



The image features a pair of rich red, draped curtains that frame a central white space. The curtains are gathered at the top and bottom, creating a classic stage-like opening. The text is centered within this white space.

Plagues, Pestilences Poxes and Pandemics

OLLI Fall 2020

Session 3:

Other Infectious Pestilences

Session Outline

- Viruses vs Bacteria, contrasts and similarities.
- Historically important diseases:
 - Polio (viral without vector).
 - Cholera (bacterial).
 - Yellow Fever (viral with vector).
 - Malaria (parasitic with vector).

Course Overview

- Session 1 Sept. 1: Definitions, Biblical Plagues.
- Session 2 Sept. 8: The PLAGUE through time & place.
- **Session 3 Sept. 15: Other Infectious Pestilences.**
- Session 4 Sept. 22: The Columbian Exchange.
- Session 5 Sept. 29: 20th Century Pandemics.
- Session 6 Oct. 6: HIV/AIDS
- Session 7 Oct. 13: 20th and 21st Century Viruses.
- Session 8 Oct. 20: Corona and other Coming plagues(?)

A detailed microscopic image showing a variety of microorganisms. In the foreground, a large, complex virus with a spherical head and numerous long, thin tail-like structures is prominent. Surrounding it are several rod-shaped bacteria of varying lengths and thicknesses, some with rounded ends. Other smaller, simpler viruses and bacterial forms are scattered throughout the field of view. The background is a dark, textured green, suggesting a biological or cellular environment.

Differences
Similarities

VIRUSES AND BACTERIA

Virus vs Bacteria

Virus

- Require a living cell.
- Cannot self-replicate.
- Made up of DNA or RNA.
- From Latin: “poison”.
- 20-400 nm (billionth).
- No self-propulsion.
- Do not need oxygen.
- Antibiotics won't work.

Bacteria

- Unicellular micro organisms.
- Can self-replicate.
- Reproduce by cell division.
- From Latin: “little stick”.
- 1000 nm (billionth).
- May self-propel.
- May/may not need oxygen.
- Antibiotics may work.

Diseases

Viral

- Measles.
- Smallpox.
- Yellow fever.
- HIV/AIDS.
- Influenza.
- Polio.
- Herpes.
- Hepatitis. (A, B, C and D).

Bacterial

- Syphilis, Gonorrhea.
- Plague.
- Whooping cough.
- Rabies.
- Tuberculosis & Leprosy.
- Anthrax.
- Typhus & Typhoid Fever.
- Botulism.

Any organ system could have bacterial or viral infections.

Viruses

Similarities

DNA Virus

- Obligate parasites.
- Contain protein capsids.
- Disease in many species.
- Naked or enveloped.
- Single or double strands.

RNA Virus

- Obligate Parasites.
- Contain protein capsids.
- Disease in many species.
- Naked or enveloped.
- Single or double strands.

Both DNA and RNA can not be found in same virus.

Viruses

Differences

DNA Virus

- Pass DNA into cell nucleus.
- Low mutation level.
- DNA polymerase stable.
- 2-step viral protein process.
- Larger.
- 2-strand most common.
- Accurate replication.

RNA Virus

- Passes RNA into cytoplasm.
- High mutation level.
- RNA Polymerase unstable.
- 5 Viral proteins in 1 step.
- Smaller.
- Single strand most common.
- Error-prone replication.

Session 3 Working Plan

For Each Disease:

- Name and meaning.
- Nature of infection.
- Transmission.
- Morbidity and Mortality.
- Distribution.
- Prophylaxis/Prevention.
- Treatment.
- Looking to the future?
- Effect on USA.



Viral Without Vector

POLIO

Name & Meaning

- Has had various names:
 - “Debility of the lower extremities”.
 - Heine-Medin’s disease.
 - Infantile spinal paralysis.
- Medical name: poliomyelitis
 - From the Greek “*polios*” = gray, “*myelos*” = marrow, and the Latin “*itis*” = inflammation.
 - Means: inflammation of nerve roots.
- Reporters and headline writers trimmed to “Polio”.

Nature of Infection

- Poliovirus (PV) RNA enterovirus (intestinal).
- 3 Types: PV1, PV2, and PV3.
- Highly infectious, fecal-oral route.
- Mostly seasonal in warm, humid weather.

Transmission

- Occurs naturally only in humans.
- Food or water containing human feces.
- Less commonly from infected saliva.
- Infected persons may spread it for up to 6 weeks.
- Asymptomatic transmission may occur.

Morbidity & Mortality ⁽¹⁾

Symptoms:

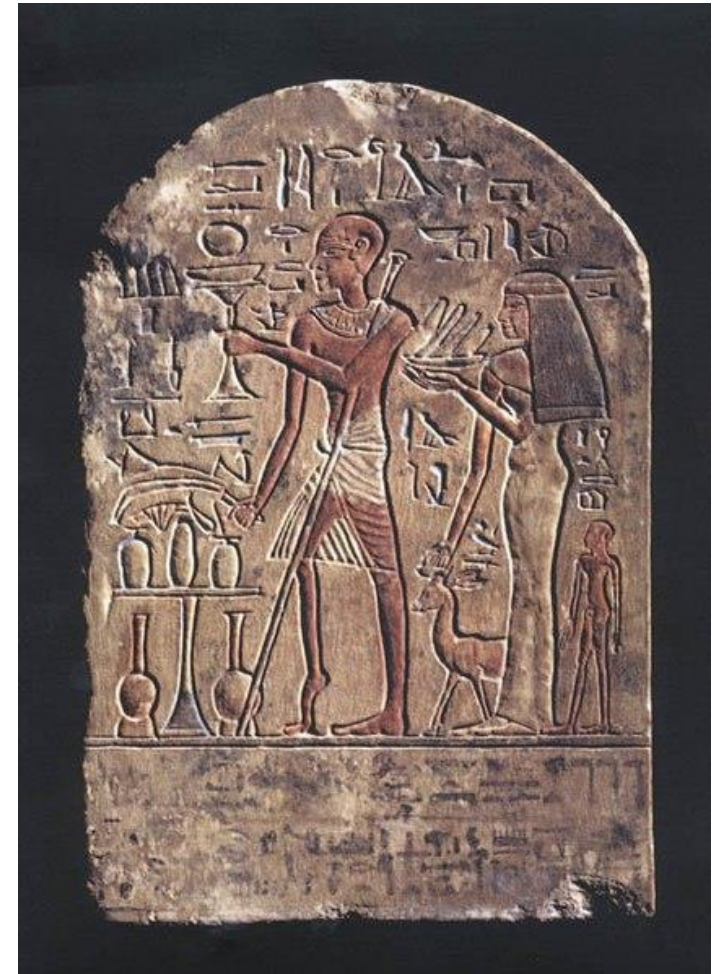
- 70 % asymptomatic.
- 25 %: minor symptoms (fever, sore throat).
- 5 %: headache, neck stiffness, leg & arm pains.
- In ~0.5 percent of cases, it moves from the gut to affect the Central Nervous System.

