Coronaviridae, Caliciviridae & Reoviridae

University of Jordan

School of Medicine

Department of Pathology, Microbiology and Forensic Medicine

Section of Microbiology and Immunology

Malik Sallam, MD, PhD

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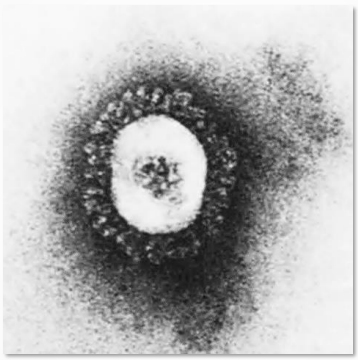
Coronaviridae



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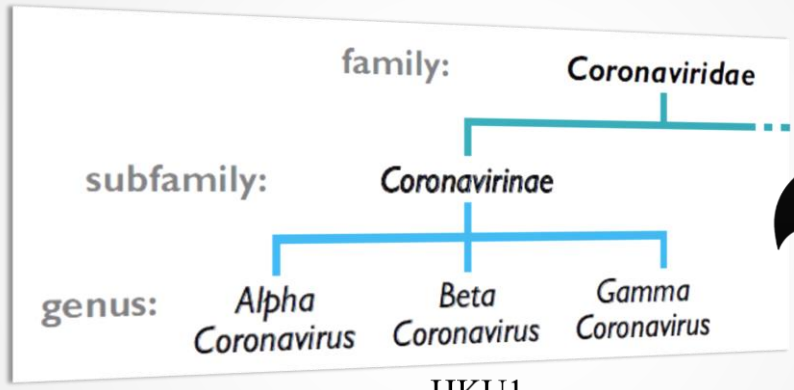
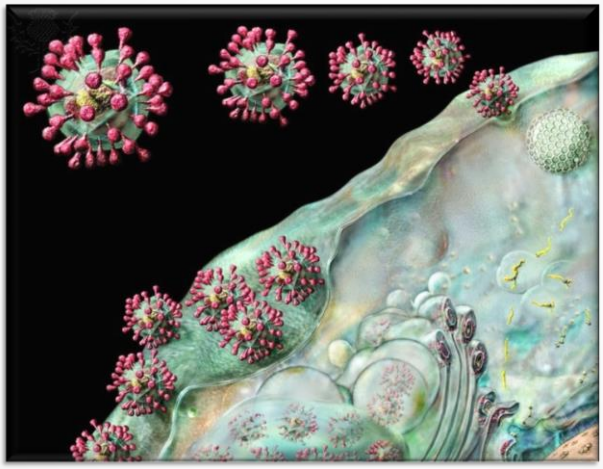
Coronaviridae Classification



HKU1
OC43
NL63
229E
SARS-CoV
MERS-CoV

3

Coronavirus Structure



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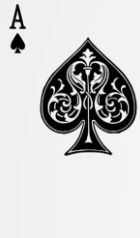
Coronavirus Receptors



SARS-CoV

NL63

Aminopeptidase N (APN; CD13)

229E

Dipeptidyl peptidase 4 (DPP4;CD26)

MERS-CoV

N-acetyl-9-*O*-acetylneuraminic acid

OC43

O-acetylated sialic acid

HKU1

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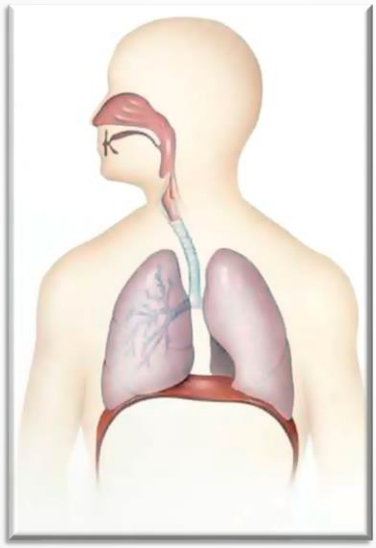
Coronavirus Transmission & Clinical Features



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Clinical Features of Coronavirus Infections

HCoV	Clinical Symptoms	Case Fatality Rate	Incubation Period	Median Time to Death
229E	Coryza	N/A	2-5 days	-
OC43	Coryza	N/A	2-5 days	-
SARS-CoV	Fever, myalgia, headache, chills, cough, dyspnea, respiratory distress, diarrhea	**9%**	2-11 days	23 days
NL63	Coryza, Croup	N/A	2-4 days	-
HKU1	Coryza	N/A	2-4 days	-
MERS-CoV	Fever, myalgia, headache, chills, cough, dyspnea, pneumonia, vomiting, diarrhea	**36%**	2-13 days	14 days

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Coronavirus Origin & Epidemiology

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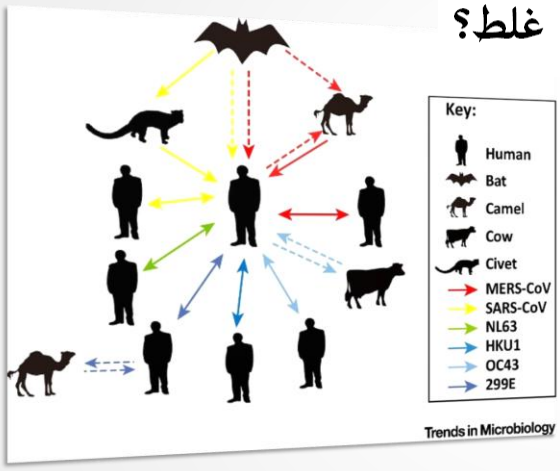

