Notes on

Medical Virology

What YOU Really Need To Know

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Preface

Medical virology is always an interest to all healthcare disciplines, undergraduate and postgraduate students. These *"Notes on Medical virology"*, includes *"what you really need to know"*. The book comes in a new format, which places cases, keywords, facts and other considerations in colored tables and boxes only. As a result, extra spaces have been provided so that without expanding the length of the book the readers can enjoy a personal and practical learning experience.

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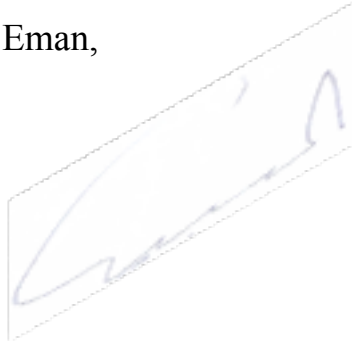

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Notes on Medical Virology what you Really Need to Know

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1. Some General Concepts

Viruses contribute significantly to the global burden of infectious diseases. Most of the diseases are mild, but viruses may cause severe diseases in susceptible individuals, such as the mal-nourished, immuno-compromised, the very old and the very young.

What is a virus?	Very simple structures consisting essentially of a nucleic acid genome, protected by a shell of protein. May or may not have a lipoprotein envelope. Has no organelle. Very small, sizes range 20 - 200 nm, beyond the resolving power of the light microscope. Metabolically inert and can only replicate inside a host cell. Genome consists of ONLY one type of nucleic acid; either RNA or DNA. Viral genome codes for the few proteins necessary for replication: some proteins are non-structural e.g. polymerase, and some are structural, i.e. form part of the virion structure.

2. Terminology

Virion	Infectious virus particle
Capsid	Protein shell which surrounds and protects the genome. It is built up of multiple (identical) protein sub-units called capsomers. Capsids are either icosahedral or tubular in shape.
Nucleocapsid	Genome + capsid.
Envelope	Lipoprotein membrane which surrounds some viruses, derived from the plasma membrane of the host cell.
Glycoproteins	Proteins found in the envelope of the virion; usually glycosylated.

3. Classification of Viruses

Viruses are mainly classified by phenotypic characteristics, such as morphology, nucleic acid type, mode of replication, host organisms, and the type of disease they cause.

Morphology	Helical morphology is seen in many filamentous and pleomorphic viruses. Icosahedral morphology is characteristic of many “spherical” viruses. The number and arrangement of the capsomeres (morphologic subunits of the icosahedron) are useful in identification and classification. Many viruses also have an outer envelope.
Chemical Composition and Mode of Replication	The genome of a virus may consist of DNA or RNA, which may be single stranded (ss) or double stranded (ds), linear or circular. The entire genome may occupy either one nucleic acid molecule (monopartite genome) or several nucleic acid segments (multipartite genome). The different types of genome necessitate different replication strategies.
Classification of viruses	A classification places viruses into one of seven groups depending on a combination of their nucleic acid (DNA or RNA), strandedness (single-stranded or double-stranded), Sense, and method of replication. Viruses can be placed in one of the seven following groups: a. dsDNA viruses (e.g. Adenoviruses, Herpesviruses, Poxviruses) b. ssDNA viruses (+ strand or “sense”) DNA (e.g. Parvoviruses) dsRNA viruses (e.g. Reoviruses) c. (+)ssRNA viruses (+ strand or sense) RNA (e.g. Picornaviruses, Togaviruses) d. (−)ssRNA viruses (− strand or antisense) RNA (e.g. Orthomyxoviruses, Rhabdoviruses) e. ssRNA-RT viruses (+ strand or sense) RNA with DNA intermediate in life-cycle (e.g. Retroviruses) f. dsDNA-RT viruses (e.g. Hepadnaviruses)

4. Atypical Virus Like Particles

There are four exceptions to the typical virus as described previously:

Defective viruses	Composed of viral nucleic acid and proteins, but cannot replicate without a helper virus.
Pseudoviruses	Contain host DNA instead of viral DNA.
Viriods	Consist of a single molecule of circular RNA with no protein coat or envelope.
Prions	Smallest known infectious particles.

5. Viral Replication

Viruses are totally dependent on a host cell to replicate. While the sequence and period of events varies somewhat from virus to virus, the general strategy of replication is similar:

Adsorption (attachment)	Highly specific, the surface of the virion contains structures that interact receptors on the surface of the host cell. It defines and limits the host species and type of cell that can be infected by a particular virus. Damage to the binding sites on the virion or blocking by specific antibodies (neutralization) can render virions non-infectious.
Uptake (Penetration)	The process whereby the virion enters the cell; as a result of fusion of the viral envelope with the plasma membrane of the cell or endocytosis.
Uncoating	The protein coat of the virion dissociates and the viral genome is released into the cytoplasm.
Early phase	Transcription of viral mRNA and translation of a number of non-structural ("early") proteins takes place.
Genome replication	Multiple copies of the viral genome are synthesized by a viral polymerase.
Late phase	Transcription and translation of viral mRNA and synthesis of the structural "late" proteins which are needed to make new virions.
Assembly (of new virions)	The proteins self-assemble and a genome enters each new capsid. This takes place either in the nucleus or in the cytoplasm of the cell, or sometimes, just beneath the cell surface.
Release of progeny virions	Release of new infectious virions is the final stage of replication. This may occur either by budding from plasma membrane (for enveloped viruses), or else by disintegration (lysis) of the infected cell (for non-enveloped viruses). Some viruses use the secretory pathway to exit the cell.

6. How do Viruses Cause Diseases?

Viruses are capable of infecting all types of living organisms from bacteria to humans.

Cell tropism	A major factor that controls which cell type a virus can infect; presence of the appropriate receptor on the cell surface, to which the virus must attach in order to gain entry into the cell.
Viruses enter the body	By inhalation, ingestion, sexually, parentral or inoculation through the skin or mucous membranes. Infection may also sometimes be passed from a mother to her fetus transplacentally (vertical transmission).
Type of infection	May either remain localised to the site of entry, or it may cause a disseminated infection according to the site of target. Virus replicates initially at the site of entry, but then enters the blood (viraemia) or lymphatics and spreads throughout the body .Other viruses may replicate locally initially, and then enter nerve endings and travel up the axon to infect the central nervous system.
Incubation period	Time from exposure to an organism to the onset of clinical disease. Viruses that cause localized infections have short incubation periods (<7 days), while in disseminated infections, the incubation period tends to be longer.
Immune response	Viruses replicate intracellularly, so recovery from a viral infection requires the action of specific cytotoxic T lymphocytes. Virus-specific antibody levels rise during the course of the infection, but antibody plays only a limited role in recovery. Specific antibodies play a very important role in preventing reinfection of the host with the same virus. Certain viruses are able to evade the immune response and establish persistent infections in their host.

7. Viral pathogenesis

Pathogenesis is the process by which an infection leads to disease.

Pathogenic Mechanisms of Viral Disease	1. Implantation of virus at the portal of entry. 2. Local replication. 3. Spread to target organs (disease sites). 4. Spread to sites of shedding of virus into the environment.
Factors that Affect Pathogenic Mechanisms	1. Accessibility of virus to tissue. 2. Cell susceptibility to virus multiplication. Virus susceptibility to host defenses. Natural selection favors the dominance of low-virulence virus strains.
Cellular Pathogenesis	Direct cell damage and death from viral infection may result from: 1. Diversion of the cell's energy. 2. Shutoff of cell macromolecular synthesis. 3. Competition of viral mRNA for cellular ribosomes. 4. Inhibition of the interferon defense mechanisms. Indirect cell damage can result from: 1. Integration of the viral genome. 2. Induction of mutations in the host genome. 3. Inflammation. 4. Host immune response.
Tissue Tropism	Viral affinity for specific body tissues is determined by: 1. Cell receptors for virus. 2. Cell transcription factors that recognize viral promoters and enhancer sequences. 3. Ability of the cell to support virus replication. 4. Physical barriers 5. Local temperature, pH, and oxygen tension enzymes and non-specific factors in body secretions. 6. Digestive enzymes and bile in the gastrointestinal tract that may inactivate some viruses.
Implantation at the Portal of Entry	Virions implant onto living cells mainly via the respiratory, gastrointestinal, skin-penetrating, and genital routes (other routes can be used). The final outcome of infection may be determined by the dose, location of the virus, infectivity and virulence.
Local Replication and Local Spread	Most viruses spread among cells extra-cellularly, but some may also spread intra-cellularly. Local infection may lead to localized disease and localized shedding of virus.
Dissemination from the Portal of Entry	Viremic: The most common route of systemic spread from the portal of entry is the circulation, which the virus reaches via the lymphatics. Neural: Dissemination via nerves usually occurs (e.g rabies, herpes and poliovirus).
Multiplication in Target Organs	Depending on the balance between virus and host defenses.
Shedding of Virus	Respiratory tract, alimentary tract, urogenital tract and blood are the most frequent sites of shedding, but diverse viruses may be shed at virtually every site.
Congenital Infections	Infection of the fetus as a target "organ". The virus must cross additional physical barriers. Transfer of the maternal defenses is partially blocked by the placenta, the developing first-trimester fetal organs are vulnerable to infection, and hormonal changes are taking place.

8. Antivirals

In principle, a molecule can act as an anti-viral drug if it inhibits some stage of the virus replication cycle, without being too toxic to the body's cells. The possible modes of action of anti-viral agents would include being able to prevent:

1. Viral attachment and/or entry.
2. Replication of the viral genome.
3. Synthesis of specific viral protein(s).
4. Assembly or release of new infectious virions, or inactivate extracellular virus particles.
5. It must keep in mind that the potential problem of the emergence of mutant virus strains resistant to a drug is always a concern.

Before cell entry	Can be inhibited in two ways: • Using agents which mimic the virus-associated protein (VAP) and bind to the cellular receptors. • Using agents which mimic the cellular receptor and bind to the VAP.
Entry inhibitor	A number of "entry-inhibiting" or "entry-blocking" drugs are being developed to fight HIV.
Uncoating inhibitor	Amantadine and rimantadine, have been introduced to combat influenza. These agents act on penetration/uncoating.
Reverse transcription	By developing nucleotide or nucleoside analogues and deactivate the enzymes that synthesize the RNA or DNA once the analogue is incorporated. This is associated with the inhibition of reverse transcriptase .
Integrase	Splices the synthesized DNA into the host cell genome.
Transcription	Block attachment of transcription factors to viral DNA.
Translation	Based on "antisense" molecules or ribozyme antivirals that have been developed to treat HIV infections.
Protease inhibitors	It is used to treat selected patients with HIV infection.
Release phase	Two drugs zanamivir (Relenza) and oseltamivir (Tamiflu) that have been introduced to treat influenza prevent the release of viral particles by blocking a molecule named neuraminidase that is found on the surface of flu viruses.

9. Laboratory Diagnosis

There are four approaches to confirming a viral infection in the laboratory:

- Serology demonstrating an antibody response in a patient's serum.
- Direct detection of viral antigens in a clinical sample.
- Virus culture.
- Viral nucleic acid detection.

Antibody assays	Antibody assays are usually testing by means of the Enzyme-Linked Immune Sorbant Assay (ELISA) technique. ▪ Presence of specific IgM in a single serum sample or a sero-conversion, a rise in titre of specific IgG in paired sera.
Direct demonstration of virus	▪ Electron Microscopy; not a tool that is routinely used to identify viruses in a diagnostic setting. ▪ Demonstration of virus-infected cells in clinical samples by labelled antibodies.
Cultivation	Use of laboratory animals, or chick embryos but have largely been replaced by the use of cell monolayers.
Molecular techniques	Nucleic acid amplification techniques such as Polymerase Chain Reaction (PCR). It is very sensitive (able to detect only a few viruses in a clinical sample. Can also be used to measure the amount of virus (viral load) in a patient's sample.

10. Disinfection and Inactivation of Viruses

A variety of disinfection and inactivation methods are targeted to specific viruses.

Heat	Most are inactivated at 56°C for 30 minutes or at 100°C for a few seconds.
Drying	Variable; enveloped viruses are rapidly inactivated.
Ultra-violet irradiation	Inactivates viruses.
lipid solvents (Chloroform, Ether, Alcohol)	Enveloped viruses are inactivated. Non-enveloped viruses are resistant.
Oxidizing and reducing agents	Viruses are inactivated by formaldehyde, chlorine, iodine and hydrogen peroxide.
Phenols	Most viruses are resistant.

11. DNA viruses

- Enveloped DNA viruses
- Non-enveloped DNA viruses

Enveloped DNA viruses

Herpesviridae

a. Herpes Simplex Virus 1 (Hsv1)

Case A 2 years old child with a fever for 2 days was not eating and was crying often. On examination, the physician noted that the mucous membranes of the mouth were covered with numerous shallow, pale ulcerations. A few red papules and blisters were also observed around the border of the lips. The symptoms worsened over the next five days and then slowly resolved, with complete healing after two weeks. **My comments:**	**Key words** Red papules and blisters Around the border of the lips Complete healing after two weeks **Facts** HSV1 can cause genital herpes, but most cases of genital herpes are caused by HSV2.

Other Considerations

i. Some groups are more likely to have severe, frequent outbreaks and experience complications from herpes if the immune system is suppressed from:

- HIV or AIDS.
- Chemotherapy for cancer.
- Long term use of high doses of corticosteroids.
- Medications that intentionally suppress the immune system.

ii. Complications of herpes might include:

- Herpes infection in the esophagus.
- Herpes infection of the liver which can lead to cirrhosis (liver failure).
- Encephalitis and/or meningitis.
- Lung infection.
- Eczema herpetiform -- widespread herpes across the skin.

Herpes Simplex Virus 1 (HSV1) /Human Herpesvirus 1	
General Characteristics	Linear ds DNA Icosahedral Enveloped Establish latent infection that persists for life
Reservoirs	Humans are the only reservoir.
Transmission	Direct contact with virus containing body fluids
Diseases	**Herpes Labialis - Cold sore** • Painful ulcerating vesicles at the site of initial infection. • Primarily occurs on the lips and/or the buccal mucosa. • Spontaneously resolves in < 2 weeks. • Reactivation of latent HSV-1 in the trigeminal ganglia; Reoccurrence of the painful ulcerating vesicles at the site of initial infection. • May also complicate to meningoencephalitis. **Herpetic Keratitis** • Ulcerating vesicles on the cornea. • May complicate by causing corneal scarring and blindness. **Herpetic Whitlow** • Painful ulcerating vesicles on the cuticles of the Fingernails. **Encephalitis and Meningitis**
Pathogenesis	The virus spreads to innervating neurons transported to dorsal root ganglia where latency established Recurrence after reactivation triggered by different factors
Treatment	Indirect viral DNA polymerase inhibitors (Acyclovir or Acyclovir pro drugs) Acyclovir resistant infections are treated with foscarnet.

b. Herpes Simplex Virus 2 (HSV2)

Case A 23 years old female medical student was told, by clinical exam, that she had genital herpes four years earlier when she went to student health service for a sore spot in the area between her vagina and anus. She has had no genital symptoms since then. She has returned now and wants to know if she really has genital herpes? What kind? and what to do about it if she has it?! At this visit, she has no symptoms. An HSV1 and 2 IgG type specific serologic antibody test is drawn. The result is HSV 1 IgG index value 4.2 and HSV 2 IgG index value of 0.03. She was given a PCR swab kit to take home and was told if and when she develops symptoms either orally or genitally that could be herpes (she was educated about the symptoms), she is to vigorously swab and return the kit to the clinic to send to the lab. **My comments:**	**Key words** Genital Sore spot Between vagina and anus Orally **Facts** CDC estimates that 776,000 people in the USA get new herpes infections annually.

