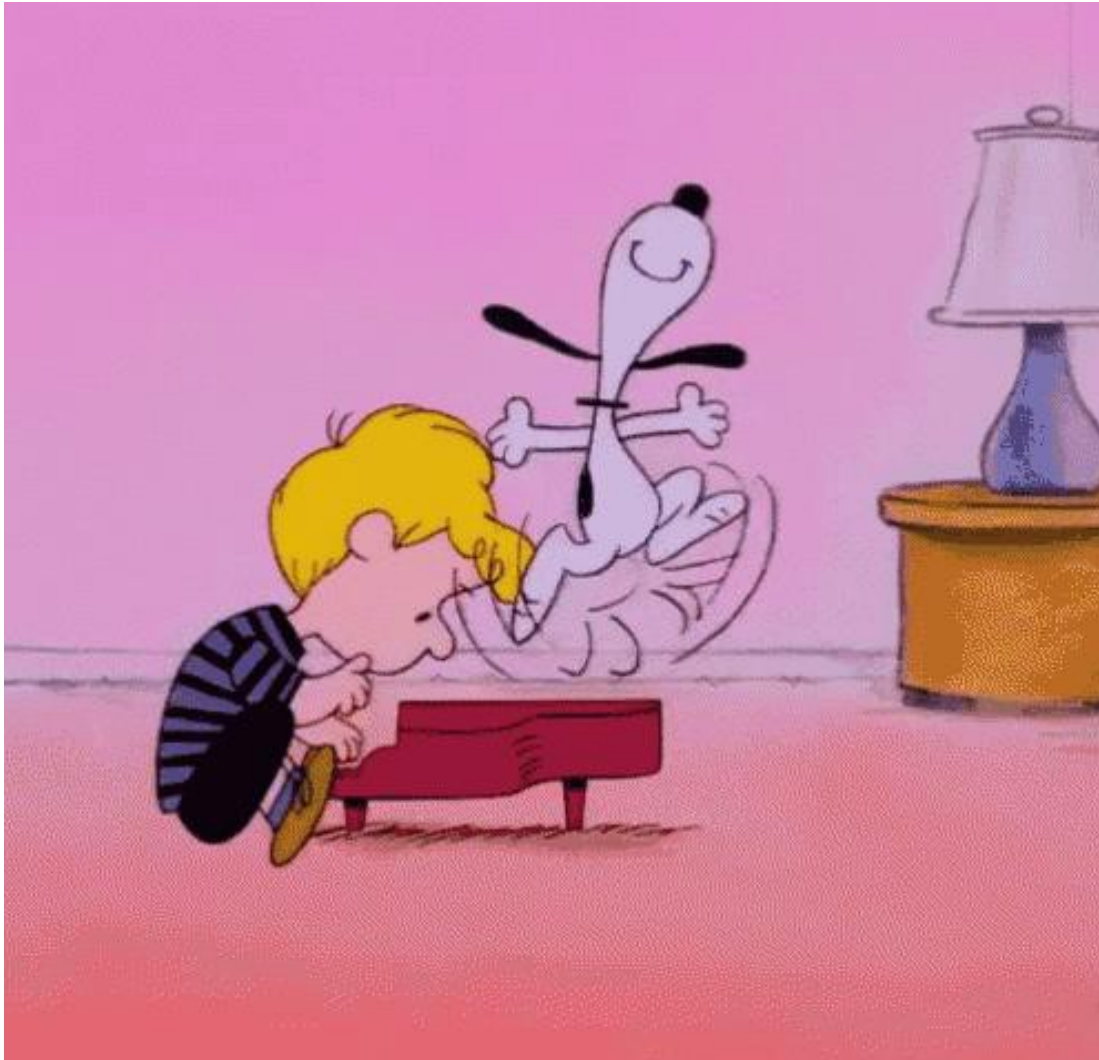
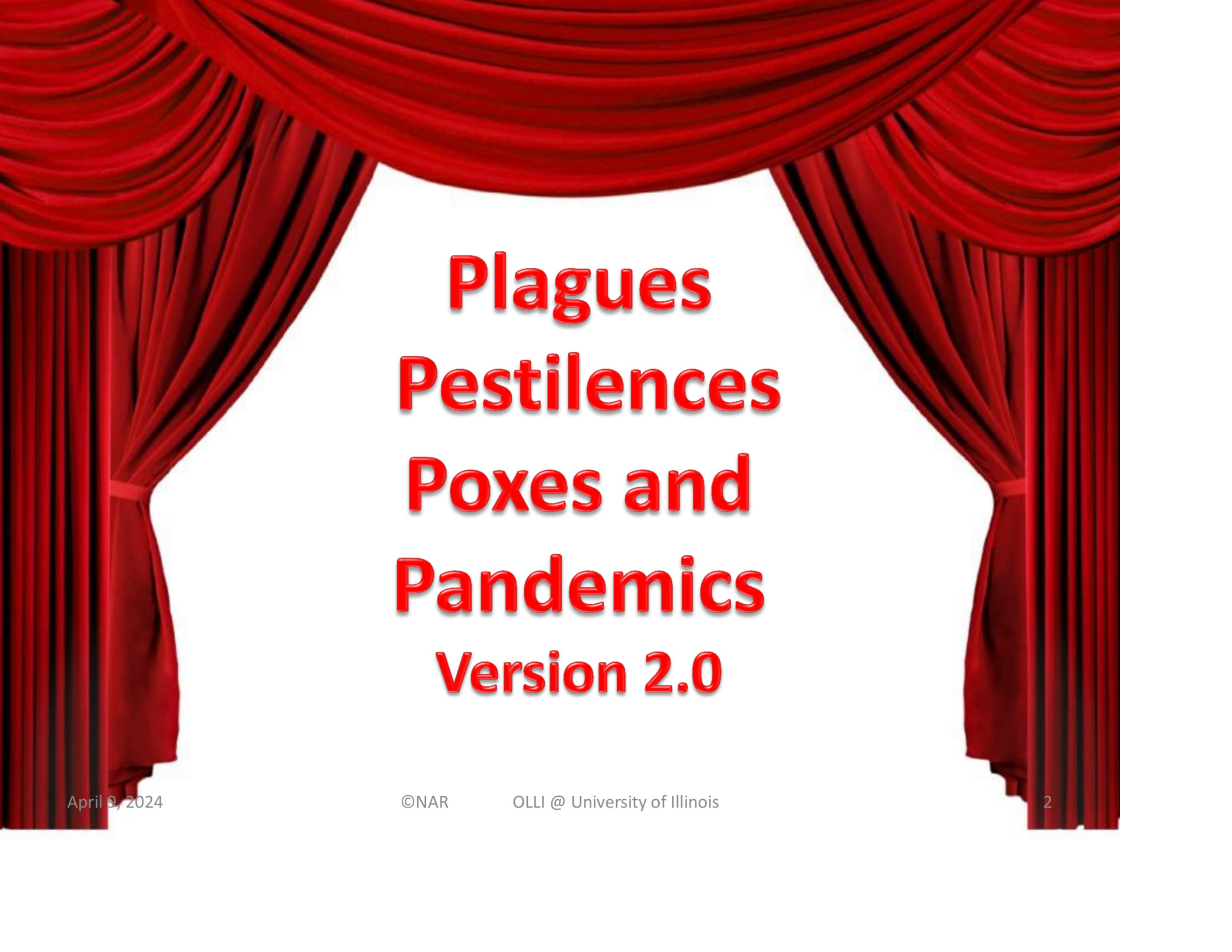


# Good Afternoon!



The background of the slide features a pair of rich red, textured curtains that are drawn back to reveal a white central area. The curtains have a classic, draped appearance with visible folds and shadows, creating a theatrical or stage-like atmosphere.

# **Plagues Pestilences Poxes and Pandemics Version 2.0**

April 9, 2024

©NAR

OLLI @ University of Illinois

2



OLLI Spring 2024 Semester

# Session 7

Néstor A. Ramírez, MD, MPH

# Plan for the Course

Spring 2024 Semester

- Session 1 February 27<sup>th</sup> : Definitions, Biblical Plagues.
- Session 2 March 5<sup>th</sup> : The PLAGUE through time, new theories.
- Session 3 March 12<sup>th</sup> : Other Infectious Pestilences
- Session 4 March 19<sup>th</sup> : The Columbian Exchange.
- Session 5 March 26<sup>th</sup> : 20<sup>th</sup> Century Pandemics, past & current.
- Session 6 April 2<sup>nd</sup> : HIV/AIDS, new treatments.
- **Session 7 April 9<sup>th</sup> : 20<sup>th</sup> and 21<sup>st</sup> Century Viruses.**
- Session 8 April 16<sup>th</sup> : Crystal ball into the future?

# 20th and 21st Century Viruses

**April 9, 2024**



# Alphabetical List of Some “Baddies”

- Borna
- Chikungunya\*
- Corona\*
- Dengue\*
- Ebola
- Hanta
- Hendra
- Herpes
- HIV\*
- Influenza\*
- Junín
- Lassa
- Machupo
- Marburg
- MERS\*
- Nipah\*
- Noro\*
- Polio\*
- Poxes: small, chicken, monkey\*
- SARS\*
- Sin Nombre
- West Nile\*
- Yellow Fever\*
- Zika

# Plan for the Session

- Chikungunya
- Dengue
- West Nile
- Nipah
- Noro
- The Coronas:
  - SARS
  - MERS
  - CoVid-19



# MOSQUITOES CAUSE MORE DEATH & DISEASE THAN ANY OTHER ANIMAL ON THE PLANET

MALARIA DENGUE FEVER YELLOW FEVER  
JAPANESE ENCEPHALITIS WEST NILE VIRUS  
CHIKUNGUNYA FEVER KUNJIN VIRUS  
JAMESTOWN CANYON VIRUS  
VENEZUELAN EQUINE ENCEPHALITIS  
ST. LOUIS ENCEPHALITIS POGOSTA DISEASE  
ROSS RIVER VIRUS LYMPHATIC FILARIASIS  
EASTERN EQUINE ENCEPHALITIS  
MURRAY VALLEY ENCEPHALITIS  
RIFT VALLEY FEVER LA CROSSE ENCEPHALITIS



# Those Pesky Mosquitoes!

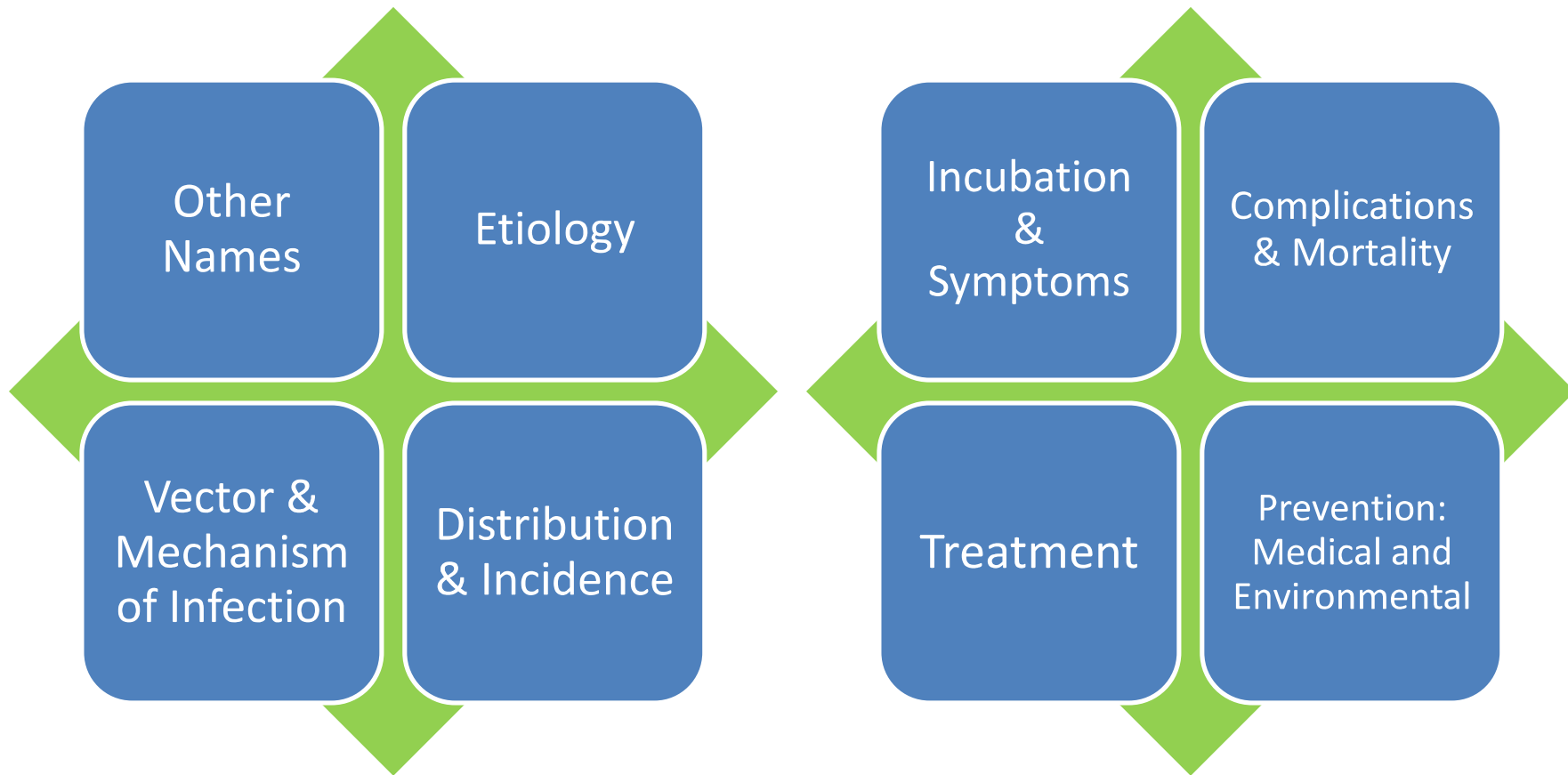




All of today's topics  
are related and very  
interconnected.