Morbidity & Mortality (2)

- Muscle weakness → flaccid paralysis:
 - 2 - 5% of children die.
 - 15 - 30 % of adults die.
- Rest back to normal within 1 - 2 weeks.
- Many people appear to recover fully.
- Years after, *post-polio syndrome* may occur.

Distribution

- Existed since antiquity
- Worldwide.
- Currently endemic only in Afghanistan and Pakistan.
- Eradicated elsewhere.



Prophylaxis/Prevention

- Oral Polio vaccine in 3 serotypes.
- Reduced the number reported cases/year from 350,000 in 1988 to 33 in 2018.
- Safe in pregnancy and HIV/AIDS.
- 3 cases of vaccine-associated paralytic polio per million doses, compared with 5,000 cases per million paralyzed after a polio infection.

Treatment

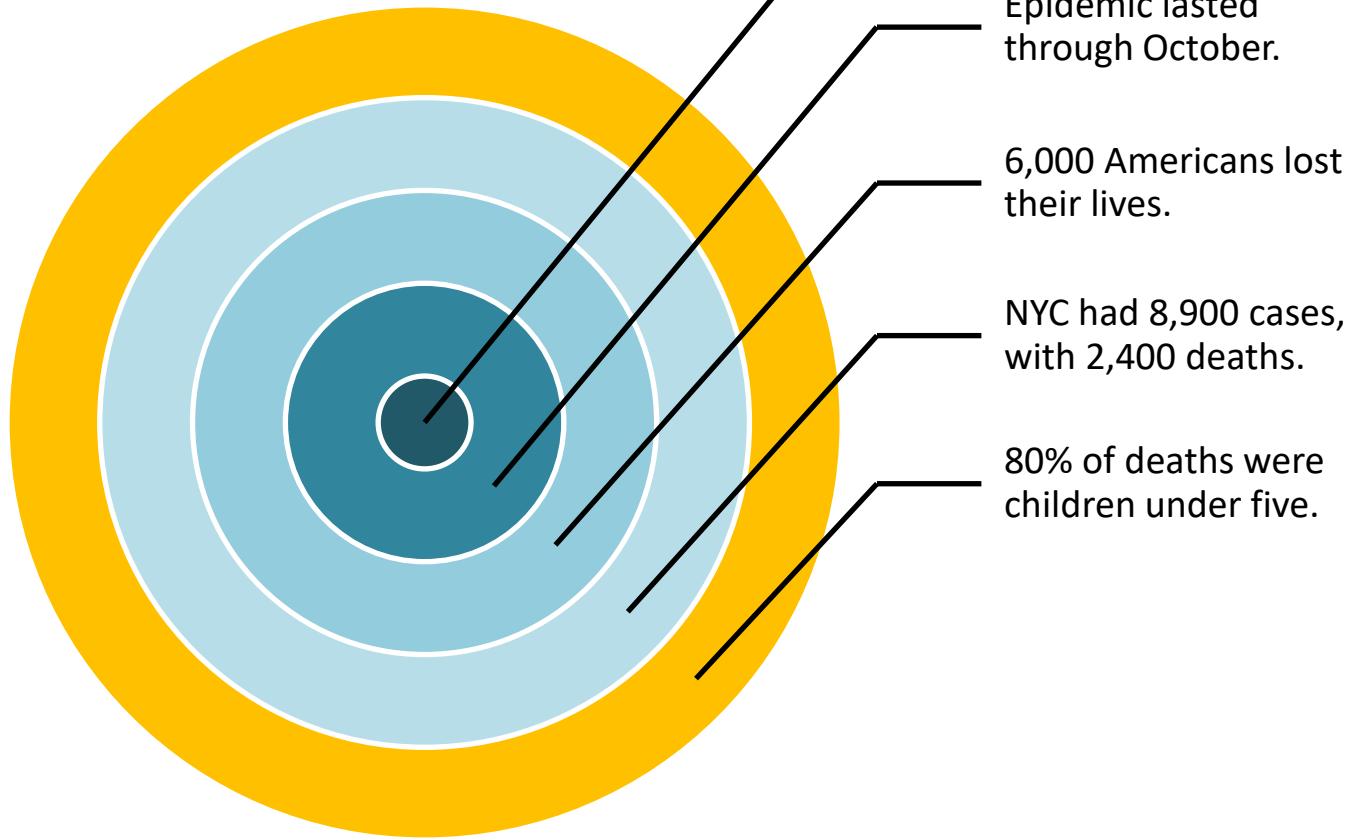
- No cure exists.
- Physical Therapy.
 - Prevent deformity.
 - Loss of muscle function.
- If post-polio, therapy as needed:
 - Sleep apnea.
 - Problems with breathing or swallowing.
 - Muscle weakness and muscle mass loss.
 - Excessive sensitivity to low temperatures.

Looking to the Future?

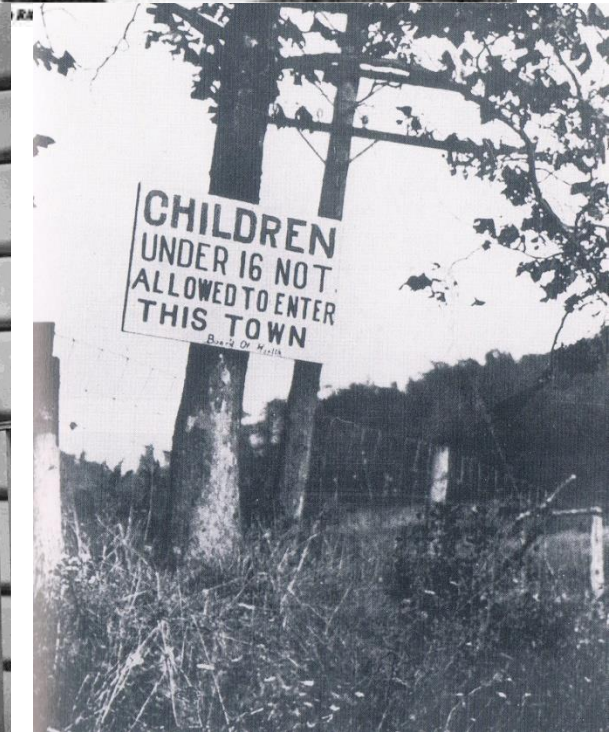
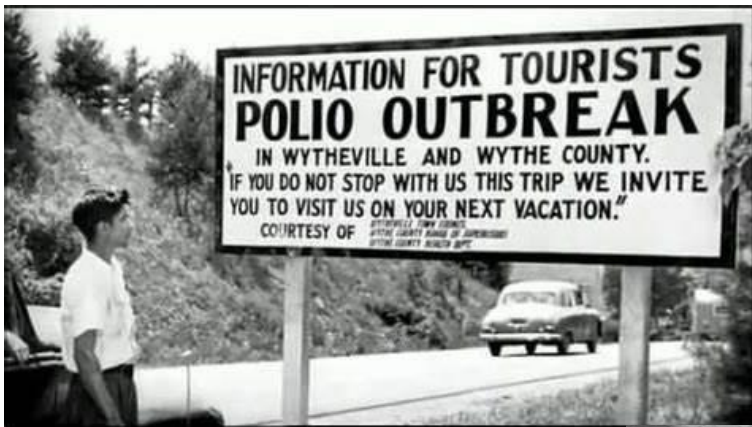
Eradication:

- Only a few cases in 2 countries last 5 years.
- Prevention through vaccination.
- Improvements in sanitation.

Polio in US

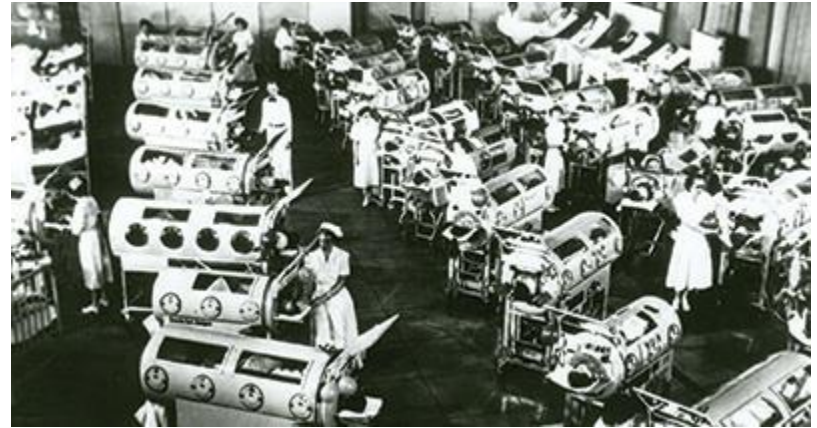
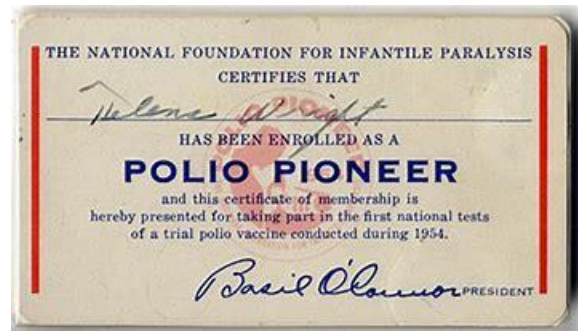


In 1921, at the age of 39, FDR got polio while on vacation in Canada.



Polio Facts

- Between 1940's and 1950's:
 - 10X more children killed in accidents.
 - 3X more killed by cancer.
- NF turned a horrific but relatively uncommon disease into the most feared affliction of its time.
- Disease of white middle-class children.
- False that **blacks not as susceptible.**
- Not caused by filth, squalor or poverty.






"Wellbee" says
BE WELL!
take
ORAL
POLIO
VACCINE

- *tastes good*
- *works fast*
- *prevents polio*



END POLIO NOW

WORLD POLIO DAY
OCTOBER 24TH

Rotary  *"Rotary in particular has inspired my own personal commitment to get deeply involved in achieving eradication." Bill Gates*



Questions?



Bacterial No Vector

CHOLERA



The Basics

The Seven Pandemics

CHOLERA

“Cholera is something else, it is the invisible, it is the curse of the olden days, of times passed, a sort of evil spirit that comes back and that surprises us so much that it haunts us, because it belongs to what appears to be a forgotten age.”

Guy de Maupassant

Name and Meaning

- *Choler, from Greek: irascibility, anger, irritability.*
- Old Physiology: yellow bile, related to 1 of the 4 basic humors.
- Known as “*cholera morbus*”.
- Also called “the blue death”.

Nature of Infection.

- Extremely transmissible contagious disease:
 - Contamination of water supplies.
 - Contact with infected feces.
- Deadly if not treated quickly and efficiently:
 - Kills ~ 135,000 per year worldwide.
 - Can kill in about 24 hours.

Transmission

- Fecal-Oral transmission route due to poor sanitation.
- People drink water or foods contaminated with the germ, *Vibrio cholerae*.
- Can acquire infection eating undercooked or raw shellfish from warm and salty waters.
- *Vibrio cholerae* accumulates in planktonic crustaceans and oysters eat the zooplankton.

Morbidity and Mortality ⁽¹⁾

- Infects 3M to 5M people yearly worldwide and kills 28K to 120K according to WHO.
- ~80 % of infected people don't get symptoms and the infection resolves on its own.
- ~20% develop cholera, get massive diarrhea, vomiting, and leg cramps; untreated mortality ~60%.
- A person may make **3 to 5 gal.** of painless rice-water diarrhea a day, becomes dehydrated, and loses electrolytes.

Morbidity and Mortality ⁽²⁾

- ~100M bacteria must be ingested to cause cholera in a normal healthy adult.
- Less with lowered gastric acidity (PPI users).
- Children more susceptible, 2-4 year-olds have highest rates of infection.
- Type O blood the most susceptible.
- Lowered immunity: AIDS, malnourished.

Mechanism of Disease

- The vibrio multiplies massively.
- Attaches to the intestinal mucosa with a pilus.
- Joins with other vibrios to blanket the wall.
- Secretes enterotoxin that extracts water and electrolytes from the upper GI tract.
- Pumps it into the lumen where the fluid and electrolytes are excreted as diarrheal fluid.

Distribution

- Worldwide but mostly in countries with bad sanitation.
- War and natural disasters increase risks.
 - Wars impede sanitation, hinder water supply.
 - Earthquakes, volcanoes, hurricanes, floods.
- Currently limited to the Indian subcontinent and some countries in Africa.

Prophylaxis/Prevention

- Oral Vaccines available, about 90% effective.
- Start at 10 days, last for ~3-6 months.
- For adults traveling to active cholera area.
- Sanitation and safe water chief measures.

