**Textbook: Infectious Disease**

**The Problem**

Despite remarkable breakthroughs in medical research and advancements in immunization and treatments, infectious diseases are undergoing a global resurgence. Worldwide, infectious diseases are the leading killer of children and adolescents and are one of the leading causes of death for adults. The impact of emerging infectious diseases in developing countries is well documented. But these diseases also impact Americans, with consequences for the public health system, the delivery of medical care, the economy, and national security.

At least 170,000 Americans die annually from newly emerging and re-emerging infectious diseases, a number that could increase dramatically during a severe flu pandemic or yet-unknown disease outbreak. Factors including globalization, increased antimicrobial (drug) resistance, and climate and weather changes are contributing to the increased threat. "Infectious diseases are not just a crisis for the developing world. They are a real threat right here, right now to America's economy, security, and health system," said Jeffrey Levi, PhD, Executive Director of TFAH. "Infectious diseases can come without warning, crossing boarders, often before people even know they are sick. Americans are more vulnerable than we think we are, and our public health defenses are not as strong as they should be."  *From the Trust for America's Health website.*

**Know the Terms:**

1. **Allergy:** Hypersensitivity disorder of the immune system, producing antibodies to normally harmless substances.
2. **Antibiotics:** Also known as antibacterial; medicine used to fight bacterial infections.
3. **Antibodies:** Also known as an immunoglobulin, a large Y-shaped protein produced by B-cells that is used by the immune system to identify and destroy foreign objects such as bacteria and viruses.
4. **Antigen:** Any substance capable of triggering an immune response; evokes production of one or more antibodies.
5. **Autoimmune Disease:** Disease caused by an inappropriate immune response against the body's own cells.
6. **Bacteria:** Single-celled microorganisms.
7. **Cell-Mediated Immunity:** Immune response that does not involve antibodies but rather involves the activation of phagocytes, natural killer cells, antigen-specific cytotoxic T-lymphocytes, and the release of various cytokines in response to an antigen.
8. **Epidemic:** (epi) meaning upon, and (demos) meaning people; a disease outbreak that affects many people in a community, region, or country at the same time.
9. **Histamine:** Chemical substance that dilates blood vessels, increases mucous secretion, and other allergic responses; histamine also triggers the body's inflammatory response.
10. **Humoral Immunity:** Immune response that is mediated by secreted antibodies (as opposed to cell-mediated immunity, which involves T lymphocytes).
11. **Lymphocyte:** A type of white blood cell in the immune response.
12. **Macrophage:** Greek word for (big eater), is a type of white blood cell that ingests cellular debris and pathogens.
13. **Pandemic:** World-wide or global epidemic of a disease.
14. **Parasitic worms:** A worm classified as a parasite, the largest of all pathogens, also referred to as helminthes.
15. **Pathogen:** Disease causing agent.
16. **Prion:** Infectious agent composed of protein and not genetic material (DNA, RNA, etc.); it is self-replicating and believed to be the smallest infectious particle.
17. **Protozoans:** Microscopic single-celled organisms with animal-like behavior which can cause disease.
18. **Sexually Transmitted Infection (STI):** Also referred to as sexually transmitted diseases (STD) and venereal diseases (VD); infection that is passed from person to person during intimate sexual contact.
19. **Vaccination:** Also referred to as inoculation; administration of antigenic material (a vaccine) to stimulate the immune system to develop an adaptive immunity to a disease.
20. **Virulent:** Highly infective; strong enough to cause disease; ability to overcome host resistance.
21. **Virus:** Small infectious agent that can replicate only inside the living cells of an organism.
Infectious Disease: Basic Training

1. The Basics Defined:
   - **Infectious Disease:**
     - A disease caused by agents (pathogens that invade the body (host), and cause harm to the body tissues (cause disease).
   - **Communicable Disease:**
     - Also referred to as contagious disease, an infectious disease that has the ability to spread from person to person.
   - **Infection:**
     - Results when a pathogen invades and begins growing within a host.
     - Disease results only if and when, as a consequence of the invasion and growth of a pathogen, tissue function is impaired.
   - **Pathogens:**
     - Disease causing agent or microorganisms.
   - **Antigen:**
     - Any substance capable of triggering an immune response; evokes production of one or more antibodies.
   - **Antibody:**
     - Also known as an immunoglobulin, a large Y-shaped protein produced by B-cells that is used by the immune system to identify and destroy foreign objects such as bacteria and viruses.
   - **Microbes:**
     - Tiny organisms, too tiny to see without a microscope
     - They are abundant on Earth, live everywhere (in air, soil, rock, and water).
   - **Epidemic:**
     - Disease outbreak that affects many people in a community or region at the same time.
   - **Pandemic:**
     - A global epidemic.