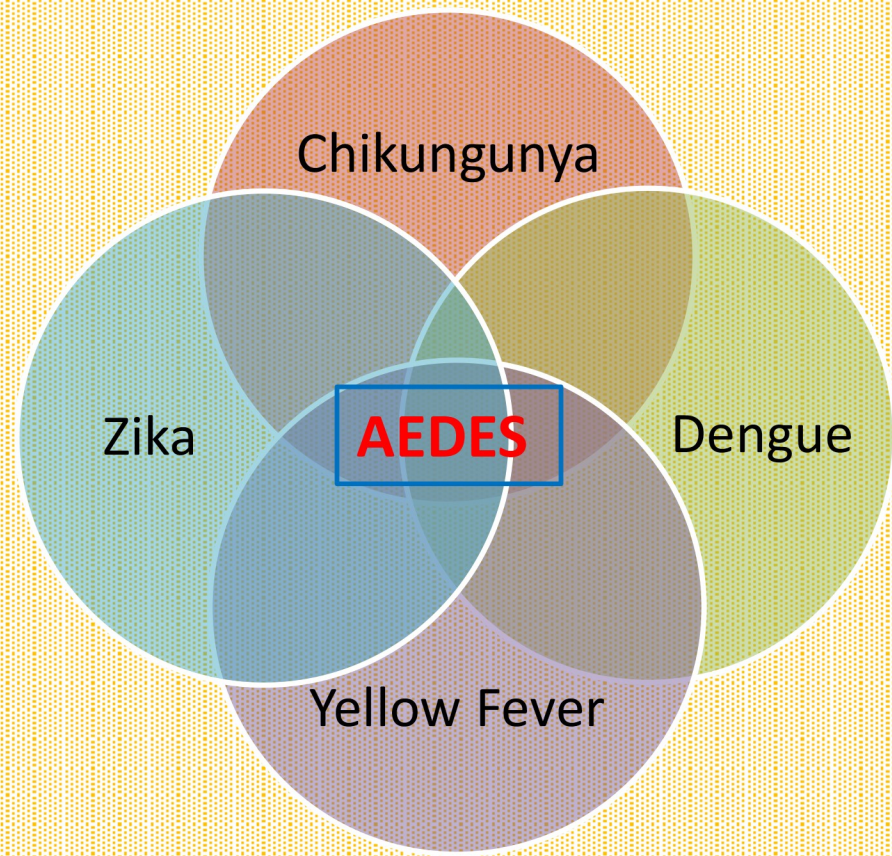
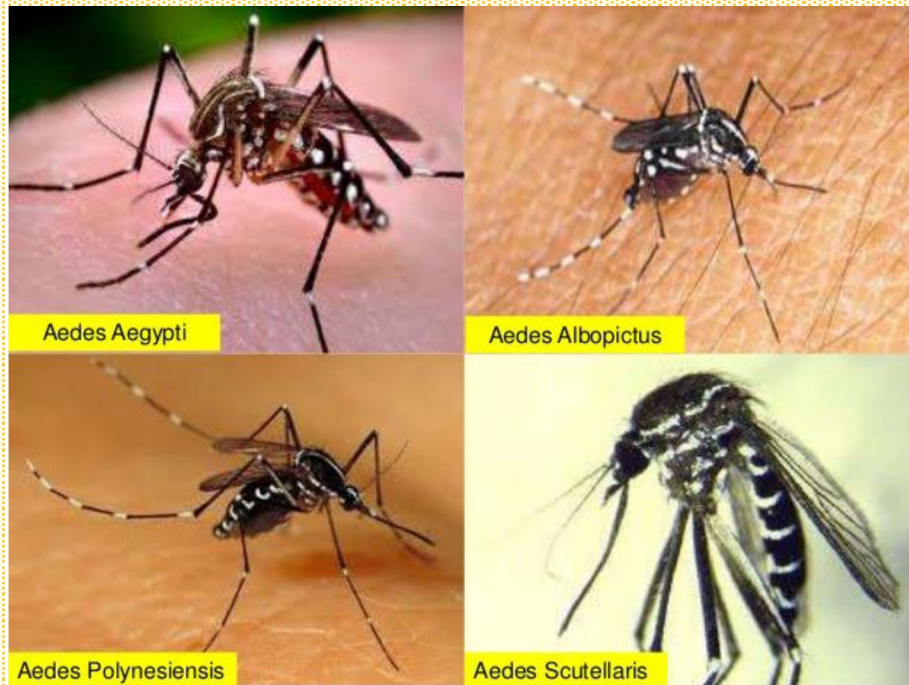


# For All the Viral Fevers





# The *Aedes* Vector Superfecta







# ***ORTHOFLAVIVIRUS* GENUS**

# *Orthoflavivirus*

(renamed from *Flavivirus* in 2023)

- *Flavus* = yellow in Latin
- RNA viruses with arthropod vectors, cause of serious human diseases like yellow fever, dengue, West Nile, various types of encephalitis, and hepatitis C.
- Share several aspects:
  - common size 40–65 nm (billionth of a meter)
  - symmetry: enveloped, icosahedral nucleocapsid
  - single-stranded RNA, positive-sense
  - about 10,000–11,000 bases
  - similar appearance in the electron microscope





# CHIKUNGUNYA



# Chikungunya



It has NOTHING to do with **Chickens** !



# Chikungunya

## Other Names

- CHIKV
- from the Makonde root verb *kungunyala*, meaning “bent over or contorted in pain”
- in Tanzania, locals call it *LangraJor*
- in Latin America: *Fiebre Chica* (little fever)





# Chikungunya

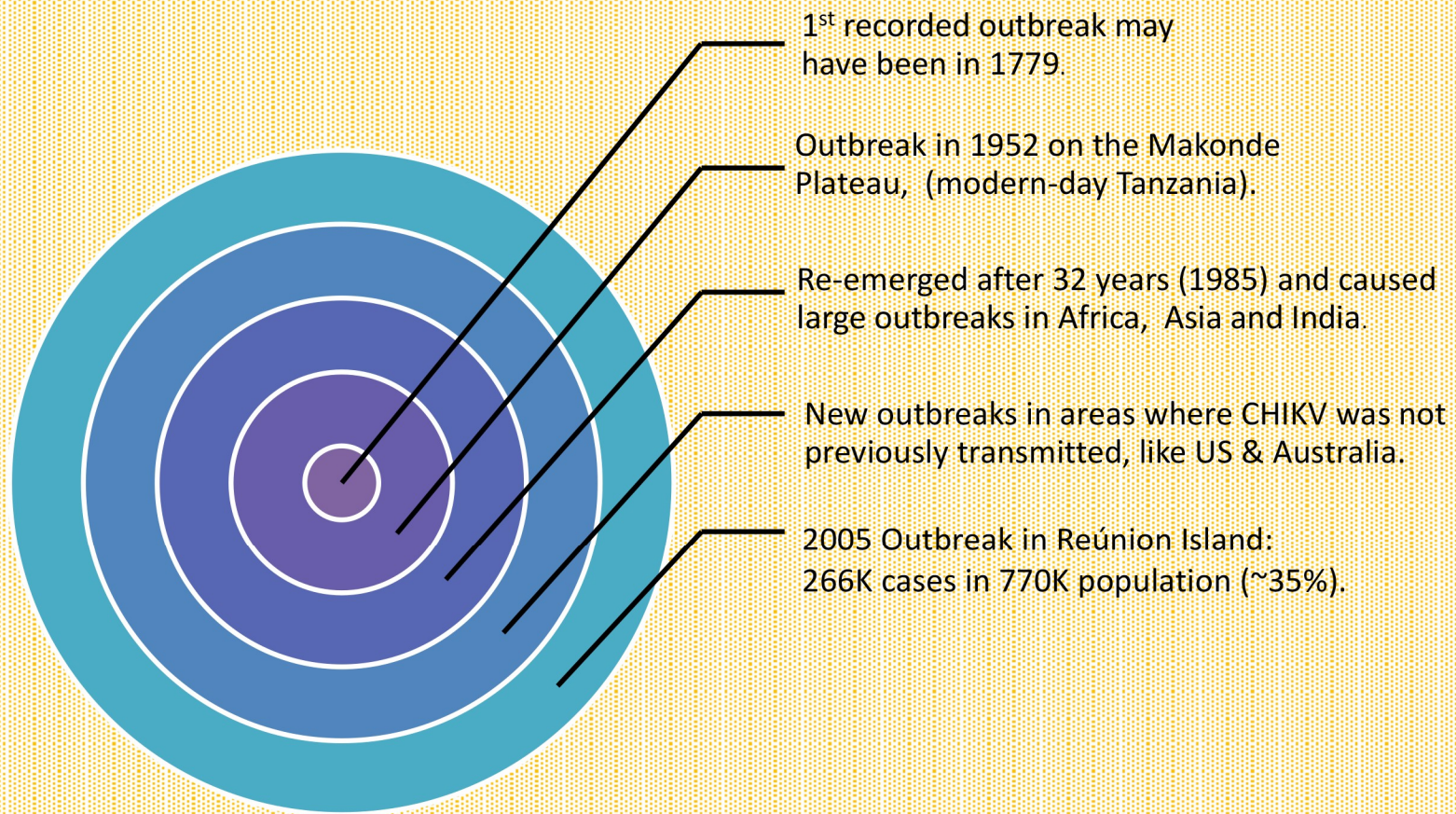
## Etiology & Mechanism of Infection (1)

- CHIKV is a single-strand RNA arbovirus transmitted by an arthropod, *Aedes* mosquito.
- Arbovirus = **Ar**thropod **borne** virus.
- Mosquito bites, injects saliva and sucks blood.
- Salivary glands of *Aedes* are infected with CHIKV.



# Chikungunya

## Historical Perspective





# Chikungunya

## Signs & Symptoms

Most frequent: sudden high fever, joint and muscle pain, headache, fatigue and rash.

Symptoms usually begin 3–7 days after being bitten.

Often not deadly, but symptoms can be severe and disabling.

Most patients feel better within a week. In some, the joint pain may persist for months.

An infected person is likely to have lifelong immunity.

At higher risk:

- Newborns infected around the time of birth.
- Older adults  $\geq 65$  years
- People with high blood pressure, diabetes, or heart disease.



# Chikungunya

## Joint Pains (Arthralgias)



joint stiffness, strong pains and rare swelling in 87-98% of cases

occur 2 to 12 days after exposure

joint pain may last for months or years

can be debilitating, with near immobility

joints are affected symmetrically in both arms and legs

pain most common in peripheral joints



# Chikungunya



*Aedes aegypti*  
in the act of  
biting a  
human.



# Chikungunya

## Etiology & Mechanism of Infection (2)

- CHIKV injected by female *Aedes* mosquito; males do not suck blood.
- In the 1<sup>st</sup> week, CHIKV is found in the blood and can pass from a person to a mosquito (reverse zoonosis or zooanthroponosis).
- An infected mosquito can then spread the virus to other people.
- Mothers who have chikungunya during pregnancy do not transmit the virus to their babies, but mother-to-baby transmission can occur when the mother has fever in the days immediately prior to or during delivery.



# Chikungunya

## Viral Genetics

- A recent mutation in the viral coat protein allows the virus to multiply more easily in mosquito cells.
- CHIKV can now use the Asian tiger mosquito, *A. albopictus* in addition to the main tropical vector, *A. aegypti*.
- *Aedes albopictus* is an invasive species which has spread worldwide, and increases outbreak risks wherever the Asian tiger mosquito is found.



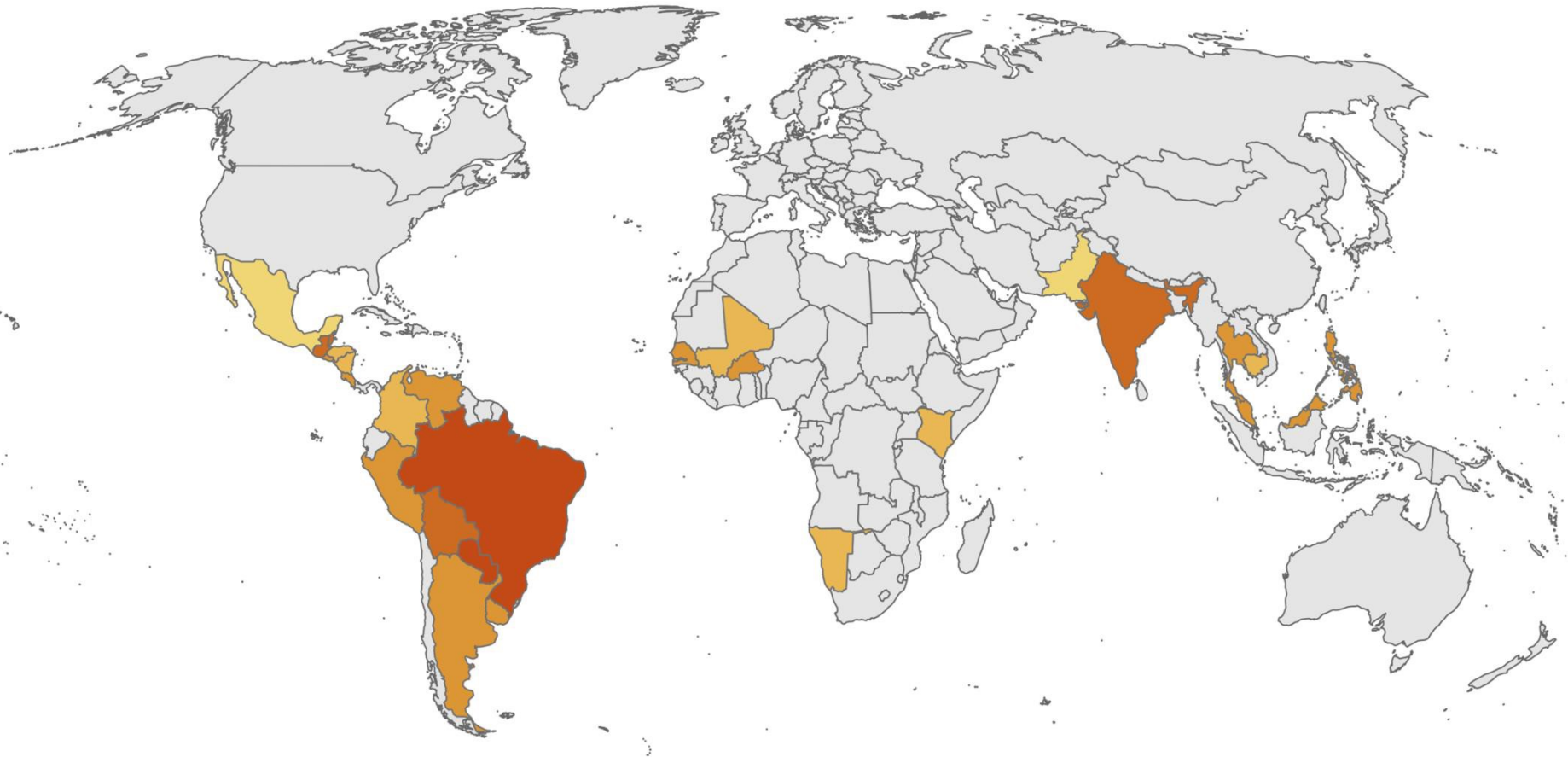
# Chikungunya

## Distribution

- Outbreaks have occurred in Africa, Asia, Europe, and the Indian and Pacific Oceans.
- In late 2013, the virus was found for the first time on islands in the Caribbean, and Central & South America.
- The virus is imported to new areas by infected travelers.
- No human-to-human transmission.



# Reported CHIKV cases November 2022-October 2023



Notification rate per 100 000 persons



Note: Data refer to Chikungunya virus cases reported in the last 12 months (November 2022-October 2023) [Data collection: November 2023]. Administrative boundaries: © EuroGeographics  
The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. ECDC. Map produced on 09 November 2023

(European Centre for Disease Prevention)



# World Incidence

- PAHO epidemiological alert reported:
  - in 2021: >137K cases and 12 deaths (0.9%)
  - in 2022: > 765K cases and 95 deaths (1.2%)
  - in 2023: > 460K cases and 360 deaths (7.8%)
  - By 29 Feb. 2024: 70K cases and 15 deaths (2.1%)
- As of October 31, 2023, most of the countries with high CHIKVD burden were from South and Central America.
- No locally acquired cases of CHIKVD in continental Europe in 2023.

