

Pathophysiology 1

Sections 3 & 4



**IMMUNE SYSTEM, LYMPHATIC SYSTEM &
INFECTIOUS DISEASE**

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The Immune System & Lymphatic System- Unit 3



References:

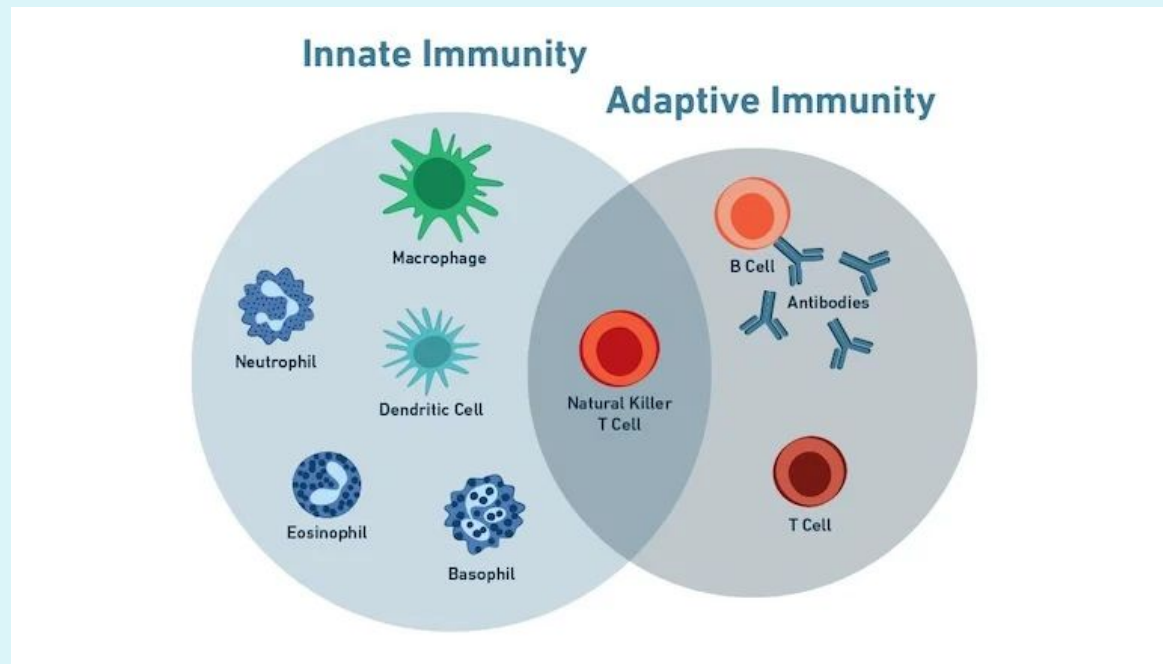
Ch. 9 Mosby's Pathology for Massage Professionals &
Ch. 21 of The Human Body in Health and Illness



Immune System overview



- <https://youtu.be/GIJK3dwCwCw>
- <https://youtu.be/2DFN4IBZ3rI>
- <https://youtu.be/rd2cf5hValM>



Non – Specific Immunity AKA Innate Immunity



Defenses that you are born with.

1st Line of Defense:

- 1) Mechanical barriers** such as skin, mucous membranes
- 2) Chemical barriers** such as lysozyme in tears and saliva, stomach acid, pancreatic enzymes
- 3) Reflexes** such as sneezing, coughing, vomiting, diarrhea

Non – Specific Immunity AKA Innate Immunity

2nd Line of Defense:

1) Phagocytosis:

<https://youtu.be/Q84-mPocGWQ?feature=shared>

Neutrophils roam the bloodstream and gobble up foreign invaders, then they die & become pus.

Macrophages- Monocytes become macrophages after they leave the bloodstream (via **diapedesis**) & enter the tissue. Can be free or fixed – in organs such as the liver, lungs, spleen & lymph nodes. After consuming the pathogen, they will stay alive and display antigens on their surface (become an **Antigen presenting cell** or APC) therefore stimulating adaptive immunity.

<https://youtu.be/AUo-R82Xhmw>

Non – Specific Immunity AKA Innate Immunity

2) Protective Proteins:

- ***Interferon*** – produced by cells infected with viruses. Sends messages to neighbor cells to protect them.
- ***Complement proteins***- Circulate in blood. When activated, can punch holes in bacteria, allowing water to flood in & cause the bacterial cell to ***lyse*** open.
- Also play a role in hypersensitivity reactions.

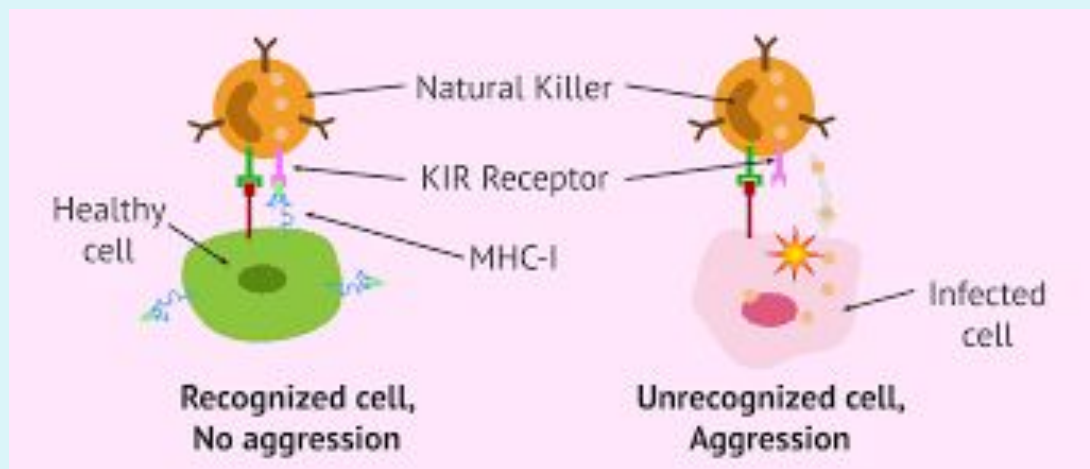
<https://youtu.be/B299e2ffR5A?feature=shared>

Innate Immunity AKA Non-Specific Immunity



2nd line of defense cont.

3) Natural Killer Cells – special “assassin” lymphocytes. Roam the bloodstream targeting foreign invaders and cancer cells.



Innate or Non-Specific Immunity



2nd Line of Defense Cont.

4) Inflammation-

Any injury, including an invasion by microorganisms, causes inflammation in the affected area.

Inflammation is a complex reaction where damaged tissue releases substances that cause inflammation and direct the immune system to do the following:

- Attack and kill any invaders
- Dispose of dead and damaged tissue
- Begin the process of repair

Inflammation may not be enough to overcome large numbers of microorganisms.

<https://youtu.be/uc6IV85mf3s>

OVERVIEW OF INFLAMMATION



Inflammation is characterized by 4 features: Redness, swelling, heat & Pain.

During inflammation, the *blood supply increases*, causing the infected area near the surface of the body becomes *red and warm*.

Walls of blood vessels become more porous, allowing fluid and white blood cells (in the process of ***diapedesis***) to pass into the affected tissue.

Increase in fluid causes the inflamed tissue to *swell*.

White blood cells attack the invading microorganisms and release substances that continue the process of inflammation.

Other substances trigger clotting in the capillaries in the inflamed area, which delays the spread of the infecting microorganisms and their toxins.

Many of the *substances produced during inflammation* stimulate the nerves, causing *pain*.

Reactions to the substances released during inflammation include the chills, fever, and muscle aches that commonly accompany infection.

Innate Immunity Cont.



5) Fever AKA Pyrexia

Body temperature increases as a protective response to infection and injury. An elevated body temperature (fever) enhances the body's defense mechanisms

The hypothalamus controls body temperature. Fever results from an actual resetting of the hypothalamus's thermostat.

The body raises its temperature to a higher level by shunting blood from the skin surface to the interior of the body (reduces heat loss)

Shivering (chills) may occur to increase heat production through muscle contraction.

Later, when the thermostat is reset to its normal level, the body eliminates excess heat through sweating and shunting of blood to the skin.

Certain people (such as alcoholics, the very old, and the very young) are less able to generate a fever. These people may experience a drop in temperature in response to severe infection

<https://youtu.be/jRvxnpfCDS0>

Innate Immunity Review



1st Line of Defense:

- 1) Physical barriers
- 2) Chemical Barriers
- 3) Reflexes

2nd Line of Defense

- 1) Phagocytosis
- 2) Protective Proteins
- 3) Natural Killer Cells
- 4) Inflammation
- 5) Fever

Specific Immunity AKA Adaptive Immunity



AKA 3rd Line of Defense

Specific or Adaptive Immunity refers to the immunity that you develop over your lifetime, by being exposed to different pathogens

There are two main *ways* that you develop specific immunity:

1) Active Immunity – immunity that you develop through exposure to pathogens, stimulation of your B lymphocytes to produce antibodies

Naturally by having by being exposed to the pathogen

Artificially by vaccination

2) Passive Immunity- immunity that you are given by resources that your body did not produce - your own B lymphocytes do NOT produce antibodies

- *Naturally* by getting antibodies from your mother in the womb & through breastmilk
- *Artificially* by getting IV Immunoglobulin (someone else's antibodies)

ADAPTIVE IMMUNITY Cont.



There are two main **types** of Adaptive immunity: Cell-mediated & Antibody-mediated

1) Cell-Mediated Immunity - T lymphocytes attack pathogens directly

T cells originate in the bone marrow, but mature in the **thymus**

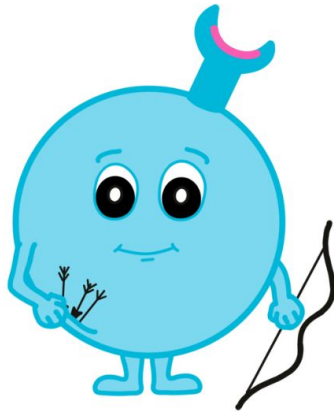
There are 4 types of T lymphocytes:

- **Helper Ts (CD4)** - Help stimulate both B & T lymphocyte into action
- **Cytotoxic Ts (CD8)** - Release substances that can kill pathogens
- **Regulatory Ts** - Help shut down the adaptive immune response when pathogen levels drop
- **Memory Ts** - Long-lived cells that help stimulate a faster response when the pathogen is encountered again

Adaptive Immunity

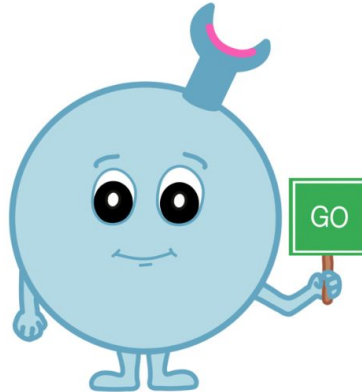
Cell - Mediated Immunity

cytotoxic T cells



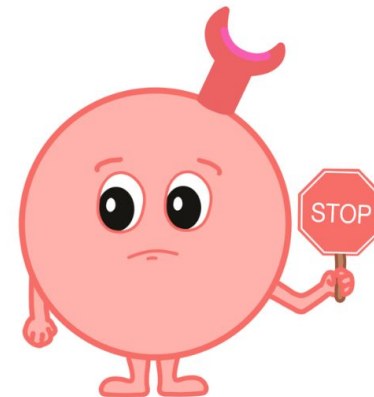
produce toxic agents to kill their targets

helper T cells



stimulate B cells to make antibodies
stimulate T cells to become active

regulatory T cells



suppress immune responses

ADAPTIVE IMMUNITY cont



2) Antibody Mediated Immunity (aka Humoral Immunity)

- B Lymphocytes produce antibodies to attack pathogens

B Cells originate and mature in the *bone marrow*.

Types of B cells:

- **Naïve B cells** – B cell not yet exposed to an antigen. After exposure, it will turn into a plasma cell or a memory B cell.
- **Plasma cell** – secretes a single type of antibody. (remember cancer of these cells is multiple myeloma)
- **Memory B cells** – long-lived cells that live in our lymph tissue (nodes, Peyer's patches, tonsils etc) Can change into plasma cells quickly upon exposure to a familiar antigen

Antibodies



The antibodies produced by B lymphocytes are also known as ***Immunoglobulins***.

There are 5 main types:

- 1) **IgG**- the most common & plentiful type, present in plasma and can cross the placenta and blood brain barrier. Very effective against some bacteria, viruses & toxins.
- 2) **IgA** - Found in exocrine secretions (tears, saliva, sweat, gastric juice & breast milk)
- 3) **IgM** - found in plasma & surface of RBCs, associated with blood type.
- 4) **IgD** - found on the surface of B cells
- 5) **IgE** - Found in exocrine secretions. Not much of a role in pathogen defense but a huge role in allergies.

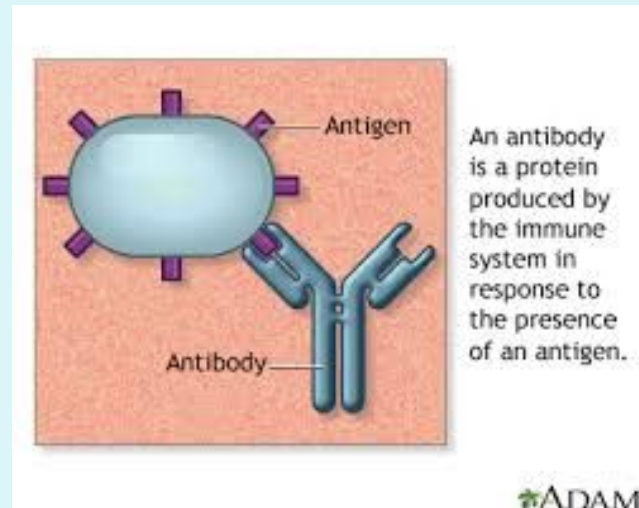
Antibodies cont.



Antibodies destroy **antigens** - usually proteins or sugars that may be found on: toxins, chemicals, bacteria, viruses, pollens & even certain types of our own cells.

Antibodies can attack an antigen directly by binding to it in a process called **agglutination**. The new antibody-antigen complex that is formed is large and stimulates phagocytosis.

Antibodies may also attack a pathogen indirectly, by stimulating complement proteins.



