The Process of Infection

- *Infection*: a disease or condition caused by a microorganism

- *Microorganisms* are the tiniest living organisms on earth that eat, reproduce, and die

- An infection is considered an illness or disease if it interferes with your usual lifestyle or shortens your life

- The process of infection often follows a typical course
The Chain of Infection

- *Chain of infection*: the process by which an infectious agent, or pathogen, passes from one organism to another
- *Pathogen*: infectious agent capable of causing disease
  - *They often live in large communities, called reservoirs*
  - *Some cannot survive in the environment and require a living host*
  - *To cause infection, they must have a portal of exit from the reservoir or host, and a portal of entry into a new host*
The Chain of Infection

- **Vector**: animal or insect that transmits a pathogen from a reservoir or an infected host to a new host
- Breaking the chain of infection at any point can either increase or decrease the risk of infection
- **Virulence**: speed and intensity with which a pathogen is likely to cause an infection
- **Epidemic**: widespread outbreak of a disease that affects many people
The Chain of Infection
### Types of Pathogens

<table>
<thead>
<tr>
<th>Types</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Viruses</strong></td>
<td>• HIV • Common cold (over 200 viruses) • Influenza • Human papillomavirus (warts, cervical cancer) • Hepatitis A, B, C • Polio • Rabies</td>
</tr>
<tr>
<td><strong>Bacteria</strong></td>
<td>• <em>Staphylococcus aureus</em> and MRSA • <em>Neisseria meningitides</em> (meningitis) • Chlamydia • Gonorrhea • Tuberculosis</td>
</tr>
<tr>
<td><strong>Prions</strong></td>
<td>• Bovine spongiform encephalopathy (mad cow disease) • Creutzfeldt-Jakob disease (CJD) • Kuru</td>
</tr>
<tr>
<td><strong>Fungi</strong></td>
<td>Candidiasis (yeast infection) • Tinea (athlete’s foot, ringworm) • Histoplasmosis</td>
</tr>
<tr>
<td><strong>Helminths</strong></td>
<td>• Hookworm • Pinworm • Tapeworm • Liver flukes</td>
</tr>
<tr>
<td><strong>Protozoa</strong></td>
<td>• Giardia • Toxoplasmosis • Amebiasis • Malaria • Trichomoniasis</td>
</tr>
<tr>
<td><strong>Ectoparasites</strong></td>
<td>• Fleas • Ticks • Lice • Scabies • Bed bugs</td>
</tr>
</tbody>
</table>
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
The Immune System

- **Immune system**: a complex set of cells, chemicals, and processes that protects the body against pathogens when they succeed in entering the body
  - **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
Immune system

Acquired

T-cell immunity
  (cell-mediated immunity)
  Whole T-cells released into:
    Suppressor T-cells
    Helper T-cells
    Cytotoxic T-cells
  Death of the body's cells that are infected with a virus or otherwise damaged

B-cell immunity
  (humoral immunity)
  Antigen exposure
    Lymphoblasts
    Plasma cells
    Antibodies
    Complement cascade
    Classical pathway
    Complement cascade
    Alternative pathway
    Memory B-cells

Bloodbourne
  Complement cascade
  Phagocytes
    Neutrophils
    Macrophages
    Basophils
    Eosinophils
    Natural killer cells
  Death of dangerous organisms
  Direct killing of bacteria

Innate

Physical barriers
  1. Skin
  2. Mucous membranes
  3. Saliva
  4. Flushing action of urine and tears
  5. Stomach acid
  Stops infection before it enters the body
Innate Immune System

- Cells of the innate immune system:
  - *Acute inflammatory response is the body’s initial reaction to tissue damage; a series of changes that increases flow of blood to the site*
  - *Neutrophils and macrophages: white blood cells that travel to areas of infection or tissue damage and digest damaged cells, foreign particles, and bacteria*
  - *Natural killer cells: white blood cells that recognize and destroy virus-infected cells or those that have become cancerous*
Acquired Immune System

- Cells of the acquired immune system:
  - **Lymphocytes**: white blood cells that circulate in the bloodstream and lymphatic system
  - **T cells**: type of lymphocyte that monitor events
    - 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**: monitor the blood and tissue fluids
    - When they encounter a specific antigen, they mature and produce **antibodies**: proteins that bind to specific antigens and trigger their destruction
Immunity

- After surviving infection by a pathogen, a person often acquires immunity to future infections by the same pathogen.