Other Considerations

Pregnancy and HSV2

Pregnant women who are infected with HSV1 or HSV2 have a higher risk of miscarriage, premature labor, slow fetal growth, or transmission of the herpes infection to the infant during vaginal delivery. Herpes infections in newborns can be life-threatening or cause disability. Delivery by cesarean section is recommended to avoid infecting the baby.

Herpes Simplex Virus 2 (HSV2)/ Human Herpesvirus 2	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Sexual -Venereal disease Perinatal
Diseases	**Herpes Genitalis** • Painful ulcerating encrustating vesicles at the site of initial infection. • Primarily occurs on the external genitalia, periorally (if oral intercourse) or perirectally (if anal intercourse). • Spontaneously resolves in < 2 weeks. • Reactivation of latent HSV-2 in the lumbosacral paravertebral ganglia; reoccurrence of the painful ulcerating vesicles at the site of initial infection. • May also complicate to meningoencephalitis. **Herpetic Keratitis** **Herpetic Whitlow** **TORCH Syndrome** • Spontaneous abortion, stillbirth, premature birth, birth defects, viral interstitial pneumonitis, acute viral hepatitis leading to jaundice, hepatosplenomegaly, generalized lymphadenomegaly and neonatal meningoencephalitis leading to mental retardation, seizures, deafness and blindness.
Treatment	Indirect viral DNA polymerase inhibitors (Acyclovir or Acyclovir prodrugs) Acyclovir resistant infections are treated with foscarnet.
Prevention	Barrier contraceptives and safe sex.

c. Varicella-Zoster Virus (VZV)

Case 18 month old child was presented to emergency room with fever (39°C), a diffuse rash with some areas showed older crusted lesions **My comments:**	**Key words** 18 month old Fever Diffuse rash Older crusted lesions **Facts** VZV is one of the eight herpes viruses known to infect humans and vertebrates.

Other Considerations

i. The shingles vaccine is not recommended for people who have :

- Had a reaction to gelatin or neomycin.
- A weakened immune system, or have taken drugs to suppress the immune system (such as corticosteroids).
- Tuberculosis.
- A history of lymphatic or bone marrow cancer.

ii. Special Populations

- If immune system is weakened, shingles blisters may spread to other parts of the body and it will likely take longer for the symptoms to heal. Conditions that weaken immune function include:
- HIV or AIDS.
- Organ transplant recipient.
- Cancer, especially leukemia, Hodgkin's disease and other lymphomas, or receiving chemotherapy.
- Having an autoimmune disease (like rheumatoid arthritis, lupus, multiple sclerosis, and Crohn's disease.

Varicella-Zoster Virus (VZV)/ Human Herpesvirus 3	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet Contaminated fomites
Diseases	**Varicella -** "chickenpox" (Primary) Erythematous ulcerating encrustating vesicles beginning on the face and trunk and then progressing towards the extremities, as well as mucous membranes Spontaneously resolves in < 1 week May complicate to interstitial pneumonitis and meningoencephalitis (primarily occurs in immunocompromized), may progress to zoster **Zoster -** "shingles" (Recurrence) Reoccurrence of the erythematous ulcerating encrustating vesicles on 1 or more dermatomes Occurs years after initial infection Caused by reactivation of latent VZV in the paravertebral ganglia
Treatment	Indirect viral DNA polymerase inhibitors (Acyclovir or Acyclovir pro drugs) Acyclovir resistant infections are treated with foscarnet
Prevention	In 2006, the United States Food and Drug Administration approved Zostavax for the prevention of shingles A live attenuated VZV vaccine

d. Epstein - Barr Virus (EBV)

Case An 18 years old freshman college student presents to the health center complaining of sore throat and fever for 3 days. She also states that she has been feeling tired for the past week. On physical exam, she is tired and subdued with a temperature of 38°C. Her tonsils are enlarged and erythematous. She has enlarged posterior cervical lymph nodes bilaterally, which are mildly tender to palpation. She has no supraclavicular, axillary, or inguinal lymphadenopathy. Her spleen tip is palpable below the left costal margin. A throat swab is obtained to test for group A streptococcal antigen, which is negative. Laboratory testing reveals a mild leukocytosis with the presence of atypical lymphocytes. A Monospot test is positive. She declines a course of corticosteroid therapy. Her symptoms improved in a week. **My comments:**	**Key words** 18 yrs old Sore throat, fever Enlarged tonsils Enlarged posterior cervical lymph nodes bilaterally Spleen enlargement Negative for group A streptococcal antigen Atypical lymphocytes Positive Monospot test **Facts** EBV, "Kissing disease" affects more than 90 percent of the population worldwide.

Other considerations

i. Nasopharyngeal carcinoma and Burkitt's lymphoma are rare, and may not be caused solely by Epstein Barr Virus.

ii. Prevention of Epstein Barr Virus is difficult, because so many adults are already infected with the virus. The virus is spread through contact with the saliva of an infected person. Since a very large percentage of adults are already infected with the dormant virus, no specific prevention procedures are recommended by the CDC.

Epstein-Barr Virus (EBV) /Human Herpesvirus 4	
Characteristics	Latency in B lymphocytes.
Reservoirs	Humans (only reservoir)
Transmission	Saliva.
Diseases	**Infectious Mononucleosis** Fever, headache, severe pharyngitis, splenomegaly and generalized Lymphadenomegaly. Spontaneously resolves in < 6 weeks. Primarily occurs in children and young adults. EBV infection of the B lymphocytes in the nasopharynx; dissemination of EBV in virtually every lymphoid organ. May progress to burkitts lymphoma and/or nasopharyngeal carcinoma. **Burkitt Lymphoma** Malignant neoplasm of B lymphocytes. Primarily occurs in children. Persistent EBV infection of B lymphocytes. **Nasopharyngeal Carcinoma** Malignant neoplasm of the pharyngeal epithelium. Primarily occurs in adults. Reactivation of latent EBV infection of the pharyngeal epithelial cells.

Treatment	None in particular.
Prevention	No vaccine available.

e. Cytomegalovirus (CMV)

Case A 10 month old sarah, presented with loose motions and vomiting since 3 days. She had 2 episodes of multifocal convulsions 1 month back for which she was admitted in a private hospital and treated with carbamazepine. A CT brain was done which showed periventricular calcifications. Her birth was normal. There was no history of rash or fever in the mother during pregnancy. She was immunized till age and weaning had been started. On examination, she had insignificant cervical lymphadenopathy. With persistent loose motions, she went into septic shock and was treated with IV antibiotics and ionotropic support. An MRI brain was done which showed extensive nodular calcifications in periventricular white matter with generalized cerebral atrophy suggestive of in-utero insult with perimesencephalic vasculopathy suggestive of CMV infection. **My comments:**	**Key words** 10 month old Loose motions and vomiting Multifocal convulsions Periventricular calcifications in brain Cervical lymphadenopathy Septic shock Extensive nodular calcifications in periventricular white matter **Facts** In the United States, about 30,000 children are born with congenital CMV infection each year.

Other considerations

• About 1 in 150 children is born with congenital (present at birth) CMV infection; 80% of babies born with congenital CMV infection never have symptoms or problems.

• About 1 in 750 children in the United States is born with or develops permanent problems due to congenital CMV infection; 5,000 children each year suffer permanent problems caused by CMV infection.

Cytomegalovirus (CMV) /Human Herpesvirus 5	
Characteristic	Opportunistic pathogen in HIV and AIDS patients
Transmission	Direct contact Perinatal
Diseases	**Infectious Mononucleosis-Like Syndrome** Analogous to infectious mononucleosis May complicate by reactivation of latent CMV in the paravertebral ganglia Viral interstitial pneumonitis, acute viral hepatitis, and retinitis leading to blindness; primarily occurs in immunocompromised people **TORCH Syndrome/ congenital infection**
Treatment	Gancyclovir and Valgancyclovir are the drugs of choice Foscarnet for resistant infections to Gancyclovir.
Prevention	Barrier contraceptives and safe sex.

f. Human Herpesvirus 6 (HHV6)

Case A 18 years old woman was admitted to Hospital with a fifteen day history of flu-like syndrome. She had been healthy and had a history of self-limiting viral infections including measles and rubella in childhood. Physical examination revealed left cervical lymphadenopathy, splenomegaly and sever jaundice. Abnormal laboratory findings included a white blood cell count of 4.9 × 10^9/L (3% atypical lymphocytes) with large granular cells and anisocytosy in peripheral smear. Anti-HHV-6 antibody (IgG and IgM) were detected with IgM index of 3.2 (cut off for positive control > 1.1). **My comments:**	**Key words** 15 day history of flu-like syndrome Cervical lymphadenopathy Splenomegaly Sever jaundice **Facts** Primary HHV6 infection is the most common cause of fever-induced seizures in children aged 6-24 months.

Other considerations

HHV6 may be associated with various complications such as:

• Encephalitis.

• A possible role in CNS infections and demyelinating conditions.

• May increase the severity of CMV infection in immunocompromised and transplant populations.

• A possible role in lymphoproliferative syndromes.

• HHV6 infection induces bone marrow suppression, respiratory failure, and encephalitis in patients undergoing hematopoietic stem cell or solid-organ transplantation.

Roseola Virus (HHV6)/ Human Herpesvirus 6	
Characteristic	Opportunistic virus
Reservoirs	Humans (only reservoir)
Transmission	Saliva
Diseases	**Roseola Infantum** - "Exanthema subitum" High fever and cervical lympadenomegaly Erythematous rash on the neck and trunk spontaneously resolves in < 1 week. May complicate by reactivation of latent Roseola Virus in the paravertebral ganglia Infectious mononucleosis-like syndrome Viral interstitial pneumonitis, acute viral hepatitis and meningoencephalitis (primarily occurs in immunocompromized) Primarily occurs in infants
Treatment	Indirect viral DNA polymerase inhibitors
Prevention	No vaccine available

g. Kaposi Sarcoma (KS) - Herpesvirus8 (HHV8)

Case	**Key words**
A 32 years old HIV-infected man presents to clinic having noticed reddish-brown nodular lesions on his skin. His risk factor for acquisition of HIV is having sex with other men, his CD4 count is 230 cells/ mm^3, and he has never taken antiretroviral agents (ART). A biopsy confirms Kaposi's sarcoma.	Reddish-brown nodular lesions HIV Homosexual Kaposi's sarcoma
My comments:	**Facts** Gay and bi-sexual men are more susceptible to infection (through unknown routes of sexual transmission) whereas the virus is transmitted through non-sexual routes in developing countries.

Other considerations

KS has been divided into several classes essentially by epidemiology;

- **Classic KS:** Almost exclusively seen in elderly men (possibly due to hormonal factors) of Mediterranean, Middle Eastern or Eastern European origin.
- **Iatrogenic KS:** In the 1960s, rare cases of KS began to be reported in people being treated with immunosuppressive drugs, especially those who had received organ transplants. This form of KS is rarely aggressive and usually goes away once the immunosuppressive treatment is stopped.
- **Endemic or African KS:** In east and central Africa described KS as a relatively common, though sometimes much more aggressive form of classic KS that could also affect children and young adults.
- **Epidemic or AIDS-related KS:** Follows a variable course, though without ART, it is eventually always progressive.

Kaposi Sarcoma Herpesvirus (KSHV)/ Human Herpesvirus 8	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact / saliva Sexual / Semen Perinatal
Diseases	**Kaposi Sarcoma** Malignant neoplasm of vascular smooth muscle – spindle cell tumor Lesions on skin, face and oral cavity
Treatment	None in particular
Prevention	No vaccine available

Poxviridae

a. Poxvirus

Case	**Key words**
There were cultures of the smallpox virus in about 70 laboratories around the world in 1977. In 1978, a photographer in Birmingham, England came down with smallpox and this was transmitted to her parents. Medical authorities contained the case and determined that the virus had escaped from a research laboratory directly below the photographer's dark room. The researcher responsible for the small pox virus committed suicide out of guilt. After the escape of the virus from the research laboratory in England the WHO's program for the destruction of the laboratory cultures of smallpox continued until officially there were only two places where smallpox cultures were held, one in the U.S. and one in the U.S.S.R.	1977 Cultures of smallpox escaped from a research laboratory WHO's program Two places where smallpox cultures
My comments:	**Facts** The idea of Smallpox vaccination originated in India, as few of the ancient Sanskrit medical texts described the process of inoculation

Other Considerations

Recent studies suggest that variola and its experimental surrogate, vaccine have a remarkable ability to modify the human immune response through complex mechanisms that scientists are only just beginning to unravel. Further studies that might require intact virus is essential. Moreover, modern science now has the capability to recreate smallpox or a smallpox-like organism in the laboratory in addition to the risk of nature re-creating it as it did once before.

Variola "smallpox"	
General Characterstics	Large brick-shaped Enveloped dsDNA
Special Characteristics	Naturally occurring smallpox was eradicated from 1977
Reservoirs	Humans (only reservoir)
Transmission	Respiratory droplets Contaminated fomites
Diseases	**"Smallpox"** Fever, chills, headache, backache, and myalgia followed by characteristic rash leaving scars on survivors Centrifugal distribution of rash Death results from toxemia and systemic shock Recovery confers lifelong immunity
Treatment	Cidofovir Vaccinia immune globulins for adverse reactions of vaccine
Prevention	A live attenuated vaccine

b. Molluscum Contagiosum Virus (MCV)

Case A 48 years old HIV-infected man comes in for routine care and evaluation of skin lesions on his face. His most recent labs showed a CD4 count of 38 cells/mm^3 and HIV RNA of 87,000 copies/ml. The patient describes a 2-3 month history of persistent papules on his face that has gradually increased in number and size. The lesions have not responded to over-the-counter acne therapies. A clinical diagnosis of molluscum contagiosum is made. **My comments:**	**Key words** HIV-infected CD4 count of 38 cells/mm^3 and HIV RNA of 87,000 copies/ml 2-3 month history of persistent papules **Facts** MCV is more common in hot climates and with poor hygiene

Other considerations

• Some investigations report that spread of molluscum contagiosum is increased in swimming pools. However, it has not been proved how or under what circumstances swimming pools might increase spread of the virus. Activities related to swimming might be the cause. For example, the virus might spread from one person to another if they share a towel or toys. More research is needed to understand if and for how long the molluscum virus can live in swimming pool water and if such water can infect swimmers.

• Persons with weakened immune systems (such as cancer, organ transplantation, HIV etc.) are at increased risk for catching molluscum and may develop very large growths (the size at least 15 millimeters in diameter).

Molluscum Contagiosum Virus (MCV)	
Characteristics	Opportunistic pathogen
Transmission	Direct contact Sexually
Disease	Benign nodular skin lesions with no systemic symptoms
Treatment	No specific antiviral therapy
Prevention	No vaccine available

c. Monkeypox virus

Case In the Democratic Republic of Congo [DRC]), a 9 years old boy developed a smallpox like illness showing signs of profuse nasal discharge, ocular discharge, dyspnea, lymphadenopathy, and mucocutaneous lesions, after playing with ill prairie dog which was eventually confirmed as human monkey pox. **My comments:**	**Key words** Democratic Republic of Congo 9-year-old Smallpox like illness **Facts** Human cases of an African virus related to smallpox have jumped 20-fold since 1986.

