38.1 Airborne Diseases

1. Report the common viral diseases spread by airborne transmission

2. Identify typical signs and symptoms of viral diseases spread by airborne transmission

3. Correlate airborne viral infection and disease severity with viral virulence factors
Airborne Diseases

- When human is source, airborne viruses are propelled from respiratory tract by coughing, sneezing, or vocalizing
Chickenpox (Varicella) and Shingles (Herpes Zoster)

- DNA virus, member of Herpesviridae
- Humans serve as reservoir and source
- Acquired by droplet inhalation into respiratory system
- Chickenpox
  - results from initial infection
  - vaccine prevents or shortens illness
Chickenpox (Varicella) and Shingles (Herpes Zoster)

- Shingles (herpes zoster; postherpetic neuralgia)
  - reactivated form of chickenpox
    - virus resides in cranial and sensory neurons
    - reactivation - virus migrates down neuron

- Treatment
  - supportive; acyclovir and others
Influenza (Flu)

• Respiratory system disease caused by influenza virus
  – RNA virus; segmented genome
  – four groups A, B, C, and Thorgoto
  – numerous animal reservoirs
  – acquired by inhalation or ingestion of respiratory secretions
• 31 possible pandemics
• Worst pandemic in 1918 killed ~50 million people
Influenza (Flu)

- Subtypes based on hemagglutinin (HA) and neuraminidase (NA)
  - membrane surface glycoproteins
  - HA/NA function in viral attachment and virulence
  - 16 HA/9 NA antigenic forms
Influenza (Flu)

• An important feature of the influenza viruses is the frequency with which changes in antigenicity occur
  – antigenic drift – due to accumulation of mutations in a strain within a geographic area
  – antigenic shift – due to reassortment of genomes when two different strains of flu viruses (from humans and animals) infect the same cell and are incorporated into a single new capsid
Influenza Antigenic Shift

- H5N1 subtype (known as bird flu)
  - severe disease and death in humans but low infection in humans
- H1N1 (swine flu) is current pandemic
Influenza (Flu)

• Clinical manifestations
  – chills, fever, headache, malaise, and general muscular aches and pains
  – recovery usually within 3 to 7 days
  – often leads to secondary infections by bacteria

• Treatment, prevention, and control
  – rapid immunologic tests
  – symptomatic/supportive therapy
  – inactivated virus vaccine
Measles  
(Rubeola)

- Measles  
  - rash caused by measles virus (RNA virus)  
  - enters body through respiratory tract
- Subacute sclerosing panencephalitis  
  - rare progressive degeneration of central nervous system caused by measles virus
- Treatment, prevention, and control  
  - symptomatic/supportive therapy  
  - attenuated MMR vaccine (measles, mumps, rubella)
Mumps

- Caused by mumps virus, RNA virus
- Clinical manifestations
  - develop 16–18 days after infection
  - fever, and swelling and tenderness of salivary glands
  - complications include meningitis and orchitis (inflammation of testis)
- Treatment, prevention, and control
  - symptomatic/supportive therapy
  - live, attenuated vaccine (MMR)
Respiratory Syndromes and Viral Pneumonia

• Caused by viruses called acute respiratory viruses

• Clinical manifestations
  – rhinitis, tonsillitis, laryngitis, bronchitis, and pneumonia
  – vary in degree of severity

• Treatment, prevention, and control
  – in most cases, symptomatic/supportive therapy
Respiratory Syncytial Virus (RSV)

• In children, the most dangerous respiratory infection
• RSV is negative strand RNA virus
  – causes formation of syncytia (fused cells)
• Spread by hand contact and respiratory secretions
• Clinical manifestations
  – acute onset of fever, cough, rhinitis, nasal congestion
  – may progress quickly to bronchitis/viral pneumonia
• Treatment, prevention, and control
  – rapid immunologic tests
  – inhaled ribavirin and RSV-immune globulin
  – isolation, protective clothing, and hand washing
Rubella (German Measles)

- Enveloped RNA virus
- Mild brief rash acquired from respiratory droplets
- Congenital rubella syndrome
  - disastrous disease in the first trimester of pregnancy
  - can lead to fetal death, premature delivery, or congenital defects
- Attenuated vaccine reduced cases to 1000 and 10 congenital rubella cases per year
Severe Acute Respiratory Syndrome (SARS)