Immune System Timeline

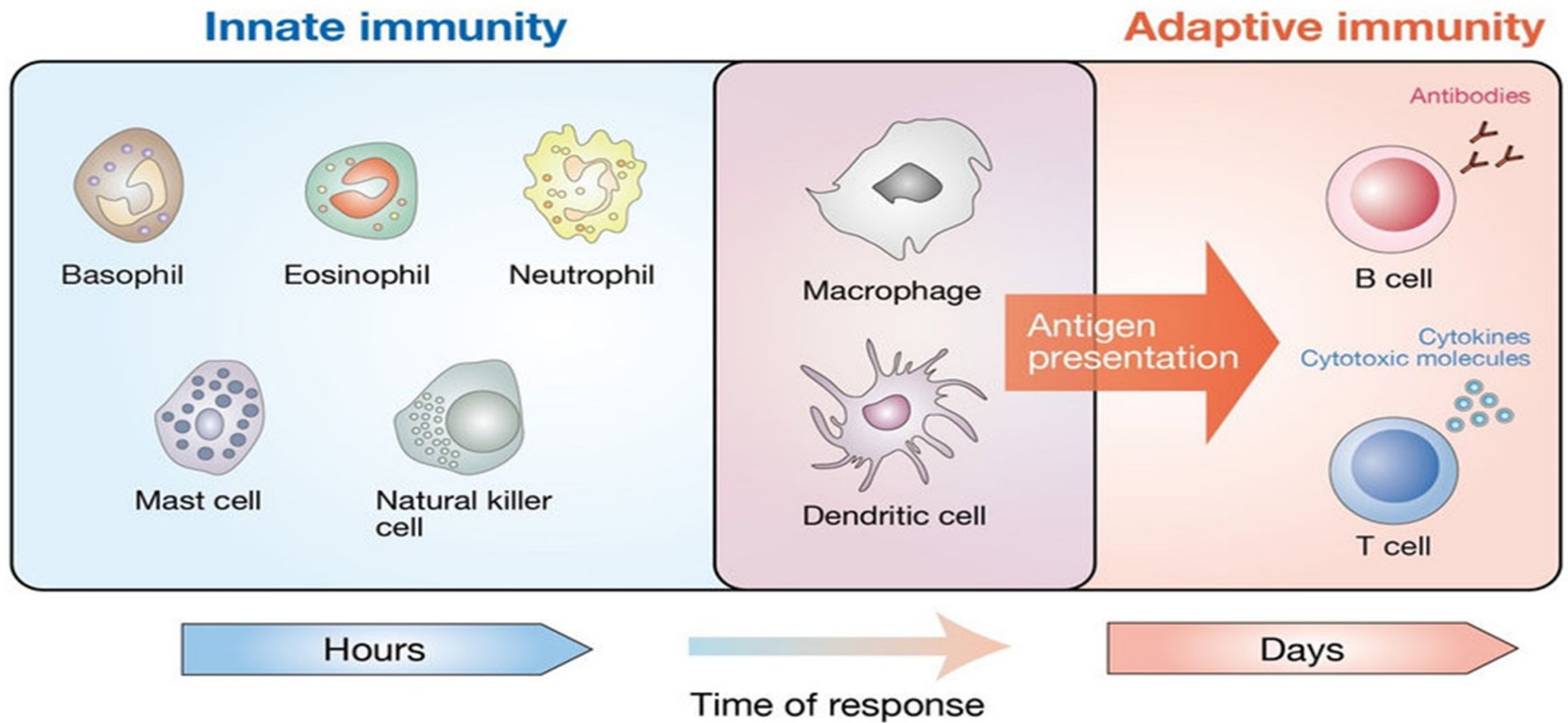


Image ref: Hippo Pathway in Mammalian Adaptive Immune System - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Cellular-components-of-the-mammalian-immune-system-The-mammalian-immune-system-consists_fig2_332777013 [accessed 23 Oct, 2022]

How does your immune system know what to target?

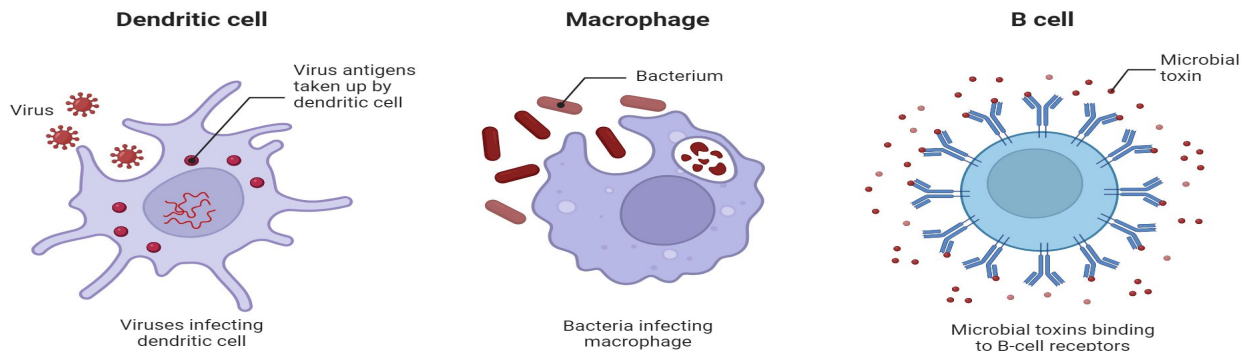


Antigen Presenting Cells - the bridge between your innate & your adaptive immune system.

APCs include macrophages, B cells and dendritic cells. They ingest foreign invaders or damaged cells, digest them & present pieces of them “antigens” on their cell membranes, bound to MHC proteins.

These “tags” or “shark tooth necklaces” tell the B & T lymphocytes which cells to target for destruction.

Different Types of Antigen Presenting Cells

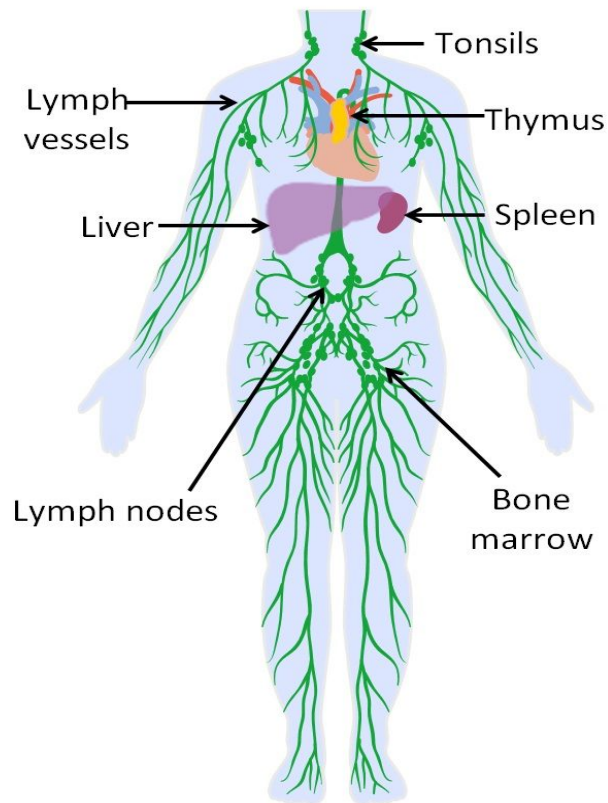


Lymph System



teachoo

LYMPHATIC SYSTEM



Lymph - a colourless liquid containing white blood cells that bathes the tissues and drains through the lymphatic system back into the bloodstream. It is formed of the approx. 15% of extracellular fluid that did not get reabsorbed into a venous capillary.

Lymph System - a collection of channels, lymph nodes, and lymphoid tissue in organs that carries the **lymph fluid**. It acts as a filter against pathogens, organic wastes, toxins & other debris.

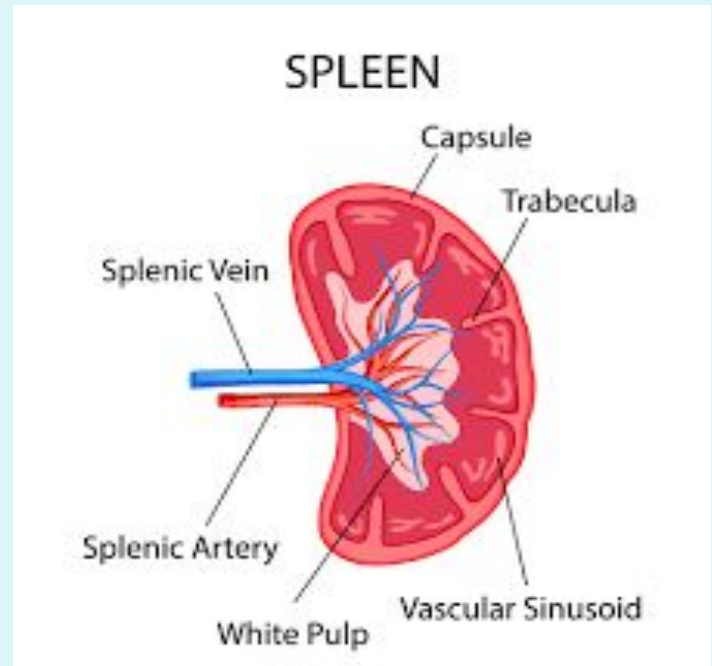
Lymph Organs = Spleen, Thymus Gland & Lymph nodes.

Lymph Organs



Spleen - Located in the LUQ of the abdomen.

- Consists of **red pulp** - which contains venous sinuses filled with blood, as well as *lymphocytes* & *fixed macrophages* which will filter the blood of pathogens and misshapen blood cells
- Also consists of **white pulp** - lymphoid tissue that contains many lymphocytes
- If injured, the spleen can be removed.
- A person can live without a spleen, but their immunity will be compromised



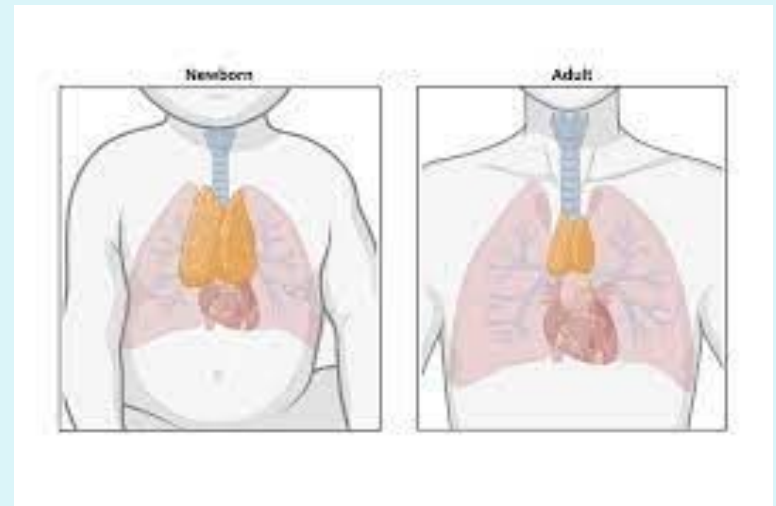
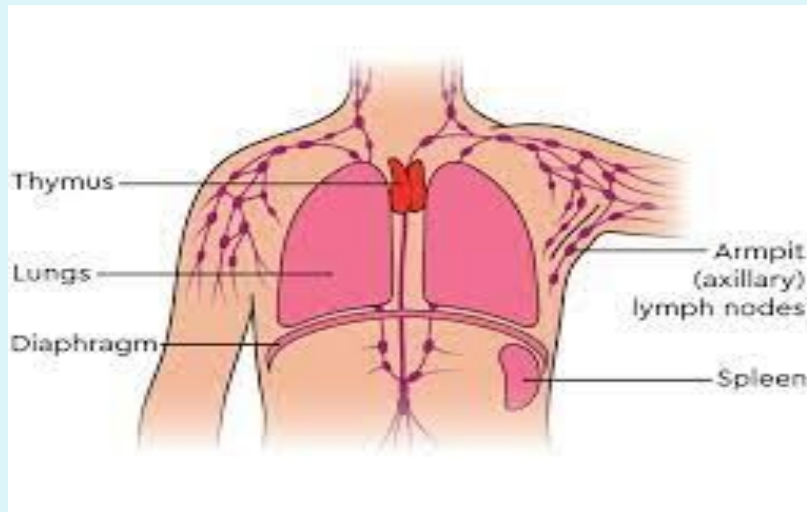
Lymph Organs Cont



Thymus - Located in the mediastinum, behind the sternum.

- Quite large in childhood, it begins to shrink after puberty.
- Contains many lymphocytes, which will mature into T lymphocytes.
- Also secretes **thymosins** which are hormones that encourage growth & development of T lymphocytes in lymphatic tissue throughout the body.

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Lymphatic Nodules



Includes the **tonsils**, **MALT**, **Peyer's patches** & the **appendix**.

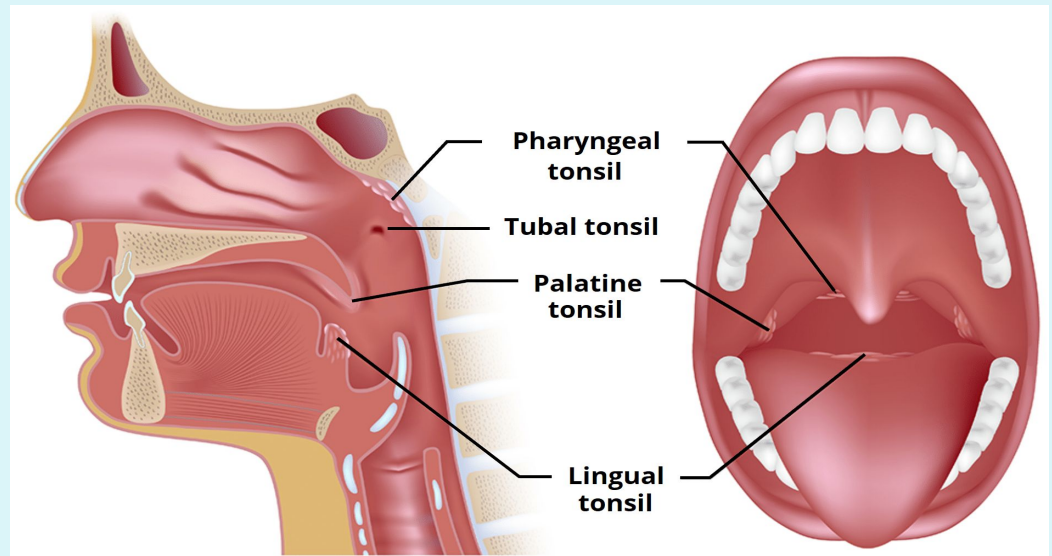
Tonsils- Partially encapsulated lymph nodes in the throat area.