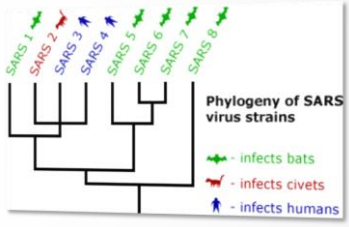

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Coronavirus Origin & Epidemiology





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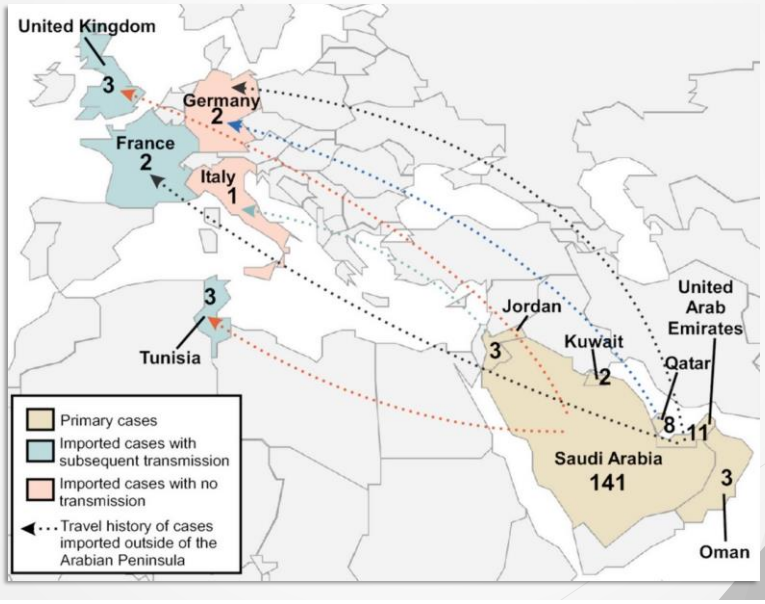
Coronavirus Origin & Epidemiology



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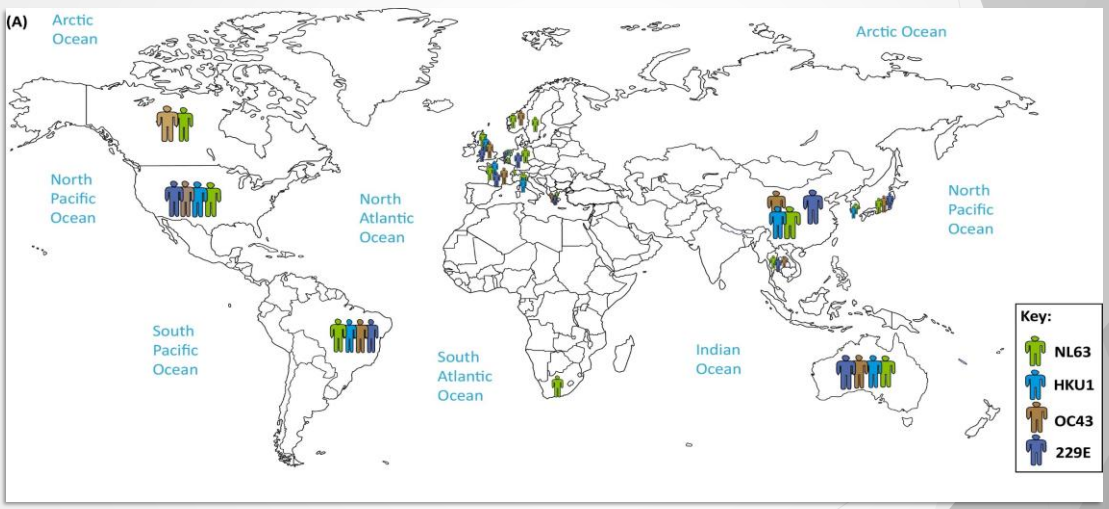
Coronavirus Origin & Epidemiology



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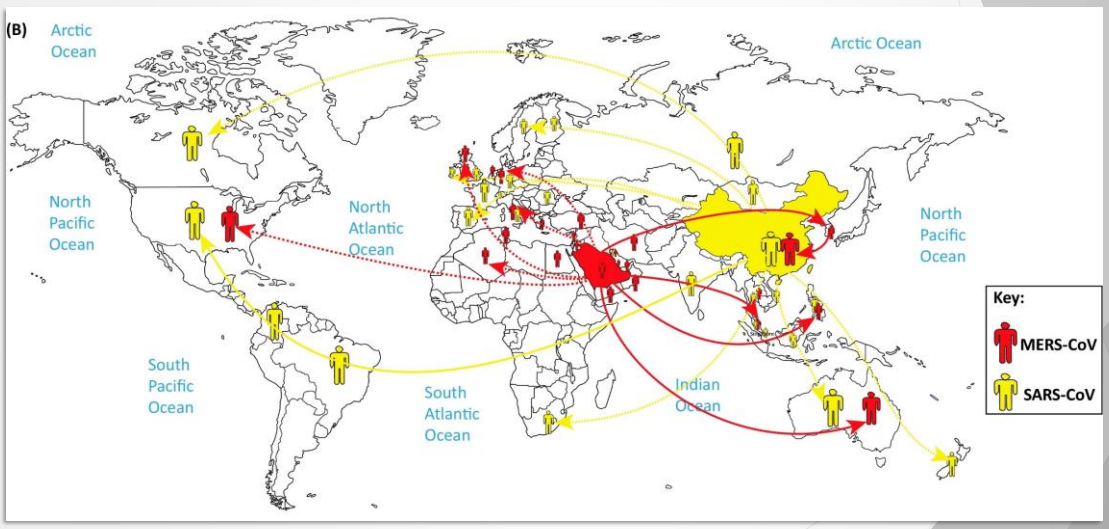
Coronavirus Origin & Epidemiology



