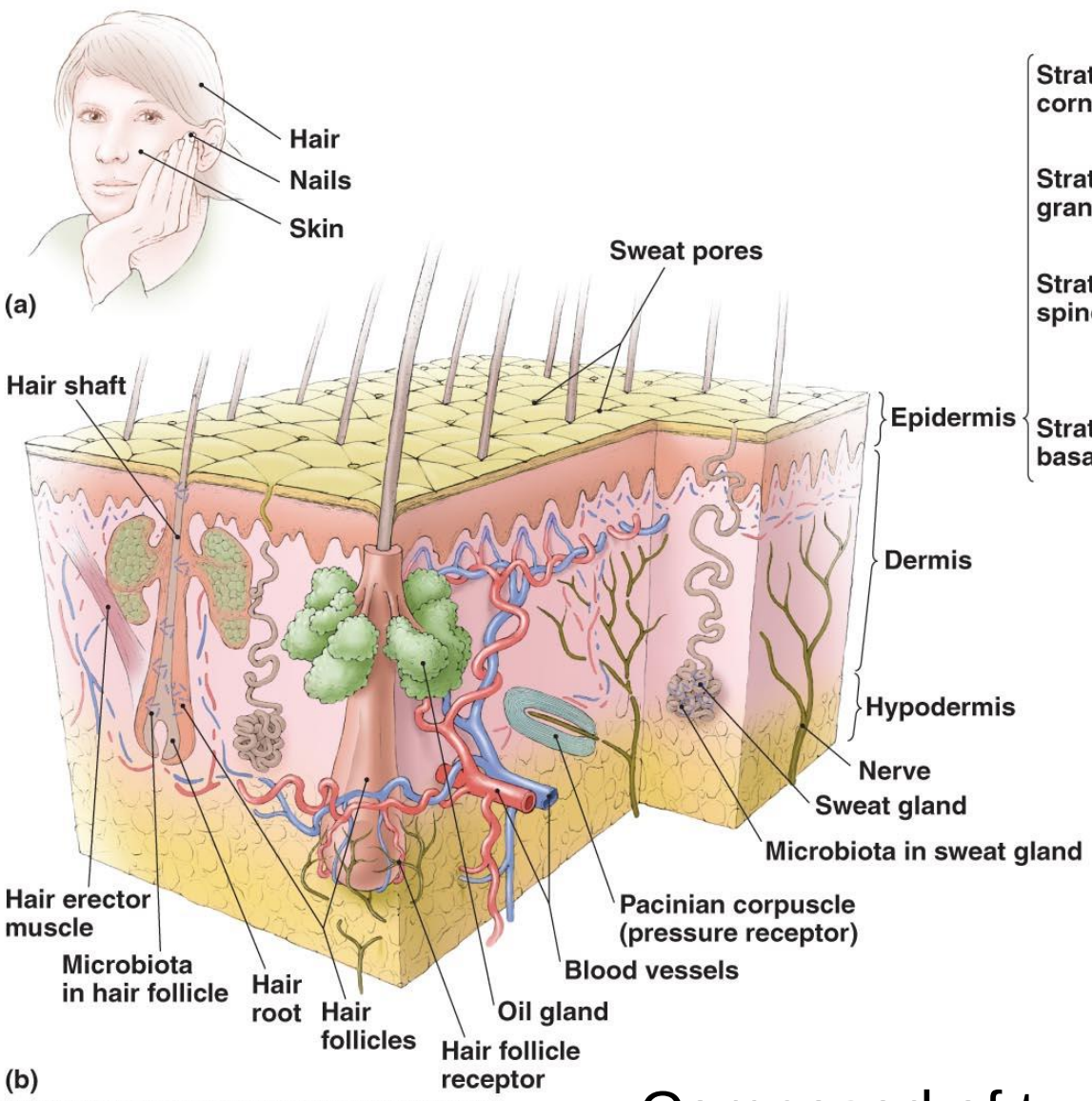
Epidemilogy Diseases of the Skin

- Functions of the skin
  - Prevents excessive water loss
  - Important to temperature regulation
  - Involved in sensory phenomena
  - Barrier against microbial invaders
    - Wounds allow microbes to infect deeper tissues



Composed of two main layers:

- Dermis
- Epidermis

Microbiota

- Halotolerant
- Dense populations in skin folds
  - Total numbers determined by location and moisture content
- May be opportunistic pathogens

- Most skin flora categorized in three groups:
  - Diphtheroids (*Corynebacterium* and *Propionibacterium)*
  - Staphylococci (*Staphylococcus epidermidis)*
  - Yeasts (*Candida* and *Malassezia)*

TABLE 18.3A Skin Terms

Descriptive Name	Appearance	Examples
Macule	Flat, well-demarcated lesion characterized mainly by color change	Freckle, tinea versicolor (fungus infection)
Papule	Small elevated, solid bump	Warts, cutaneous leishmaniasis
Maculopapular Rash	Flat to slightly raised colored bump	Measles, rubella, fifth disease, roseola
Plaque	Elevated flat-topped lesion larger than 1 cm (i.e., a wider papule)	Psoriasis
Vesicle	Elevated lesion filled with clear fluid	Chickenpox
Bulla	Large (wide) vesicle	Blister, gas blisters in gangrene
Pustule	Small elevated lesion filled with purulent fluid (pus)	Acne, smallpox, mucocutaneous leishmanisasis, cutaneous anthrax
Cyst	Raised, encapsulated lesion, usually solid or semisolid when palpated	Severe acne
Purpura	Reddish-purple discoloration due to blood in small areas of tissue; does not blanch when pressed	Meningococcal bloodstream infection (see chapter 19)
Petechiae	Small purpura	Meningococcal bloodstream infection
Scale	Flaky portions of skin separated from deeper portions	Ringworm of body and scalp, athlete's foot

