INFECTIOUS DISEASES IN THE MOVIES: FACT OR FICTION

David Jay Weber, M.D., M.P.H.
Professor of Medicine, Pediatrics & Epidemiology
Technical Assistance: Gordon Palmer
UNC Medical Illustration & Photography

1

LECTURE GOALS

- Provide entertainment (learning medicine should be fun)
- Provide trivia for your next cocktail party or Jeopardy appearance
- Develop an appreciation for classic movies
- Place infectious diseases in historical perspective

2

DISCLOSURES

- No honoraria or grants from film companies
- No mention of off label use of FDA approved drugs (in fact no mention of drugs at all)
- As an intern I took care of Marion Morrison

3

DISCLOSURES

- No honoraria or grants from film companies
- No mention of off label use of FDA approved drugs (in fact no mention of drugs at all)
- As an intern I took care of Marion Morrison (i.e., John Wayne or “The Duke”)

4

TRIVIA QUIZ: QUESTIONS 1 & 2

- Most common infectious disease in US presidents
  - **A. Tuberculosis**
  - **B. Malaria**
  - **C. Syphilis**
  - **D. Rheumatic fever**
- Number of presidents with the disease
  - **A. 3**
  - **B. 7**
  - **C. 11**
  - **D. 13**

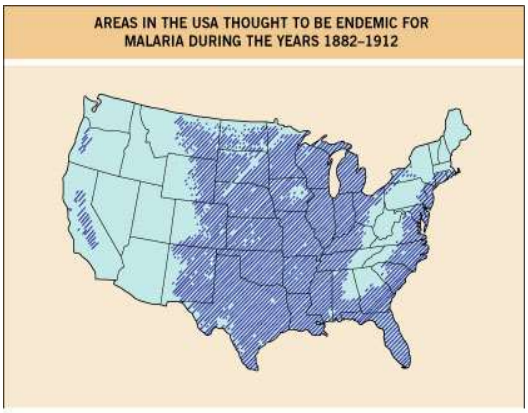
5

TRIVIA QUIZ: ANSWERS

- Most common infectious disease in US presidents
  - **A. Tuberculosis**
  - **B. Malaria**
  - **C. Syphilis**
  - **D. Rheumatic fever**
- Number of presidents with the disease
  - **A. 3**
  - **B. 7**
  - **C. 11**
  - **D. 13**

6

MALARIA, US



7

INFECTIOUS DISEASES IN THE MOVIES

Historical movies-overcoming adversity
- **Miracle Worker, 1962: scarlet fever**
- **Tombstone, 1993: Tuberculosis**

Period movies – overcoming adversity
- **Five Pennies, 1959: Polio**
- **Philadelphia, 1993: AIDS**
- **Finding Neverland, 2004: Tuberculosis**

Tear jerkers
- **Little Women, 1949: Scarlet fever**
- **Old Yeller, 1957: Rabies**

Infectious diseases as natural hazards
- **African Queen, 1951: Mosquitoes, leeches**
- **To Kill A Mocking Bird, 1962: Rabies**
- **Motorcycle Diaries, 2004: Leprosy**

Scary movies
- **War Of The Worlds, 1953: "Common" bacteria**
- **Outbreak, 1995: Ebola**
- **Cujo, 1983: Rabies**

8

9

NEW DISEASES: THE FACTS

- Mars is the most earth-like of the planets
- Many recent epidemics have been due to microbes jumping species lines
- We live in a sea of “organisms”
- Fortunately, our host defenses, in general, prevent us form acquiring infections from most environmental microbes (most infections come from endogenous flora)

10

NEW DISEASES: FICTION

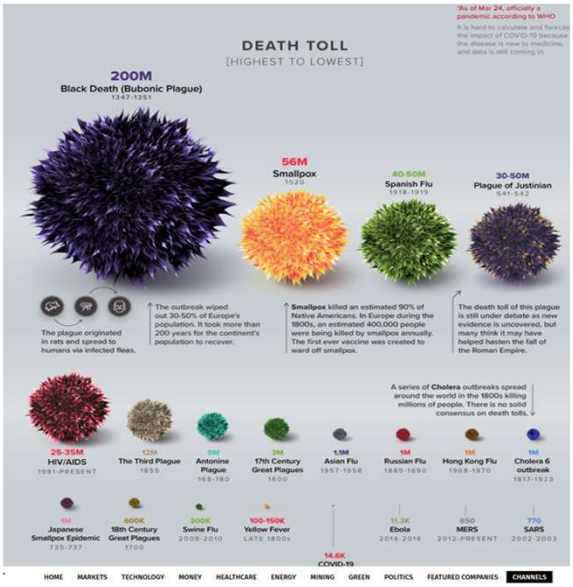
- No life on mars
- Most microbes that have jumped species lines and caused recent epidemics have been viruses (not bacteria)
- Host resistance varies; implausible that an entire species would be killed by a single microbe simultaneously

11

HISTORY OF PANDEMICS AND EMERGING DISEASES

Name	Time period	Type / Pre-human host	Death toll
Antonine Plague	165-180	Believed to be either smallpox or measles	5M
Japanese smallpox epidemic	735-737	Variola major virus	1M
Plague of Justinian	541-542	Yersinia pestis bacteria / Rats, fleas	30-50M
Black Death	1347-1351	Yersinia pestis bacteria / Rats, fleas	200M
New World Smallpox Outbreak	1520 – onwards	Variola major virus	56M
Great Plague of London	1665	Yersinia pestis bacteria / Rats, fleas	100,000
Italian plague	1629-1631	Yersinia pestis bacteria / Rats, fleas	1M
Cholera Pandemics 1-6	1817-1923	V. cholerae bacteria	1M+
Third Plague	1885	Yersinia pestis bacteria / Rats, fleas	12M (China and In
Yellow Fever	Late 1800s	Virus / Mosquitoes	100,000-150,000 (U
Russian Flu	1889-1890	Believed to be H2N2 (avian origin)	1M
Spanish Flu	1918-1919	H1N1 virus / Pigs	40-50M
Asian Flu	1957-1958	H2N2 virus	1.1M
Hong Kong Flu	1968-1970	H3N2 virus	1M
HIV/AIDS	1981-present	Virus / Chimpanzees	25-35M
Swine Flu	2009-2010	H1N1 virus / Pigs	200,000
SARS	2002-2003	Coronavirus / Bats, Civets	770
Ebola	2014-2016	Ebolavirus / Wild animals	11,000
MERS	2015-Present	Coronavirus / Bats, camels	850
COVID-19	2019-Present	Coronavirus – Unknown (possibly pangolins)	14,500 (as of Mar 2 2020)

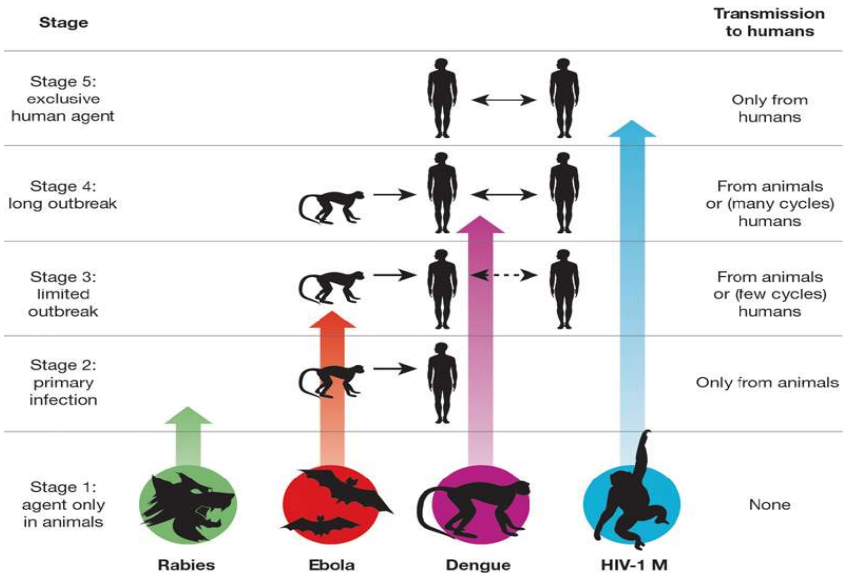
Note: Many of the death toll numbers listed above are best estimates based on available research. Some, such as the a of Justinian, are subject to debate based on new evidence.



EMERGING DISEASES IN THE US

DISEASE (source)	CASES	OUTCOME	YEAR
West Nile virus (Israel)	Thousands	Endemic (US)	1999
SARS (China)	8096 (8 US, 1 UNC)	Controlled	2003
Monkeypox (Africa)	71	Controlled	2003
Novel flu, H1N1 (Mexico)	Thousands	Endemic (Worldwide)	2009
MERS-CoV (Arabian Peninsula)	Hundreds	Epidemic (Arabian area)	2014
Enterovirus D68	Hundreds (13 UNC)	Epidemic (US)	2014
Ebola	Thousands (1 US)	Epidemic (West Africa)	2014-15
SARS-CoV-2	Millions	Endemic (Worldwide)	2019-present