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Coronavirus Infection Management

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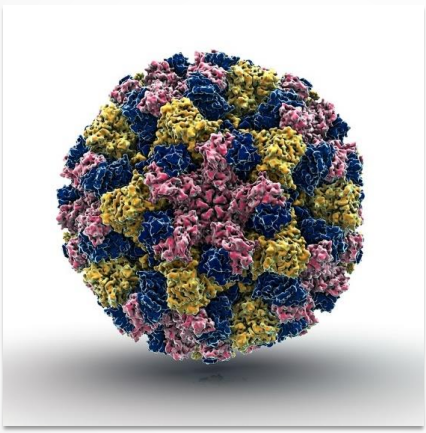
Caliciviridae



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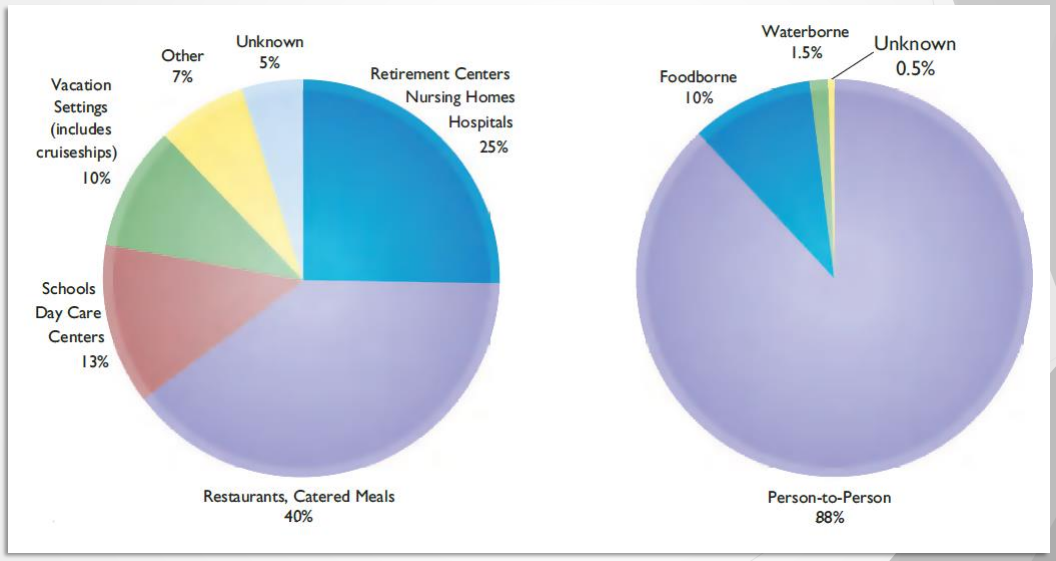
Norovirus Transmission



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Clinical Features of Norovirus Infection

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REOviridae

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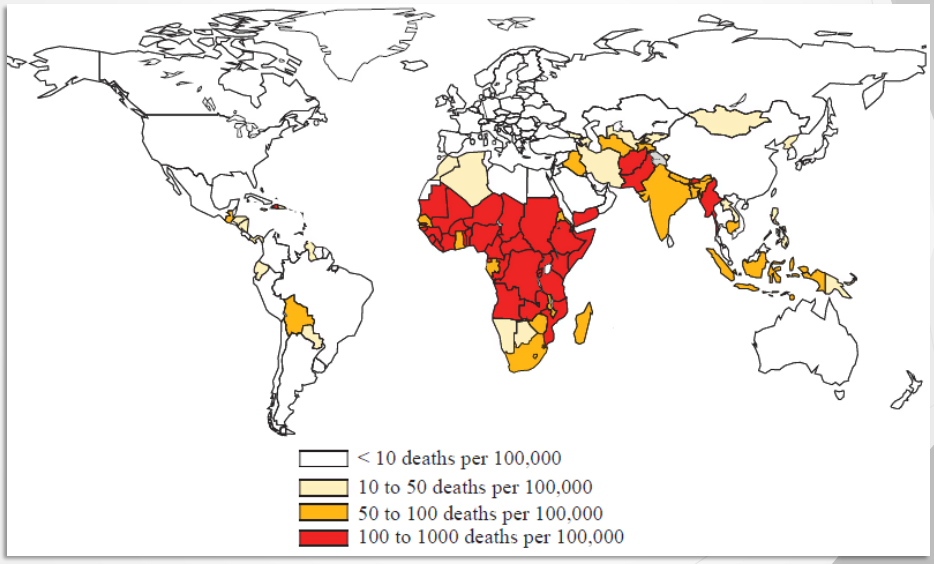
Rotavirus Gastroenteritis