Folliculitis

- Causative Agent
  - Most commonly caused by *Staphylococcus*
    - Salt tolerant
    - Tolerant of desiccation

- Signs and symptoms
  - Infection of the hair follicle often called a pimple
    - Called a sty when it occurs at the eyelid base
  - Spread of the infection can produce furuncles or carbuncles

- Furuncles
  - extended redness, pus, swelling and tenderness
- Carbuncles
  - Numerous sites of draining pus
  - Usually in areas of thicker skin

Furuncle

Carbuncle

- Epidemiology: endogenous
  - Two species commonly found on the skin
    - *Staphylococcus epidermidis*
    - *Staphylococcus aureus*
  - Transmitted through direct or indirect contact

– Diagnosis
  - Gram-positive cocci in grapelike arrangements isolated from pus, blood, or other fluids

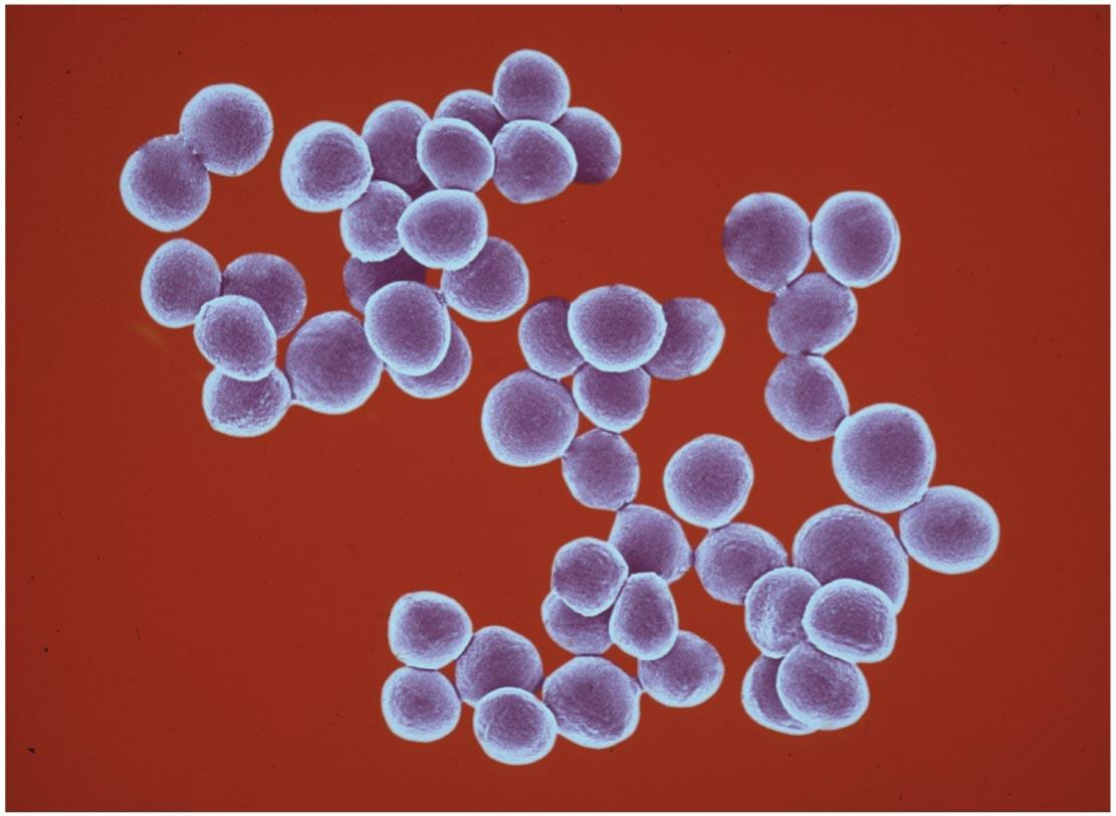


Table 19.1 Comparison of Virulence Factors of Two Staphylococcal Species

Virulence Factor	*S. aureus*	*S. epidermidis*
Enzymes		
Coagulase	+	–
Staphylokinase	+	–
Lipase	+	+
β-Lactamase	Present in 90% of strains	–
Factors That Inhibit Phagocytosis		
Polysaccharide slime layer	+	+
Protein A on cell surface	+	–
Toxins		
Cytolytic toxins	+	–
Leukocidin	+	–
Exfoliative toxin	Present in some strains	–
Toxic shock syndrome toxin	Present in some strains	–

Table 19.2 Some Diseases Caused by *Staphylococcus aureus*

Disease	Discussed on Page
Skin disease: folliculitis, sty, furuncle, carbuncle	554
Staphylococcal scalded skin syndrome	556
Impetigo	557
Staphylococcal toxic shock syndrome	Chapter 24
Bacteremia	Chapter 21
Endocarditis	Chapter 21
Pneumonia	Chapter 22
Food poisoning	Chapter 23