- Highly contagious viral disease caused by the SARS-associated corona virus (SARS-CoV)
  - transmitted by droplet spread; can be fatal
  - Sudden onset, severe illness in healthy individuals
  - dry cough develops in days; most will develop pneumonia
- No specific treatment is currently approved
Smallpox (Variola)

- Caused by variola virus
  - large, brick-shaped complex virus
  - linear dsDNA
- Transmitted by aerosol or contact
  - humans are the only natural host
Clinical Forms of Smallpox

• Once highly prevalent
  – no longer in human populations
  – potential bioterrorism agent

• Variola major
  – most common, severe form
  – extensive rash and higher fever
  – 33% fatality rate

• Variola minor
  – less common form and less severe
  – fatality rates of 1% or less

• Both forms usually transmitted by direct and fairly prolonged face-to-face contact
Eradication of Smallpox

• 1977 – last case from a natural infection occurred in Somalia
• Why eradication was possible –
  – disease has obvious clinical features
  – humans are only hosts and reservoirs
  – there are no asymptomatic carriers
  – short infectivity period (3–4 weeks)
Protection from Smallpox

• Obtained from vaccination
  – use vaccinia virus in a live virus vaccine
• Routine immunization no longer done in the U.S.
• Use of vaccine is controversial because of its unknown efficacy in the prevention of bioterrorism and potential side effects
• Food and Drug Administration has not approved any treatment for smallpox
38.2 Arthropod-Borne Diseases

1. Report the two common arthropod-borne viral diseases
2. Identify typical signs and symptoms of two arthropod-borne viral diseases
3. Correlate arthropod-borne virus infection with geography and time of year
Arthropod-Borne Diseases

• Arboviruses
  – viruses transmitted by bloodsucking arthropods from one vertebrate host to another
  – multiply in tissues of vector without producing disease
    • vector acquires a lifelong infection
Clinical Syndromes

• Arboviral disease syndromes can be placed into three subsets
  – Undifferentiated fevers, with or without rash
  – Encephalitis
    • inflammation of the brain
    • fatality rate is usually high
  – Hemorrhagic fevers
    • frequently severe and fatal
• Supportive treatment, no vaccines available
Equine Encephalitis

• RNA virus causing disease transmitted to humans by mosquitoes
  – a spectrum of symptoms which can ultimately result in death

• Genetically distinct strains found in different geographic locations
  – e.g., Western equine encephalitis (WEE) and Eastern equine encephalitis (EEE) strains

• No vaccine available
West Nile Fever (Encephalitis)

- Caused by a flavivirus, RNA virus
- Appeared in New York in 1999 causing human and animal deaths
- By 2006 found in all continental U.S. states, infecting humans or animals
- Transmitted to humans by *Culex* spp., mosquitoes that feed on sparrows and crows
West Nile Fever

• Human to human spread has occurred through blood and organ donation
• Only one antigen type exists and immunity is presumed to be permanent
• Clinical manifestations
  – fever, lymphadenopathy, rash
  – >1/100 patients develop serious complications (e.g., encephalitis)
• Treatment, prevention, and control
  – serology tests
  – supportive treatment
  – mosquito control measures
38.3 Direct Contact Diseases

1. Report the common viral diseases spread by direct contact
2. Identify typical signs and symptoms of viral diseases spread by direct contact
3. Correlate direct contact virus infection and disease severity with viral virulence factors
Direct Contact Diseases

• Transmission of disease through direct personal contact
  – touching, kissing, sexual contact, contact with body fluids, contact with open wounds
  – many diseases including AIDS
Acquired Immune Deficiency Syndrome (AIDS)

- Caused by human immunodeficiency virus (HIV)
  - RNA virus family *Retroviridae*
    - Pandemic with uncertain origin
      - HIV-1 evolved from chimp virus SIVcpz
    - only group M HIV-1 is widespread in U.S.
    - HIV-2 is widespread in Africa
HIV Transmission

• When infected blood, semen, or vaginal secretions come in contact with uninfected person’s broken skin or mucous membranes
HIV Life Cycle