Palatine tonsils - 2, located one on each side of the throat.
Removed in a tonsillectomy.

Pharyngeal/Adenoid - located near the opening of the nasal cavity into the pharynx. Removal is an adenoidectomy.

Lingual - 2 located at the back of the tongue.

Tubal - 2 located where The Eustachian tube Meets the nasopharynx



Lymphatic Nodules Cont.



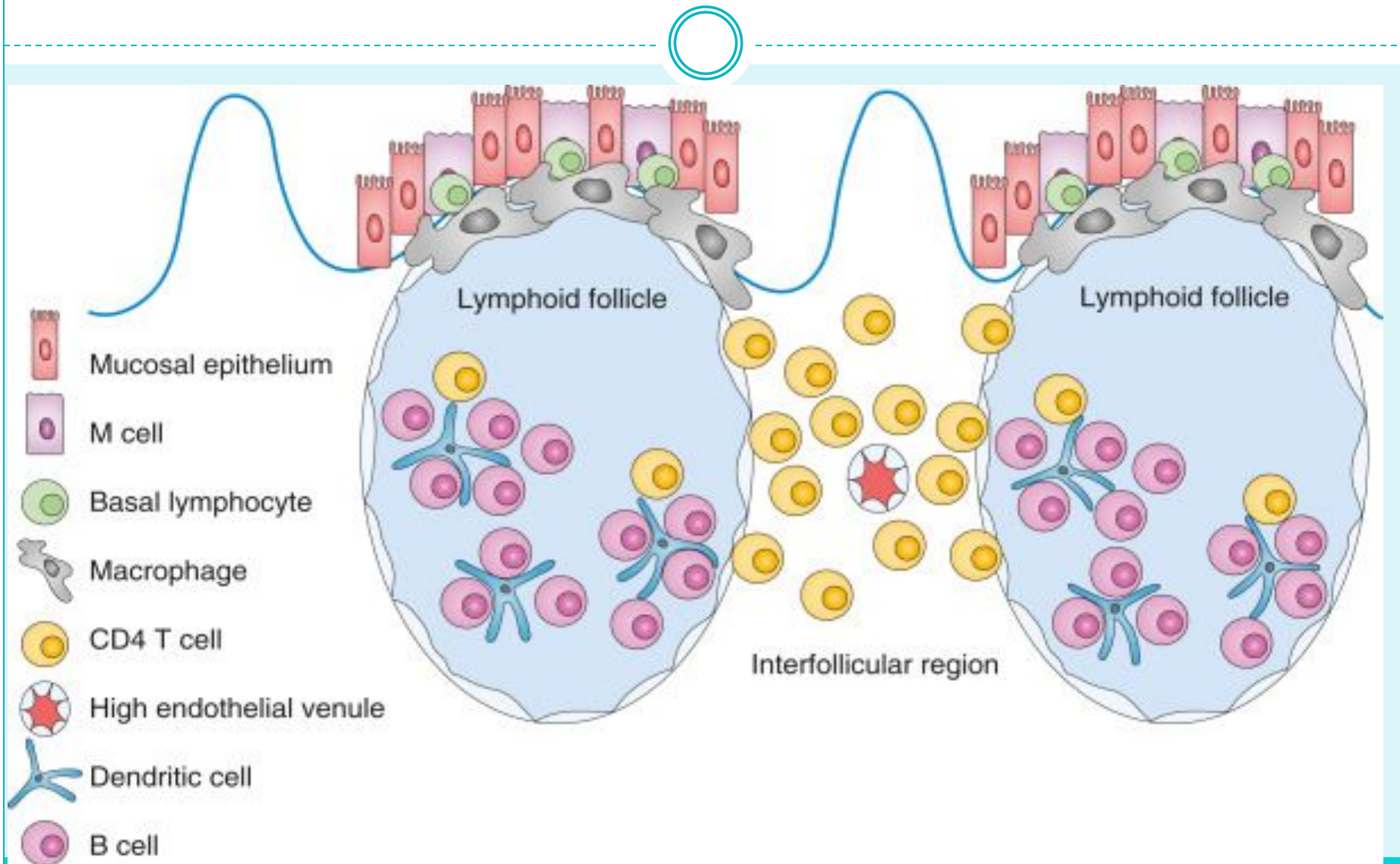
MALT- Mucosal-Associated Lymphatic Tissue

- Scattered throughout the body in its mucous membranes.
Wherever the body is open to the external environment.

Peyer's Patches- Lymph nodules found in the lower part of the small intestine

Appendix - Outpouching of the intestine that occurs where the large intestine begins.

FYI: MALT diagram



Lymph Nodes



Lymph Nodes - pea-shaped patches of lymph tissue, that consist of many lymph sinuses surrounded by *macrophages* and *lymphocytes*. The lymph fluid is thus filtered when it passes through these nodes. There are about 800 lymph nodes in the human body.

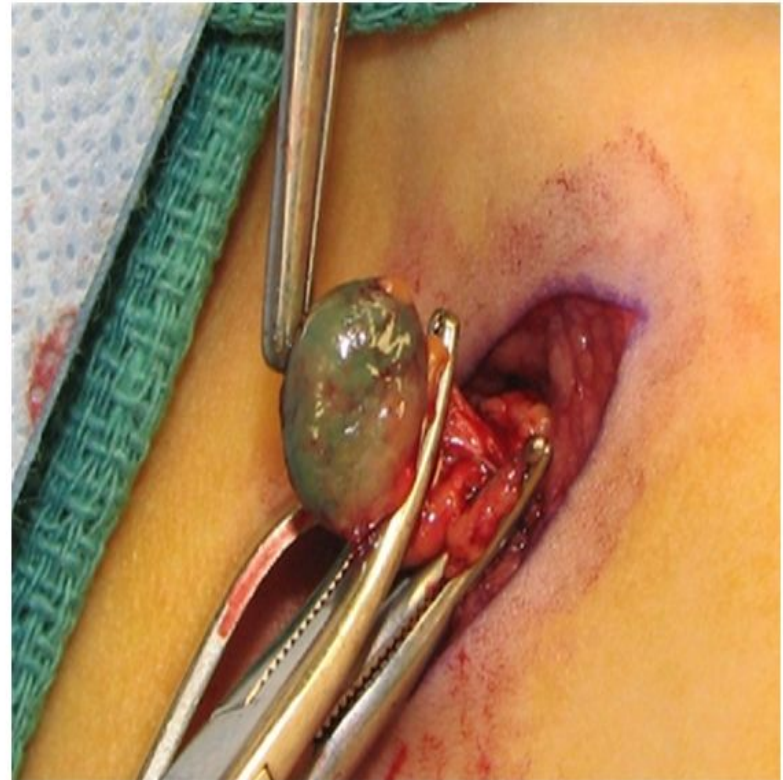
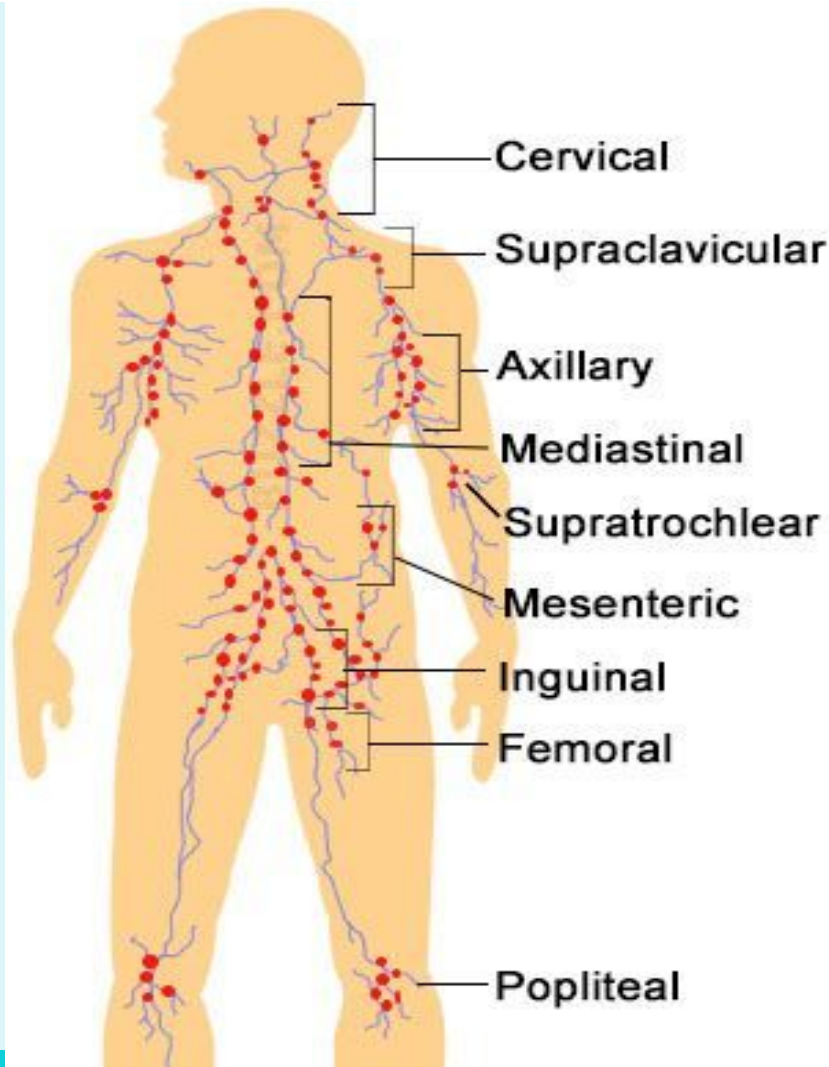
Important locations of lymph nodes:

Cervical- Approx. 300 nodes that drain & filter the lymph of the head & neck

Axillary - 20 - 30 nodes that drain & filter lymph from the arms, shoulders & breast/chest.

Inguinal - About 10 nodes located in the groin area that drain & filter lymph from the legs & external genitalia.

Lymph Nodes



Lymph Vessels



Lymph vessels consist of capillaries & larger vessels that mirrors the venous circulatory system.

Lymph capillaries- have a single celled epithelial walls that overlap to create “flaps” -

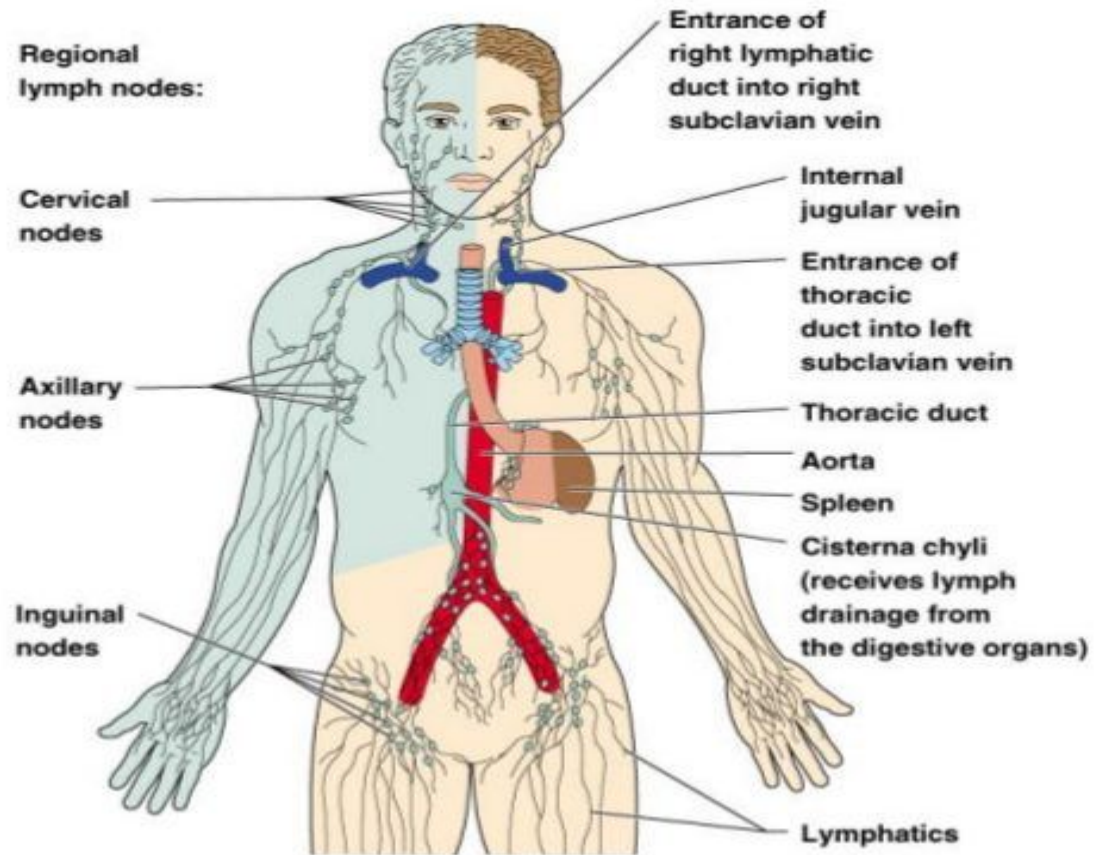
when the interstitial pressure is *higher* than in the lymph capillary, the flaps will open & allow interstitial fluid into the lymph capillary

When the pressure *inside* the lymph capillary is higher, the flaps will stay closed.

Lymph will move into larger lymphatic vessels until it reaches *either* the **right lymphatic duct** which drains lymph from the right arm, head & thorax into the **right subclavian vein** *OR*

The **thoracic duct** which drains lymph from everywhere else in the body into the **left subclavian vein**.

Lymph Drainage



Movement of Lymph



Similar to veins, lymph does not have the pressure of the heart or a thick layer of muscle in its vessel walls, so it relies upon the following for movement ;

- 1) The “milking” action of the skeletal muscle
- 2) The movement of the chest during respiration. The expanding chest creates a low pressure environment that helps draw lymph fluid towards it.
- 3) The rhythmic contraction of the smooth muscle within the walls of the lymphatic vessels
- 4) The presence of **valves**. Like in veins, they prevent backflow.

Pathologies of the Immune & Lymph Systems



Pathologies of the Immune System - Allergic Reactions



- A person who is overly reactive to a substance that is tolerated by most others is said to be hypersensitive or allergic. Whenever an allergic reaction occurs, there is tissue injury. The antigens that induce an allergic reaction are called allergens.

