

Skin and soft-tissue infections

Pharmaceutical Microbiology

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Skin defense mechanisms

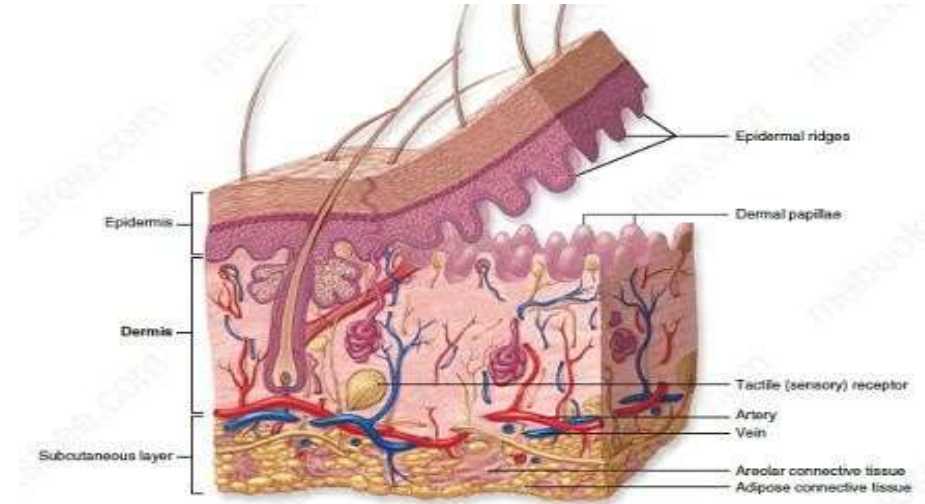
- A huge population of normal microflora colonizes on skin
- Moist areas support the growth of M.O, oil & sweat provide nutrients.
- Oil is decomposed by some M.O giving fatty acids that reduce the pH (5.5) which acts as a first line defense (innate defense) as many M.O can't grow at this pH
- Sweat is rich in salt, which acts as another defense. However, few M.O are salt tolerant
- Rapid shedding of skin cells.

Normal flora of skin

- The normal skin is colonised mainly by Gram positive microorganisms (staphylococci and diphtheroids).
- Some Gram-negatives and yeasts, which can survive in the relatively harsh conditions – dryness, acidity and the presence of fatty acids, sebum, and salt.
- The normal skin flora protects against infection by other microorganisms that must compete to survive.

Pathogenesis of skin

- Superficial skin infections affect the epidermis and dermis, e.g. impetigo
- Deeper infections affect the subcutaneous tissue, e.g. cellulitis
- Infections of skin structures cause folliculitis.
- Infections may arise from pathogens that gain entry through damaged skin (streptococcal cellulitis).
- Bacterial toxins produced by infections at other sites may also result in skin changes (group A streptococci causing scarlet fever)



DISEASES OF THE SKIN

1. Uncomplicated disease: have a low risk for life- or limb-threatening infection and many can be treated with empiric oral antibiotics, with occasional surgical drainage (folliculitis, acne, impetigo, and cellulitis). Severe infections require IV antibiotics.

2. Complicated disease: have a high risk for life- or limb-threatening infection, and often necessitate hospital admission, surgical debridement, along with broad-spectrum antibiotic therapy

Bacterial Skin Diseases

Type of Infection	Appearance of Lesion	Description of Lesion	Layer of Skin Involved	Common Pathogens	Treatment
Impetigo		Vesicles with honey-colored crust, often on the face of a child	Epidermis	<i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i>	Few lesions: topical antibiotics (e.g., mupirocin); numerous lesions: systemic therapy (e.g., cephalexin, clindamycin)
Cellulitis		Erythematous diffuse, flat lesion with irregular border	Deep dermis	<i>Streptococcus pyogenes</i> , <i>Streptococcus agalactiae</i> > <i>Staphylococcus aureus</i>	Systemic antibiotics, eg cephalexin or cefazolin
Folliculitis		Localized, inflamed papules containing a small amount of pus	Hair follicle	<i>S. aureus</i> , <i>Pseudomonas aeruginosa</i> (associated with hot tubs)	Antibiotics often not needed; warm, moist compresses are useful

Scarlet fever

is a bacterial illness that develops in some people who have strep throat.