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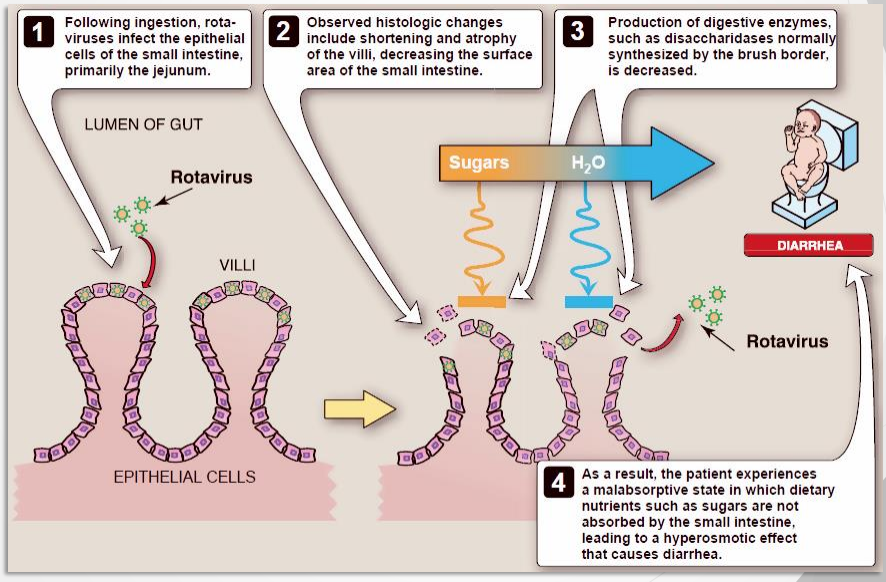
Rotavirus Gastroenteritis



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Rotavirus Dx, Rx and Prevention

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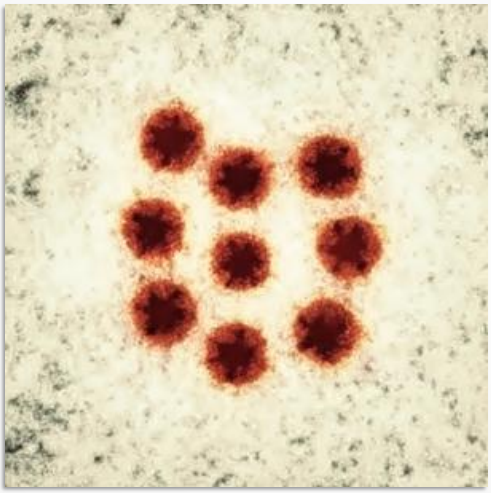
Astrovirus



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ARBOviruses & Ebola

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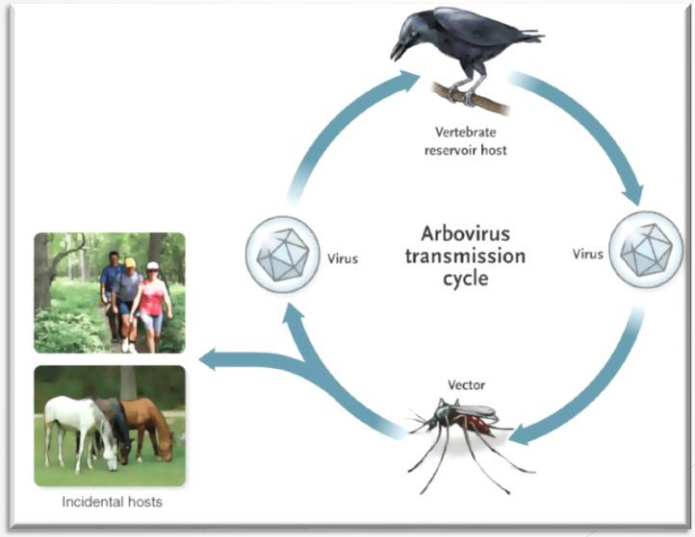
Introduction



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Arbovirus Replication

- The life cycle of the arboviruses is based on the ability of these viruses to multiply in both the **vertebrate host** and the **bloodsucking vector**.

- For effective transmission to occur, the virus must be present in the bloodstream of the vertebrate host (viremia) in sufficiently high titer to be taken up in the small volume of blood ingested during an insect bite.

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Arbovirus Replication

- After ingestion, the virus replicates in the gut of the arthropod and then spreads to other organs, including the **salivary glands**.

- Only **the female** of the species serves as the vector of the virus, because only she requires a blood meal in order for progeny to be produced.

Arbovirus Replication

- Usually, humans are **dead-end hosts**, because the concentration of virus in human blood is *too low* and the duration of viremia is *too brief* for the next bite to transmit the virus.

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Togaviridae (Alphavirus)

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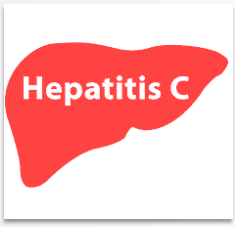
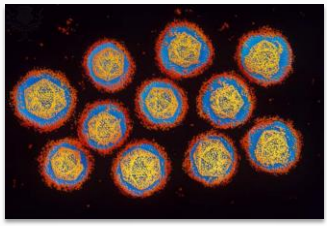
Flaviviridae





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Dengue Fever

- Dengue (**breakbone fever**) is a mosquito-borne infection that is characterized by fever, severe headache, muscle and joint pain, nausea and vomiting, eye pain, and rash.
- Dengue is endemic in more than 100 countries and is considered the most prevalent of all arboviruses in humans.
- Control depends on antimosquito measures.