There are **four basic types** of hypersensitivity reactions (remember with the acronym **ACID**):

1. **Type I (Allergy):**

Allergy results from the interaction of allergens with *IgE* antibodies on the surface of mast cells and basophils. Develops within 20 mins of exposure. Can be mild or can progress to *anaphylaxis*, which is the most severe type of allergy. Anaphylaxis may progress to anaphylactic shock, involving wheezing and shortness of breath as airways constrict and extremely low blood pressure due to vasodilation and fluid loss from blood. This is a *life-threatening emergency*.

Type I reactions are often associated with eating potentially allergenic food such as peanuts, tree nuts, shellfish, or eggs. Also associated with bee and wasp stings. Pollen exposure usually causes milder symptoms.

Immune System Pathologies - Allergic Reactions cont.



- **2. Type II (cytotoxic)** reactions are caused by antibodies (IgG or IgM) directed against a person's blood cells or tissue cells. The reaction of antibodies and antigens usually leads to activation of complement. Type II reaction, which may occur in *incompatible blood transfusion reactions*, damage cells by causing lysis.
- **3. Type III (immune complex)** aka *Autoimmune reactions* involve antigens (not part of a host tissue cell), antibodies (*IgA or IgM*), and complement. Antibody-antigen complexes then deposit in tissue, causing symptoms. Some type III conditions include glomerulonephritis, systemic lupus erythematosus, and rheumatoid arthritis.

Immune System Pathologies - Allergic Reactions



- 4. **Type IV (delayed/cell-mediated)** reactions or delayed hypersensitivity reactions usually appear *12-72 hours* after exposure to an allergen and occur when allergens are taken up by antigen-presenting cells that migrate to lymph nodes and present the allergen to *T cells*. Intracellular bacteria, such as the one that causes tuberculosis, trigger this type of cell-mediated immune response. *IgG* antibodies are involved.

Some examples are: contact dermatitis from a nickel jewelry allergy or poison ivy, or delayed food reactions such as celiac disease, or sensitivities to foods such as soy or nightshade vegetables.

Immune System Pathologies - Autoimmune Disorders



- In an autoimmune disease the immune system fails to display self-tolerance and attacks the person's own tissue. These diseases usually arise in early adulthood and are common, affecting an estimated 5-8% of adults in North America and Europe. *Females suffer from autoimmune diseases twice as often as males.* Some disorders that you will look at in greater detail in future courses include: *multiple sclerosis, diabetes mellitus, rheumatoid arthritis, and ulcerative colitis.*
- There are around 100 different known autoimmune conditions. Most of them share the characteristic feature of “waxing and waning” - Periods of **remission** when the disease gets better and **exacerbation** or “flare-ups” when the symptoms are worse

Immune System Pathologies - Autoimmune

Systemic Lupus Erythematosus

- **Systemic lupus erythematosus (lupus or SLE)**

A chronic autoimmune, inflammatory disease that affects multiple body systems.

- Characterized by periods of active disease and remission, and symptoms range from mild to life threatening.
- Develops between the ages of 15-44, and is *10-15 times more common in women than men.*
- **Signs and symptoms include:** joint pain, muscle pain, chest pain with deep breaths, headaches, pale or purple fingers or toes, kidney dysfunction, low blood cell count, nerve or brain dysfunction, slight fever, fatigue, oral ulcers, weight loss, swelling in the legs or around the eyes, enlarged lymph nodes and spleen, photosensitivity, rapid loss of large amounts of scalp hair, and sometimes ***an eruption across the bridge of the nose and cheeks called a “butterfly rash” or malar rash.***
- *Renal failure* is the most common cause of death.
- There is no cure, but drug therapy can minimize symptoms, reduce inflammation, and forestall flare-ups.
- <https://youtu.be/iftoxga6bhA>
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Immune System Pathologies - HIV Infection



The **HIV (Human Immunodeficiency Virus)** was first identified in 1984, three years after the disease that it causes was named **AIDS (acquired immunodeficiency disease)**

HIV probably evolved from a similar virus that affects chimpanzees and seems to have started to affect humans as far back as the 1930s. Genetic studies have shown that it first entered the U.S. in the late 1970s.

In the early 1980s, clusters of cases began to appear in New York, with the gay male community most heavily impacted. A huge stigma affected those with the virus and disease, which finally started to relent after development of treatment in 1987, Princess Diana's public handshake and touch of AIDS patients in the late 80s, Magic Johnson coming forward with his diagnosis in 1991 & the Oscar winning movie Philadelphia coming out in 1993.

Immune System Pathologies - HIV



- Since 1981, when doctors first recognized HIV/AIDS as a new illness, scientists have learned much about how a person becomes infected with HIV. The virus is spread through contact with an infected person's body fluids, especially through blood, semen and vaginal fluids. HIV can be transmitted:
 - During sex (anal, vaginal and oral)
 - By contaminated blood (by sharing or accidentally being stuck with a contaminated needle)
 - Through blood transfusions (before blood products started being screened for HIV in 1985)
 - By being born to a mother who is infected with HIV

Immune System Pathologies - HIV



- Once inside the body, HIV particles invade CD4 (Helper T) cells and use the cell's own building materials to produce billions of new HIV particles. These new particles cause the infected CD4 cells to burst (lyse). The new particles can then enter the bloodstream and infect other cells.
- Once someone is infected with HIV, the number of their CD4 cells continues to decrease. HIV is actively copying itself and killing CD4 cells from the time the infection starts. Eventually, the number of **CD4 cells drops below the threshold level needed to defend the body against infections (200 per mm³ of blood), and the person develops AIDS.**

Continued



- According to the World Health Organization (WHO), just under 40 million people worldwide are living with HIV. Survival has improved dramatically in developed countries. But that is not the case in many underdeveloped countries.
- <https://www.who.int/teams/global-hiv-hepatitis-and-sti-s-programmes/hiv/strategic-information/hiv-data-and-statistics>
- It is important for people infected with HIV to know their status so they can get medical treatment before AIDS develops and they can take steps to prevent passing the virus to someone else. In 2023, the WHO found only 86% of people were aware of their HIV status.

HIV Symptoms



- In its early stages, HIV infection often causes transient flu-like symptoms, such as fever, sore throat, rash, nausea and vomiting, diarrhea, fatigue, swollen lymph nodes, muscle aches, headaches, and joint pain. Doctors call this **acute HIV infection**.
- The symptoms of acute HIV can be mild. So, the person or doctor may attribute the symptoms to a routine cold or flu. However, sometimes people will describe acute HIV infection as the “Worst flu of their life”

HIV Symptoms



After the acute HIV infection symptoms have receded, the person now enters **the latent period/chronic HIV infection**.

This period can last a decade or longer, even without treatment, as the HIV virus is slowly replicating & killing off CD4 (Helper T) cells. If a person knows that they are positive, and starts the HAART medication regimen, this stage may last indefinitely.

Without treatment, the **viral load** (amount of virus) will continue to increase and the CD4 cells will continue to decrease, leading to reduced immunity & frequent infections, including **opportunistic infections** (infections by organisms that are unlikely to cause disease in healthy individuals). Many opportunistic infections are caused by fungi.

Development of AIDS



- Finally, with further decreases in the levels of CD4 cells, the person develops AIDS. For an HIV-infected person, some signs that AIDS has developed (known as AIDS-defining conditions) are:
 - **The CD4 cell count has decreased to fewer than 200 cells per cubic milliliter of blood.**
 - A severe opportunistic infection has developed, indicating that the immune system is severely weakened. These types of infections include: PCP pneumonia, Candida respiratory infections, Burkitt lymphoma & **Kaposi's sarcoma** (an otherwise incredibly rare form of cancer)

STAGES OF HIV INFECTION



1 ACUTE INFECTION:

During this time, large amounts of the virus are being produced in your body.

Many, but not all, people develop flu-like symptoms often described as the “worst flu ever.”

2 CLINICAL LATENCY:

During this stage of the disease, HIV reproduces at very low levels, although it is still active.

During this period, you may not have symptoms. With proper HIV treatment, people may live with clinical latency for several decades. Without treatment, this period lasts an average of 10 years, but some people may progress through this stage faster.

3 AIDS:

As your CD4 cells fall below 200 cells/mm³, you are considered to have progressed to AIDS.

Without treatment, people typically survive 3 years.

Diagnosis



- Doctors usually ask the patients about possible HIV risk factors, such as previous sexual partners, intravenous drug use, blood transfusion and occupational exposure to blood, such as accidentally being stuck by needles.
- If a person has been diagnosed with HIV by an **antibody test**, the doctor will order additional tests including a **viral load** and **CD4 cell count**.
- To diagnose people with acute HIV, a **viral load blood test** is needed, as they may not yet be producing a significant amount of antibodies.

Expected Duration



- HIV infection is a lifelong illness. There is no known cure for HIV. However, advances in treatment have changed the thinking about HIV as a fatal disease. Doctors now consider HIV a chronic condition that can be controlled with medications and healthy lifestyle choices.
- <https://youtu.be/hor8xLVpCg>
- <https://youtu.be/ng22Ucr3.3aw>

Prevention



- HIV infection can be passed from person to person in any of the following ways:
 - Unprotected sexual intercourse (heterosexual or homosexual and anal, vaginal or oral sex) with an infected person
 - A contaminated transfusion (extremely rare in the developed countries since 1985, when blood products started being tested for HIV)
 - Needle sharing (if one intravenous drug user is infected)
 - Occupational exposure (needle stick with infected blood)
 - Artificial insemination with infected semen
 - Organ transplant taken from an HIV-infected donor
 - Newborns can catch HIV infection from their mothers before or during birth or through breastfeeding.

Continued



- There is no evidence that HIV can be spread through the following: kissing; sharing food utensils, towels or bedding; swimming in pools; using toilet seats; using telephones; or having mosquito or other insect bites. Casual contact in the home, workplace or public spaces poses no risk of HIV transmission.
- Although several HIV vaccines are being tested, none has been yet approved. We can decrease our chances of being infected with HIV by avoiding high-risk behaviors

Continued



- **To decrease the risk of HIV infection:**
 - Have sex with only one partner at a time who is also committed to having sex with only you. Consider getting tested together for HIV.
 - Use condoms with each act of sexual intercourse.
 - If you use intravenous drugs or inject steroids, never share needles.
 - If you are a health care worker, strictly follow universal precautions (the established infection-control procedures to avoid contact with bodily fluids).
 - If you are a woman thinking about becoming pregnant, have a test for HIV beforehand, especially if you or your partner have a history of behaviors that could have put you at risk of HIV infection. Pregnant women who are HIV-positive need special prenatal care and medications to decrease the risk that HIV will pass to their newborn babies.
 - If you believe you may have been exposed to HIV (through sexual contact or through exposure to blood, such as through a needle containing infected blood), medications may help prevent HIV infection before it takes hold in the body. The medication should be taken as soon as possible but not more than 72 hours (3 days) after exposure.

Treatment



- Today, most experts recommend starting treatment immediately after the diagnosis is confirmed.
- The doctor will choose a combination of drugs called antiretrovirals to fight the HIV infection. To control the reproduction of HIV in the body, several medications must be used together, often called ***highly active antiretroviral therapy (HAART)***.
- These medications attack HIV at multiple points in its growth cycle and are more effective in suppressing the virus. Combining drugs also limits the risk that HIV will become resistant to drugs.

Prognosis



- The average time for HIV infection to progress to AIDS is 10 to 11 years for people who do not take antiretrovirals. In people with very high HIV viral load, AIDS may develop sooner (within 5 years after infection). Once HIV infection has progressed to AIDS, there is an increased risk of death that varies dramatically from person to person. For example, some people with AIDS have died shortly after they were diagnosed, whereas others have lived 12 years or more.
- Today, the life expectancy for many people with HIV is close to that of people that don't have the infection. The outlook is especially good for those who begin antiretrovirals at an early stage of the disease.
- The AIDS-related death rate in some parts of the developing world, however, remains staggeringly high due to lack of access to life-saving antiretrovirals.

Massage Therapy in HIV/AIDS



Massage therapy has shown benefits for people with HIV/AIDS, including increases in Natural Killer Cell activity and in CD4 & CD8 cell levels.

See Massage Therapy for HIV patients handout

Safety: You are not allowed to ask patients their HIV status on a standard intake form, although they may disclose their status to you. So treat all patients as if they may have HIV by upholding the highest standards of cleanliness and care.

The client's health is the primary concern - please reschedule if you are unwell.

Lymph Disorders



Lymphedema- swelling caused by damaged or missing lymphatic channels

1)Primary - Rare, congenital missing or deformed lymphatics.

2)Secondary - Damaged or removed lymphatic vessels - usually a consequence of surgery or radiation therapy. Can also be caused by ***Elephantiasis*** - a parasitic nematode transmitted by mosquito bites. It is endemic to tropical and subtropical areas.

Potential Complications-

Lymphangitis - a bacterial infection of the lymph vessels

Cellulitis - Bacterial infection of the skin & underlying tissue

Lymphedema



Edema



Edema is swelling caused by fluid trapped in your body's tissues, with no damage to the lymphatic system.

There are many different types of edema:

Generalized - affects most areas of the body

Localized - confined to a specific area or organ such as:
pulmonary edema (lungs), cerebral edema (brain)

Dependant - edema in gravity dependant areas such as ankles and feet when standing.

Ascites - abdominal swelling due to excessive fluid in the peritoneal cavity. Most common in advanced liver disease & cancer.

https://youtu.be/VToE_p_tcPc

Edema



FLUID IN PERITONEAL CAVITY [ASCITES]



**Edema (swelling) of
the ankles and feet**

Pitting vs Non-Pitting Edema



Non-pitting edema: No indentation is left in the tissue upon applying pressure.

Extracellular fluid is high in proteins and salts.

Causes: Hypothyroid or lymphatic conditions.

Treatments: address underlying conditions, elevation of limbs, compression stockings



Pitting Edema



Pitting Edema: an indentation is left behind when finger pressure is applied. This is because the edema fluid is mostly water. The degree of pitting can be graded as follows:

- 1+ Slight pitting of 2 mm
 - Rebounds rapidly (slight)
- 2+ Roughly 4 mm
 - Rebounds in few sec (mild)
- 3+ Roughly 6 mm
 - Rebounds in 10-20 sec (moderate)
- 4+ Very deep pit of 8 mm or deeper
 - Rebound in 20 sec to several min (severe)

Pitting Edema Cont.