13



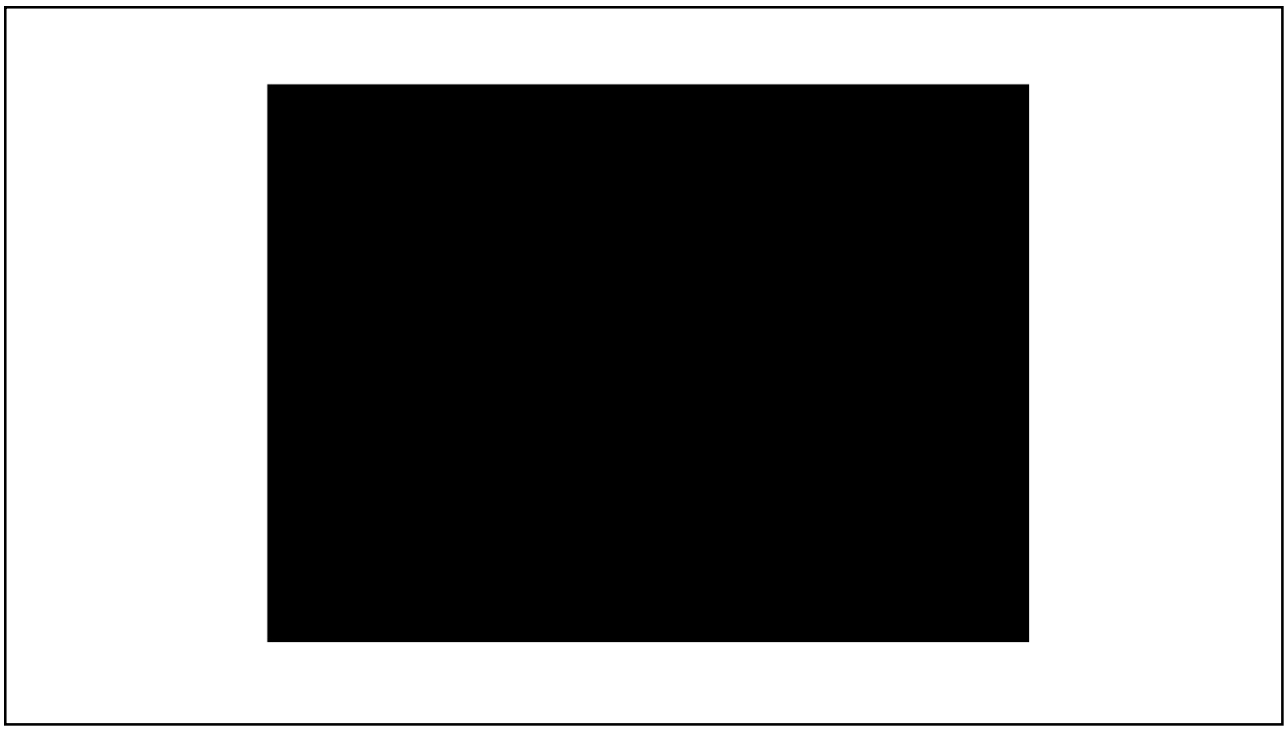
http://web.stanford.edu/group/parasites/ParaSites2012/Lassa%20Libby%20Burch

14

BASIC CONCEPTS IN DISEASE EMERGENCE

- Emergence of infectious diseases is complex
- Infectious diseases are dynamic
- Most new infections are not caused by genuinely new pathogens
- Agents involved in new and reemergent infections cross taxonomic lines
- The concept of the microbe as *the* cause of disease is inadequate and incomplete
- Human activities are the most potent factors driving disease emergence
- Social, economic, political, climatic, technologic, and environmental factors shape disease patterns and influence emergence
- Understanding and responding to disease emergence require a global prospective, conceptually and geographically
- The current global situation favors disease emergence

15



16

EBOLA: THE FACTS

- Multiple outbreaks described in Africa; first outbreak in Zaire 1967
- Acquisition from monkeys
- High mortality
- Person-to-person transmission; healthcare personnel at high risk
- Therapy has advanced from supportive to monoclonal antibodies approved in 2020 (Inmazeb, Ebanga)
- Pre-exposure prophylaxis now also available with rVSV-ZIBOV (Ervoba), approved by FDA in 2019

17

EBOLA: FICTION

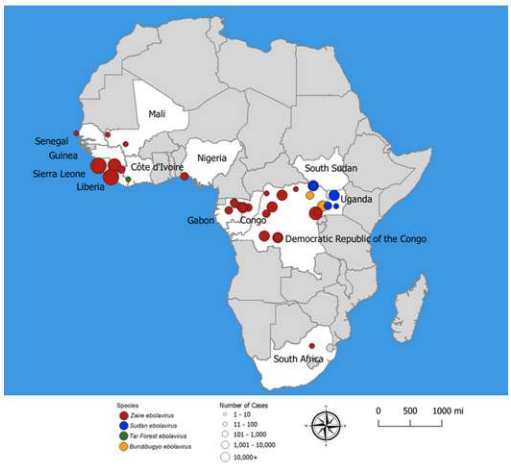
- The US doesn't destroy villages suffering an outbreak of Ebola
- The reservoir is probably bats
- Pandemic unlikely; high mortality and short incubation period

18

Emergence of Ebola in Humans

Viral and epidemiologic data suggest that Ebola virus existed long before these recorded outbreaks occurred. Factors like population growth, encroachment into forested areas, and direct interaction with wildlife (such as bushmeat consumption) may have contributed to the spread of the Ebola virus.

Since its discovery in 1976, the majority of cases and outbreaks of Ebola Virus Disease have occurred in Africa. The 2014-2016 Ebola outbreak in West Africa began in a rural setting of southeastern Guinea, spread to urban areas and across borders within weeks, and became a global epidemic within months.



https://www.cdc.gov/vhf/ebola/history/summaries.html

19

Chronology of Previous Ebola Virus Disease Outbreaks, WHO

Year	Country	EVD	Cases	Deaths	Case fatality
2021	Guinea	Zaire	Ongoing		
2021	Democratic Republic of the Congo	Zaire	Ongoing		
2020	Democratic Republic of the Congo	Zaire	130	55	42%
2018-2020	Democratic Republic of the Congo	Zaire	3481	2299	66%
2018	Democratic Republic of the Congo	Zaire	54	33	61%
2017	Democratic Republic of the Congo	Zaire	8	4	50%
2015	Italy	Zaire	1	0	0%
2014	Spain	Zaire	1	0	0%
2014	UK	Zaire	1	0	0%
2014	USA	Zaire	4	1	25%
2014	Senegal	Zaire	1	0	0%
2014	Mali	Zaire	8	6	75%
2014	Nigeria	Zaire	20	8	40%
2014-2016	Sierra Leone	Zaire	14124*	3956*	28%
2014-2016	Liberia	Zaire	10675*	4809*	45%
2014-2016	Guinea	Zaire	3811*	2543*	67%
2014	Democratic Republic of the Congo				
2012	Democratic Republic of the Congo	Bundibugyo	57	29	51%
2012	Uganda	Sudan	7	4	57%
2012	Uganda	Sudan	24	17	71%
2011	Uganda	Sudan	1	1	100%
2008	Democratic Republic of the Congo	Zaire	32	14	44%
2007	Uganda	Bundibugyo	149	37	25%
2007	Democratic Republic of the Congo	Zaire	264	187	71%
2005	Congo	Zaire	12	10	83%
2004	Sudan	Sudan	17	7	41%
2003 (Nov-Dec)	Congo	Zaire	35	29	83%
2003 (Jan-Apr)	Congo	Zaire	143	128	90%
2001-2002	Congo	Zaire	59	44	75%
2001-2002	Gabon	Zaire	65	53	82%
2000	Uganda	Sudan	425	224	53%
1996	South Africa (ex-Gabon)	Zaire	1	1	100%
1996 (Jul-Dec)	Gabon	Zaire	60	45	75%
1996 (Jan-Apr)	Gabon	Zaire	31	21	68%
1995	Democratic Republic of the Congo	Zaire	315	254	81%
1994	Côte d'Ivoire	Taï Forest	1	0	0%
1994	Gabon	Zaire	52	31	60%
1979	Sudan	Sudan	34	22	65%
1977	Democratic Republic of the Congo	Zaire	1	1	100%
1976	Sudan	Sudan	284	151	53%
1976	Democratic Republic of the Congo	Zaire	318	280	88%

* Include Suspect, Probable and Confirmed EVD cases.

EBOLA VIRUS DISEASE, KEY FACTS, WHO

- Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever, is a rare but severe, often fatal illness in humans.
- The virus is transmitted to people from wild animals and spreads in the human population through human-to-human transmission.
- The average EVD case fatality rate is around 50%. Case fatality rates have varied from 25% to 90% in past outbreaks.
- Community engagement is key to successfully controlling outbreaks.
- Good outbreak control relies on applying a package of interventions, namely case management, infection prevention and control practices, surveillance and contact tracing, a good laboratory service, safe and dignified burials and social mobilization.
- Vaccines to protect against Ebola have been developed and have been used to help control the spread of Ebola outbreaks in Guinea and in the Democratic Republic of the Congo (DRC).
- Early supportive care with rehydration, symptomatic treatment improves survival. Two monoclonal antibodies (Inmazeb and Ebanga) were approved for the treatment of Zaire ebolavirus (Ebolavirus) infection in adults and children by the US Food and Drug Administration in late 2020.
- Pregnant and breastfeeding women with Ebola should be offered early supportive care. Likewise vaccine prevention and experimental treatment should be offered under the same conditions as for non-pregnant population.

https://www.who.int/news-room/fact-sheets/detail/ebola-virus-disease

21

KEY CONSIDERATIONS IN ASSESSING AND MANAGING THE THREAT OF AN EMERGING INFECTIOUS DISEASE

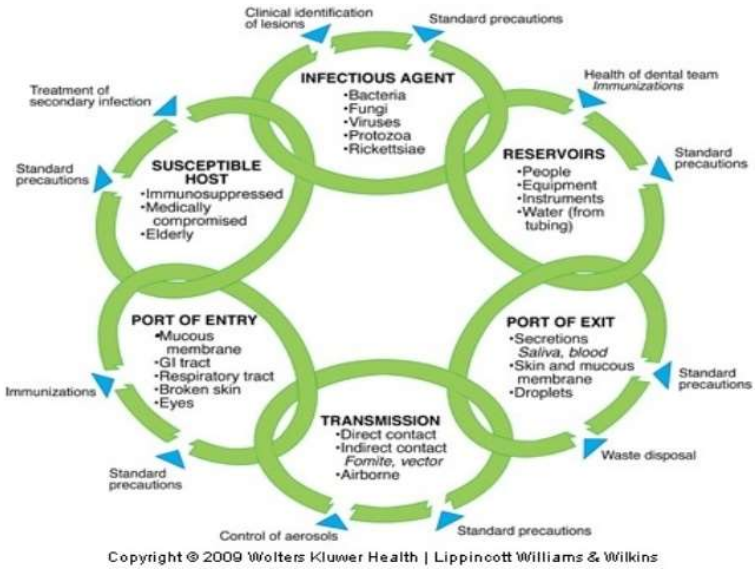
- Pathogen
  - Taxonomy (provides clues regarding transmission routes, environmental stability, germicide susceptibility)
  - Hosts
- Epidemiology
  - Locations of endemicity (i.e., locations in the world where sources or reservoirs reside)
  - Incubation period
  - Transmission routes
  - Infectivity (i.e., communicability)
  - Duration of infectivity
- Clinical
  - Symptoms
  - Signs
  - Risk factors for acquisition of infection
  - Morbidity
  - Mortality
  - Risk factors for morbidity and mortality
  - Diagnostic methods (sensitivity, specificity, biosafety)
  - Therapy (availability, efficacy, safety)