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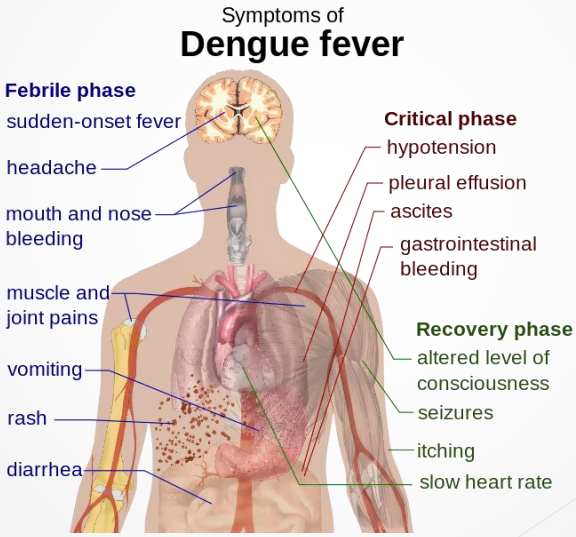
Dengue Fever



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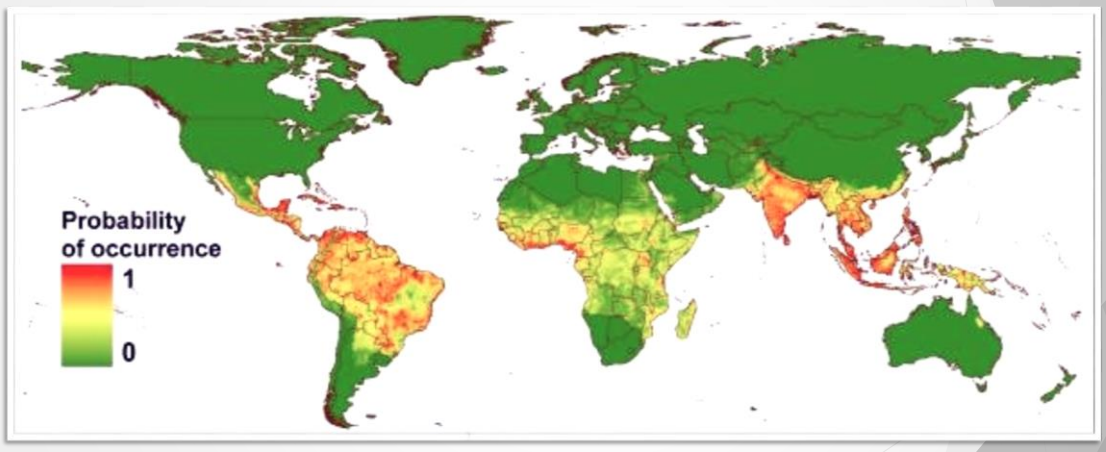
Dengue Fever Epidemiology



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West Nile Fever (WNF)

- It occurs in Europe, the Middle East, Africa, the former Soviet Union, Southwest Asia, and, more recently, the United States.
- It appeared unexpectedly in the New York City area in 1999, resulting in seven deaths and extensive mortality in a range of domestic and exotic **birds**.

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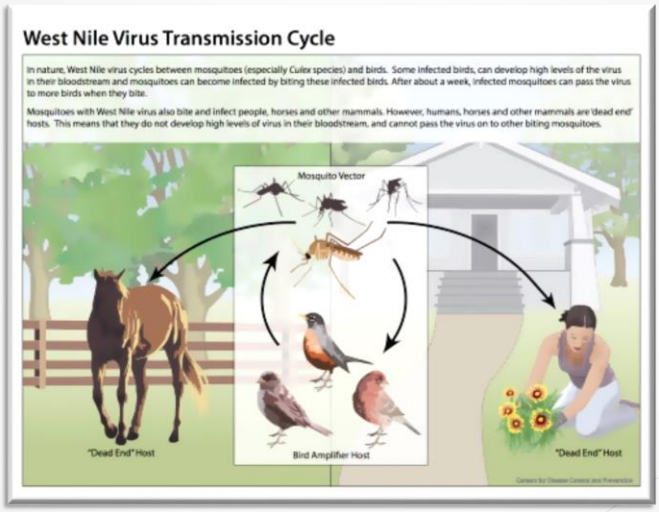
West Nile Fever (WNF)



West Nile Fever (WNF)

- Sequence analysis of virus isolates showed that it originated in **the Middle East**; it probably crossed the Atlantic in an infected bird, mosquito, or human traveler.

- About 80% of West Nile infections are **asymptomatic**, with about 20% causing **West Nile fever** (fever, headache, skin rash, and LAP) and less than 1% causing **neuroinvasive disease** (meningitis, encephalitis).

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Zika Fever

- Zika virus is transmitted by mosquitoes.
- Other nonvector modes of Zika virus transmission include **congenital** and sexual.
- Infection is likely asymptomatic in about 80% of cases.
- When symptoms occur, they are typically mild, self-limiting, and nonspecific.