Scarlet fever is caused by the same type of bacteria that causes strep throat — group A streptococcus.

Scarlet fever features a bright red rash that covers most of the body.

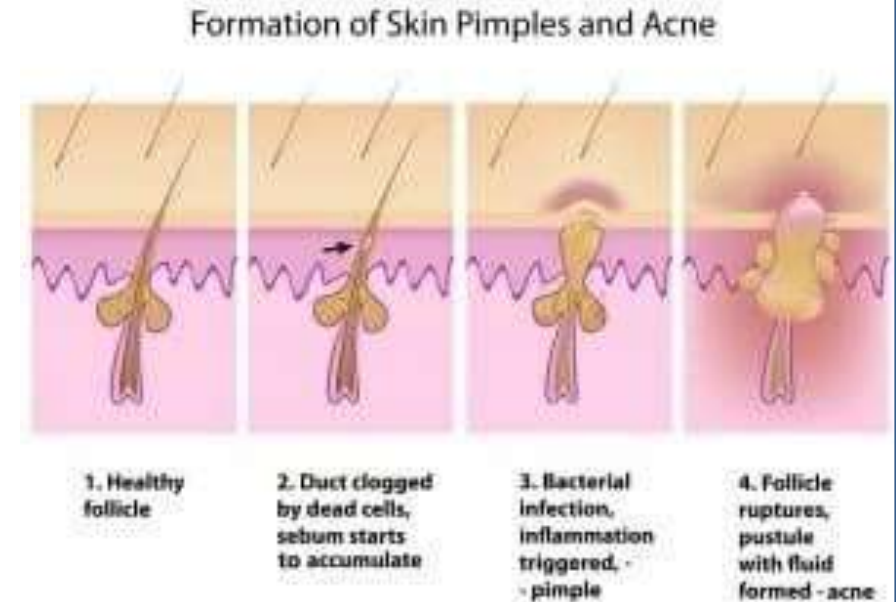
The infection spreads from person to person by droplets released when an infected person coughs or sneezes.



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Bacterial Skin Diseases

- **Acne** occurs in both males and females
- M.o feed on sebum. Ducts of glands & tissue become inflamed
- lesions occur within sebaceous follicles with keratin plugs blocking the sebaceous canal, resulting in 'blackheads.'
- Blackheads" are mild form of acne where hair follicles & sebaceous glands are plugged with sebum & keratin, as the surface oxidizes, they take black color .



Bacterial Skin Diseases-

Acne

- Bacteria, especially *Propionibacterium acnes*, infect the area and cause more inflammation, more tissue destruction, and scarring.
- Acne is treated with frequent cleansing of the skin and topical ointments to reduce the risk of infection.
- (Acutane®) Isotretinoin (Vit A derivative) for severe & persistent cases, it inhibits sebum production, but has serious side effects

Bacterial Skin Diseases -**Burn Infections**

- **Burn Infections** Severe burns destroy much of the body's protective covering and provide ideal conditions for infection
- Burn infections (mainly nosocomial), are responsible for 80% of deaths among burn patients.
- *Pseudomonas aeruginosa* is the prime cause of life-threatening burn infections. Many strains of these Gram-negative bacilli are antibiotic-resistant.
- *Pseudomonas aeruginosa* infection should be suspected when a greenish discoloration appears at the burn site and cultures have a grapelike odor.

Bacterial Skin Diseases -**Burn** **Infections**

- The thick crust formed over severe burn (eschar) lacks blood vessels & bacteria grow beneath it cause severe infections → antibiotics can not reach these areas,

removal of eschar by surgical scraping (debridement) helps antibiotics reach these sites.

