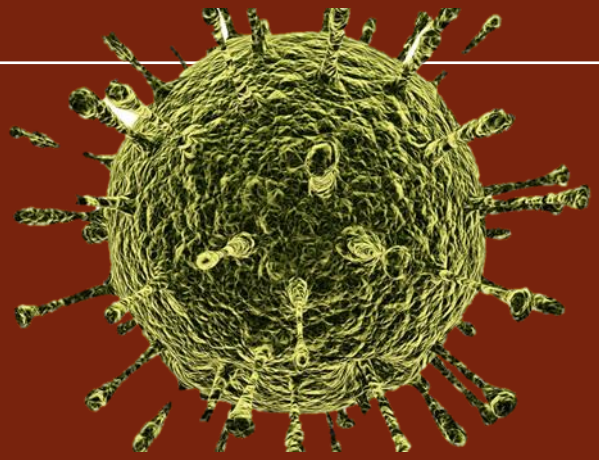


FOODBORNE VIRUSES

03052021

ASSESSMENT

1. 20% TEST 1 (MCQ) – 17/06/2021
2. 30% TEST 2 (Essay) – 12/07/2021
3. 10% Presentation (Outbreak investigation) – 21 & 24/06/2021
4. 20% Assignment 1 (Outbreak investigation report) – 28/06/2021
5. 10% Assignment 2 (Pathogenesis essay) – 01/07/2021
6. 10% Assignment 3 (Infographic) – 15/07/2021

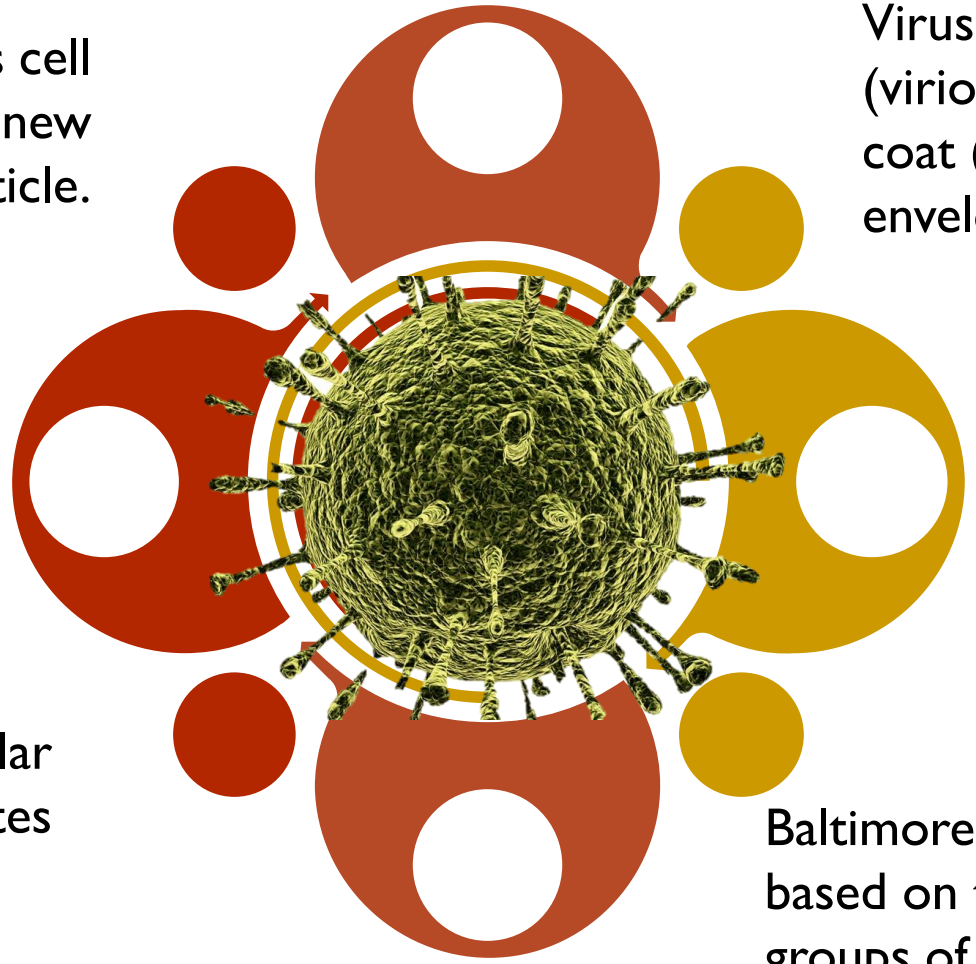
CONTENTS

What is a VIRUS?

Virus uses their host's cell machinery to produce a new generation of viral particle.

It can only multiply inside living cells.

Obligate intracellular parasites

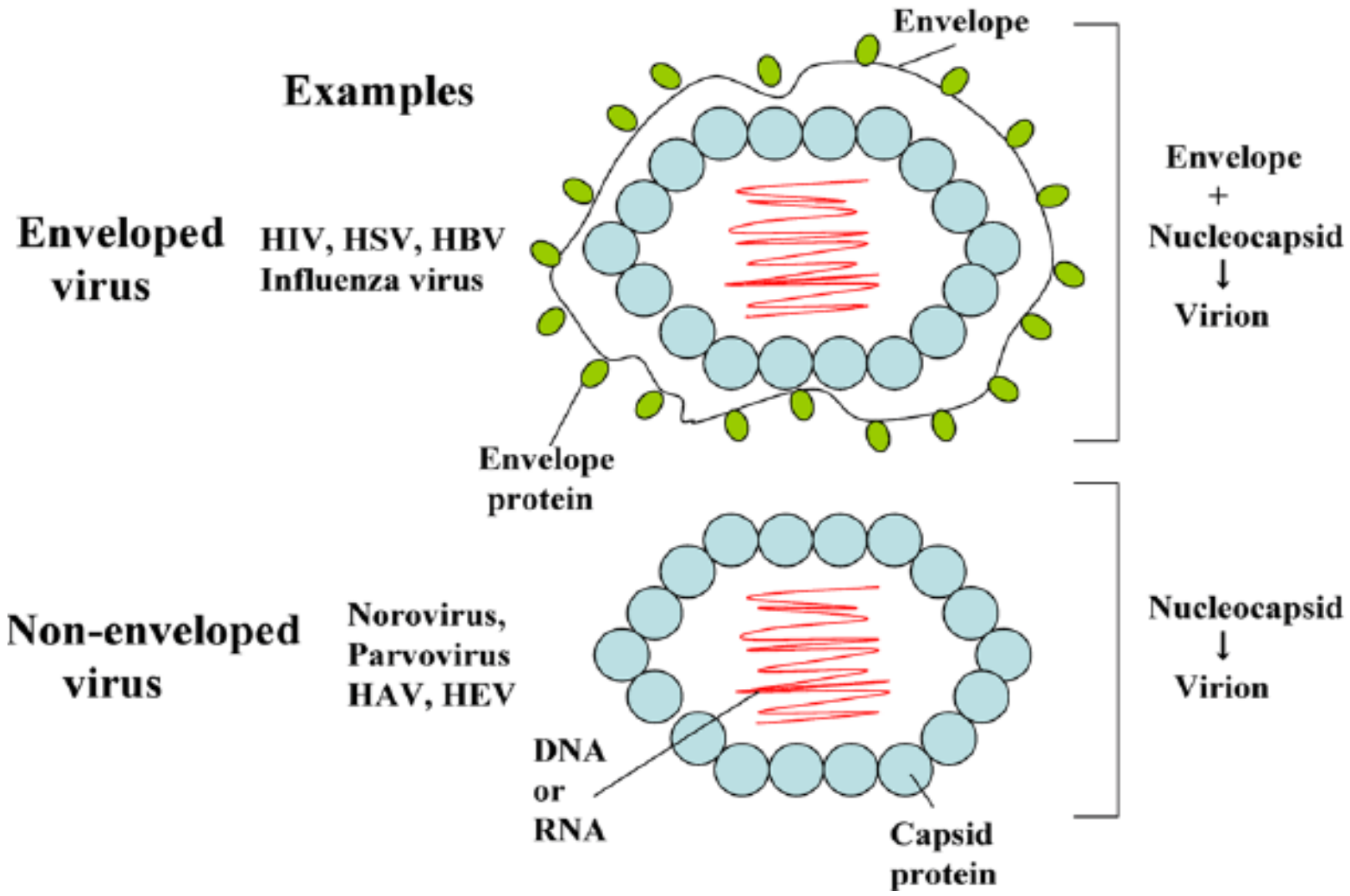


Virus is a small infectious particle (virion). Surrounded by a protein coat (capsid) and sometimes an envelope.

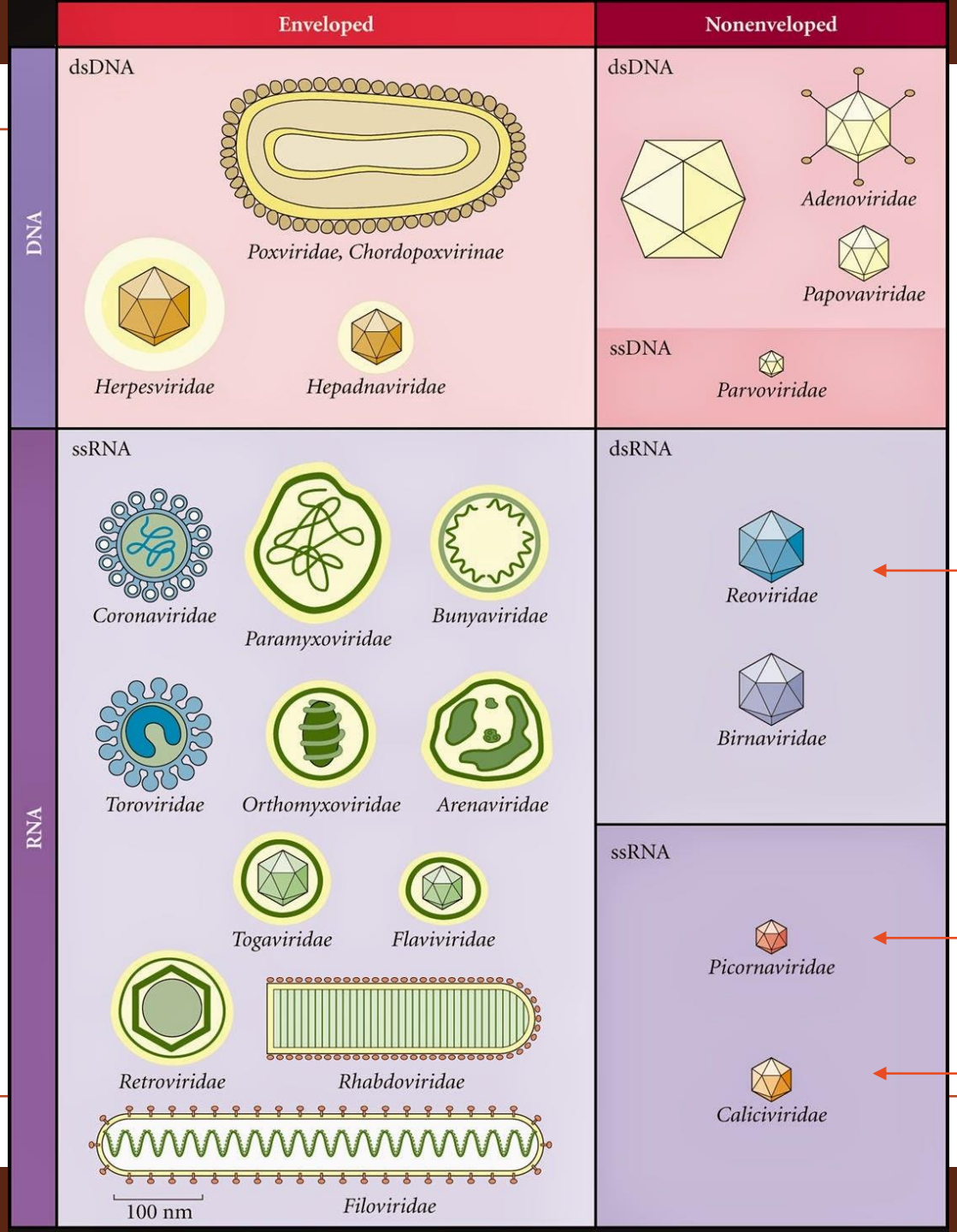
The genetic materials are either RNA or DNA (single- or double-stranded).

Baltimore system: Virus classification is based on the genomic structure. 7 groups of viruses.

