

# Virology Summary (Med-Term)

## **General Properties of Viruses**

- Viruses are the smallest infectious agents and contain only one type of nucleic acid (DNA or RNA).
  - Known viruses are highly diverse, varying in size, shape, and genetic content; only some types possess a lipid envelope.
  - Viruses are classified into groups, designated virus families, based on common properties, such as virion morphology, genome structure, virus protein properties, and strategies of replication.
  - Viruses are obligate intracellular parasites and multiply only in living cells. The viral nucleic acid encodes virus specific products, and the host cell provides energy, biochemical precursors, and biosynthetic machinery.
  - Steps in viral replication include attachment to a cell via binding to specific receptors on the cell surface, entry into the cell, uncoating of the viral genome, regulated expression of viral transcripts, synthesis of viral proteins, replication of viral genomic nucleic acid, assembly of new progeny viruses, and release of new virions from the cell. The duration of replication cycles varies widely among different virus types. The infected cells may be killed or may survive with little damage. Not all infections lead to new progeny virus.
  - New viral diseases are emerging, termed “emerging infectious diseases,” as new agents are recognized, known agents evolve and spread, and new host populations become infected.
  - Some viruses are potential bioterrorism agents based on ease of host-to-host transmission and mortality rates.
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## **Pathogenesis and Control of Viral Diseases**

- Viral pathogenesis is the process when a virus infects a host.
- Most viruses enter their hosts through the respiratory or gastrointestinal tract.
- Most viral infections are inapparent and do not result in clinical disease.
- Most viral infections are self-limiting and are cleared by the host, but some lead to chronic (persistent) long-term infections.
- Both innate and adaptive immune responses (both humoral and cellular components) are important in recovery from viral infections.
- Interferons are cytokines that are central to the antiviral innate immune response of the host.
- Both viral and host factors determine the outcome of viral infections.

- Some viruses cause localized infections at the primary site of entry; other viruses spread and produce disease at distant sites in the body.
  - A few viruses can infect the fetus in utero and may cause serious damage, leading to fetal death or congenital defects.
  - Relatively few effective antiviral drugs exist because of difficulties in selectively inhibiting viral functions and not cell processes; available ones primarily target human immunodeficiency virus and herpesviruses.
  - Viral vaccines are the most effective method for preventing viral infections; vaccines are available against several serious viral diseases.
  - Both killed-virus and live-virus vaccines are available; each type has certain advantages and disadvantages.
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### **Parvoviruses**

- Parvoviruses are small, very simple viruses with singlestranded DNA genomes.
  - Human B19 virus targets erythroid progenitor cells.
  - B19 is associated with erythema infectiosum (fifth disease), transient aplastic crisis, pure red cell aplasia, and hydrops fetalis (most commonly in early pregnancy).
  - Human bocaviruses have been linked with acute respiratory disease and gastroenteritis in children, but causation has not been proven.
  - Human B19 and bocaviruses are difficult to grow; laboratory diagnosis depends on molecular assays.
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### **Adenoviruses**

- Adenoviruses are nonenveloped, icosahedral viruses with a DNA genome.
- Adenoviruses exist all over the world and are present year round; community outbreaks of disease are unusual.
- Adenoviruses are excellent models for molecular studies of eukaryotic cell processes.
- Several serotypes induce tumors in laboratory animals and serve as models for studies of cancer mechanisms.
- Group C viruses establish long-term latent infections in tonsils and adenoids.
- Group C viruses cause respiratory infections in children (types 1–7) and in military recruits (types 3, 4, 7).

- Types 8, 19, and 37 cause severe eye infections (epidemic keratoconjunctivitis).
  - Enteric adenoviruses, types 40 and 41, cause gastroenteritis in young children.
  - There are no specific treatments for adenovirus infections.
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## Herpesviruses

- Herpesviruses are large viruses with a double-stranded DNA genome; about 100 different herpesviruses are known that infect different species.
- Members of the herpesvirus family vary widely in biologic properties.
- All herpesviruses establish lifelong latent infections. • Several herpesviruses are important human pathogens, causing a wide variety of diseases.
- Diseases associated with primary infection and reactivated infection by a given herpesvirus may vary markedly.
- Herpesviruses may cause severe disease in immunocompromised persons.
- Herpes simplex virus types 1 and 2 share some sequence homology, exhibit a broad host range, grow rapidly, and establish latent infections in nerve cells.
- Herpes simplex virus type 1 is usually associated with oropharyngeal lesions, and type 2 primarily causes genital infections.
- Several antiviral drugs are effective against herpes simplex virus.
- Herpes simplex virus type 1 is the most common cause of sporadic, fatal encephalitis.
- Varicella-zoster virus causes chickenpox on primary infection in children and zoster (shingles) after reactivation in adults.
- A live, attenuated varicella vaccine is available. A stronger version of the vaccine is licensed to prevent shingles in older individuals.
- Cytomegaloviruses are important causes of developmental defects and mental retardation after congenital infections.
- Inapparent infections with cytomegalovirus are common during childhood.
- Organ transplant recipients are at risk for reactivated cytomegalovirus disease, especially pneumonia.
- Varicella-zoster virus and cytomegalovirus grow slowly in cell culture.
- Epstein-Barr virus establishes latent infections in B lymphocytes.
- Epstein-Barr virus causes infectious mononucleosis and is associated with several human cancers, including Burkitt lymphoma and nasopharyngeal carcinoma.
- Kaposi sarcoma herpesvirus is not as ubiquitous as other herpesviruses.

- Kaposi sarcoma herpesvirus is the cause of Kaposi sarcoma, a vascular tumor.
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## **Hepatitis viruses**

- Five different viruses are causative agents of hepatitis (inflammation of the liver): hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), hepatitis D virus (HDV), and hepatitis E virus (HEV).
- The five hepatitis viruses are classified in different virus families and genera, varying in virion, genome properties, and replication patterns.
- HAV and HEV are transmitted by fecal–oral exposures; HBV, HCV, and HDV are transmitted by parenteral routes.
- HAV causes outbreaks of disease, often in camps or institutions.
- Whereas HBV, HCV, and HDV frequently establish chronic infections, HAV and HEV do not.
- Serologic markers help determine the causative agent of individual cases of hepatitis.
- Most individuals infected with HBV as infants develop chronic infections and are at risk for liver disease as adults.
- The majority of HCV infections lead to chronic infections even in adults; those individuals are at risk of later development of liver disease.
- Liver disease associated with HCV is the most frequent cause for adult liver transplantation.
- HDV superinfections of HBV carriers may lead to highly fatal fulminant hepatitis.
- HBV and HCV are both causes of liver cancer that may arise many years after infection.
- Virus vaccines are available against HAV and HBV.