- B and T cells become *memory cells* when exposed to an infectious agent, allowing recognition and quick action to destroy the invader before the illness begins.

- **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*
# Recommended Adult Immunizations

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Age Group</th>
<th>19–21 years</th>
<th>22–26 years</th>
<th>27–49 years</th>
<th>50–59 years</th>
<th>60–64 years</th>
<th>≥65 years</th>
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</thead>
<tbody>
<tr>
<td>Influenza</td>
<td></td>
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<tr>
<td>Tetanus, diphtheria, pertussis (Td/Tdap)</td>
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<td></td>
<td></td>
<td></td>
<td>Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs</td>
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<tr>
<td>Varicella</td>
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<tr>
<td>Human papillomavirus (HPV)</td>
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<td></td>
<td></td>
<td></td>
<td>2 doses</td>
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<tr>
<td>Female</td>
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<td>Human papillomavirus (HPV)</td>
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<tr>
<td>Zoster</td>
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<tr>
<td>Measles, mumps, rubella (MMR)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1 or 2 doses</td>
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<tr>
<td>Pneumococcal polysaccharide (PPSV23)</td>
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<td></td>
<td></td>
<td></td>
<td>1 or 2 doses</td>
<td></td>
<td>1 dose</td>
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<tr>
<td>Pneumococcal 13-valent conjugate (PCV13)</td>
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<td></td>
<td></td>
<td>1 dose</td>
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<tr>
<td>Meningococcal</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1 or more doses</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 doses</td>
<td></td>
<td></td>
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<tr>
<td>Hepatitis B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 doses</td>
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</tr>
</tbody>
</table>

For all persons in this category who meet the age requirements and who lack evidence of immunity (e.g., lack documentation of vaccination or have no evidence of prior infection) Recommended if some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indications)
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

- The immune system can malfunction due to the following:
  - *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

- Changes in food production and distribution can affect disease transmission
  - *The widespread distribution of food may:*
  - Decrease the nutrient value of food
  - Increase environmental impact
  - Increase the risk that contaminated food will cause infectious disease
  - *More than 250 organisms are associated with food-related illnesses*
- Viruses
- Bacteria
- Prions
- Parasites
Behavior-Related Changes

- Behavior-related changes can have an affect on disease transmission
  - 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
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

- Four leading causes of global infectious disease mortality:
  - 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

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Infectious Diseases on Campus

- Pertussis (whooping cough): infection of the respiratory tract that is highly contagious
- *Staphylococcus aureus* skin infections: infection from a common bacterium carried on the skin or in the noses of healthy people
- Urinary tract infections: most common bacterial infection in women
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*
HIV/AIDS

- Cause: HIV virus attacks the helper T cells (CD4) 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)
HIV/AIDS

- Most infected people are asymptomatic or can remain symptom-free for years, even though antibodies have been formed within weeks of infection.

- Eventually the following symptoms may appear due to opportunistic infections:
  - Rapid weight loss
  - Cough
  - Night sweats
  - Diarrhea
  - Rashes or skin blemishes
  - Memory loss
People Living with HIV in 2012

Total: 35.3 million [range of 32.2 million – 38.8 million]
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

- Drug cocktails: complicated drug combinations that combat the development of resistant viral strains
  - *Complexity, cost, and risk of side effects increase*

- New prevention possibilities
  - *Vaccine trials are under way*
  - *Microbicide*
Bacterial STIs

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

- Gonorrhea
  - *Highest rates in young women; Blacks 17 times higher than Whites*

- 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*
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

More...
Prevention and Treatment of Infectious Diseases

■ 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