Bacterial Skin Diseases

- Associated with deep wounds, **gas gangrene** often is a mixed infection caused by two or more species of *Clostridium*, especially *C. perfringens*.
- Spores of these obligately anaerobic organisms are introduced by injuries or surgery into tissues where circulation is impaired.
- In body regions where oxygen concentration is low, spores germinate, multiply, and produce toxins and enzymes such that kill other host cells and extend the anaerobic environment.



Bacterial Skin Diseases

- **Gas gangrene**
- A foul odor is such a prominent feature of gas gangrene
- Characterized by high fever, shock, tissue destruction & blackening of skin, if not treated causes death
- Treatment: Penicillin & removal of dead tissue or amputation to affected limbs
- Controversial treatment: use of hyperbaric O₂ (inhibits obligate anaerobes)
- Prevention: adequate cleaning of wounds, delaying closing of wounds & providing drainage when they are closed.

Viral Skin Diseases

- **Rubella, or German measles**, is the mildest of several human viral diseases that cause **exanthema** or skin rash.

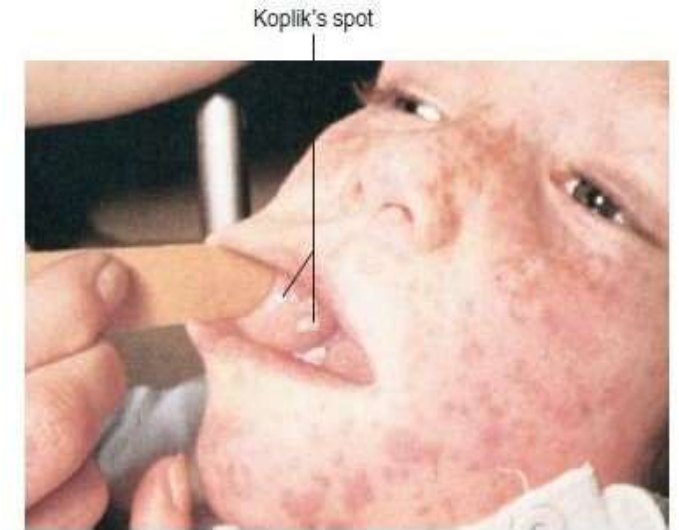


A rash, the main symptom of rubella, appears first on the trunk 16 to 21 days after infection. The rash is pink & flat

- Transmission: Rubella highly contagious, transmitted by nasal secretions before & after the appearance of rash.
- Immunity: part of attenuated viral vaccine (MMR).
Viruses appear in the nasopharynx after immunization & some individuals experience mild symptoms

Viral Skin Diseases

- **Measles, or rubeola**, is a febrile (accompanied by fever) disease with a rash caused by the rubeola virus. The paramyxovirus invades lymphatic tissue and blood.
- After the virus enters the body through the nose, mouth, or conjunctiva, symptoms appear in 9 to 11 days in children and in 21 days in adults.
- **Koplik's spots**, white spots with central bluish specks, appear on the upper lip and cheek mucosa 2 or 3 days before other symptoms such as fever, conjunctivitis, and cough.



Viral Skin Diseases

- **Measles, or rubeola**
- If the virus invades the lungs, kidneys, or brain, the common childhood disease often is fatal.
- **Transmission. The measles virus is** highly contagious; its portal of entry is the respiratory tract while coughing and sneezing.
- Treatment: alleviating symptoms
- Immunity: vaccination (MMR). Immunity acquired after the disease is life long.