Viral structure



YouTube:Viruses - Part 1: Enveloped and Non-Enveloped Viruses
https://youtu.be/miOPtXTeHYE

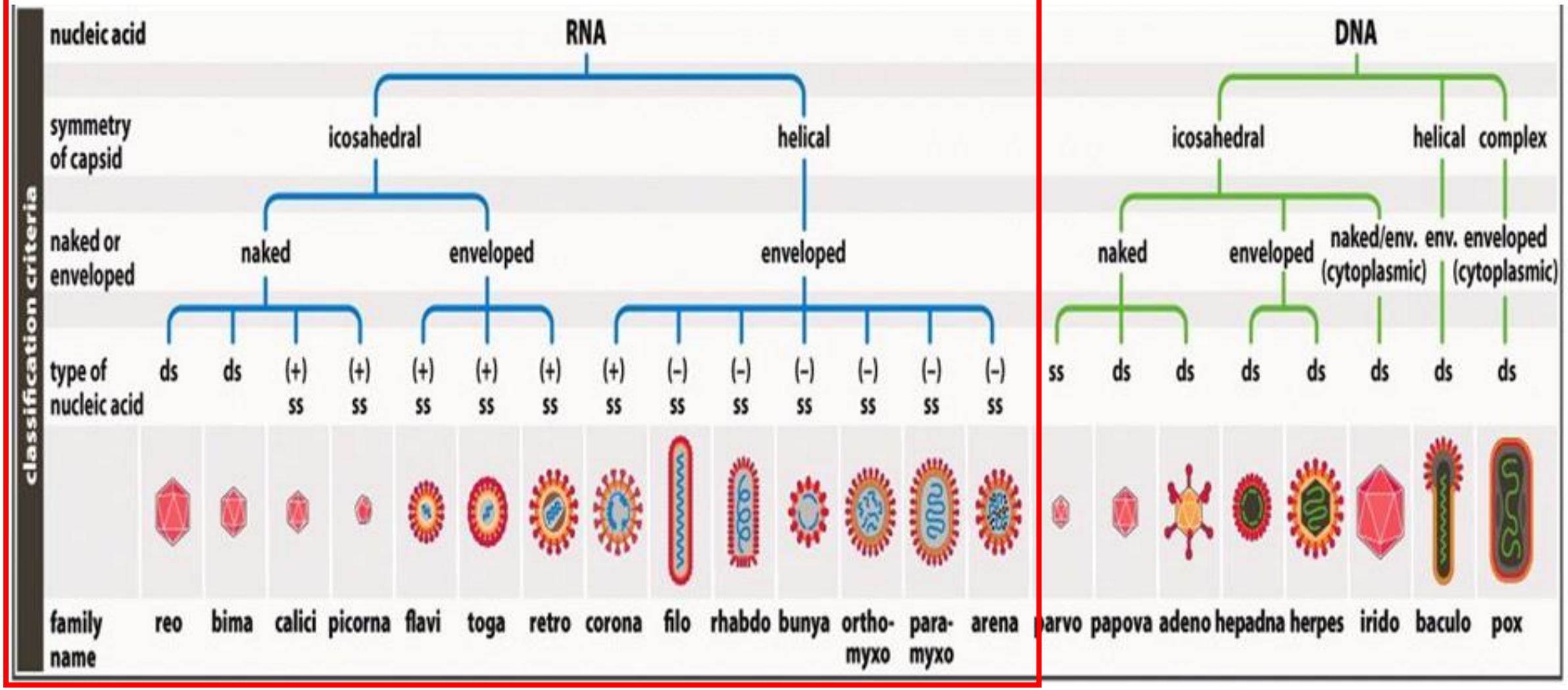


Rotavirus

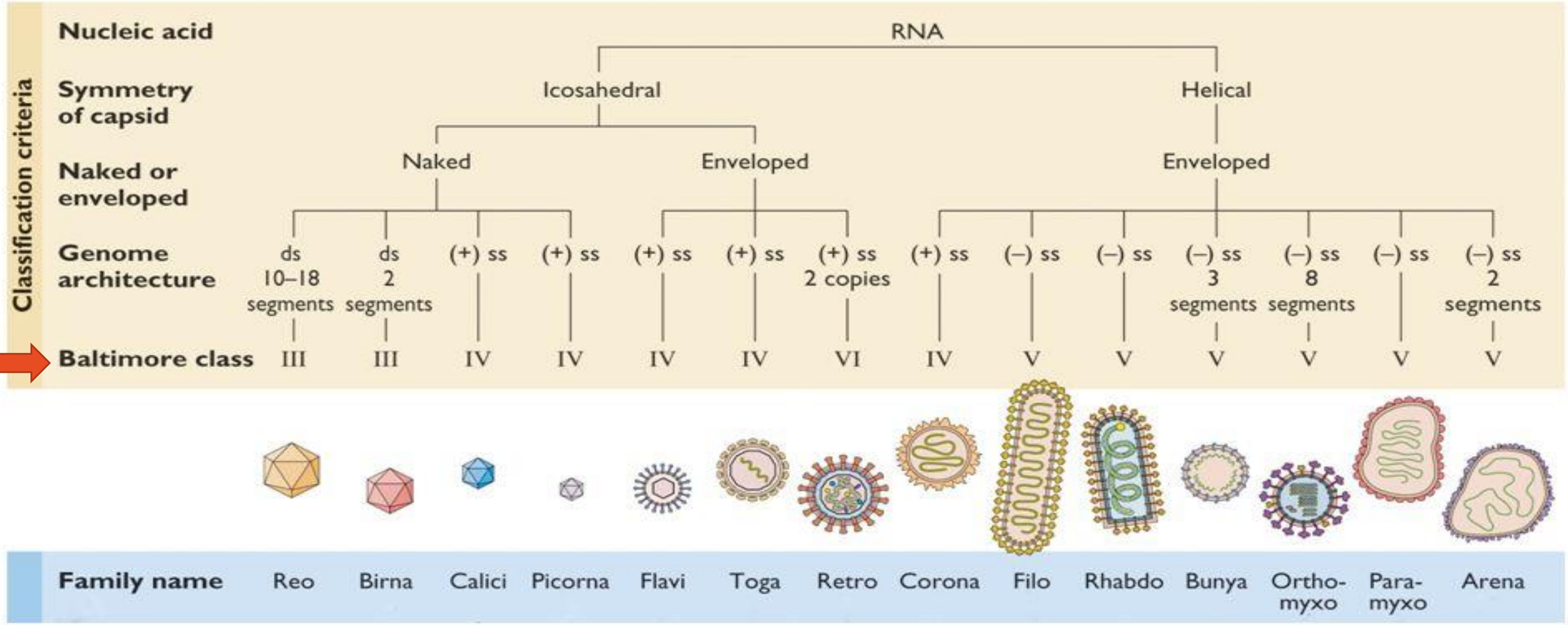
Hepatitis A virus

Norovirus

Virus classification



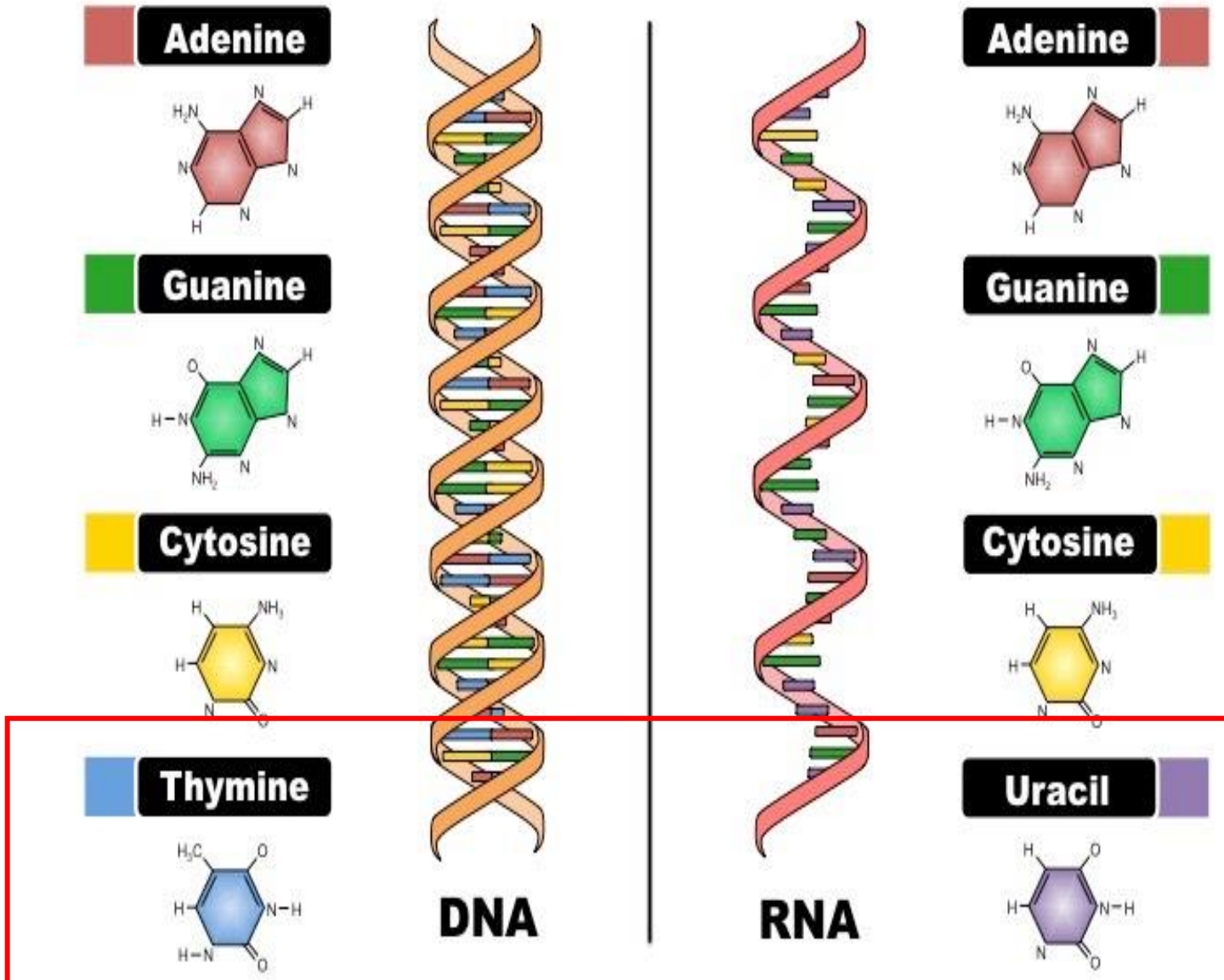
RNA Virus Families

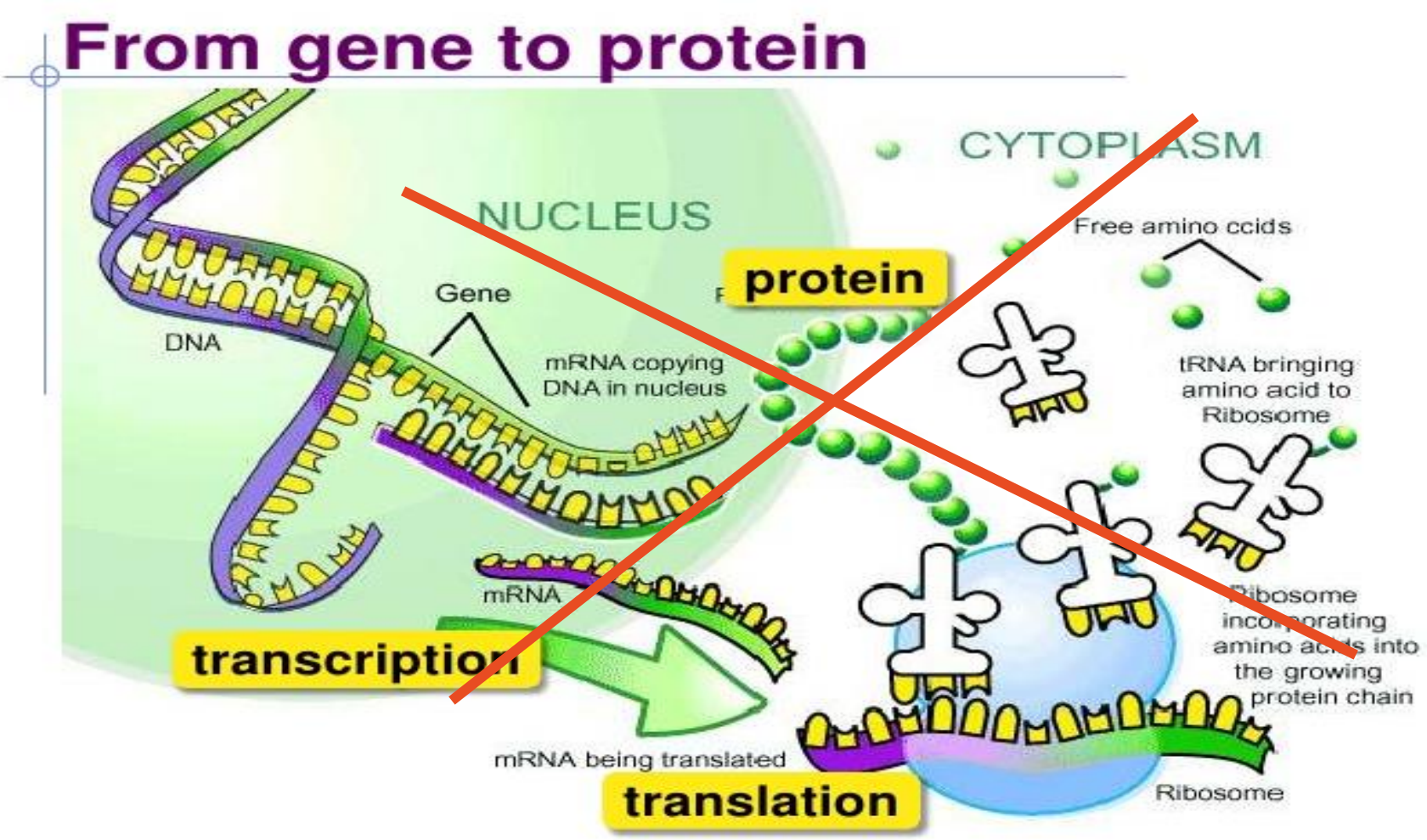


YouTube: Viruses - Part 2: DNA vs. RNA Viruses
https://youtu.be/IvMnnvv5NBA

Baltimore Classification

Group	Characteristics	Mode of mRNA Production	Example
I	Double-stranded DNA	mRNA is transcribed directly from the DNA template	Herpes simplex (herpesvirus)
II	Single-stranded DNA	DNA is converted to double-stranded form before RNA is transcribed	Canine parvovirus (parvovirus)
III	Double-stranded RNA	mRNA is transcribed from the RNA genome	Childhood gastroenteritis (rotavirus)
IV	Single stranded RNA (+)	Genome functions as mRNA	Common cold (pircornavirus)
V	Single stranded RNA (-)	mRNA is transcribed from the RNA genome	Rabies (rhabdovirus)
VI	Single stranded RNA viruses with reverse transcriptase	Reverse transcriptase makes DNA from the RNA genome; DNA is then incorporated in the host genome; mRNA is transcribed from the incorporated DNA	Human immunodeficiency virus (HIV)
VII	Double stranded DNA viruses with reverse transcriptase	The viral genome is double-stranded DNA, but viral DNA is replicated through an RNA intermediate; the RNA may serve directly as mRNA or as a template to make mRNA	Hepatitis B virus (hepadnavirus)


Adenine
Guanine
Cytosine
Thymine
DNA
RNA
Adenine
Guanine
Cytosine
Uracil

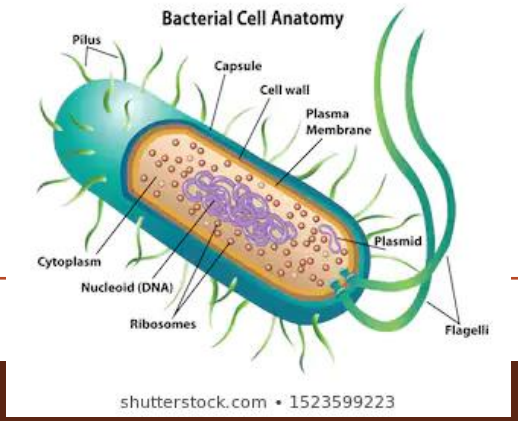


Viruses - Part 3: Viral Replication Process
https://youtu.be/-DGkZ2AM7RU

Bacteria vs Viruses

Bacteria

- Living organism
- Single-cell organism
- Bigger size (~1000 nm)
- Can be seen under light microscope
- Genetic material is DNA
- Has metabolic machinery
- Does not need host cells to reproduce
- Respond to antibiotic
- Maybe beneficial/harmful

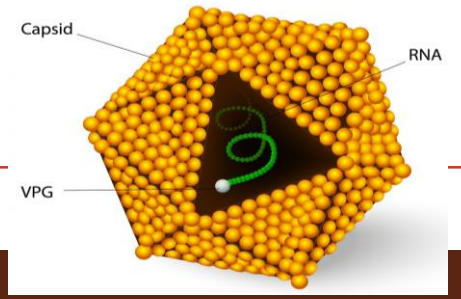


Similarities

Both can be a foodborne pathogen and cause disease to human.

Viruses

- Intermediate between living and non-living.
- Acelluar, just a particle
- Smaller size (20-400 nm): need an electron microscope
- Genetic material can be DNA/RNA
- No metabolic machinery
- Need a host cell to reproduce
- Need antiviral drug
- Always harmful



Numerous foodborne viruses can be found in the human intestinal tract and cause different type of disease:

GASTROENTERITIS

Norovirus, Astrovirus, Rotavirus, Adenovirus, Saporovirus

HEPATITIS

Hepatitis A virus, Hepatitis E virus

OTHERS

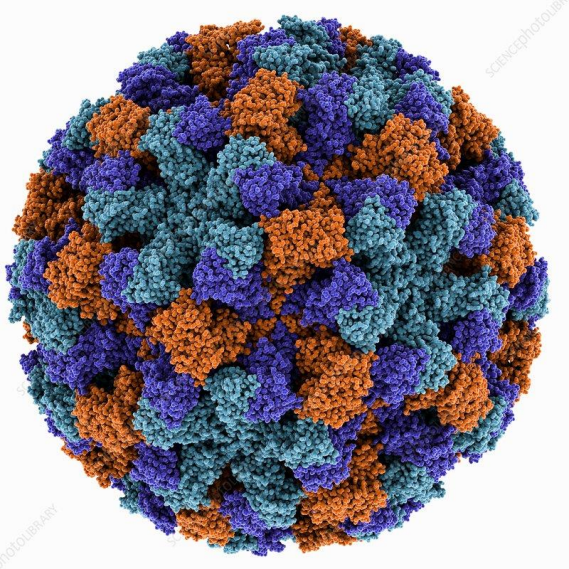
Enteroviruses

Main viruses: Noroviruses (NoV), Hepatitis A virus (HAV) and Rotavirus – highly infectious

Diseases caused by foodborne viruses?

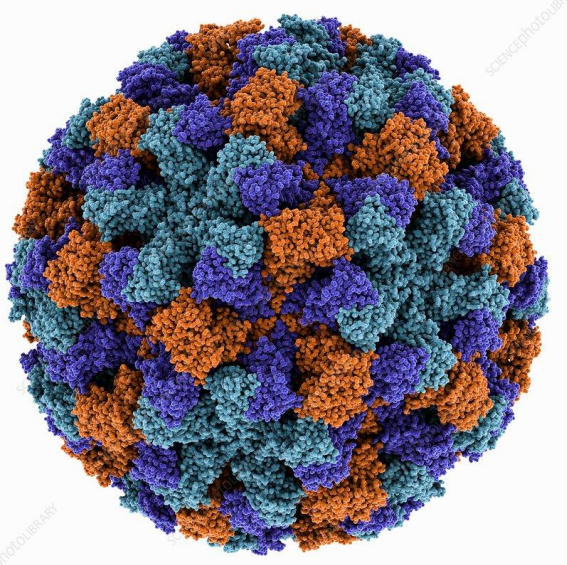
GASTROENTERITIS

NOROVIRUS (NoV)



- Family: Caliciviridae, Genus: Norovirus
- Noroviruses are small (27-32 nm), nonenveloped virus, containing a single-stranded positive sense RNA that is enclosed in a capsid (outer shell protein).
- Icosahedral symmetry – identical subunit that make up equilateral triangles
- Norovirus are genetically diverse and distributed into 10 genogroups (G1 to GX) with altogether 48 genotypes – GI, GII, and GIV infecting human
- Considered as the major cause of gastrointestinal outbreak worldwide.