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Zika Fever

- Commonly reported symptoms include rash, fever, arthralgia, myalgia, fatigue, headache, and conjunctivitis
- Rash, a prominent feature, is maculopapular and pruritic in most cases.
- Spontaneous resolution within 1–4 days of onset.
- Congenital infection association with microcephaly?

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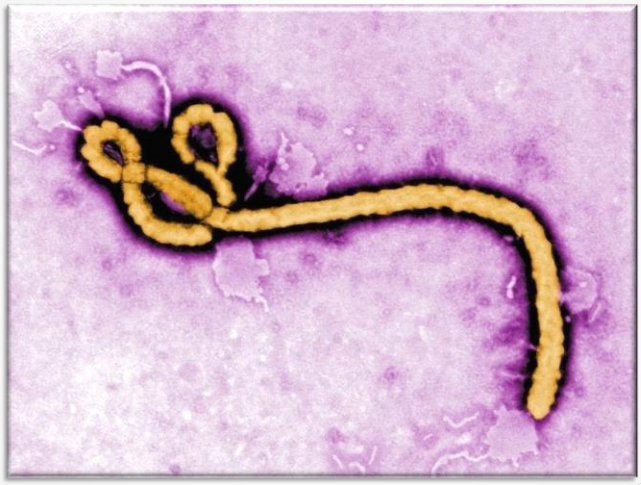
Ebola



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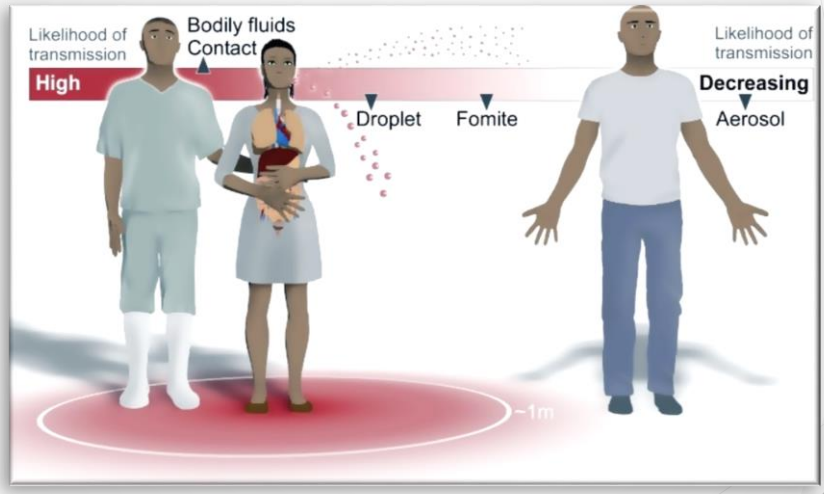
Ebola Transmission



Ebola

- Characterized by fever, headache, sore throat, and myalgia followed by abdominal pain, vomiting, diarrhea, and rash, with both internal and external bleeding, often leading to shock and death.

- Ebola virus has a tropism for cells of the macrophage system, dendritic cells, interstitial fibroblasts, and endothelial cells.

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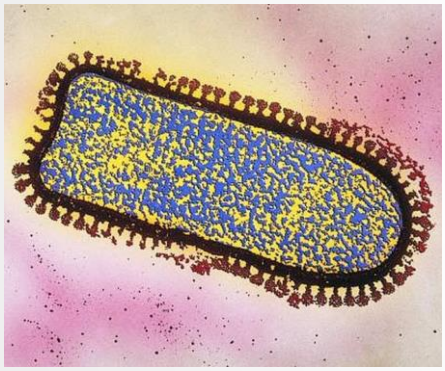
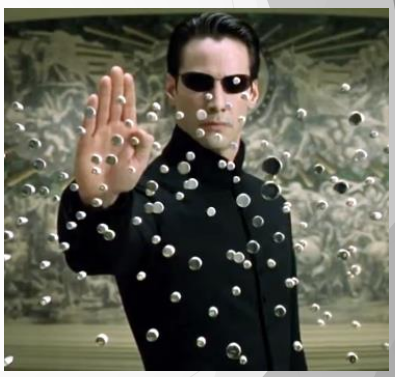
Ebola

- Very high titers of virus are present in many tissues, including the liver, spleen, lungs, and kidneys, and in blood and other fluids.
- Filoviruses have the highest mortality rates of all the viral hemorrhagic fevers.

Rabies Virus Description





Animal Susceptibility

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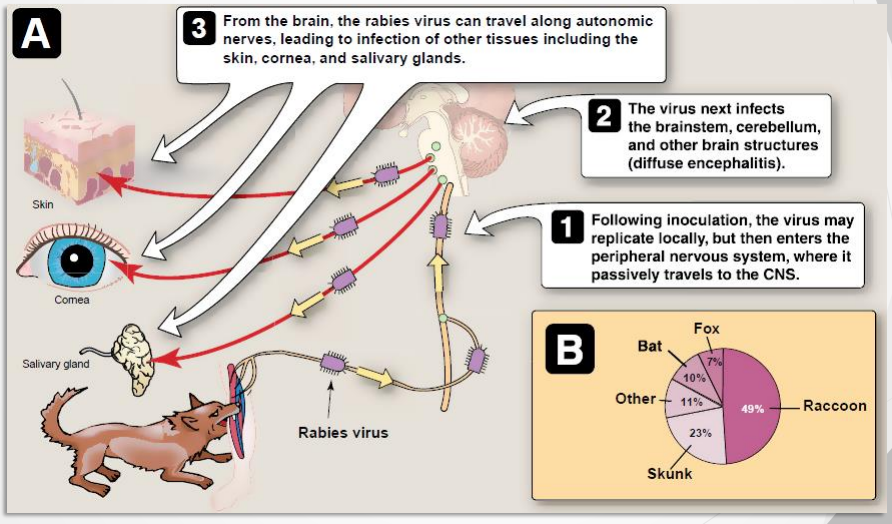
Rabies Pathogenesis and Pathology