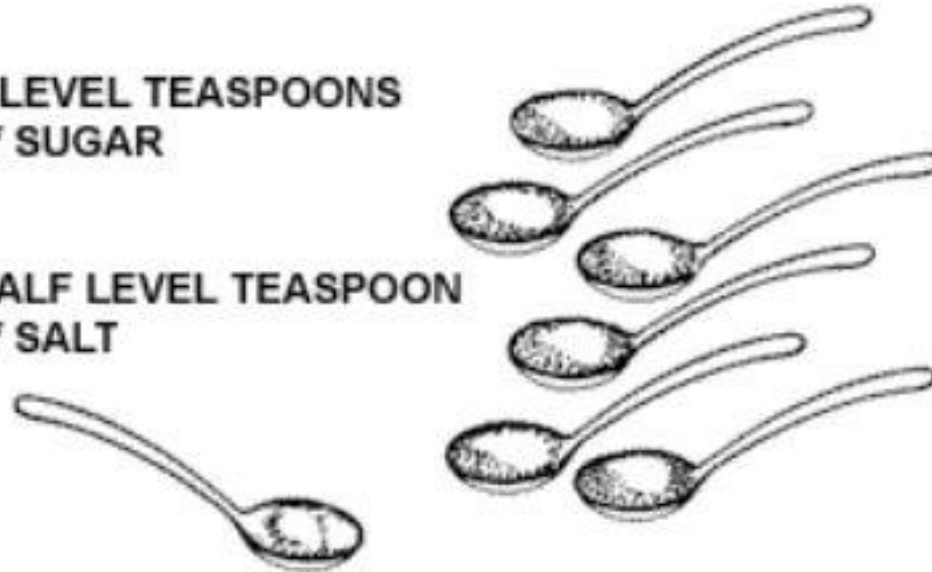
Treatment

- Aggressive rehydration:
 - Intravenous dextrose-saline solutions.
 - Oral Rehydration Solution (ORS).
 - US Commercial \$3-\$5/liter.
 - WHO: 10-25¢/liter.
 - Homemade: 5-10¢/liter.
- Supportive measures: B.R.A.T. diet.
- Antibiotics.

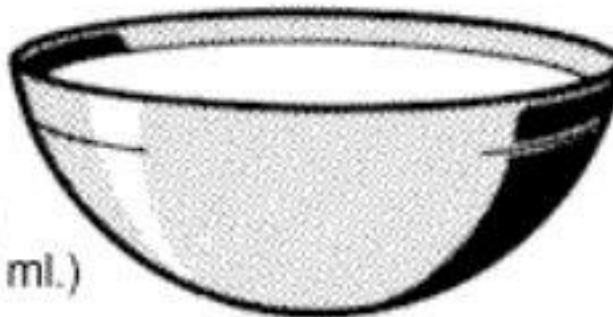
Home – made ORS

6 LEVEL TEASPOONS
of SUGAR

HALF LEVEL TEASPOON
of SALT



1 LITRE
OF WATER
5 cupfuls
(each cup
about 200 ml.)



www.rehydrate.org

Thoughts on the Causes

- France: doctors believed it was a disease of communities with poverty or poor environment.
- Russians believed it was contagious, although doctors did not understand how it spread.
- United States believed that cholera was brought by recent Irish immigrants from British ports.
- British thought the disease might arise from divine intervention.

NY Newspaper Ad

NOTICE.

PREVENTIVES OF

CHOLERA!

Published by order of the Sanatory Committee, under the sanction of the
Medical Counsel.

BE TEMPERATE IN EATING & DRINKING!

Avoid Raw Vegetables and Unripe Fruit !.

Abstain from COLD WATER, when heated, and above all from *Ardent Spirits*, and if habit have rendered them indispensable, take much less than usual.

1st Cholera Pandemic (1)

- Ganges Delta in Jessore, India, in **1817**, originating in contaminated rice.
- Spread throughout most of India, Myanmar, and Sri Lanka along trade routes.
- By 1820, it spread to Thailand, Indonesia (killed 100K people on Java) and the Philippines.
- Spread to China in 1820 and Japan in 1822 by way of infected people on ships.

1st Cholera Pandemic (2)

(1817-1823)

- In 1821, British troops traveling from India to Oman brought cholera to the Persian Gulf.
- Got to Europe, reaching modern-day Turkey, Syria and Southern Russia.
- Pandemic died out in 1823 due to a severe winter which may have killed the bacteria in water supplies.

2nd Cholera Pandemic ⁽¹⁾

(1826-1837)

- Restarted in India, followed trade routes.
- Autumn of 1830, made it to Moscow.
- Spring of 1831, reached Finland, Poland, Hungary and Germany.
- Late 1831 reached Great Britain via the port of Sunderland, and London in spring of 1832.

2nd Cholera Pandemic (2)

(1826-1837)

- In 1832, the epidemic reached Quebec, Nova Scotia, Ontario, Detroit and New York City.
- Between 1832 and 1834, reached the Pacific Coast of North America.
- In mid-1832, 57 Irish immigrants who had been laying a stretch of railroad 30 miles west of Philadelphia died of cholera.

3rd Cholera Pandemic

(1846-1860)

- 3rd outbreak originating in India. (Most Deadly!)
- Researchers believe it may have started in 1837 and lasted until 1863.
- In Russia, more than one million people died.
- In London more than 100K died and 23,000 in Great Britain during 1853-1854.

4th Cholera Pandemic

(1863-1875)

- Pilgrims to Mecca, 30,000 dead Muslims.
- Zanzibar: 70,000 dead
- Netherlands: 20,000 dead.
- London: 5,600 dead.
- Hungary: 30,000 dead.
- Belgium: 30,000 dead.
- Algeria: 80,000 dead.
- Russia: 90,000 dead.
- Italy: 113,000 dead

5th Cholera Pandemic

(1881-1896)

- Russia: 200,000 dead.
- Japan: 90,000 dead.
- Hamburg, Germany: 8,600 dead.
- Sanitary measures based on the findings of John Snow kept cholera out of Britain and the United States.
- This was the last serious European cholera outbreak of the century.

6th Cholera Pandemic

(1899-1923)

- India: 800,000 dead.
- By 1923, cholera had receded from most of the world, although many cases were still present in India.
- Overlapped with part of WWI. (1914-1918)

7th Cholera Pandemic

(1961-Present)

- Only one originating in Indonesia, not India.
- 1991: Peru, 10,000 dead.
- 1994: Rwandan Refugee camps 30,000 dead.
- 2008: Zimbabwe 500 dead.
- 2010: Haiti 250 dead (earthquake).
- 100,000/year still die worldwide.