- Currently no vaccine available

NOROVIRUS (NoV)



- First outbreak in 1968: occurred in an elementary school in Norwalk, Ohio – 50% of students and teachers developed gastroenteritis.
- Norovirus outbreak peak in winter – winter vomiting disease
- Cause of >200,000 deaths annually – young children (>5 years old) & adults.
- 16% of the population are asymptomatic
- Not able to propagate NoV in the laboratory.
- Norovirus is sometimes called the stomach flu or stomach bug. But not related to the flu which is caused by influenza virus.
- Infectious dose can be as low as 1—100 virus particle.

Stability of Norovirus

- Norovirus is acid-stable - Can infect GIT.
  - Retain its infectivity after exposure to pH 2.7 for 3 h at room temperature.
  - Survive food processing & preservation conditions designed for low pH (e.g., pickling in vinegar and fermentation type processes such as yogurt).
  - People infected after eating shellfish pickled in brine and vinegar.
- Survives up to 80 °C.
  - Norovirus heated to 60°C for 30 min remained infectious for volunteers.
  - Shellfish must be cooked to Temp. up to 90 °C for 1.5 min.
  - It is uncertain that it would be inactivated completely in many pasteurization processes.
  - High risk of contamination in fruits and vegetables - raw
- Remains infectious after refrigeration and freezing.
- Resistant to many disinfectants.

Dissemination

- Fecal-oral route
  - Virus can be transmitted through fecal contaminated water and food
  - Contaminated water can contaminate crops / fish / shellfish
  - filter-feeding shellfish can accumulate viruses in their gastrointestinal tract
  - Eating raw/undercooked contaminated fresh produce and shellfish can cause illness
- Person-to-person –direct contact with infected person
  - E.g. food handler / visitor / etc.
  - Symptomatic vs asymptomatic carrier
  - Virus may be transmitted during the incubation period and after recovery from illness
- Contaminated surface (vomitus/ feces)
  - Virus can sticks on surfaces for quite a while & resistant to common disinfectant
  - Vomiting greatly contribute to the spread of Norovirus in closed settings such as restaurant, hotels, health care facilities and cruise ship.





How You Get Norovirus From People or Surfaces

Norovirus spreads when a person gets poop or vomit from an infected person in their mouth.

PROVIDING CARE

TOUCHING YOUR MOUTH

SHAKING HANDS

CHANGING DIAPERS

TOUCHING CONTAMINATED SURFACES

YOU BECOME ILL WITH NOROVIRUS

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

For more information, visit www.cdc.gov/norovirus

CS297713-A

Common Settings of Norovirus Outbreak

Healthcare facilities

Restaurants and catered events

School and childcare centers

Cruise ships

WHY NOROVIRUS IS OFTEN ASSOCIATED WITH CRUISE SHIP

- Norovirus is a very contagious virus – cause vomiting & diarrhea
- Health officials track illness on cruise ships.
  - Outbreak are found & reported more quickly on a cruise ship than on land.
- Person-to-person transmission - Close living quarters, shared dining areas, increase the amount of group contact
- Rapid turnover of passenger
  - Arrival of new passengers every 1 or 2 weeks
  - Passenger may bring the virus and spread to others
- Environmental contamination – NoV persistent on surface
  - Vomitus, flushed toilet, vomit unexpectedly