# Prevention of Mosquito Bites

- wear light-colored long sleeves and pants
  - stay in ventilated places or with air conditioning
  - rooms should have door and window screens
  - use bed-net impregnated with insecticide
  - avoid strong perfumes
  - use bug lightbulbs
- use insect repellent:
    - ultrasonic clip-ons, smartphone apps (?)
    - vitamin B1 tablets/patches?
    - natural oils: clove, neem, lemon-eucalyptus, lavender, peppermint-castor(?)
    - wristbands with geraniol, citronella & lemongrass (?)
    - icaridin (picaridin)\*
    - DEET\*



# Mosquito Protection



Bug bulb




Bug zapper



# Chikungunya

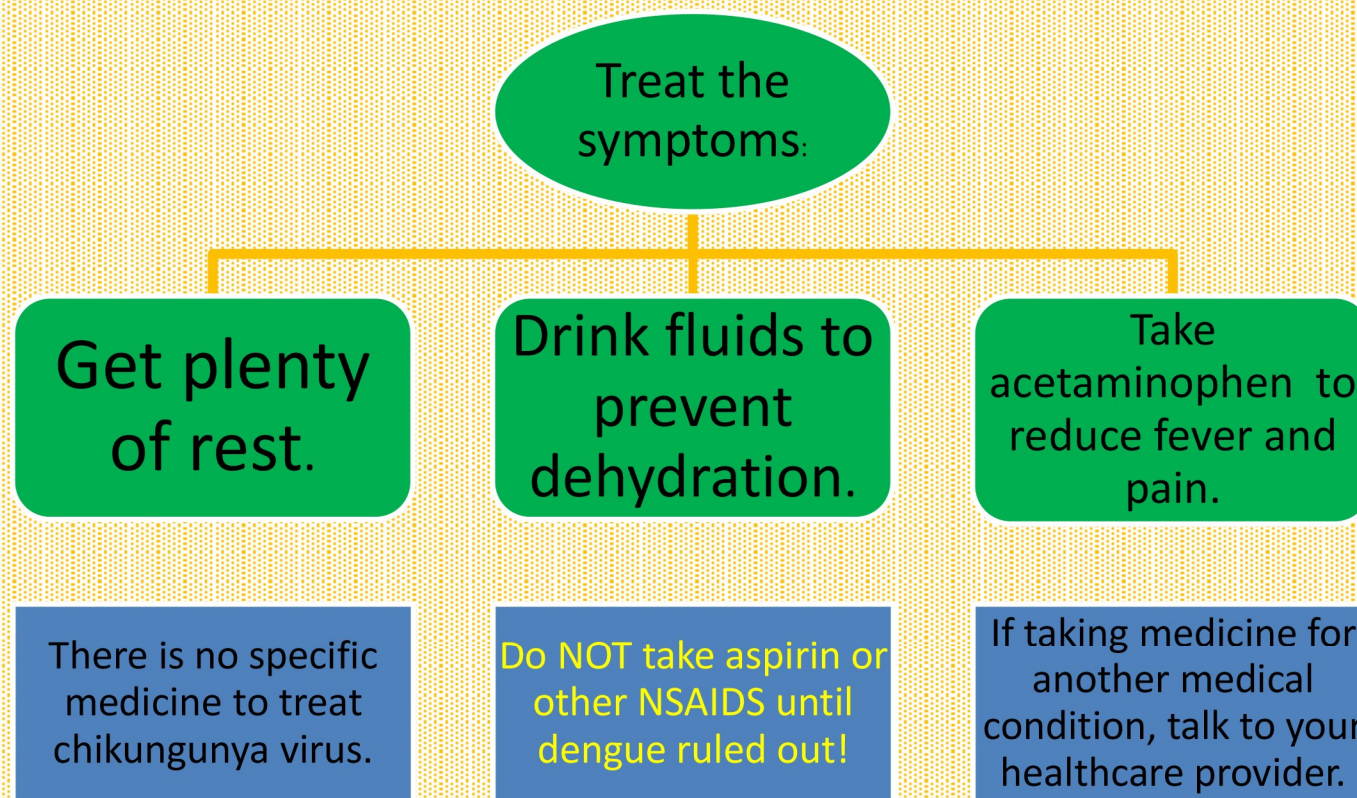
## Environmental Prevention

- Stop mosquitoes from laying eggs in or near water.
  - Once a week:
    - empty and scrub:
    - turn over:
    - cover or throw out:
- 
- Items that hold water, like tires, buckets, planters, toys, pools, birdbaths, flowerpots, or other containers.
- Check indoors **and** outdoors.



# Chikungunya

## Treatment





# Dengue virus

## DENGUE FEVER



# Dengue Fever

## Other Names

Breakbone/Breakheart fever

*E.Africa: Kidinga pepo = a cramp-like seizure*

Dandy fever

Pasito Tun-Tun

Philippine/Thai hemorrhagic fever.

## Etiology <sup>(1)</sup>

Bite of infected mosquito

Single bite can infect

Infected blood products

Organ transplants

Sexual transmission (rare)

Mother to baby: pregnancy or childbirth



# Dengue Fever

## Etiology <sup>(2)</sup>

single strand  
linear positive  
sense RNA

*Orthoflavivirus*  
genus  
flavus=yellow

4 strains:  
viral genetic  
variation is  
region-specific

infection with 1  
strain gives life-  
long immunity  
to that strain

same family as  
yellow fever,  
Zika & West  
Nile

humans  
primary host,  
also other  
primates

minimal  
immunity to  
other 2 strains

2<sup>ary</sup> infection by  
another strain  
increases risk  
of severe  
disease



# Dengue Fever

## Etiology <sup>(3)</sup>

Larvae found in water-filled habitats of human dwellings, often indoors.



Dengue virus transmitted through the bite of an infective female *Aedes*.



Virus infects mosquito mid-gut and then salivary glands over 8-12 days incubation.



Virus can then be transmitted to humans during subsequent probing or feeding.

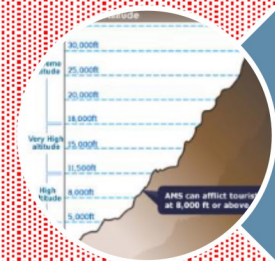




*Aedes*, from the Greek “unpleasant, odious.” (*Aedes aegypti*, *albopictus* and *polynesiensis*.)



Between Lat. 35° North and 35° South



Elevation < 3,300 ft



May bite at any time of day  
(but prefer early morning and evening)

# Dengue Fever

The Vector (1)



# Dengue Fever

## The Vector (2)

infection rates higher outdoors in daytime, when *Aedes albopictus* bite most frequently

*Ae. albopictus*, a forest species, has adapted to all human environments

*Ae. aegypti* breed indoors and can bite all day

Indoor habitat increases the mosquitoes' longevity

*Ae. albopictus* spread to Africa, the Americas and Europe, via the international trade in used tires

eggs can withstand very dry conditions and remain viable for many months even in the absence of water

females may spend their lifetime in or around the houses where they became adults

usually fly at most 1,200 feet, so it's people that rapidly move the virus within and between places



# Dengue Fever

## The Vector <sup>(3)</sup>

- A study in *Acta Tropica* in March 2019 found that the song "Scary Monsters and Nice Sprites" by Skrillex delays host attack, blood feeding, and disrupts the mating process of *Aedes aegypti*.
- This research opens new avenues for the development of music-based personal protective and control measures for mosquitoes.
- The research involved that song only, not the influence of other different ones.



# Dengue Fever

- About ½ of the world's population is at risk of dengue with an estimated 100–400 M infections each year.
- Acetaminophen (paracetamol) is often used to control pain, and NSAIDs like *ibuprofen* and *aspirin* are avoided as they can increase the risk of bleeding.
- There is a vaccine for people who have had dengue at least once and live in places where it is endemic.



# Dengue Fever

## Distribution & Incidence

common in  
more than 120  
countries

in 2022: ~ 100 M  
symptomatic infections  
worldwide, with about  
40 K deaths

worldwide cost of  
dengue is  
estimated at  
US \$9 B/year

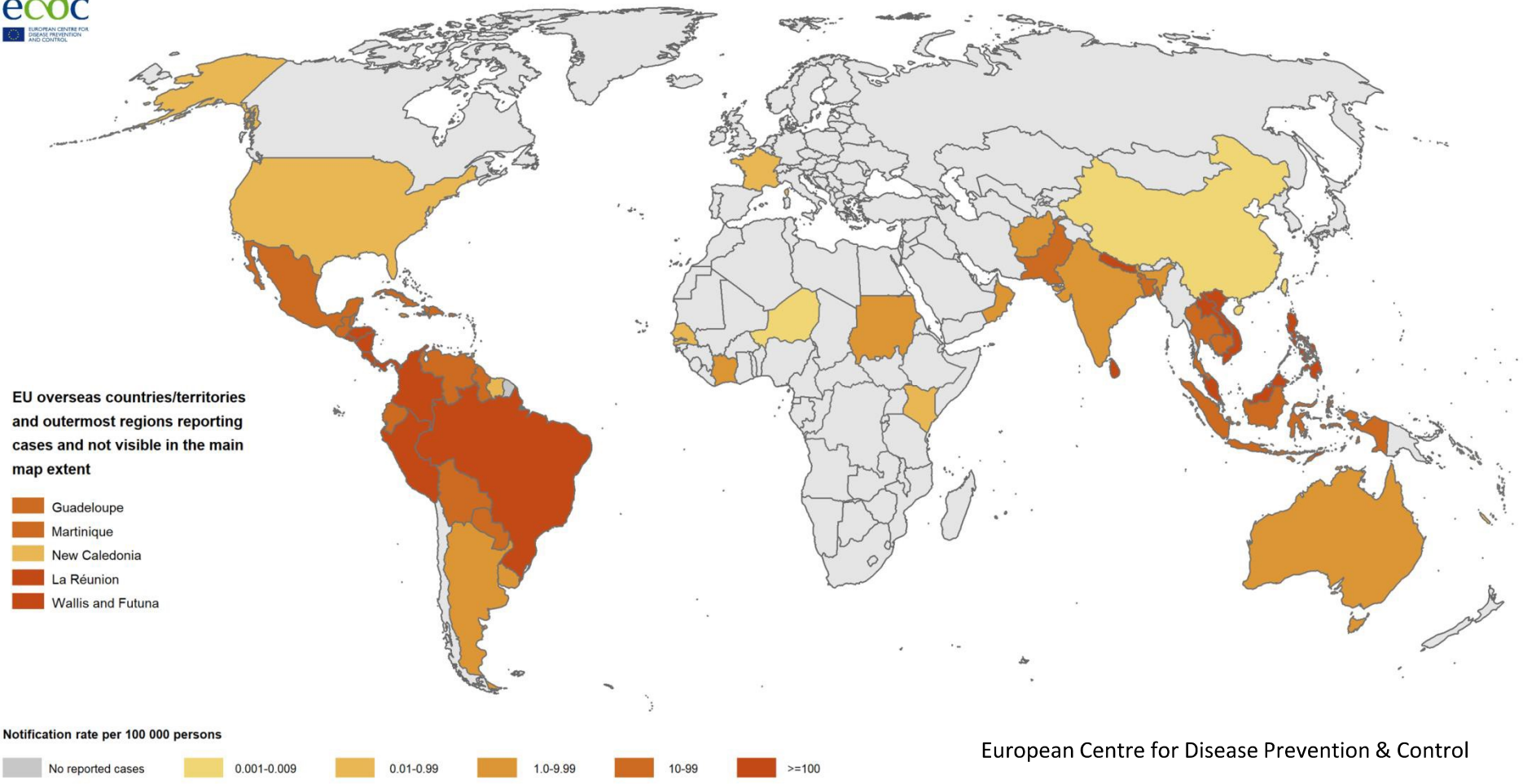
12 countries in SE Asia  
estimated to each have  
~3 M infections and 6K  
deaths annually

in 2019 the Philippines  
declared a National  
Dengue Epidemic due  
to 622 deaths that year

In >22 countries in Africa,  
20% of population at risk



# Dengue Virus Disease January-December 2022



European Centre for Disease Prevention & Control

Note: Data refer to cases reported in the last 12 months. Administrative boundaries: © Eurographics  
 The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. ECDC. Map produced on 19 January 2023



# Dengue Fever

## Symptoms

- 80% are asymptomatic or have only mild symptoms.
- 5% have more severe illness; in a small portion it is life-threatening.
- The incubation period is 3 to 14 days, average 4 to 7.
- If symptoms start >14 days after arriving home, travelers returning from endemic areas are unlikely to have dengue



# Dengue Fever



Half of patients with DHF get DSS (Dengue Shock Syndrome) with severe hypotension, shock & possible death.

- 80% have benign course with fever, rash, headache, prostration, severe joint, muscle pain, lymphadenopathy.
- Typical “*dengue triad*”:
  - fever,
  - rash
  - behind-the-eyes headache.
- 1 to 5 % of patients get severe dengue, known as **Dengue Hemorrhagic Fever (DHF)**:
  - blood vessels leak
  - patients bleed from their gums
  - hemorrhages under the skin
  - 20% may die.



# Dengue Fever

## Symptoms in Children

- Children have symptoms like the common cold and gastroenteritis (vomiting and diarrhea).
- They are more at risk of severe complications.
- Initial symptoms are generally mild but include high fever.
- More pronounced risk of DHF and DSS in **well-nourished children!**



# Dengue Fever

## Dengue Hemorrhagic Fever and Dengue Shock Syndrome

Spread of dengue post-WWII is attributed to ecologic disruption.

Also led to different disease serotypes into new areas and the emergence of DHF and DSS.

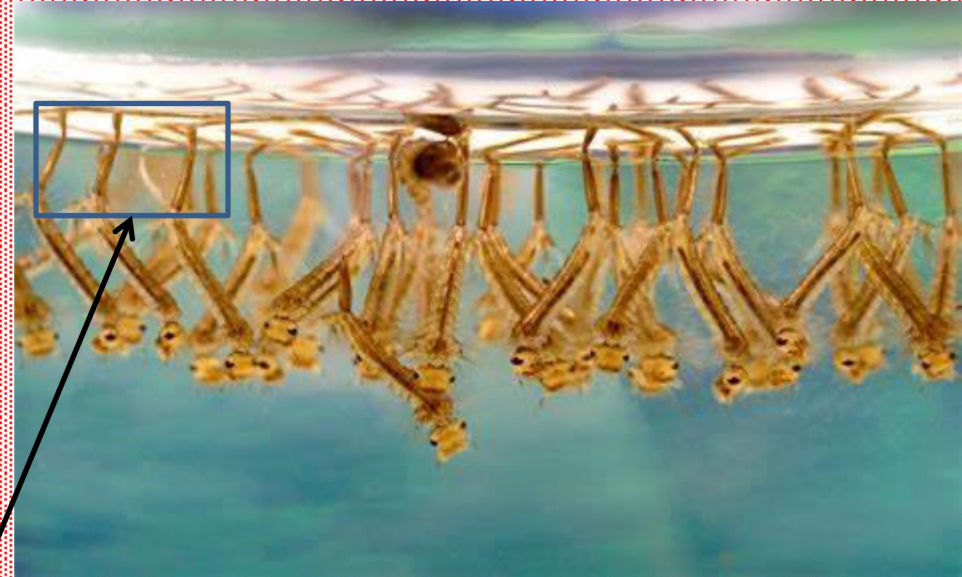
DHF and DSS first noted in Central and South America in 1981, becoming a major cause of child mortality.

People previously infected with DENV-1, later on have a higher risk of getting severe dengue with DENV-2.



# Dengue Fever

## Larvae in Water



Caudal appendage (“periscope”) to absorb oxygen.

Non-toxic tips to eliminate larvae:

- cinnamon oil
- apple cider vinegar
- aerator pumps
- decrease surrounding vegetation
- soapy water



# Dengue in Brazil

- The Federal District, where Brasilia is situated, issued an emergency decree in early 2024 due to a dangerous Dengue outbreak that began in 2022.
- The Federal District is Brazil's most affected state this year.
- By Feb. 17, it surpassed 72,600 confirmed cases (equal to the total for all of 2023).