– Treatment
  - Dicloxacillin (semi-synthetic penicillin)
  - Vancomycin or Bactrim used to treat resistant strains
  - May require surgical draining

– Prevention
  - Hand antisepsis
  - Proper cleansing of wounds and surgical openings, aseptic use of catheters or indwelling needles, and appropriate use of antiseptics

Scalded Skin Syndrome

- Staphylococcal scalded skin syndrome (SSSS)
  - Bacterial agent is *Staphylococcus aureus*
  - Toxin mediated disease

- Signs & Symptoms
  - Skin appears burned (scalded)
  - Other symptoms include malaise, irritability, fever; nose, mouth and genitalia may be painful

– Exfolative toxin released at infection site
  - causes split in epidermis
– Outer layer of skin is lost
  - Causes body fluid loss and increase susceptibility to secondary infection

- Epidemiology
  - 5% of *S. aureus* strains produce exfoliatins
  - Disease can appear at any age group
    - Most frequently seen in infants, the elderly and immunocompromised
  - Transmission is generally person-to-person

- Prevention and treatment
  - Only preventative measure is patient isolation
  - Treatment includes bactericidal antibiotics
    - Anti-staphylococcals such as penicillinase-resistant penicillins like cloxacillin
  - Treatment also includes removal of dead skin

Impetigo (Pyoderma)

- Characterized by pus production
- Causative agents:
  - Pyodermic cocci
  - 80% cases caused by *S. aureus*
  - Others caused by *Streptococcus pyogenes*
    - Group A *Streptococcus*
      - Gram-positive coccus, arranged in chains, β-hemolytic

- Signs & Symptoms
  - Superficial skin infection
  - Blisters just below outer skin layer
  - Blisters replaced by weepy yellow crust
  - There is little fever or pain
  - Lymph nodes enlarge near area
  - May result in erysipelas

- Epidemiology
  - most prevalent among children
    - Most affected are two to six years of age
  - Disease primarily spread person-to-person
    - Also spread by insects and fomites

- Prevention and treatment
  - Prevention is directed at cleanliness and avoidance of individuals with impetigo
  - Prompt treatment of wounds and application of antiseptics can lessen chance of infection
  - Active cases are treated with penicillin, erythromycin or vancomycin

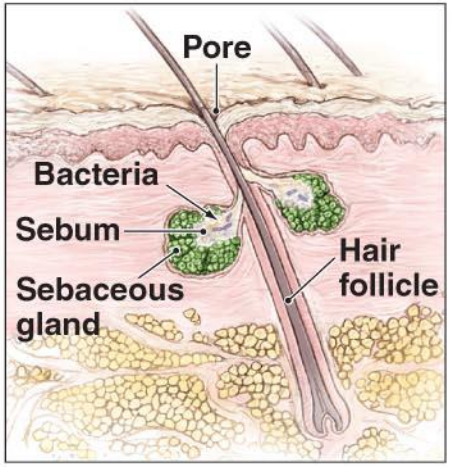
Features of impetigo caused by *Streptococcus pyogenes* or *Staphylococcus aureus*

CHECKPOINT — **Impetigo**

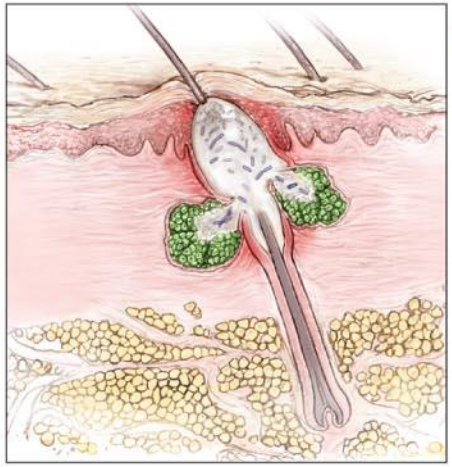
Causative Organism(s)	*Staphylococcus aureus*	*Streptococcus pyogenes*
Most Common Modes of Transmission	Direct contact, indirect contact	Direct contact, indirect contact
Virulence Factors	Exfoliative toxin A, coagulase, other enzymes	Streptokinase, plasminogen-binding ability, hyaluronidase, M protein
Culture/Diagnosis	Routinely based on clinical signs, when necessary, culture and Gram stain, coagulase and catalase tests, multitest systems, PCR	Routinely based on clinical signs, when necessary, culture and Gram stain, coagulase and catalase tests, multitest systems, PCR
Prevention	Hygiene practices	Hygiene practices
Treatment	Penicillin, erythromycin or vancomycin	Penicillin or erythromycin
Distinguishing Features	Seen more often in older children, adults	Seen more often in newborns; may have some involvement in all impetigo (preceding *S. aureus* in staphylococcal impetigo)