22

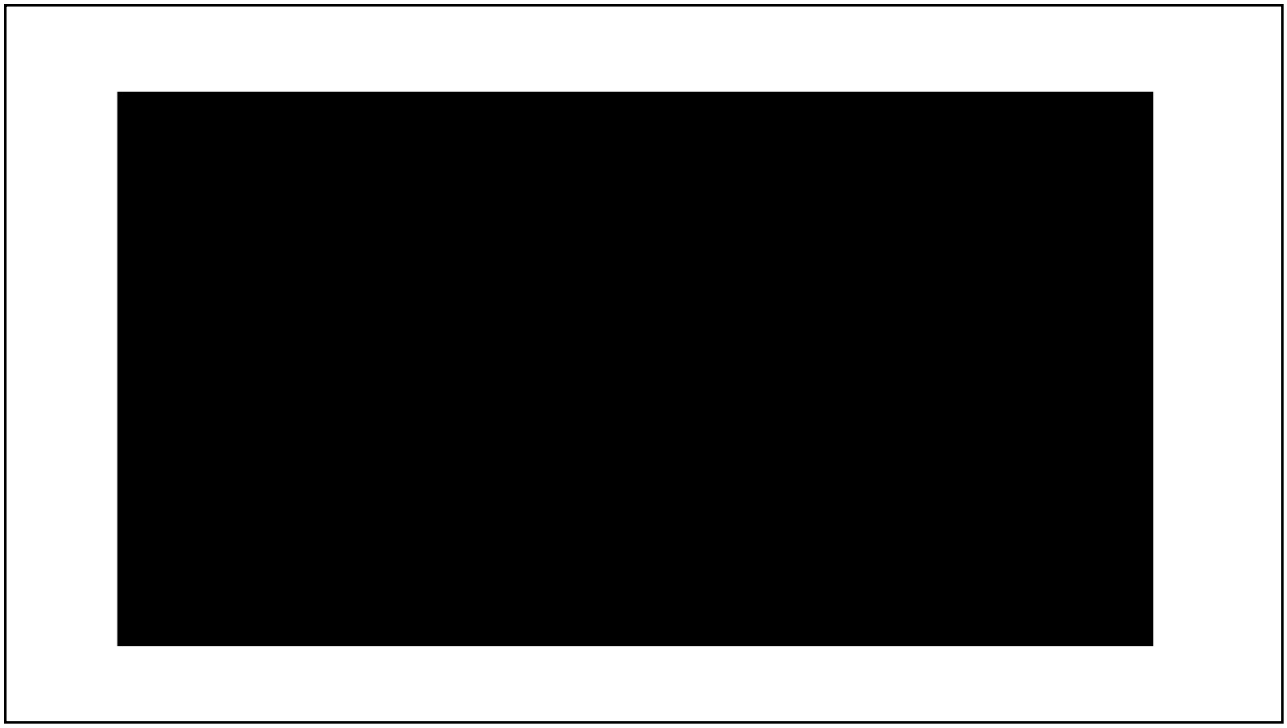
KEY CONSIDERATIONS IN ASSESSING AND MANAGING THE THREAT OF AN EMERGING INFECTIOUS DISEASE

- Infection Prevention
  - Environmental survival
  - Germicide susceptibility
  - Isolation recommendations
  - Recommended personal protective equipment
  - Pre-exposure prophylaxis (availability, efficacy, safety)
  - Postexposure prophylaxis (availability, efficacy, safety)
  - Recommended biosafety level in the laboratory
  - Recommended waste disposal (liquids and solids
- Managing a pandemic
  - Sensitive and specific (ideally rapid) diagnostic test
  - Early identification of patients
  - Protecting our healthcare personnel (PPE, donning, doffing)
  - Sufficient staff, inpatient/ICU beds, ventilators
  - Managing shortages

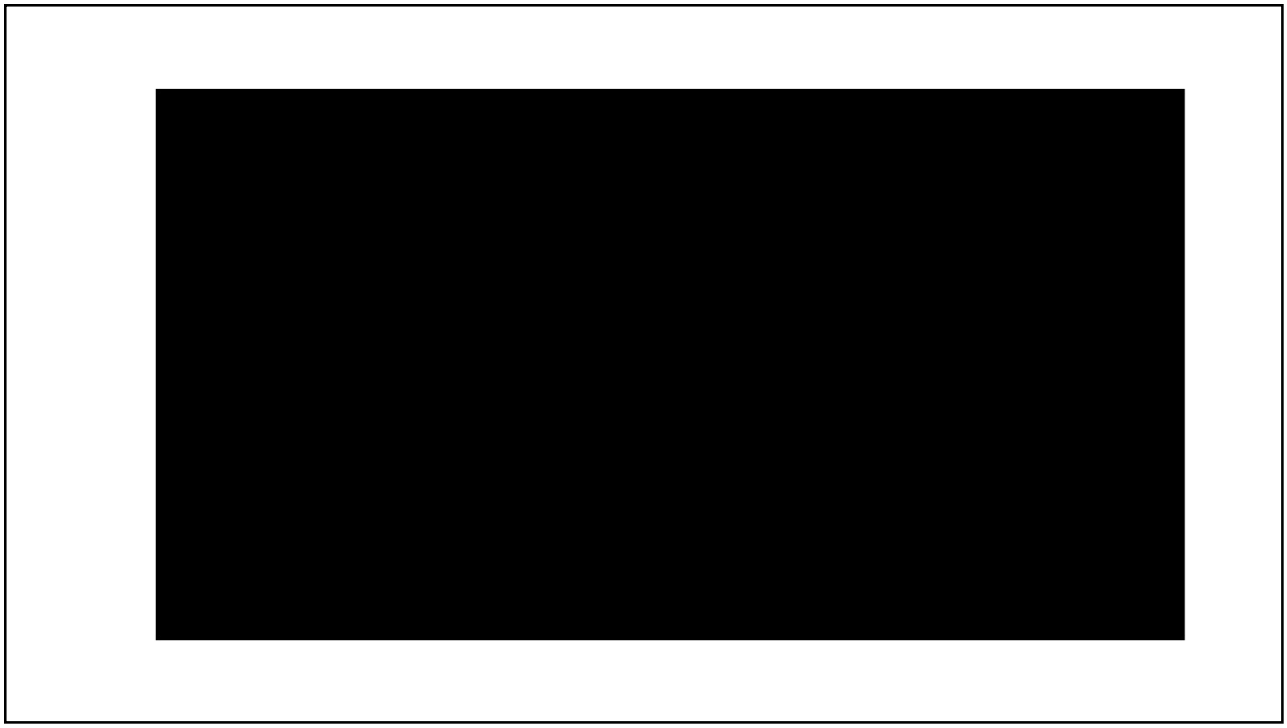
23



24



25



26

RABIES: EPIDEMIOLOGY

- Agent: *Rhabdoviridae* (genus *Lyssavirus*)
- Reservoir: Small mammals, bats
  - Bat species include silver-haired bats and eastern pipistrelles
- Transmission
  - Animal bite or scratch (contact with infectious saliva)
  - Airborne: Spelunking (rare) or laboratory generated aerosol
  - Iatrogenic: Corneal transplants (8 cases), transplanted organs (2 outbreaks) or improperly inactivated vaccines
- Deaths, US
  - From 1960 to 2018, 127 human rabies cases were reported in the United States, with roughly a quarter resulting from dog bites received during international travel. Of the infections acquired in the United States, 70% were attributed to bat exposures.
- Prevention (or post-exposure therapy)
  - Rabies vaccine + RIG

27

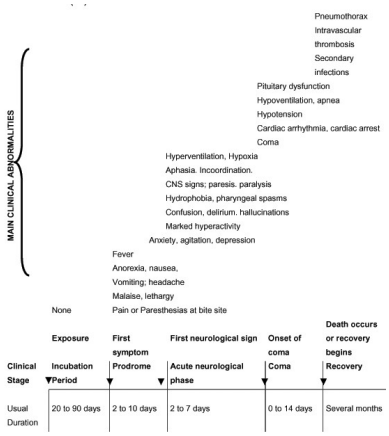
Estimated Incubation Period (days) per Bite Site

Bite site	<7 (%)	8–14 (%)	15–21 (%)	22–30 (%)	31–90 (%)	91–365 (%)	>365 (%)
Face, head, neck	5 (0.3)	32 (1.8)	49 (2.8)	57 (3.3)	84 (4.8)	46 (2.6)	12 (0.7)
Fingers	0	0	13 (0.7)	21 (1.2)	44 (2.5)	106 (6.1)	39 (2.2)
Upper extremities	0	0	3 (0.2)	8 (0.5)	76 (4.4)	225 (12.9)	85 (4.9)
Lower extremities	0	0	0	5 (0.3)	58 (3.3)	369 (21.2)	151 (8.7)
Other sites (buttocks, back, chest, genitalia)	0	0	1 (0.1)	6 (0.3)	23 (1.3)	31 (1.8)	14 (0.8)
Multiple bite	2 (0.1)	5 (0.3)	16 (0.9)	24 (1.4)	69 (4.0)	34 (2.0)	8 (0.5)
Non-bite (eating raw dog meat)	0	0	0	3 (0.2)	7 (0.4)	11 (0.6)	0
Total cases[b]	7 (0.4)	38 (2.1)	92 (5.0)	155 (8.4)	498 (27.1)	785 (42.8)	251 (13.7)

[a] Time of exposure to the time of manifest signs and symptoms; eight cases were of 5 years incubation (0.4%) and one case was of 27 years incubation (0.1%).
[b] Not all bite locations were recorded, thus $n = 1835$ for total cases and $n = 1742$ for all cases for which a bite location was recorded.

