Review Notes

Chapter 26: Infectious Disease Prevention and Control

I. Historical and current perspectives. In 1900 communicable diseases were the leading causes of death in the United States. By 2000 improved nutrition and sanitation, vaccines, and antibiotics had put an end to the epidemics that once ravaged entire populations. Infectious diseases have not vanished, however. They are still the number one cause of deaths worldwide. Organisms once susceptible to antibiotics are becoming increasingly drug resistant. New killers are emerging, and old familiar diseases are taking on different, more virulent characteristics. AIDS developed in the 1980s; Legionnaire’s disease, toxic shock syndrome, Lyme disease, mad cow disease, Ebola virus, West Nile virus, and SARS all are diseases of recent development.

II. Transmission of communicable diseases

A. Transmission of communicable diseases depends on the successful interaction of three factors: the infectious agent, the host, and the environment—together known as the *epidemiologic triangle*. Changes in any of these three factors may result in disease transmission.

1. Four main categories of infectious agents that can cause infection or disease: bacteria, fungi, parasites, and viruses

2. A human or animal host may harbor an infectious agent. Four host factors influence the spread of disease: host resistance, immunity, herd immunity, and infectiousness.

a. Resistance: The ability of the host to withstand infection

b. Immunity: A resistance to an infectious agent. It may be natural or acquired and may occur actively or passively.

c. Herd immunity: The resistance of a group of people to invasion and spread of an infectious agent. Herd immunity is seen when a large proportion of group members are resistant to a specific infection.

d. Infectiousness: A measure of the potential ability of an infected host to transmit the infection to other hosts. It reflects the relative ease with which the infectious agent is transmitted to others.

3. *Environment* refers to all that is external to the human host: physical, biological, social, and cultural factors. Environmental factors aid the transmission of an infectious agent from an infected host to other susceptible hosts. Changing environmental factors can reduce communicable disease risk.

B. Modes of transmission

1. *Vertical transmission* is passing an infection from parent to offspring through sperm, placenta, milk, or contact in the vaginal canal at birth.

2. *Horizontal transmission* is person-to-person spread of infection and can happen in four ways: direct/indirect contact, common vehicle, airborne, and vector-borne.

3. Infection vs. disease. Infection does not always cause disease. *Infection* refers to the entry, development, and multiplication of the infectious agent in the susceptible host. *Disease* is one of the possible outcomes of infection and may indicate a physiological dysfunction or pathological reaction.

4. *Incubation period* is the time interval between invasion by an infectious agent and the first appearance of signs and symptoms of the disease.

5. *Communicable period* is the time interval during which an infectious agent may be transferred directly or indirectly from an infected person to another person.

C. Disease spectrum. People with infectious diseases may exhibit a broad spectrum of disease that ranges from subclinical infection to severe and fatal disease. At the community level, the disease may occur in endemic, epidemic, or pandemic proportion.

1. Endemic: Constantly present in a given geographical area or population

2. Epidemic: A greater than normally expected occurrence of disease in a community or region

3. Pandemic: A worldwide epidemic affecting large populations. SARS is a recent example of a pandemic.

III. Surveillance of communicable disease. Surveillance is systematically collecting, organizing, and analyzing current, accurate, and complete data for a defined disease condition. This information is promptly provided to those who need it for planning, implementation, and evaluation of disease prevention and control programs.

A. Since the 9/11 terrorist attacks, disease surveillance has heightened for any disease possibly associated with a biological agent.

B. Disease reporting is mandated by state rather than federal law. Lists of reportable diseases vary by state. There are currently 58 diseases included in the National Notifiable Diseases Surveillance System.

IV. Emerging infectious diseases are those diseases with an increased incidence in the past two decades or with the potential to increase in the near future. They can include newer or known infectious diseases.

A. Recent examples are the Ebola virus outbreaks in Africa, the Hantavirus pulmonary syndrome in the southwestern United States, and the West Nile virus.