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Rabies Pathogenesis and Pathology

- Rabies virus multiplies in muscle at the site of inoculation and then enters peripheral nerves at NMJs and spreads up the nerves to the CNS.
- The virus multiplies in the CNS and progressive **encephalitis** develops.
- The virus then spreads through peripheral nerves to the salivary glands and other tissues.
- **The organs with the highest titers of virus are the salivary gland**. Other organs where rabies virus has been found include pancreas, kidney, heart, retina, and cornea.

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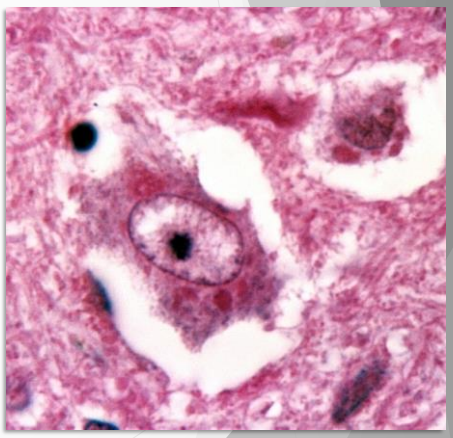
Rabies Pathogenesis and Pathology

- The incubation period (typically 1–3 months but may vary from 1 week to 1 year) depends on the host's age, genetics, and immune status, the viral strain, amount of inoculum, the severity of lacerations, and the distance the virus has to travel from its point of entry to the CNS.

- There is a higher attack rate and shorter incubation period in persons bitten on the face or head; the lowest mortality occurs in those bitten on the legs.

Rabies Pathogenesis and Pathology

- Rabies virus produces a specific eosinophilic cytoplasmic inclusion, **the Negri body**, in infected nerve cells, that are filled with viral nucleocapsids.
- **The presence of such inclusions is pathognomonic of rabies** but is not observed in at least 20% of cases.



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Rabies Clinical Features

- The clinical spectrum can be divided into three phases:
  - **Prodrome**: malaise, anorexia, headache, photophobia, nausea and vomiting, sore throat, and fever.
  - **Acute neurologic phase**: CNS signs including nervousness, apprehension, hallucinations, and bizarre behavior. sympathetic overactivity is observed, including lacrimation, pupillary dilatation, and increased salivation and perspiration. Hydrophobia and aerophobia are common as well.
  - **Coma and death**: The major cause of death is cardiorespiratory arrest.

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Rabies Diagnosis

- Clinical through history of exposure.
- Rabies antigens or nucleic acid detection.
- Serology.
- Virus isolation.

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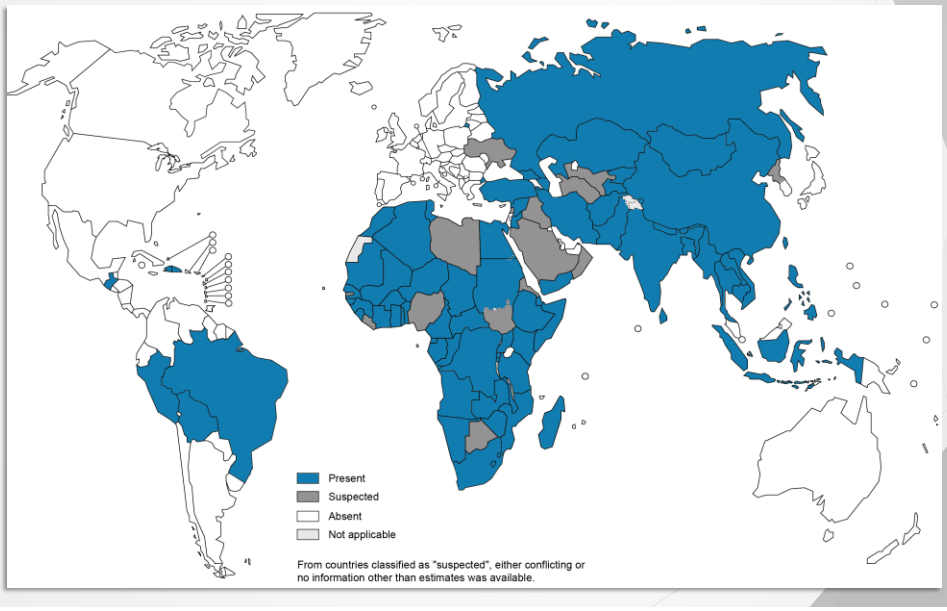
Rabies Management

- Once an individual has clinical symptoms of rabies, there is no effective treatment.
- A killed rabies virus vaccine is available for prophylaxis.
- Postexposure prophylaxis refers to treatment after an animal bite or suspected of being rabid, and consists of thorough **cleaning of the wound**, **passive immunization**, and **active immunization**.
- Prevention of initial exposure is, however, the most important mechanism for controlling human rabies.