# Dengue in Brazil

- At least 6 Brazilian states are facing dengue epidemics and 17 cities have declared a state of emergency.
- The country has already registered 1M cases of dengue in the first 2 months of 2024 (more than half the 1.6M cases confirmed in 2023, which was almost 18% higher than in 2022).
- Deaths in those same two months was 214 (0.2%)



# Dengue

- Perú is in the midst of an epidemic, while Bangladesh, Nepal, Pakistan, Sri Lanka and Vietnam have also seen dengue spike dramatically.
- Niger, a subtropical country, reported its first case of the disease in 2022.
- In 2023, high-heat states like California, Texas, and Florida have seen several unexpected cases.
- In 2024, Puerto Rico has had 549 cases, most in San Juan.



# Dengue

- Over the last 20 years, WHO reports that yearly dengue cases has increased by 8X, with 100M to 400M registered worldwide every year.
- Roughly,  $\frac{1}{2}$  the world's population is at risk of infection.
- Why is dengue having such unprecedented growth?
- The answer lies in the method of transmission – and the changing environment of Earth.



# *Aedes aegypti*

- The mosquitoes are thriving in areas where climate change has made temperatures higher and precipitation more abundant than in the past.
- This species likes it hot and humid.
- In the last few years, migration, urbanization and other socioeconomic issues have all helped to provide ideal conditions for the spread of *Aedes aegypti* and the diseases it can carry.



# Questions? 1





# Dengue Fever

## Prevention

- Prevention is similar to other arboviruses:
  - eliminate the vector's habitats
  - drain stagnant water
  - animals which eat the larvae: guppies, copepods
  - spray mineral oil on still waters to choke larvae
- Insecticides & larvicide dunks may be toxic to humans or pets.
- Genetically modified males that produce non-flying offspring.
- Bacteria to infect the mosquito (*Wolbachia*).



# *Wolbachia wMel*

- World Mosquito Program (WMP) uses a *Wolbachia wMel* strain to infect *Aedes* mosquitos, blocking virus replication so they cannot transmit the disease.
- In 2014, WMP released *wMel*-infected mosquitos in Townsville, an Australian city plagued by dengue with 187K inhabitants and by 2018, no cases of dengue and no environmental ill-effects were reported.
- The cost was ~US\$10 per inhabitant, but could be reduced to US\$1 in countries with lower labor costs.

# Wolbito

- The World Mosquito Program is building a mosquito biofactory, in Brazil, with a project named **Wolbito**.
- This will produce mosquitoes infected with *Wolbachia*, a bacteria found naturally in the majority of insects (including other types of mosquitoes) but not in *Aedes aegypti*.

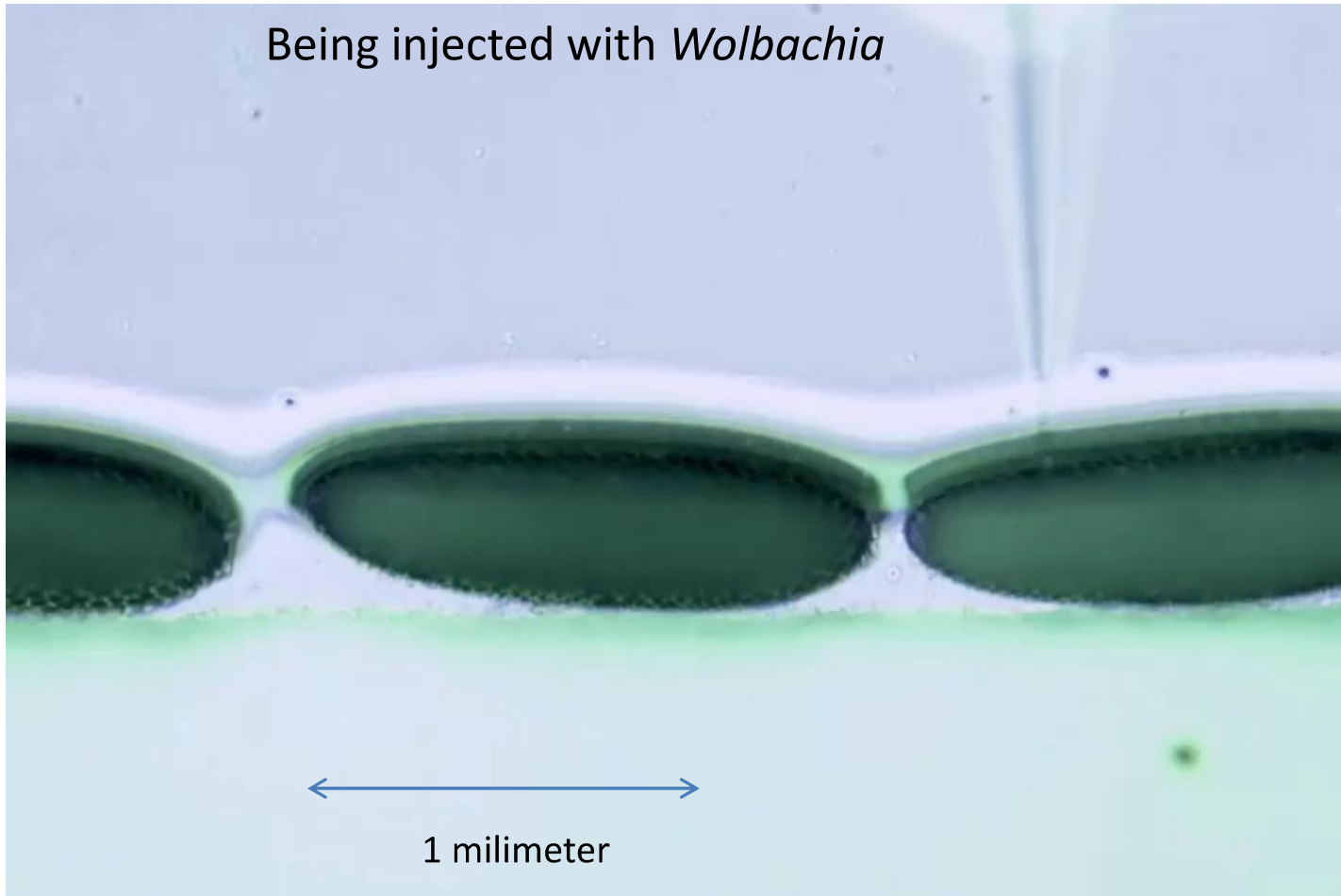


# Wolbito

- In 2025, the mosquito biofactory will be able to produce 400 million *Wolbachia*-infected *Aedes aegypti* eggs per month.
- This will help not only with dengue, but also with Yellow fever, Chikungunya and Zika, because *Aedes* carries and transmits them.

# *Aedes aegypti* eggs

Being injected with *Wolbachia*





# *Wolbachia wMel*

- In 2016, WMP allocated US\$18M to use *wMel* mosquitos to fight zika and dengue viruses, and deployment was done early 2017 in Colombia and Brazil.
- In Colombia, in 2022, the incidence of dengue was shown to be reduced by 95% in Bello, 94% in Medellín and 97% in Itagüí, after establishment of *wMel*, compared to the pre-intervention period.
- In Brazil, there was a 69% reduction in reported dengue cases over three years compared with a control area.

# *Wolbachia wMel*

- Between 2016 and 2020, WMP conducted a RCT in Yogyakarta, an Indonesian city of about 400K inhabitants.
- In August 2020, Indonesian scientists reported that the trial showed a 77% reduction in dengue cases after 3 years, compared to the control areas.
- When modified mosquitoes were released in Singapore in 2018, dengue incidence was observed to have been reduced by 88% after a year.



# *Wolbachia*

Residents often have a lot of questions:

- Can the bacteria contaminate the environment when the mosquito dies?  
(NO, when the mosquito dies at the end of its lifespan the bacteria dies with it.)
- Does *Wolbachia* pass to humans when they're bitten?  
(NO, it doesn't.)
- Does the process genetically modify the mosquitoes?  
(NO, their genes stay the same).

# Dengue Vaccine

- A tetravalent, live-attenuated vaccine (**Dengvaxia<sup>®</sup>**) can help prevent dengue, caused by all four distinct virus types, DENV-1, DENV-2, DENV-3, and DENV-4.
- Starting in 2022 it is available for use in children 9 through 16 years old who have laboratory-confirmed previous dengue virus infection and are living in a dengue endemic area.
- Dengue-endemic areas include the U.S. territories of American Samoa, Puerto Rico, and the U.S. Virgin Islands, and freely associated states, including the Federated States of Micronesia, the Republic of Marshall Islands, and the Republic of Palau.



# Dengue Vaccine

## Dengvaxia

The reasons for needing laboratory-confirmed previous dengue in 9-16 year-olds are:

- Risk Reduction: Children without previous dengue infection are at an increased risk for severe dengue disease and hospitalization if they contract dengue after being vaccinated with ***Dengvaxia***.
- Clinical Trials: The vaccine was more effective at preventing hospitalization or severe dengue in children aged 9–16 who are at the highest risk compared to younger children.

# Dengue Vaccine

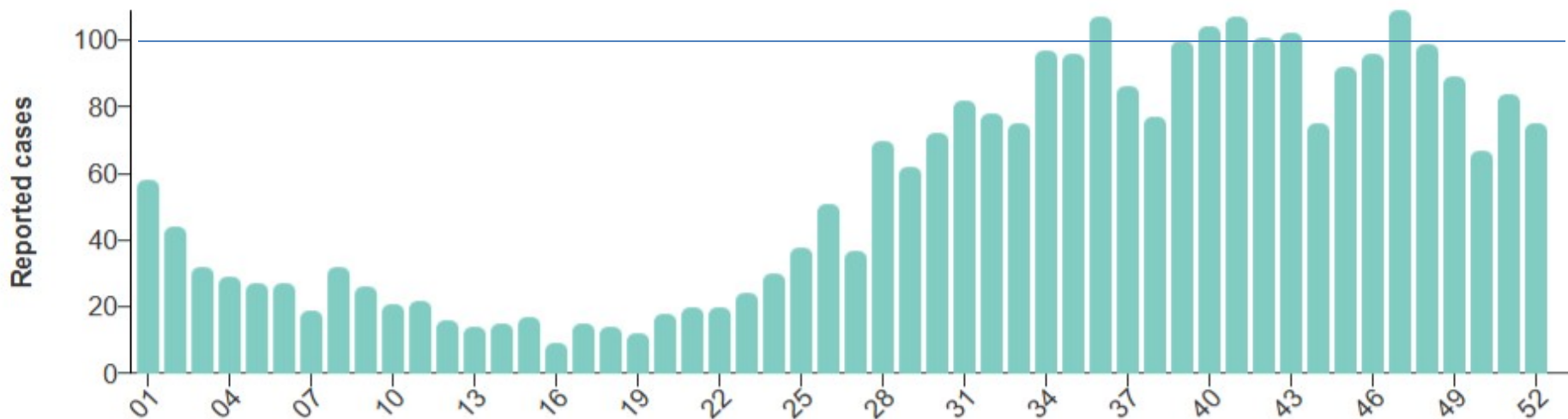
- In February, 2024, Brazil's public health-care system started using Japan's 2-dose **Qdenga** vaccine in its first attempt to immunize the most vulnerable members of the population.
- During clinical trials, the vaccine's efficacy was 80% one year after the second dose.



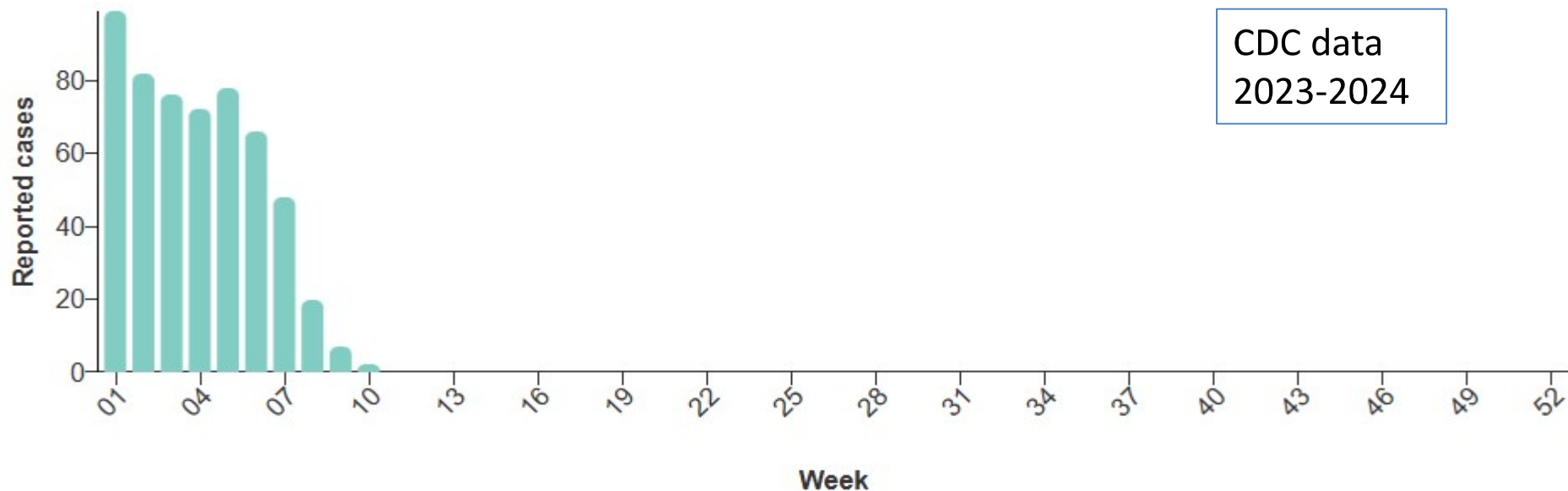
# Dengue Vaccine

- The Butantan Institute, in São Paulo, is also developing a vaccine to prevent all four variations of dengue.
- In recent clinical trials, from 2013 to 2015, the single-dose vaccine protected 79.6% of those immunized.
- But dengue vaccines are controversial: the Philippines attempted to immunize children nationwide in 2016, and at least 10 deaths were blamed on the vaccine, leaving the population cautious about new vaccines.

All dengue cases by week in US states and territories, 2023



All dengue cases by week in US states and territories, 2024





# Dengue Fever

(WHO statistics)

- In 2000, 500K recorded cases and in 2022, over 4.2 M recorded cases, an 8-fold increase, with Asia having around 70% of the global burden.
- The mosquito has been present in 22 European countries for >10 years, and dengue and chikungunya infections transmitted by *Aedes* have since been reported.
- Climate change, the increased movement of people and goods, urbanization and pressure on water and sanitation have driven the spread of dengue fever.