- Virion has viral protein spike, gp120
  - attaches to CD4 cells (T helper cells and other cells) and co-receptors CCR5 and CXCR4
- RNA virus carries reverse transcriptase into host cell
- Reverse transcribed into dsDNA, which integrates into human genome as provirus
HIV Life Cycle

- Integrates into host cell’s DNA as a provirus
- Can remain latent – asymptomatic
- Can direct synthesis of viral RNA $\rightarrow$ synthesis of new viral particles
  - new virion are assembled and released through budding and eventual lysis
Course of Disease

• Some patients rapidly develop clinical AIDS; die within 2–3 years

• Some patients remain relatively healthy for at least 10 years post infection

• In majority of patients HIV infection progresses to AIDS in 8–10 years

• T helper cell count reduces and opportunistic infections begin
CDC Classification System for Stages of HIV-Related Conditions

• Acute
  – 2–8 weeks after infection
  – most experience brief illness called acute retroviral syndrome
  – rapid multiplication and dissemination of virus throughout body
  – stimulation of immune response

• Asymptomatic (latent)
  – may last from 6 months to 10 or more years
  – levels of detectable HIV in blood decrease, although viral replication continues
  – effects on immune functions may occur
CDC Classification System for Stages of HIV-Related Conditions

• Chronic symptomatic
  – formerly called AIDS-related complex
  – can last for months to years
  – viral replication continues
  – numbers of CD4\(^+\) cells in blood significantly decrease

• results in patients developing a variety of illnesses often caused by opportunistic pathogens and AIDS related cancers
### Table 38.1 Disease Processes Associated with AIDS

<table>
<thead>
<tr>
<th>Disease Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candidiasis of bronchi, trachea, or lungs</td>
</tr>
<tr>
<td>Candidiasis, esophageal</td>
</tr>
<tr>
<td>Cervical cancer, invasive</td>
</tr>
<tr>
<td>Coccidioidomycosis, disseminated or extrapulmonary</td>
</tr>
<tr>
<td>Cryptosporidiosis, chronic intestinal (≥1 month’s duration)</td>
</tr>
<tr>
<td>Cyclospora, diarrheal disease</td>
</tr>
<tr>
<td>Cytomegalovirus disease (other than liver, spleen, or lymph nodes)</td>
</tr>
<tr>
<td>Cytomegalovirus retinitis (with loss of vision)</td>
</tr>
<tr>
<td>Encephalopathy, HIV-related</td>
</tr>
<tr>
<td>Herpes: chronic ulcer(s) (≥1 month’s duration); or bronchitis, pneumonitis, or esophagitis</td>
</tr>
<tr>
<td>Histoplasmosis, disseminated or extrapulmonary</td>
</tr>
<tr>
<td>Isosporiasis, chronic intestinal (≥1 month’s duration)</td>
</tr>
<tr>
<td>Kaposi’s sarcoma</td>
</tr>
<tr>
<td>Lymphoma, Burkitt’s</td>
</tr>
<tr>
<td>Lymphoma, immunoblastic</td>
</tr>
<tr>
<td>Lymphoma, primary, of brain</td>
</tr>
<tr>
<td><em>Mycobacterium avium complex or M. kansasii</em></td>
</tr>
<tr>
<td><em>Mycobacterium tuberculosis infection</em>, any site</td>
</tr>
<tr>
<td><em>Mycobacterium infection</em>, other species or unidentified species</td>
</tr>
<tr>
<td>Pneumocystis pneumonia</td>
</tr>
<tr>
<td>Pneumonia, recurrent</td>
</tr>
<tr>
<td>Progressive multifocal leukoencephalopathy</td>
</tr>
<tr>
<td><em>Salmonella</em> septicemia, recurrent</td>
</tr>
<tr>
<td>Toxoplasmosis of brain</td>
</tr>
<tr>
<td>Wasting syndrome</td>
</tr>
</tbody>
</table>
CDC Classification System for Stages of HIV-Related Conditions

• AIDS – fourth and last stage
  – immune system no longer able to defend against virus

• Definition of AIDS
  – all HIV-infected individuals who have fewer than 200 CD4$^{+}$ T cells/microliter of blood or a CD4$^{+}$ cell percentage of lymphocytes of less than 14
Central Nervous System Disease Caused by HIV