Dimaano EM, et al. International J Infect Dis 2011;15:e495-e499

RABIES, FREQUENCY ABND TIME COURSE OF SYMPTOMS



Consales CA, Boizan VL. J Venom Toxins incl. Trop Dis 13(1) 2007

Rabies cases according to type of exposure and clinical manifestations, $N = 1839$

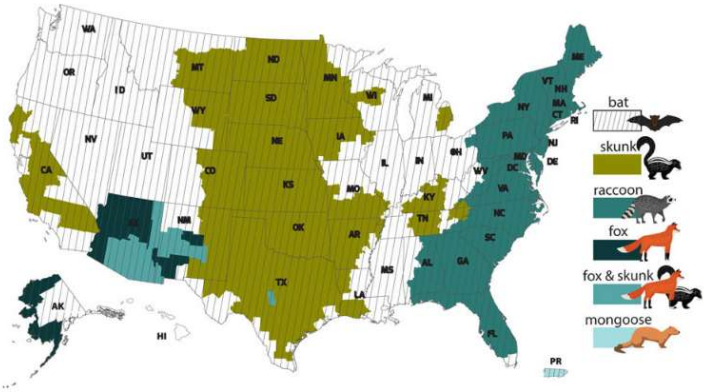
	No. of cases (%)
Type of exposure	
Bite exposure	1814 (98.6)
Single bite	1563 (86.2)
Face, head, and neck	285 (15.7)
Fingers	223 (12.3)
Upper extremities	397 (21.9)
Lower extremities	583 (32.1)
Others (buttocks, back, chest, genitalia, etc.)	75 (4.1)
Multiple	158 (8.7)
Unknown bite site	93 (5.1)
Non-bite exposure	25 (1.4)
Eating raw dog meat	21 (84)
Unknown	4 (16)
Clinical manifestations	
Hydrophobia[a]	1839 (100)
Aerophobia	1756 (95.5)
Fever	173 (9.4)
Restlessness	169 (9.2)
Hypersalivation	124 (6.7)
Behavioral changes (agitation, aggressiveness, irritability)	123 (6.7)
Nausea/vomiting	119 (6.5)
Chest pain	115 (6.3)
Incoherence	108 (5.9)
Urinary frequency	87 (4.7)
Dysuria	83 (4.5)
Bite site pain	76 (4.1)
Paralysis/paresis	71 (3.9)
Numbness of bite site	48 (2.6)
Itchiness of bite site	43 (2.3)
Other:	
Photophobia	24 (1.3)
Epigastric pain	15 (0.8)
Upward rolling of eyeballs/nystagmus	8 (0.4)
Facial palsy/asymmetry	2 (0.1)

[a] Case definition included hydrophobia.

Dimaano EM, et al. International J Infect Dis 2011;15:e495-e499

29

Rabies virus is adapted to its reservoir host and different variants exists in the United States, such as racoon variant, bat variant, fox variant, and skunk variant. Although cross-species transmission of rabies virus variants does occur (for example, infection of dogs with raccoon rabies variant), rabies virus variants are primarily transmitted within the species they are adapted to, such as the raccoon variant primarily being transmitted between raccoons. Rabies virus variants associated with the major mesocarnivore species (such as raccoons, skunks, foxes, and mongooses) are distributed in distinct geographic regions.



Between 2013-2017, bats with rabies were found in every state except for Hawaii. Skunks with rabies have been found in parts of California, the Midwest, Texas, Kentucky, Virginia, North Carolina, and Tennessee. Raccoons with rabies have been found in the South and Eastern states. Foxes with rabies have been found in Alaska, Arizona, and New Mexico. Foxes and skunks with rabies have been found in Arizona, New Mexico, and Texas. Mongoose with rabies have been found in Puerto Rico.

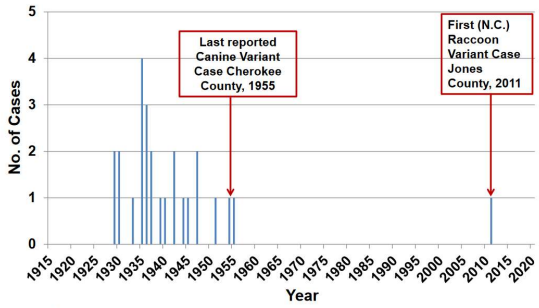
Animal Rabies, US

https://www.cdc.gov/rabies/location/usa/surveillance/wild_animals.html

30

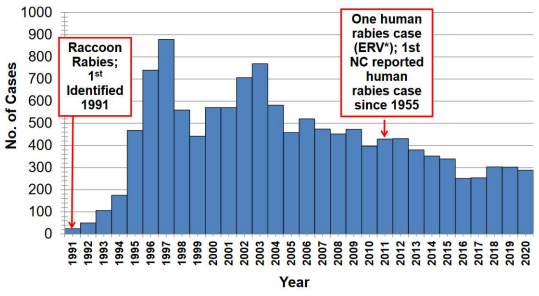
HUMAN AND ANIMAL RABIES BY YEAR, NC

Human Rabies Reported Cases
North Carolina, 1929 - 2020 (n = 26)



NC Department of Health and Human Resources
Reported Communicable Diseases, Data Accessed Jan 2021

Confirmed Rabid Mammals by Year,
North Carolina, 1991 − 2020 (n = 12,746)



Source: NC State Laboratory of Public Health
Updated Jan 2021

*ERV = Eastern Raccoon Variant

https://epi.dph.ncdhhs.gov/cd/rabies/figures.html#graphs

RABIES AROUND THE WORLD

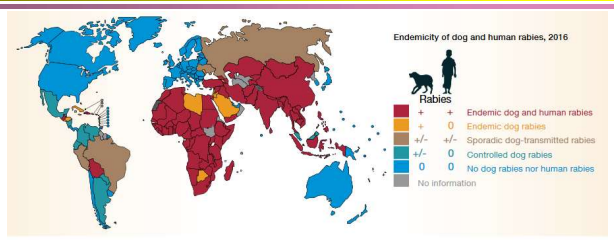
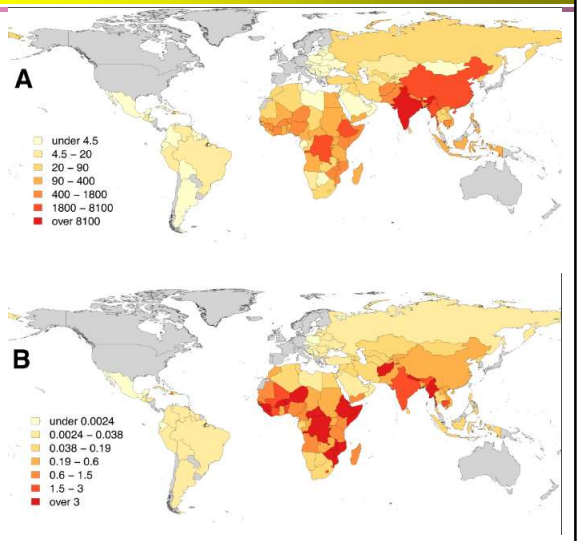


Figure A1.1. Endemicity of dog-mediated human rabies *(2)*

file:///C:/Users/dweber/AppData/Local/Temp/9789241513838-eng.pdf

https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0003709#pntd-0003709-g003



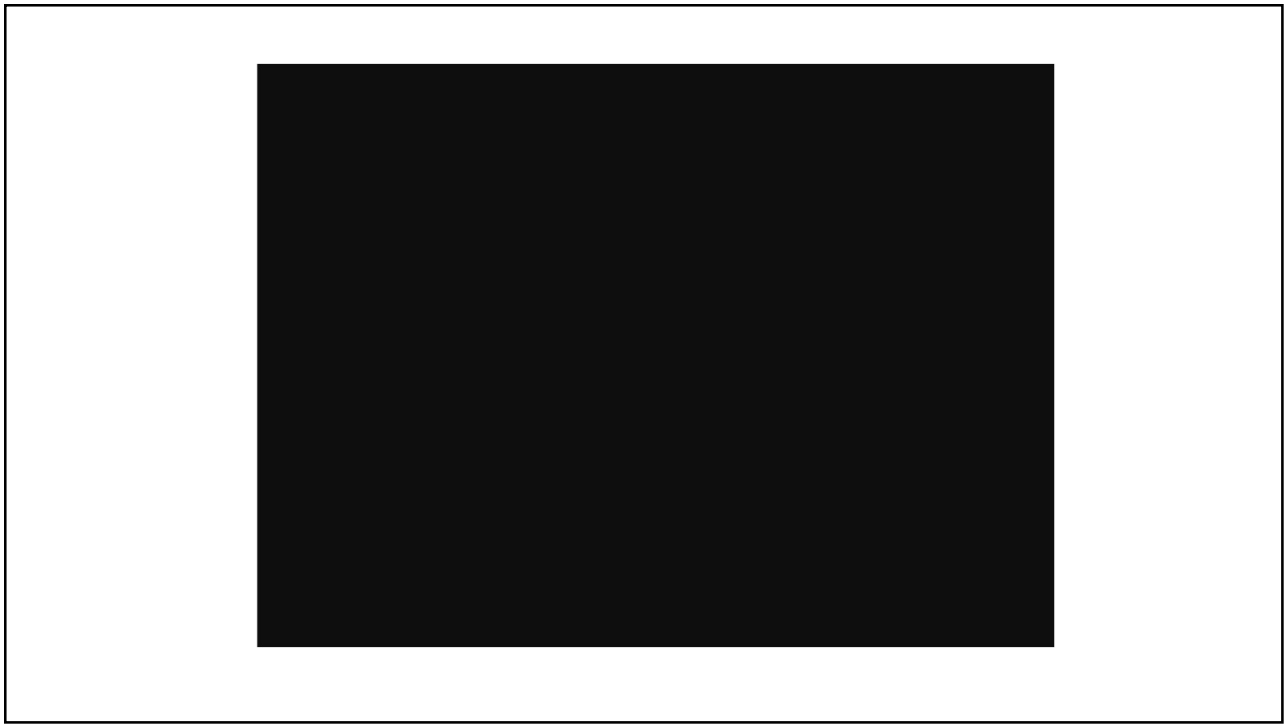
The distribution of the global burden of rabies, 2015: A) human rabies deaths (~59,000), B) per capita death rates (per 100,000 persons)