2. The Chain of Infection:
   - A set of elements or processes that must be present for infection to occur. Each link must be present and in sequential order for an infection to occur; and include:
     - **Infectious Agent or Pathogen must be present.**
       - The five major types of infectious agents include bacteria, viruses, fungi, protozoa, and helminths. In addition, a new class of infectious agents, the prions, has recently been recognized.
       - The greater the organism's **virulence** (it's ability to grow and multiply), **invasiveness** (it's ability to enter tissue) and **pathogenicity** (it's ability to cause disease), the greater the possibility the pathogen will cause an infection.
     - **A Reservoir**
       - A site where the infectious agent can thrive and reproduce.
     - **Portal of Exit from the Reservoir**
       - A place of exit providing a way for a microorganism to leave the reservoir, (e.g. the nose, mouth, or open wound, etc.)
     - **Mode of Transmission**
       - Method of transfer by of the organism from one host to the other, (e.g. sneeze, cough, or being carried on contaminated hands, etc)
     - **Portal of Entry into a New Host:**
       - An opening which allows the microorganism to enter the host (e.g. mucus membranes, open sores or wounds, etc.)
     - **Susceptible Host:**
       - Lacking immunity or physical resistance to overcome the invasion by the pathogen or microorganism.

3. Disease Causing Microbes:
   - **Bacteria:**
     - Single-cell organism that can thrive and are mobile in many environments can self-replicate (reproduce by themselves)
• Most bacteria do not cause disease.
• Most bacterial infections are treatable with Antibiotics
• Three main types are:
  • Cocci (spherical shape)
    • Staphylococci (staph infection)
    • Streptococci (strep throat)
    • Streptococcus pneumoniae (pneumonia)
  • Bacilli (rod or tube shape)
    • Salmonella (food poisoning)
    • E-coli (food poisoning, bladder and kidney infection)
    • Pertussis (whooping cough)
  • Spirilla (spiral shape)
    • Syphilis (STD)
    • Borrelia burgdorferi (Lyme disease)

• Virus:
  • Among the smallest of all microbes, most viruses cause disease.
  • Virus is a non-cellular core of genetic material (DNA, RNA)
  • Viruses cannot reproduce on their own, they must invade healthy body cells and take over
their reproductive machinery to reproduce.
  • Antibiotics have no effect on virus.

• Fungi:
  • Actually a primitive plant, found in air, in soil, on plants, and in water.
  • Fungal diseases are called mycoses.

• Protozoa:
  • A group of microscopic one-celled animals that usually cause disease in humans.

• Prions:
  • Derived from the words "protein" and "infection", it is an infectious protein particle that
contains no genetic material (unlike virus) and does not trigger an immune response,

• Helminth:
  • Simple, invertebrate animals, some of which are infectious parasites.
  • Because they are animals, their physiology is similar to humans, making parasitic helminth
infections difficult to treat because drugs that kill helminths are frequently very toxic to human
cells.

4. Your Immune System:
• The immune system is a network of cells, tissues, and organs that work together to defend the body
against attacks by "foreign" invaders.
• The immune system is amazingly complex in it's development of "Immunity" towards a pathogen.
• It can recognize and remember millions of different enemies, and it can produce secretions (release
of fluids) and cells to match up with and wipe out nearly all of them.

5. Types of Immunity:
• Innate Immunity:
  • The immunity that you are born with and the initial response by the body to eliminate
microbes and prevent infection.
  • Innate immune defenses are non-specific, meaning these systems respond to pathogens in
a generic way, and include:
    • Anatomic Barriers such as skin, saliva, tears, stomach acid, mucus, and cilia in the
      respiratory and intestinal tracks
    • Humoral Barriers respond if pathogens penetrate the first line of defense (anatomic
      barriers above). This process includes
      • Inflammation and fever.
      • Complement System: a biochemical cascade (series of chemical reactions)
        that attacks the surfaces of foreign cells. It contains over 20 different proteins
        and is named for its ability to "complement" the killing of pathogens by
        antibodies.
• Cellular Barriers which involves Leukocytes (white blood cells) acting like independent, single-celled organisms and are the second arm of the innate immune system, they include:
  • Phagocytes (macrophages, neutrophils, and dendritic cells),
  • Mast cells
  • Eosinophils
  • Basophils
  • Lymphocytes (two types):
    • B cells produce antibodies. Antibodies attach to a specific antigen and make it easier for the immune cells to destroy the antigen.
    • T cells attack antigens directly and help control the immune response. They also release chemicals, known as cytokines, which control the entire immune response.