Other considerations

• Infections of index cases result from direct contact with the blood, bodily fluids, or rashes of infected animals.

• Monkeypox is usually transmitted to humans from rodents, pets, and primates through contact with the animal's blood or through a bite.

• Secondary transmission is human-to-human, resulting from close contact with infected respiratory tract excretions, with the skin lesions of an infected person or with recently contaminated objects. Transmission can also occur by inoculation or via the placenta (congenital monkeypox).

Monkeypox virus	
Characteristics	Viral zoonosis
Transmission	Close contact with infected mammalian pets Person to person uncommon
Disease	Vesicular and pustular rash differentiated from smallpox by lymphadenopathy
Treatment	No specific treatment
Prevention	Vaccination with smallpox vaccine Isolation and infection control guidelines

Non-Enveloped DNA Viruses

Adenoviridae

a. Adenoviruses (HAdV)

Case A 32-years-old white female with acute onset of left red eye beginning three days prior thinks her right eye is also becoming involved. Her roommate had red eyes two weeks prior. She complains of a watery discharge and her left eye hurts. The left eye has a subconjunctival hemorrhage overlying generalized conjunctival injection. This hemorrhage results from inflammation caused by the primary infectious process. **My comments:**	**Key words** Red eye Roommate Watery discharge **Facts** Transmission of adenovirus in recreational waters, primarily inadequately chlorinated swimming pools, has been documented via faecally-contaminated water and through droplets.

Other considerations

Health Professionals should;

• Consider adenoviruses as a possible cause of severe pneumonia cases and outbreaks of pneumonia of unknown etiology.

• Adenovirus types 3, 4 and 7 are most commonly associated with acute respiratory disease.

Adenoviruses (HAdV)

Species	50 different human serotypes
General Characteristics	Linear ds DNA Icosahedral capsid Non-enveloped
Reservoirs	Humans are only reservoir
Transmission	Depending on the syndrome; Direct contact ("person-to-person") Respiratory droplet Fecal-oral Contaminated fomites
Diseases	**The Common Cold** • Fever, rhinitis leading to rhinorrhea and pharyngitis leading to sore throat • May complicate by progressing to laryngotracheobronchitis and viral pneumotitis, primarily occurs in children **Keratoconjunctivitis - "Pink eye"** • Keratitis and conjunctivitis leading to conjunctival hyperemia and preauricular lymphadenomegaly **Pharyngoconjunctival Fever** • Fever, rhinitis, pharyngitis, conjunctival hyperemia and preauricular lymphadenomegaly **Gastroenteritis** • Abdominal pain vomiting and watery diarrhea
Treatment	Oral fluid and electrolyte replacement in gastroenteritis
Prevention	No vaccine available Hand washing and good infection control practices

Papovaviridae

a. Human Papillomavirus (HPV)

Case A 32 years old woman who presents for evaluation after a screening test is positive for Human Papillomavirus (HPV). She has had sporadic but negative Papanicolaou (Pap) tests in the past, with no history of treatment to her cervix. **My comments:**	**Key words** 32 yr old Screening test HPV Negative Pap tests **Facts** Boys and girls at ages 11 or 12 are most likely to have the best protection provided by HPV vaccines, and their immune response to vaccine is better than older women and men.

Other considerations

Most HPV infections (90%) go away by themselves within two years. But, sometimes, HPV infections will persist and can cause a variety of serious health problems. Health problems that can be caused by HPV include:

• Genital warts.

• Recurrent Respiratory Papillomatosis (RRP), a rare condition in which warts grow in the throat.

• Cervical cancer.

• Other, less common, but serious cancers, including genital cancers (cancer of the vulva, vagina, penis, or anus), and a type of head and neck cancer called oropharyngeal cancer (cancer in the back of throat, including the base of the tongue and tonsils).

Human Papilloma Virus (HPV)	
General Characteristics	Circular ds DNA Icosahedral capsid Non-enveloped
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Sexual Perinatal Contaminated fomites
Diseases	**Common Cutaneous Warts - "Verrucae vulgaris"** Painless superficial medium-sized rough hyperkeratinized nodules at the site of initial infection. Primarily occurs on the hands and fingers as well as on the feet May progress to deep palmo-plantar warts. **Deep Palmo-Plantar Warts "Myrmecias"** Painful deep medium-sized rough hyperkeratinized pigmented nodules at the site of initial infection. Primarily occurs on the feet and toes as well as on the hands Caused by progression of common cutaneous warts. **Anogenital Warts - "Condyloma acuminata"** Multiple small papules coalescing to form a large cauliflower-like lesion at the site of initial infection. Primarily occurs on the external genitalia or perirectally (in case of anal intercourse). **Cervical Intraepithelial Neoplasia "CIN"** Benign neoplasm of the cervix May progress to cervical carcinoma Cervical Carcinoma Malignant neoplasm of the cervix Caused by progression of cervical intraepithelial neoplasia
Treatment	Topical liquid nitrogen (if common cutaneous warts, deep palmoplantar warts and/or anogenital warts).
Prevention	Two vaccines (Cervarix and Gardasil) protect against cervical cancers. One vaccine (Gardasil) also protects against genital warts and cancers of the anus, vagina and vulva. Both vaccines are available for females, whereas Gardasil is available for males.

Polyomaviridae

a. Polyomaviruses (JCV and BKV)

Case A 56 years old male patient of BK-virus nephropathy (BKN) had complications affecting his renal allografts and causing graft dysfunction. Manifestations included interstitial nephritis, ureteric stenosis and renal dysfunction. He had a graft loss due to acute allograft rejection Patients were diagnosed by the presence of intranuclear viral inclusion bodies in cells shed in urine and in renal epithelial cells ('decoy cells'). Molecular diagnosis based on real-time Quantitative Polymerase Chain Reaction (Q-PCR) on urine/blood strengthens the suspicion. Final diagnosis was made by specific findings in the allograft biopsy, in particular positive immunohistochemical staining for viral proteins **My comments:**	**Key words** BK-virus nephropathy Acute allograft rejection **Facts** For nearly 40 years, only two plyomaviruses were known to infect humans. Genome sequencing technologies have recently discovered seven additional human polyomaviruses, including one causing most cases of Merkel cell carcinoma and another associated with Transplant-Associated Dysplasia (TSV)

Other considerations

Merkel Cell Polyomavirus (MCV or MCPyV) was first described in January 2008. It is suspected to cause the majority of cases of Merkel cell carcinoma, a rare but aggressive form of skin cancer. Approximately 80% of Merkel cell carcinoma (MCC) tumors have been found to be infected with MCV. MCV appears to be a common infection of older children and adults. It is found in respiratory secretions suggesting that it may be transmitted by a respiratory route. But it also can be found shedding from healthy skin, and in gastrointestinal tract tissues and elsewhere, and so its precise mode of transmission remains unknown.

Polyomaviruses (JCV and BKV)	
General Characteristics	Circular ds DNA Icosahedral capsid Small Non-enveloped
Special Characteristics	Persist as latent infections in a host without causing disease May produce tumor (Oncogenic)
Reservoirs	Humans (only reservoir)
Transmission	The mechanism of human-to-human transmission of the polyomaviruses JC virus (JCV) and BK Virus (BKV) has not been firmly established
Diseases	Highly common childhood and young adult infections mostly cause little or no symptoms. Lifelong persistence among almost all adults Most common among persons who become immunosuppressed by AIDS, old age or after transplantation and include Merkel cell carcinoma, PML and BK nephropathy Progressive multifocal leukoencephalopathy caused by reactivation of JC virus Nephropathy and Merkel cell cancer (Merkel cell virus) caused by reactivation of BK virus
Treatment	No known treatment
Prevention	Non available

Parvoviridae

a. Human Parvovirus B19

Case A kidney transplant recipient, was unresponsive to treatment of severe anemia, and presented hypocellular hematopoietic marrow, megaloblastosis and hypoplasia of erythroid lineage with larger cells with clear nuclei chromatin and eosinophilic nuclear inclusions. This patient was seropositive for Epstein-Barr and Cytomegalovirus infections and negative for anti-parvovirus B19 IgM and IgG antibodies, although symptoms were suggestive of parvoviruses infection. A qualitative polymerase chain reaction testing for B19 in serum sample revealed positive results for B19 virus DNA.	**Key words** Kidney transplant recipient Unresponsive to treatment Seropositive for EBV and CMV PCR positive for B19 **Fact** People with fifth disease are most contagious before they get rash or joint pain and swelling.

Other considerations

At the moment, there are no treatments that directly target the Parvovirus B19 virus. Intravenous Immunoglobulin Therapy (IVIG) therapy has been a popular alternative because doctors can administer it without stopping chemotherapy drugs like MEL-ASCT. Also, the treatment's side effects are rare as only 4 out of 133 patients had complications (2 had acute renal failure and 2 had pulmonary edema) even though 69 of the patients had organ transplants and 39 of them were HIV positive. This is a large improvement over administering Rituximab. The monoclonal antibody against the CD20 protein has been shown to cause acute hepatitis, neutropenia via Parvovirus B19 reactivations, and even persistent Parvovirus B19 infection. However, it is important to note that IVIG therapy is not perfect as 34% of treated patients will have a relapse after 4 months.

Human Parvovirus B19	
General Characteristics	Linear ss DNA Icosahedral capsid Non-enveloped
Reservoirs	Humans
Transmission	Direct contact Perinatal Parenteral
Diseases	**Erythema Infectiosum - "slapped-cheek disease"** Erythematous rashes of the cheeks as well as on the trunk and extremities. May complicate by infection of the bone marrow, aplastic anemia, transient aplastic crisis (primarily occurs in infants, immunocompromized or if already anemic) Spontaneously resolves in < 1 week Primarily occurs in children
Treatment	None in particular.
Prevention	Not available.

Hepatitis Viruses

- Enterical transmitted hepatitis viruses, I (HAV, HEV)
- Parentral transmitted hepatitis viruses, II (HBV, HDV, HCV and HGV)

Enterical Transmitted Hepatitis Viruses, I (HAV, HEV)

a. Hepatitis A Viruses (HAV) - Picornaviridae

Case In July 2013, 134 people have been confirmed to have hepatitis A after eating "Townsend Farms Organic Antioxidant Blend" in 8 US states. **My comments:**	**Key words** 134 people 8 states Eating **Facts** • Globally, there are an estimated 1.4 million cases of hepatitis A every year.

Other considerations

• Hepatitis A virus infection can be prevented if a person has been exposed to the Hepatitis A virus from contaminated food or water. If the exposure occurred within the last 14 days, a dose of Hepatitis A vaccine or Immunglobulin (IG) can prevent illness. Vaccination after 14 days is not believed to help prevent a person from getting hepatitis A.

• Vaccine is used to prevent Hepatitis A virus infection from contaminated food or water; which depends upon a person's age and health status.

• Two different shots may be used: the hepatitis A vaccine and Immunglobulin (IG). Persons who are Immunocompromised, with chronic liver disease, and for whom Hepatitis A vaccine is contraindicated should receive immunglobulin.

Hepatitis A Virus (HAV)	
General Characteristics	Linear positive-sense (does not need a viral RNA-dependent RNA Polymerase to replicate) ss RNA Icosahedral capsid Non-enveloped
Special Characteristic	Epidemic infectious hepatitis
Reservoirs	Humans Animals (primarily primates)
Transmission	Direct contact Fecal-oral Contaminated water and food (primarily seafood)
Diseases	Acute Viral Hepatitis Moderate hepatic damage Fever, abdominal pain, vomiting, hepatomegaly and jaundice Spontaneously resolves in < 3 months
Treatment	None in particular
Prevention	A formalin- inactivated HAV vaccine for travelers Passive immunization with HAV immunoglobulin for post exposure prophylaxis Hand washing

b. Hepatitis E Virus (HEV) - Caliciviridae

Case During 2011, 5 persons in Lazio, Italy were infected with a strain of Hepatitis E virus that showed high sequence homology with isolates from swine in China. Detection of this genotype in Italy parallels findings in other countries in Europe. **My comments:**	**Key words** 5 persons Strain Genotype **Facts** • Every year there are 20 million hepatitis E infections, over three million acute cases of hepatitis E, and 57 000 hepatitis E-related deaths.

Other considerations

• Hepatitis E is most common in developing countries with inadequate water supply and environmental sanitation. Large hepatitis E epidemics have been reported in Asia, the Middle East, Africa, and Central America.

• People living in refugee camps or overcrowded temporary housing after natural disasters can be particularly at risk.

• The unique characteristic of HEV is displaying different epidemiological and clinical characteristics between developing and developed countries.

• Hepatitis E virus is spread by animals: there is a possibility of zoonotic spread of the virus. HEV RNA had been extracted from meat and organ of some animal species including pigs, boar, and deer. Food borne infection could occur from consumption of uncooked/undercooked products from infected animals.

Hepatitis E Virus (HEV)	
General Characteristics	Linear (+) ss RNA Icosahedral capsid Non-enveloped
Special Characteristics	Same diseases and treatment as HAV
Reservoirs	Humans Animals (primarily primates, swine and rodents)
Transmission	Fecal-oral Contaminated water

Diseases	Acute Viral Hepatitis Moderate hepatic damage Fever, abdominal pain, vomiting, hepatomegaly and jaundice Spontaneously resolves in < 3 months
Treatment	None in particular
Prevention	No vaccine is available for HEV infection to date Improved sanitary lower transmission rate Travelers to endemic areas should be cautioned about contaminated water

Parenteral Transmitted Hepatitis Viruses, II (HBV, HDV, HCV and HGV)

a. Hepatitis B Virus (HBV) - Hepednaviridae

Case The patient is 24 years old who has recently passed her third year in dental school. She is HBsAg (+), HBeAg (+), anti-HBe (-). Her HBV DNA is 400 million copies/mL (approximately 80 million int. unit/mL) and serum ALT is 45 (upper limit of normal 40 int. unit/L). Her liver biopsy shows macrovesicular fat, no portal fibrosis. **My comments:**	**Key words** Dentist HBsAg (+), HBeAg (+), anti-HBe (-) 400 million copies/mL Serum ALT is 45 **Facts** One third of the world's population has been infected with the hepatitis B virus

Other considerations

Vaccination is recommended for certain groups, including:

- Anyone having sex with an infected partner or people with multiple sex partners.
- Anyone with a sexually transmitted disease.
- Men who have sexual encounters with other men.
- People who inject drugs.
- People who live with someone with Hepatitis B.
- People with chronic liver disease, end stage renal disease, or HIV infection.
- Healthcare and public safety workers exposed to blood.
- Travelers to certain countries.
- All infants at birth.