RABIES: EPIDEMIOLOGY AND PREVENTION, WHO

- Rabies is a vaccine-preventable viral disease which occurs in more than 150 countries and territories.
- Dogs are the main source of human rabies deaths, contributing up to 99% of all rabies transmissions to humans.
- Interrupting transmission is feasible through vaccination of dogs and prevention of dog bites.
- Infection causes tens of thousands of deaths every year, mainly in Asia and Africa.
- Globally rabies causes an estimated cost of US$ 8.6 billion per year
- 40% of people bitten by suspect rabid animals are children under 15 years of age.
- Immediate, thorough wound washing with soap and water after contact with a suspect rabid animal is crucial and can save lives.
- Engagement of multiple sectors and One Health collaboration including community education, awareness programes and vaccination campaigns are critical.

https://www.who.int/news-room/fact-sheets/detail/rabies

33



34

RABIES: THE FACTS

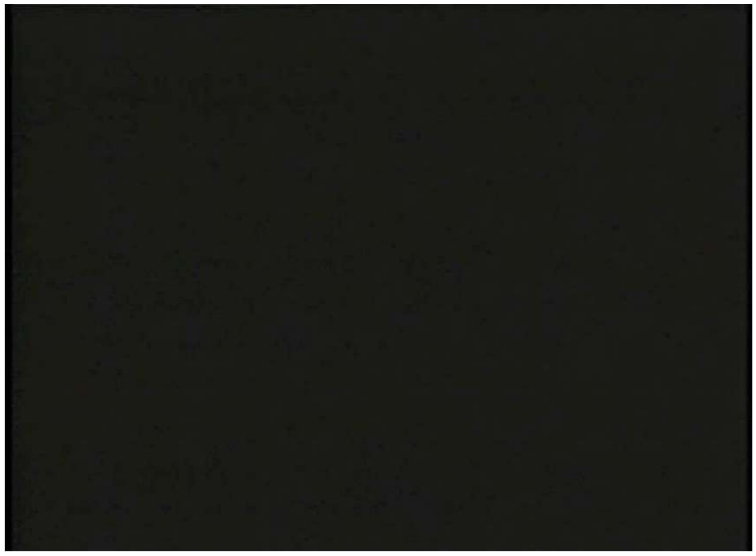
- Rabies endemic throughout the world
- Main source of human rabies in the US in the past was dogs
- Highly fatal to all mammals (only 6 human survivors)
- No treatment once symptoms appear
- In South America ruminants are a major source of human rabies (due to vampire bats)
- Animal saliva is source of infection (dead animals are indeed dangerous)

35

RABIES: FICTION

- All rabid animals are aggressive “furious rabies”
  - In 15-20% of cases the infected animal or human demonstrates the paralytic form (“dumb rabies”)
- Most human cases in US were due to domestic or wild animal bites (most cases in US are now due to bats)
- Domestic animals rarely infected since dogs must be immunized in all states (cats also in most states including NC)

36



37

POLIO: THE FACTS

- Summer outbreaks were common
- Children most commonly infected
- Death commonly due to respiratory failure (therapy = support using a ventilator)
- Prior to vaccine, >20,000 cases per year of paralytic polio
  - The number of polio cases in the U.S. peaked at 57,879, resulting in 3,145 deaths.
- 1987 survey revealed 670,00 Americans living with sequelae of paralytic polio

https://ourworldindata.org/polio

Hospital room in the US, 1952

38

POLIO: FICTION

- Polio not transmitted by respiratory route; masks not necessary (fecal-oral transmission)
- Following acute polio, progressive improvement is the usual course (post-polio syndrome {PPS} affects ~25-40% of survivors, usually 15-40 years after the initial infection; many survivors experience a modest decline in function and muscle strength over many years)
  - Symptoms of PPS: Muscle weakness; mental and physical fatigue; joint pain
  - Some people with PPS have only minor symptoms, while others develop more visible muscle weakness and atrophy (a decrease in muscle size). PPS is rarely life-threatening, but the symptoms can make it difficult for an affected person to function independently.

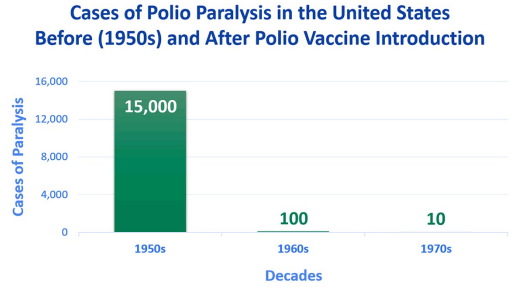
39

INACTIVATED POLIO VACCINE (SALK) PROGRAM, 1955

First and second graders in San Diego line up to be vaccinated in 1955. Bettman Collection via Getty Images

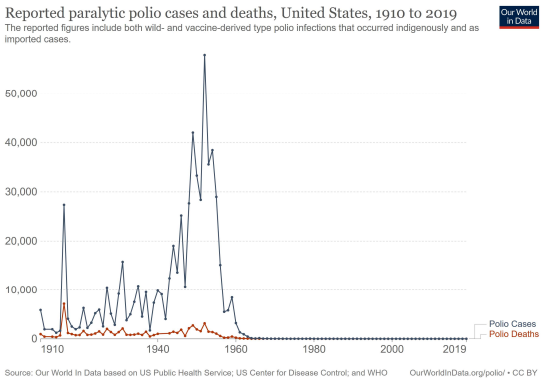
40

POLIO ELIMINATION IN THE US



https://www.cdc.gov/polio/what-is-polio/polio-us.html

Polio was once one of the most feared diseases in the U.S. In the early 1950s, before polio vaccines were available, polio outbreaks caused more than 15,000 cases of paralysis each year. Following introduction of vaccines—specifically, trivalent inactivated poliovirus vaccine (IPV) in 1955 and trivalent oral poliovirus vaccine (OPV) in 1963—the number of polio cases fell rapidly to less than 100 in the 1960s and fewer than 10 in the 1970s.



Salk vaccine was FDA approved in 1955, Sabin vaccine in 1962
Last case of US originated polio, 1979

https://ourworldindata.org/polio

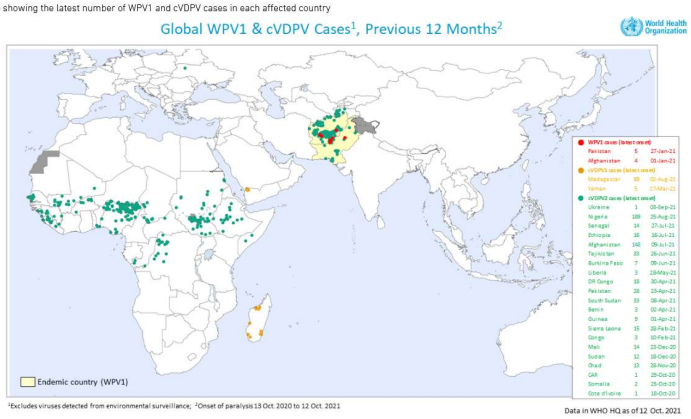
41

POLIO ERADICATION

- Poliomyelitis (polio) is a highly infectious viral disease that largely affects children under 5 years of age. The virus is transmitted by person-to-person spread mainly through the fecal-oral route or, less frequently, by a common vehicle (e.g. contaminated water or food) and multiplies in the intestine, from where it can invade the nervous system and cause paralysis.
- In 1988, the World Health Assembly adopted a resolution for the worldwide eradication of polio, marking the launch of the Global Polio Eradication Initiative, spearheaded by national governments, WHO, Rotary International, the US CDC, UNICEF, and later joined by the Bill & Melinda Gates Foundation and Gavi, the Vaccine Alliance. Wild poliovirus cases have decreased by over 99% since 1988, from an estimated 350,000 cases in more than 125 endemic countries then to 175 reported cases in 2019.
- Of the 3 strains of wild poliovirus (type 1, type 2 and type 3), wild poliovirus type 2 was eradicated in 1999 and no case of wild poliovirus type 3 has been found since the last reported case in Nigeria in November 2012. Both strains have officially been certified as globally eradicated. As at 2020, wild poliovirus type 1 affects two countries: Pakistan and Afghanistan.
- The strategies for polio eradication work when they are fully implemented. This is clearly demonstrated by India's success in stopping polio in January 2011, in arguably the most technically challenging place, and polio-free certification of the entire WHO Southeast Asia Region in March 2014.