- Headaches, fever, subtle cognitive changes, abnormal reflexes, and ataxia
- Dementia and severe sensory and motor changes observed in advanced cases
- Autoimmune neuropathies, cerebrovascular disease, and brain tumors are common
Diagnosis

- Viral isolation and culture
- Assays for reverse transcriptase activity or viral antigens
- Most commonly done by detection of specific anti-HIV antibodies in the blood
  - routine screening tests use ELISA assays which have many false positive results which are retested using Western blot technique
- Most sensitive test uses polymerase chain reaction
Treatment

• No cure for AIDS
• Treatment directed at reducing viral load, disease symptoms, and treating disease and malignancies
• Most successful treatment involves a combination of drugs
  – nucleoside reverse transcriptase inhibitors, e.g., AZT
  – nonnucleoside reverse transcriptase inhibitors, e.g., delavirdine
  – protease inhibitors, e.g., indinavir
  – fusion inhibitors (FIs) – prevent entry of HIV into cells, e.g., enfuvirtide
Prevention and Control

- Achieved primarily through education
- Barrier protection from blood and body fluids
- Not sharing intravenous needs or syringes
- Continued screening of blood and blood products
Vaccine

• Not available but ongoing research

• Ideal vaccine
  – would stimulate the production of neutralizing antibodies which would bind to virus preventing it from entering host cells
  – promote formation of cytotoxic T cells capable of destroying cells infected with virus

• Problems with development of vaccine
  – envelope proteins of virus continually change their antigenic properties
Study of Long-Term Nonprogressors

• HIV-infected people who
  – maintain CD+ T cell counts of at least 600 cells/μl of blood
  – have <5,000 copies of HIV RNA/ml of blood
  – have remained this way for >10 years after documented infection

• Explanations of phenomena
  – effective immune response to relatively conserved proteins
  – initial infection was with attenuated strain
  – predisposing genetic differences
Cold Sores

• Fever blisters (herpes labialis)
• Usually caused by herpes simplex virus type 1 (HSV-1); rarely herpes simplex virus type 2 (HSV-2)
  – enveloped dsDNA virus with icosahedral capsid
• HSV infect epithelium at oral sites
  – virus enters cells, migrates to nucleus
  – active infection
    • explosive multiplication of virus
  – latent infections
    • virus moves to trigeminal ganglion and is non-detectable unless reactivated
Cold Sores

• Clinical manifestations
  – characteristic blister at site of inoculation
  – gingivostomatitis – lips, mouth, and gums
  – herpetic keratitis – cornea
  – lifetime latency develops, with periodic reactivation in times of stress

• Treatment, prevention, and control
  – diagnosis by ELISA, direct fluorescent antibody screening of tissue or PCR
  – acyclovir and other antivirals
  – no vaccine, education important
Common Cold

• Caused by many different rhinoviruses (ssRNA viruses); also by corona-viruses and parainfluenza viruses

• Seasonal peaks and transmitted by:
  – excretion of virus in nasal secretion
  – airborne transmission by droplets
  – contaminated hands or fomites

• Symptomatic/supportive therapy
Cytomegalovirus Inclusion Disease

• Worldwide distribution
  – caused by human cytomegalovirus (HCMV)
  – dsDNA virus, *Herpesviridae*
  – enveloped icosahedral capsid
  – HCMV can infect any cell of the body
  – causes formation of intra-nuclear inclusion bodies and cytoplasmic inclusions
HCMV Inclusion Disease

- Virus shed in semen and cervical solutions
  - can be transmitted by transfusions/organ transplants
- Usually asymptomatic infection
  - can be serious in immunocompromised individuals
  - leading cause of congenital viral disease
  - symptoms often resemble mononucleosis
- Treatment, prevention, and control
  - antiviral agents used for high-risk patients
  - avoiding close personal contact with infected individual
  - blood transfusions and organ transplants from seronegative donors
Genital Herpes

• Usually caused by herpes simplex type 2
  – linear dsDNA
  – enveloped virus

• Very common sexually transmitted disease and to infant during vaginal delivery (congenital or neonatal herpes)

• Active and latent disease with reactivations
**Genital Herpes**

- Clinical manifestations
  - fever, burning sensation, genital soreness, and blisters in infected area
  - blisters heal spontaneously, but virus remains latent and is periodically reactivated