Hepatitis B Virus (HBV)	
Characteristics	Circular ds DNA Icosahedral capsid Enveloped
Reservoirs	Humans (only reservoir)
Transmission	Direct contact (saliva, skin lesions, body fluids) Sexual Perinatal Parenteral
Diseases	**Acute Viral Hepatitis** May progress to hyperacute viral hepatitis. **Hyperacute Viral Hepatitis - "fulminant hepatitis"** Severe hepatic damage Hepatic failure leading to generalized edema, ascites, coagulopathies and hepatic encephalopathy Primarily occurs in immunoreactive **Chronic Persistent Viral Hepatitis** Moderate hepatic cirrhosis Fever, abdominal pain, vomiting, hepatomegaly and jaundice Primarily occurs in moderately immunocompromised May progress to chronic aggressive viral hepatitis **Chronic Aggressive Viral Hepatitis** Severe hepatic cirrhosis and Hepatic failure Primarily occurs in severely immunocompromised **Chronic Carrier State** No hepatic damage and no hepatic cirrhosis (asymptomatic) **Hepatocellular Carcinoma** Malignant neoplasm of the hepatocytes
Diagnosis	Biochemical tests + serologic assays IgM antibody to HBcAg indicates acute infection Antibody to to HBsAg indicates immunity to HBV
Treatment	Chronic HBV is treated with interferon-alpha, lamivudine or adefovir
Prevention	Recombinant HBsAg vaccine Passive immunization with HBV immune globulin to neonates born to HBsAg (+) mothers and after needlestick exposure Avoid high risk behavior

b. Hepatitis D Virus (HDV) - Deltaviridae

Case Seven patients with Hepatitis Delta Virus (HDV) cirrhosis underwent liver transplantation. In every case the HDV infection was florid but accompanied by an inactive Hepatitis B Virus (HBV) infection. The patients were given Anti-HB Surface Antigen (HBsAg) serum globulins and HBV vaccine. Two patients cleared the HBsAg and the HDV, and are alive and well 14 and 15 months, respectively, after transplantation. HDV infection recurred in the other five patients: hepatitis developed in three, another died, and the fifth was re-transplanted for cause's unrelated to viral hepatitis (reinfection was shown by the presence of HD antigen in the graft). Liver transplantation is feasible in patients with HDV disease but involves a high risk of HDV reinfection that cannot be predicted by the virological pattern of the native HBV infection or prevented by conventional HBV prophylaxis. **My comments:**	**Key words** HDV Cirrhosis Liver transplantation Inactive HBV HBsAg serum globulins and HBV vaccine **Facts** Severe often fatal acute and chronic HDV is among indigenous people of Venezuela, Colombia, Brazil and Peru

Other considerations

i. Two epidemiological patterns of HDV infection exists;

- In Mediterranean countries infection is endemic among HBV carriers, and is transmitted by close personal contact.
- In Western Europe and North America, HDV is confined to persons exposed to blood or blood products, e.g. intravenous drug addicts sharing unsterilized injection needles.

ii. New foci high HDV prevalence continues to be identified as in the case of island of Okinawa in Japan, areas in China, North India and Albania.

Hepatitis D Virus (HDV)	
General Characteristics	Linear negative-sense ss RNA (needs a viral RNA-dependent RNA polymerase to replicate) Icosahedral capsid Non-enveloped (needs HBV envelope to become infective)
Special Characteristics	Same reservoirs, transmission and diseases as HBV
Treatment	None in particular
Prevention	HBsAg vaccine

c. Hepatitis C Virus (HCV) - Flaviviridae

Case A prominent former doctor and endoscopy clinic owner was convicted of 27 criminal charges including second-degree murder in a hepatitis C outbreak. Endoscopy clinic nurse-anesthetist was found guilty for 16 of 27 charges against him. The murder conviction stemmed from the death of 77-year-old patient was visiting the clinic. **My comments:**	**Key words** Endoscopy clinic Hepatitis outbreak Nurse-anesthetist 77yr old died **Facts** ~3% of the world's population is living with chronic hepatitis C. Egypt has high rates (14.7%) of infection.

Other considerations

Early diagnosis can prevent health problems that may result from infection and prevent transmission to family members and other close contacts. Some countries recommend screening for people who may be at risk for infection. These include:

- Current or former injecting drug users (even those who injected drugs once many years ago.
- People on long-term haemodialysis.
- Health-care workers.
- People living with HIV.
- People with abnormal liver tests or liver disease.
- Infants born to infected mothers.
- 12-24 hours after needle exposure.

Hepatitis C Virus (HCV)	
General Characteristics	Linear negative-sense ss RNA (needs a viral RNA-dependent RNA polymerase to replicate) Icosahedral capsid Non-enveloped (needs HBV envelope to become infective)
Special Characteristics	Same reservoirs, transmission and diseases as HBV
Reservoirs	Humans (only reservoir)
Transmission	Direct contact (saliva, skin lesions, body fluids) Perinatal Sexual and Parenteral (not confirmed)
Treatment	A combination of interferon-alpha and ribavirin for chronic HCV hepatitis
Prevention	No vaccine available Screening blood products and avoiding intravenous drug use

Hepatitis G Virus (HGV)	
Characteristics	Same reservoirs and transmission as HBV
Diseases	None directly associated
Treatment	None in particular
Prevention	No vaccine available. Screening blood products and avoiding intravenous drug use

RNA Viruses

- Non-enveloped RNA Viruses
- Enveloped RNA Viruses

Non-Enveloped RNA Viruses

Picornaviridae

a. Polioviruses

Case A 14 months old Hassan, from Morocco with residual paralysis and major histocompatibility class II (MHC II) immunodeficiency was reported through the Spanish Acute Flaccid Paralysis Surveillance System. The patient had received 2 OPV doses at birth and at 6 months of age in Morocco; eight months later, meningoencephalitis developed. The case was immediately considered suspicious and was therefore monitored at least monthly until the boy died. Sampling was conducted, coinciding with his visits to the hospital to receive therapy with immunoglobulin (γ globulin 0.5 g/kg). His contacts were studied, environmental surveillance was conducted, and molecular analysis of all detected viruses was performed. **My comments:**	**Key words** Residual paralysis MHC II immunodeficiency 2 OPV doses Meningoencephalitis Immunoglobulin therapy Environmental surveillance Molecular analysis **Facts** • In 2013, only three countries (Afghanistan, Nigeria and Pakistan) remain polio-endemic, down from more than 125 in 1988.

Other considerations

Economic modeling has found that the eradication of polio would save at least US$ 40–50 billion over the next 20 years, mostly in low-income countries. Most importantly, success will mean that no child will ever again suffer from the terrible effects of lifelong polio-paralysis.

Poliovirus	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplets Fecal-oral
Diseases	Inapparent Poliomyleitis Low-grade fever, headache and pharyngitis Spontaneously resolves in < 1 week Primarily occurs in children Caused by Poliovirus infection of the nasopharynx May progress to non-paralytic poliomyelitis and/or paralytic poliomyelitis Non-Paralytic Poliomyleitis Meningitis leading to high fever, vomiting and nuchal rigidity Spontaneously resolves in < 1 week Primarily occurs in children Poliovirus infection of the meninges Paralytic Poliomyleitis Asymmetric flaccid paralysis, muscular atrophy and loss of myotatic reflexes (“stretch reflexes”) May complicate by flaccid paralysis of the respiratory muscles Death Primarily occurs in teenagers and adults Caused by Poliovirus infection of the peripheral motor neurons
Treatment	**None in particular**
Prevention	Live attenuated vaccine (Sabin) or killed vaccine (Salk).

b. Coxsackie Virus A (CAV)

Case SARAH, a 4 years old girl, had a 3 day history of fever, rash on her hands and feet, vesicles and ulcers on the tongue and oral mucosa, irritability and lack of appetite. On examination no other rashes are found. **My comments:**	**Key words** 4yr old Rash on hands and feet Ulcers on the tongue **Facts** If acquired in the first trimester of pregnancy, Coxsackieviruses can cause spontaneous abortion.

Other considerations

Maternal Coxsackievirus associated diseases;

- Maternal Coxsackievirus infections have also been associated with type 1 diabetes in the offspring.
- Maternal Coxsackievirus B infection has been associated with an increase in fetal cardiac abnormalities.
- Coxsackieviruses A and B can cross the placenta and cause stillbirth by villous necrosis and a variety of other means.
- Coxsackievirus infection has also been linked with Chronic Fatigue Syndrome (CFS), also referred to as Myalgic Encephalitis (ME).

Coxsackie A Virus (CAV)	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet Fecal-oral

Diseases	**The Common Cold** May complicate by CAV viremia, meningoencephalitis Caused by CAV infection of the nasopharynx May progress to herpangina **Herpangina** High fever and painful ulcerating erythematous vesicles on the Pharynx Caused by progression of the common cold May progress to hand-foot-and-mouth disease **Hand-Foot-and-Mouth Disease** High fever and painful ulcerating erythematous vesicles on the bucca and tongue as well as on the palms and soles Caused by progression of herpangina
Treatment	None in particular
Prevention	No vaccine available

c. Coxsackie B Virus (CBV)

Case A 33 years old woman was transferred from a referring hospital because of sore throat, fever, and chills. Her neurologic findings progressed from headache with mild photophobia to lethargy, cogwheeling, increased tone in all 4 limbs, and brisk reflexes. The patient was diagnosed as having coxsackievirus B4 meningoencephalitis and, despite treatment with the experimental antiviral agent pleconaril, died of an overwhelming central nervous system infection and myocarditis. Magnetic resonance imaging showed focal hyperintense lesions in the substantia nigra. **My comments:**	**Key words** Headache Mild photophobia Increased tone in all 4 limbs Brisk reflexes CNS infection Myocarditis **Facts** Coxsackie B Virus causes Type 1 diabetes which is considered a progressive autoimmune disease, in which the beta cells that produce insulin are slowly destroyed by the body's own immune system.

Other considerations

Not much is known about the presence of viruses in water, but it is known that fecally contaminated water is an important factor. The groundwater from which well water is obtained can be fecally contaminated from failed septic systems or sewage lagoons and leaking sewer lines. The contaminated substances can reach the groundwater through soils and cracks in the ground. Other factors that contribute to the contamination of drinking water occur at or near water-supply wells. The main causes are poor well location and/or construction and the presence of test-holes or exploratory wells. Inadequately disinfected distribution systems, including storage towers, can also be a major source of microbial water contamination.

Coxsackie B Virus (CBV)	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet Fecal-oral
Diseases	**The Common Cold** May complicate by CBV viremia, meningoencephalitis, infective myocarditis and acute pericarditis May progress to pleurodynia **Pleurodynia- "Bornholm disease"** High fever, headache and intercostal striated muscle necrosis leading to severe pain during inspiration ("pleuritic pain")
Treatment	None in particular
Prevention	No vaccine available

d. Echovirus

Case Newborn babies in the hospital are becoming ill due to an epidemic. After an investigation, which includes giving them different antibiotics, it turns out all babies were actually infected with a virus called echovirus 11. They got it through teddy bears in the hospital. The teddy bears were covered with the virus since the lady delivering them was carrying the virus herself. **My comments:**	**Key words** Newborns Epidemic Hospital **Facts** 1 in 5 cases of viral meningitis is caused by an ECHO virus.

Other considerations

In aseptic meningitis outbreak, community spread was associated with swimming in a crowded campground pool. Chlorine levels were low in the evening; hot sun and high occupancy likely reduced chlorine levels during the day, allowing the pool water to become intermittently contaminated with enterovirus.

The cohort's high attack rate was likely facilitated by secondary intrahousehold enterovirus spread among residents of the same campsite promoted by crowding; risk for illness was higher in campsites with more campers. Crowding results in more frequent person-to-person contact and possibly less personal hygiene (e.g., hand washing).

Echovirus	
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet Fecal-oral
Diseases	**The Common Cold** May complicate by Echovirus viremia, meningoencephalitis, infective myocarditis and acute pericarditis **Keratoconjunctivitis** Caused by Echovirus infection of the eye **Gastroenteritis** Primarily occurs in infants
Treatment	None in particular
Prevention	No vaccine available

Reoviridae

a. Rotaviruses

Case	Key words
A 2 years old boy started developing diarrhea, vomiting, and a moderate fever (about 38.5°C). Over the following 12 h, the vomiting episodes gradually decreased while the diarrhea progressively worsened, reaching 8 to 10 discharges. On this basis, the young patient was rehydrated per os at home by means of a solution (Humana Idravita), No sign of dehydration. During the subsequent night, the patient's clinical picture deteriorated further, with severe hyporeactivity and asthenia. The child was hospitalized at pediatric emergency department in cardiorespiratory arrest. At admission, his pupils were dilated and not photoreactive; in addition, the patient had mottled extremities and labial/nail cyanosis and respiratory movements were completely absent. The child was intubated for ventilation. However, after 30 min of cardiopulmonary resuscitation, ventilatory support was discontinued and the child was pronounced dead. **My comments:**	2-yrs old Diarrhea 8 to 10 discharges Vomiting Rehydrated Hospitalized Cardiorespiratory arrest Mottled extremities Cyanosis Respiratory movements were completely absent Died **Facts** In June 2013, new data was released showing a small increase in cases of intussusception from rotavirus vaccination.

Other considerations

Rotavirus vaccines are very effective in preventing rotavirus gastroenteritis. CDC recommends routine vaccination of infants with either of the two available vaccines:

- RotaTeq® (RV5), which is given in 3 doses at ages 2 months, 4 months, and 6 months; or
- Rotarix® (RV1), which is given in 2 doses at ages 2 months and 4 months.

Both rotavirus vaccines are given orally. The vaccines are very effective (85% to 98%) in preventing severe rotavirus disease. Rotavirus vaccines will not prevent diarrhea or vomiting caused by other viruses, but they are very effective against rotavirus infection.

Rotavirus	
Characteristics	Linear segmented (11 segments) dst RNA Icosahedral capsid Non-enveloped
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Fecal-oral Contaminated water, food and fomites
Diseases	**Gastroenteritis** Most common cause of gastroenteritis Abdominal pain, vomiting and severe watery diarrhea (> 20 liter per day) May complicate by leading to hypovolemia shock,death My also complicate by Rotavirus viremia, meningoencephalitis Primarily occurs in children
Treatment	Oral fluid and electrolyte replacement
Prevention	Two different rotavirus oral vaccines are currently licensed for infants in the United States. The vaccines are RotaTeq® (RV5) and Rotarix® (RV1) Improved sanitation measures and good hygiene practice is important methods of control

Enveloped RNA viruses

Orthomyxoviridae

a. Influenza Virus A, B and C

Case	Key words
On April 1st 2013, the World Health Organization (WHO) reported three human infections with a new Influenza A (H7N9) virus in China. Additional cases have been reported since then. A case has been reported in Chinese poultry, after coming into contact with infected poultry. China's investigations suggest that human-to-human transmission of H7N9 is rare and not ongoing. **My comments:**	A new Influenza A (H7N9) virus China Infected poultry **Facts** "Human flu" in the U.S. results in approximately 36,000 deaths and more than 200,000 hospitalizations each year.

Other considerations

- Influenza produces direct costs due to lost productivity and associated medical treatment, as well as indirect costs of preventative measures.
- In the United States, influenza is responsible for a total cost of over $10 billion per year, while it has been estimated that a future pandemic could cause hundreds of billions of dollars in direct and indirect costs.

Influenza Virus	
General Characteristics	Linear segmented (8 segments) (-) ssRNA Helical capsid (spirally-shaped protein coat) Enveloped
Serotypes	Influenza Virus Type A, Type B and Type C.
Reservoirs	Humans Animals (primarily birds, only Influenza Virus Type A)
Transmission	Direct contact Respiratory droplet Zoonotic (only Influenza Virus Type A)
Diseases	Antigen variation of hemaglutinin and neuroaminidase is responsible for epidemics and pandemics. 2 types of antigenic variation are known; antigenic shift and antigenic drift.