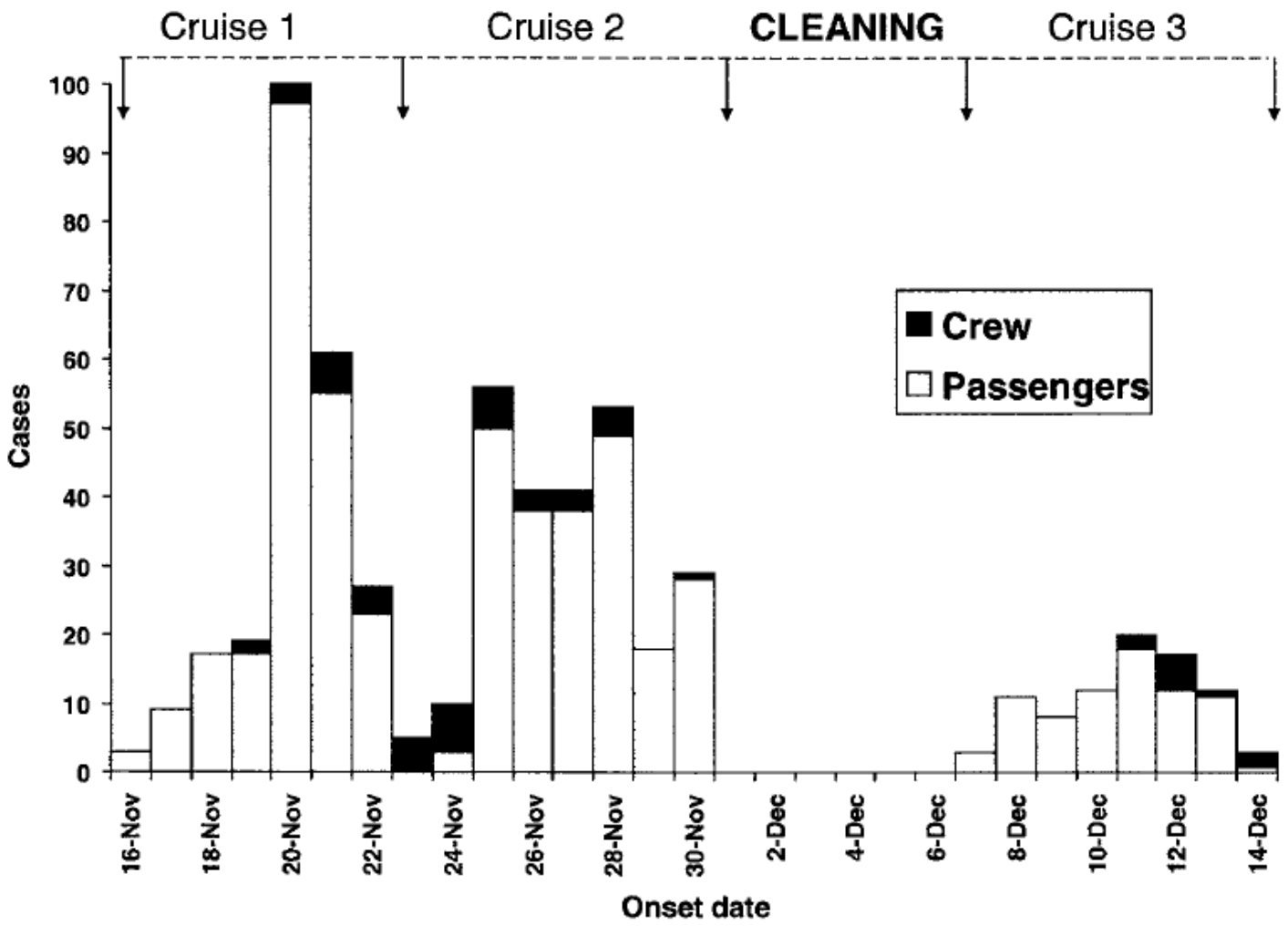


Figure 1 Number of passengers and crew reporting acute gastroenteritis during three consecutive cruises on one ship, 16 November to 14 December 2002 (n = 575). (Reprinted from reference 67.)

- Although the crew may act as a source of infection,
- Rapid increase in incidence within 1 to 2 days of sailing after cleaning strongly suggests a common environmental source.
- Most investigations fail to find a common food exposure.

Disease

- Norovirus cause **acute gastroenteritis** (AGE) / "stomach flu" / "winter vomiting disease' – lead to severe dehydration
- Main problem for people kept in tight space: cruise ship, hospitals, nursing home,
- Infective dose: 1-100 particle (VERY LOW)
- Onset/incubation time: 24-48 hr, Duration: 12-60 hrs
- Virus shedding for 72 hour - > 1 week
- Symptoms: Acute-onset vomiting (often explosive), watery diarrhea, headache, low-grade fever, chills, and muscle aches; **self-limiting**
  - 30% of infected people display no illness but **asymptomatic**
  - **Silent shedder** – shed high level of virus in stools
  - **Dehydration** is the most common complication

Norovirus may be the causative agent in over **23 million** gastroenteritis cases every year in the **United States**, representing approximately **60%** of all **acute gastroenteritis** cases.

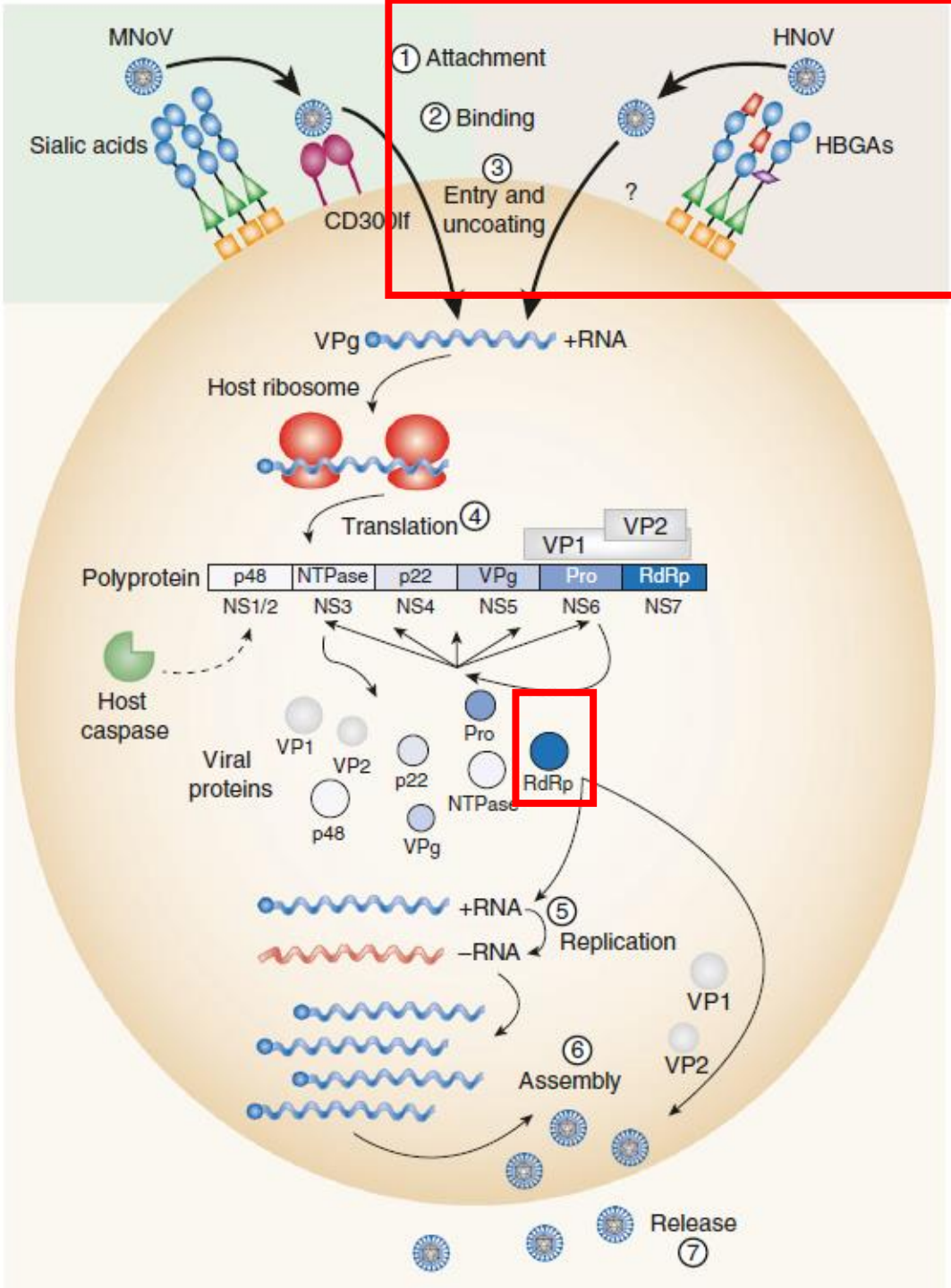
https://www.cdc.gov/infectioncontrol/guidelines/norovirus/background

Pathogenesis mechanism

- Norovirus infection causes gastroenteritis, an inflammation of the **small** and **large intestines**.
- Infects enterocytes of the duodenum and jejunum resulting in **malabsorption** and **increased secretion**.
- Precise pathogenic pathway of infection is unknown.
- Due to hampered progress in propagating the virus in the laboratory.
- Usually detect virus in **blood of patient**.

Replication cycle of Norovirus in host cell

- Norovirus binds to histo-blood group antigens (HBGS) – attachment factors on host cells
  - HBGAs are glycans (sugar-based polymers) that are determinants of the ABO blood group system.
  - They are expressed on the surface of specific cells including enterocytes
- Virus enter the host cell and uncoated its protein coat
- The positive sense RNA genome is then exposed in the cytoplasm, bound at its 5′ end to viral protein VPg.
- VPg recruits and engages host translation factors, leading to translation of a large polyprotein (Non-structural protein , NS), and structural protein (VP)
- The viral RNA-dependent RNA polymerase then engages viral +RNA to start transcription and replication of the virus genome
  - Typical for RNA viruses, replication ensues through a –RNA replication intermediate that serves as a template to produce new viral +RNA genomes.
- Viral structural proteins then combine with viral +RNA molecules for assembly (6) of new virus particles that exit the cell



Outbreak

A highly-contagious stomach virus is sweeping the Olympics, with 261 confirmed cases — and two skiers have now gotten it

Hilary Brueck, Business Insider US

February 16, 2018

- At least 261 people at the Winter Olympics in Pyeongchang, South Korea have been diagnosed with norovirus.
- The stomach bug spreads easily, especially in cramped environments, like cruise ships, daycare centers, and athletic events.
- Most people who catch it can recover in a few days without seeing a doctor, but the virus can be deadly – it kills hundreds of people every year in the US alone.

Norovirus, a dangerous and miserable stomach bug, has been spreading at the Winter Olympics.

Although most of the cases have been among workers at the Games, two athletes have now come down with the virus. According to Reuters, the Swiss freestyle ski team announced Friday that two of its members had norovirus – the first confirmed cases among athletes in Pyeongchang.

The International Olympic Committee said the skiers were not staying at the village where most other athletes lodge, Reuters reported.

As of Friday, officials in South Korea have documented 261 confirmed cases. Of those, 44 people are quarantined and 217 have returned to normal health.

Norovirus outbreak during Winter Olympics in Pyeongchang, South Korea
261 people infected
44 quarantined
217 recovered

Sri KL urges students and teachers with norovirus to stay home

NATION

Saturday, 3 Sep 2016

By **Sira Habibu**

PETALING JAYA: Sri Kuala Lumpur school has imposed a quarantine order on students and staff suffering from diarrhoea and vomiting after one of its teachers tested positive for the norovirus.

Those affected were told to remain at home for at least two days after symptoms ceased, not wanting to risk spreading the virus.

"To date, we have no further confirmation from other staff members and students on the specifics of their infections other than that it is viral in nature.

"As such, we are continuing to respond to this outbreak as a viral infection which is most likely a norovirus," the board said.

The school has ruled out food poisoning, as students who did not consume canteen food also displayed similar symptoms.

Although it has also rescheduled the trial examination dates, students displaying the gastric flu symptoms will be barred from sitting for the trial.

Sri KL chief operating officer Haniff Othman Merican said the school was closed yesterday after the teacher was tested positive.

Haniff said the school would reopen on Monday, adding that they had notified the Education and Health ministries.

He believed more than 300 out of the 1,200 secondary school students were affected, but only about a third reported sick.

"Of the 1,150 primary school pupils, at least six had reported sick with similar symptoms," he said, adding that at least four school staff members also reported suffering from similar symptoms.

Norovirus outbreaks in Malaysia

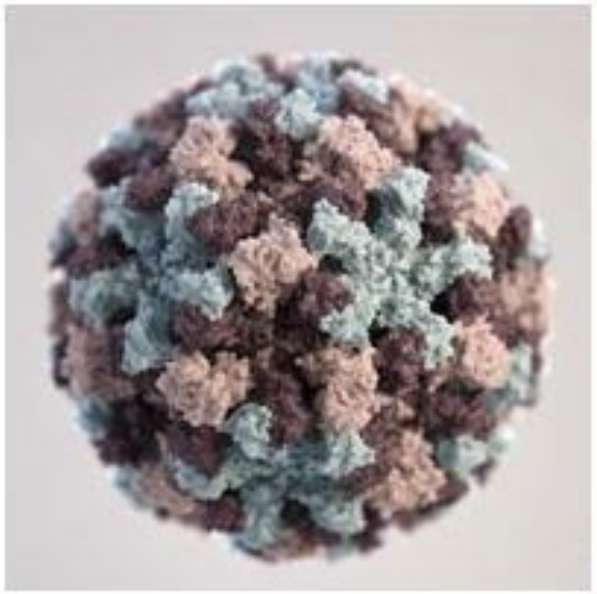
- Sri Kuala Lumpur school
- Students and staffs suffering from diarrhea and vomiting
- One of the teachers were tested positive for norovirus
- School were closed, reschedule the trial exam

Why Norovirus is not reportable

- Currently, state, local, and territorial health departments are not required to report individual cases of norovirus illness to a national surveillance system.
- Because most hospitals and doctor's offices do not have capability to test for norovirus.
- The virus is usually diagnosed only when an outbreak happens.
- Not able to propagate Norovirus in the laboratory
- But mystery has recently been solved!