# Dengue Fever in 20<sup>th</sup> Century

Location	Dates	Mortality
Central America	2000	>40
Indonesia	2004	658
India	2006	>50
Pakistan	2006	>50
Philippines	2006	1,000 *
Puerto Rico, D.R., Mexico	2007	183
Brazil	2008	67
Cambodia	2008	407
Philippines	2008	172
Bolivia	2009	18
Queensland	2009	18
Peshawar	2017	69
Asia-Pacific, Latin America	2019-present	3,930 *

Ramírez 2021

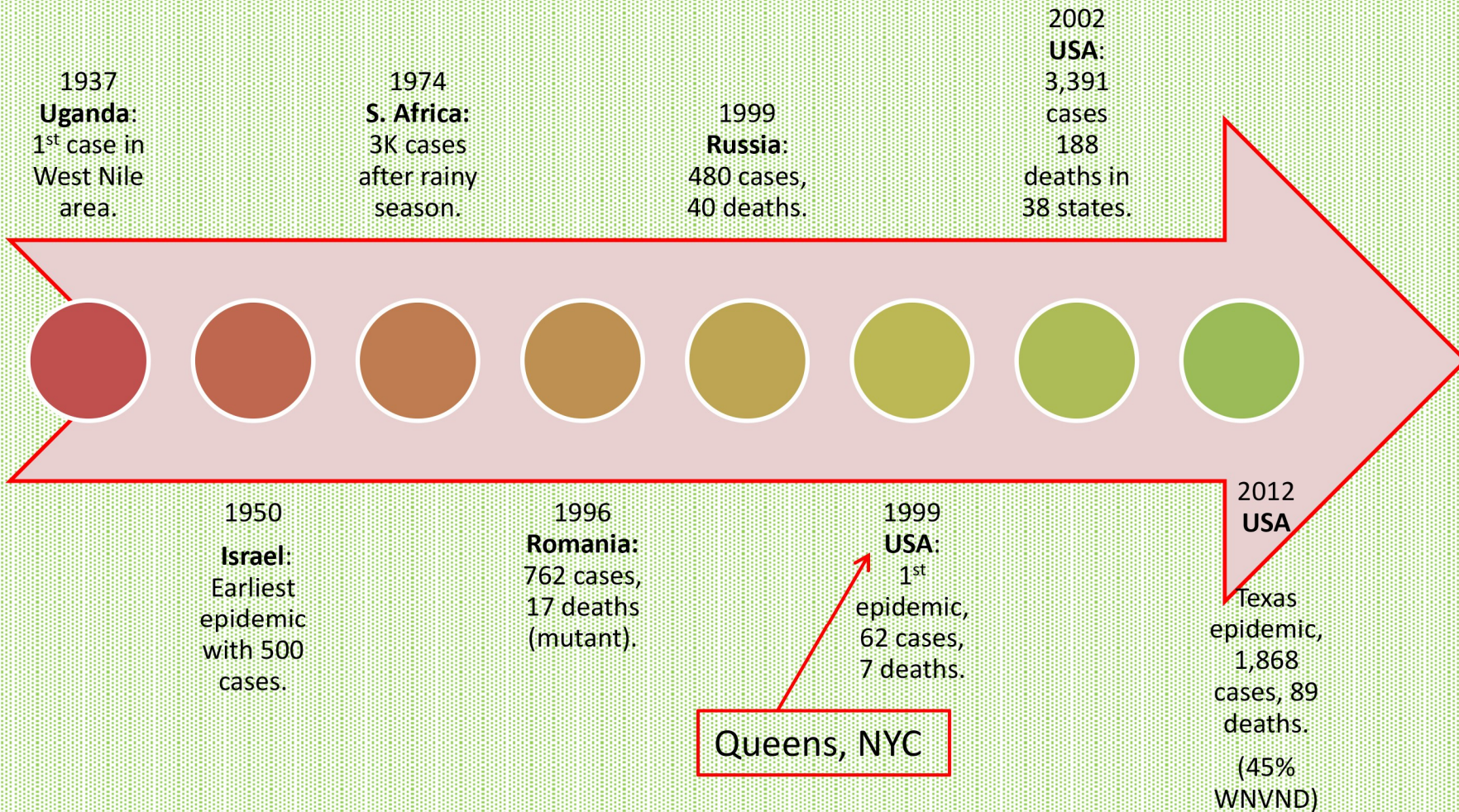






# West Nile Virus

## WNV Timeline







FLY THE FLAG

IDYLLIC Weather, Pages 2, 32

WEDNESDAY, AUGUST 7, 2002

Sports Final

# WEST NILE VIRUS HITS ILLINOIS



West Nile virus is transmitted to humans through mosquito bites. Symptoms include fever, muscle aches and a rash.



This test strip of mosquitoes collected in the Chicago area came back positive for West Nile virus.

## 22-year-old woman is first to contract disease in state

By Dave McKinney  
and Gary Wisny

SPRINGFIELD—Perhaps it came during an evening walk from her car to her house or in the parking lot of a grocery or on her back patio. No one knows for sure when a mosquito unleashed its sting on an unwitting 22-year-old student.

What is known is that nearly two weeks ago, the young woman came down with fever, aching muscles and a slight rash and tested through tests completed Tuesday that she had become the first

Turn to Next Page

*Illinois' first human case of West Nile disease is confirmed on August 6, 2002.*



# West Nile Virus (WNV)

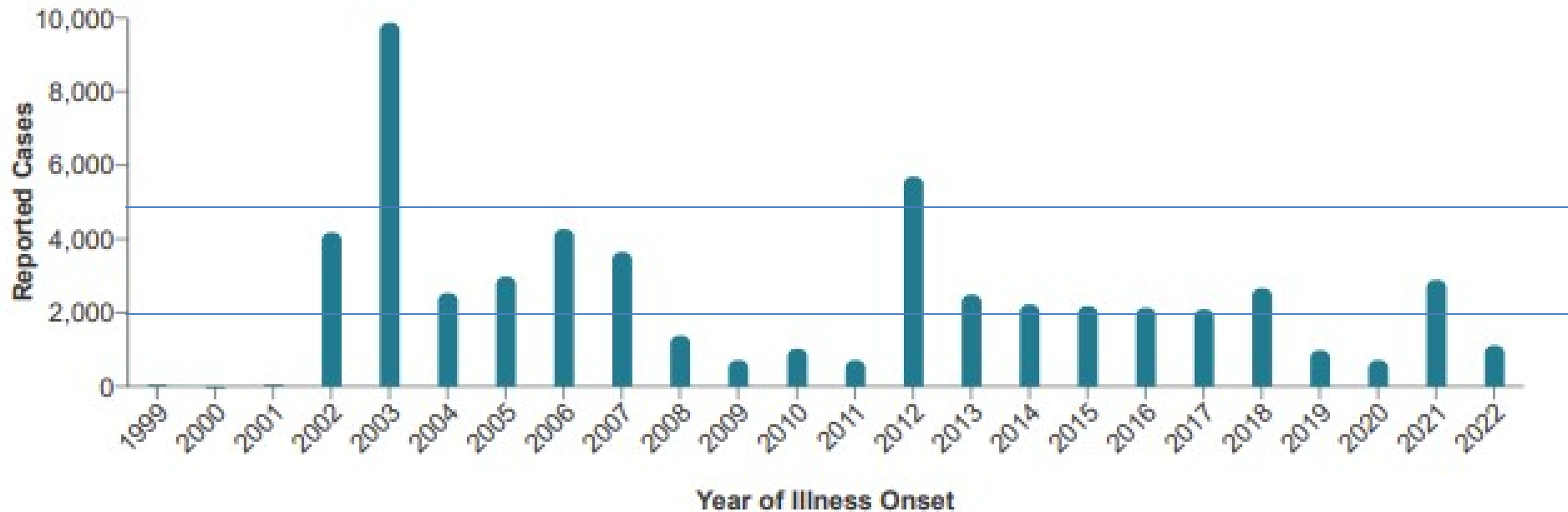
## Etiology

- Most common mosquito-borne disease in the USA.
- Single strand, positive sense, RNA *orthoflavivirus* in the same antigenic sero-complex of Japanese, Murray Valley, Saint Louis, Venezuelan equine and other encephalitides.
- Unlike in birds, it does not spread directly between people and is rarely spread through transfusions, organ transplants, or from mother to baby during pregnancy, delivery, or breastfeeding.
- Phylogenetic studies have shown that West Nile Virus (WNV) emerged as a distinct virus ~1000 years ago.



# USA Incidence WNV

West Nile virus human disease cases by year of illness onset, 1999-2022



# West Nile Virus in USA

2021

- In 2021, there were 2,911 total cases with 2,008 cases (69%) of WNV neuroinvasive disease\*:
  - 1,276 cases of WNVE (63.5%)
  - 602 cases of meningitis WNVM (30.0%)
  - 88 cases of unspecified neurologic illness (4.4%)
  - 42 cases of flaccid paralysis (2.1%) [12 also had WNVE or WNVM]
- A total of 227 deaths were reported (11.3%) with a median age of 75 years.
- In 2021, in Maricopa County, AZ, there were 1,487 cases 1,014 hospitalizations, and 101 deaths (6.8%).



# West Nile Virus in USA

2021

- Arizona reported the largest number of neuroinvasive cases (1,140) and the highest incidence of WNV neuroinvasive disease (15.7 per 100,000 population).
- 3 counties: Maricopa, Pima, and Pinal, accounted for >50% of WNV neuroinvasive disease cases nationwide.
- States with the next highest numbers of WNV disease cases were Texas (130), Colorado (101), California (96), and Nebraska (69).
- Incidence was 60% higher overall among males (0.8) than among females (0.5), and increased with age.

# West Nile Virus in USA (2)

Year	Cases	Deaths	%
1999*	62	7	11
2000	21	2	10
2001	66	10	15*
2002	4,156	284	7
2003	9,862*	264	3
2004	2,539	100	4
2005	3,000	119	4
2006	4,269	177	4
2007	3,623	124	3
2008	1,356	44	3
2009	720	57	4
2010	1,021	57	6

Year	Cases	Deaths	%
2011	712	43	6
2012	5,674	286*	5
2013	2,469	119	5
2014	2,205	97	4
2015	2,175	146	7
2016	2,149	106	5
2017	2,097	146	7
2018	2,647	167	6
2019	958	54	6
2020	731	66	9
2021	2,911	227	8
2022	1,132	93	8
2023	2,556	227	9.4

Ramírez 2024 from CDC 2023 data



# US West Nile Virus Cases

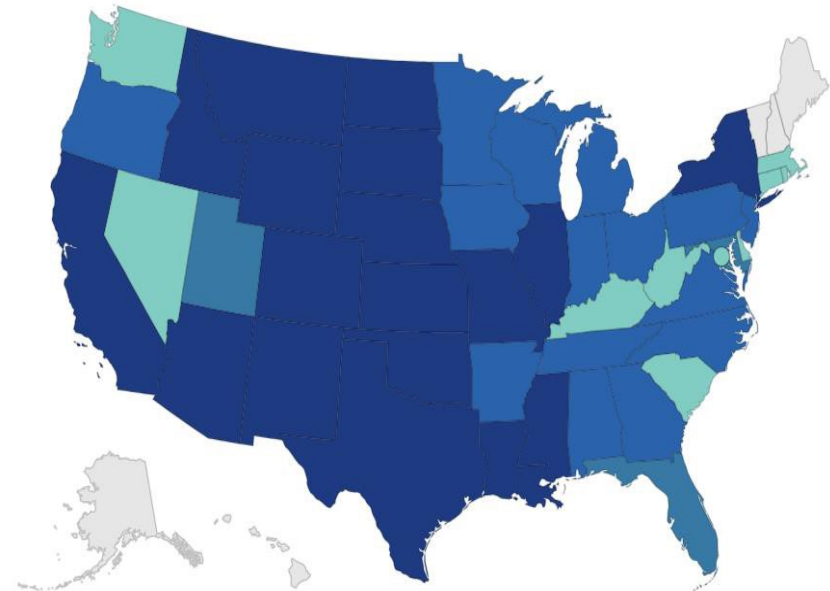
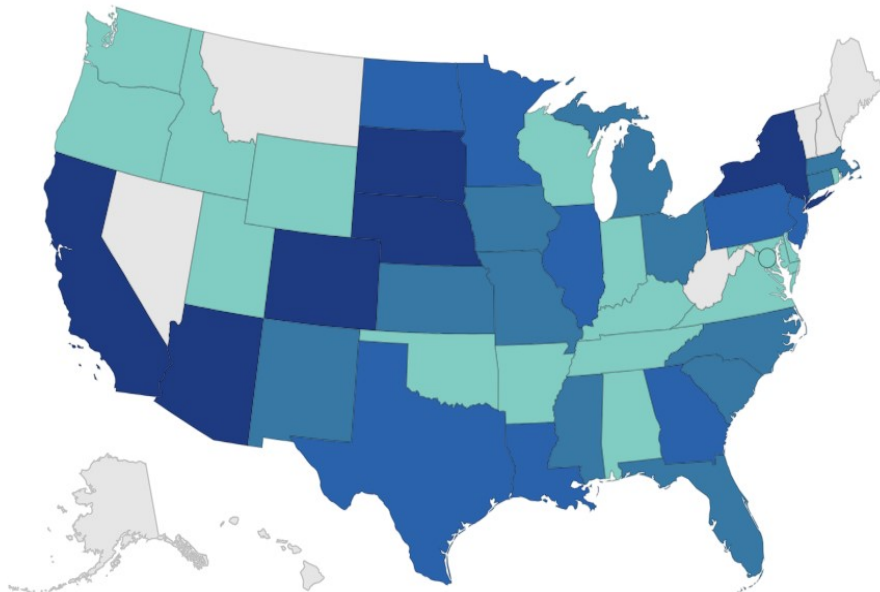
2022

Comparison

2023

West Nile virus human disease cases reported by state of residence, 2022, All disease cases

West Nile virus human disease cases reported by state of residence, 2023



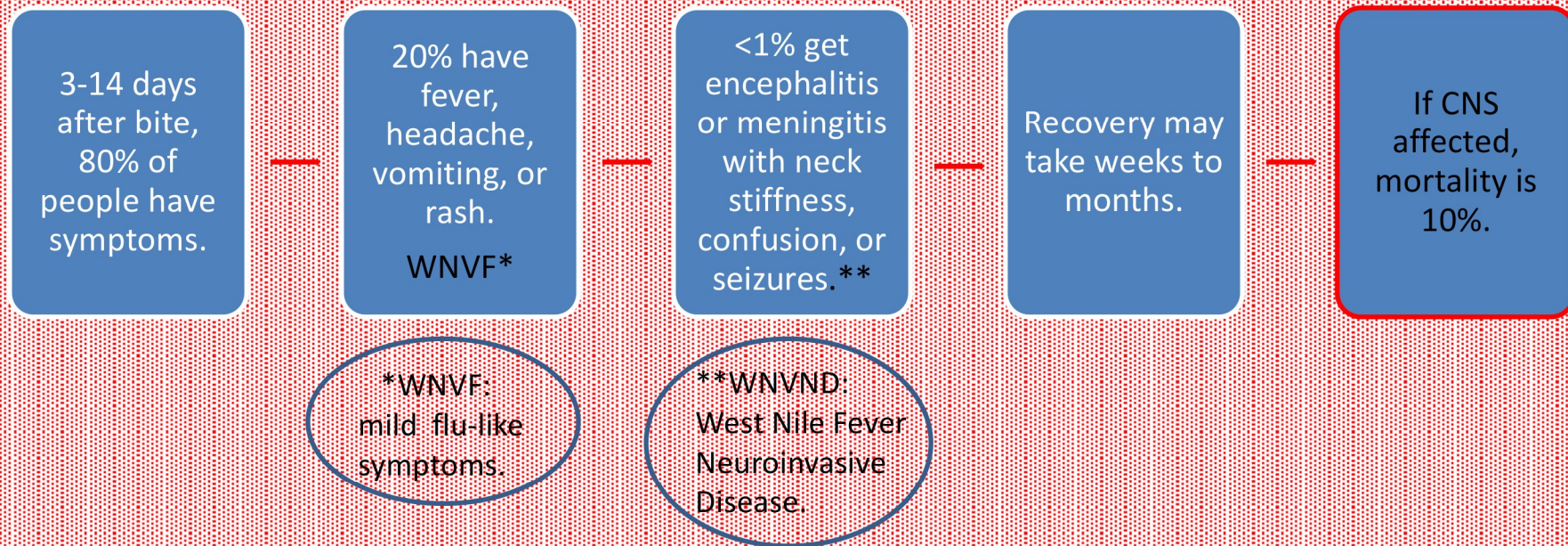
Why the increase?