Acne

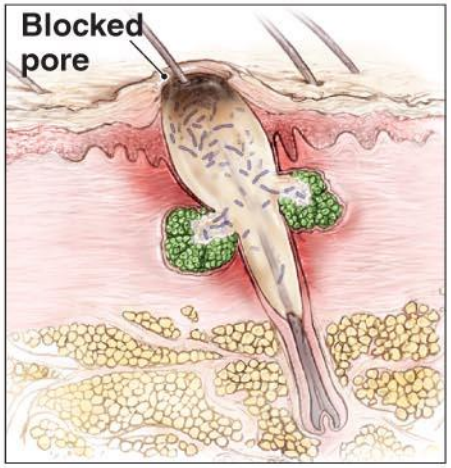
- Follicle-associated lesion
- Causative agent
  - Most serious cases caused by *Propionibacterium acnes*
    - Gram-positive, rod-shaped diphtheroids
    - feed on sebum and keratin in plugged pores & follicles
  - Epidemiology: endogenous



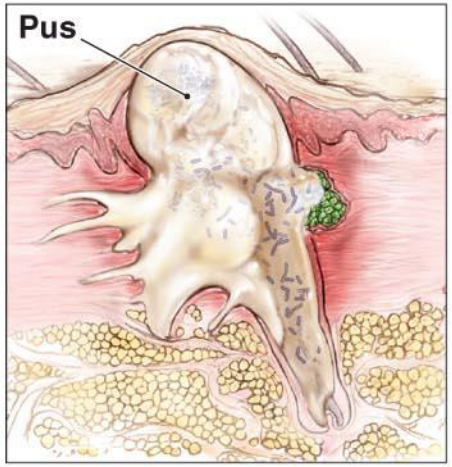
1 Normal skin
Oily sebum produced by glands reaches the hair follicle and is discharged onto the skin surface via the pore.



2 Whitehead
Inflamed skin swells over the pore when bacteria infect the hair follicle, causing the accumulation of colonizing bacteria and sebum.



3 Blackhead
Dead and dying bacteria and sebum form a blockage of the pore.



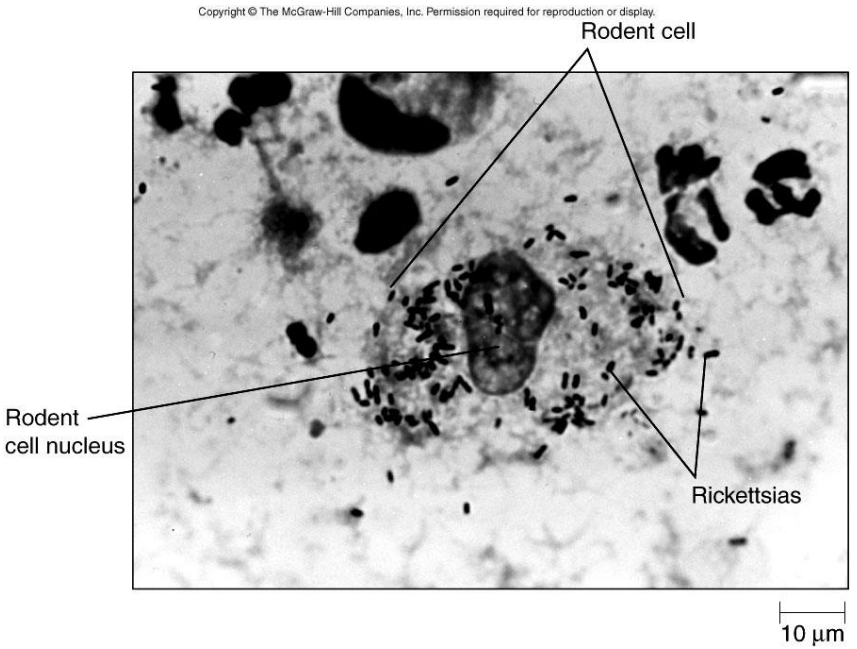
4 Pustule formation
Severe inflammation of the hair follicle causes pustule formation and rupture, producing cystic acne, which is often resolved by scar tissue formation.

– Prevention
  - remove oils as often as possible

– Treatment
  - prophylactic tetracycline
  - Benzoly peroxide or salicylic acid
  - New treatment uses blue light radiation
  - Accutane in severe cases

Rocky Mountain Spotted Fever

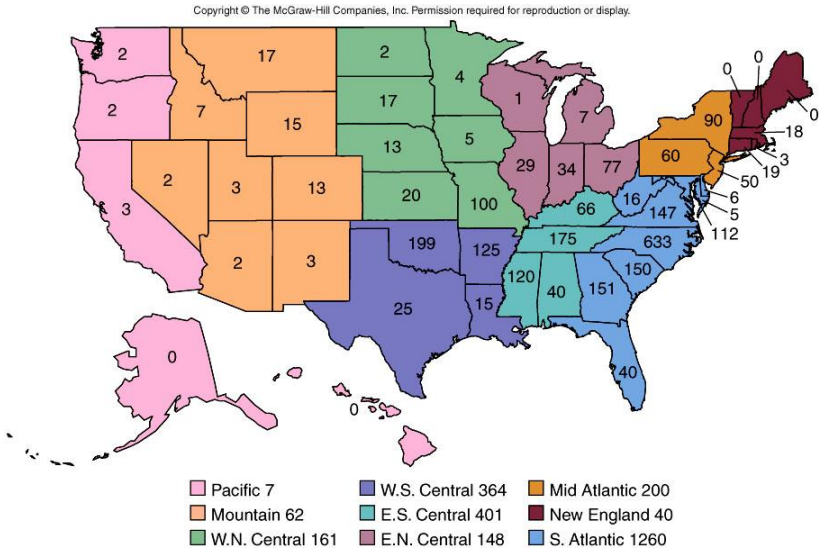
- Causative agent:
  - *Rickettsia rickettsii*
  - Obligate, intracellular bacterium
  - Gram negative, non-motile, coccobacillus