Treatment	**Influenza- "The flu"** High fever, headache, myalgias, rhinitis leading to rhinorrhea, pharyngitis leading to sore throat, and non-productive cough May complicate by progressing to laryngotracheobronchitis and viral interstitial pneumonitis (primarily occurs in elderly and immunocompromized people) **Complications include:** Secondary bacterial pneumonia (common) and primary viral pneumonia
Treatment	Viral uncoating and assembly inhibitors Viral exit inhibitors
Prevention	Killed vaccine containing current influenza type A and B strains for 50years and older, chronic cardiopulmonary diseases and immunosuppression persons A live attenuated influenza A vaccine (intranasally) for healthy adults and children

Coronaviridae

a. Coronavirus (CoVs)

Case In eastern Saudi Arabia, five people had been confirmed to have Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection developed severe acute respiratory illness. They had fever, cough, and shortness of breath. Three of these people died. **My comments:**	**Key words** Eastern Saudi Arabia Severe acute respiratory illness Three out of five died **Facts** In 2013, there have been twenty-two cases and ten deaths in eastern Saudi Arabia by the new MERS-CoV

Other considerations

In 2012, what is believed to be a sixth new type of coronavirus, tentatively referred to as Novel Coronavirus 2012, being like SARS (but still distinct from it and from the common-cold coronavirus) was discovered in Qatar and Saudi Arabia. WHO has accordingly issued a global alert and an interim case definition to help countries to strengthen health protection measures against it. WHO update on 28th September 2012, said that the virus did not seem to pass easily from person to person. On 12th May 2013, a case of contamination from human to human in France was confirmed by the French Ministry of Social Affairs and Health. Cases of person-to-person transmission have been reported by the Ministry of Health in Tunisia. Two confirmed cases seem to have caught the disease from their late father, who became ill after a visit to Qatar and Saudi Arabia. After the Dutch Erasmus Medical Centre sequenced the virus, the virus was given a new name, Human Corona Virus-Erasmus Medical Centre (HCoV-EMC). The final name for the virus is: Middle East Respiratory Syndrome Coronavirus (MERS-CoV).

Coronavirus (CoVs)	
General Characteristics	Linear (+) ssRNA Helical capsid Enveloped
Special Characteristic	Surface projections creating an image reminiscent of the solar corona Five different currently known strains of coronaviruses infect humans The most publicized human coronavirus, SARS-CoV which causes SARS
Reservoirs	Humans Animals
Transmission	Respiratory droplet Fecal oral
Diseases	Severe Acute Respiratory Syndrome - SARS A unique pathogenesis, it causes both upper and lower respiratory tract infections and can also cause gastroenteritis Common colds in human adults Upper respiratory and gastrointestinal tract of mammals and birds
Treatment	None in particular
Prevention	No vaccine currently available Washing hands often with soap and water Adhering to good food-safety practices

Paramyxoviridae

a. Mumps Virus

Case Multiple cases of mumps have been reported to the Virginia Department of Health. On May 28th 2013, 110 cases of mumps are under investigation in different regions of the state. The majority of cases are part of an outbreak of mumps occurring at one university in the central region of the state. As investigations continue, additional cases are possible. It is also possible that the cases under investigation will decrease as investigations are completed and cases are ruled out. **My comments:**	**Key words** Multiple cases Outbreak One university **Facts** Children who receive the MMR vaccine are more likely to have febrile seizures 8-14 days after vaccination than children who are not vaccinated at all.

Other considerations

Some individuals don't need the MMR vaccine if they had;

- Two doses of the MMR vaccine after 12 months of age or one dose of the MMR vaccine plus a second dose of measles vaccine.
- One dose of MMR and not at high risk of measles or mumps exposure.
- Blood tests that demonstrate immunity to measles, mumps and rubella.

Although concerns have been raised about a connection between the MMR vaccine and autism, extensive reports from the American Academy of Pediatrics, the Institute of Medicine and the Centers for Disease Control and Prevention conclude that there is no scientifically proven link between the MMR vaccine and autism.

Mumps Virus	
General Characteristics	Linear (-) ssRNA Helical capsid Enveloped
Special Characteristic	Highly contagious
Reservoirs	Humans (only reservoir)
Transmission	Direct contact (salivary secretions or urine) Respiratory droplet
Diseases	**Mumps** Fever, headache and parotitis leading to painful swollen jaws May complicate by progressing to meningoencephalitis (primarily occurs in children) May also complicate by progressing to orchidoepididymitis and/or oophoritis (primarily occurs in teenagers and adults) Primarily occurs in children
Treatment	None in particular
Prevention	A live attenuated vaccine given in combination with measles and rubella vaccine (MMR)

b. Measles Virus

Case In 2011, measles outbreaks in Somalia resulted in the exposure and apparent infection of 2 physicians, both of whom had a documented history of vaccination with >2 doses of measles-mumps-rubella vaccine. These physicians were suspected of having been infected with measles after treating patients who subsequently received a diagnosis of measles. The clinical presentation was non-classical in regard to progression, duration, and severity. Both of the physicians continued to see patients, because neither considered that they could have measles. Despite surveillance for cases among contacts, including unvaccinated persons, no additional cases were identified. **My comments:**	**Key words** Outbreak 2 doses or less Non- classical **Facts** Measles vaccination resulted in a 71% drop in measles deaths between 2000 and 2011 worldwide.

Other considerations

• Measles is still common in many developing countries – particularly in parts of Africa and Asia. More than 20 million people are affected by measles each year. The overwhelming majority (more than 95%) of measles deaths occur in countries with low per capita incomes and weak health infrastructures.

• Measles outbreaks can be particularly deadly in countries experiencing or recovering from a natural disaster or conflict. Damage to health infrastructure and health services interrupts routine immunization, and overcrowding in residential camps greatly increases the risk of infection.

Rubeola Virus (Measles Virus)	
Reservoirs	Humans (only reservoir).
Transmission	Direct contact. Respiratory droplet.
Diseases	**Rubeola- "Measles"** High fever, rhinitis, pharyngitis, conjunctivitis, non-productive cough and generalized lymphadenomegaly medium-sized erythematous rash with bluish-white centers on the bucca and tongue "koplik's spots". Erythematous maculopapular rash beginning on the face and then progressing descendingly to the feet, Spontaneously resolves in < 2 weeks. May complicate by causing viral interstitial pneumonitis, infective myocarditis and meningoencephalitis. Primarily occurs in children. May progress to subacute sclerosing panencephalitis. **Subacute Sclerosing Panencephalitis - "SSPE"** Stupor and myclonic spasms in awaken state (spasms normally occurring in healthy as they fall asleep, deafness, blindness, seizures and Coma. > 25% mortality. Occurs years after initial infection. Caused by reactivation of latent Rubeola Virus.
Treatment	None in particular
Prevention	A live attenuated vaccine given in combination with mumps and rubella vaccine

c. Parainfluenza virus (PIV)

Case An outbreak of HPIV-4 infection in a developmental disabilities unit, involving 38 institutionalized children and three staff members, during a 3-week period in autumn 2004. Most subjects had Upper Respiratory Tract Infections (URTI), While Lower Respiratory Tract Infections (LRTI) occurred in three children (7%), one complicated by respiratory failure requiring ventilation support. All patients recovered. Nasopharyngeal aspirates tested for HPIV-4 were Positive By Reverse Transcriptase PCR (RT-PCR) in all 41 cases (100%). **My comments:**	**Key words** Outbreak HPIV-4 Children Autumn URTI **Facts** The second main cause of hospitalization in children under 5 years of age suffering from a respiratory illness.

Other considerations

PIV-3 infections are second only to Respiratory Syncytial Virus (RSV) infections as a viral cause of serious ARI in young children. Pneumonia and bronchiolitis from PIV-3 infection occur primarily in the first six months of life, as is the case for RSV infection. Croup is the signature clinical manifestation of infection with parainfluenza viruses, especially PIV-1, and is the chief cause of hospitalization from parainfluenza infections in children two to six years of age. However, this syndrome is relatively less frequent in developing countries. The proportions of hospitalizations associated with PIV infection vary widely in hospital-based studies.

Parainfluenza virus (PIV)	
General Characteristics	Four distinct serotypes, "HPIV-4 (A and B) and subgroups/genotypes of HPIV-1 and HPIV-3 Enveloped ss RNA

Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet
Diseases	HPIV-1 to HPIV-3 is major causes of lower respiratory infections in infants, young children, the immunocompromised, the chronically ill, and the elderly Upper respiratory tract infections such as a common cold, ear infections, or sore throat Lower respiratory tract infections such as Croup; an inflammation of the larynx and trachea, Pneumonia and Bronchiolitis Symptoms occur in many types of parainfluenza infections include; rough barking cough, rapid noisy or labored breathing, hoarseness and wheezing, redness of the eye, runny nose, cough, fever, vomiting and diarrhea
Treatment	No specific treatment but Ribavirin has shown good potential for the treatment of hPIV-3
Prevention	No vaccines currently exist

d. Respiratory Syncytial Virus "RSV"

Case A 4 months old boy was presented to the Pediatric Nurse Practitioner (PNP) at the Emergency Department (ED) with rhinorrhea and tachypnea for the past 4 days. A fever that developed during the night prompted his mother to bring him to the ED. He has had no cough, but his mother reported that when he breathes, he sounds "funny" and his chest looks funny. He has been recently exposed to other sick children at his daycare center. He was hospitalised in the special care nursery for 1 week with an oxygen requirement for several days. He was discharged home with no medications or other therapies. His immunisations are up to date to 4 months, and he has not received immunoprophylaxis with palivizumab **My comments:**	**Key words** 4-month-old Rhinorrhea Tachypnea Breathes sounds "funny" Hospitalized in the special care Immunoprophylaxis with Palivizumab **Facts** Each year, 75,000 to 125,000 children in this age group are hospitalized due to RSV infection

Other considerations

Premature infants, children less than 2 years of age with congenital heart or chronic lung disease, and children with compromised (weakened) immune systems due to a medical condition or medical treatment are at highest risk for severe disease. Adults with compromised immune systems and those 65 years old and older are also at increased risk of severe disease.

Respiratory Syncytial Virus (RSV)	
General Characteristics	Enveloped ss RNA F proteins on the surface of the virus cause the cell membranes on nearby cells to merge, forming syncytia
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet
Diseases	In some children, RSV causes bronchiolitis, leading to severe respiratory illness requiring hospitalization and, rarely, causing death. A worsening croupy cough, unusually rapid breathing, difficulty breathing, and a bluish color of the lips or fingernails caused by low levels of oxygen in the blood. RSV can cause middle ear infections (otitis media) in preschool children. Many persons with RSV infection show no symptoms. It might leads to recurrent wheezing or whether those already predisposed to asthma are more likely to become severely ill with RSV has yet to be determined
Treatment	No specific treatment
Prevention	No vaccines currently exist Palivizumab is available to prevent severe RSV illness in certain infants and children who are at high risk Frequent hand washing and wiping of hard surfaces with soap and water or disinfectant may help stop infection and spread of RSV

Togaviridae

a. Rubella Virus

Case An infant was born by cesarean delivery at approximately 32.5 weeks' gestational age, weighing 650 g. Conditions noted after birth included cataracts, Dandy-Walker syndrome, intrauterine growth retardation, thrombocytopenia, chorioretinitis, coarctation of the aorta, mild liver dysfunction, mildly elevated transaminases, mild direct hyperbilirubinemia, and persistent elevation of C reactive protein. The child was discharged after 6 months. Diagnosis was confirmed by a positive rubella IgM test result The mother was an immigrant from Sudan in her late 20s. Her rubella vaccination status was unknown; however, rubella vaccine is not part of the routine vaccination schedule in Sudan. The mother reported not having had a rash or fever after pregnancy. She reported that she along with her husband and two daughters (aged 3 and 5 years), traveled by airplane to the United States via Cairo, Egypt. The two daughters in the household had documented receipt of measles, mumps, and rubella vaccine, but the father's vaccination status was unknown **My comments:**	**Key words** Conditions noted after birth Positive rubella IgM Mother rubella vaccination status was unknown Mother traveled via Cairo, Egypt **Facts** Worldwide, an estimated 110 000 babies are born with Congenital Rubella Syndrome (CRS) every year

Other considerations

In USA the most important prevention message to international travelers is they should be immune to rubella. This is because many imported cases result from US residents returning from countries where rubella vaccination is not widespread. Acceptable presumptive evidence of immunity to rubella for international travelers includes the following:

- Documentation of receipt of ≥1 dose of rubella-containing vaccine on or after the first year of life.
- Laboratory evidence of rubella immunity (a positive serologic test for rubella-specific IgG)
- Born before 1957 (except women of childbearing age who could become pregnant).

Rubella Virus	
General Characteristics	Linear (+) ssRNA Icosahedral capsid Enveloped
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Respiratory droplet

Diseases	**Rubella-"German measles"** Low-grade fever, rhinitis, pharyngitis, conjunctivitis and painful postauricular and suboccipital lymphadenomegaly Small erythematous rash on the soft palate "forchheimer's spots" Erythematous maculopapular rash beginning on the face and then progressing descendingly to the feet Spontaneously resolves in < 1 week May complicate by progressing to infective arthritis Analogous to rubeola, Primarily occurs in children TORCH Syndrome
Treatment	No specific treatment
Prevention	A live attenuated vaccine given in combination with mumps and measles vaccine

Caliciviridae

a. Norwalk Virus

Case On Friday September 18th 1998, after a locker-room lunch, the members and the staff of a North Carolina college football team flew to Florida for a 7 p.m. game the next evening. During the football game, several players on the North Carolina team suddenly began to vomit and have diarrhea. They continued to play despite their illness. The nature of the game made it difficult for players to avoid contact with feces and vomitus. Other members of the North Carolina team and staff who did not travel to Florida also became ill. By Sunday evening, some of the Florida players also had similar gastrointestinal symptoms. The only contact between the teams had been on the playing field. An investigation was conducted to determine the cause of this gastrointestinal illness, the source of infection, and the mode of transmission. **My comments:**	**Key words** Locker-room lunch Sudden vomiting and diarrhea Contact with feces and vomitus Team and staff ill Other team players ill with gastrointestinal symptoms **Facts** It causes about 21 million illnesses and contributes to about 70,000 hospitalizations and 800 deaths.

Other considerations

Norwalk virus is the leading cause of foodborne illness in the United States. It is responsible for;

- 58% of domestically-acquired foodborne illnesses, and
- 50% of foodborne disease outbreaks due to known agents.

Most foodborne outbreaks of Norwalk virus illness are caused by eating food that was contaminated by a food handler. However, widespread outbreaks of can also be caused by food, such as oysters, raspberries, and leafy greens, that were contaminated at their source.

Waterborne outbreaks of Norwalk virus illness also occur in community settings. This is often caused by sewage contaminated wells and untreated recreational water.

Norwalk Virus	
General Characteristics	Same reservoirs, transmission and treatment as Rotavirus.
Diseases	**Gastroenteritis** Primarily occurs in teenagers and adults. Caused by Norwalk Virus infection of the Gastro Intestinal tract
Treatment	No specific antiviral therapy
Prevention	No vaccine is available Frequent hand washing and disposal of contaminated food and disinfection of contaminated materials, prevent transmission

Rhabdoviridae

a. Rabies

Case Immigrant Mahmood from Indonesia develops fever, headache, and vomits. He refuses to take pills and drink water due to pain on swallowing. Two days later he has a 41°C fever, is confused, delirious, becomes paralyzed, goes into coma, and dies. Autopsy indicates Negri bodies in a brain biopsy. Father recalls son being bitten on leg by a dog 6 months earlier. **My comments:**	**Key words** Vomit Refuses to drink water Pain on swallowing 41°C fever Confused, delirious, Paralyzed, coma, Died Negri bodies Dog bite **Facts** The earliest record of canine rabies appears in Mesopotamian cuneiform law tablets from about 2000 BC.