CDC 2023



# West Nile Virus

## Incubation & Symptoms





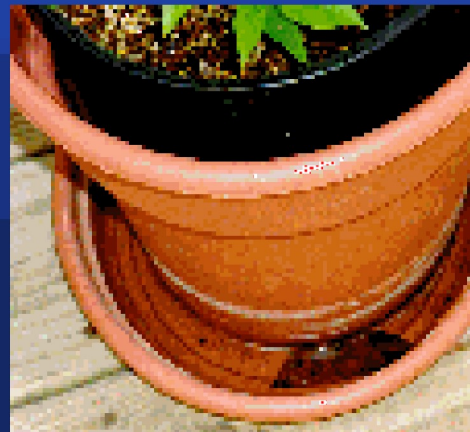
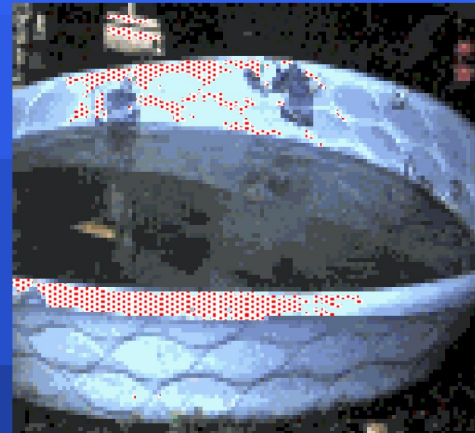
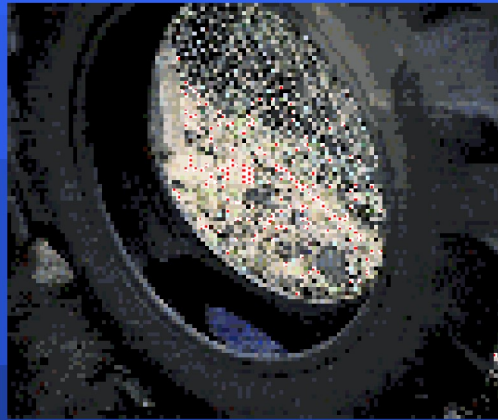
# West Nile Virus

## Prevention

- No vaccine for humans (but yes for horses).
- Reduce infection risk by avoiding mosquito bites.
- Eliminate standing pools of water, like old tires, buckets, gutters, and swimming pools.
- Mosquito repellent, window screens, and mosquito nets reduce the risk of being bitten.



# Mosquito Breeding Sites





# West Nile Virus

## Treatment

- No specific treatment.
- Treat symptomatically.
- Treat complications, especially CNS.
- Prevention is your best treatment.



# West Nile Virus

## WN Virus Complications

- Neuroinvasive Disease (WNVND) <1% :
  - Encephalitis (WNE)
  - Meningitis (WNM)
  - Poliomyelitis (WNP)
- Non-neurologic complications:
  - **fulminant** hepatitis and/or pancreatitis
  - myocarditis or cardiac dysrhythmias
  - rhabdomyolysis
  - orchitis, nephritis
  - skin rashes
  - optic neuritis or chorioretinitis
  - hemorrhagic fever with coagulopathy

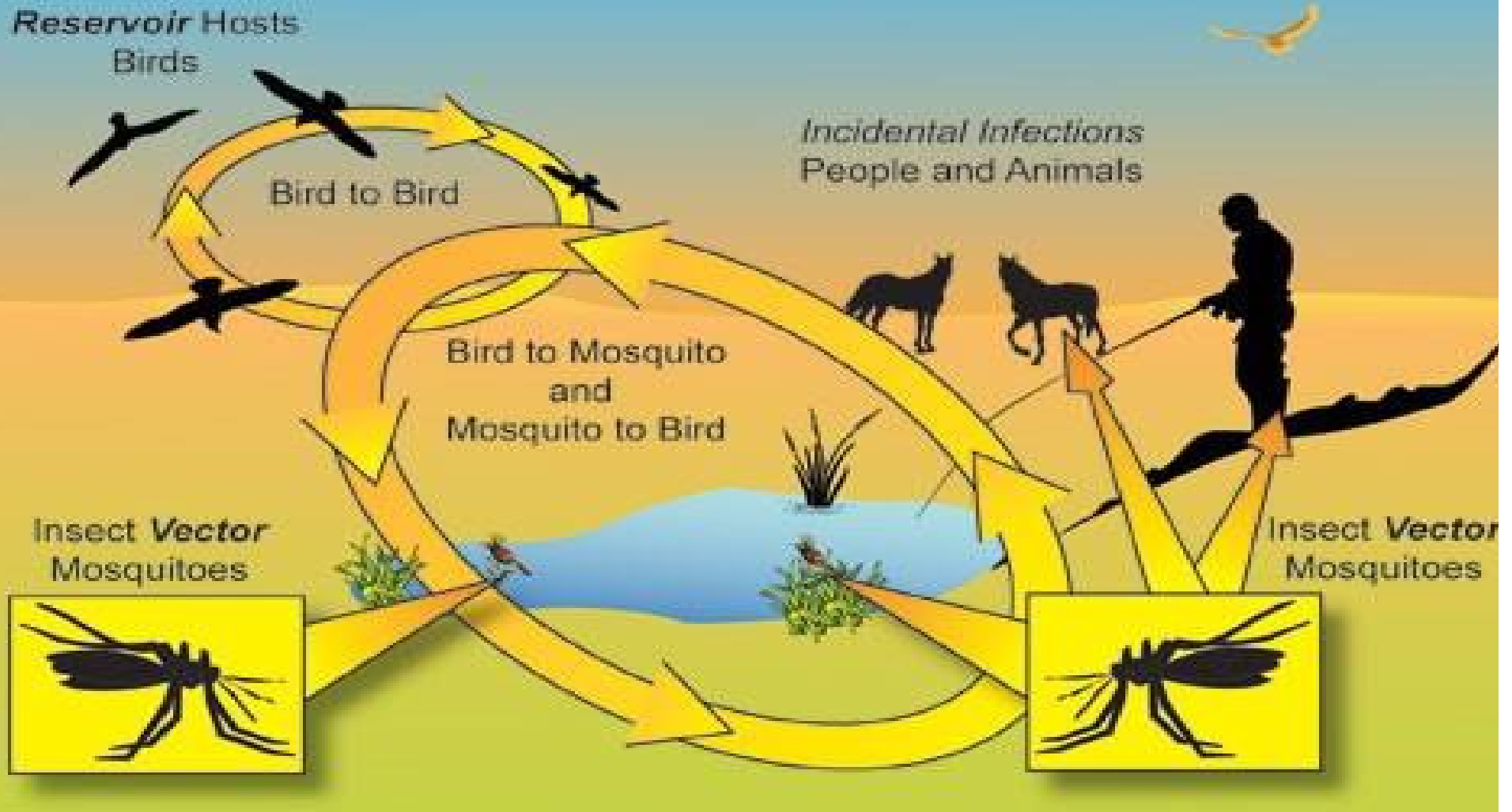


# West Nile Virus

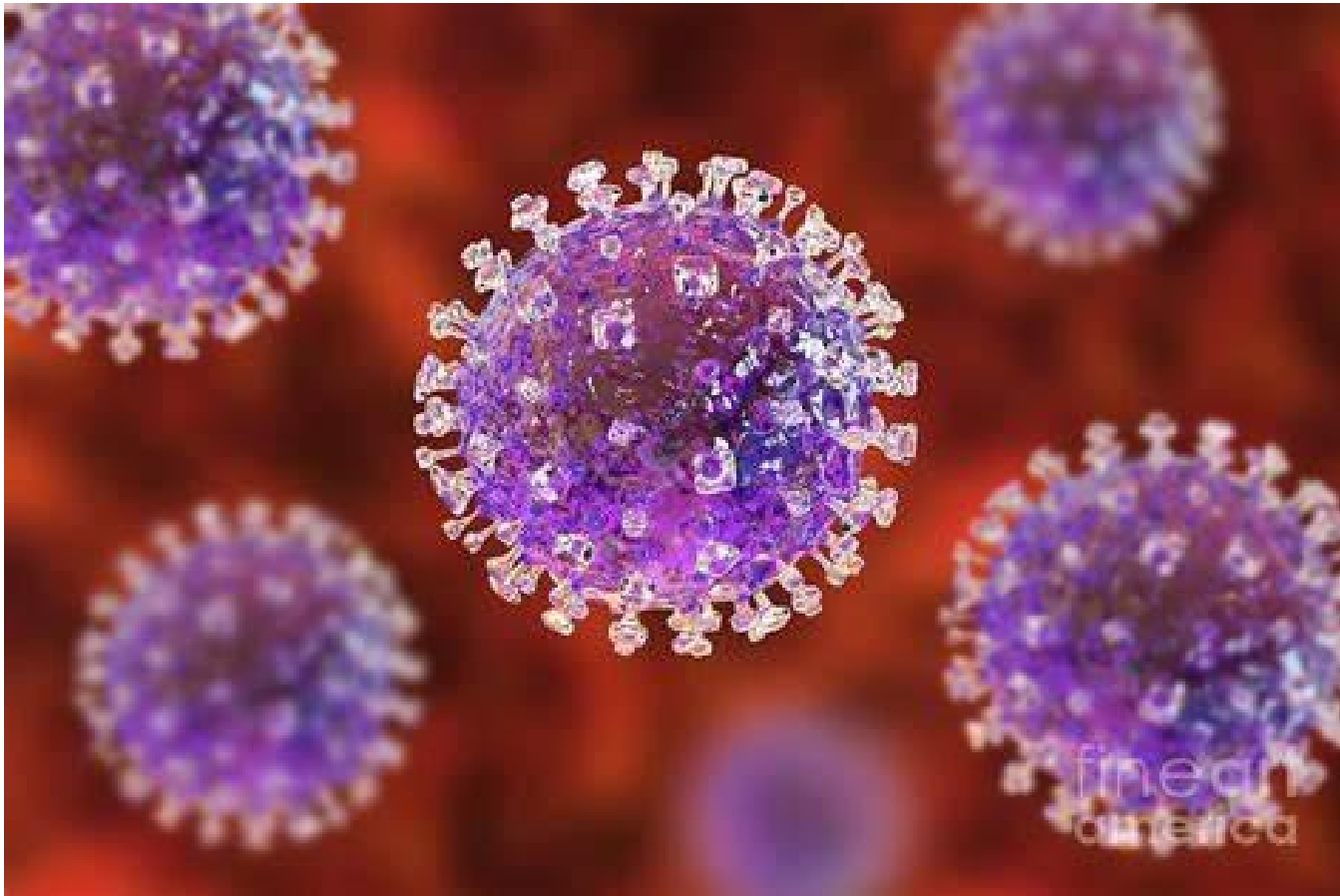
## Vector & Mechanism of Infection

- Mosquitoes of the genus *Culex*:
  - *C. Pipiens*: Eastern US, urban areas north of 36-39°N.
  - *C. Tarsalis*: Midwest and West.
  - *C. Quinquefasciatus*: Southeast.
- WNV vectors prefer members of the thrush family like the American crow and the American robin.
- Infected mosquito bites a healthy bird, the virus amplifies within the bird, an uninfected mosquito bites the bird and now the mosquito is infected.
- Bird may die gradually or suddenly in 10-14 days.

# West Nile Virus Transmission Cycle







# NIPAH VIRUS

# Nipah Virus (NiV)

- Human infections:
  - asymptomatic
  - 3-14 days of fever, headache, cough, myalgia, vomiting, sore throat
  - acute respiratory infection with difficulty breathing
  - dizziness, drowsiness, altered consciousness, seizures
  - fatal acute encephalitis leading to coma within 24 to 48 hours
- Death in 40-75% of cases
- Most survivors make a full recovery, but relapses or long-term persistent convulsions and personality changes can happen.



# Nipah virus (NiV)

- drinking raw palm sap (palm toddy) contaminated by bat urine
- eating fruits partially consumed by bats
- using water from wells infected by bats

# Nipah virus (NiV)





# Nipah virus (NiV)



# Nipah Virus (NiV)

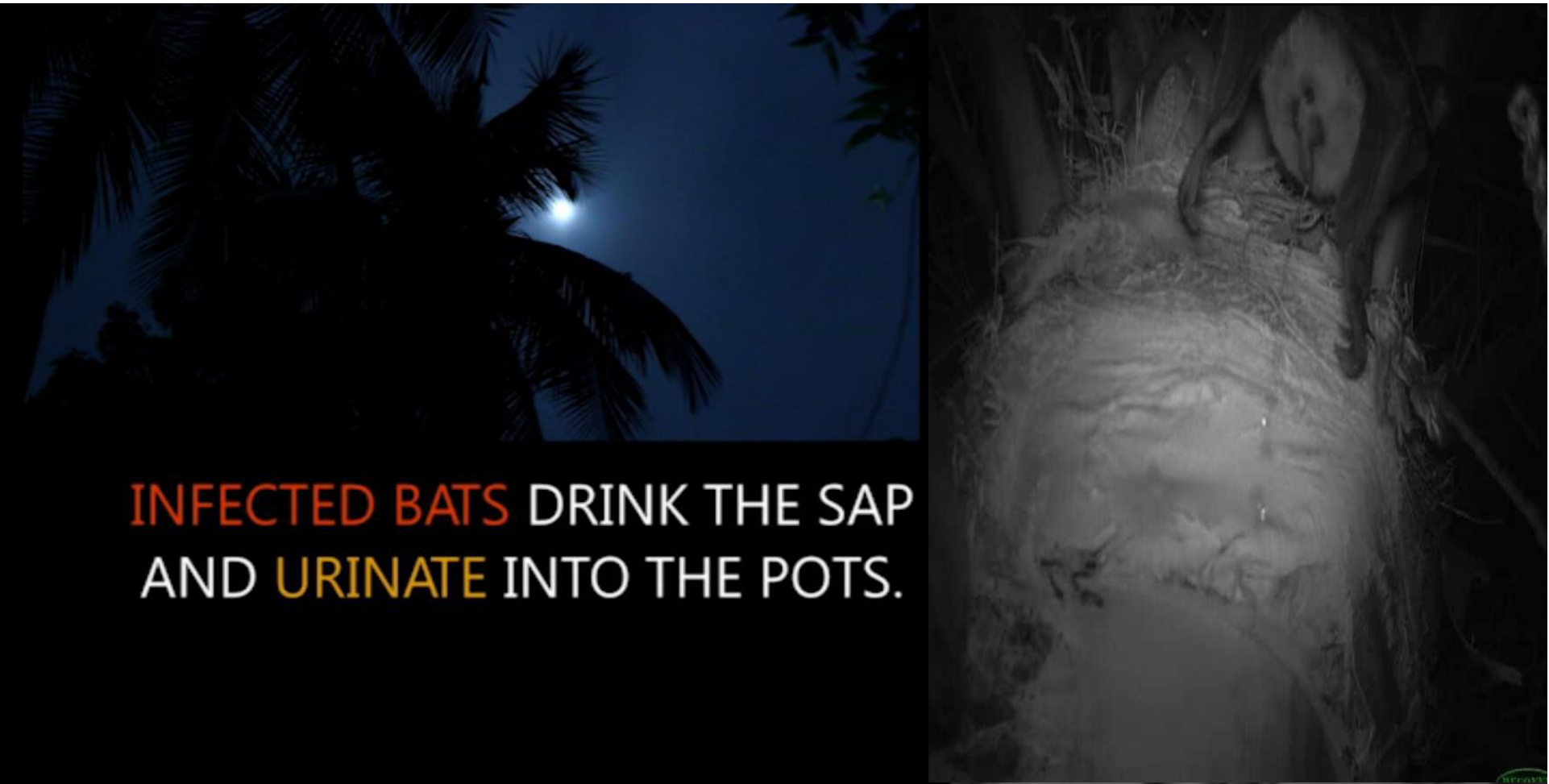


IT DRIPS OUT OF THE TREE INTO A CLAY POT.