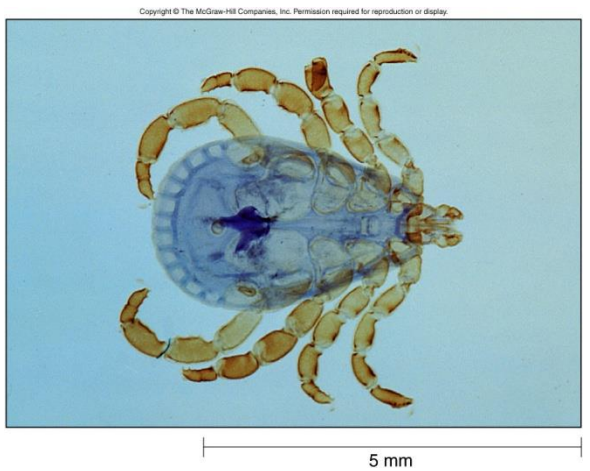
- Signs and symptoms
  - Flu-like symptoms
  - Rash of faint pink spots
    - Begins on wrists and ankles then spreads to other parts of body
  - Petechiae – subcutaneous hemorrhages (50%)

- Bacteria are released into blood and taken up by cells lining vessels
  - Results in apoptosis
- Bacterial toxin released in bloodstream can cause disseminated intravascular coagulation
- Shock or death can occur when certain body systems become involved
  - Commonly targets heart and kidney

- Epidemiology
  - Zoonotic disease
    - Spread from animals to humans



  - Main vectors include wood tick, *Dermacentor andersoni* and the dog tick, *Dermacentor variabilis*
    - Vectors remain infected for life
    - Transovarian transmission occurs

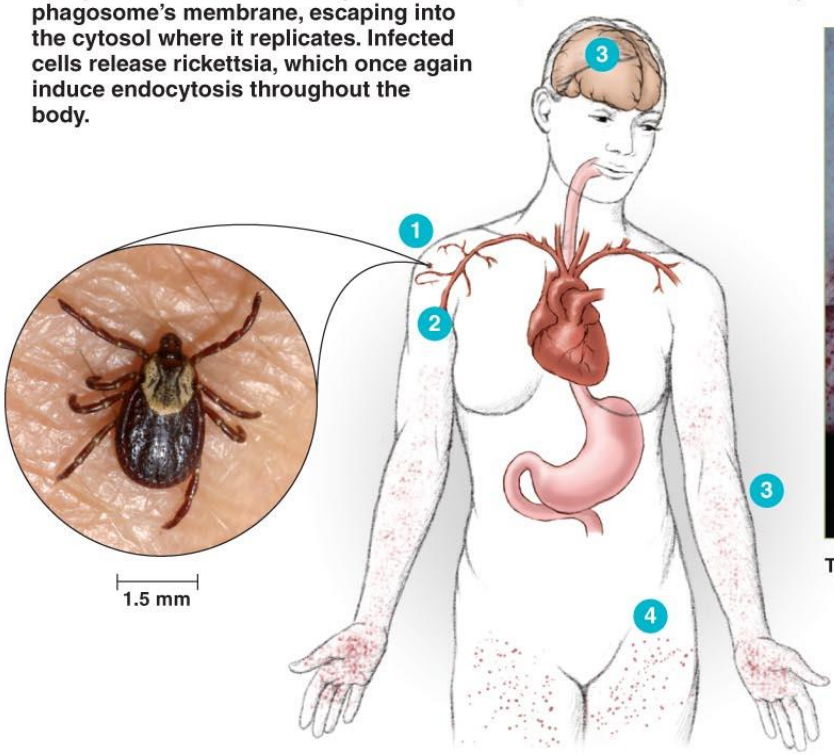


1. Infected tick (*Dermacentor*) introduces *Rickettsia* while feeding.

2. *Rickettsia* induces endocytosis by cells lining blood vessels; then it lyses the phagosome's membrane, escaping into the cytosol where it replicates. Infected cells release rickettsia, which once again induce endocytosis throughout the body.

3. Patient develops non-itchy rash on appendages, including palms and soles, that spreads to trunk; other manifestations include fever, headache, chills, muscle pain, nausea, and vomiting.

4. Damage to cells lining blood vessels allows blood to escape, producing petechiae, low blood pressure, and insufficient delivery of oxygen and nutrients to the body's cells.



The rash in a case of Rocky Mountain spotted fever

Cause: *Rickettsia rickettsii* (aerobic, Gram-negative, obligate intracellular, rod-shaped bacterium).

Portal of entry: Skin via bite of infected tick.

Signs and symptoms: A non-itchy, spotted rash on the trunk and appendages, including the palms and soles; and fever, headache, chills, muscle aches, nausea, vomiting, and petechiae.

Incubation period: Five to ten days.

Susceptibility: People in highly endemic areas are particularly susceptible due to increased exposure.