Other considerations

Historical detective work uncovers two intriguing formulas for creating biological weapons in an ancient Indian manual of warfare. The Arthashastra by Kautilya (fourth century BC) tells how to make many different types of poison arrows.

One recipe calls for mixing various toxins with the blood of a musk rat. "Anyone pierced with this arrow," wrote Kautylia, "will be compelled to bite ten companions, who will each in turn bite ten more people." The implication is that musk rats were a vector of rabies in India.

The other poison arrow recipe calls for "The blood of a man and a goat to induce biting madness," which sounds suspiciously like rabies. Perhaps goats were susceptible to rabid animal bites.

Rabies Virus	
Characteristics	Linear (-) ss RNA Helical capsid Enveloped
Reservoirs	Humans Animals (primarily dogs, cats and bats)

Transmission	Direct contact Zoonotic
Diseases	**Furious Rabies** Fever, headache and neuralgia at the site of initial infection. Encephalitis leading to delirium, psychosis and bursts of furious rage, and severe pharyngeal spasms upon drinking "hydrophobia" leading to foaming of the mouth. Symmetric flaccid paralysis and seizures. Coma and respiratory center dysfunction. > 90% mortality rate (within 2 weeks). **Most common** Caused by Rabies Virus infection of wounds, Migration of Rabies Virus through sensory neurons into the CNS. **Apathetic Rabies** Fever, headache and neuralgia at the site of initial infection. Encephalitis leading to insomnia, stupor and apathy. Symmetric Flaccid paralysis and seizures. Coma and respiratory center dysfunction. -> 90% mortality rate (within 2 weeks). Caused by Rabies Virus infection of wounds, migration of Rabies Virus along sensory neurons into the CNS.
Treatment	No specific treatment one clinical symptoms developed.
Prevention	**Post exposure prophylaxis** – passive immunization (treatment after exposure to the bite of a rabid animal) and **pre-exposure prophylaxis-** active immunization are available

Slow viruses

a. Prions

Case A 70 years old woman had severe headaches, dull and apathetic. She has memory loss, and moments of confusion. With abnormal EEG, coma-like state, occasional spontaneous clonic twitching of the arms and legs and myoclonic jerking response to a loud noise. Patient died four months after onset of pneumonia. Died astrocytic gliosis of the cerebral cortex with fibrils. Intracellular vacuolation throughout the cerebral cortex were seen microscopically. There were no swelling and no inflammation. **My comments:**	**Key words** 70yr old Memory loss Moments of confusion Abnormal EEG Coma-like state Spontaneous clonic twitching Died Onset of pneumonia Intracellular vacuolation of cerebral cortex **Facts** Prions also have at least one known useful function, in the cells that insulate nerves, and are suspected to have more

Other considerations

A team of researchers from Case Western Reserve University School of Medicine have identified a mechanism that can prevent the normal prion protein from changing its molecular shape into the abnormal form responsible for neurodegenerative diseases. This finding, published in the July, 2013 18 issue of Cell Reports, offers new hope in the battle against a foe that until now has always proved fatal.

Prions	
General Characteristics	"Proteinaceous infectious particles" Not viruses Consists solely of protein ("prion protein", "PrP")
Reservoirs	Humans Animals (primarily cattle)
Transmission	Zoonotic Contaminated food and fomites Inherited
Diseases	**variant Creutzfeldt-Jakob Disease "vCJD"** "Bovine spongiform encephalopathy", "BSE", "mad cow disease", in cattle Cerebral and cerebellar granulovacoular degeneration Chronic progressive encephalopathy leading to insomnia, stupor, apathy, myclonic spasms in awakens state and finally coma. 100% mortality (in less than 2 years) Caused by Prion viremia, Prion accumulation in the CNS
Treatment	No specific treatment one clinical symptoms developed
Prevention	Not available

Retroviridae

a. Human T-Lymphotrophic Virus 1 (HTLV1)

Case Seven patients who were Human T-Lymphotropic Virus type 1 (HTLV-1) carriers, had a pathological diagnosis of de novo diffuse large B-cell lymphoma. Three of the cases showed positive expression of Epstein-Barr-virus, (EBV-) encoded RNA within the tumor cells indicating a possible interaction between these two viruses. Furthermore, three EBV-positive cases presented with similar clinical characteristics such as early clinical stage and low-risk indices. **My comments:**	**Key words** Large B-cell lymphoma EBV positive **Facts** Acute Human T-Cell Lymphotropic Virus (HTLV) infection is rarely suspected or diagnosed.

Other considerations

In considering HTLV infection, the most important historical information pertains to risk assessment. Because detecting accurate seroprevalence in low-endemic populations is inherently problematic, it is important to stratify a patient's risk. Screening Enzyme Immunoassays (EIAs) yield false-positive results in more than 50% of cases in areas of low prevalence. Therefore, a high-risk individual is anyone who has any of the following characteristics:

- Lived or lives in an endemic area (ie, Japan, the Caribbean, Central or West Africa, South America).
- A Native American Indian.
- Parents or sexual partners from an endemic area.

- Received blood-product transfusions in the United States before 1988.
- Received blood transfusions anywhere that lacks active blood-bank screening.
- A history of injection drug use.
- Sexual partners with a history of injection drug use.
- Multiple sexual partners and does not use barrier protection.
- Strongyloidiasis hyperinfection.

Human T-Lymphotrophic Virus 1 (HTLV-1)	
General Characteristics	Linear diploid (2 exact copies) (+) ss RNA Complex capsid Enveloped
Special characteristics	Oncogenic
Reservoirs	Humans (only reservoir).
Transmission	Sexual Perinatal Parenteral
Diseases	**Tropical Spastic Paraparesis - "HTLV-1 associated myelopathy"** Skeletal muscle spasms and generalized striated muscle asthenia, including external urethral and external rectal sphincters leading to incontinence HTLV-1 infection of the CNS **Acute T-Lymphocytic Leukemia** Malignant neoploasm of T lymphocytes HTLV-1 infection of T lymphocytes
Treatment	None in particular.
Prevention	Prevention should be divided into two steps; 1. Prevention of HTLV-1 transmission, by screening for HTLV-1 among blood donors and refraining from breastfeeding among pregnant women who are HTLV-1 carriers. 2. Prevention of ATLL development among HTLV-1 carriers.

b. Human Immunodeficiency Virus (HIV)

Case A 30 years old female, HIV positive at labour, was given a single dose of Nevirapine and drops of the drug to the newborn hours after birth. This act, reduced mother-to-child-transmission of HIV from 25 percent to 8 percent. **My comments:**	**Key words** HIV positive female At labour Nevirapine Mother-to-child-transmission of HIV **Facts** CDC estimates that approximately 50,000 people in the United States are newly infected with HIV each year. Nearly two thirds of these new infections occurred in gay and bisexual men

Other considerations

HIV patients might need;

• **Integrated Planning Group;** an advisory group to the HIV/STD. The group might assist with developing a plan for providing prevention and care services for HIV, viral hepatitis, and other sexually transmitted infections.

• **HIV Case Management;** The HIV Care and Treatment Program contracts with county health departments and community based organizations around the state to provide HIV case management services to person living with HIV and their families.

Human Immunodeficiency Virus (HIV)	
General Characteristics	Linear diploid (2 exact copies) (+) ss RNA Complex capsid Enveloped Have reverse transcriptase enzyme 7 genera but only 2 linked to human disease
Reservoirs	Humans (only reservoir)
Transmission	Direct contact Sexual Perinatal Parenteral
Diseases	**Acquired Immunodeficiency Syndrome - "AIDS"** Infectious mononucleosis-like syndrome Immunodeficiency leading to a torrent of opportunistic bacterial, viral, fungal protozoal and helmithic superinfections, as well as a torrent of malignant neoplasms May complicate by HIV infection of both the central and peripheral nervous system, encephalopathies, myelopathies and peripheral neuropathies (AIDS dementia complex) 100% mortality (eventually) Caused HIV dissemination in virtually every Lymphoid organ and HIV infection of helper T lymphocytes
Treatment	**HAART**, Indirect viral reverse transcriptase inhibitors Direct viral reverse transcriptase inhibitors, plus viral protease inhibitors

Arboviruses

Arthropod Transmitted Viruses

Flaviviridae

a. Yellow Fever Virus

Case A 67 years old man was admitted to Hospital Vozandes in Quito, Ecuador, with a five-day history of a febrile illness, headache, severe abdominal pain, anxiety, nausea and vomiting, dyspnea, jaundice, leucopenia, and thrombocytopenia. His symptoms started three days after receiving a yellow fever vaccine and became progressively worse. After blood and urine cultures, he was given ceftriaxone and intravenous hydration. Three hours after admission, he was transferred to an intensive care unit because of multiorgan system failure and was given intravenous pressors, hydrocortisone, vancomycin, and cefepime. On the third day in the hospital, a cardiac arrhythmia developed, the patient did not respond to cardiopulmonary resuscitation, and he died. All cultures of blood, urine, and tissues were negative for bacteria. The presence of yellow fever virus antigens and nucleic acids in heart, liver, and spleen; the chronology of receipt of the vaccine; and the clinical picture of multiorgan failure are all indicative of a viscerotropic yellow fever virus infection caused by the vaccine virus. **My comments:**	**Key words** 67 yrs old Ecuador Symptoms started three days after receiving a yellow fever vaccine Multiorgan system failure Cardiac arrhythmia **Facts** Yellow fever is a very rare cause of illness in U.S

Other considerations

If a person has any of the following conditions, healthcare provider can decide whether it is safe to receive the vaccine or not:

• HIV/AIDS or other disease that affects the immune system.

• Weakened immune system as a result of cancer or other medical conditions, transplant, or drug treatment (such as steroids, chemotherapy, or others that affect immune function).

• Thymus disorder.

• Adults 60 years of age and older.

• Infants 6 - 8 months of age.

Yellow Fever Virus (YFV)	
Reservoirs	Humans Animals (primarily primates and marsupials)
Transmission	Zoonotic Vectorial (mosquitoes)
Diseases	**Yellow Fever** Fever, headache and myalgias (primarily of the lower back) Toxic acute tubular necrosis leading to intrarenal acute renal failure and uremia, and acute viral hepatitis leading to jaundice and coagulopathies > 40% mortality
Treatment	None in particular.
Prevention	Yellow fever can be prevented by vaccination. International regulations require proof of yellow fever vaccination for travel to and from certain countries. People who get vaccinated should be given an International Certificate of Vaccination. Also note that the vaccine is to be given 10 days before travel to an endemic area Travelers should also take precautions against mosquito bites in areas with yellow fever transmission

Togaviridae

a. Western Equine Encephalitis Virus (WEEV)

Case In Uruguay, a 14 years old boy, had fever, asthenia, and headaches. At hospital admission, he was febrile and without neurologic signs; amoxicillin treatment was initiated. On day 1, headache, vomiting, neck stiffness, and partial left seizures on the left side developed. A cerebrospinal fluid sample was negative for bacteria in cultures. The patient was brought to the intensive care unit with a clinical diagnosis of viral encephalitis. Another CSF specimen was taken, and PCR results were negative for herpesvirus and enterovirus. Seventy-two hours after admission, the patient died. **My comments:**	**Key words** Uruguay Fever, asthenia, and headaches Vomiting, neck stiffness, and seizures CSF negative for bacteria Viral encephalitis PCR were negative for HSV and enterovirus Patient died **Facts** Transmission cycle occurs between birds and mosquitoes

Other considerations

We face some challenges like:

• No licensed vaccine for human use.

• No effective therapeutic drug.

• Unknown overwintering cycle.

• Control measures expensive.

• Limited financial support of surveillance and prevention.

Some opportunities:

• Education of health-care workers and the public.

• Integrated State and community prevention efforts.

• Therapeutic development.

Western Equine Encephalitis Virus (WEEV)	
Reservoirs	Humans Animals (primarily horses, rodents and birds)
Transmission	Vectorial (mosquitoes)
Diseases	**Western Equine Encephalitis "WEE"** Meningitis leading to high fever, vomiting and nuchal rigidity Encephalitis leading to delirium, stupor, seizures and coma < 10% mortality
Treatment	No effective therapeutic drug
Prevention	No licensed vaccine for human use

Eastern Equine Encephalitis Virus (EEEV)	
Characteristics	Same reservoirs, transmission and treatment as WEEV
Diseases	**Eastern Equine Encephalitis "EEE"** Analogous to WEE > 60% mortality
Venezuelian Equine Encephalitis Virus (VEEV)	
Characteristics	Same transmission and treatment as WEEV
Reservoirs	Humans Animals (primarily horses)
Diseases	**Venezuelan Equine Encephalitis "VEE"** Analogous to WEE < 20% mortality
Treatment	No specific treatment other than supportive care is available
Prevention	A live-attenuated VEE vaccine has been used in horses A formalin-inactivated vaccine has been developed for use in humans, although further investigation of its protective effects is needed

Bunyaviridae

a. California Encephalitis Virus (CEV)

Case A 65 years old man, became ill with blurred vision and dizziness. Eight days after the onset of symptoms, he visited his primary physician. A physical examination was remarkable only for nystagmus. A magnetic resonance image and arteriogram were normal. One month after the initial visit, the patient no longer complained of blurred vision or vertigo, and nystagmus had disappeared. Two years after the episode, he had no neurologic sequelae. The patient traveled outside the United States. He visited Egypt and several Caribbean islands. An acute-phase serum specimen was sent to the Viral and Rickettsial Disease Laboratory, California Department of Health Services. Indirect immunofluorescence antibody tests were negative for St. Louis encephalitis and Western equine encephalomyelitis virus. **My comments:**	**Key words** 65 yrs Blurred vision and dizziness Visited Egypt and several Caribbean islands Tests were negative for St. Louis encephalitis and Western equine encephalomyelitis virus **Facts** 20% of patients develop behavioral problems or recurrent seizures

Other considerations

• La Crosse virus (LACV) is a California (CAL) serogroup virus, in the genus Bunyavirus, family *Bunyaviridae*. Members of the family *Bunyaviridae* have three segments of single-stranded RNA; the virus particles are spherical or oval, enveloped, and are 90-100 nm in diameter.

• Other CAL serogroup viruses found in the United States include California encephalitis virus, Jamestown Canyon virus, Snowshoe hare virus, and Trivitattus virus. Because almost all recognized CAL serogroup virus disease cases are caused by LACV, and other CAL serogroup viruses rarely cause recognized human illness.

California Encephalitis Virus (CEV)	
General Characteristics	Linear segmented (3 segments) (-) ss RNA Helical capsid Enveloped
Special Characteristics	Same transmission and treatment as WEEV
Reservoirs	Humans Animals (primarily rodents)
Diseases	**California Encephalitis** Analogous to WEE < 1% mortality
Treatment	No specific antiviral treatment for clinical LACV infection is available. Patients with suspected LAC encephalitis should be hospitalized and supportive treatment (including seizure control) should be provided
Prevention	No vaccine against LACV infection

b. Hantavirus

Case On November 1st, the National Park Service (NPS) has announced a total of 10 confirmed cases of hantavirus infection in people who recently visited Yosemite National Park, USA. NPS public health officials believe that 9 of the 10 people with confirmed hantavirus infection were exposed to the virus while staying at the Signature Tent Cabins in Curry Village in Yosemite National Park. The other park visitor with hantavirus infection was probably exposed to the virus while hiking or staying at the High Sierra Camps located about 15 miles from Curry Village **My comments:**	**Key words** 10 confirmed cases National Park Staying at the Tent Cabins **Facts** Every two to three years, large outbreaks of hantavirus disease are caused by Pumalavirus, which is transmitted by bank voles and is endemic to southwestern and western Germany

Other considerations

Recent research results show that many people who became ill with HPS developed the disease after having been in frequent contact with rodents and/or their droppings around home or a workplace.