# Nipah virus (NiV)



# Nipah virus <sup>(6)</sup>

WHEN PEOPLE DRINK THE **SAP**  
THEY MAY CATCH **NIPAH**  
AND DIE.





# Corona Viruses

Related strains:

SARS, MERS, COVID-19



Severe Acute Respiratory Syndrome

# SARS



# CORONA VIRUSES (1)

## SARS

- Severe acute respiratory syndrome (SARS) is a zoonotic origin virus called SARS-CoV or SARS-CoV-1.
- Caused the 2002–2004 SARS outbreak.
- In 2017, Chinese traced the virus through Asian palm civets to cave-dwelling horseshoe bats in Yunnan.
- At end of the epidemic in June 2003, the incidence was 8,422 cases with a case fatality rate (CFR) of 11%.

No cases of SARS-CoV have been reported since 2004.

# Civet cats and SARS

- A sarbecovirus circulating in horseshoe bats seeded the progenitor of SARS-CoV in an intermediate animal host, most probably civet cats.
- Other possible intermediate hosts for SARS-CoV were identified, like raccoon dogs and badgers, for sale with civet cats in animal markets.
- However, civet cats within markets were the conduits of transmission to humans from the horseshoe bat, but were not reservoirs of SARS-CoV.



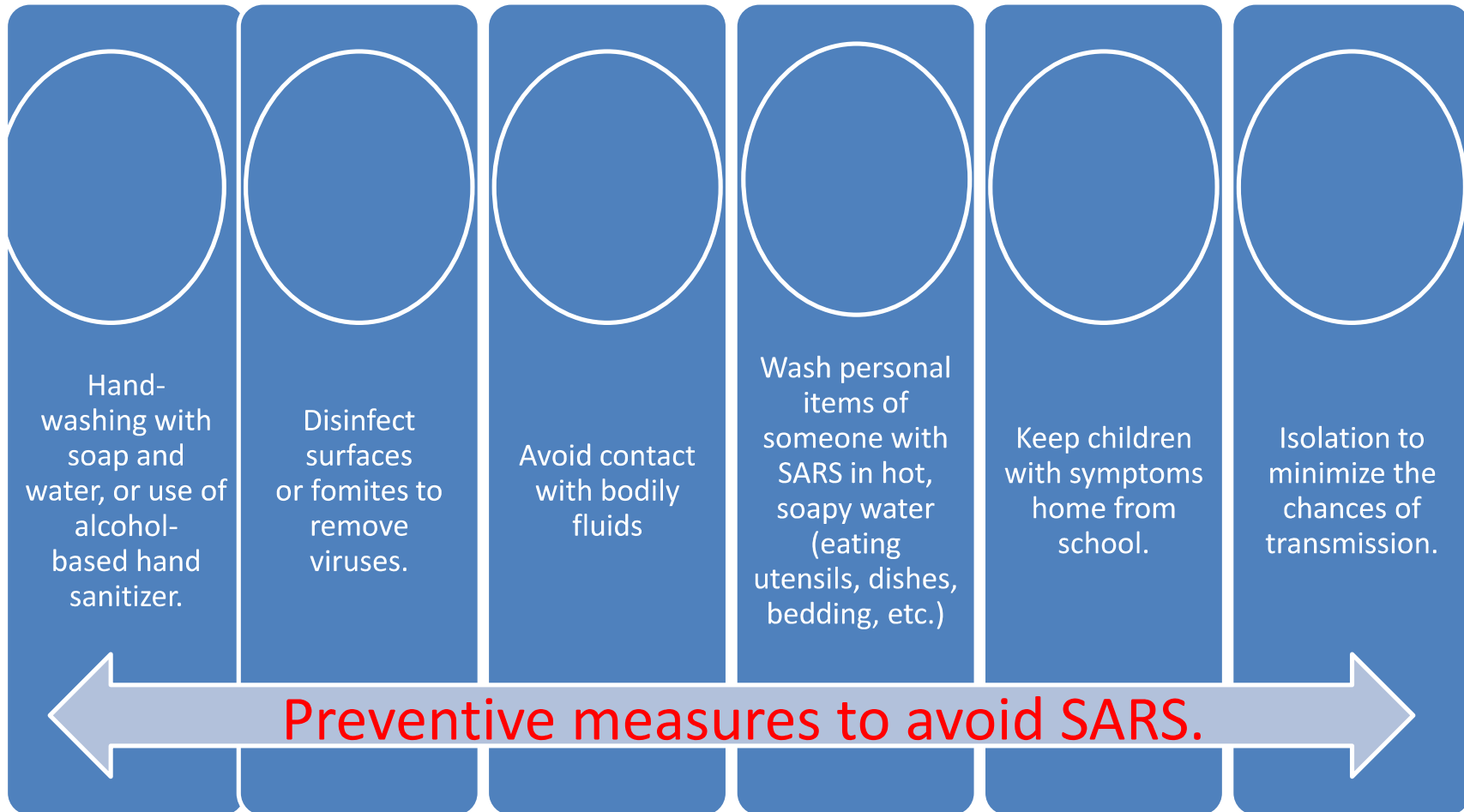
# CORONA VIRUSES (2)

## SARS

- flu-like symptoms: fever, muscle pain, lethargy, cough, sore throat, diarrhea and other nonspecific symptoms
  - common to all patients is a fever above 100 °F
  - may lead to shortness of breath and pneumonia; either viral or secondary bacterial pneumonia
- average incubation is 4–6 days (range 1 to 14)
  - transmission is through respiratory droplets or fomites
  - $R_0$  ranges from 2 to 4 depending on different analyses
  - control measures in April 2003 reduced  $R_0$  to 0.4

# CORONA VIRUSES (3)

## SARS Prevention





# Corona Viruses <sup>(4)</sup>

## SARS Treatment

- Symptomatic only.
- Antibiotics only for 2<sup>ndary</sup> bacterial infections.
- Antivirals like ribavirin, lopinavir, ritonavir, type I interferon, have not been useful.
- British recommend corticosteroids in severely ill patients with O<sub>2</sub> saturation of <90%.
- No vaccine available.

# MERS-CoV





# CORONA VIRUSES (5)

## MERS (Other Names)

- Other Names:
  - **M**iddle **E**ast **R**espiratory **S**yndrome
  - the “Camel flu”
  - Saudi Arabia’s SARS-like virus
- MERS-CoV is a single strand coronavirus believed to come originally from bats.

# CORONA VIRUSES (6)

## MERS Symptoms

- Symptoms: none to mild to severe:
  - fever: 98%
  - cough: 83%
  - diarrhea: 26%
  - vomiting 21%
  - abdominal pain 17%
  - shortness of breath (SOB): 72%
  - myalgia: 32%
- 72% required mechanical ventilation



# CORONA VIRUSES (7)

## MERS Symptoms & Complications

- incubation of 5.5 days (range 2 to 15)
- high incidence of severe pneumonia and respiratory failure
- ECMO useful in improving outcomes
- neither combination of antivirals and interferons nor corticosteroids improved outcomes

# CORONA VIRUSES (8)

## MERS Transmission (a)

- Unclear how virus goes from camels to humans.
- WHO advises:
  - avoiding contact with camels
  - eating only fully cooked camel meat
  - drinking only pasteurized camel milk
  - avoid drinking camel urine
- Limited evidence of spread of MERS-CoV from person to person in households and in hospitals, but no evidence of transmission from asymptomatic cases.



# CORONA VIRUSES <sup>(9)</sup>

## MERS Transmission <sup>(b)</sup>

- humans are typically infected from camels, either during direct contact or indirectly
- Saudi Ministry of Agriculture advises wearing masks when around camels
- some people have refused to listen to the government's advice, and in defiance, kiss their camels

# CORONA VIRUSES (10)

## MERS

- first case in June 2012 in Saudi Arabia
- most cases have occurred in the Arabian Peninsula
- about 35% of those diagnosed die from it
- large outbreaks have occurred in South Korea in 2015 and in Saudi Arabia in 2018



# MERS 2023 DATA

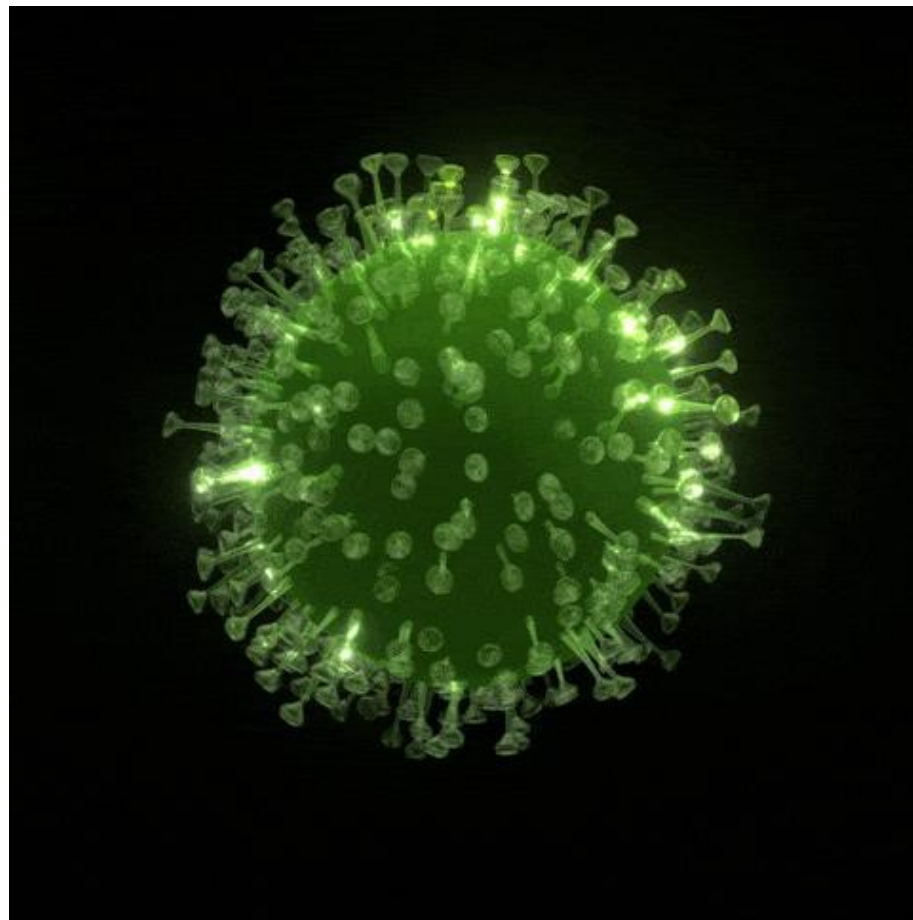
- Since the beginning of 2023, there have been 2 new MERS-CoV cases reported, with 1 case each in the United Arab Emirates and Saudi Arabia.
- Globally, from April 2012 until January 2024, a total of 2,605 laboratory-confirmed MERS cases have been reported, causing 937 deaths (43%).
- Most cases were reported in Saudi Arabia, with 2,196 cases and 856 related deaths (39%).

# Summary

Virus	Vector	Treatment	Vaccine	Fatality
CHIKV	Aedes mosquitoes	Symptomatic	No	0.1%
Dengue	Aedes mosquitoes	Symptomatic	Tetravalent	10%
MERS	Camel	Symptomatic	No	35%
SARS	Rat/Civet?	Symptomatic	No	11%
West Nile	Culex mosquitoes	Symptomatic	No	3-15%

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# COVID19 (SARS CoVID-2)

# COVID-19

- Spillover from bats to pigs?
- Very rapid respiratory transmission
- Preventive measures politicized in USA and other countries
- Loss of faith in health institutions
- Incomplete/erroneous knowledge



# $R_0$ of COVID-19

- The estimated  $R_0$  (basic reproduction number) of COVID-19 is generally believed to be between 2 and 3.
- However,  $R_0$  can change based on factors like public health measures and people's behavior.
- It's important to follow guidelines like wearing masks, practicing social distancing, and getting vaccinated to help control the virus's spread.

# WHO COVID-19 Stats

As of 27 March 2024, global numbers:

- Total Confirmed Cases: 704,489,005
- Total Deaths: 7,008,101 (9.9%)
- Total Recovered: 675,328,148
- Currently Infected Patients: 22,152,756
  - in mild condition 22,117,696 (99.8%)
  - serious or critical 35,060 (0.2%)

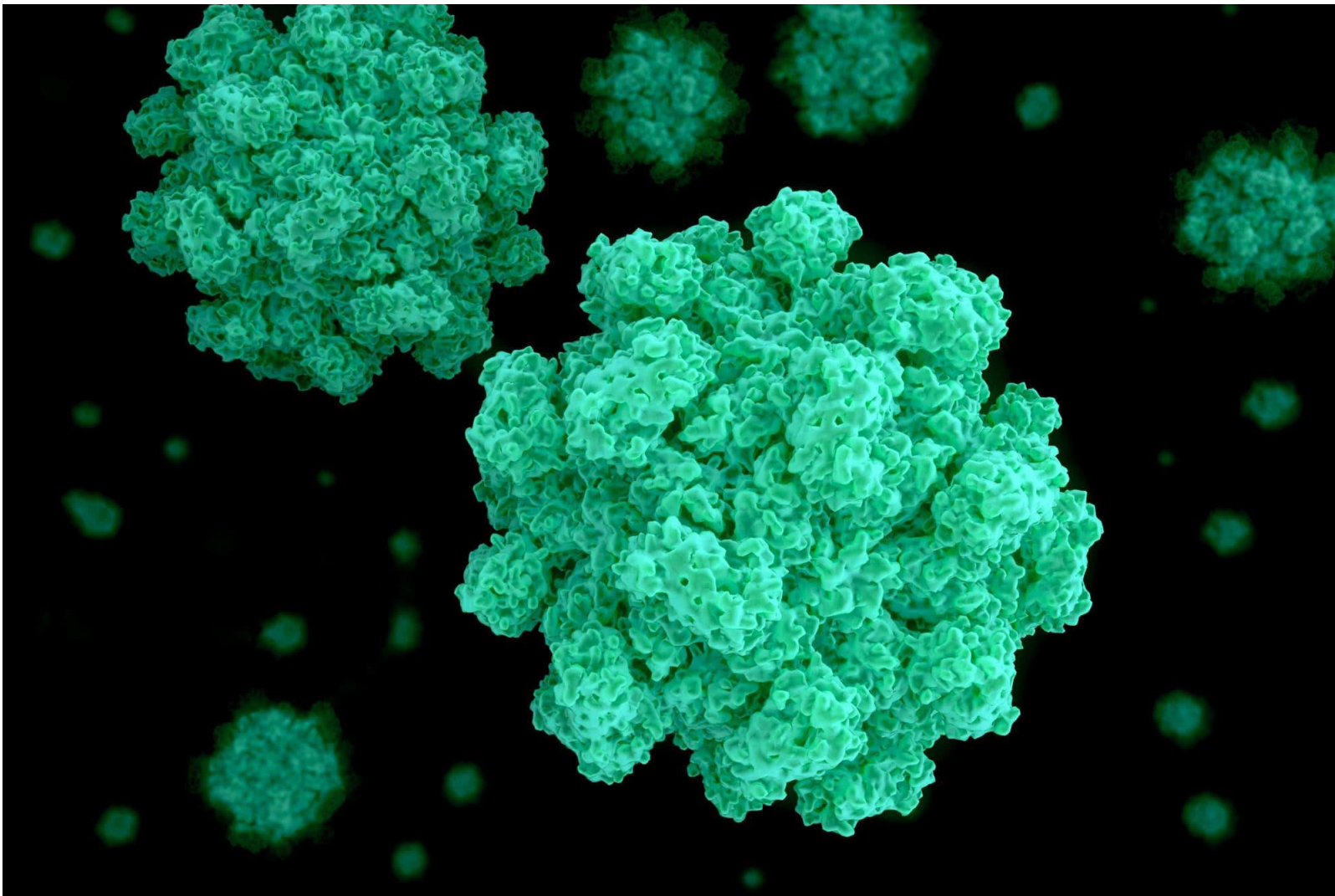


# WHO COVID-19 Stats

As of 27 March 2024, by region:

Region	Cases	Deaths	Recovered
North America	131,789,367	1,694,524 (1.3%)	127,468,084
Asia	221,477,737	1,553,389 (0.71%)	205,666,029
Europe	253,317,367	2,101,166 (8.3%)	248,661,763
South America	70,108,311	1,366,810 (1.95%)	66,650,237
Oceania	14,874,197	32,904 (0.22%)	14,729,553
Africa	12,860,292	258,884 (2.01%)	12,090,791

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# NOROVIRUS



# NORO virus

- Named after the city of Norwalk, Ohio, where an outbreak occurred in 1968.
- Also known as the “cruise-ship virus” or the “winter vomiting bug”.
- Symptoms are non-bloody diarrhea, stomach pain, vomiting, fever or headaches, usually develop 12 to 48 hours after exposure, and patients typically recover within 1 to 3 days.