POLIO ERADICATION WORLDWIDE

A map showing the latest number of WPV1 and cVDPV cases in each affected country



https://polioeradication.org/polio-today/polio-now/

POLIO ERADICATION AND RESURGENCE

- Poliomyelitis (polio) is a highly infectious viral disease that largely affects children under 5 years of age. The virus is transmitted by person-to-person spread mainly through the fecal-oral route or, less frequently, by a common vehicle (e.g. contaminated water or food) and multiplies in the intestine, from where it can invade the nervous system and cause paralysis.
- In 1988, the World Health Assembly adopted a resolution for the worldwide eradication of polio, marking the launch of the Global Polio Eradication Initiative, spearheaded by national governments, WHO, Rotary International, the US CDC, UNICEF, and later joined by the Bill & Melinda Gates Foundation and Gavi, the Vaccine Alliance. Wild poliovirus cases have decreased by over 99% since 1988, from an estimated 350,000 cases in more than 125 endemic countries then to 175 reported cases in 2019.
- Of the 3 strains of wild poliovirus (type 1, type 2 and type 3), wild poliovirus type 2 was eradicated in 1999 and no case of wild poliovirus type 3 has been found since the last reported case in Nigeria in November 2012. Both strains have officially been certified as globally eradicated. As at 2020, wild poliovirus type 1 affects two countries: Pakistan and Afghanistan.
- 2021, cVDPV2 was reported in 2021 in Ethiopia (2), Mali (1), Nigeria (23), Sierra Leone (1), and Tajikistan (1); 2022 cVDP2 reported in Israel, UK (positive wastewater – led to vaccination of London children under 10) and NY (positive wastewater and 1 patient with paralytic polio)
- The strategies for polio eradication work when they are fully implemented. This is clearly demonstrated by India's success in stopping polio in January 2011, in arguably the most technically challenging place, and polio-free certification of the entire WHO Southeast Asia Region in March 2014.

44

PARALYTIC POLIO, US

- Transmission: Fecal-oral (direct contact, indirect via contaminated water or food); droplet – infected people can shed virus for weeks from GI tract; virus can survive for weeks in the environment
- Long-term carrier states (>6 mo) may occur in immunocompromised persons
- Most cases of polio are asymptomatic but 25% develop flu-like symptoms: Pharyngitis, fever, fatigue, nausea, headache, abdominal pain – duration 2-5 days
- Meningitis = 1% to 5%; Paralysis = 0.5% to 0.05% (Between 2 and 10 out of 100 die)
- Post-polio syndrome: Development of new muscle pain, weakness, or paralysis as adults,15 to 40 years after recovery (25%-40% of patient with hx paralytic polio).
- Diagnosis: Detection in stool
- Vaccine: Only inactivated vaccine available in US (risk VAPP with oral vaccine, ½.4 million); routine childhood vaccination; effectiveness (3 doses) 99%-100%; >90% have antibody after 25 years

Summary

What is already known about this topic?

Sustained poliovirus transmission has been eliminated from the United States for approximately 40 years; vaccines are highly effective in preventing paralysis after exposure.

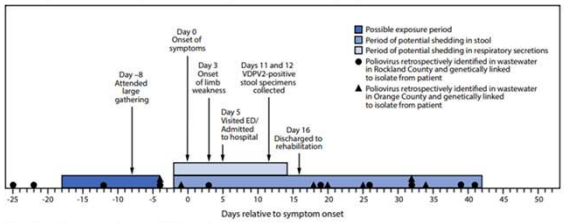
What is added by this report?

In June 2022, poliovirus was confirmed in an unvaccinated immunocompetent adult resident of New York hospitalized with flaccid lower limb weakness. Vaccine-derived poliovirus type 2 was isolated from the patient and identified from wastewater samples in two neighboring New York counties.

What are the implications for public health practice?

Unvaccinated persons in the United States remain at risk for paralytic poliomyelitis if they are exposed to either wild or vaccine-derived poliovirus; all persons in the United States should stay up to date on recommended poliovirus vaccination.

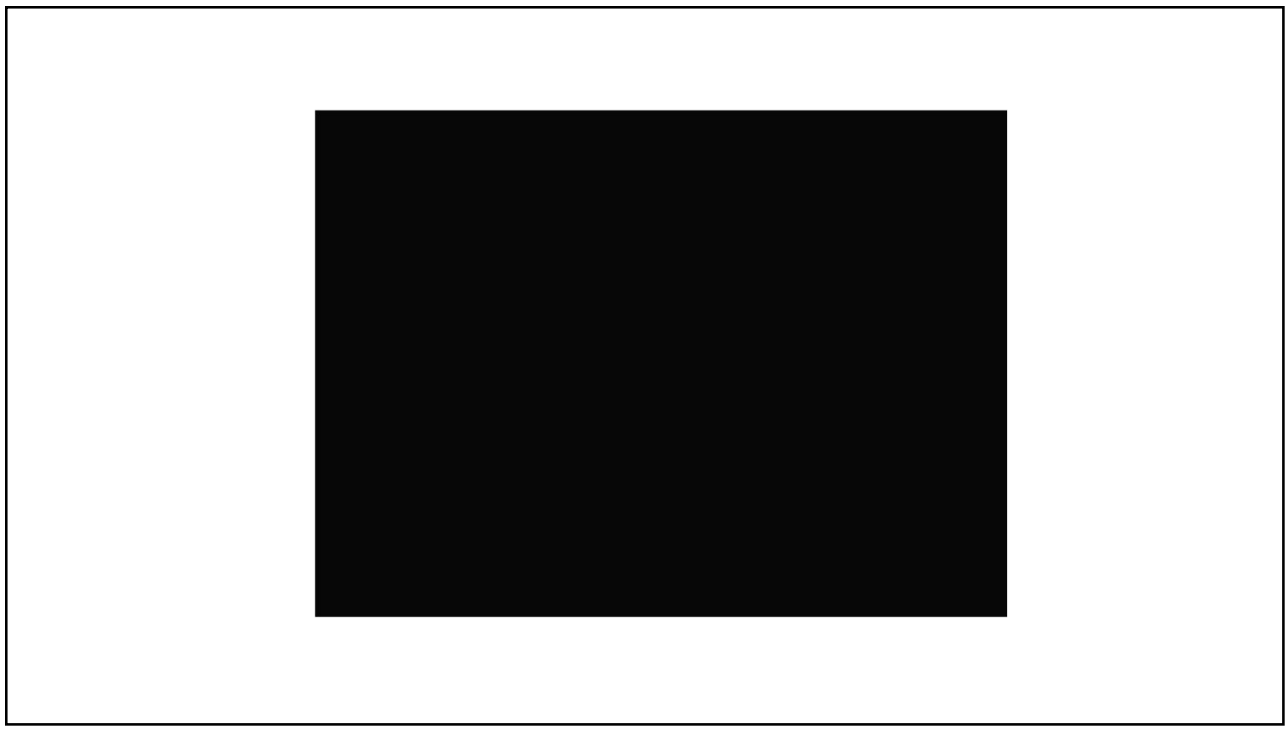
FIGURE. Timeline of patient activities, potential poliovirus exposures, shedding, and poliovirus-positive wastewater* samples† genetically linked to a patient with a case of type 2 vaccine-derived poliovirus — New York, May–August 2022



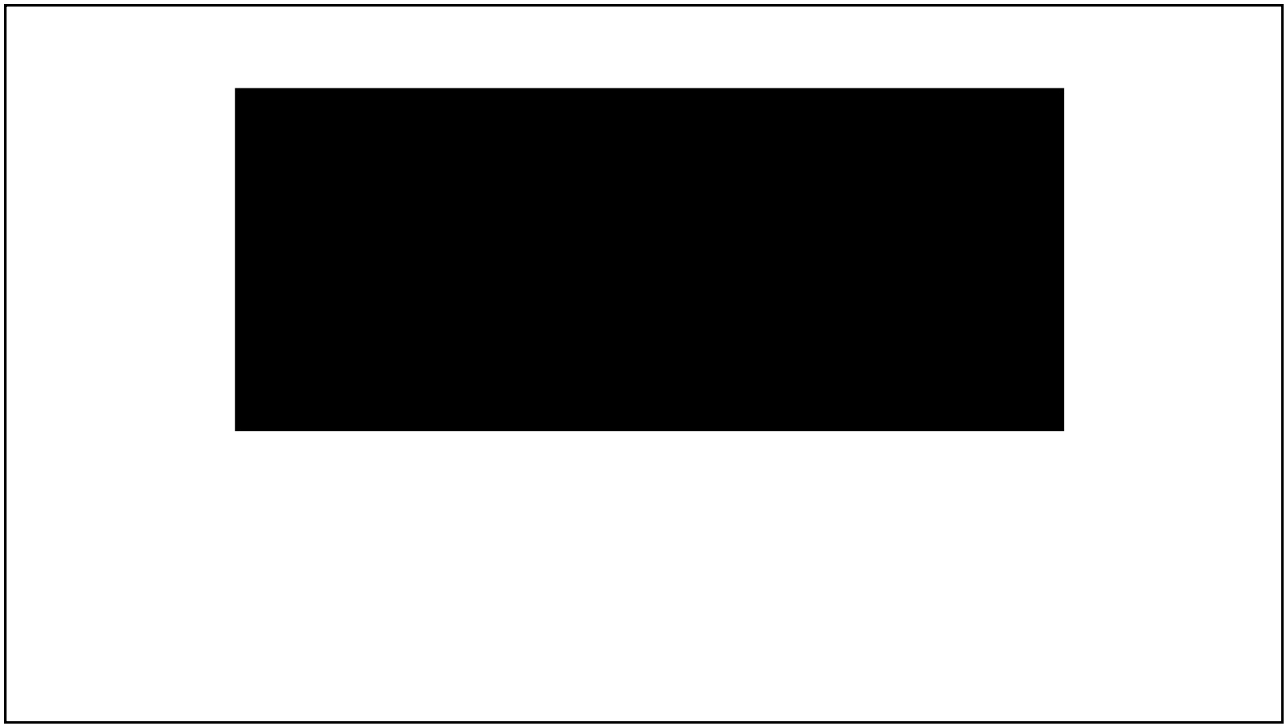
Abbreviations: ED = emergency department; VDPV2 = type 2 vaccine-derived poliovirus.
* Wastewater, also referred to as sewage, includes water from household or building use (e.g., toilets, showers, and sinks) that can contain human fecal waste and water from non-household sources (e.g., rain and industrial use).
† More than one positive wastewater sample might have been collected on the same day in Rockland County or Orange County.