Rubella	Measles
Rubella is caused by the Rubella virus that invades the lymph nodes, eyes, and skin.	Measles is caused by Morbillivirus that infects the respiratory system.
Usually mild, but can get severe in pregnant women.	Severe and can be life-threatening.
Characterized by a pink rash that starts in the face and spreads to the body, lasting for three to five days. The rash may be itchy and associated with other symptoms, such as red and watery eyes, running nose, headache, and joint pain.	Symptoms start with high fever, runny nose, cough, and red, watery eyes. Tiny white spots with bluish-white centers on a red background are found inside the mouth on the inner lining of the cheek (Koplik's spots) two-three days after the initial symptoms. The rash appears as flat red spots on the face at the hairline and spreads downward to the neck, trunk, arms, legs, and feet.

Viral Skin Diseases

- **chickenpox (varicella) and shingles (zoster)**
- Two diseases caused by a herpes virus (varicella-zoster virus VZV)
- Chickenpox is a highly contagious disease that causes skin lesions and usually occurs in children.
- Infection can be spread by respiratory secretions and contact with moist lesions but not from crusted lesions.
- the virus enters the upper respiratory tract and conjunctiva and replicates at the site of entry. New viruses are carried in blood to various tissues, where they replicate.



Viral Skin Diseases

- Release of these viruses causes fever and malaise. Then small, irregular, rose-colored skin lesions appear
- The fluid in them becomes cloudy, and they dry and crust over in a few days.
- They start on the scalp and trunk and spread to the face and limbs.
- **Diagnosis and Treatment.** Chickenpox is usually diagnosed by a history of exposure and the nature of lesions.
- **Immunity and Prevention.** Having chickenpox as a child confers lifelong immunity in most cases. Recurrences (in the form of shingles) are seen only in individuals with low concentrations of VZV antibodies and weak cell-mediated immunity
- **Acyclovir**, to be useful in early stages of the disease to reduce its severity, has not proven successful.

Viral Skin Diseases

- In **shingles**, painful lesions like those of chickenpox usually are confined to a single region supplied by a particular nerve.
- Eruptions arise from latent viruses acquired during a prior case of chickenpox.
- During the latent period, these viruses reside in ganglia in the cranium and near the spine. When reactivated, the viruses spread from a ganglion along the pathway of its associated nerve(s).
- The latent virus is activated when cell-mediated immunity drops below a critical, minimal level.



Shingles

- Symptoms range from mild itching to continuous, severe pain and can include headache, fever, and malaise. Lesions often appear on the trunk in a girdle-like pattern (*zoster*, “*girdle*”).
- Shingles is most severe in individuals with malignancies or immune disorders. In such patients, lesions may cover wide areas of the skin and sometimes spread to internal organs, where they can be fatal.
- Treatment of shingles usually includes a combination of antiviral and pain-relieving medications. The areas affected by the rash should be kept clean and dry. In general, it is best to avoid applying lotions or creams (eg, moisturizer) to the affected area, as this can further irritate the skin.

Viral Skin Diseases

- **Warts** caused by human papilloma viruses (HPV).
 - **HPV specifically attack skin and** mucous membranes.
 - Warts grow freely in many sites in the body -the skin, the genital and the oral cavity.
 - **The Nature of Warts. Warts vary in appearance, area** of occurrence, and pathogenicity. Some are barely visible and self-limiting—that is, they do not grow or spread— and others, such as laryngeal warts, are larger but benign.
- A few warts are malignant -cause 99% of all cases of cervical cancer



Viral Skin Diseases

Warts

Transmission. .. human papilloma viruses are **transmitted by direct** contact, usually between humans, or by fomites.

- **Dermal warts form when the virus enters the** skin or mucous membranes through abrasions. Genital warts are sexually transmitted.
- Treatment: cryotherapy (freezing & excision), caustic chemical agents, surgery.