# NORO Virus



- It is common both in the developed and developing world.
- Causes 685M cases of disease and 200K deaths (0.03%) globally per year.
- Those under the age of 5 are most often affected, and in this group it results in about 50K deaths in the developing world.

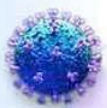





# NORO virus in US

- Sickens about 21M Americans (6% of the population) every year, normally peaking around February & March.
- About 109K are hospitalized, and 900 (0.83%) die.
- Occurs more commonly during winter months, often in outbreaks, mostly among those living in close quarters.
- Cause of about half of all foodborne disease outbreaks.



**COVID-19**      **Symptoms**      **Norovirus**  
**VS**



Loss of taste or smell                  Abdominal pain



Cough                  Vomiting & Nausea

Runny nose                  Diarrhea

**Both**

      Chills      

      Fever      

      Headache      



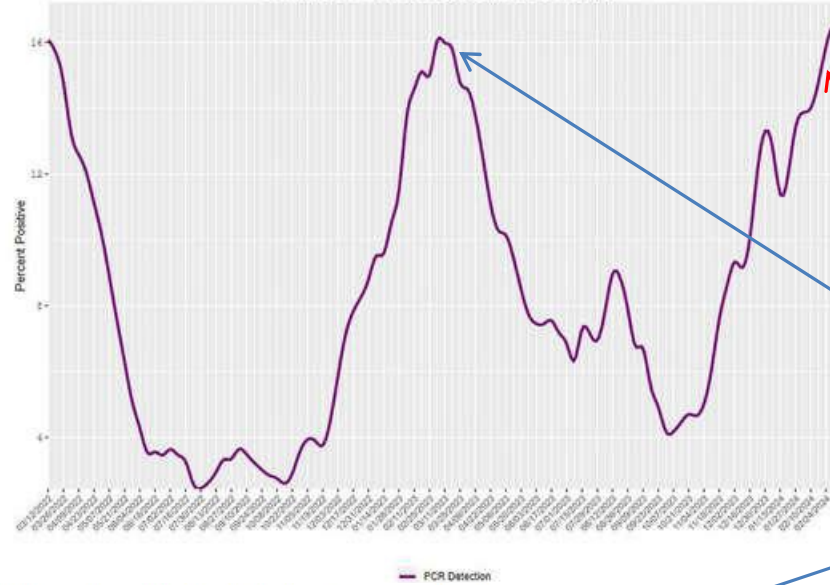
# Norovirus Outbreaks

2023-2024

- Defined as an occurrence of 2 or more similar illnesses resulting from a common exposure that is either suspected or laboratory-confirmed to be caused by norovirus.
- During August 1, 2023–February 12, 2024, there were 759 norovirus outbreaks reported by NoroSTAT-participating states.
- During the same period last seasonal year, there were 521 norovirus outbreaks reported by these states.
- Positive tests are going up fastest in the South, surging by nearly 10 percent in just four months.

# Northeastern United States Census Region

Norovirus for Census Region 2 (3 week average)



The numbers are % positive PCR tests. Peaks occurred in:

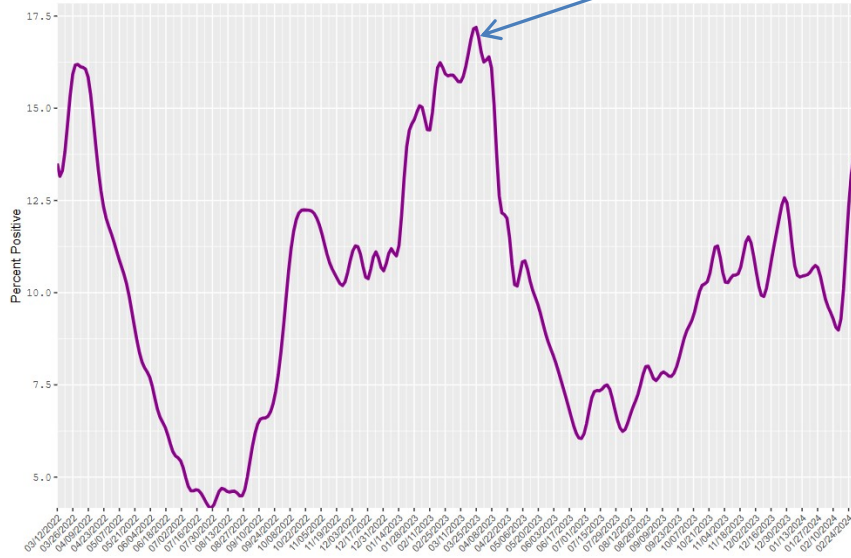
January 2023

March 2023

February 2024

# Midwestern United States Census Region

Norovirus for Census Region 3 (3 week average)





# Final Questions?



# We Are at the Cusp!





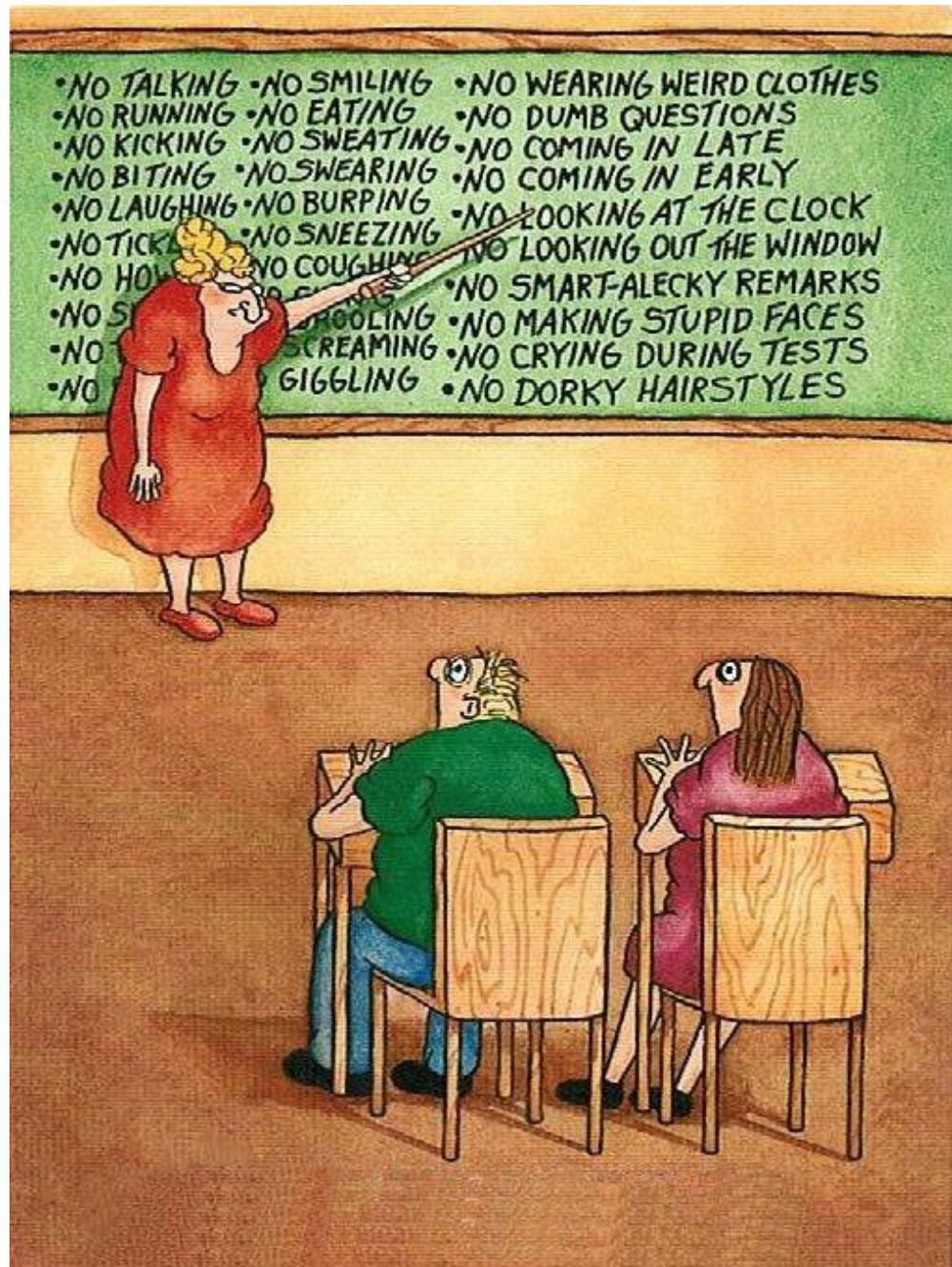
# Next Week

- Session 1 February 27<sup>th</sup> : Definitions, Biblical Plagues.
- Session 2 March 5<sup>th</sup> : The PLAGUE through time, new theories.
- Session 3 March 12<sup>th</sup> : Other Infectious Pestilences
- Session 4 March 19<sup>th</sup> : The Columbian Exchange.
- Session 5 March 26<sup>th</sup> : 20<sup>th</sup> Century Pandemics, past & current.
- Session 6 April 2<sup>nd</sup> : HIV/AIDS, new treatments.
- Session 7 April 9<sup>th</sup> : 20<sup>th</sup> and 21<sup>st</sup> Century Viruses.
- **Session 8 April 16<sup>th</sup> : Crystal ball into the future?**





# Some Housekeeping Rules Before We Begin



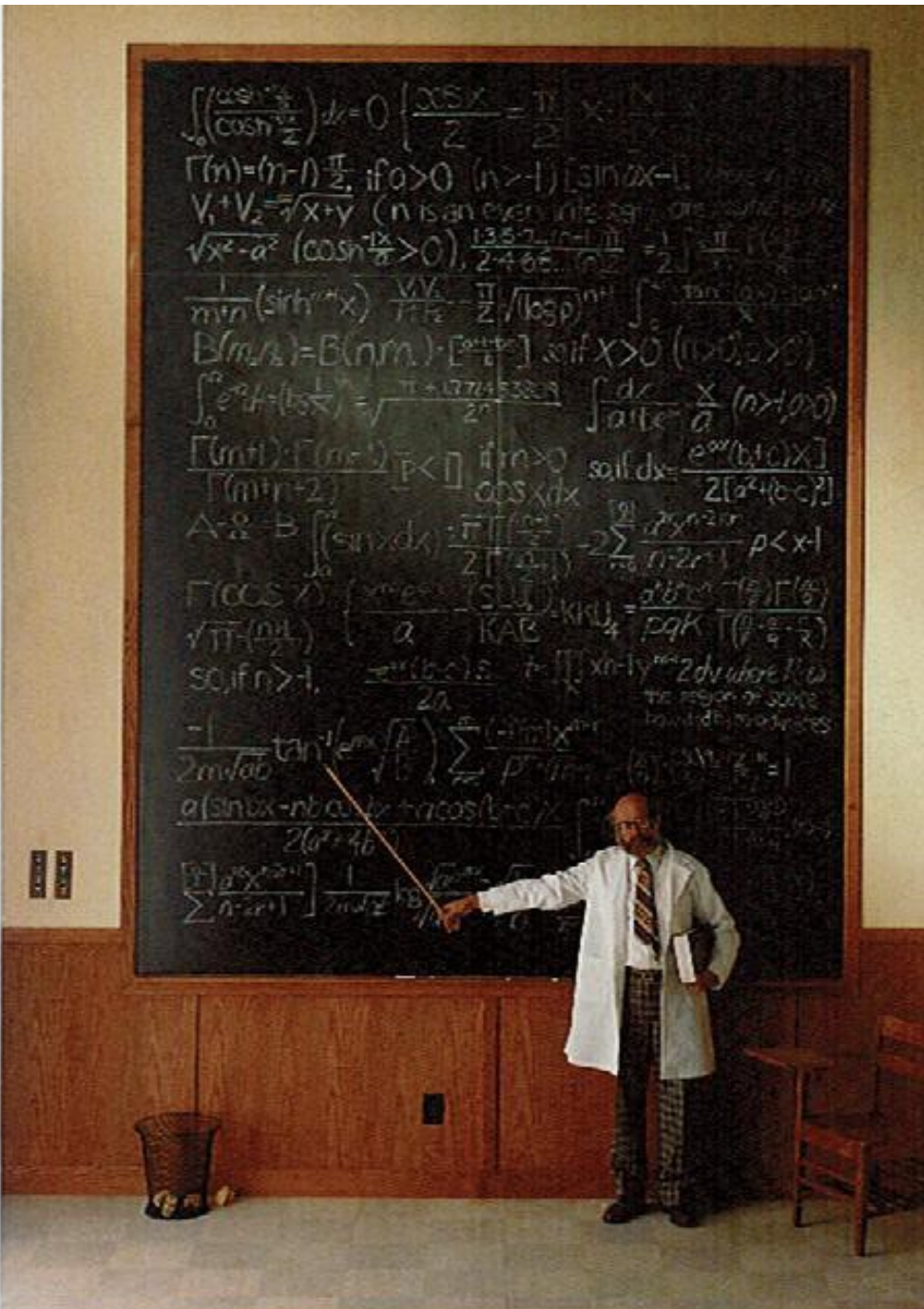
- NO TALKING
- NO SMILING
- NO WEARING WEIRD CLOTHES
- NO RUNNING
- NO EATING
- NO DUMB QUESTIONS
- NO KICKING
- NO SWEATING
- NO COMING IN LATE
- NO BITING
- NO SWEARING
- NO COMING IN EARLY
- NO LAUGHING
- NO BURPING
- NO LOOKING AT THE CLOCK
- NO TICKING
- NO SNEEZING
- NO LOOKING OUT THE WINDOW
- NO HOWLING
- NO COUGHING
- NO SMART-ALECKY REMARKS
- NO SLEEPING
- NO SCREAMING
- NO MAKING STUPID FACES
- NO CRYING DURING TESTS
- NO GIGGLING
- NO DORKY HAIRSTYLES

April 9, 2024

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Illinois

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I'll try to keep it simple!





Hope You Get  
a Charge  
From Today's  
Session!

of