• Adaptive or Acquired Immunity:
  • Immunity that develops with exposure to various antigens (substance capable of triggering immune response).
  • Immune system builds a memory and tailored defense that is specific to each antigen.

• Artificial Immunity:
  • Immunity that is acquired through vaccination.

• Passive immunity:
  • Developed immunity by antibodies that are produced in a body other than your own.
  • Infants have passive immunity because they are born with antibodies that are transferred through the placenta from their mother.
  • These antibodies disappear between 6 and 12 months of age.
    • Passive immunization may also be due to injection of antiserum, which contains antibodies that are formed by another person or animal. It provides immediate protection against an antigen, but does not provide long-lasting protection. Immune serum globulin (given for hepatitis exposure) and tetanus antitoxin are examples of passive immunization.

6. Vaccines, When the Body Needs Help:
• Vaccines help develop immunity by imitating an infection, but this "imitation" infection does not cause illness.
  • A dead or weakened form of the the disease germ or pathogen is injected into the body.
  • The imitation infection will cause the immune system to develop the same response as it does to a real infection so the body can recognize and fight the vaccine-preventable disease in the future.
  • Some vaccines can cause minor symptoms (such as fever), which are normal and should be expected as the body builds immunity.
  • Scientists take many approaches to designing vaccines which are based on
    • Information about the germs (viruses or bacteria) the vaccine will prevent
    • How it infects cells
    • How the immune system responds to it
    • Regions of the world where the vaccine would be used, are also important because the strain of a virus and environmental conditions, such as temperature and risk of exposure, may be different in various parts of the world.
  • Some Vaccines present a lifetime of immunity, where others need to be re-administered each year.
    • Flu viruses are always changing or drift to create new viruses, meaning specific immunity is no longer present.

7. Sexually Transmitted Infections and Disease:
• Sexually Transmitted Infection:
  • Infection or invasion of body tissue by a microorganism (bacteria, virus, protozoa) that can be passed from one person to another during intimate bodily contact.
  • Infection has the potential to cause disease or illness, but the infected individual is asymptomatic (not experiencing symptoms) and may not feel sick.
  • Someone with an STI can unknowingly pass on an infection as they are often unaware they are carrying an infection and may not take the proper precautions toward protecting their partner.
• Sexually Transmitted Disease:
  • Disease (damage) resulting from a Sexually Transmitted Infection (above).
  • An infection with symptoms

Talk’n Stats:

Did You Know?

• Each year, roughly one in six Americans (48 million people) gets sick. 128,000 are hospitalized and 3,000 die of foodborne diseases. Reducing foodborne illness by 10 percent would keep about 5 million Americans from getting sick each year.
• Most food poisoning is caused by bacteria, viruses and parasites, rather than toxic substances in the food.
• Raw foods are the most common source of foodborne illnesses because they are not sterile.
• When food is cooked and left out for more than two hours at room temperature, bacteria can multiply quickly.
• Some people are at greater risk for bacterial infections because of their age or an unhealthy immune system. Young children, pregnant women and older adults are at the greatest risk.
• Hand-washing and wearing gowns and gloves in hospitals cuts the number of infections of methicillin-resistant staphylococcus aureus, also known as (MRSA), and other hospital-acquired infections.
• Vaccination is the only medical intervention that has ever completely eliminated an illness in humans.
• One in nine people who contract a meningococcal disease, such as meningitis, will die from it, even if they are diagnosed and treated quickly. Cases and deaths from the most vaccine-preventable diseases targeted since 1980, such as chickenpox, have declined by 80 percent or more because of widespread immunization.
• The Centers for Disease Control and Prevention recommends vaccinations from birth through adulthood to provide a lifetime of protection against many diseases and infections, such as influenza, pneumococcal disease, human papillomavirus and hepatitis A and B.

Above Statistics from National Public Health Week, Communicable Disease Fact Sheet; www.nphw.org

Thoughts for Living:

Be Smart and Prevent Infections:

1. Keep immunizations current. Follow recommendations for childhood and adult immunizations (above) and get those shots on time.
2. Avoid touching your eyes, nose, or mouth
3. Wash your hands often (See Antibacterial Soap Tip on Right)
   o After using the bathroom
   o Before eating or handling food
   o After changing a diaper
   o After blowing your nose, sneezing, or coughing
   o After caring for a sick person
   o After playing with a pets.
4. Be aware of what you eat, and how you cook it.
   o Keep hot foods hot and cold foods cold until you eat them or cook them.
   o Be sure temperature controls in the refrigerators or freezers are working properly.
   o Wash counter tops, cutting boards, and utensils carefully with soap and hot water, especially after preparing poultry or other meats.
   o Wash fresh fruits and vegetables before eating them.
   o Cook ground beef until you can no longer see any pink.
5. Don’t share personal items (Toothbrushes, towels, razors, handkerchiefs, nail clippers, etc)
6. Use antibiotics exactly as prescribed.
   o Take them for the full course prescribed by your doctor, but not for colds or other nonbacterial illnesses.
   o Never medicate yourself with antibiotics or share them with family or friends.
7. **Report to your doctor** any infection that is quickly getting worse or any infection that does not get better after you take a prescribed antibiotic.

8. **Be cautious around all wild animals** and domestic animals that are not familiar to you.
   - If bitten, clean the skin with soap and water, and seek medical care immediately.

9. **Avoid areas of insect infestation.**
   - Use skin and clothing repellents when in areas where ticks or mosquitoes are common.
   - If you have visited wooded or wilderness areas and are now sick, your doctor needs all the details to diagnose both rare and common illnesses quickly.

10. **Practice safe, protected sex and injected drug use.**

11. **Do your homework before you travel.**
   - Stay alert to disease threats when you travel or visit undeveloped areas.
   - Get all recommended immunizations and use other protective medications for travel, especially to areas with malaria.
   - If you become ill when you return home, tell your doctor where you’ve been.
   - **Hotel Health:**
     - Hotel bedspread off immediately; it never gets washed.
     - Avoid drinking from in-room glassware; if they’re glass, they probably have just been wiped clean with a cloth, so you might want to use a plastic cup.
     - TV remotes never get cleaned, so either put it inside of a plastic bag or bring some kind of a hand wipe to clean it off. (includes hospital television remotes as well).

12. **When you are sick, allow yourself time to heal and recover.** Be courteous to others: wash your hands frequently, and sneeze or cough into your sleeve.

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**Bolster your immune system:**

1. **Feast on Fish:**
   - EPA (eicosapentaenoic acid), the essential omega-3 fatty acid found in fatty fish (and fish oil), limits several cellular processes associated with inflammation.
   - Or ask your doctor about daily supplements of EPA plus DHA, another omega-3

2. **Have Happy Habits:**
   - **Sufficient sleep:**
     - Sleep deprivation lowers immunity and increases levels of proteins associated with inflammation.
   - **Stay active:**
     - In a recent study, when a group of overweight couch potatoes started exercising five times a week, they gained a definite cold-fighting edge over non-exercisers.
   - **Avoid Immune Busters:**
     - *Excessive alcohol* weakens the immune system and prevents restful sleep.
     - *Smoking* weakens the immune system by depressing antibodies and decreasing immune cells.

3. **Go Red and Go Nuts:**
   - Red wine, red grapes, and peanuts are great sources of resveratrol, a compound that protects against immune system aging and inflammation.
   - Resveratrol supplements are somewhat overpriced and untested. stick with the red grapes, blue berries, and peanuts.

4. **Manage Your Stress:**
   - Your nervous system and immune system are closely linked.
   - Unmanaged stress reduces your natural killer cell count; explaining the link between a stressful day and catching a cold.

5. **Sunshine and Vitamin D:**
   - Found in food as well as synthesized by your skin with sun exposure, evidence is growing that the vitamin greatly impacts our immune system.
   - Since it's difficult to get what you need from food alone, ask your doctor about supplements, especially in winter months when the sun disappears.
   - In a recent study, people with low blood levels of vitamin D were 55 percent more likely to develop a cold than people with three times as much D in their blood.

6. **Get Colorful:**
Apples, Broccoli, and Red Onions are bursting with quercetin, a flavonoid that boosts immunity, even when you're tired.
The fiber and antioxidants in these little wonders also help reduce inflammation instigators. In addition, Tea is full of flavonoids, powerful vitamin-like substances that reduce immune-system aging.

7. **C the Zinc:**
- Vitamin C helps you produce more bullets to kill invading germs.
- Bell peppers and oranges are packed with vitamin C; other good C options include strawberries, cantaloupe, and broccoli.
- Or take 400 milligrams of vitamin C as a supplement three times a day.
- Go to the end of the alphabet for a mineral that supports immunity (it may also defend against cancer cells).
- You can get the zinc you need, 12 milligrams a day, from crab, oysters, pork, poultry, beans, cashews, and yogurt and pumpkin seeds.
- Or find a good multivitamin with less than 15 milligrams.
- However, too much of the stuff could stop other important minerals from doing their jobs.