Rabies Epidemiology



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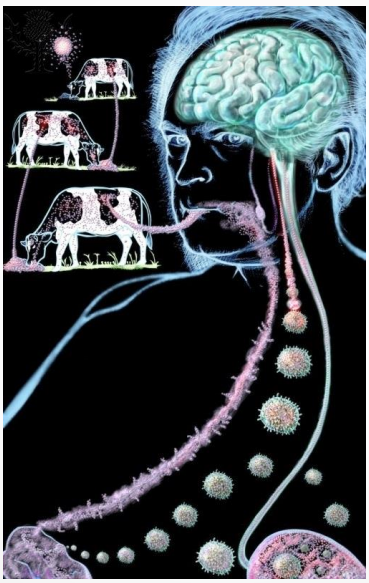
Transmissible Spongiform Encephalopathies (Prion Diseases)



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Transmissible Spongiform Encephalopathies (Prion Diseases)

- Transmissible spongiform encephalopathies are **degenerative CNS diseases**.
- Infectivity is associated with **proteinaceous material devoid of detectable amounts of nucleic acid**.
- Prions are resistant to treatment with formaldehyde, dry heat, boiling, ethanol, proteases, and ionizing radiation.
- Prions are sensitive to phenol, household bleach, ether and autoclaving (1 hour, 121°C). Guanidine thiocyanate is highly effective in decontaminating medical supplies and instruments.

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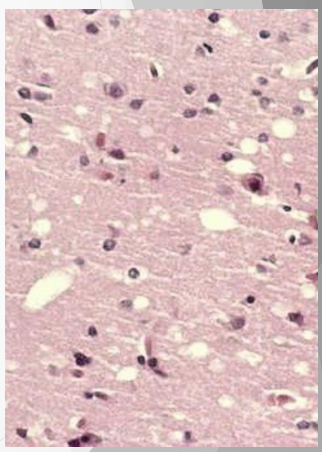
Prion Diseases

- Prion diseases are **confined to the nervous system**.
- The basic features are **neurodegeneration and spongiform changes**.
- Long incubation periods (months to decades) precede the onset of clinical illness and are followed by chronic progressive disease (weeks to years).
- The diseases are always fatal, with no known cases of remission or recovery.



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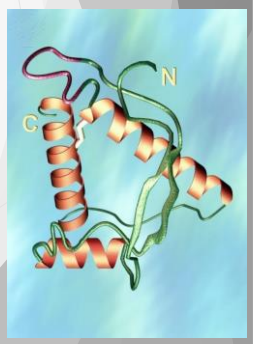
Prion Diseases

- PrP^C Protein (encoded by a chromosomal gene, designated PRNP in humans)
- The PrP gene is located on the short arm of chromosome 20 in humans.
- In contrast to viruses, prions are nonimmunogenic.
- The crossing of prions from one species to another is restricted by what has been called the "species barrier".
- The prion diseases are uniformly fatal. No human or animal has ever recovered from a prion disease once neurologic dysfunction is manifest.



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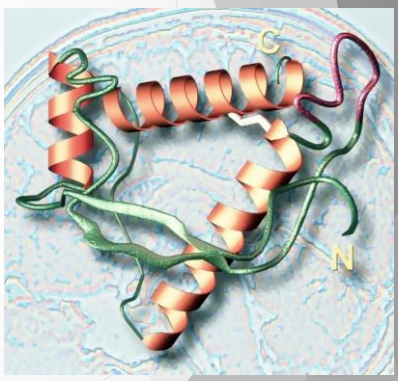
Transmissible Spongiform Encephalopathies (Prion Diseases)

- Prions are composed entirely of protein.
- It is proposed that PrP^{Sc} acts as a template which promotes the conversion of PrP^{C} to PrP^{Sc} and that this conversion involves **only conformational change**.
- In humans, the PrP prion diseases occur in three different forms: (a) sporadic, (b) inherited, and (c) infectious



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Kuru and Creutzfeldt–Jakob Disease

- CJD is a progressive multifocal dementia, peak onset between 60–65.
- Kuru occurred only in the eastern highlands of New Guinea and was spread by customs surrounding **ritual cannibalism** of dead relatives. Since the practice has ceased, the disease has disappeared.
- CJD in humans develops gradually, with progressive dementia, ataxia, and myoclonus, and leads to death in 5–12 months.

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BSE and vCJD

- A disease similar to scrapie, designated bovine spongiform encephalopathy (BSE), or "mad cow disease," emerged in cattle in Great Britain in 1986.
- This outbreak was traced to the use of cattle feed that contained contaminated bone meal from scrapie-infected sheep and BSE-infected cattle carcasses.
- The use of such cattle feed was prohibited in 1988. The epidemic of "mad cow disease" peaked in Great Britain in 1993.

BSE and vCJD

- In 1996, a new variant form of CJD was recognized in the United Kingdom that occurred in younger people and had distinctive pathologic characteristics similar to those of BSE.
- It is now accepted that the new variant forms of CJD and BSE are caused by a common agent, indicating that the BSE agent had infected humans.
- Through 2006, over 150 people had been diagnosed with new variant CJD in England, and most had died.

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References

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Any Questions?

Thanks for Being Nice and BEST of LUCK

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