toes and soles of the feet; webbing between the toes is heavily infected	Human reservoirs in toe webbing; carpeting holding infected skin cells
Tinea cruris ("jock itch")	<i>T. rubrum</i> ; <i>T. mentagrophytes</i> var. <i>interdigitale</i> ; <i>E. floccosum</i>	Red, raised lesions on and around the groin and buttocks	Usually spreads from the feet
Tinea unguium (onychomycosis)	<i>T. rubrum</i> ; <i>T. mentagrophytes</i> var. <i>interdigitale</i>	Superficial white onychomycosis: patches or pits on the nail surface; Invasive onychomycosis: yellowing and thickening of the distal nail plate, often leading to loss of the nail	Humans
Tinea corporis	<i>T. rubrum</i> ; <i>Microsporum gypseum</i> ; <i>M. canis</i>	Red, raised, ringlike lesions occurring on various skin surfaces (tinea corporis on the trunk, tinea capitis on the scalp, tinea barbae of the beard)	Can spread from other body sites; can be acquired following contact with contaminated soil or animals
Tinea capitis	<i>M. canis</i> ; <i>M. gypseum</i> ; <i>T. equinum</i> ; <i>T. verrucosum</i> ; <i>T. tonsurans</i> ; <i>T. violaceum</i> ; <i>T. schoenleinii</i>	Ectothrix invasion: fungus develops arthroconidia on the outside of the hair shafts, destroying the cuticle; Endothrix invasion: fungus develops arthroconidia inside the hair shaft without destruction; Favus: crusts form on the scalp, with associated hair loss	Humans; can be acquired following contact with contaminated soil or animals

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## Mycoses of the Hair, Nails, and Skin

### • Cutaneous Mycoses

- Pathogens
  - Three genera cause most dermatophytoses
    - *Microsporum*
    - *Trichophyton*
    - *Epidermophyton floccosum*
- Pathogenesis
  - Dermatophytes colonize skin, nails, and hair
    - Use keratin as nutrient source
  - Infection is rare
    - Fungi must invade living layers of skin

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## Mycoses of the Hair, Nails, and Skin

### • Cutaneous Mycoses

- Epidemiology
  - Dermatophytes are among the few contagious fungi
  - Dermatophytes classified by natural habitat
    - Anthropophilic: associated with humans
    - Zoophilic: associated with animals
    - Geophilic: soil fungi



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## Mycoses of the Hair, Nails, and Skin

### • Cutaneous Mycoses

- Diagnosis, treatment, and prevention
  - Diagnosed by clinical observation
  - KOH preparation of skin or nail samples confirms diagnosis
  - Limited infections treated with topical agents
  - Widespread infections treated with oral drugs



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## Mycoses of the Hair, Nails, and Skin

### • Wound Mycoses

- Some fungi grow in deep tissues but do not become systemic
- Fungi eventually grow into the epidermis to produce skin lesions



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## Parasitic Infestations of the Skin

### • Leishmaniasis

- Signs and symptoms
  - Cutaneous
    - Produces large, painless skin lesions
  - Mucocutaneous
    - Skin lesions enlarge to encompass mucous membranes
  - Visceral
    - Parasite is spread by macrophages throughout body
- Pathogen and virulence factors
  - *Leishmania* is the causative agent
  - Protozoan transmitted by female sand flies



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Figure 19.24 Mucocutaneous leishmaniasis.



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## Parasitic Infestations of the Skin

### • Leishmaniasis

- Pathogenesis and epidemiology
  - Infected macrophages stimulate inflammatory responses
  - Leishmaniasis is endemic in parts of the tropics and subtropics
- Diagnosis, treatment, and prevention
  - Diagnosed by microscopic identification of the protozoa
  - Most cases heal without treatment
  - Antimicrobials are needed for severe infections
  - Prevention involves reducing exposure to the reservoir host



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## Parasitic Infestations of the Skin

### • Scabies

- Signs and symptoms
  - Characterized by intense itching and rash at infection site
  - Lesions common between the fingers, around the genitalia, and on the wrists, elbows, and knees
- Pathogen and virulence factors
  - The mite *Sarcoptes scabiei* is the causative agent
  - Inflammation and damage to nerve endings occur as the mites burrow



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Figure 19.25 Scabies mites (*Sarcoptes scabiei*) burrowing in human skin.

SEM 100 μm



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## Parasitic Infestations of the Skin

### • **Scabies**

- Pathogenesis and epidemiology
  - Itching blisters occur where female mites lay eggs
  - Mites transmitted via prolonged body contact
  - Epidemics occur in crowded conditions
- Diagnosis, treatment, and prevention
  - Diagnosis made by observing mites, eggs, or fecal matter in skin samples or the characteristic burrows
  - Treated with mite-killing lotions and cleaning of contaminated items
  - Prevented only by good personal hygiene