Link-Gelles R, et al. MMWR 2022;71:1065

45



46



47

FAMOUS PEOPLE WITH TUBERCULOSIS

- *C. P. E. Bach: Musician
- *Frederic Chopin: Musician
- Noel Coward: Author
- Ralph Waldo Emerson: Writer
- Paul Erhlich: Physician
- *Doc Holliday: Gunman
- *Vivian Leigh: Actress
- Franklin Pierce: President
- F. Scott Fitzgerald: Writer
- *George Orwell: Writer
- *Eleanor Roosevelt: Wife of president
- *Henry David Thoreau: Writer
- Leon Trotsky: Writer
- George Washington: President
- *Walt Whitman: Writer

* Died of tuberculosis

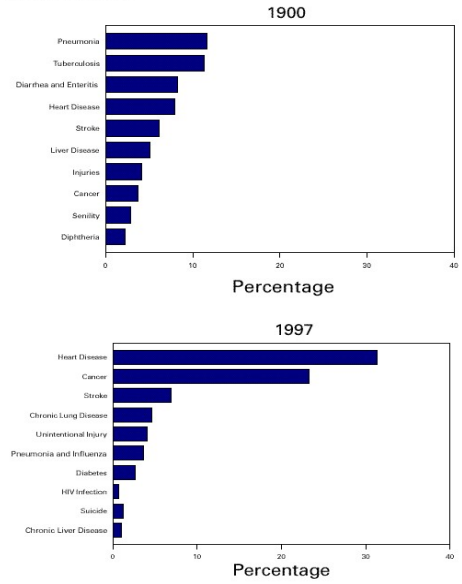
48

DR. JOHN HENRY “DOC” HOLLIDAY

- 1851: Born in Griffin, Georgia, to a wealthy family
- 1870-72: Studied dentistry
- 1873: Found to have tuberculosis (possible nosocomial acquisition) and moved West after being told he had “3 months to live”
- 1873: Gave up dentistry due to his chronic cough
- 1875-1882: Killed >10 men
- 1882: Fought along the Earps at O.K. Corral
- 1887: Died of tuberculosis

49

FIGURE 2. The 10 leading causes of death as a percentage of all deaths — United States, 1900 and 1997



50

TUBERCULOSIS: THE FACTS

- Tuberculosis primarily a disease of the industrial age
- Common cause of chronic illness
- Well described by term “consumption”
- Transmission via airborne route
  - Coughing in source increases transmission frequency
  - Infection control: Mask on source case, detection & therapy LTBI
- Reactivation TB
  - Hemoptysis, 25%
- No effective therapy until mid-20th century
- Highly effective vaccine still lacking

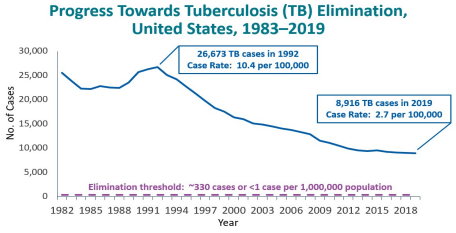
51

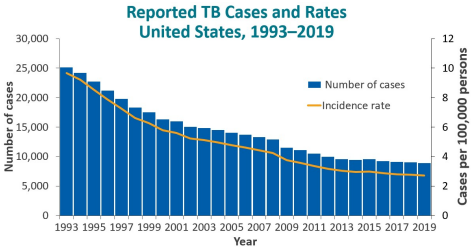
TUBERCULOSIS TODAY

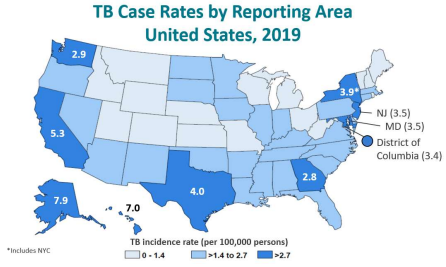
- Falling incidence in the U.S.
- Increasingly a disease of immigrants
- Worldwide concerns of multi-drug resistance (MDR-TB; resistant to INH and rifampin)
- Growing threat of extreme-drug resistance (XDR-TB; resistant to INH, rifampin, and ≥2 classes of injectable treatment)
- Important cause of death in HIV-infected persons

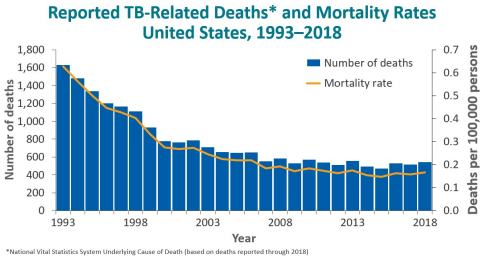
52

TB EPIDEMIOLOGY, US, CDC







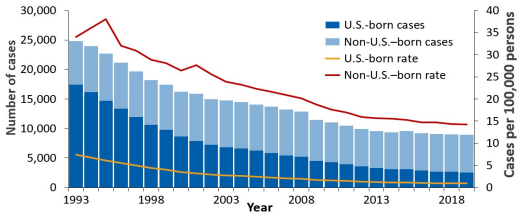


53

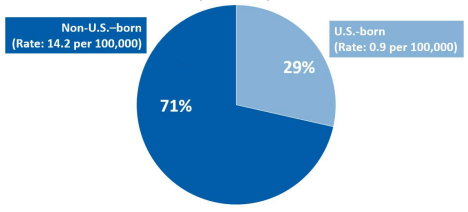
TB EPIDEMIOLOGY, US, CDC

https://www.cdc.gov/tb/statistics/surv/surv2019/default.htm

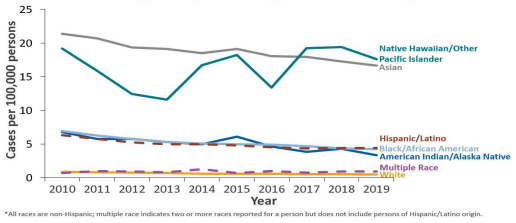
TB Cases and Rates Among U.S.-born versus Non-U.S.–born Persons, United States, 1993–2019



TB Cases by Origin of Birth, 2019 (N=8,905)

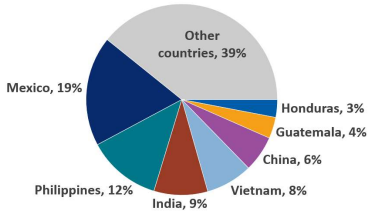


TB Case Rates by Race/Ethnicity*, United States, 2010–2019

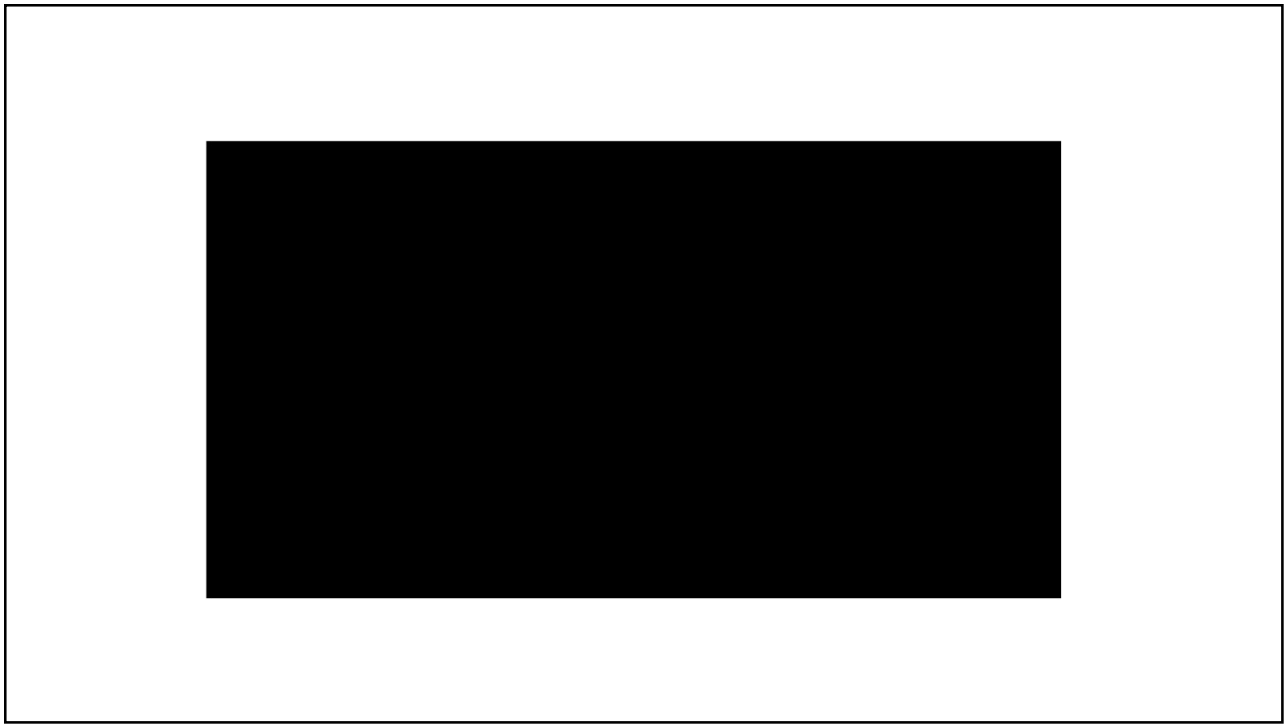


*All races are non-Hispanic; multiple race indicates two or more races reported for a person but does not include persons of Hispanic/Latino origin.