B. A variety of factors influences the emergence of these diseases. Most of the influential factors relate to consequences of activities and behavior of the human hosts and to environmental changes, such as deforestation, urbanization, and industrialization.

V. Prevention and control of communicable diseases. Prevention and control programs seek to reduce the prevalence of a disease to a level at which it no longer poses a major community health problem.

A. Elimination focuses on removing the disease from a large geographical area, such as a country or region of the world. *Eradication* refers to the irreversible termination of all transmission of infection by extermination of the infectious agents worldwide.

B. Primary prevention seeks to reduce the incidence through health promotion and education. Secondary prevention seeks to reduce the prevalence of disease or to diminish the morbidity through early diagnosis and treatment. Tertiary prevention seeks to reduce complications and disabilities related to disease through treatment and through mental and physical rehabilitation.

C. Role of the nurse. Prevention is at the center of public and community health. Examples are education, immunizations, and screening.

VI. Agents of bioterrorism. Six infectious agents are considered of highest concern: anthrax*,* plague*,* smallpox, botulism, tularemia, and selected hemorrhagic viruses.

A. Anthrax. Deaths in the fall of 2001 caused by letters deliberately contaminated with anthrax and transmitted through the postal service profoundly changed the worldview of this infectious disease.

1. Anthrax is an acute disease caused by the spore-forming bacterium *Bacillus anthracis.* It perpetuates itself by forming spores.

2. Anthrax disease may manifest in one of three syndromes: cutaneous, gastrointestinal, and respiratory or inhalational. Cutaneous is the most common form.

3. Because of the ability for aerosolization, the resistance to environmental degradation, and a high fatality rate, inhalational anthrax has long been considered to have an extremely high potential for being the single greatest biological warfare threat.

B. Smallpox. It has been considered eradicated since 1979. The last known natural death from smallpox occurred in 1977.

1. The United States stopped routinely immunizing for smallpox in 1982. The only documented existing virus sources are located in freezers at the CDC in Atlanta and a research institute in Russia.

2. Smallpox is considered a leading candidate agent for bioterrorism. Susceptibility is 100% in the unvaccinated, and the fatality rate is estimated at 20% to 40% or higher.

3. Because of the potential for bioterrorism and the fact that many health care providers have never seen this disease, it is important to become familiar with the clinical and epidemiologic features of smallpox and how it is differentiated from chickenpox.

VII. Vaccine-preventable diseases. Vaccines are one of the most effective methods of preventing and controlling communicable diseases. Many diseases, such as polio, diphtheria, pertussis, and measles, are controlled by vaccines; they have not been eradicated. In the United States, most children are immunized by the time they enter school. However, many infants and toddlers, the group most vulnerable to these potentially severe diseases, do not receive scheduled immunizations. Inner-city children from minority and ethnic groups are at risk for incomplete immunization. Because many children receive their immunizations at public health departments, nurses can work to increase immunization coverage of infants and toddlers.

A. Routine childhood immunization schedule. Children in the United States are routinely immunized against hepatitis B, diphtheria, pertussis, measles, mumps, rubella, polio, *Haemophilus influenzae* type B, meningitis, varicella (chickenpox), and *Streptococcus* *pneumoniae*–related illnesses. Other vaccines are available for use in special circumstances, including those for hepatitis A and influenza.

B. Measles is an acute, highly contagious disease caused by the rubeola virus. It spreads rapidly and is actually the most contagious before people realize they are infected. Immunization has led to a dramatic decrease in measles cases in the United States.

C. Rubella (German measles) is moderately contagious. Transmission is through inhalation of or direct contact with infected droplets from the respiratory secretions of infected persons. Children may show few or no symptoms; adults often have several days of low-grade fever, headache, malaise, runny nose, and conjunctivitis before the rash appears. Maternal rubella is linked to certain congenital defects. Congenital rubella syndrome may include cataracts, congenital glaucoma, deafness, microcephaly, mental retardation, cardiac abnormalities, and diabetes mellitus.