Fungal skin diseases

- The fungi that invade keratinized tissue are called **dermatophytes**
- fungal skin diseases are called **dermatomycoses**.
- They can be caused by any one of several organisms mainly :
Epidermophyton, Microsporum, and Trichophyton.
- ***They cause various types of*** ringworm and attack the skin, nails, and hair.
- Fungi that invade subcutaneous tissue live in soil or as airborne spores. They enter tissues through wounds

Common dermatophyte (ringworm) infections

Infection	Site	Dermatophyte	Clinical features
Tinea corporis	Trunk	<i>Epidermophyton floccosum</i>	Pruritus; circular erythematous lesion, scaling, clearing from centre
	Limbs	<i>Trichophyton</i> spp. <i>Microsporum</i> spp.	
Tinea cruris	Groin	<i>Epidermophyton floccosum</i> <i>Trichophyton rubrum</i>	Pruritus; lesions similar to tinea corporis
Tinea pedis	Feet	<i>Epidermophyton floccosum</i> <i>Trichophyton</i> spp.	Pruritus; cracking and scaling between toes
Tinea unguium	Nails	<i>Trichophyton</i> spp.	Thick, yellowish nails with surrounding erythema
Tinea capitis	Hair	<i>Trichophyton tonsurans</i>	Erythematous patches on scalp with scaling; hairs break, leaving bald patches
		<i>Microsporum audouinii</i>	
		<i>Microsporum canis</i>	

Common dermatophyte (ringworm) infections



**Tinea
capitis**



**Tinea
pedis**



**Tinea
corporis**

Fungal skin diseases

- **Athlete's Foot. In athlete's foot, or tinea pedis**
- **Fungi** invade the skin between the toes and cause dry, scaly lesions. Fluid filled lesions develop on moist, sweaty feet.
- Then the skin cracks and peels, and a secondary bacterial infection leads to itchy, white areas between the toes.
- Prevention of athlete's foot depends on maintaining healthy, clean, dry feet that can resist the opportunism of fungi.
- Treatment : topical miconazole
- Prevention: keeping clean & dry feet.

Fungal diseases

Opportunistic fungal infections

Candidiasis

- Some fungi & yeast can invade human tissues when immunity is impaired.
- *Candida albicans* (yeast) present as normal flora in GI & urogenital tracts.
- Superficial candidiasis appears as thrush, (milky patches of inflammation on oral mucosa) in infants, diabetics, immunocompromised patients or those receiving AB for long time.
- it causes vaginitis (in pregnancy, diabetics, those using contraceptives as sugar level is elevated in vagina).



Fungal skin diseases

- **Dandruff**-flaking skin cells from an inflamed scalp.
- In dandruff sufferers, the cells flake off in big clusters in only 7 to 10 days
- The yeast, *Malassezia*, occurs in everyone's scalp, but only overgrows in some, causing inflammation, and excessive shedding.
- Treatment: apply shampoos as ketoconazole.



Infections of the eye

- **Viral conjunctivitis:**

- Viral conjunctivitis is commonly caused by adenovirus and is often called pink eye.
- It can also be caused by herpes simplex virus, varicella zoster virus, and various other viruses.
- Viral conjunctivitis often begins in one eye and then infects the other eye within a few days.
- Patients often present with an upper respiratory tract infection or recent exposure to someone with viral conjunctivitis .
- Antiviral medications may be an option if your doctor determines that your viral conjunctivitis is caused by the herpes simplex virus.



Infections of the eye

- **Bacterial conjunctivitis**, or pinkeye, is an inflammation of the conjunctiva caused by organisms such as *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Pseudomonas species*, and *Haemophilus influenzae*.
- is extremely contagious, especially among children.
- Topically applied sulfonamide ointment or erythromycin is an effective treatment.
- Do not share towels or eye cosmetics



Infections of the eye



Viral conjunctivitis

The type of conjunctivitis most commonly associated with the term "pink eye." Appearance: red, itchy, watery eye. Can affect one or both eyes. Highly contagious.

Bacterial conjunctivitis

A red eye with a sticky yellow or yellow/green discharge. Eyelids may be stuck together upon waking. Can affect one or both eyes. Usually spread by direct contact only.