Treatment: Doxycycline is the drug of choice, although tetracycline and chloramphenicol are also effective.

Prevention: Wear light-colored, tight-fitting clothes that limit tick exposure. Use tick repellant, promptly remove ticks, examine skin for ticks and bites, and if possible, avoid tick-infested areas.

- Prevention
  - No vaccine currently available
  - Prevention should be directed towards:
    - Use protective clothing
    - Use tick repellents containing DEET
    - Carefully inspecting body
    - Removing attached ticks carefully

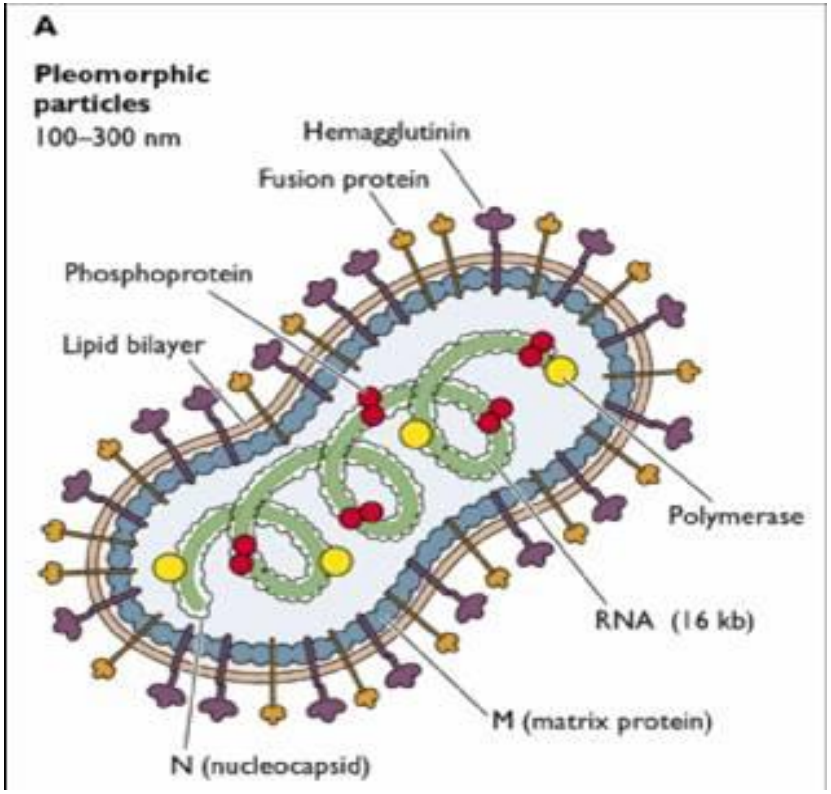
- Treatment
  - Antibiotics are highly effective in treatment if given early
    - Doxycycline and chloramphenicol used most often
  - Without treatment mortality around 20%
  - With early diagnosis and treatment, mortality drops to around 5%

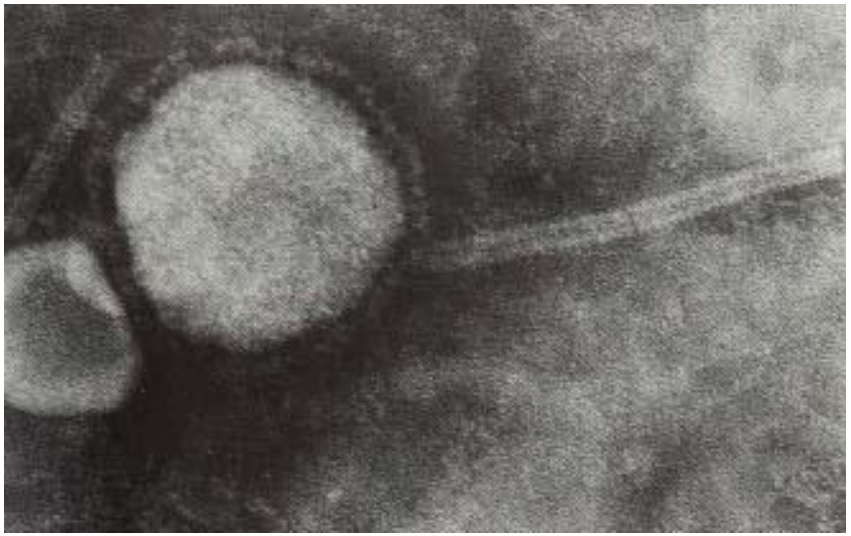
MEASLES (Rubeola)

Measles is an acute, highly infectious disease characterized by a maculopapular rash, fever, and respiratory symptoms.

Properties of the Virus. Measles virus is a typical paramyxovirus, related to canine and bovine . All 3 lack neuraminidase activity.

- In culture, produces characteristic intranuclear inclusion bodies and syncytial giant cells.