- Can be treated with antiviral drugs (e.g., acyclovir)
Genital Herpes

• Congenital (neonatal) herpes
  – usually HSV-2
  – one of the most life-threatening of all infections in newborns
  – ~1,500–2,200 babies/year in U.S.
  – can result in neurologic involvement and blindness
  – Caesarian section recommended
Human Herpesvirus 6 Infections

• HHV-6
  – enveloped with icosahedral capsid
  – dsDNA
  – tropism is wide, including CD8\(^+\), CD4\(^+\), natural killer, and epithelial cells
  – proviral DNA in human chromosomes

• Probably transmitted in saliva
HHV-6 Infections

• Clinical manifestations
  – exanthem subitum
    • short-lived disease of infants
    • high fever for 3 to 4 days, followed by macular rash
  – pneumonitis in immunocompromised individuals
  – implicated in chronic fatigue syndrome, lymphadenitis, and multiple sclerosis in immunocompetent adults

• No treatment or prevention measures
Human Parvovirus B19 Infections

• Icosahedral, naked virus with ssDNA genome
  – genome so small that virus uses overlapping reading frames
  – tricks host into copying viral DNA
• Significant human pathogen
• Infection thought to be by respiratory route
Human Parvovirus B19: Clinical Manifestations

- Mild symptoms (fever, headaches, chills, malaise) in most normal adults
- Erythema infectiosum (fifth disease) in children
- Joint disease in some adults
- Aplastic crisis in sickle-cell disease or autoimmune hemolytic anemia
- Red cell aplasia in immunocompromised patients
- Anemia and fetal hydrops in fetuses
Human Parvovirus B19 Infections

- Treatment, prevention, and control
  - passive immunization with anti-B19 antibodies
  - infection usually followed by lifelong immunity
  - hand washing is best prevention for disease
Mononucleosis (Infectious)

- Caused by Epstein-Barr virus (EBV)
  - herpes virus
  - dsDNA, icosahedral with envelope
  - infects B cells
  - also associated with Burkitt’s lymphoma and nasopharyngeal carcinoma

- Spread by mouth-to-mouth contact
Mononucleosis

- Clinical manifestations
  - enlarged lymph nodes and spleen, sore throat, headache, nausea, general weakness and tiredness, and mild fever
  - self-limited disease, lasting 1 to 6 weeks

- Treatment, prevention, and control
  - rapid diagnostic tests
  - symptomatic/supportive therapy
Viral Hepatides

• Hepatitis
  – inflammation of liver
  – caused by 11 different viruses
    • 2 herpesviruses—Epstein-Barr virus (EBV) and cytomegalovirus (CMV)
      – cause mild, self-resolving disease
      – no permanent hepatic damage
      – signs and symptoms include fatigue, nausea, and malaise
    • 9 hepatotrophic viruses
### Table 38.2 Characteristics of Hepatitides Caused by Hepatotropic Viruses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Genome</th>
<th>Classification</th>
<th>Transmission</th>
<th>Outcome</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis A</td>
<td>RNA</td>
<td><em>Picornaviridae, Hepatovirus</em></td>
<td>Fecal-oral</td>
<td>Subclinical, acute infection</td>
<td>Killed HAV (Havrix vaccine)</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>DNA</td>
<td><em>Hepadnaviridae, Orthohepadnavirus</em></td>
<td>Blood, needles, body secretions, placenta, sexually</td>
<td>Subclinical, acute chronic infection; cirrhosis; primary hepatocarcinoma</td>
<td>Recombinant HBV vaccines</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>RNA</td>
<td><em>Flaviviridae, Hepacivirus</em></td>
<td>Blood, sexually</td>
<td>Subclinical, acute chronic infection; primary hepatocarcinoma</td>
<td>Routine screening of blood</td>
</tr>
<tr>
<td>Hepatitis D</td>
<td>RNA</td>
<td>Satellite</td>
<td>Blood, sexually</td>
<td>Superinfection or coinfection with HBV</td>
<td>HBV vaccine</td>
</tr>
<tr>
<td>Hepatitis E</td>
<td>RNA</td>
<td><em>Hepeviridae, Hepevirus</em></td>
<td>Fecal-oral</td>
<td>Subclinical, acute infection (but high mortality in pregnant women)</td>
<td>Improve sanitary conditions</td>
</tr>
</tbody>
</table>