Cholera in the US ⁽¹⁾

- Spread throughout the Mississippi river system, killing over 4,500 in St. Louis.
- Thousands died in New York, a destination for Irish immigrants.
- Nashville outbreak in 1849–1850 took the life of former U.S. President James K. Polk.

Cholera in the US (2)

- New York had outbreaks in
 - 1832: 3,515 dead,
 - 1849: 5,000 dead
 - 1866: 1,137 dead
- Cincinnati: 8,000 dead.
- Chicago: 3,500 dead.
- New Orleans: 3,000 dead.
- Total US dead: ~150,000.

Cholera in the US ⁽³⁾

- During the California Gold Rush, it followed the California, Mormon and Oregon Trails.
- 6K to 12K are believed to have died on their way to Utah and Oregon in 1849–1855.
- Cholera claimed more than 150,000 victims in the US between 1832 and 1849.

Viral With Vector

YELLOW FEVER

Name and Meaning

- Yellow fever: from the yellowish color (jaundice, French *jaune*=yellow) of the skin caused by liver illness.
- *Fièvre jaune.*
- *Fiebre amarilla, vómito negro.*
- Also called *xekik* (black vomit) by Mayans.

Nature of Infection

- Acute febrile viral disease.
- Bite of female *Aedes Aegypti* mosquito.
- RNA Flavivirus.
- Not contagious.

Transmission

A close-up photograph of a mosquito with a blood-filled abdomen, positioned over a human skin surface. The mosquito's legs and wings are visible, and its proboscis is inserted into the skin. The background is a soft, out-of-focus green.

- Bite of an infected female *Aedes* mosquito.
- Infected or carrier mosquito injects the virus into host when biting and sucking blood.
- No person to person transmission.

Morbidity and Mortality

- Fever, headaches, chills, back pain, nausea, loss of appetite start 3-6 days after bite.
- 85% get better in 3-4 days.
- 15% go to 2nd phase with recurring fevers, jaundice, vomit with blood, bleeding eyes & mouth.
- If jaundice, mortality = 20-50%.
- Overall fatality 3-7%.

Distribution

- Endemic worldwide in tropical and subtropical areas of Africa and South America.
- ~600 million people live in endemic areas.
- **No** natural cases in Asia, only imported cases.
- Requires habitat for *Aedes* mosquitoes.

Prophylaxis/Prevention ⁽¹⁾

- Avoid bites, use repellent.
- Repellent-impregnated clothing, long sleeves.
- Vaccine works after 10 days in 95% of people.
- Immunity last for about 10 years.

Prophylaxis/Prevention (2)

- Vaccination recommended for visitors to an active area. (Locals have some immunity.)
- *Aedes* bites during daylight hours, but insecticide-impregnated mosquito nettings are helpful.
- Vector control: larvicides, insecticides, eliminate breeding areas, larvae-eating fish and copepods.
- *Aedes* also carries dengue and chikungunya.

Treatment

- No cure known, no antiviral effective.
- Hospital care, hydration, pain relief.
- Isolation not required.
- No aspirin: interferes with blood clotting.

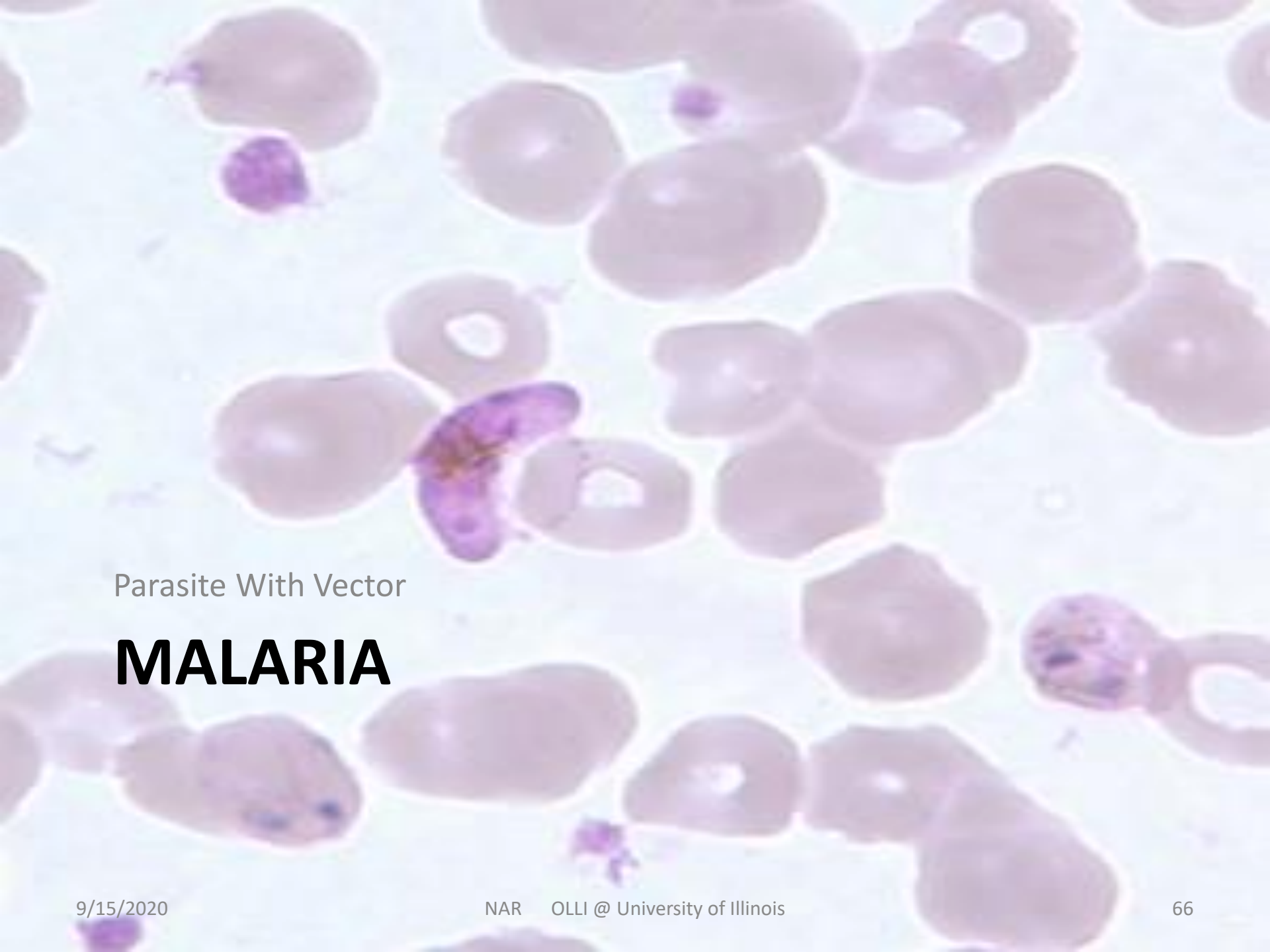
Looking to the future?