D. Pertussis (whooping cough) is caused by the bacterium *Bordetella pertussis* and is transmitted via an airborne route through contact with infected droplets. It is highly contagious and considered endemic in the United States. Although it is predominantly a disease of young children, the increasing number of cases in adolescents and young adults is a growing problem. Nurses need to encourage parents to immunize their children against pertussis.

E. Influenza (flu) is a viral respiratory infection. Transmission is airborne and through direct contact with infected droplets. Outbreaks are common in the winter and early spring in areas where people gather indoors.

1. The most important factors to note about influenza are its epidemic nature and the mortality that results from its pulmonary complications, especially in the elderly. There are three types of influenza viruses, A, B, and C. Types B and C are fairly stable, but type A is constantly changing.

2. The first known cases of avian influenza virus A were reported in Hong Kong. This virus appears to have been transmitted to people through contact with infected poultry. Hong Kong officials ordered all chickens in the country slaughtered, which appears to have stopped the spread of this disease.

3. Vaccines are prepared each year based on the best possible prediction of what type and variant of virus will be most prevalent that year. Immunization is necessary annually and is given in the fall before the flu season begins.

4. Immunization is highly recommended for the elderly, individuals with chronic respiratory disease, or those with other chronic disease conditions that impair the immune system, in addition to health care workers and anyone involved in essential community services.

VIII. Foodborne and waterborne diseases. Food infection results from bacteria or from viral or parasitic infection of food. Food intoxication results from toxins produced by bacterial growth, chemical contaminants (heavy metals), and a variety of disease-producing substances found naturally in certain foods, such as mushrooms and some seafood. Examples of food intoxications are botulism and mercury poisoning. Much foodborne illness can be prevented through effective food preparation, handling, and storage.

A. Salmonellosis is a bacterial disease characterized by sudden onset of headache, abdominal pain, diarrhea, nausea, sometimes vomiting, and almost always fever. Onset typically occurs within 48 hours of eating the contaminated food. Outbreaks occur commonly in restaurants, hospitals, nursing homes, and children’s institutions. The transmission route is eating inadequately cooked food that comes from an infected animal or is contaminated by feces of an infected animal or person. Meat, poultry, and eggs are the foods most often associated with salmonellosis outbreaks.

B. *Escherichia coli* 0157:H7 was first described in humans in 1992 after two outbreaks of illness were associated with eating undercooked hamburgers from a fast-food restaurant chain. Infection causes bloody diarrhea, abdominal cramps, and infrequently fever. Hamburger appears to be involved in outbreaks because the grinding process exposes pathogens that were on the exterior piece of beef to the interior of the ground meat and mixes the bacteria so thoroughly throughout the hamburger that searing the surface no longer kills all the bacteria. The best protection is to thoroughly cook food before eating it.

C. Waterborne pathogens usually enter water supplies through animal or human fecal contamination and frequently cause enteric disease. Hepatitis A is the most widely publicized waterborne viral agent. The most important waterborne bacterial diseases are cholera, typhoid fever, and bacillary dysentery. Protozoa are especially problematic for municipal water because they do not respond to traditional chlorine treatment as do enteric and coliform bacteria.

IX. Vector-borne diseases are transmitted by vectors, usually insects, either biologically or mechanically. With biological transmission, the vector is necessary for the developmental stage of the infectious agent. Mechanical transmission occurs when an insect simply contacts the infectious agent with its legs or mouth and carries it to the host.