On the other hand, many people who became ill reported that they had not seen rodents or rodent droppings at all. Therefore, if they live in an area where the carrier rodents are known to live, they should try to keep home, vacation place, workplace, or campsite clean.

Hantavirus (Hantaan Virus)	
Reservoirs	Humans Animals (primarily rodents)
Transmission	Direct contact Zoonotic Aerosolized
Diseases	**Hantavirus Pulmonary Syndrome - "HPS"** Fever, headache and myalgias (primarily of the lower back) Alveolar capillary endothelial damage leading to adult respiratory distress syndrome (ARDS) > 80% mortality (in < 1 week) Caused by Hantavirus viremia (primarily of the pulmonary (circulation) **Hantavirus Hemorrhagic Fever with Renal Syndrome - "HFRS"** Fever, headache and myalgias (primarily of the lower back) Disseminated capillary endothelial damage leading to hemorrhages in the skin and mucous membranes, and toxic acute tubular Necrosis leading to intrarenal acute renal failure and uremia < 10% mortality Caused by Hantavirus viremia (primarily of the systemic (circulation)
Diseases	**California Encephalitis** Analogous to WEE < 1% mortality
Treatment	Indirect viral DNA polymerase inhibitors People with severe cases need immediate treatment in an intensive care unit. They will be intubated and given oxygen therapy to help them through the period of severe respiratory distress
Prevention	No WHO-approved vaccine has gained widespread acceptance

Filoviridae

a. Marburg Virus

Case A 40 years old woman travelled to Uganda in 2008, and entered caves on two occasions. She was reportedly exposed to fruit bats during a visit to the "python cave" in the Maramagambo Forest. A large bat population was seen in the cave and the woman was reported to have had direct contact with one bat. The woman returned to the Netherlands in good health. After the first symptoms (fever and chills), she was admitted to hospital. Rapid clinical deterioration with liver failure and severe hemorrhaging occurred on. The patient remained in a critical clinical condition. **My comments:**	**Key words** Uganda Caves Fruit bats Liver failure Severe hemorrhaging **Facts** Marburg virus was first recognized in 1967, when outbreaks of hemorrhagic fever occurred simultaneously in laboratories in Marburg and Frankfurt, Germany and in Belgrade, Yugoslavia

Other considerations

• With modern means of transportation that give access even to remote areas, it is possible to obtain rapid testing of samples in disease control centers equipped with Biosafety Level 4 laboratories in order to confirm or rule out Marburg virus infection.

• A full understanding of Marburg hemorrhagic fever will not be possible until the ecology and identity of the virus reservoir are established. In addition, the impact of the disease will remain unknown until the actual incidence of the disease and its endemic areas are determined.

Marburg Virus	
General Characteristics	Linear (-) ss RNA Helical capsid Enveloped
Reservoirs	Humans Animals (primarily primates)
Transmission	Direct contact Zoonotic
Diseases	**Marburg Hemorrhagic Fever** Fever headache and myalgias (primarily of the lower back) Disseminated capillary endothelial damage Leading to hemorrhages in the skin, mucous membranes as well as other organs Multiple organ failure > 25% mortality
Treatment	None in particular
Prevention	Measures for prevention of secondary transmission are similar to those used for other hemorrhagic fevers

b. Ebola Virus (EBOV)

Case On July 28th 2012, the Uganda Ministry of Health reported an outbreak of Ebola Hemorrhagic Fever in the Kibaale District of Uganda. A total of 24 human cases (probable and confirmed only), 17 of which were fatal, have been reported since the beginning of July. Laboratory tests of blood samples, conducted by the Uganda Virus Research Institute (UVRI) and the U.S. Centers for Disease Control and Prevention (CDC), confirmed Ebola virus in 11 patients, four of whom have died. On October 4, 2012, the Uganda Ministry of Health declared the outbreak ended. **My comments:**	**Key words** Uganda Outbreak of Ebola Hemorrhagic Fever 17 were fatal **Facts** Viral haemorrhagic fever outbreaks have a case fatality rate of up to 90%

Other considerations

• The provision of health care for suspected or confirmed Ebola patients requires specific control measures and the reinforcement of standard precautions, particularly basic hand hygiene, and the use of personal protective equipment, safe injections practices and safe burial practices.

• Laboratory workers are also at risk. Samples taken from suspected human and animal Ebola cases for diagnosis should be handled by trained staff and processed in suitably-equipped laboratories.

• Scientists and researchers are faced with the challenges of developing additional diagnostic tools to assist in early diagnosis of Ebola HF and conducting ecological investigations of Ebola virus and its possible reservoir. In addition, one of the research goals is to monitor suspected areas to determine the incidence of the disease. More extensive knowledge of the natural reservoir of Ebola virus and how the virus is spread must be acquired to prevent future outbreaks effectively.

Ebola Virus (EBOV)	
General Characteristics	Same reservoirs, transmission and treatment as Marburg Virus
Diseases	**Ebola Hemorrhagic Fever- "EHF"** Analogous to Marburg hemorrhagic fever > 90% mortality
Treatment	No standard treatment for Ebola HF Patients receive supportive therapy
Prevention	Few established primary prevention measures are available

Arenaviridae

a. Lassa Virus

Case	**Key words**
Seven patients aged between 17 months and 40 years, had operative intervention for suspected appendicitis, perforated typhoid ileitis, intussuception and ruptured ectopic pregnancy after routine investigations. All seven were post-operatively confirmed as Lassa fever cases. Four patients died postoperatively, most before commencement of ribavirin, while the other three patients eventually recovered with appropriate antibiotic treatment including intravenous ribavirin. **My commen**	Operative intervention Suspected appendicitis, perforated typhoid ileitis, intussuception and ruptured ectopic pregnancy Post-operatively confirmed as Lassa fever **Facts** Studies show up to half a million cases of Lassa fever per year in West Africa, with about 5,000 resulting in death

Other considerations

• Surgeons working in West Africa should include Lassa fever in the differential diagnosis of acute abdomen, especially appendicitis. The presence of high grade fever, proteinuria and thrombocytopenia in patients with acute abdomen should heighten the suspicion of Lassa fever. Prolonged intra-operative bleeding should not only raise suspicion of the disease but also serve to initiate precautions to prevent nosocomial transmission.

• Further educating people in high-risk areas, about ways to decrease rodent populations in their homes will aid in the control and prevention of Lassa fever. Other challenges include developing more rapid diagnostic tests and increasing the availability of the only known drug treatment, ribavirin. Research is presently under way to develop a vaccine for Lassa fever.

Lassa Virus	
General Characteristics	Linear segmented (2 segments) (-) ss RNA Helical capsid Enveloped
Reservoirs	Humans Animals (primarily rodents)
Treatment	Direct contact Zoonotic Aerosols Contaminated food and fomites
Diseases	**Lassa Fever** Analogous to Marburg hemorrhagic fever < 1% mortality
Treatment	Ribavirin, an antiviral drug, has been used with success in Lassa fever patients
Prevention	Primary transmission of the Lassa virus from its host to humans can be prevented by avoiding contact with Mastomys rodents, especially in the geographic regions where outbreaks occur

b. Lymphocytic Choriomeningitis Virus (LCMV)

Case	**Key words**
A case of lymphocytic choriomeningitis virus (LCMV) infection led to investigation of the reservoir. LCMV was detected in mice trapped at the patient's home, and 12 isolates were recovered. Genetic analysis showed that human and mouse LCMVs were identical and that this LCMV strain was highly divergent from previously characterized LCMV. **My commen**	Investigation of the reservoir Home mice trapped Genetic analysis **Facts** About 5% of mice throughout the United States carry LCMV

Other considerations

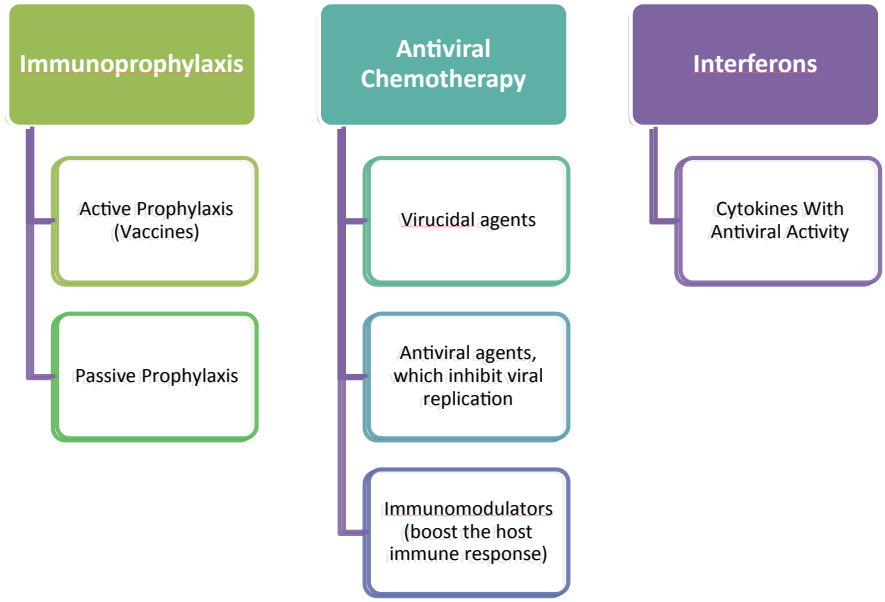
The geographic distributions of the rodent hosts are widespread both domestically and abroad. However, infrequent recognition and diagnosis, and therefore underreporting, of LCM, have limited scientists' ability to estimate incidence rates and prevalence of disease among humans. Understanding the epidemiology of LCM and LCMV infections will help to further delineate risk factors for infection and develop effective preventive strategies. Increasing physician awareness will improve disease recognition and reporting, which may lead to better characterization of the natural history and the underlying immunopathological mechanisms of disease, and stimulate future therapeutic research and development.

Lymphocytic Choriomeningitis Virus (LCMV)	
Reservoirs	Humans Animals (primarily primates, rodents, swine and dogs)
Transmission	Direct contact Zoonotic Aerosols Contaminated food and fomites
Diseases	**Lymphocytic Choriomeningitis "LCM"** Fever, headache and myalgias Meningoencephalitis < 1% mortality
Treatment	None in particular
Prevention	Can be prevented by avoiding contact with house mice and by taking precautions when handling pet rodents

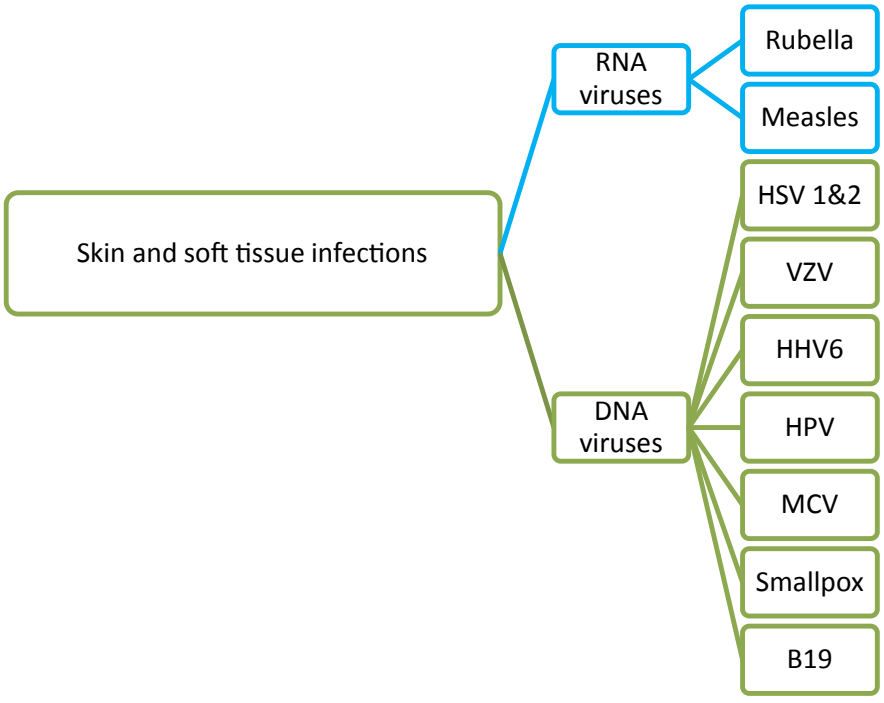
The Big Picture

Concept maps; diagrammatically summarizes the major infections in the context of target organ.