First Ever - Human norovirus successfully grown in a lab!

CDC celebrates the work of scientists at Baylor College of Medicine in Texas, who recently developed a way to grow human norovirus in cells that line the human intestine. This is a major scientific achievement that has been more than 40 years in the making after numerous attempts by many labs, ever since norovirus was first discovered. This discovery will help us better understand basic human norovirus biology, and how to prevent and treat norovirus infections, the most common cause of diarrhea and vomiting in the United States and globally. Learn more from our partners at NoroCORE or read the article.



NOROVIRUS, CULTURED.

A 48 YEAR MYSTERY SOLVED

Dr. Mary Estes and her Lab at Baylor College of Medicine have successfully cultured human norovirus in intestinal cells.

Scientists have been trying to culture the virus since the first norovirus outbreak was described in 1968.

The lack of an *in vitro* culture system has long been considered the single greatest barrier to norovirus research.

HISTORY OF NOROVIRUS RESEARCH

1929
RUMORED

Dr. John Zahorsky, a pediatrician, gives the name "winter vomiting disease" to a common childhood illness that causes vomiting, diarrhea, and a fever.

1968
DESCRIBED

An elementary school in Norwalk, OH experiences an outbreak of "winter vomiting disease." A virus is suspected.

1972
VISUALIZED

The Norwalk virus is first seen by Dr. Albert Kapikian and his team at NIH using immune electron microscopy (IEM).

1990
CLONED

The Norwalk virus genome is cloned, paving the way for an era of molecular studies.

1992
CREATED

Empty shells of norovirus proteins (capsids) are artifically created by the Estes Lab. These virus-like particles are not infectious and enable studies of the capsid.

2016
CULTURED

Human noroviruses are successfully cultured by Dr. Mary Estes and her team at Baylor College of Medicine.

READ THE ARTICLE

K. Ettayebi *et al.*, *Science* 10.1126/science.aaf5211 (2016).

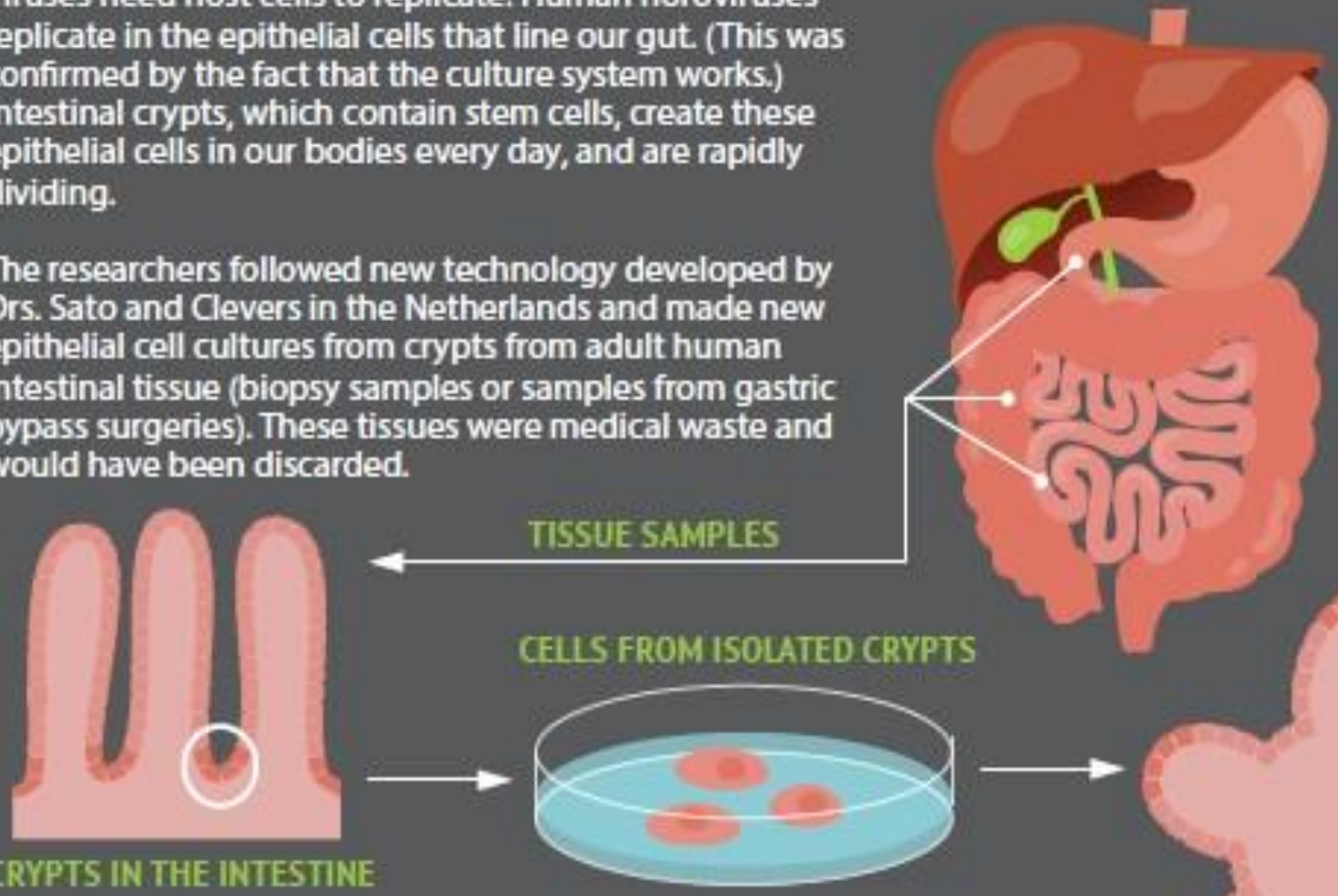
WHAT IS NOROVIRUS?

- It is a tiny (≈27nm), spherical virus belonging to the *Caliciviridae* family.
- It is the most common cause of diarrhea in the world and the most common cause of foodborne illness in the United States.
- An estimated 1 in 15 Americans experience the virus each year, amounting to around 20 million cases.

HOW DOES THE CULTURE SYSTEM WORK?

Viruses need host cells to replicate. Human noroviruses replicate in the epithelial cells that line our gut. (This was confirmed by the fact that the culture system works.) Intestinal crypts, which contain stem cells, create these epithelial cells in our bodies every day, and are rapidly dividing.

1 The researchers followed new technology developed by Drs. Sato and Clevers in the Netherlands and made new epithelial cell cultures from crypts from adult human intestinal tissue (biopsy samples or samples from gastric bypass surgeries). These tissues were medical waste and would have been discarded.



2 Under the right conditions, the stem cells in the crypts multiply and form the surface (epithelial) layer of our gut, only in miniature and in a dish, to become Human Intestinal Enteroids (HIEs) or "miniguts." They function like the tissue they came from, and can be used indefinitely.

A SECRET INGREDIENT

Through careful experimentation, the Estes team found a key addition to the media greatly increased virus yields. It was human bile. We produce bile in our livers and secrete it into our gut to help digest food. They found that some norovirus types, like GII.3, need bile to replicate, while it only enhances replication of other noroviruses, like GII.4. The bile is affecting the cells, not the virus itself, and pig bile works as a substitute for human bile.

3 These "miniguts" were inoculated with human norovirus, and after 72 hours, the researchers were seeing far more viral genetic material than they initially added (a 1,000-fold increase), indicating the virus was infecting and multiplying in the cells.

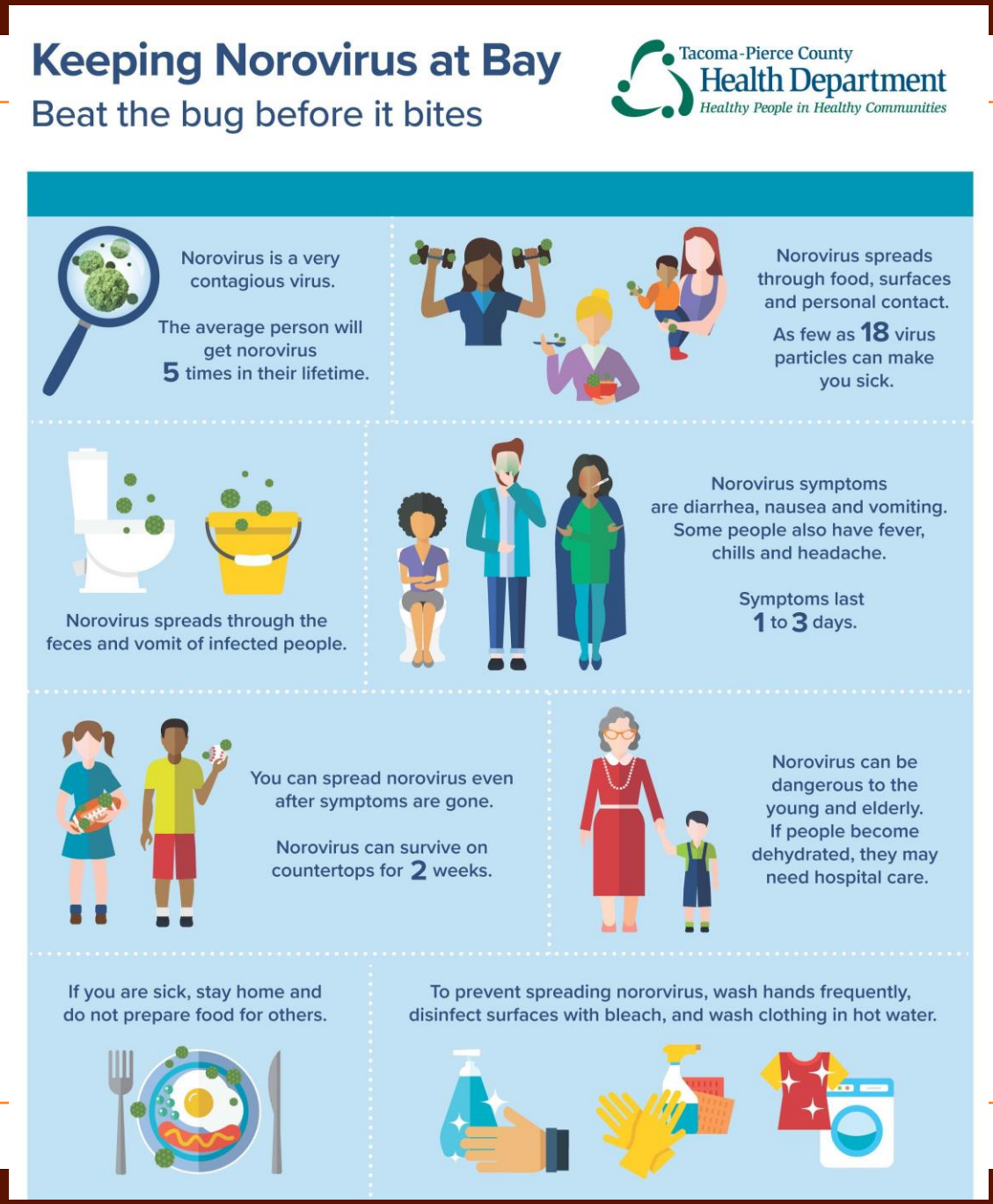
Potential norovirus vaccines are in development, but currently, none are licensed for public use.

