Infectious Diseases
LEARNING OBJECTIVES

- Describe the process or chain of infection
- Discuss the body’s defenses for fighting infection and disease
- Discuss the spread of infectious disease
- Explain the transmission, treatment, and health effects of STIs
- Describe the prevention and treatment of infectious diseases
Infectious Diseases

Caused by pathogenic microorganisms

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td><strong>Viruses</strong></td>
<td>Tiny pathogens consisting of genome (DNA or RNA) and protein covering</td>
</tr>
<tr>
<td></td>
<td>• HIV • Common cold (over 200 viruses) • Influenza • Human papillomavirus (warts, cervical cancer) • Hepatitis A, B, C • Polio • Rabies</td>
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<tr>
<td><strong>Bacteria</strong></td>
<td>Single-celled organisms that are spherical, rodlike, or spiral in shape</td>
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<td></td>
<td>• Staphylococcus aureus and MRSA • Neisseria meningitides (meningitis) • Chlamydia • Gonorrhea • Tuberculosis</td>
</tr>
<tr>
<td><strong>Prions</strong></td>
<td>Organisms believed to consist entirely of protein</td>
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<td></td>
<td>• Bovine spongiform encephalopathy (mad cow disease) • Creutzfeldt-Jakob disease (CJD) • Kuru</td>
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<tr>
<td><strong>Fungi</strong></td>
<td>Single-celled or multicelled organisms</td>
</tr>
<tr>
<td></td>
<td>Candidiasis (yeast infection) • Tinea (athlete's foot, ringworm) • Histoplasmosis</td>
</tr>
<tr>
<td><strong>Helminths</strong></td>
<td>Parasitic worms that live on or in host</td>
</tr>
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<td></td>
<td>• Hookworm • Pinworm • Tapeworm • Liver flukes</td>
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<tr>
<td><strong>Protozoa</strong></td>
<td>Single-celled organisms that generally live independently of host</td>
</tr>
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<td></td>
<td>• Giardia • Toxoplasmosis • Amebiasis • Malaria • Trichomoniasis</td>
</tr>
<tr>
<td><strong>Ectoparasites</strong></td>
<td>Complex organisms that usually live on the host's skin</td>
</tr>
<tr>
<td></td>
<td>• Fleas • Ticks • Lice • Scabies • Bed bugs</td>
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</tbody>
</table>
Pathogens:

Often live in large communities, called *reservoirs*.

A reservoir is an ecological niche where infectious agents can survive and reproduce.

Human reservoirs, animal reservoirs or reservoirs in non-living things (soil, water, etc...)

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The Chain of Infection

The process by which an infectious agent, or pathogen, passes from one organism to another

Can be spread, directly or indirectly, from one person to another

*Vector:* animal or insect that transmits a pathogen from a reservoir or an infected host to a new host
To cause infection, pathogens must have a *portal of exit* from the reservoir or host, and a *portal of entry* into a new host.
**Virulence:** speed and intensity with which a pathogen is likely to cause an infection

**Epidemic:** widespread outbreak of a disease that affects many people (Ebola, Zika)
Stages of Infection

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Summary:
- **Incubation Period** (no symptoms)
- **Prodromal Phase** (full-blown illness)
- **Acme** (peak of disease)
- **Decline Phase** (symptoms brought under control)
- **Convalescent Period** (body is repairing damage)
- **Sequelae** (remaining symptoms the body can’t repair)

Exposure: Organism enters body

Time
Body’s Defenses
The Immune System

Defends the body against foreign invaders

Distinguishes between what belongs in the body (self) and what does not (nonself or foreign)

*Complex array of organs, cells and molecules distributed throughout the body*
External Barriers

- Skin is the body’s first line of defense
- Nasal passages and ear canals are protected by hair
- Lungs are protected by the cough reflex and cilia
- Saliva contains special proteins that break down bacteria
- Stomach acids make it difficult for most organisms to survive
- Small intestines contain bile and enzymes that break down pathogens
- Vagina is slightly acidic, discouraging the growth of abnormal bacteria
Nasal passages  Mucous membrane lining, hair, sneeze reflex
Ears  Hair, ear wax
Whole body  Skin
Small intestine  Bile, enzymes
Eyes  Eyelids, eyelashes, tears
Mouth  Mucous membrane lining, saliva
Lungs  Mucous membranes, cilia, cough reflex
Stomach  Stomach acid
Large intestine  Normal flora
Genitals  Mucous membrane lining, normal flora; vagina has slightly acidic environment

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The Lymphatic system

Network of lymph nodes connected by lymphatic vessels + other structures

This system transports lymph throughout the body
Lymph is a fluid containing oxygen, proteins, and other nutrients that seeps into the tissues for nourishment.

