#### **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





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## 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

- Respiratory system disease caused by influenza virus
  - RNA virus; segmented genome
  - fours 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

- 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



- 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

- 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)







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#### 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



World Health Organization (WHO)/Brian W.J. Mahy, BSc, MA, PhD, ScD, DSc

#### **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 arthropodborne 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 Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



## **HIV Life Cycle**

- Virion has viral protein spike, gp120
  - attaches to CD4 cells (T helper cells and other cells) and co-receptors CCR5 and CXCR-4
- RNA virus carries reverse transcriptase into host cell
- Reverse transcribed into dsDNA, which integrates into human genome as provirus

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## **HIV Life Cycle**

- Integrates into host cell's DNA as a provirus
- Can remain latent asymptomatic
- Can direct synthesis of viral RNA → 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

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# **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<sup>+</sup> cells in blood significantly decrease
    - results in patients developing a variety of illnesses often caused by opportunistic pathogens and AIDS related cancers



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#### Table 38.1Disease Processes Associated with AIDS

Candidiasis of bronchi, trachea, or lungs

Candidiasis, esophageal

Cervical cancer, invasive

Coccidioidomycosis, disseminated or extrapulmonary

Cryptosporidiosis, chronic intestinal (>1 month's duration)

Cyclospora, diarrheal disease

Cytomegalovirus disease (other than liver, spleen, or lymph nodes)

Cytomegalovirus retinitis (with loss of vision)

Encephalopathy, HIV-related

Herpes: chronic ulcer(s) (>1 month's duration); or bronchitis, pneumonitis, or esophagitis

Histoplasmosis, disseminated or extrapulmonary

Isosporiasis, chronic intestinal (>1 month's duration)

Kaposi's sarcoma

Lymphoma, Burkitt's

Lymphoma, immunoblastic

Lymphoma, primary, of brain

Mycobacterium avium complex or M. kansasii

Mycobacterium tuberculosis infection, any site

*Mycobacterium infection,* other species or unidentified species

Pneumocystis pneumonia

Pneumonia, recurrent

Progressive multifocal leukoencephalopathy

Salmonella septicemia, recurrent

Toxoplasmosis of brain

Wasting syndrome

# **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<sup>+</sup> T cells/microliter of blood or a CD4<sup>+</sup> 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 though 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</li>
  - 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 nondetectable 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





CDC/Dr Herrman

**Common Cold** 

 Caused by many different rhinoviruses (ssRNA viruses); also by coronaviruses 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 intranuclear inclusion bodies and cytoplasmic inclusions



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Courtesy of Dan Wiedbrauk, Ph.D, Warke Medical Laboratory Ann Arbor, Michigan

# **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)

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a: CDC/Dr. Fred Murphy & Sylvia Whitfield; b: CDC/Dr. Fiumara and Dr. Gavin Hart; c: CDC/Susan Lindsley

#### **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<sup>+</sup>, CD4<sup>+</sup>, 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

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CDC

- 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

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- 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

rapid diagnostic tests

Nucleus

Barbara O'Connor

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 hepatotropic viruses

Table 38.2	Characteristics of Hepatitides Caused by Hepatotropic Viruses				
Disease	Genome	Classification	Transmission	Outcome	Prevention
Hepatitis A	RNA	Picornaviridae, Hepatovirus	Fecal-oral	Subclinical, acute infection	Killed HAV (Havrix vaccine)
Hepatitis B	DNA	Hepadnaviridae, Orthohepadnavirus	Blood, needles, body secretions, placenta, sexually	Subclinical, acute chronic infection; cirrhosis; primary hepatocarcinoma	Recombinant HBV vaccines
Hepatitis C	RNA	Flaviviridae, Hepacivirus	Blood, sexually	Subclinical, acute chronic infection; primary hepatocarcinoma	Routine screening of blood
Hepatitis D	RNA	Satellite	Blood, sexually	Superinfection or coinfection with HBV	HBV vaccine
Hepatitis E	RNA	Hepeviridae, Hepevirus	Fecal-oral	Subclinical, acute infection (but high mortality in pregnant women)	Improve sanitary conditions

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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





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# 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 (2<sup>nd</sup> 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



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#### 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- $\alpha$

# Genital Warts (Anogenital Condylomata)

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(c)

- 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)

b: CKenneth Greer/Visuals Unlimited; c: CDC
# **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 foodborne 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

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Table 38.3	Medically Important Gastroenteritis Viruses		
Virus	Epidemiological Characteristics	Clinical Characteristics	
Rotaviruses Group A	Endemic diarrhea in infants worldwide	Dehydrating diarrhea for 5–7 days; fever, abdominal cramps, nausea, and vomiting common	
Group B	Large outbreaks in adults and children in China	Severe watery diarrhea for 3–5 days	
Group C	Sporadic cases in children in Japan	Similar to group A	
Noroviruses	Epidemics of vomiting and diarrhea in older children and adults; occur in families, communities, and nursing homes; often associated with shellfish, other food, or water and infected food handlers, cruise ship occurrences	Acute vomiting, fever, myalgia, and headache lasting 1–2 days, diarrhea	
Sapoviruses	Pediatric diarrhea; also associated with shellfish and other foods in adults	Rotavirus-like illness in children; norovirus-like illness in adults	
Astroviruses	Pediatric diarrhea; also reported in nursing homes	Watery diarrhea for 1–3 days	
Adenoviruses	Pediatric diarrhea; also reported on military bases	Gastroenteritis, more severe in immunocompromised adults	

#### **Hepatitis A Virus**

- Infectious hepatitis
- HAV (Picornaviradae 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



100 nm

#### **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

- 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.



- 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

- 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

- 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

- 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



- 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**

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Table 38.4      Prion Diseases of Humans	Prion Diseases of Humans		
Disease	Nature of Disease	Nature of Disease	
Creutzfeldt-Jakob disease (CJD) (sporadic, iatroge new-variant)	familial, Spongiform encephalopathy (degen nervous system)	Spongiform encephalopathy (degenerative changes in the central nervous system)	
Kuru	Spongiform encephalopathy	Spongiform encephalopathy	
Gerstmann-Sträussler-Scheinker disease (GSD)	Genetic neurodegenerative disease	Genetic neurodegenerative disease	
Fatal familial insomnia (FFI)	Genetic neurodegenerative disease	Genetic neurodegenerative disease with progressive, untreatable insomnia	

- 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