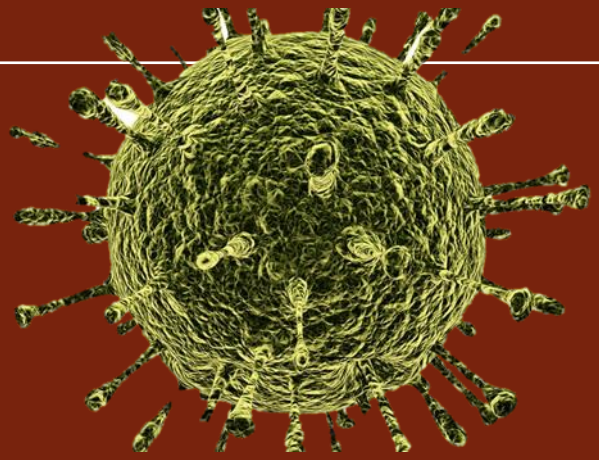
(Food Safety News, 2020)

Rapid evolution of the virus and large number of antigenically distinct genotypes (>30) is the main challenge in vaccines development

- https://www.foodsafetynews.com/2020/04/a-norovirus-vaccine-would-save-hundreds-of-lives-and-millions-of-dollars/

SUMMARY of NoV



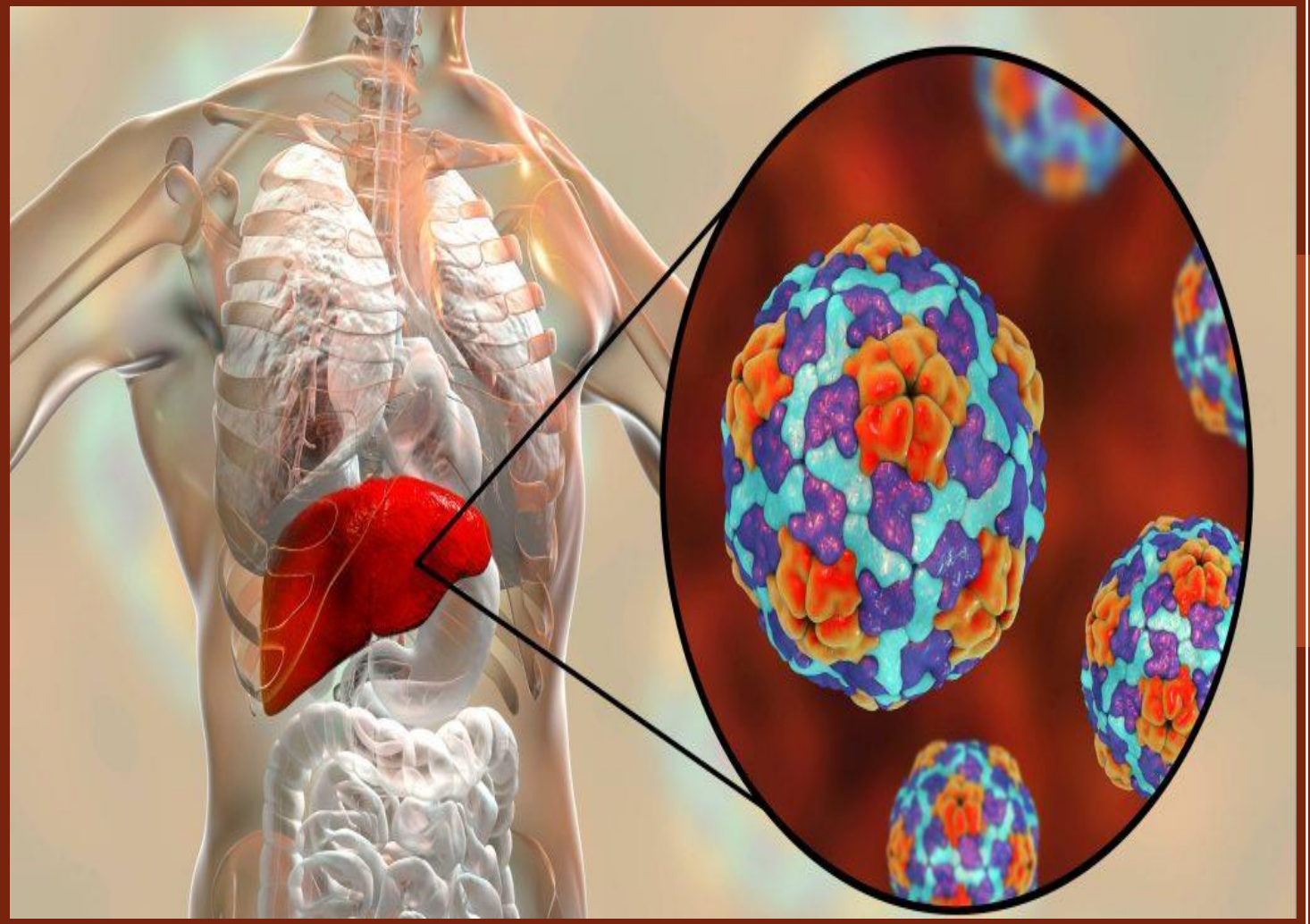


FOODBORNE VIRUSES

06052021

HEPATITIS

(Inflammation of the liver)



What is HEPATITIS?

Definition

Hepatitis is a **liver inflammation** due to **viral infection**, toxic substances (alcohol/drugs) and autoimmune disease. It can be self-limiting or can progress to cirrhosis or liver cancer.

Hepatitis viruses

There are 5 main hepatitis viruses:

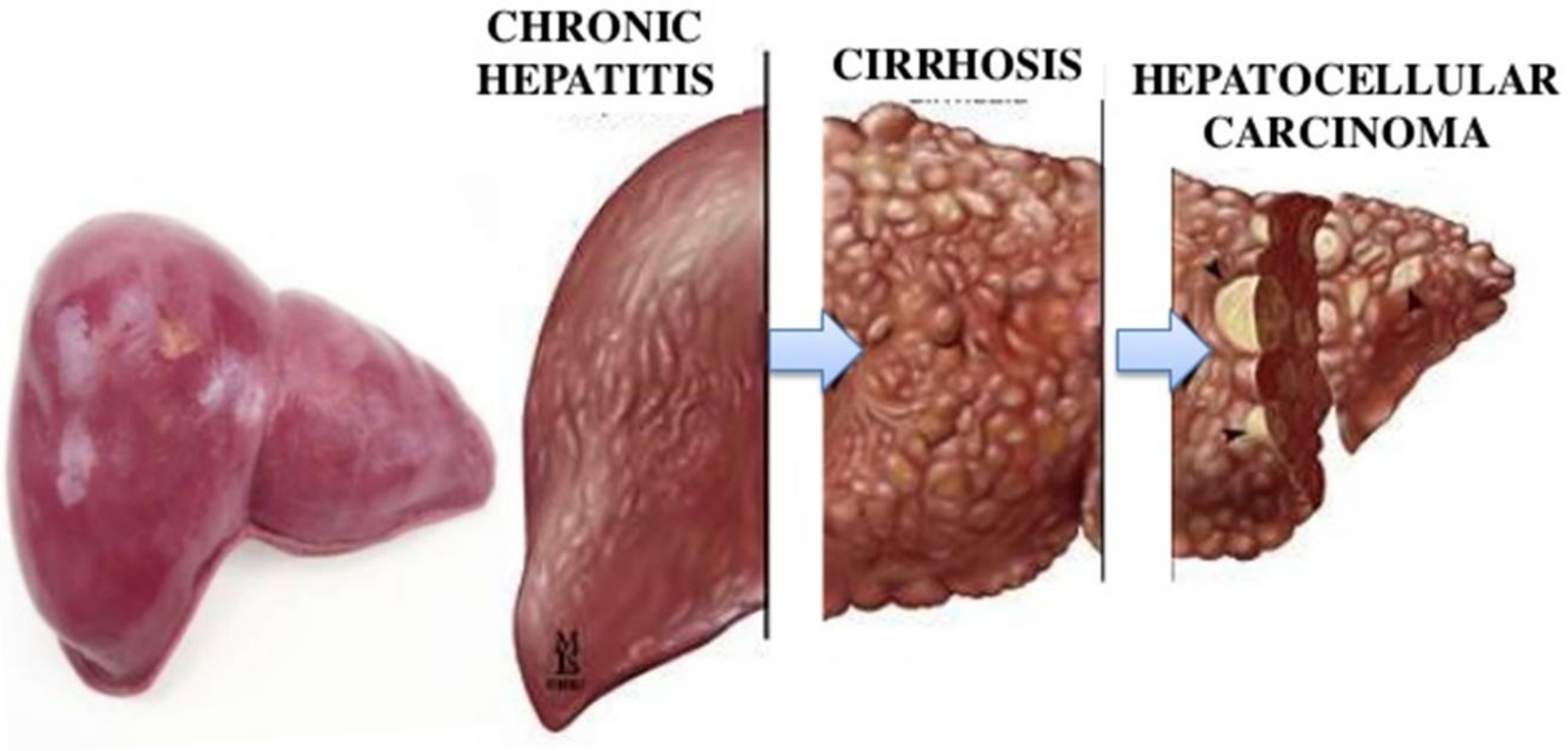
Hepatitis virus A, B, C, D, E

Foodborne viruses.
Disease is caused by the ingestion of contaminated food/ water or direct contact with infectious person
Short-term infection (does not become chronic)

Hepatitis A & E

Bloodborne viruses
E.g. receipt of contaminated blood, transmission from mother to baby, sexual contact.
Begin as a short term acute infection and can lead to chronic disease

Hepatitis B, C, and D



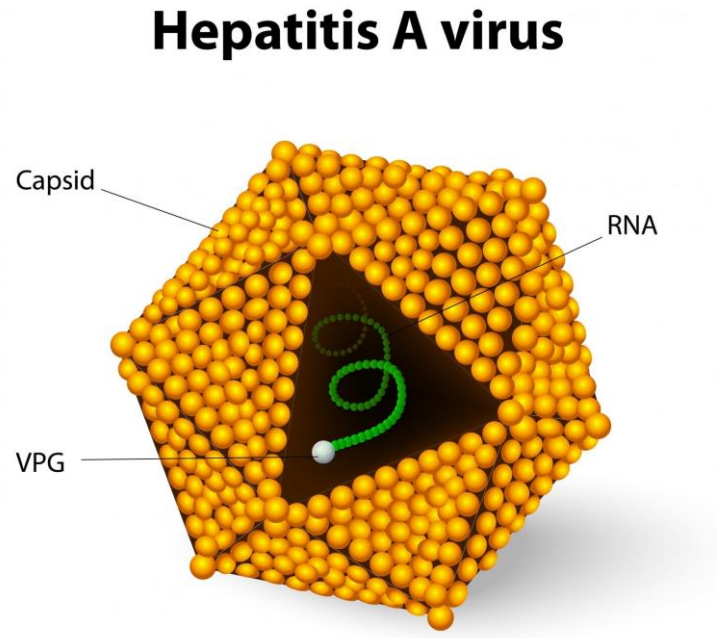
HEALTHY LIVER

FIBROSIS
a scar tissue within the liver

CIRRHOSIS
Scar tissue replaces normal healthy tissues

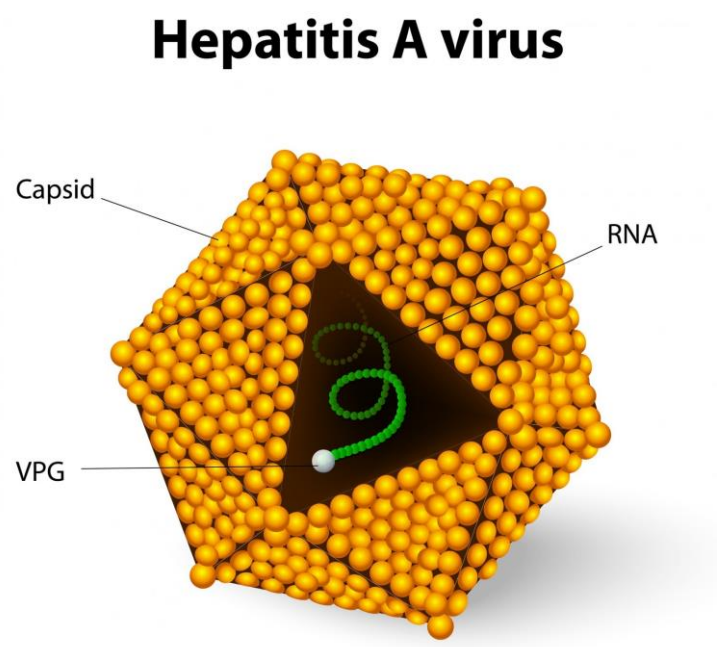
LIVER CANCER
Formation of malignant tumor in liver

HEPATITIS A VIRUS (HAV)



- Family: Picornaviridae, Genus: Hepatovirus
- HAV are small (27-32 nm), non-enveloped virus., icosahedral symmetry
- Comprises of a single positive-stranded RNA genome protected by a protein capsid ("shell")
- 6 HAV genotypes (I-VI)
- Genotypes I, II, and III contain strains associated with human infections,
- Genotypes I-III further divided into sub-genotypes A and B for each genotype.
- Hepatitis associated to subgenotype IIIA is more severe & require longer hospitalization.

HEPATITIS A VIRUS (HAV)



- Worldwide problems.
- Endemic in some areas, particularly South America, Africa, Middle East, Asia
- Especially in developing countries with poor sanitary conditions and hygienic practices
- Children become infected at a young age but only cause mild illness or **asymptomatic**, end up developing **full immunity**.
- Causes **liver disease** and **inflammation** of the **liver**.