Lymph also transports foreign substances that may be present in tissues into the lymphatic vessels and to lymph organs for disposal.

Lymph contains many white blood cells.
The Lymphatic System

- tonsils
- thymus gland
- lymph nodes
- spleen
- lymph nodes
- bone marrow
White Blood Cells

Monocyte
Eosinophil
Basophil
Lymphocytes
Neutrophil
Neutrophils: most abundant type of white blood cells (40-60%), short lived, first responders to inflammation site, mainly bacterial infections

Basophils: (0.5-1%), release histamine in allergic reactions

Eosinophils: (1-6%), combat multicellular parasites (helminths) and important responders to allergic reactions

Monocytes: (1-10%), the largest, develop into macrophages
**Lymphocytes:** (15-40%) white blood cells that circulate in the bloodstream and lymphatic system.

- **Stem cell** gives rise to **Pre-B cell** and **Pre-T cell** which then mature into **B cell** and **T cell** in the **Thymus**.
- **B cell** and **T cell** are produced by the **thymus** and circulate in the bloodstream.
- **B cells** produce antibodies.
- **T cells** can kill virus-infected and damaged cells.
- **CD8** (cytotoxic T cells) help other immune cells.
- **CD4** (helper T cells) help **cytotoxic T cells** and **B cells** in their immune functions.
The Immune System

**Innate immune system:** part of the immune system designed to rapidly dispose of pathogens in a nonspecific manner

**Acquired immune system:** part of the immune system that recognizes specific targets
Innate Immune System

*Acute inflammatory response* is the body’s initial reaction to tissue damage (injury or infection)
Series of changes that increases flow of blood to the site

**Neutrophils and macrophages**: travel to areas of infection or tissue damage and digest damaged cells, foreign particles, and bacteria (the first-responders, mostly during bacterial infections)

**Natural killer cells**: recognize and destroy *virus-infected* cells or cancerous cells
Acquired Immune System

B-cell & T-cell

TO SERVE AND PROTECT
**T cells** differentiate into three types

**Helper T cells** “read” cells’ infection messages and trigger production of killer T cells and B cells

**Killer T cells** attack and kill foreign cells and infected body cells

**Suppressor T cells** slow down and halt the immune response when the threat has been handled
**B cells:** When they encounter a specific antigen, they mature and produce antibodies.

Some the B cells and T cells become memory cells recognizing previous invaders and the strategies to get rid of them.
Immunity

After surviving infection by a pathogen, a person often acquires immunity to future infections by the same pathogen (*B and T memory cells*).

**Passive Immunity:** antibodies for certain diseases are passed from mothers to their babies in breast milk.

**Vaccine:** a preparation of weakened or killed microorganisms administered to confer immunity to various diseases.

- Protects you by stimulating an immune response
- Protects society by shrinking the reservoir of infectious agents
Risk Factors for Infection

**Controllable**
- Eating a balanced diet
- Exercising
- Getting enough sleep
- Managing stress properly
- Receiving vaccinations, when available
- Good hygiene
- Protecting skin from damage

**Uncontrollable**
- Age
- Undergoing surgical procedures
- Having chronic diseases
- Genetic predispositions
- Sociocultural issues
  - Overcrowded living conditions
  - Poverty
Disruption of Immunity

Autoimmune diseases
Mistaken identity in the body that allows the immune system to create an immune response, causing damage to body cells and tissues

Allergies
Body identifies a harmless foreign substance as an antigen and creates an immune response

Stress
Long-term stress can suppress the immune system, causing illness
Food-Related Pathogen Transmission

More than 250 organisms are associated with food-related illnesses

Viruses
Bacteria
Prions
Parasites

Eat food that is grown, processed and distributed locally
Behavior-Related Changes

Travel

SARS outbreak (2003)

Climate change

Changing patterns of infectious disease, especially water and vector borne diseases

Sexual behavior

Variables: partner, personal susceptibility, sex act

Illicit drug use

Use of contaminated needles and syringes

Hepatitis C
Death Rate from Infectious Diseases, United States

- Influenza pandemic
- Last human-to-human transmission of plague
- First use of penicillin
- Salk vaccine introduced
- Passage of Vaccination Assistance Act

1900-2000

Rate** per 100,000 population per year.