Causes: many, ranging from mild to severe

Venous insufficiency- such as varicose veins or valve failure

Poor circulation- may be caused by inactivity, obesity, pregnancy, low protein levels

Nutritional causes - too much salt intake, deficiency of Vit B1

Medication side effects: Estrogens, Steroids, NSAIDs, etc

Kidney Disease

Congestive Heart Failure

Liver Disease

DVT - sudden onset, one-sided edema (usually of a limb)



Angioedema



Angioedema- a sudden fluid build up in the subcutaneous, dermal or submucosal layers of tissue. It is usually caused by exposure to an *allergen* and the body's subsequent release of *histamine* causing leaky blood vessels. It can be part of *anaphylaxis* and when the larynx & pharynx are involved, it can be fatal.

It most commonly affects the *eyes, lips and face*. It can also affect the *GI system and genitals*.

Non allergic types of angioedema can be: *drug-induced (esp. With ACE inhibitors and NSAIDs), hereditary (related to genes that affect complement response), or idiopathic*.

Treatment: immediate referral to emergency care, antihistamine, corticosteroids

Angioedema examples



Infectious Diseases - Unit 4



Source of Infection



- Infections are a significant problem that human beings have to face. They can affect the body in the most unpleasant ways and they also have a multitude of causes, some of the completely uncontrollable.
- In many parts of the world, infections are a huge problem.
- Infections can be of numerous types, mostly depending on the most common sources of infection.
- Infections may be asymptomatic infections while other symptoms are obvious.
- Knowing which the sources of infections are, can help you protect yourself better and avoid exposure as much as possible.
- <https://youtu.be/9axOFtPqSoc>

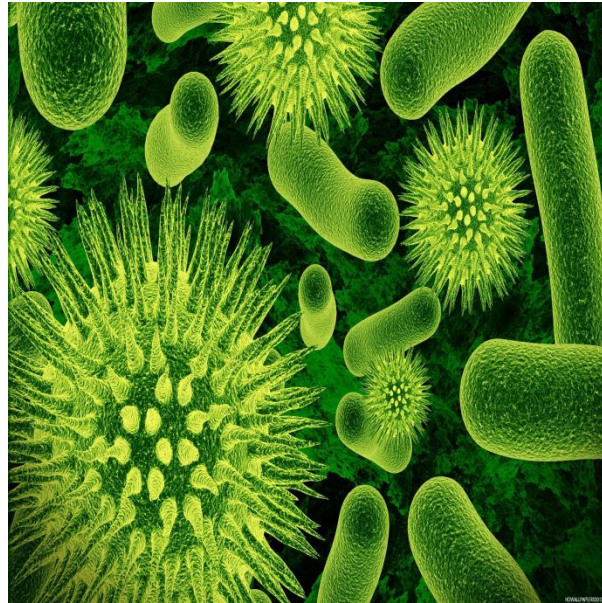
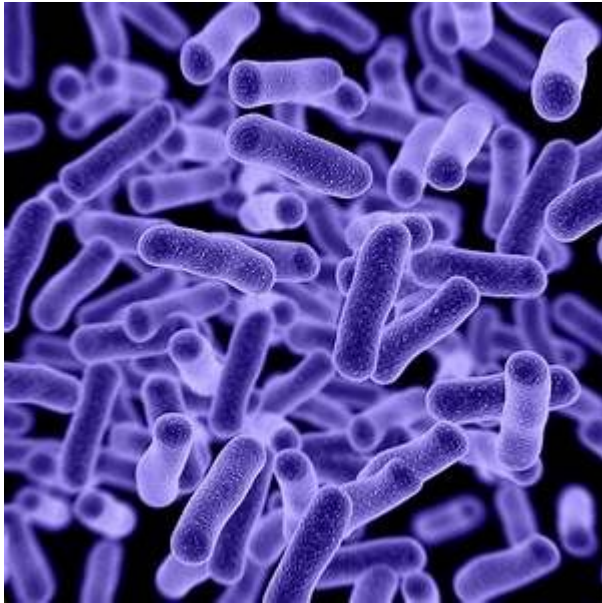
Infectious Disease as Cause of Death



In 2019, 13·7 million people worldwide died from infectious syndromes, 5·2 million of which co-occurred with non-communicable diseases. 3 million of these deaths occurred in children under the age of 5 years. Globally, respiratory infections and bloodstream infections are the deadliest. Regional disparities are stark, with a death rate of 52·6 per 100 000 for bloodstream infections in sub-Saharan Africa, compared with 37·7 per 100 000 in high-income countries. The burden varies across age groups: adults aged 50–69 years face the highest burden from bloodstream infections, whereas children under the age of 5 years are most burdened by respiratory infections. - The Lancet

<https://ourworldindata.org/causes-of-death#all-charts>

Agents of infectious Disease



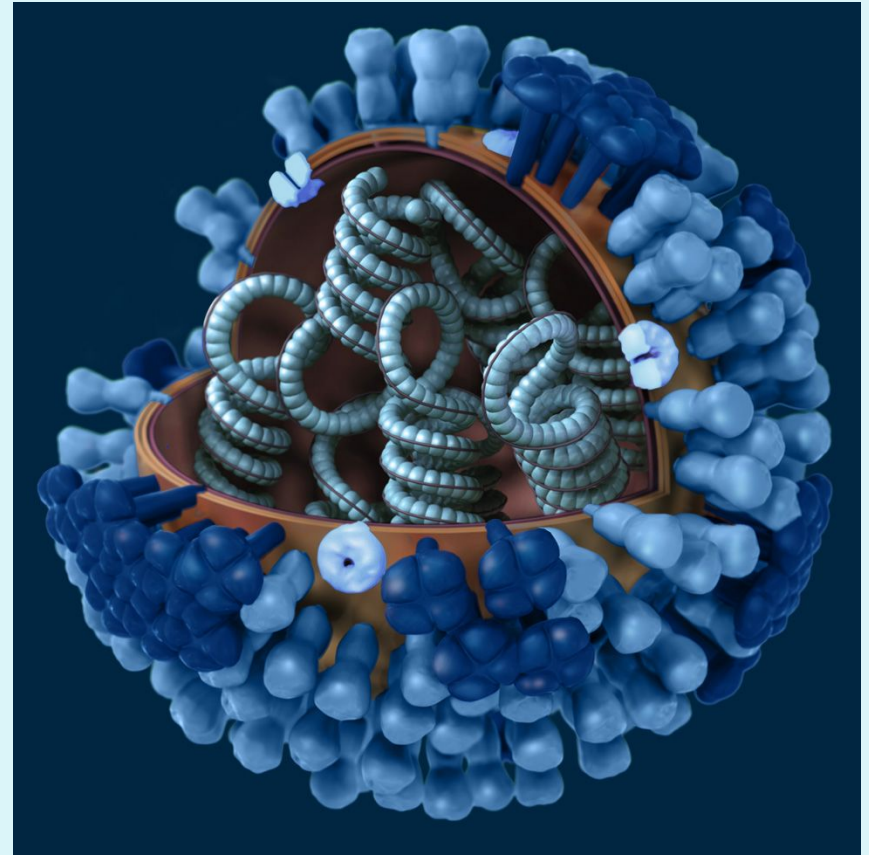
Agents of Infectious Disease



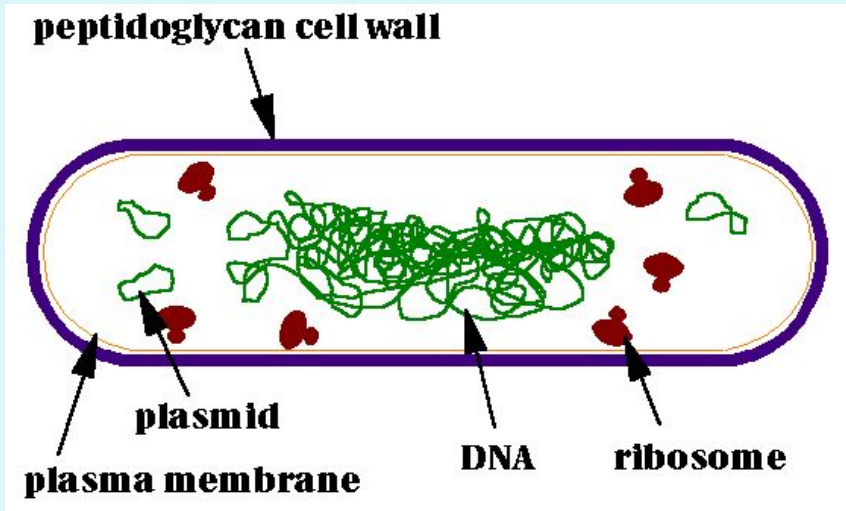
- Viruses
- Bacteria incl. Rickettsia
- Fungi
- Parasites
 - - Protozoa
 - - Worms/Helminths

Viruses

- Smallest pathogens
- Have no organized cellular structure
- Consist of a protein coat surrounding a nucleic acid core of DNA or RNA
- Are incapable of replication outside a living cell
- Don't respond to antibiotics.



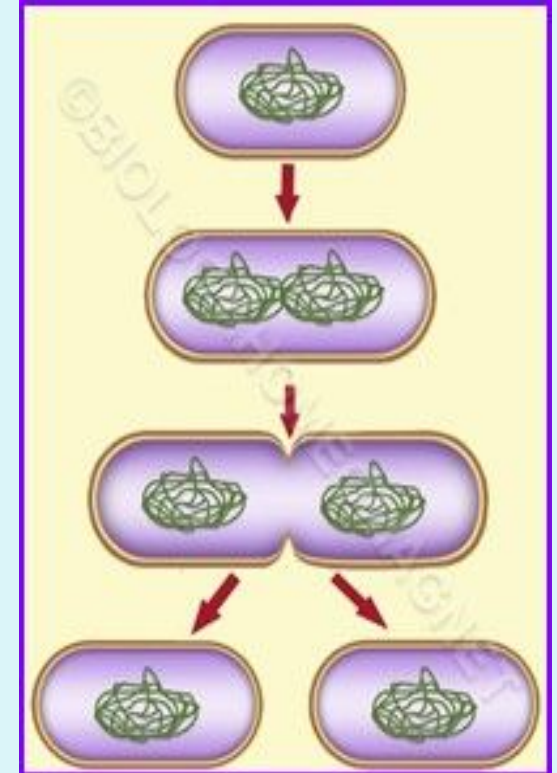
Bacteria



- microscopic single-celled organisms that thrive in diverse environments
- entire organism consists of a single cell with a simple internal structure.
- lack membrane-bound organelles
- contain ribosomes
- bacterial cells are generally surrounded by two protective coverings: an outer cell wall and an inner cell membrane. However, certain bacteria, like the mycoplasmas do not have a cell wall at all. Some bacteria may even have a third, outermost, protective layer called the capsule
- bacterial surfaces can be covered by whip-like extensions: flagella or pili

Bacterial Reproduction

- Most bacteria multiply by a process called **binary fission**. A single bacterial cell, the "parent," makes a copy of its DNA and grows large in size by doubling its cellular content. The doubled contents are pushed out to either end of the cell. Then a small fissure emerges at the center of the parent, eventually splitting it into two identical "daughter" cells.



Rickettsia

- Rickettsia are strictly intracellular (Gram –ve) bacteria
- These bacteria multiply by binary fission in the cytoplasm of eukaryotic host cells
- Transmitted by the bite of infected lice or fleas or feces of infected lice/fleas
- Rocky mountain spotted fever spread by tick
- https://youtu.be/frdd_AvA5lo



Gram –ve vs Gram +ve Bacteria



- Bacteria react to the Gram stain differently based upon what their cell walls are made of.
- **Gram +ve bacteria** have thick cell walls made of peptidoglycan (proteins & starch)
 - they will **stain purple**
 - They can release Exotoxins which can have devastating effects
eg. Staph aureus, Anthrax, Clostridium botulinum, Clostridium tetani, Strep.mutans, Lactobacillus acidophilus
- **Gram –ve bacteria** have thinner cell walls made with more lipopolysaccharides (fats & starches)
 - They will **stain pink**
 - More resistant to antibodies
 - Release Endotoxins upon cell death leading to fever, chills, & muscle aches or possibly DIC
 - Eg. Escheria coli, Chlamydia trachomatis, Yersinia pestis, Neisseria gonorrhoeae

FYI: Gram + vs Gram -



Fungi



Fungi as Infectious Agents

- Molds and yeasts are widely distributed in air, dust, fomites, and normal flora
- Humans are relatively resistant
- Fungi are relatively nonpathogenic
- Of the 100,000 fungal species, only 300 have been linked to disease in animals
- Fungi are the most common plant pathogens
- Human **mycoses** are caused by true fungal pathogens and opportunistic pathogens

Fungi - Opportunistic



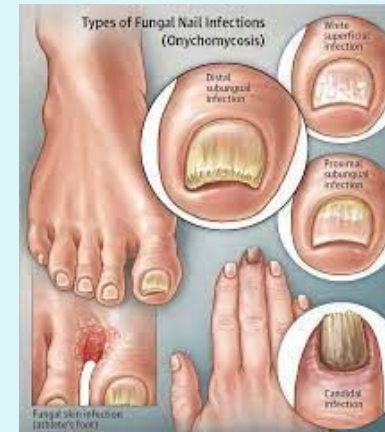
- Although **fungal diseases (mycoses)** are relatively rare in humans, we are prone to opportunistic infections from *Candida* and *Tinea*.
- *Candida albicans* is a normal part of our gut flora, it is present in the mouth, throat & vaginal environments. It is also present on our skin, esp. in warm, moist areas such as the underarm. When it overgrows, it's responsible for **thrush** – a candida infection of the mouth & throat, more common in babies and children. Also responsible for **vaginal yeast infections & skin yeast infections (heat rash)**, esp. in any folds of skin.



Fungal - opportunistic



Tinea spp. are fungal varieties that cause skin infections of various areas. ***Tinea pedis*** is athlete's foot, ***Tinea unguium*** is a nail infection, ***Tinea cruris*** causes jock itch & ***Tinea corporis*** is ringworm.



Topical or oral antifungal medications such as fluconazole/Diflucan, nystatin, & miconazole (Monistat) are usually effective treatments, although these infections may reoccur & may take a while to resolve.