- Asia could become an endemic focus.
- *Aedes* already exists in Asia.
- Eradication not possible without vector elimination.
- WHO: 200K cases with 30K mortality/year.

Yellow Fever in USA

Memphis had 6 major Yellow fever epidemics:

Year	Epidemic #	Cases	Deaths
1828	First	650	150
1855	Second	1,250	220
1867	Third	2,500	550
1873	Fourth	5,000	2000
1878	Fifth	17,000	5000+
1879	Sixth	2,000	600



Parasite With Vector

MALARIA

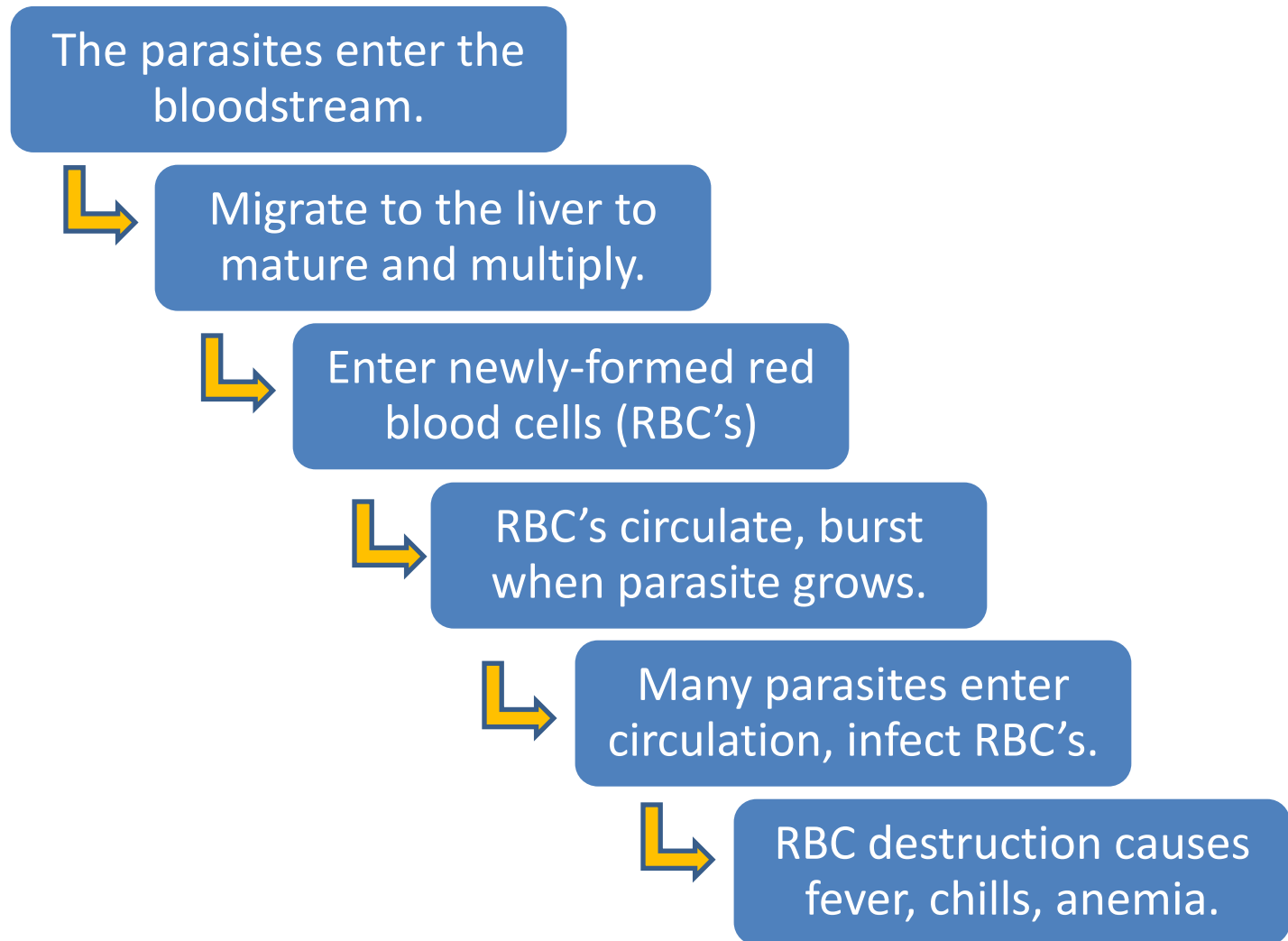
Name and Meaning

- Malaria: from the Italian *mal'aria*= bad air.
- English call it “the ague”.
- French call it *le paludisme*, Spanish *paludismo*, literally “the paleness”.
- Many cultures call it “Swamp fever”.
- In Mali the word means “sickness of the green season” because it comes with the rains.