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Hepatitis B (Serum Hepatitis)

- Hepatitis B virus (HBV)
  - dsDNA virus
  - Dane particle is infectious virion
  - transmitted through body fluids and intra-venous equipment
  - can pass the placenta and breast milk
  - ~1.25 million chronically infected in U.S., 200 million worldwide
Hepatitis B (Serum Hepatitis)

- **Clinical signs**
  - most cases asymptomatic
  - generalized symptoms occurs after 1–3 month incubation period
  - virus infects liver hepatic cells causing liver damage
    - yellow appearance (jaundice) results from bilirubin accumulation
- **Chronic infection can cause development of primary liver cancer (2nd only to tobacco as known cause of cancer)**
Hepatitis B (Serum Hepatitis)

• Prevention and control
  – passive immunotherapy within 7 days of exposure
  – excluding contact with contaminated materials
  – vaccination of high-risk groups
    • 0–18 year olds
    • contacts of carriers
    • health-care professionals
Hepatitis C Virus (HCV)

• RNA virus in *Flaviridae* family
  – multiple genotypes

• Transmission virus contaminated blood, fecal oral route, also spread from mother to fetus, and through organ transplants

• Epidemic with more than 1 million new cases/yr in U.S.
Hepatitis C Virus (HCV)

- Chronic infection common
- Leading cause of liver transplant in U.S.
- Treatment, prevention, and control
  - ELISA test for antibodies and PCR for nucleic acid
  - combination therapy of Ribovirin and recombinant interferon-alpha
Hepatitis Delta Virus (HDV)

- Delta agent, RNA virus discovered in 1977
- Dependent on HBV to provide the envelope protein (HbsAG) for HDV RNA genome
  - similarities to viroids and virusoids
- Transmission by body fluids
Hepatitis Delta Virus (HDV)

- Causes severe acute and chronic hepatitis in HBV infected
- Treatment, prevention, and control
  - serological tests for anti-HDV antibodies
  - no satisfactory treatment
Warts

- Verrucae - horny projections on skin associated with human papillomaviruses
  - DNA virus, *Papillomaviridae* family
  - more than 100 different strains
  - infect epithelium and mucus membranes
  - benign epithelial tumors and cancers
Warts

- Four major types
  - plantar warts
  - verrucae vulgaris
  - flat or plane warts
  - anogenital condylomata (genital warts)
- Direct contact and autoinoculation
- Treatment
  - physical destruction, topical application of drug podophyllum, or injection of IFN-α
Genital Warts (Anogenital Condylomata)

• Very common sexually transmitted HPV
  – 1–6 month incubation period
  – warts, usually multiple, found on external genitalia, in vagina, or cervix or in rectum
  – most infections clear spontaneous

• Specific types of HPV cause at least 90% of cervical cancers

• Vaccine available against HPV 16 and 18 (responsible for causing ~80% of cervical cancers)
38.4 Food-Borne and Waterborne Diseases

1. Report the common food-borne and waterborne viral diseases

2. Identify typical signs and symptoms of common food-borne and waterborne viral diseases

3. Correlate food-borne and waterborne virus infection and disease severity with viral virulence factors
Gastroenteritis (Viral)

• Acute viral gastroenteritis
  – inflammation of stomach or intestines
  – important disease of infants and children
  – leading cause of childhood death in developing countries
  – probably spread by fecal-oral route

• Caused by four major groups of viruses
Gastroenteritis (Viral)

- Rotavirus, adenovirus, and astrovirus
  - ~5–10 million deaths/year worldwide
  - viral diarrhea transmitted by fecal oral route
  - rotavirus live oral vaccines
- Norovirus
  - ~23 million cases of acute gastroenteritis per year
  - usually self-limited disease
  - symptomatic/supportive therapy
### Table 38.3  Medically Important Gastroenteritis Viruses