A. Lyme disease is transmitted by ixodid ticks that are associated with white-tailed deer and the white-footed mouse. It is most prevalent in northeastern, north-central, and the Pacific coast states, and it occurs most often in the summer. There are three stages. Stage I is characterized by erythema chronicum migrans, a distinctive skin lesion. It may be accompanied by or preceded by fever, fatigue, malaise, headache, muscle pains, and a stiff neck, in addition to tender and enlarged lymph nodes and migratory joint pain. Most patients diagnosed in this early stage respond well to 10 to 14 days of oral tetracycline or penicillin. Stage II may include additional skin lesions, headache and neurological and cardiac abnormalities. Stage III consists of recurrent attacks of arthritis and arthralgia, especially in the knees, which may begin months to years after the initial lesion.

B. Rocky Mountain spotted fever occurs most often in the Southeast and in Oklahoma, Kansas, and Missouri. It is transmitted via tick vector; the vector differs by region of the country. Clinical signs include sudden onset of moderate to high fever, severe headaches, chills, deep muscle pain, and malaise. It is important to start treatment as soon as clinical signs are present.

C. Vaccines are currently not available for any tick-borne diseases. The best preventive measures include wearing protective clothing when doing outside work and conducting a systematic assessment for ticks before going inside.

X. Diseases of travelers. Persons traveling outside the United States need to be aware of and take precautions again exposure to potential diseases. The diseases vary with the destination, length of stay, and the person’s own health status.

A. Malaria. Malaria is a potentially fatal disease characterized by regular cycles of fever and chills. It is caused by the blood-borne parasite *Plasmodium*. Transmission is through the bite of an infected *Anopheles* mosquito. Worldwide, malaria is the most prevalent vector-borne disease. About 90% of cases occur in Africa. No vaccine is available to protect against malaria. Prevention depends on protection against mosquitoes and appropriate chemoprophylaxis. Drug resistance is an increasing problem, so decisions about antimalarial drugs must be tailored to the individual.

B. Foodborne and waterborne diseases. Much foodborne disease can be avoided in other countries if the traveler eats thoroughly cooked foods prepared with reasonable hygiene. Water in many areas is not potable (safe to drink), and drinking unsafe water can lead to a variety of infections. To avoid unsafe water, only boiled water, bottled water, or water purified with iodine or chlorine compounds should be consumed.

XI. Zoonosis. A zoonosis is an infection transmitted under natural conditions from a vertebrate animal to a human. Means of transmission include animal bites, inhalation, ingestion, direct contact, and arthropod intermediates.

A. Rabies is a well-known zoonosis. The major carriers today in the United States are not dogs but wild animals—raccoons, skunks, foxes, and bats. Rabies is transmitted to humans through an animal bite or scratch that passes on virus-carrying saliva. Transmission may also occur if infected saliva comes into contact with a fresh cut or intact mucous membranes. The best protection against rabies is vaccinating domestic dogs, cats, cattle, and horses. No successful treatment exists for rabies once symptoms appear, but if given promptly and as directed, postexposure prophylaxis with human rabies immune globulin and rabies vaccine is effective in preventing the development of the disease.

XII. Parasitic diseases. Parasitic diseases are more common in developing countries than in the United States because of the tropical climate in many of the countries and their often inadequate prevention and control measures. Several factors are leading to an increase in parasitic infections: international travel, immigration, an increase in AIDS, and recognition of how selected parasitic diseases are transmitted. A common parasitic infection is enterobiasis (pinworm). Nurses play a key role in the prevention, diagnosis, and control of parasitic infections. Diagnosis of parasitic diseases is based on history of travel, characteristic clinical signs and symptoms, and use of laboratory tests. Effective drug treatment is available for most parasitic diseases.

XIII. Nosocomial infections. Nosocomial infections are acquired during hospitalization or develop within a hospital setting. They may involve patients, health care workers, visitors, or anyone who has contact with a hospital.

XIV. Universal precautions. In 1985, in response to concerns about the transmission of HIV infection in health care settings, the CDC developed a universal precautions policy for all health care settings for the handling of blood and body fluids of all patients. Health care workers must always perform hand hygiene and must wear gloves, masks, protective clothing, and other indicated personal protective barriers. Needles and sharp instruments must be used and disposed of properly.