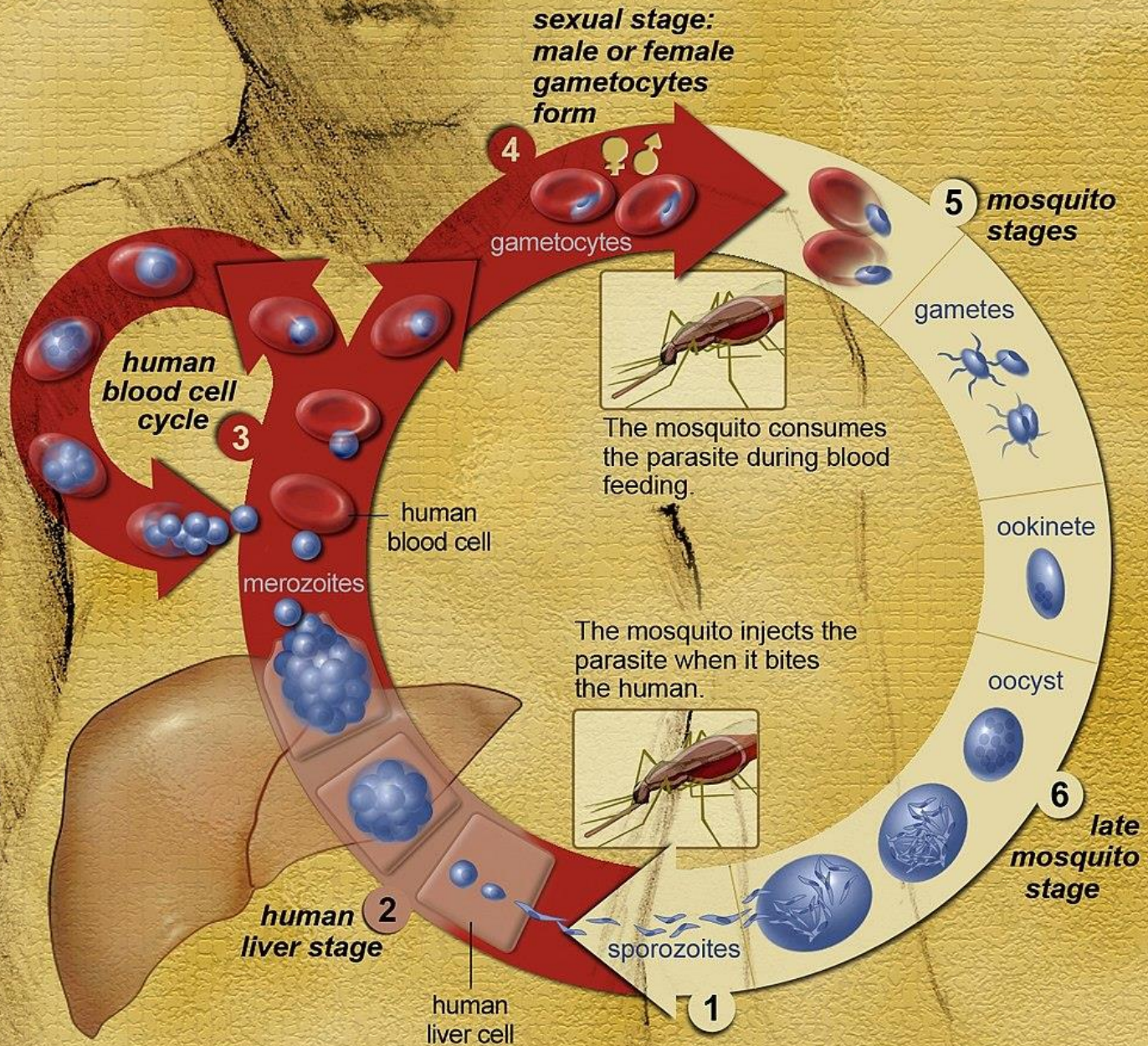
Nature of Infection ⁽¹⁾

- Acute/chronic febrile parasitic blood disease.
- Bite of female *Anopheles* mosquito injects the victim with the parasite.
- Five types:
 - *Plasmodium vivax*: Asia and Latin America.
 - ***Plasmodium falciparum***: most commonly fatal.
 - *Plasmodium malarie*: mild symptoms
 - *Plasmodium ovale*: rare, Africa & Pacific islands.
 - *Plasmodium knowlesi*: SE Asia, macaques.

Nature of Infection (2)



Life Cycle of the Malaria Parasite



Transmission

- *Anopheles* female bites, sucks blood, injects saliva with parasites into host.
- The mosquito bites at night, goes to a vertical surface to rest and digest after biting.
- Mosquito absorbs the blood cells, eliminates the fluid of the blood as urine.
- Males do not suck blood.

Morbidity and Mortality ⁽¹⁾

- Symptoms appear 8-25 days after bite.
- Initially headache, fever, joint pain, vomiting, jaundice, blood in urine, retinal hemorrhage.
- Cardinal sign is the paroxysm of fever & chills:
 - Quotidian (daily): *Falciparum*
 - Tertian (every third day): *Vivax* and *Ovale*
 - Quartan (every fourth day): *Malarie*

Morbidity and Mortality (2)

- *Falciparum* can produce:
 - Cerebral malaria with encephalopathy.
 - Severe anemia.
 - Kidney failure.
 - Enlarged spleen and liver.
 - Blackwater fever (hemoglobin in urine).
- Can affect pregnant mothers and cause stillbirth, prematurity, neonatal malaria.

Distribution

WHO Cases Data 2019

- Cases worldwide:
 - 2018: 228 million.
 - 2017: 231 million
 - 2010: 251 million.
- Most malaria cases in 2018 were:
 - WHO African Region (213 million or 93%).
 - WHO SE Asia Region (7,75 million or 3.4%).
 - WHO Eastern Mediterranean Region (4.79 million or 2.1%).
- 19 countries in sub-Saharan Africa and India HAD ~85% of the total.
- 6 countries accounted for more than ½ of all malaria cases:
 - Nigeria (25%).
 - Democratic Republic of the Congo (12%).
 - Uganda (5%).
 - Côte d'Ivoire, Mozambique and Niger (4% each= 12%).

Distribution

WHO Deaths Data 2019

- Deaths worldwide:
 - 2010: 585,000 deaths.
 - 2017: 416,000 deaths.
 - 2018: 405,000 deaths.
- Children under 5 years are the most vulnerable group, with 67% (272,000) of all deaths in 2018.
- WHO African Region had 94% of deaths in 2018.
- The Region also had 85% of the 180,000 fewer deaths.

Prophylaxis/Prevention

- Vector control is A#1 priority.
- Community education.
- Vaccine effective in 40% of children over 24 months but requires 4 doses.
- Preventive medication indicated only for people traveling or working in endemic areas.

Treatment

- Historically *Chinchona* bark (contains quinine).
- Chloroquine (Aralen) used during WWII.
- Worldwide use of chloroquine dramatically reduced the incidence of malaria.
- *P. falciparum* has become resistant to this and other new drugs and combinations.

Looking to the Future

- Eradication worldwide is not a goal of WHO.
- Better vector control measures without negative environmental impact.
- Improved therapeutics to compensate for drug resistance by *falciparum*.