<table>
<thead>
<tr>
<th>Virus</th>
<th>Epidemiological Characteristics</th>
<th>Clinical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotaviruses</td>
<td>Endemic diarrhea in infants worldwide</td>
<td>Dehydrating diarrhea for 5–7 days; fever, abdominal cramps, nausea, and vomiting common</td>
</tr>
<tr>
<td>Group A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group B</td>
<td>Large outbreaks in adults and children in China</td>
<td>Severe watery diarrhea for 3–5 days</td>
</tr>
<tr>
<td>Group C</td>
<td>Sporadic cases in children in Japan</td>
<td>Similar to group A</td>
</tr>
<tr>
<td>Noroviruses</td>
<td>Epidemics of vomiting and diarrhea in older children and adults; occur in families, communities,</td>
<td>Acute vomiting, fever, myalgia, and headache lasting 1–2 days, diarrhea</td>
</tr>
<tr>
<td></td>
<td>and nursing homes; often associated with shellfish, other food, or water and infected food</td>
<td></td>
</tr>
<tr>
<td></td>
<td>handlers, cruise ship occurrences</td>
<td></td>
</tr>
<tr>
<td>Sapoviruses</td>
<td>Pediatric diarrhea; also associated with shellfish and other foods in adults</td>
<td>Rotavirus-like illness in children; norovirus-like illness in adults</td>
</tr>
<tr>
<td>Astroviruses</td>
<td>Pediatric diarrhea; also reported in nursing homes</td>
<td>Watery diarrhea for 1–3 days</td>
</tr>
<tr>
<td>Adenoviruses</td>
<td>Pediatric diarrhea; also reported on military bases</td>
<td>Gastroenteritis, more severe in immunocompromised adults</td>
</tr>
</tbody>
</table>
Hepatitis A Virus

- Infectious hepatitis
- HAV (*Picornaviridae* family)
  - icosahedral, naked virus
  - positive strand linear RNA
- Spread by fecal-oral contamination of food, drink, or shellfish
Hepatitis A

• Clinical manifestations
  – usually mild intestinal infection
    • anorexia, general malaise, nausea, diarrhea, fever, and chills
  – occasionally viremia occurs leading to liver infection
    • jaundice

• Treatment, prevention, and control
  – immunodiagnostic tests for HAV antibodies
  – simple hygienic measures, sanitary disposal of excreta, and killed HAV vaccine
Hepatitis E Virus

- implicated in many epidemics in developing countries
- transmission by fecal contaminated water
- similar to HAV course of disease
- ~15%–25% fatality rates in pregnant women
Poliomyelitis

• Polio (infantile paralysis)
• Caused by poliovirus
  – plus strand RNA enterovirus
  – three subtypes with no cross immunity
  – very stable in food and water
  – multiplies in throat and intestinal mucosa
Polio

• Clinical manifestations
  – usually asymptomatic or brief, mild illness
    • fever, headache, sore throat, vomiting, loss of appetite
  – viremia sometimes occurs
    • usually transient; no clinical disease
    • sometimes persists and virus enters central nervous system causing paralytic polio

• Prevented by immunization with live vaccine and killed vaccine

• Likely to be the next human disease to be completely eradicated
38.5 Zoonotic Diseases

1. Report the common viral diseases spread by contact with infected animals
2. Identify typical signs and symptoms of zoonotic viral diseases
3. Correlate zoonotic virus infection and disease severity with viral attachment factors
Zoonotic Diseases

• Human viral infections in animal reservoirs before transmission to and between humans

• RNA viruses, many are on Select Agents list as potential bioweapons
  – Ebola and Marburg viruses
  – hantaviruses
  – Lassa fever virus
  – Nipah virus
Ebola and Marburg Hemorrhagic Fevers

• Viral hemorrhagic fever (VHF)
  – severe multisystem syndrome caused by many distinct viruses
  – overall host vascular system is damaged leading to vascular leaking (hemorrhage) and dysfunction (coagulopathy)
Ebola Hemorrhagic Fever

- Member of single-stranded, negative sense RNA family called the Filoviridae
- Infection is severe and ~80% fatal
- No known carrier state; fruit bat may be reservoir
- Transmission from direct contact with Ebola victim, body fluids or clinical samples
- Internal hemorrhaging
- Supportive therapy; no treatment available
- Experimental vaccines being evaluated
Marburg Hemorrhagic Fever