Parasites- Helminths (AKA Nematodes/Worms)



- **A parasite is any organism that lives and feeds off of another organism**
- Some examples of **helminth** parasites include roundworms, tapeworms, pinworms, whipworms, hookworms, and more. Because parasites come in so many different shapes and sizes, they can cause a very wide range of problems. Some consume your food, leaving you hungry after every meal and unable to gain weight.
- Others feed off of your red blood cells, causing anemia. Some lay eggs that can cause itching, irritability, and even insomnia



<https://youtu.be/ABeBqbBy2Lo>

Parasites - Protozoa

- **Single cell organisms**
 - not all protozoa are parasitic.
 - **Amoeba:** move with pseudopods
 - **Flagellates:** move with a single tail like structure
 - **Ciliates** (move by beating multiple hair-like structures)
 - Can live in soil, water, moss. Can survive in resting cysts during dry periods.
 - Not all protozoa are parasites- about 1/3rd of protozoans are parasites
- -Cause serious disease that affects many people around the world –
 - African Trypanosomiasis “Sleeping Sickness”
 - Amoebic dysentery
 - **Toxoplasmosis**
<https://youtu.be/uOBwzK3BJ4>
 - **Giardia**
<https://youtu.be/jlvXtvWm80A?feature=shared>

Parasites - Protozoa

Malaria –

The *Anopheles* mosquito transmits the *Plasmodium* protozoa that causes malaria.

Symptoms of the disease will occur in humans about 10 - 15 days after the mosquito bite.

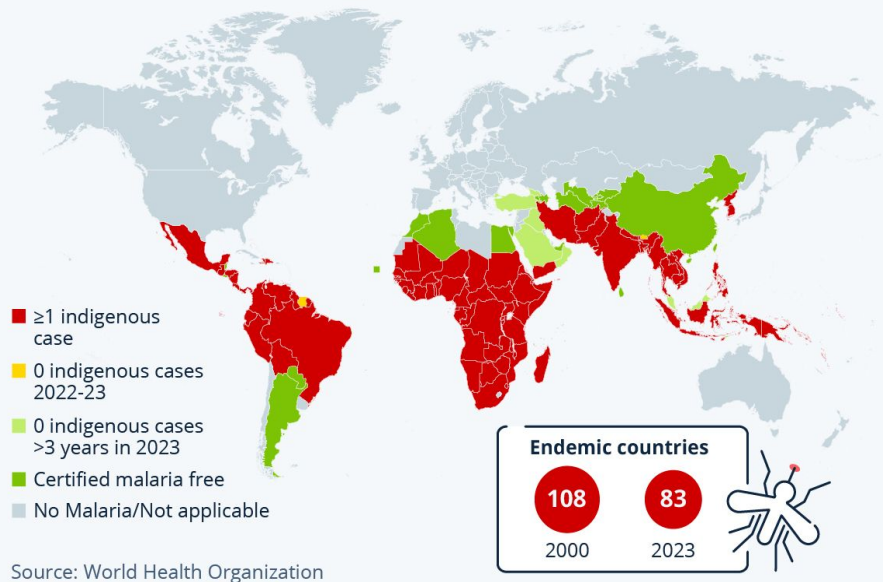
Symptoms include: high fever, fatigue, and headaches but it can progress to jaundice, seizures, coma and death

It remains a leading cause of death in sub-Saharan Africa. In 2023, there were 263 million cases and 597 000 deaths from malaria worldwide.

<https://youtu.be/qw6jnFqZ-Hk>

Malaria Is Still Endemic in 83 Countries

Status of indigenous malaria cases in 2023 in countries which had at least one case in 2000



Patterns and Defenses Against Infection



Infection - A Battle between Pathogen and Host



Just because a person comes in contact with a pathogen does not mean that they will become sick.

In general, whether or not a person develops an infection from pathogen depends on:

- 1)The strength of the person (host)'s immune system**
- 2)The amount of pathogens they are exposed to**
- 3)The route of entry - anything that bypasses the first line of defense is more problematic**
- 4)The pathogenicity of the organism**

In this section, we'll review the host's defenses to all pathogens & talk specifically about the things that make bacteria more pathogenic

Physical Barriers AKA the 1st Line of Defense



- Physical barriers are designed to keep microorganism from entering the body in the first place
- Physical barriers include
 - the skin
 - mucous membranes
 - tears
 - Earwax
 - mucus
 - stomach acid
 - normal flow of urine washes out microorganisms that enter the urinary tract

Physical Barriers/1st Line of Defense



- Usually, skin prevents invasion by microorganisms unless it is damaged by an injury, insect bite, or burn
- Mucous membranes, lining of the mouth, nose, and eyelids. Typically, mucous membranes are coated with secretions that fight microorganisms.
 - mucous membranes of the eyes are bathed in tears, contain an enzyme called lysozyme attacks bacteria and helps protect the eyes from infection.
- Airways filter out particles that are present in the air that is inhaled
 - Mucous coats linings particles stick to it and are expelled by coughing, sneezing blowing nose
 - Mucous removal is aided by cilia

Immune System - 1st line of defense



- Digestive tract barriers include
 - stomach acid
 - pancreatic enzymes
 - bile
 - intestinal secretions
- Contractions of the intestine (peristalsis) and the normal shedding of cells lining the intestine help remove harmful microorganisms.
- Bladder is protected by the urethra
 - In males older than 6 months, the urethra is long enough that bacteria, unless the bacteria are unintentionally placed there by catheters or surgical instruments
 - females, the urethra is shorter, occasionally allowing external bacteria to pass into the bladder
- In both sexes, when the bladder empties, it flushes out any bacteria that reach it.

IMMUNE RESPONSE - Second & Third Lines of Defense



- If a pathogen is able to get past the physical, chemical and reflex barriers of the first line of defense, we have many other components to help us resist.
- The second line of defense consists of: Phagocytic cells, protective proteins, fever, inflammation and Natural Killer Cells.
- After a couple of days, the Adaptive Immune response kicks in and T lymphocytes target foreign invaders with toxins and B lymphocytes produce antibodies.

Host Susceptibility

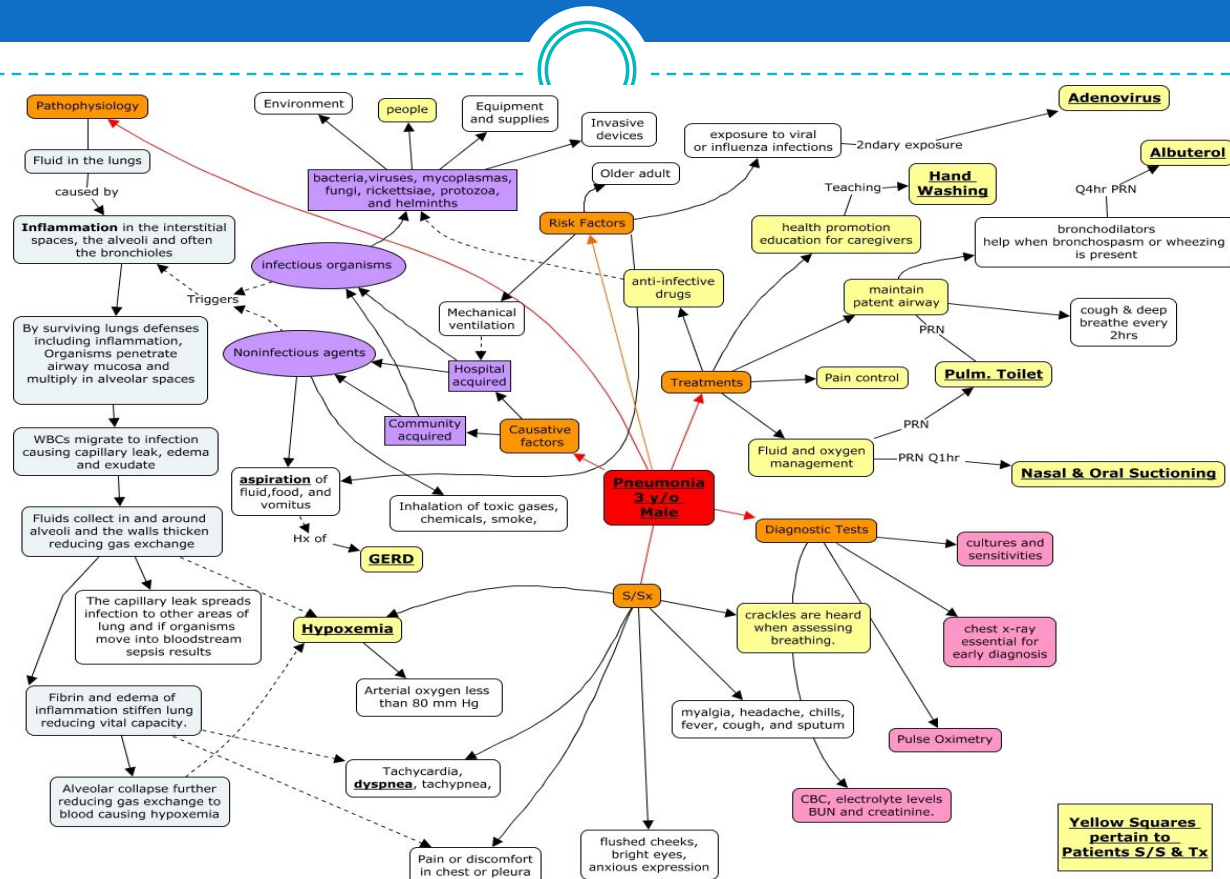


- Susceptibility to bacterial infections depends on the physiologic and immunologic condition of the host and on the virulence of the pathogen.
- The normal bacterial flora of the skin and mucosal surfaces also serves to protect the host against colonization by bacterial and fungal pathogens.
- Development of effective specific immunity (such as an antibody response to the bacterium) may require several weeks upon first exposure, so we rely on our first and second lines of defense to prevent a pathogen from taking hold.
- In most healthy individuals, pathogens that occasionally penetrate the body are cleared by the host's immune system. In contrast, individuals with defective immune responses are prone to frequent, recurrent infections with even the least virulent bacteria. The best-known example is HIV/AIDS patients

HOST RESISTANCE MECHANISMS

- Resistance mechanisms can be altered by many other processes. For example
 - **Aging** - weakens both nonspecific and specific defense systems so that they can no longer effectively combat the challenge of bacteria from the environment.
 - **Infants** - adaptive immune systems are not yet fully developed and cannot mount a protective immune response to important bacterial antigens.
 - **Genetic defects** of the complement system or cellular defenses.
 - **Granulocytopenia** - result of a predisposing disease, such as cancer, or immunosuppressive chemotherapy for organ transplants or cancer.
 - **Trauma** ex. Deep wounds, burns & **Underlying diseases** ex cystic fibrosis - which affects ciliary function & makes you more vulnerable to respirat
 - **Contact with a vector** (tick – Lyme Disease) OR anything else that allows the pathogen to bypass the first line of defense such as IV exposure.

Pathogenesis of Bacterial Infections



Pathogenesis of Bacterial Infections



- Infection is the invasion of the host by microorganisms, which then multiply in close association with the host's tissues.
- Infection is distinguished from disease (diabetes)
- Bacteria can cause a multitude of different infections, ranging in severity from unapparent to worsening quickly.
- The capacity of a bacterium to cause disease reflects its relative **pathogenicity**.

BACTERIA



- Bacteria can be organized into three major groups.
 - **Frank or primary pathogens** - considered probable agents of disease (e.g., when exposed to the Salmonella bacteria, many will develop food poisoning)
 - **Opportunistic pathogens** - these bacteria usually do not cause disease in a healthy host, but may when a host's defense mechanisms have been compromised. They may be the agents of disease (e.g., in patients who have been predisposed to urinary tract infections with Escherichia coli by catheterization).
 - **Nonpathogens** - such as Lactobacillus acidophilus, rarely or never cause human disease. Their categorization as nonpathogens may change, however, because of the adaptability of bacteria.

Virulence



- **Virulence** is a pathogen's ability to cause damage to a host.
- it is affected by numerous variables
 - number of infecting pathogens
 - route of entry into the body
 - Factors used to adhere & promote colonization
 - Ability to evade immune defenses – passively or actively
 - Bacterial toxins
- **ID₅₀** – the number of organisms required for 50% of the population to show signs of infection
- **LD₅₀** – the number of organisms needed to kill 50% of a population
- **Therefore, the lower an organism's ID₅₀ and LD₅₀ are the more *virulent* it is.**

Virulence Factors



- Factors that are produced by a microorganism and evoke disease are called virulence factors.
- **1) Avoiding or Compromising Host Defenses**
 - Passive – Bacterial Cell Walls/Capsules
 - Active- Enzymes such as Leukocidins, Hemolysins, , Coagulase
- **2) Establishment** – Pathogens use fimbriae, adhesin proteins, biofilm production or bore into the tissue (eg Treponema bacteria that causes syphilis)

<https://youtu.be/twxPyvdc-EE?feature=shared>

ENDOTOXINS & EXOTOXINS



- 3) Bacterial Toxins –
 - **EXOTOXINS**- Usually produced by Gram + Bacteria
 - Can be quite lethal.
 - **Neurotoxins**- affect nerves <https://youtu.be/yaqpoNi5dog>
 - **Enterotoxins**- affect lining of digestive system <https://youtu.be/U7yq-GwbcgE>
 - **Cytotoxins** – kill cells
 - Ex. Anthrax, Botulinum, Tetanus,, E.coli, Vibrio (Cholera)

ENDOTOXINS – Usually produced by Gram – bacteria
-released by bacterial cell walls at cell death – Usually not as severe as Exotoxins
- Cause chills, fever, muscle weakness & aches
- Worst case – ***DIC Disseminated Intravascular Clotting***
<https://youtu.be/Gmh01SomsfY>

Treatments



- Drugs have been developed to treat bacterial infections.
- Antimicrobial agents are most effective when the infection is also being fought by healthy phagocytic and immune defenses.
- Some reasons for this situation are
 - poor diffusion of antibiotics into certain sites (prostate gland)
 - ability of many bacteria to multiply or survive inside cells (where many antimicrobial agents have little or no effect)
 - bacteriostatic rather than bactericidal action of some drugs, and the capacity of some organisms to develop resistance to multiple antibiotics.