Pathogenesis and Immunity

- Transmission and initial stages of disease similar to mumps, but this virus can also infect via the eye and multiply in the conjunctivae. Viraemia following primary local multiplication results in widespread distribution to many organs.
- After a 10-12 day incubation period

Disease:

- ✓ Fever,
- ✓ Respiratory tract syndrom (dry cough, rhinorrhea, sore throat)
- ✓ conjunctivitis (virus may be excreted during this phase!), followed a few days later by the characteristic red,
- ✓ **maculopapular rash,**
- ✓ **Koplik's spots**
- Generalized virus infection in lymphoid tissues and skin

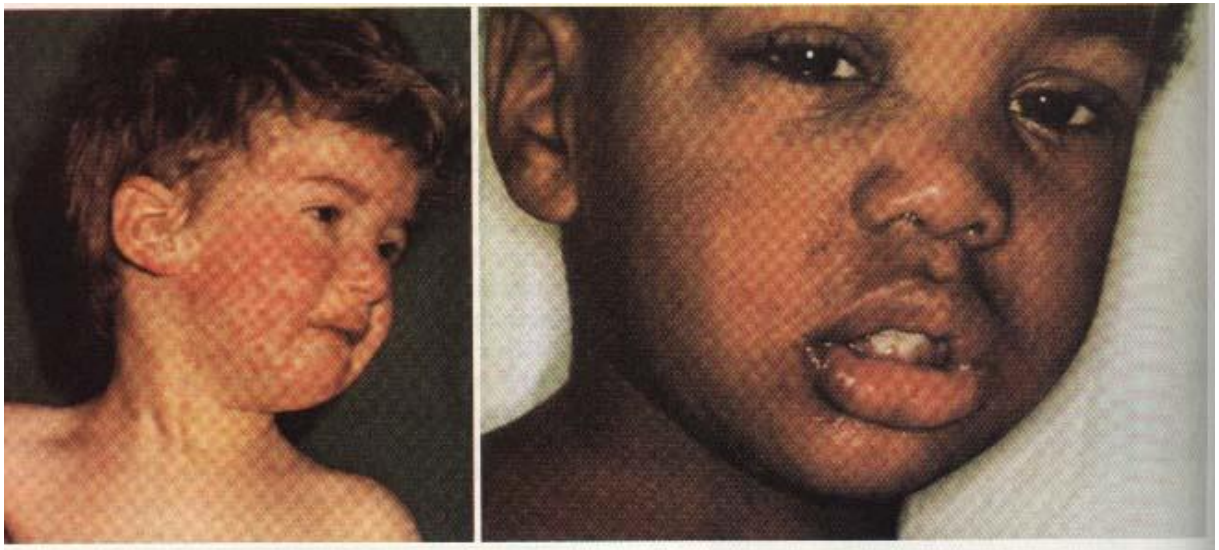


FIG. 19-17 **A,** Measles rash on first day in a caucasian child. A transient erythematous rash during the prodromal period may be confused with scarlet fever, but careful inspection of the mouth will usually disclose Koplik spots. The true rash appears behind the ears and along the hairline, quickly affects the face, and spreads progressively from above downward. On the first day of the rash the face is heavily covered but elsewhere the spots are scanty. **B,** Measles in an African-American child. Measles may be difficult to diagnose in a dark-skinned patient. Koplik spots may be found during the prodromal period.

Disease Prevention

- Wash hands before you eat and after you use the bathroom.
- Don’t share towels or wash cloths with others.
- Eat healthy.
- Keep clean.
- Stay clear of people who are ill
- Disinfection of surfaces
- Gloves, masks, goggles, gowns
- Isolation, and cohort nursing
- Immunization

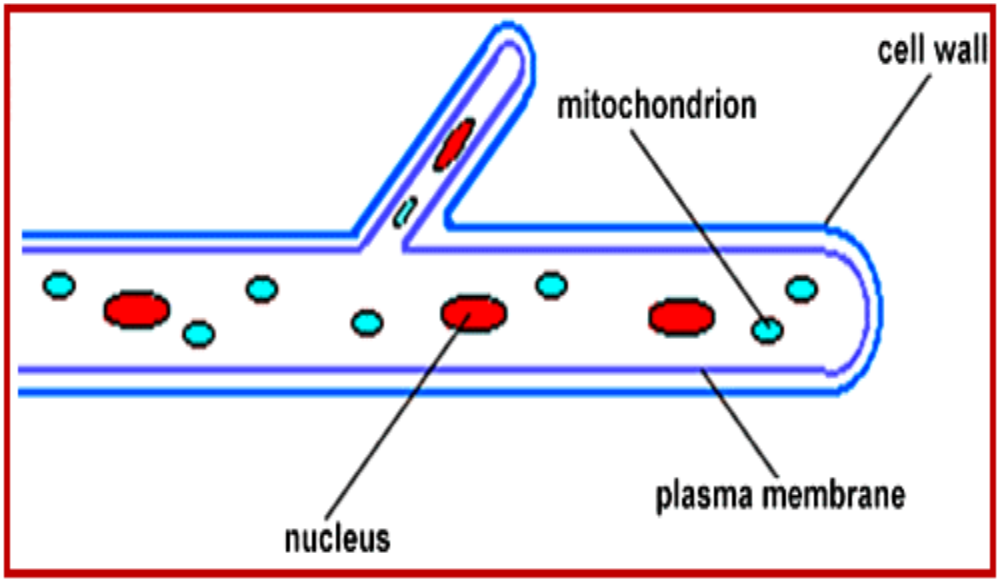
FUNGAL INFECTIONS

- The study of fungi is known as **mycology** and scientist who study fungi is known is a **mycologist**
- A fungus is a member of a large group of eukaryotic organisms
- Microorganisms such as yeasts and molds, as well as the more familiar mushrooms
- Over 60,000 species of fungi are known
- Fungi are important for the environment.
  - They are normally harmless to humans
  - Fungi can be opportunistic pathogens.