Countries of Birth Among Non-U.S.–born Persons Reported with TB, United States, 2019 (N=6,364)



54



55

HIV: THE FACTS

- Initial survival of AIDS ~18 weeks
- Wasting a common feature of AIDS
- Kaposi's sarcoma considered an AIDS defining diagnosis
- HIV infected persons did in fact face discrimination
- Initially no available therapies

56

HIV: FICTION

- Long term survival of persons with HIV infection now common due to multi-drug treatment
- PrEP and PEP now available
- HIV infected patients protected, in part, from discrimination under the ADA
- Opportunistic infections much less common due to prophylaxis
- Kaposi's sarcoma due to HHV-8
  - Incidence has dropped dramatically
  - But still a major public health concern

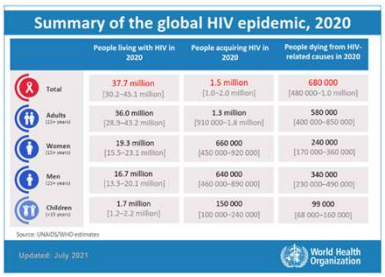
57

AIDS, WORLDWIDE

People living with HIV/AIDS
37.7 million
people living with HIV/AIDS worldwide in 2020

Mortality
680 000
people died of HIV-related illnesses worldwide in 2020

Prevention
90
low- and middle-income countries reported a total of 190 million people tested and received results in 2018



Summary of the global HIV epidemic, 2020

	People living with HIV in 2020	People acquiring HIV in 2020	People dying from HIV-related causes in 2020
Total	37.7 million [30.2–45.1 million]	1.5 million [1.0–2.0 million]	680 000 [480 000–1.0 million]
Adults (15+ years)	36.0 million [28.9–43.2 million]	1.3 million [910 000–1.8 million]	580 000 [400 000–850 000]
Women (15+ years)	19.3 million [15.5–23.1 million]	660 000 [450 000–920 000]	240 000 [170 000–360 000]
Men (15+ years)	16.7 million [13.3–20.1 million]	640 000 [460 000–890 000]	340 000 [230 000–490 000]
Children (<15 years)	1.7 million [1.2–2.2 million]	150 000 [100 000–240 000]	99 000 [68 000–160 000]

Source: UNAIDS/WHO estimates

Updated: July 2021

World Health Organization

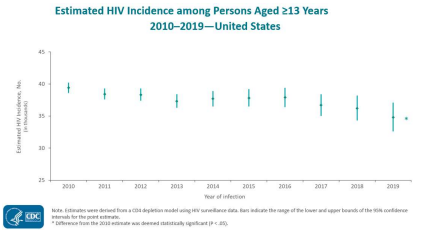
- 37.7 million [30.2 million–45.1 million] people globally were living with HIV in 2020.
- 1.5 million [1.0 million–2.0 million] people became newly infected with HIV in 2020.
- 680 000 [480 000–1.0 million] people died from AIDS-related illnesses in 2020.
- 27.5 million [26.5 million–27.7 million] people were accessing antiretroviral therapy in 2020.
- 79.3 million [55.9 million–110 million] people have become infected with HIV since the start of the epidemic.
- 36.3 million [27.2 million–47.8 million] people have died from AIDS-related illnesses since the start of the epidemic.

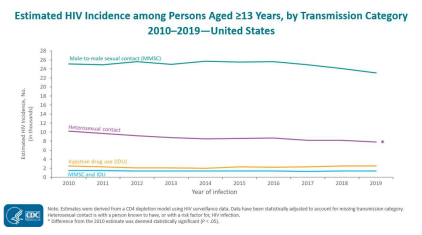
https://www.who.int/data/gho/data/themes/hiv-aids

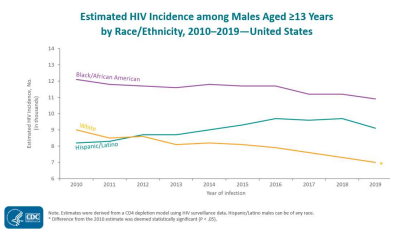
https://www.unaids.org/en/resources/fact-sheet

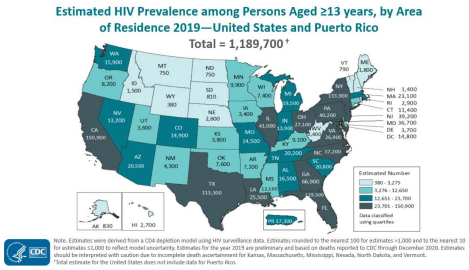
58

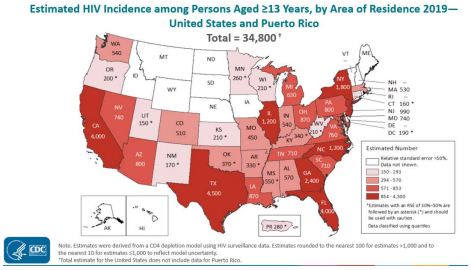
CURRENT HIV EPIDEMIOLOGY, US

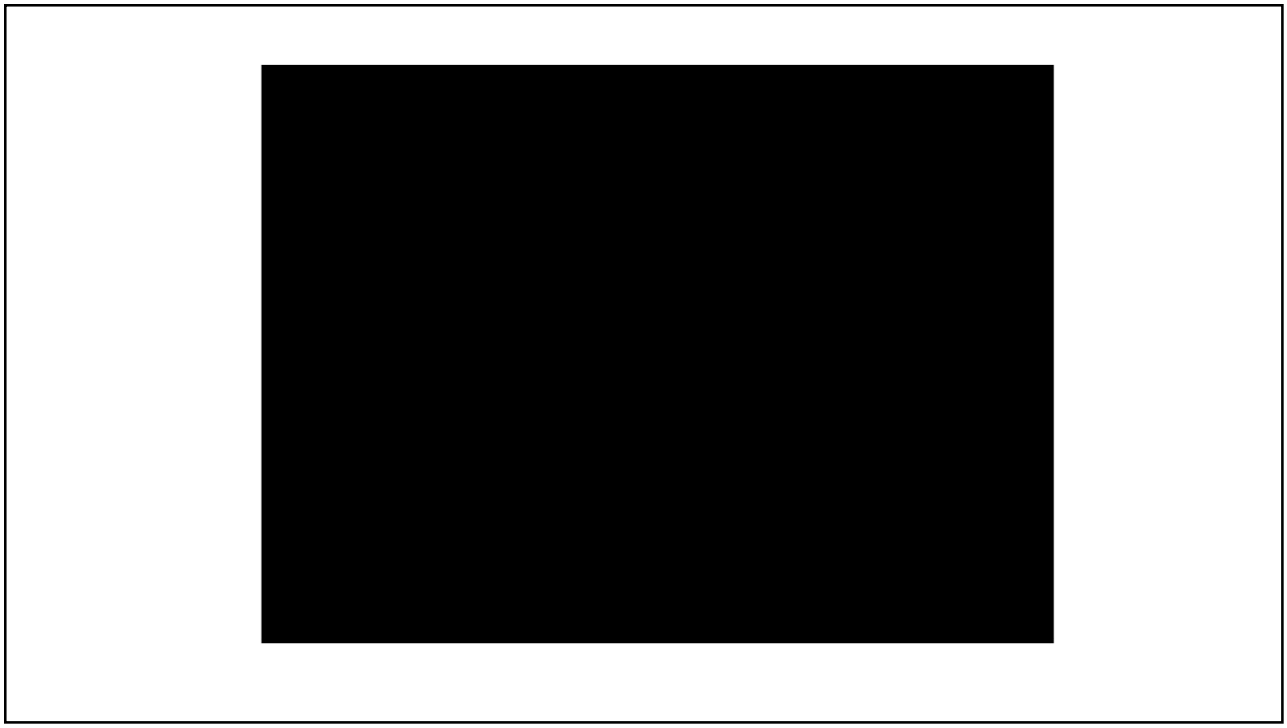








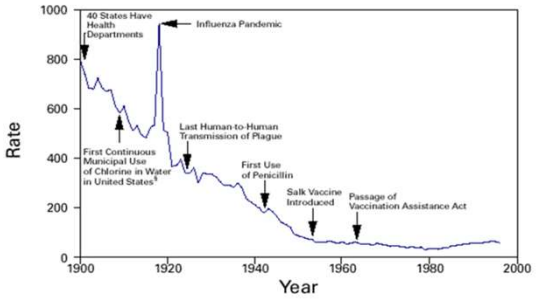




60

IMPACT OF 1918-19 INFLUENZA AND COVID-19 PANDEMICS ON DEATH RATES AND LIFE EXPECTANCY, US

FIGURE 1. Crude death rate* for infectious diseases — United States, 1900–1996†



*Per 100,000 population per year.
†Adapted from Armstrong GL, Conn LA, Pinner RW. Trends in infectious disease mortality in the United States during the 20th century. JAMA 1999:281;61–6.
§American Water Works Association. Water chlorination principles and practices: AWWA manual M20. Denver, Colorado: American Water Works Association, 1973.

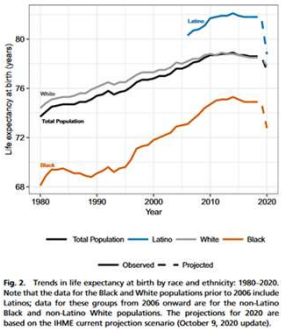


Fig. 2. Trends in life expectancy at birth by race and ethnicity: 1980–2020. Note that the data for the Black and White populations prior to 2006 include Latinos; data for these groups from 2006 onward are for the non-Latino Black and non-Latino White populations. The projections for 2020 are based on the IHME current projection scenario (October 9, 2020 update).

Table 3. Summary of the direct, indirect, and overall effects of the COVID-19 pandemic in the United States in 2020.

	Excess Mortality	Life Expectancy Loss	YLL
Direct Effects	313171	1.35 (1.35, 1.35)	5,340,469 (5,068,888, 5,627,895)
Indirect Effects	62064 (-180791, 304917)	0.32 (-0.94, 1.64)	2,022,086 (-3472687, 8041802)
Overall Effect	375235 (132380, 618088)	1.67 (0.41, 2.99)	7,362,555 (1,596,202, 13,669,696)

Values in parentheses represent the 95% prediction interval.

Chan EYS, et al. PLoS One 2021;1 September

61