Antibiotic Resistance



- MRSA & other Antibiotic Resistant Bacteria are the result of decades of often unnecessary antibiotic use.
- Antibiotics have been prescribed for colds, flu and other viral infections that don't respond to these drugs.
- When antibiotics are used inappropriately, they contribute to the rise of drug-resistant bacteria because they don't destroy every germ they target.
- Bacteria live on an evolutionary fast track, so germs that survive treatment with one antibiotic soon learn to resist
- <https://youtu.be/ZvhFeGEDFC8>

Spread of Infection



How infection Spreads



- **Direct:** Direct physical contact (body surface to body surface) between infected or colonized individual and susceptible host. Examples of transmission: Shaking hands; kissing; coitus. Examples of infections: Common cold; sexually transmitted diseases. Precautions: Hand hygiene; masks; condoms.
- **Indirect:** infectious agent deposited onto an object or surface and survives long enough to transfer to another person who subsequently touches the object (fomite). Examples of transmission: **Not washing your hands between patients;** contaminated instruments Examples of infections: Norwalk; rhinovirus; perhaps influenza. Precautions: Sterilizing instruments; disinfect surfaces and toys in school
- **Droplet:** Contact, but transmission is through the air. Examples of transmission: Sneezing & coughing. Examples of infections: Meningococcus; pertussis; influenza (maybe: there is some debate); respiratory viruses. Precautions: Masks; cover mouth.

Continued



- ***Airborne***: Transmission via aerosols (airborne particles $<5\mu\text{m}$) that contain organisms in droplet nuclei or in dusts. Can be spread via ventilation systems. Examples of transmission: Via ventilation system in a hospital; Examples of infections: TB; varicella; measles; chickenpox; smallpox (and maybe influenza: controversial, as more likely via droplets). Precautions: Masks; negative pressure rooms in hospitals
- ***Vehicle***: A single contaminated source spreads the infection (or poison) to multiple hosts. This can be a common source or a point source. Examples of transmission : Food-borne outbreak from infected batch of food; IV fluid; medical equipment. Precautions: Normal safety and disinfection standards.
- ***Vector borne***: Transmission by insect or animal vectors. Example of infections: Mosquitoes and malaria. Precautions: Protect via barriers (window screens, bed nets); insect sprays.

How Infections Spread



- **Blood borne Infections**
- Many health care workers have risk to exposure to bloodborne pathogens.
- Direct contact of infected patient blood with skin cut in hands can be potential source of transmission.
- Accidental needle pricks with infected blood can also be a mode transmission.
- Examples of Blood Borne Infections:
 - Hepatitis B virus
 - Hepatitis C
 - HIV

How Infections Spread - Sexually Transmitted Infections (STIs)

- Many diseases can be sexually transmitted by infected persons to their partners.
- Examples
 - Gonorrhea
 - Chlamydia
 - Hepatitis C, Hepatitis B
 - HIV (Human immunodeficiency virus)
 - HPV (Human Papillomavirus)
 - HSV (Herpes Simplex Virus II)
 - Trichomoniasis

Sexually Transmitted Infections - Syphilis



Syphilis - caused by the bacterium *Treponema palladium*, which has a unique corkscrew shape and action.

It is an ancient disease, with archeological evidence dating back nearly 10, 000 years. It has infected or caused the death of many historical figures, including: the pirate Blackbeard, Author Leo Tolstoy, German philosopher Nietzsche, Dracula author Bram Stoker and gangster Al Capone.

There are four stages:

Primary - One or more painless sores called a **Chancres** develops at the site of infection 1 - 12 weeks exposure & the person is very contagious.

Secondary- Lymph nodes swell and a rash develops on the soles and palms. Still very contagious.

Latent: Syphilis is still present, but symptoms are not too noticeable. May be spread, but not as contagious. May last years - decades.

Tertiary: Severe damage occurs to the heart, blood vessels and brain, causing severe symptoms including dementia. Fatal without treatment.

Syphilis in History:

<https://youtu.be/gnwKRHBiWb4?feature=shared>

<https://youtu.be/fdjBBGJvem0?feature=shared>

Endogenous vs Exogenous Infections



- The **source of infection** is the origin from which a host acquires the infection
- sources of infection can be classified as endogenous and exogenous.
- **Endogenous** infections, the agent causing the problem comes from the human body. Some of the microorganisms living there exceed their limits and start causing damage. This might happen because the immunity is compromised and it is very common in patients who have had surgery or in undernourished people.
- **Exogenous** sources of infections imply the fact that microorganisms from outside the human body find their way inside and cause illnesses or diseases, usually the source can be identified as an individual, animal environmental or object in a specific place, and at a specific time.
- <https://youtu.be/JYRkXhT1XEs>

Direct Contact



- Some diseases can be transmitted via direct contact with infected patients. **Varicella zoster** (chicken pox, shingles) can be transmitted via direct contact with ruptured vesicles containing active virus.
- Erysipelas (intradermal pyogenes infection) can be transmitted by touching the infected skin of patient with bare hands.
- This can also cause self-inoculation to distant sites which causes spread of the infection to other places of the body (Autoinfection)

<https://youtu.be/GWAQjaCoVGw>

Fecal-Oral Transmission



- Food borne disease are usually transmitted via contamination of drinking water or food with feces (either by people not washing their hands before preparing food, or untreated sewage being released into a drinking water supply) and the people who eat and drink them become infected.
- In developing countries most sewage is discharged into the environment or on cropland; even in developed countries there are periodic system failures resulting in a sewer overflow.
- This is the typical mode of transmission for the infectious agents of **Cholera, Hepatitis A, Polio, Salmonella, Shigella** and *Campylobacter jejuni*.

Animal as source of infection



- They cause infections similar way to man. Diseases that can be transmitted from animals to man are called zoonosis
- Example: Anthrax, Salmonella, Toxoplasmosis, Plague, Rabies <https://youtu.be/tMORbU5c3Y?feature=shared>
- **Reservoir of infection:** Any person, animal, plant, soil or substance in which an infectious agent normally lives and multiplies. The reservoir typically harbors the infectious agent without injury to itself and serves as a source from which other individuals can be infected
- Reservoir: Sheep, goat, ducks, pigeons, cats, deer, rodents

Environment as a Source



- Pathogens may be found in many aspects of the environment, such as soil and water.
 - Examples are:
 - ***amoeba parasites*** such as those causing dysentery and the “brain-eating” amoeba,
 - ***Helminth parasites*** such as hookworms and round worms.
 - ***Mycobacterium tuberculosis***, the bacteria that cause Tuberculosis, which can remain viable in the soil and water for an extended period.
 - ***Legionella pneumophila*** can be found in warm water systems, such as showers, cooling towers and humidifiers. Stagnant water especially in dead end pipes provides amplification sites for organism.
- Legionnaires disease** (a type of “walking” pneumonia) outbreaks have occurred in some hospitals and hotels.

Objects as source of infection



- Objects may be sources of infection; food, water, air-conditioning systems, showers, medical instruments, recreational waters, door knobs, cotton handkerchiefs ...etc.
- ***Fomite***- *Objects or materials which can carry infectious agents from one host to a new host, such as: splinters, door knobs, barbed wire, clothes, needles, utensils, phones, bedding, etc.*
- How long a pathogen can survive on a surface is variable. Research has shown influenza virus can be active on stainless steel 24 hours after exposure. Porous surfaces (cloth, paper) are more likely to be fomites of long duration because their fibers will hold on to the pathogen.
- Most man-made products that may be sources of infection are required to be produced while limiting the risk of contamination such as medical equipment.
- In most outbreak investigations, the principal objective is to identify the source of the infection. Source of infection should be distinguished from source of contamination (e.g. overflow of a septic tank, contaminating a water supply).

Person as source of Infection



- A person can be the source of infection in the following stages:
 - During the **incubation period** of a disease- in some infections the agent is secreted during the incubation period this is important as the infection is usually not known (e.g. Hep A and B)
 - **Sick man**- the majority of infections spread when a person is exhibiting clinical symptoms
 - **Convalescent** – secretion of agents occurs during convalescence (gradual recovery of health and strength after illness) i.e. as in pertussis
 - **Carriers**- short term (salmonella), long term (typhoid fever) or intermittent (secretions at certain periods)
[HTTPS://YOUTU.BE/THLZPWJMK7M](https://youtu.be/THLZPWJMK7M) (**Typhoid Mary**)

Cholera & the Start of Epidemiology and Public Health



**THE STORY OF CHOLERA & THE BEGINNINGS OF
EPIDEMIOLOGY:**

[HTTPS://YOUTU.BE/TLPZHBBFRHY](https://youtu.be/TLPZHBBFRHY)

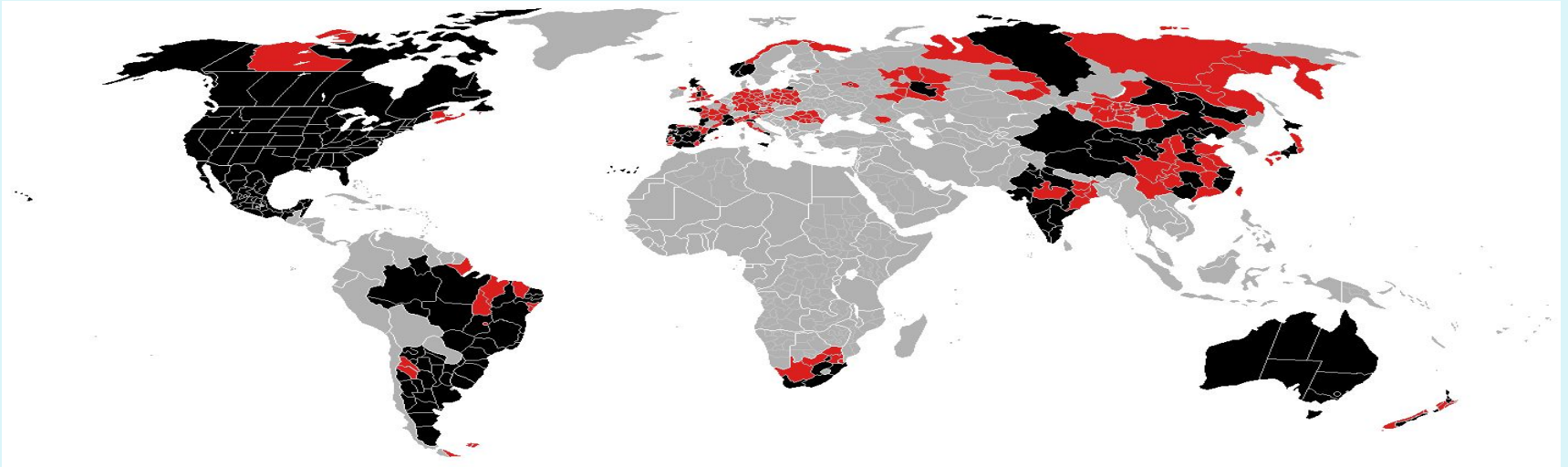
[HTTPS://YOUTU.BE/1JLSYUCUWPO](https://youtu.be/1JLSYUCUWPO)

[HTTPS://YOUTU.BE/9NVT6IZP2QG](https://youtu.be/9NVT6IZP2QG)

“Demics”



- Endemic: found in a particular geographic region
- Epidemic: abrupt and unexpected increase in the incidence of disease over endemic rates
- Pandemic: spread of disease beyond continental boundaries



Infections



"Let me guess...it's contagious!"

Stories of Disease



THE PLAGUE:

[HTTPS:YOUTU.BE/MYNMXECHI7U](https://youtu.be/MYNMXECHI7U)

TUBERCULOSIS:

<https://youtu.be/6P6zBHpWiGA?feature=shared>

HEPATITIS FORMS:

[HTTPS://YOUTU.BE/MVXMJGFPP6W](https://youtu.be/MVXMJGFPP6W)

HOW COVID 19 WORKS: [HTTPS://YOUTU.BE/5DGWOJXSXQG](https://youtu.be/5DGWOJXSXQG)

How to tell cold from influenza or “flu”



IN GENERAL, A FLU COMES ON FASTER & IS MORE OF A “FULL-BODY” SET OF SYMPTOMS

- COLDS CAUSED BY RHINOVIRUSES, CORONAVIRUSES
 - - INFLUENZA CAUSED BY INFLUENZA VIRUS:
 - A : VARIETIES CAUSE SEASONAL FLUS & PANDEMICS SUCH AS H1N1
 - B: SEASONAL FLUS, Milder ILLNESSES
- C & D: LESS COMMON, LESS SEVERE

IS IT A COLD OR FLU?

SIGNS AND SYMPTOMS	COLD	FLU
Symptom onset	Gradual	Abrupt
Fever	Rare	Usual
Aches	Slight	Usual
Chills	Uncommon	Fairly common
Fatigue, weakness	Sometimes	Usual
Sneezing	Common	Sometimes
Chest discomfort, cough	Mild to moderate	Common
Stuffy nose	Common	Sometimes
Sore throat	Common	Sometimes
Headache	Rare	Common

#FIGHT FLU

COVID & Coronaviruses



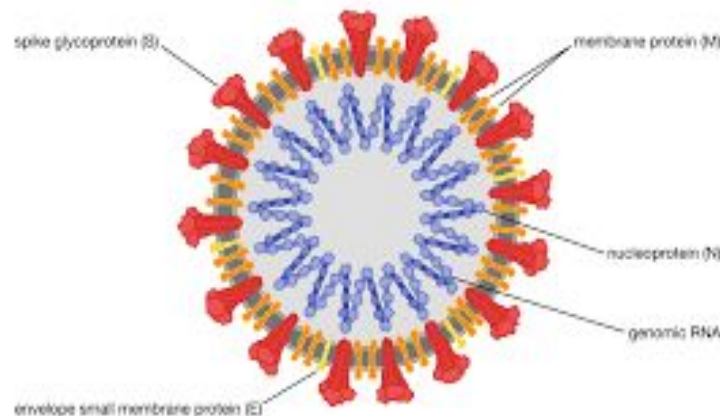
- Coronaviruses are RNA Viruses
- 7 human Coronaviruses have been discovered so far
 - Range from mild to severe

- <https://youtu.be/D9tTi-CDjDU>

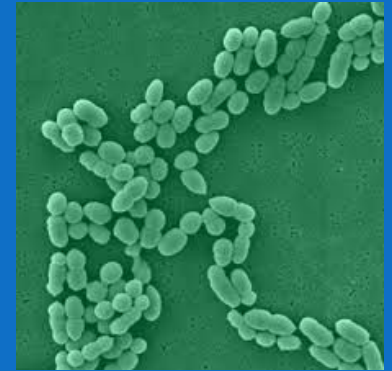
- mRNA Vaccine Development:

- <https://youtu.be/XPeeCyJReZw>

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)



Streptococcus



GRAM +VE COCCI (SPHERES)