Structure

- The main body of most fungi is made up of fine, branching, usually colourless threads called **hyphae**
- Several of these these hyphae form web called the **mycelium**
- Most fungi are multinucleate and multicellular organisms with cross wall called **septa or aseptate (coenocytic)**
- Yeasts are unicellular
- One major difference is that most fungi have cell walls that contain chitin, unlike the cell walls of plants, which contain cellulose

Single Hyphae



YEASTS AND MOLDS

- Molds - multicellular
- Yeasts - unicellular
- The simplest form of growth is budding.
  - Buds are called blastoconidia.
  - Seen in yeasts.

CLASSIFICATION OF PATHOGENIC FUNGI

Fungal diseases are classified into 4 groups:

- Superficial mycoses
- Mucocutaneous mycoses
- Subcutaneous mycoses
- Deep mycoses

SUPERFICIAL MYCOSES

Fungal infections that do not involve a tissue response:

- Piedra – colonization of the hair shaft causing black or white nodules
- Tinea nigra – brown or black superficial skin lesions
- Tinea capitis – folliculitis on the scalp and eyebrows

…SUPERFICIAL MYCOSES

- Favus – destruction of the hair follicle.
- Pityriasis – dermatitis characterized by redness of the skin and itching:
  - Caused by hypersensitivity reactions to fungi normally found on skin
  - Mostly seen in immunocompromised patients.

CUTANEOUS AND MUCOCUTANEOUS MYCOSES

Associated with:

- Skin
- Eyes
- Sinuses
- Oropharynx and external ears
- Vagina

…CUTANEOUS AND MUCOCUTANEOUS MYCOSES

Ringworm – skin lesions characterized by red margins, scales and itching:

- Classified based on location of infection
  - Tinea pedis – on the feet or between the toes
  - Tinea corporis – between the fingers, in wrinkles on the palms
  - Tinea cruses – lesions on the hairy skin around the genitalia
  - Tinea capitis – scalp and eyebrows

- Onychomycosis – chronic infection of the nail bed
  - Commonly seen in toes
- Hyperkeratosis – extended scaly areas on the hands and feet

..CUTANEOUS AND MUCOCUTANEOUS MYCOSES

Figure 14.20 Microbiology: A Clinical Approach (© Garland Science)

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…CUTANEOUS AND MUCOCUTANEOUS MYCOSES

- Mucocutaneous candidiasis – colonization of the mucous membranes
  - Caused by the yeast *Candida albicans*
  - Often associated with a loss of immunocompetence
  - Thrush – fungal growth in the oral cavity
    - An indicator of immunodeficiency.
  - Vulvovaginitis – fungal growth
    - Can be associated with a hormonal imbalance

SUBCUTANEOUS MYCOSES

Localized primary infections of subcutaneous tissue:

- Can cause the development of cysts and granulomas.
- Provoke an innate immune response - eosinophilia.

DEEP MYCOSES

Deep mycoses Usually seen in immunosuppressed patients with:

- AIDS
- Cancer
- Diabetes

- Can be acquired by:
  - Inhalation of fungi or fungal spores
  - Use of contaminated medical equipment
- Deep mycoses can cause a systemic infection – disseminated mycoses
  - Can spread to the skin

..DEEP MYCOSES

Coccidiomycoses – caused by genus *Coccidioides*

- Primary respiratory infection
- Leads to fever, erythremia, and bronchial pneumonia
- Usually resolves spontaneously due to immune defense
- Some cases are fatal

…DEEP MYCOSES

Histoplasmosis – caused by *Histoplasma capsulatum*

- Often associated with immunodeficiency
- Causes the formation of granulomas
  - Can necrotize and become calcified
- If disseminated, histoplasmosis can be fatal.

..DEEP MYCOSES

Figure 14.22 Microbiology: A Clinical Approach (© Garland Science)

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…DEEP MYCOSES

Aspergillosis – caused by several species of *Aspergillus*

- •Associated with immunodeficiency
- •Can be invasive and disseminate to the blood and lungs
  - •Causes acute pneumonia
- •Mortality is very high.
  - •Death can occur in a matter of weeks.

Candidiasis

Cause: *Candida albicans*

- Spread by contact; often part of normal flora
- Opportunistic infections common
- Vulvovaginitis
- Oral candidiasis (thrush)
- Intestinal candidiasis

Dermatomycoses

- Dermatomycoses are any fungal infection of the skin or hair.
- Caused by many different species and are generally named after the infected area rather than the species that causes it.
- Dermatomycoses are one of the most frequent sources of lesions on the skin.

…Dermatomycoses

Cause: Several genera of dermatophytic fungi

- *Trichophyton*, an ascomycete
- *Microsporum*, an ascomycete
- *Epidermophyton*, a deuteromycete
- Grow on skin, hair, nails
- Transmitted by contact with infected persons or animals

….Dermatomycoses

Tinea infections: Red, scaly or blister-like lesions; often a raised red ring; "ringworm"

- Tinea pedis
- Tinea corporis
- Tinea capitis