Malaria in the USA

Current Conditions

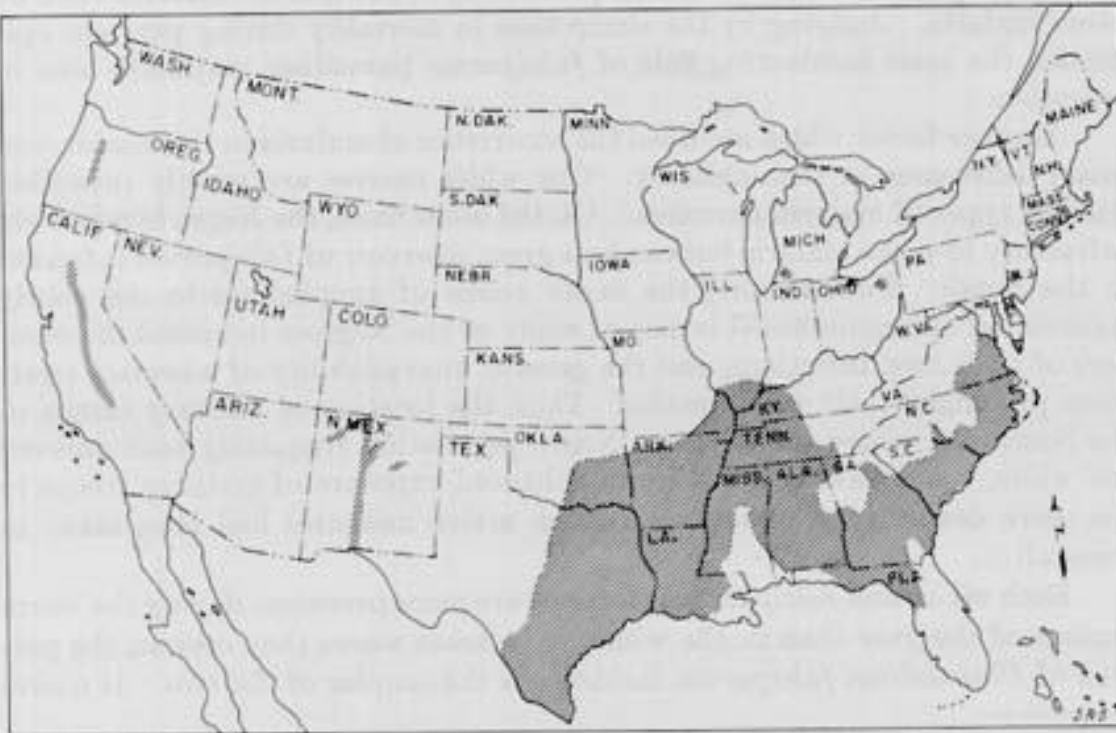
- About 2,000 cases per year, most of whom have recently traveled to an infected region.
- CDC reported 63 outbreaks in the US between 1957 and 2011.
- Local mosquitoes infected by people who acquired the parasite in endemic areas.

Malaria in the USA

Past History

- Malaria did not exist in the Americas until colonists started arriving.
- Spanish colonists brought *vivax* to the Caribbean and Portuguese brought it to Brazil.
- Need for cheap (free) labor resistant to malaria (African slaves) brought *falciparum* to North America.
- Slave work in plantations, mines and other tasks opened up Carolinas and Virginia.

Malarious Area in US (1934-1935)



MAP 4.—Areas of the continental United States believed to be malarious in 1934-35.

At some time, every state except Alaska was malaria endemic.

500,00 soldiers in WWII got malaria.

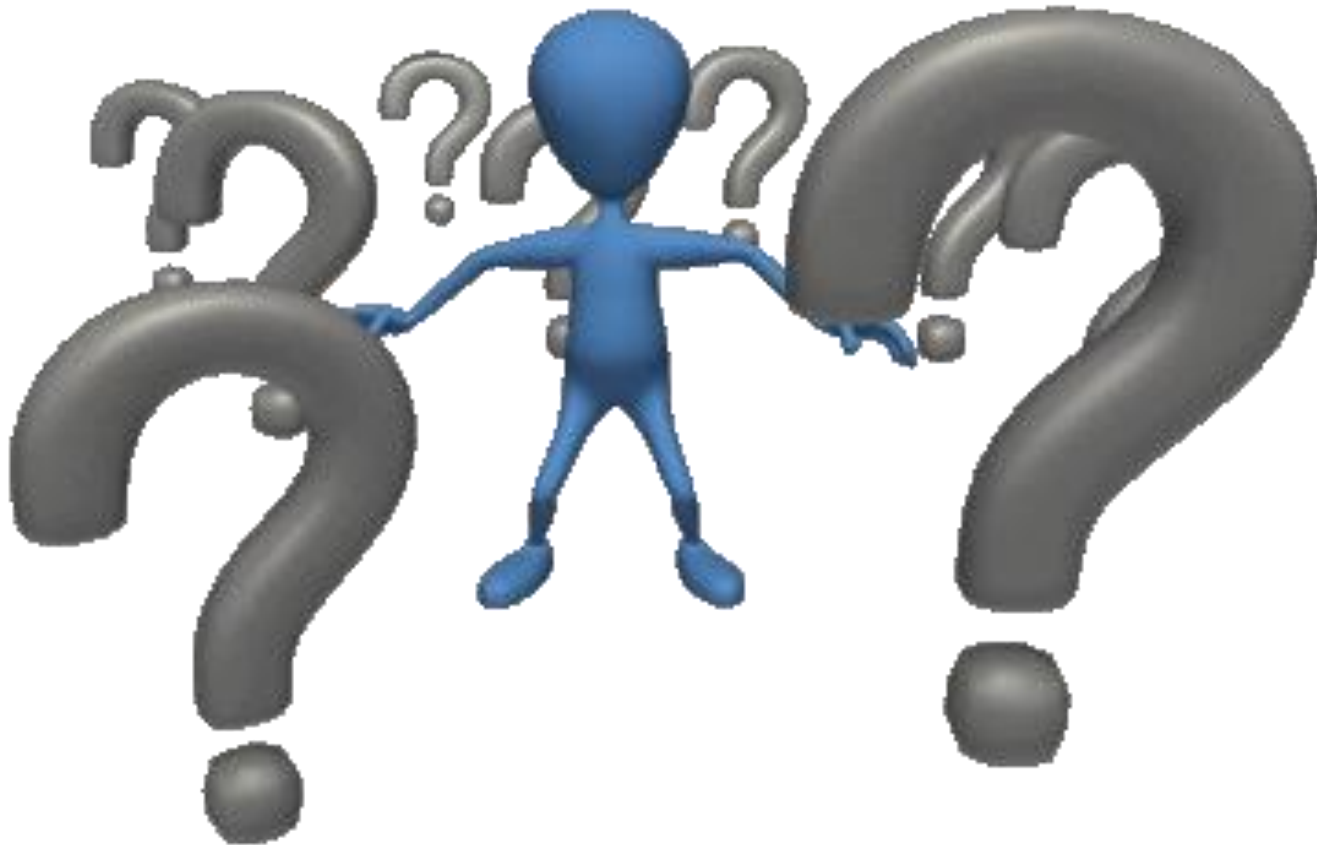
Malaria affected 30% of the TVA region in 1933. By 1947, the disease was essentially eliminated.

In 1947, 15,000 malaria cases were reported. By 1950, only 2,000 cases were reported; by 1951, malaria was considered eliminated from the United States.

Past Famous Malaria Patients

- George Washington.
- Abraham Lincoln.
- Ulysses S. Grant.
- George Clooney.
- Anderson Cooper.
- Jeremy Piven.

Questions?



Thank
You!

ChromaLuna.com