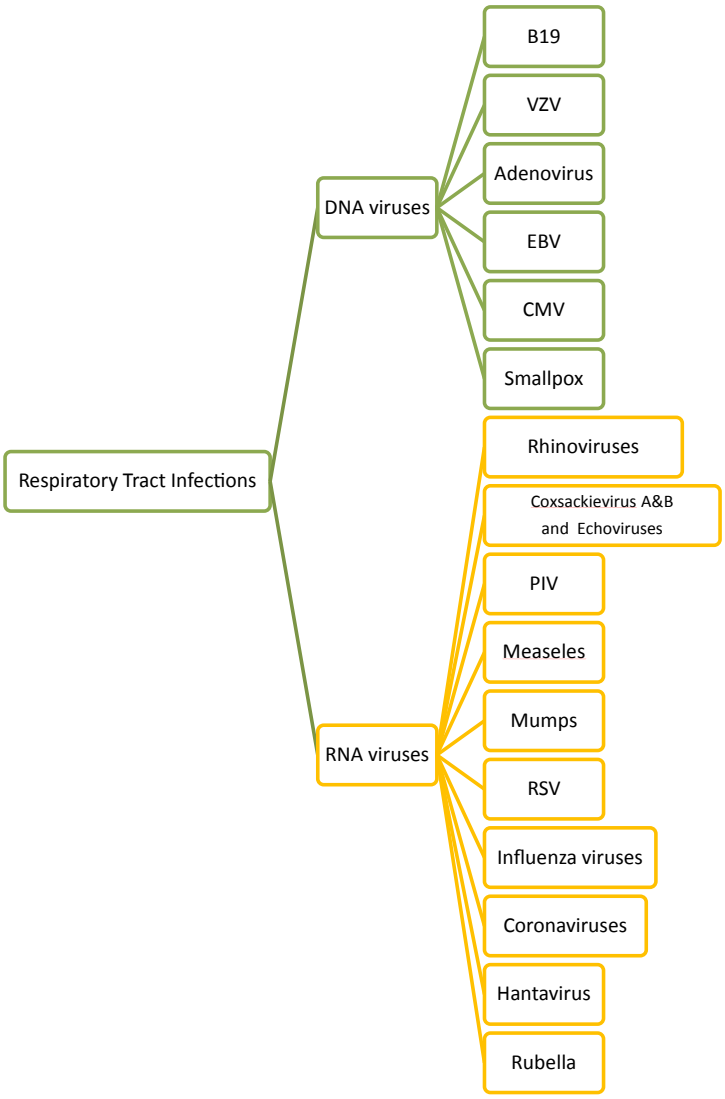
a. Control of Viral Infections



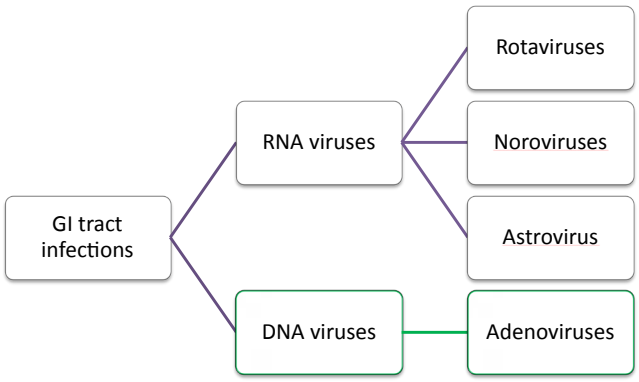
b. Skin and Soft Tissue Infections



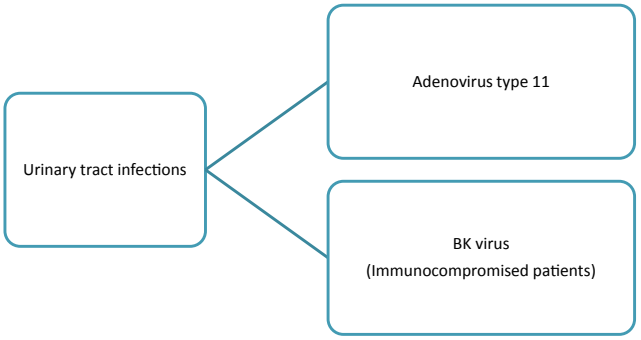
c. Respiratory Tract Infections



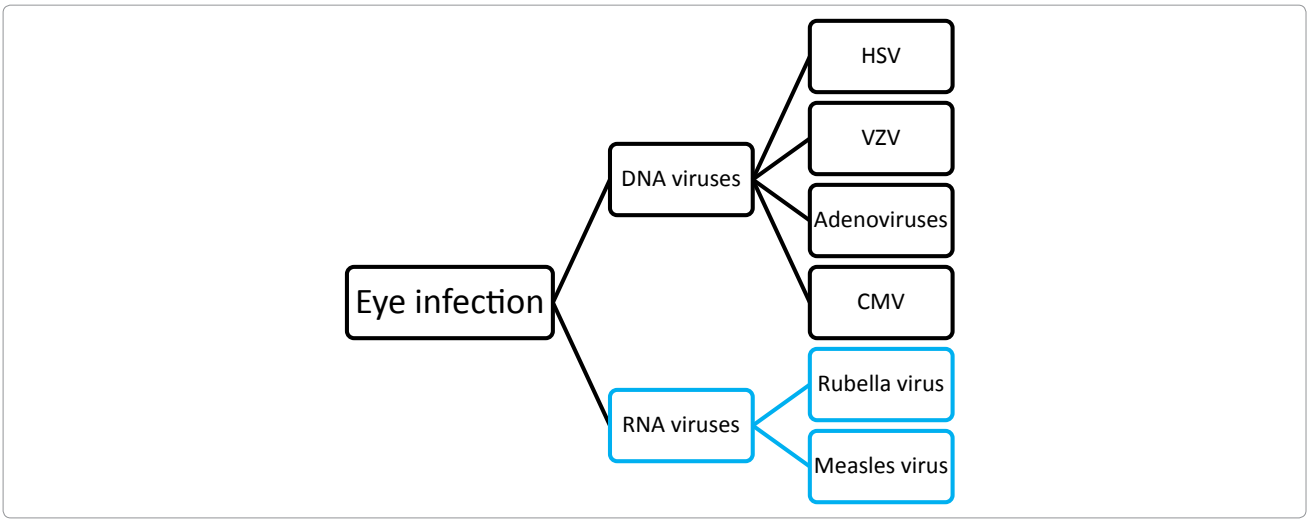
d. Gastrointestinal Tract Infections



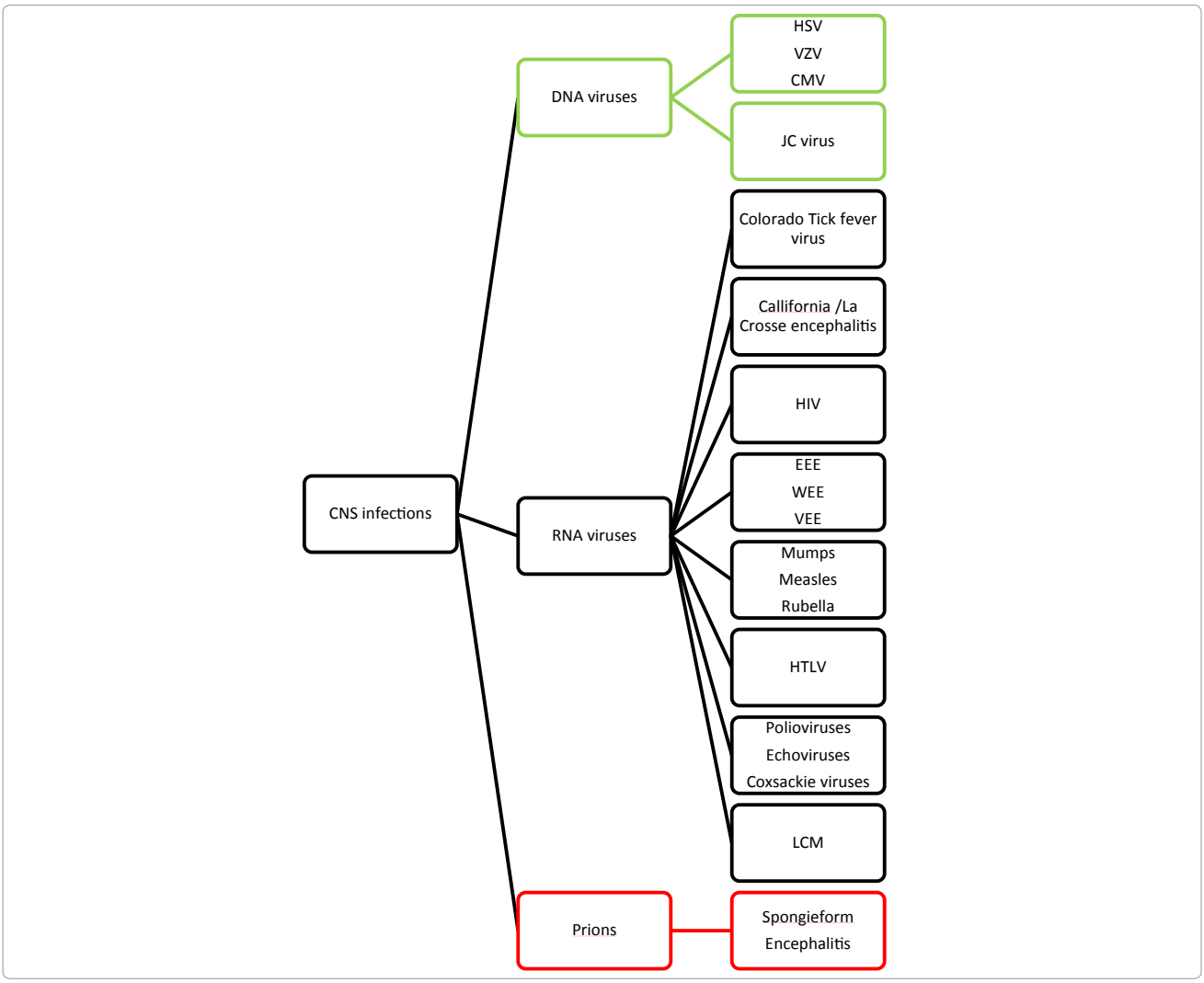
e. Urinary Tract Infections



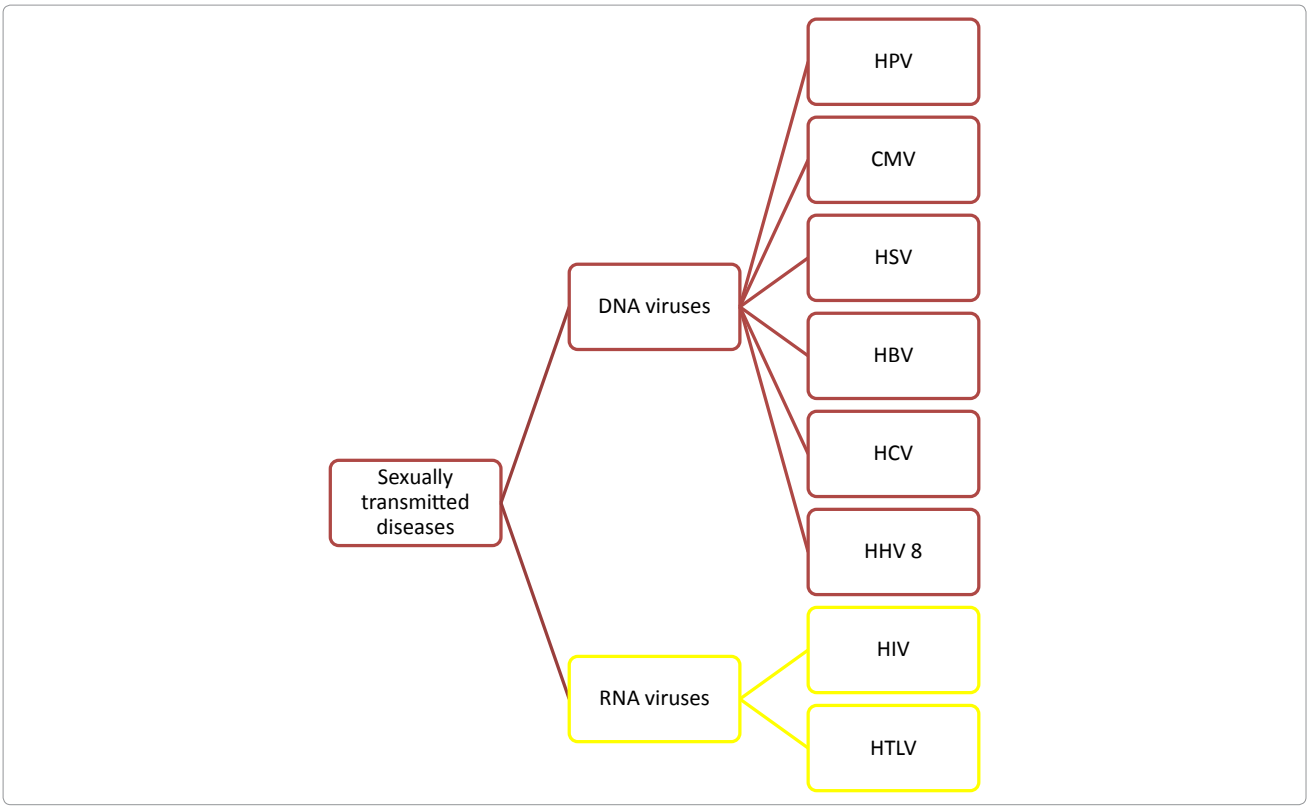
f. Eye Infections



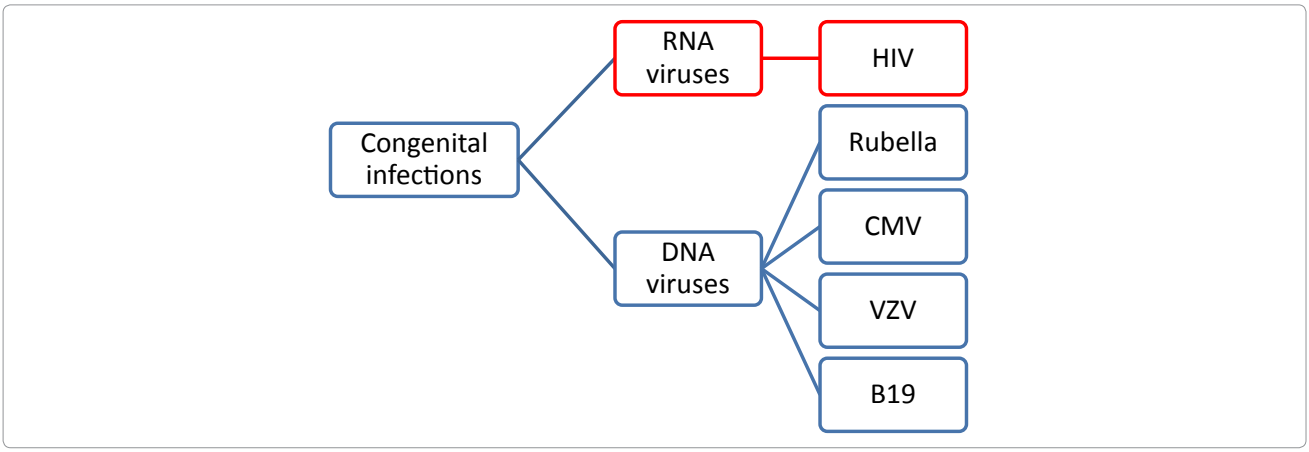
g. Central Nervous System Infections



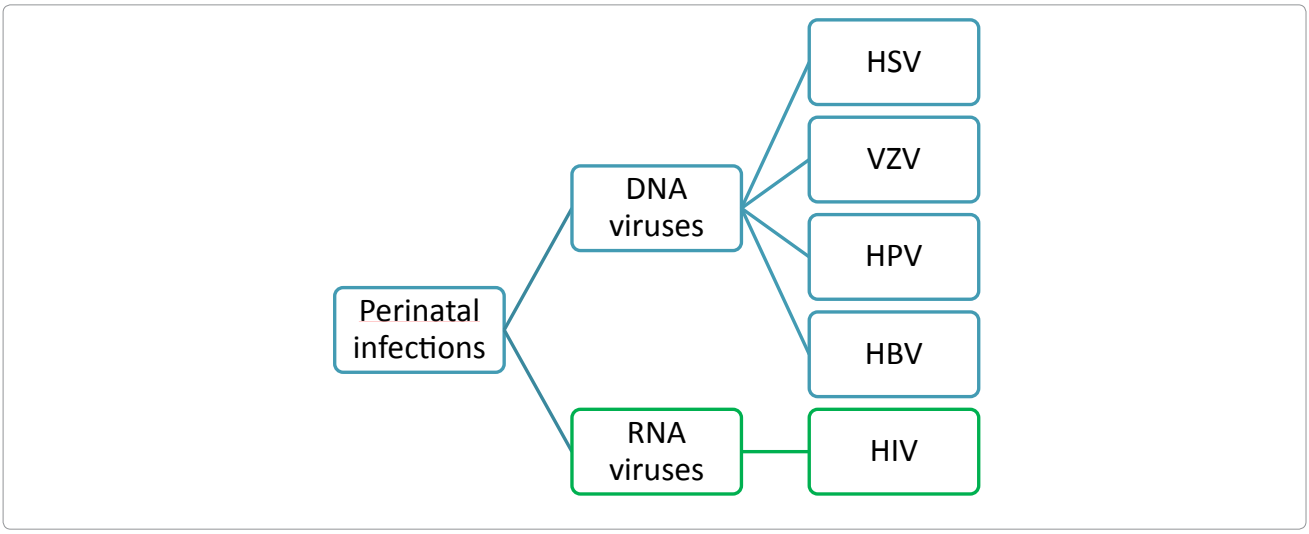
h. Sexually Transmitted Diseases



i. Congenital Infections



j. Perinatal Infections



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