40 states have health departments
Antibiotic Resistance

**Antibiotic**: drug that works by killing or preventing the growth of bacteria

**Antibiotic resistance**: lessened sensitivity to the effects of an antibiotic

Two factors are believed to account for resistance:

- *Frequency with which resistant genes arise naturally among bacteria through mutation*
- *Overuse of antibiotics*
Vaccination Controversies

As vaccine-prevented diseases become less common, people begin to question the necessity and safety of the vaccines

*Serious reactions to currently recommended vaccinations are very rare*

If rates of vaccination drop, the likelihood of a disease recurrence increases
Global Infectious Diseases

**Pneumonia:** infection of the lungs or lower respiratory tract

*Can be viral or bacterial*

**Diarrhea:** kills an estimated 700,000 children per year

**Tuberculosis:** world’s most common infectious disease

**Malaria:** mosquito-borne disease that caused 627,000 deaths in 2012
Sexually Transmitted Infections

Sexually transmitted infections (STI): infection spread predominantly through sexual contact

Preferred terminology over sexually transmitted disease (STD) because often there are no symptoms

Primary pathogens: viruses and bacteria
Bacterial STIs

- **Chlamydia**
  
  *Most common bacterial STI; young women at greatest risk*

- **Gonorrhea**
  
  *Highest rates in young women*

- **Pelvic inflammatory disease**
  
  *Infection of uterus, fallopian tubes, and/or ovaries*

- **Syphilis**
  
  *If untreated, can lead to serious complications*

- **Bacterial vaginosis (BV)**
  
  *Alteration of the normal vaginal flora*
Viral STIs

- Human papillomavirus (HPV)
  Most common STI in the U.S.; more than 40 types

- Genital herpes
  No cure; prevention particularly important

- Hepatitis
  Inflammation of the liver
Other STIs

➢ Trichomoniasis
   
   *Caused by a protozoan; transmitted from person to person by sexual activity*

➢ Candidiasis
   
   *Vaginal yeast infection*

➢ Pubic lice and scabies
   
   *In adults, most often sexually transmitted*
HIV/AIDS

HIV virus attacks the helper T cells and macrophages of the immune system

Methods of transmission:

- Sexual contact; direct contact involving the exchange of bodily fluids (blood, semen, vaginal secretions)
- Sharing of hypodermic needles
- Through infected blood products
- Perinatal transmission (mother to fetus)
Most infected people are asymptomatic

Eventually the following symptoms may appear due to *opportunistic infections*:

- Rapid weight loss
- Cough
- Night sweats
- Diarrhea
- Rashes or skin blemishes
- Memory loss
HIV Testing

Strongly recommended for anyone who has engaged in or has a partner who has:

- Injected drugs, including steroids
- Had unprotected sex (vaginal, anal, or oral)
- Had multiple partners or has exchanged sex for drugs or money
- Been diagnosed with an STI

Multiple new tests, using oral swabs or urine instead of blood

Home Access HIV-1 Test System (home test kit)
Management of HIV/AIDS

**Antiretroviral agents:** do not cure the infection, but slow the rate of replication and destruction, prolonging life and improving quality of life

**New prevention possibilities**
- Vaccine trials are under way
- Microbicide
Disproportionate Risk for HIV Infection

Men who have sex with men

Heterosexuals

Injection drug users

Number of new HIV infections

- Black men
- White men
- Hispanic men
- Black women
- White women
- Hispanic women

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Prevention and Treatment of Infectious Diseases

- Support your immune system by adopting a healthy lifestyle
  - *Eat a balanced diet, exercise, sleep, manage stress, and do not smoke*
- Cover your cough
- Avoid touching your face or mouth
- Vaccinate yourself and children
- Minimize your use of antibiotics
- Be proactive when you have been exposed to an infectious disease
Practice the ABCDs of STI prevention
- Abstain
- Be faithful
- Use Condoms
- Promote Detection

Learn about common infectious diseases if you are about to travel to a particularly high-risk area

Participate in efforts to reduce the likelihood of infectious diseases in your community