-LIVE ON BODY, IN MOUTH, NOSE & THROAT

-S.MUTANS ASSOC. WITH TOOTH DECAY, CAVITIES

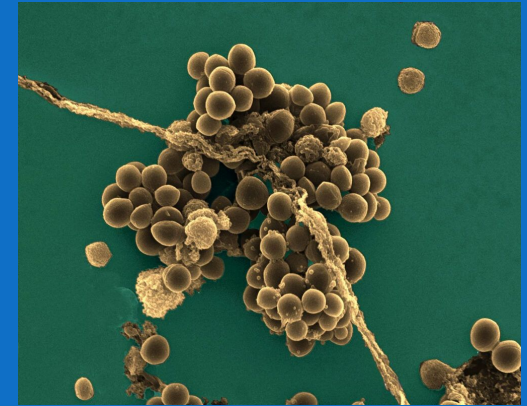
GROUP A STREP CAN CAUSE STREP THROAT

**USU. MORE PAINFUL THAN TYPICAL SORE THROAT, ENLARGED LYMPH
NODES, WHITE PATCHES ON TONSILS/THROAT. CAN BE DIAGNOSED
WITH A RAPID STREP TEST**

**SERIOUS POTENTIAL COMPLICATIONS OF STREP:
MENINGITIS, RHEUMATIC FEVER (CAN AFFECT JOINTS
OR HEART VALVES), KIDNEY DAMAGE**

[HTTPS://YOUTU.BE/ATCSWZFAWT4](https://youtu.be/atcswzfaWT4)

Staphylococcus aureus



- GRAM +VE**
- ROUND SHAPED (COCCI)**
- FOUND ON HUMAN SKIN: ARMPITS, GROIN AND IN THE NOSE**
- CAN CAUSE FOLLICULITIS, IMPETIGO, MIDDLE EAR INFECTIONS, MASTITIS (MILK DUCTS)**
- CAN ALSO BE RESPONSIBLE FOR MORE SERIOUS INFECTIONS: PNEUMONIA, SEPTIC ARTHRITIS, TOXIC SHOCK SYNDROME**

[HTTPS://YOUTU.BE/DKWFVQoQHHS](https://youtu.be/DKWFVQoQHHS)

Antibiotic Resistant Infections



Antibiotic resistance occurs when bacteria evolve mechanisms to survive exposure to antibiotics, rendering the drugs ineffective. This is a natural process that can be accelerated by the overuse and misuse of antibiotics. Resistant bacteria can make infections harder to treat, leading to longer illnesses, increased healthcare costs, and even death.

Key aspects of antibiotic resistance:

Natural process:

Bacteria can naturally develop resistance to antibiotics through mutations or by acquiring resistance genes from other bacteria.

Overuse and misuse:

The inappropriate use of antibiotics, such as taking them for viral infections or not completing the full course of treatment, contributes significantly to resistance.

Spread of resistance:

Resistant bacteria can spread from person to person, through contaminated food or water, or via contact with infected surfaces.

Consequences:

Antibiotic resistance can lead to longer illnesses, more complex treatments, increased healthcare costs, and higher mortality rates

Ex. MRSA, MRSE, VISA, VRSE

MRSA Infections



- Methicillin-resistant Staphylococcus aureus (MRSA) infection
 - caused by a strain of staph bacteria that's become resistant to many antibiotics
- Most MRSA infections occur in people who've been in hospitals or other health care settings. it's known as **health care-associated MRSA (HA-MRSA)**.
 - associated with invasive procedures or devices, such as surgeries, intravenous tubing or artificial joints.
- Another type of MRSA infection has occurred in the wider community — among healthy people. **Community-associated MRSA (CA-MRSA)**, often begins as a painful skin boil. It's spread by skin-to-skin contact.

Symptoms



- Generally start as small red bumps that resemble pimples, boils or spider bites
- Can quickly turn into deep, painful abscesses that require surgical draining
- Bacteria can remain confined to the skin, can also burrow deep into the body, causing potentially life-threatening infections in bones, joints, surgical wounds, the bloodstream, heart valves and lungs
- Warm to the touch
- Full of pus or other drainage
- Accompanied by a fever

<https://youtu.be/qC tkzz2Yak>

Cause



- Different varieties of Staphylococcus aureus bacteria, commonly called "staph," exist. Staph bacteria are normally found on the skin or in the nose of about one-third of the population. The bacteria are generally harmless unless they enter the body through a cut or other wound, and even then they usually cause only minor skin problems in healthy people.
- According to the CDC, **less than 2 percent** of the population carries the type of staph bacteria known as MRSA.

Risk factors for HA-MRSA



- Being hospitalized. MRSA remains a concern in hospitals, where it can attack those most vulnerable — older adults and people with weakened immune systems.
- Having an invasive medical device. Medical tubing — such as intravenous lines or urinary catheters — can provide a pathway for MRSA to travel into the body.
- Residing in a long-term care facility. MRSA is prevalent in nursing homes. Carriers of MRSA have the ability to spread it, even if they're not sick themselves.

Risk factors for CA-MRSA



- IV Drug Use/ Needle Sharing
- Living in crowded or unsanitary conditions. Outbreaks of MRSA have occurred in military training camps, child care centers and jails.
- Participating in contact sports. MRSA can spread easily through cuts and abrasions and skin-to-skin contact.

Complications



- MRSA infections can resist the effects of many common antibiotics, so they are more difficult to treat. This can allow the infections to spread and sometimes become life-threatening.
- MRSA infections may affect the:
 - Bloodstream
 - Lungs
 - Heart
 - Bones
 - Joints

Preventing HA-MRSA




- In the hospital, people who are infected or colonized with MRSA often are placed in isolation as a precaution to prevent the spread of MRSA. Visitors and health care workers caring for people in isolation may be required to wear protective garments and must follow strict hand hygiene procedures. Contaminated surfaces and laundry items should be properly disinfected.

Preventing CA-MRSA



- Wash hands. Careful hand-washing remains the best defense against germs. Scrub hands briskly for at least 15 seconds, then dry them with a disposable towel and use another towel to turn off the faucet. Carry a small bottle of hand sanitizer containing at least 62 percent alcohol for times when you don't have access to soap and water.
- Keep wounds covered. Keep cuts and abrasions clean and covered with sterile, dry bandages until they heal. The pus from infected sores may contain MRSA, and keeping wounds covered will help keep the bacteria from spreading.
- Keep personal items personal. Avoid sharing personal items such as towels, sheets, razors, clothing and athletic equipment. MRSA spreads on contaminated objects as well as through direct contact.
- Shower after athletic games or practices. Shower immediately after each game or practice. Use soap and water. Don't share towels.
- Sanitize linens. If you have a cut or sore, wash towels and bed linens in a washing machine set to the hottest water setting (with added bleach, if possible) and dry them in a hot dryer. Wash gym and athletic clothes after each wearing.
- <https://youtu.be/F-aqHhXeipo>

Vancomycin-resistant Staph aureus/Vancomycin intermediate Staph aureus (VRSA/VISA)



- Vancomycin intermediate Staphylococcus aureus (also called VISA) and Vancomycin-resistant Staphylococcus aureus (also called VRSA) are specific types of antimicrobial-resistant bacteria. Persons who develop this type of staph infection may have underlying health conditions (such as diabetes and kidney disease), tubes going into their bodies (such as catheters), previous infections with methicillin-resistant Staphylococcus aureus (MRSA) and recent exposure to vancomycin and other antimicrobial agents.

Helicobacter Pylori



- (H. pylori) is a type of bacteria. These germs can enter your body and live in your digestive tract. After many years, they can cause sores, called ulcers, in the lining of the stomach or the upper part of the small intestine. For some people, an infection can lead to stomach cancer.
- Infection with H. pylori is common. About two-thirds of the world's population has it in their bodies. For most people, it doesn't cause ulcers or any other symptoms. There are medicines that can kill the germs and help sores heal.
- As more of the world gets access to clean water and sanitation, fewer people than before are getting the bacteria. With good health habits, we can protect ourselves and our children from H. pylori.
- <https://youtu.be/HO9sAUctPEI>

How H. pylori Makes You Sick

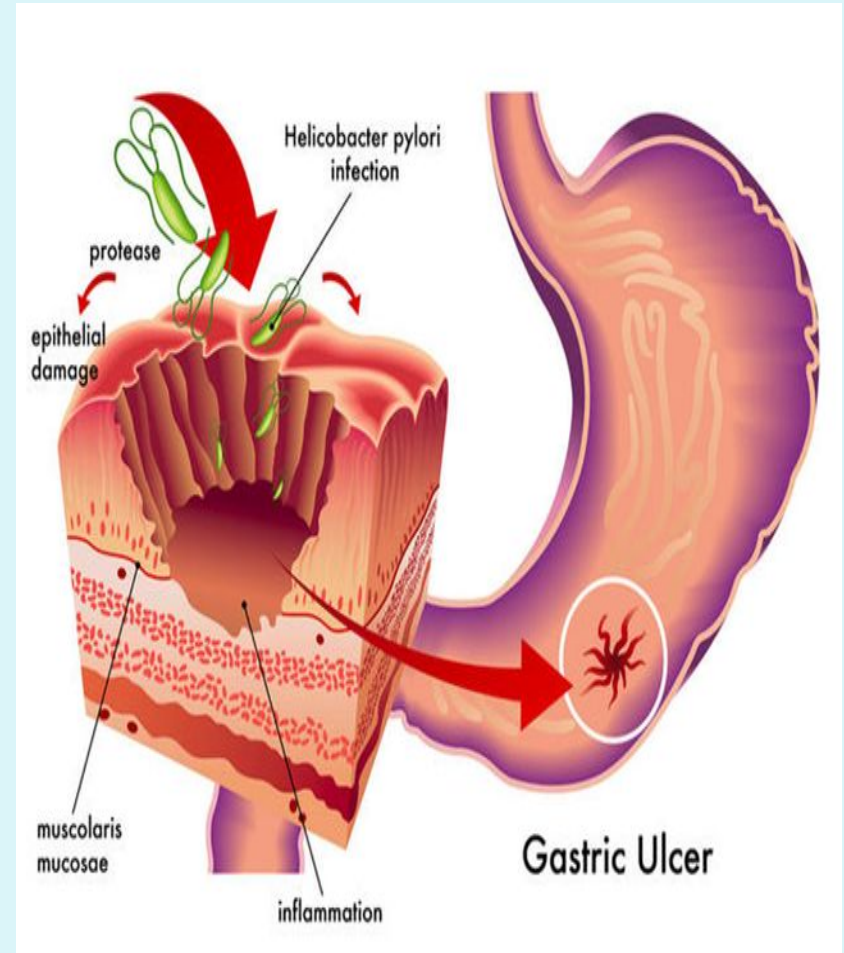


- For decades, doctors thought people got ulcers from stress, spicy foods, smoking, or other lifestyle habits. But when scientists discovered H. pylori in 1982, they found that the germs were the cause of some stomach ulcers.
- <https://youtu.be/HP6Zfiff7Sw>
- After H. pylori enters the body, it attacks the lining of the stomach, which usually protects the stomach from the acid the body uses to digest food. Once the bacteria have done enough damage, acid can get through the lining, which leads to ulcers. These may bleed, cause infections, or keep food from moving through the digestive tract.
- We may get H. pylori from food, water, or utensils. It's more common in countries or communities that lack clean water or good sewage systems. We may also pick up the bacteria through contact with the saliva or other body fluids of infected people.

H. PYLORI

Many people get H. pylori during childhood, but adults can get it, too. The germs live in the body for years before symptoms start, but most people who have it will never get ulcers. Doctors aren't sure why only some people get ulcers after an infection

<https://youtu.be/jX7nbfClY-w>



Symptoms



- If a person has an ulcer, he may feel a dull or burning pain in his belly. It may come and go, but he'll probably feel it most when his stomach is empty, such as between meals or in the middle of the night. It can last for a few minutes or for hours. He may feel better after he eats, drinks milk, or takes an antacid.
- Other signs of an ulcer include:
 - Bloating
 - Burping
 - Not feeling hungry
 - Nausea
 - Vomiting
 - Weight loss for no clear reason

ULCERS



- Ulcers can bleed into the stomach or intestines, which can be dangerous to the health. Other symptoms which may indicate a serious problem include:
- Stool that is bloody, dark red, or black
- Trouble breathing
- Dizziness or fainting
- Feeling very tired for no reason
- Pale skin color
- Vomit that has blood or looks like coffee grounds
- Severe, sharp stomach pain

ULCER -> CANCER



- It's not common, but H. pylori infection can cause stomach cancer. The disease has few symptoms at first, such as heartburn. Over time, the person may notice:
- Belly pain or swelling
- Nausea
- Not feeling hungry
- Feeling full after you eat just a small amount
- Vomiting
- Weight loss for no reason

<https://youtu.be/asfPabKR5PE>

Diagnosis



- Medicines like non-steroidal anti-inflammatory drugs (NSAIDs) can also damage the stomach lining, so it's important to find out what's causing the symptoms so the patient can get the right treatment.
- • Tests of the blood and stool, which can help find an infection
- • Urea breath test. The patient will drink a special liquid that has a substance called urea. Then he'll breathe into a bag, which his doctor will send to a lab for testing. If the patient has *H. pylori*, the bacteria will change the urea in his body into carbon dioxide, and lab tests will show that his breath has higher than normal levels of the gas.

IMAGING



- Also the doctor may use:
- Upper gastrointestinal endoscopy. In a hospital, a doctor will use a tube with a small camera, called an endoscope (Gastroduodenoscopy), to look down the throat and into the stomach and the upper part of the small intestine (Duodenum). The patient may be asleep or awake during the procedure, but some medicine usually given to make the patient more comfortable.
- Upper GI tests (Barium meal). In a hospital, the patient will drink a liquid that has a substance called barium, then an abdominal X-ray taken. The fluid coats the oesophagus, stomach and duodenum and makes them stand out clearly on the image.
- Computed tomography (CT) scan. It's a powerful X-ray that makes detailed pictures of the inside of the body.

Treatment for H. pylori



- If a person has ulcers caused by H. pylori, he'll need treatment to kill the germs, heal the stomach lining, and keep the sores from coming back. It usually takes 1 to 2 weeks of treatment to get better.
- Doctors will probably advise the patient to take **Triple Therapy** : **2 antibiotics** – Clarithromycin, Amoxicillin &/or Metronidazole **PLUS a Proton Pump Inhibitor** (one type of acid reducer) such as Omeprazole (Losec/Prilosec)
- Treatment could mean patient will take 14 or more pills per day for a few weeks, which seems like a lot of medicine. If the patient doesn't take antibiotics the right way, bacteria in his body can become resistant to them, which makes infections harder to treat.
- About a month after the treatment, the doctor may test the breath or stool again to make sure the infection is gone.

The End