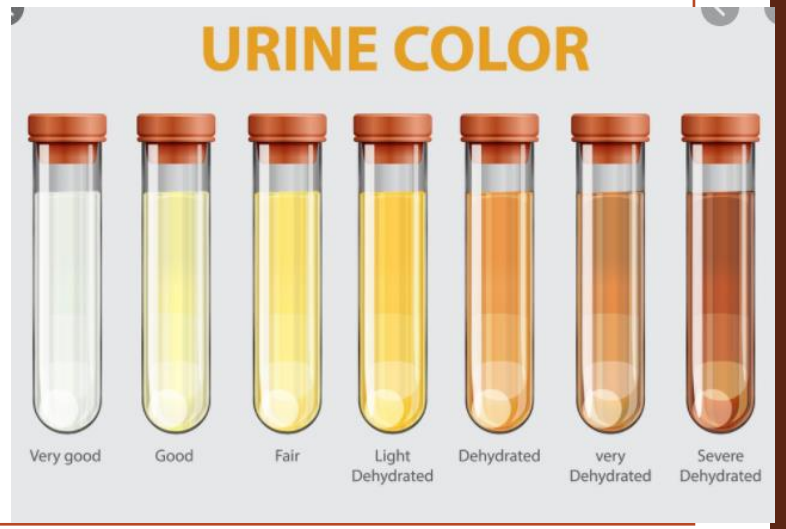
Geographic Distribution of Hepatitis A Virus Infection

Dissemination

- Primarily transmitted via **fecal-oral route** – ingestion of fecally contaminated food (shellfish, vegetables, etc), and water
  - Secreted in feces of the infected people (symptomatic and asymptomatic) up to **36 days**.
- **Contaminated water** (sewage-contaminated / inadequately treated water)
- **Person-to-person contact**.
- **Environmental surfaces** (e.g., contaminated table tops, cooking utensils)
- HAV are extremely stable under a wide range of environmental conditions (freezing, heat, chemicals, and desiccation)
- Common disinfectants are not effective.

Disease (Hepatitis A)

- Infective dose: 10-100 viral particles (LOW)
- Onset/incubation time: 30 days (15-50 d)
- Duration: few days to a few weeks
- Symptoms: Malaise, fever, nausea, abdominal pain, vomiting, diarrhea, **dark urine** and **jaundice** (yellowing of the skin and white of the eyes)
- Virus can shed in feces 2 weeks before the onset of jaundice
- Concentration of virus declines after jaundice appear
- The illness is usually is self-limiting

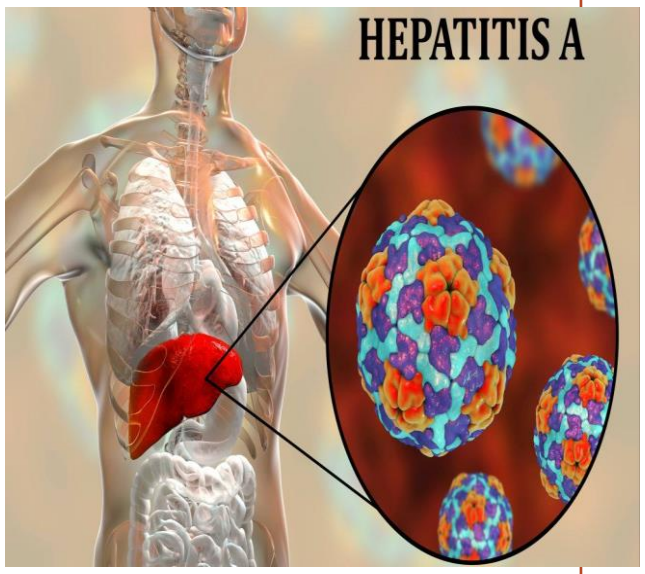


Disease (Hepatitis A)

- Most infection are asymptomatic in children (<6 yo) or just having mild symptoms, recovery in 1-2 w
- The severity of disease and fatal outcomes are higher in older age groups.
- Symptomatic infection in adults
  - 10-15% of cases - prolonged or relapsing disease up to 6 months
  - 1-1.5% of cases - fulminant hepatic disease / necrosis in patients with chronic liver disease (70-80% fatality)
  - 3-20% of cases shown to have a relapse of jaundice in 1-3 months (reactivation of viral shedding)
- No specific treatment

Pathogenesis mechanism

- Virus enters via the gastrointestinal tract.
- From the intestinal tract, the virus is transported to the liver via the **blood** (Viremia).
- **Hepatocytes** are the site of viral replication.
- The virus is thought to be excreted by the hepatocytes and transported to the intestinal tract via **bile**
  - Bile is a fluid that is made and released by the liver and stored in the gallbladder – help to digest fat
- However, some studies suggest that initial replication may occur in **crypt cells** of the small intestine.

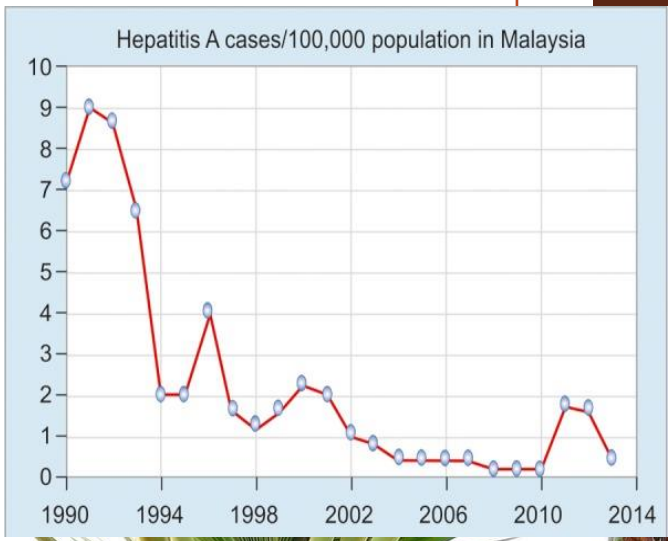


Hepatitis A Outbreak

- Outbreaks of hepatitis A are common in crowded situations such as institutions, schools, prisons, military forces, etc.
- In developed countries, most of the cases are related to international travel to high-risk area
- Shanghai 1988 – Hepatitis A outbreak involving 250 000 cases occurred in association with consumption of contaminated **clamps,** 47 died
- Sweden – 13 persons developed hepatitis A after eating contaminated **frozen strawberries** from Poland https://www.foodsafetynews.com/2018/07/thirteen-infected-with-hepatitis-a-virus-from-frozen-strawberries/

Hepatitis A outbreak in Malaysia

- Hepatitis A has been reported in Malaysia since 1988
- The national incidence rate had dropped due to the introduction of government control programs – improving living standard
- However, reintroduction of the virus to the nonimmune population could result in outbreak
  - 2002: Hulu Langat – river water fecal contamination by Orang Asli – 51 cases
  - 2011: Terengganu – 800 cases, – contamination of river water
  - 2012: Manjung, Perak – 78 cases – toddy (palm wine) affected with HAV
    - ✓ Observation: Unhygienic processing places, no toilets available, toddy was mixed with bare hands, a common bucket was used before bottling, and well water was used to wash at the premises, including the washing of utensils.



https://www.infosihat.gov.my/multimedia/garis-panduan/item/garis-panduan-pengurusan-wabak-hepatitis-a-di-malaysia-jilid-6.html

Hepatitis A Outbreak in Hulu Langat District, Selangor State, Malaysia During April - October 2002

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Summary

A Hepatitis A outbreak occurred in Mukim Hulu Langat, Hulu Langat district from April 2002 to October 2002. Of the 51 cases notified, most were among students and the ethnic groups involved were Malays and the Orang Asli (local indigenous community). Epidemiological investigations revealed that the cases were localized along rivers used for recreational activities in this area. River water analysis indicated human faecal contamination and it was believed that the contamination was due to the Orang Asli community living upstream. This occurred due to lack of toilet facilities, water at point of use and the existing traditional practices of the Orang Asli community. Control measures instituted were intense health education to the Orang Asli to avoid using the rivers for defecation, multi agency efforts to provide sanitary toilets and adequate water to the villages affected. Future measures include conducting a sero- prevalence survey to determine the feasibility of Hepatitis A immunization to the susceptible population in this area. The outbreak that began in April 2002 was controlled by October 2002.

Investigation of hepatitis A outbreak in district of Manjung, Perak, Malaysia, October 2012

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Background: In September 2012, 10 cases suspected to be hepatitis A were notified to the Manjung District Health Department. An investigation was conducted to identify the possible mode of transmission, source of the outbreak and to recommend prevention and control measures.

Methods: A case was a person with acute illness with discrete onset of symptoms and jaundice or elevated serum aminotransferase levels in September 2012 in the Manjung District. We conducted a case-control study and environmental assessments of processing plants and food premises.

Results: There were 78 confirmed cases of hepatitis A; an attack rate of 3.1 per 10 000 population. Multiple logistic regression showed that being male (odds ratio [OR]: 18.4 [5.13–65.9]; $P < 0.001$) and drinking toddy at processing place A (Adjusted OR: 2.70 [1.17–6.25]; $P < 0.05$) were associated with being a case. Environmental investigations of this and one other processing place found them to be unhygienic, and the pH of the toddy was at levels that encouraged growth of hepatitis A virus.

Conclusion: Toddy was possibly the primary source of this outbreak based on both epidemiological and environmental results. Both toddy preparation places and several food premises were closed as a result of this investigation.

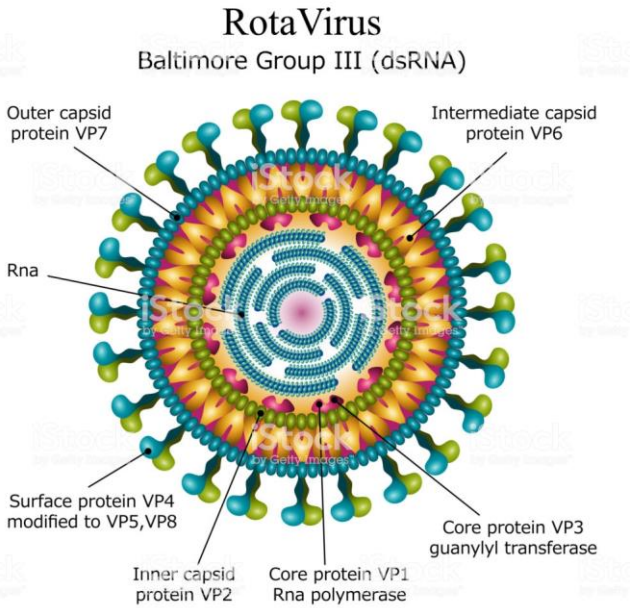
Prevention method

- Control quality of water used for agriculture.
- Proper sewage management
- Food handler must practice good personal hygiene
- Routine vaccination for children & food handlers
  - hepatitis A vaccine is commercially available which can provide immunity against HAV for almost >20 years
- Heating foods (such as shellfish) to temperatures > 85C for min 1 minute
- Disinfecting surfaces with sodium hypochlorite solution (3 – 10 mg/L for 5 – 15 min) will inactivate HAV.

GASTROENTERITIS

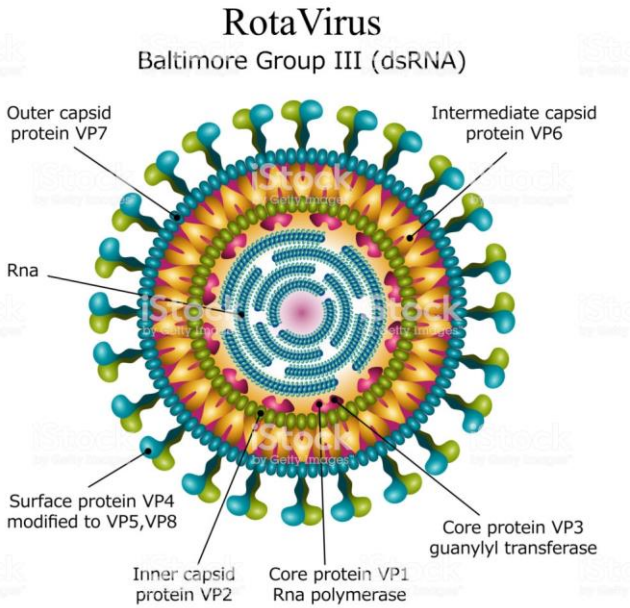
(Inflammation of the lining of the intestines)

ROTAVIRUS



- Family: Reoviridae, Genus: Rotavirus
- Larger in size: 60-100 nm
- Double stranded RNA virus, with multi-layered capsid, nonenveloped, icosahedral symmetry.
- Rotavirus genome comprise of 11 segments of double stranded RNA that code for structural (VP1-VP8) and non-structural protein – multi-layered capsid (core, inner, outer capsid)
- There are 10 Rotavirus group (RV A to J): Group A, B, C are associated with human infection
- Rotavirus is the most common cause of severe diarrhea among **infants** and **children**.
- Globally, causes the death of about 500,000 children annually.