• Genetically unique RNA virus in *Filoviridae*
• Rare, severe disease that affects human and nonhuman primates
• Indigenous to Africa
• Definitive animal host not identified
• Symptoms come on abruptly and become increasingly severe → multi-organ dysfunction
• Supportive therapy but no specific treatment available
Hantavirus Pulmonary Syndrome (HPS)

- Single-stranded, negative sense RNA virus in *Bunyaviridae* family
- Transmitted to humans by inhalation of virus particles shed in urine, feces, or saliva of infected rodents
- Potentially deadly for humans but do not cause disease in their reservoir (rodent) hosts
- Supportive therapy but no specific treatment available
**Rabies**

- Caused by different strains of rabies virus
  - negative strand, bullet shaped, RNA virus
  - highly neurotropic
- Transmitted by:
  - bites of infected animals
  - aerosols in caves where bats roost
  - contamination of scratches, abrasions, open wounds, or mucous membranes with saliva of infected animals
- Fewer than 10 cases/yr in U.S.
Rabies

- Enters host cell and multiplies
- Enters nervous system, spreads to spinal cord
  - first specific symptoms (pain or paresthesia at wound) may occur
- Rapidly progressive encephalitis develops as virus spreads through central nervous system
- Then spreads through body along peripheral nerves, including salivary glands, where it is shed in saliva
Rabies

• Clinical manifestations
  – begins 2 to 16 weeks after exposure
  – pain or paresthesia at wound site, anxiety, irritability, depression, fatigue, loss of appetite, fever, and sensitivity to light and sound
  – quickly progresses to paralysis
  – death results from destruction of regions of the brain that regulate breathing
Rabies

• Diagnosis
  – previously used microscopic observation of Negri bodies, masses of viruses or unassembled particles
  – currently use direct immunofluorescent antibody (dIFA) of brain tissue, virus isolation, Negri body detection and a rapid rabies enzyme-mediated immunodiagnosis test
Rabies

• Treatment, prevention, and control
  – numerous diagnostic tests, including rapid immunodiagnostic tests
  – postexposure vaccination
  – preexposure vaccination of individuals with high risk of exposure, dogs, and cats
38.6 Prion Diseases

1. Describe diseases caused by prions
2. Differentiate prion disease by route of infection
Prion Diseases

• Transmissible spongiform encephalopathies
  – fatal neurogenerative disorders caused by prions
  – remains clinically silent for months or years
  – ends in profound disability or death

• Diseases include
  – Kuru, Creutzfeldt-Jacob (CJD) disease, and variant CJD, bovine spongiform encephalopathy (BSE)

• Transmission
  – medical procedures, genetic, food-borne
Prion Diseases

- Prions (protein infectious particles) consist of abnormally folded proteins (PrPsc) which can induce normal forms of protein PrPc to abnormally fold.

- BSE agent survives gastrointestinal tract passage, and is neurotropic, both serve as source of agent.
Prion Diseases

- Dementia is primary symptom
- Usually accompanied by motor dysfunction
- Symptoms appear after prolonged incubation and last from months to years prior to death
- Produce characteristic spongiform degeneration of brain and deposition of amyloid plaques
- Share many characteristics with Alzheimer’s disease
New-Variant CJD

- Transmitted from cattle with bovine spongiform encephalopathy (BSE) or mad cow disease
- Cattle experimentally infected with BSE test positive for prion agent
  - evidence suggests human vCJD may be acquired by eating meat products (brain and spinal cord tissue) from infected cattle

<table>
<thead>
<tr>
<th>Disease</th>
<th>Nature of Disease</th>
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<tbody>
<tr>
<td>Creutzfeldt-Jakob disease (CJD) (sporadic, iatrogenic, familial, new-variant)</td>
<td>Spongiform encephalopathy (degenerative changes in the central nervous system)</td>
</tr>
<tr>
<td>Kuru</td>
<td>Spongiform encephalopathy</td>
</tr>
<tr>
<td>Gerstmann-Sträussler-Scheinker disease (GSD)</td>
<td>Genetic neurodegenerative disease</td>
</tr>
<tr>
<td>Fatal familial insomnia (FFI)</td>
<td>Genetic neurodegenerative disease with progressive, untreatable insomnia</td>
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</tbody>
</table>