ROTAVIRUS

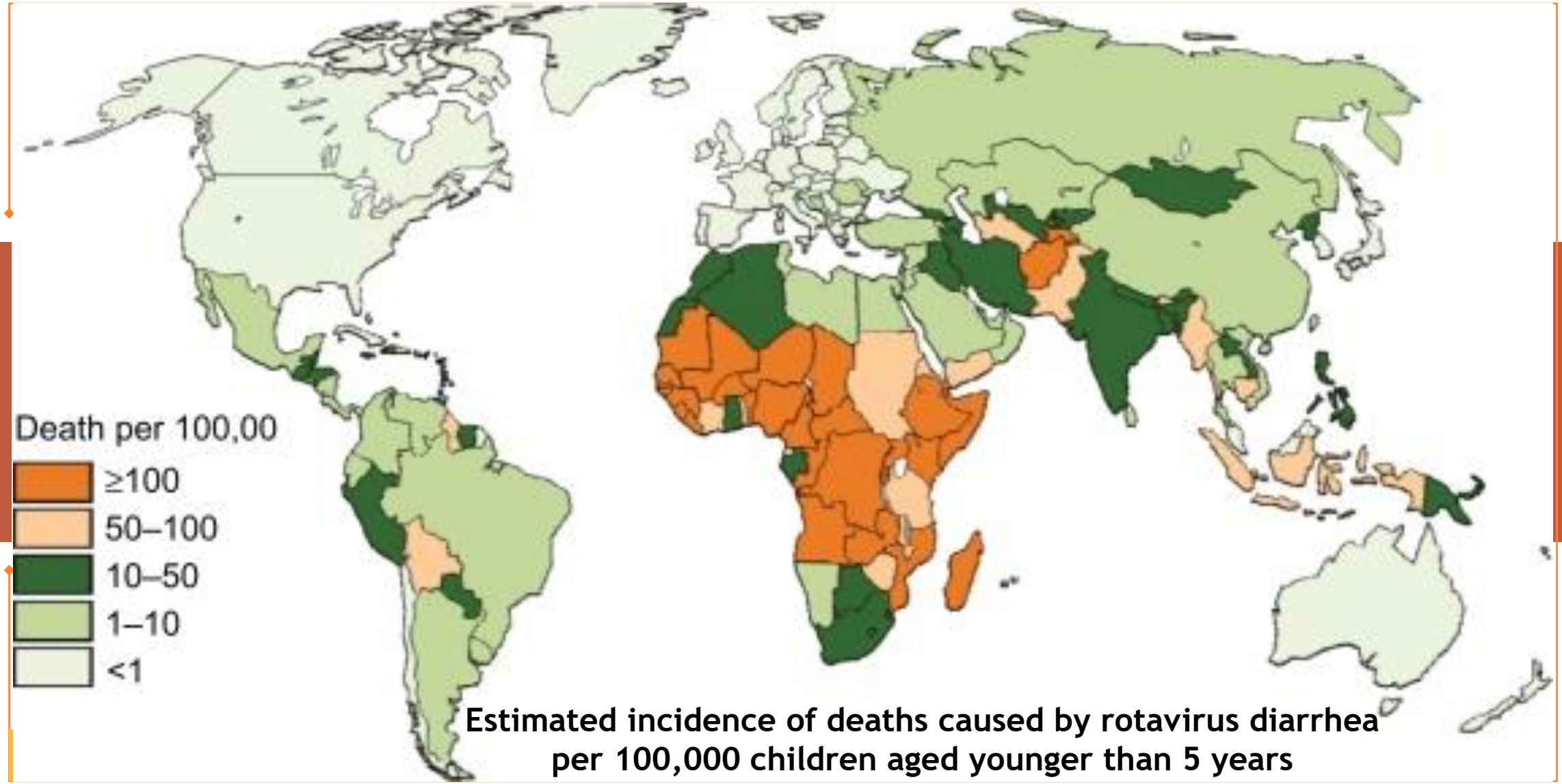


- Infects the bowels, causing a severe inflammation of the stomach and bowels / intestines (gastroenteritis).
- Repeat infections with different viral strains are possible, and most children had several episodes of rotavirus infection in the first years of life.
- After several infections, children acquire immunity to rotavirus.
- Adults sometimes become infected, but the resulting illness is usually mild.
- Since 2006, vaccination has been available for rotavirus infection.

Disease

- Acute gastroenteritis in infants and children
- Malnutrition increases the susceptibility of children to gastrointestinal infections
- 61% of children who die of diarrhea have malnutrition problem.
- Incubation period: 1-3 days
- Symptoms resolves within a week of disease onset
- **Treatments:**
  - Oral rehydration solution (ORS)

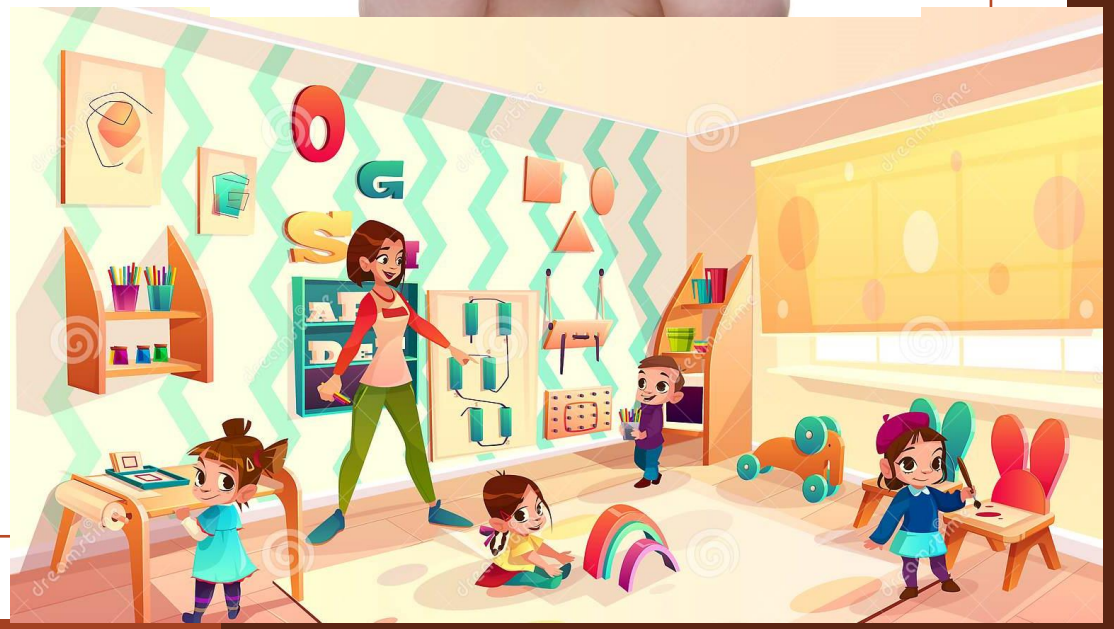
- **Symptoms**:
  - watery diarrhea (4 -7 days)
  - Vomiting
  - Fever
  - Severe dehydration
    - ✓ Dry, cool skin
    - ✓ absence of tears when crying
    - ✓ dry or sticky mouth
    - ✓ sunken eyes/ sunken fontanel (the soft spot on the head of infants)
    - ✓ extreme thirst
    - ✓ Lack of urine



Estimated incidence of deaths caused by rotavirus diarrhea per 100,000 children aged younger than 5 years

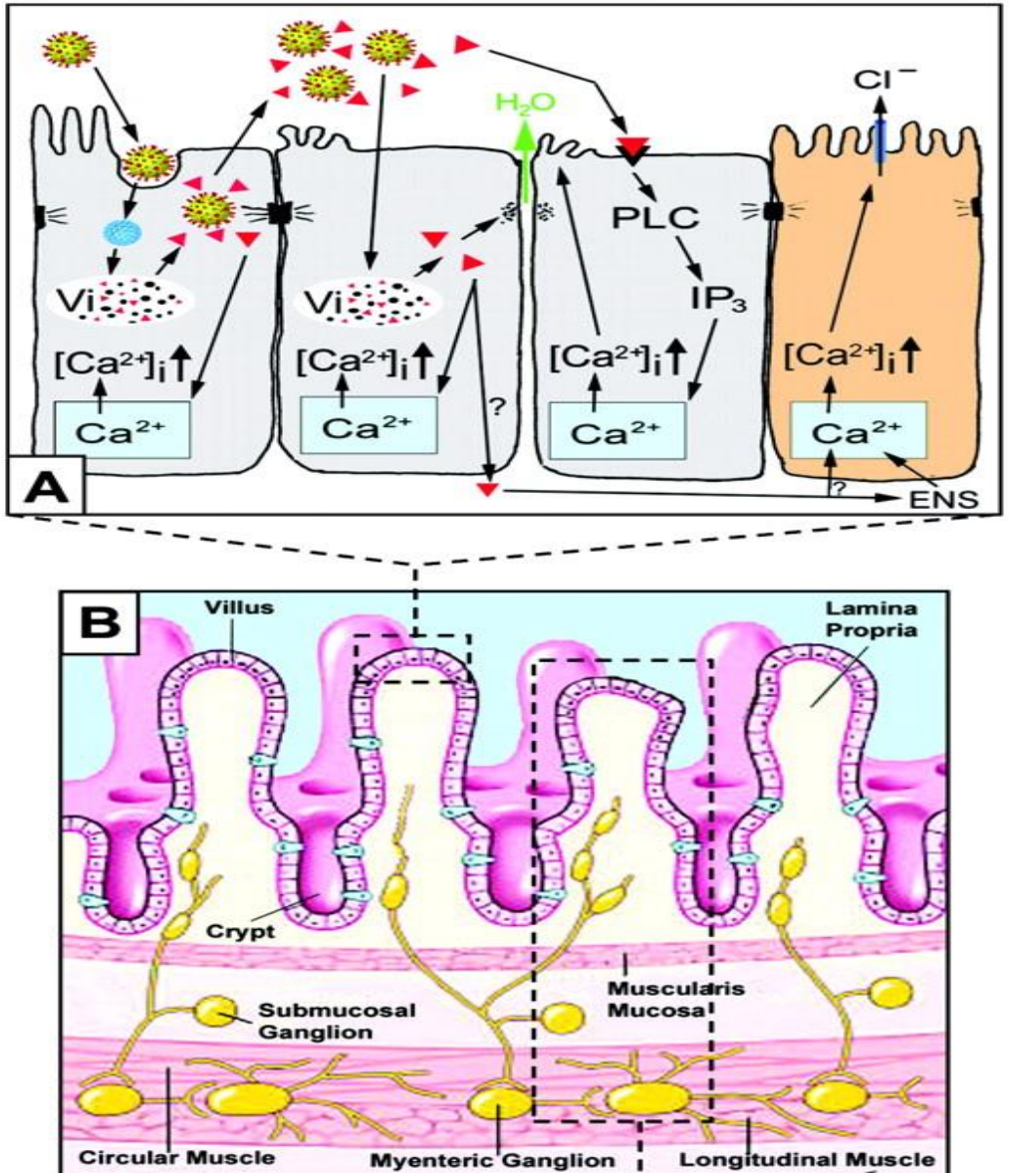
Dissemination

- Fecal-oral-route
- Close personal contact – caregiver, baby, visitors, etc
- Contact with contaminated environmental sources
- Rotavirus infection is highly contagious & spread easily among infants and young children – nursery
  - By putting the unwashed hands into mouth
  - Touching contaminated objects/surfaces & put finger in mouth
  - Eat contaminated food



Pathogenesis

- Upon ingestion, Rotavirus targets the epithelial lining of the intestine
- Rotavirus disrupts the function of gastrointestinal mucosa.
- The viral enterotoxin (NSP4) alter the permeability of the gut mucosa by weakening the tight junction between cells, disrupting the cytoskeleton of the infected cell.
- This will increase the secretion of Cl^- ions.
- The uncontrolled outflux of water into the intestinal lumen results in diarrhea.



Prevention

- Practice personal hygiene – frequent handwashing esp. after changing diapers and before cooking
- Proper cleaning and sanitizing of all food contact surfaces and utensils
- Rotavirus vaccines.

SUMMARY

- Foodborne viruses: Norovirus, Hepatitis A virus, Rotavirus
- Main foodborne illness caused by viruses are gastroenteritis and hepatitis A.
- Dissemination/Mode of transmission: fecal-oral-route
- Prevention method: personal hygiene, vaccination

THANK YOU