Beth Israel Lahey Health
Mount Auburn Hospital

Harvard Medical School

Travel and Tropical Vaccine Update

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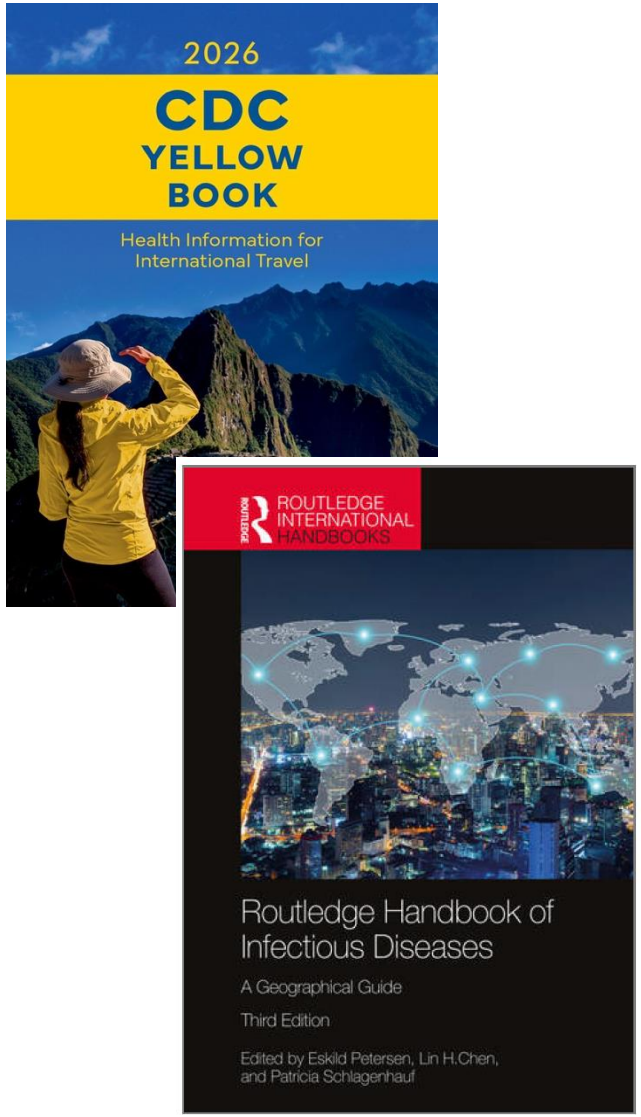
ASTMH Update Course, September 27, 2025



Disclosures

- DSMBs: Valneva (resigned at start of ACIP term)
- Consultant/lecturer: Valneva, Takeda, MSD, Bavarian Nordic (before ACIP term)
- Medical Content Editor: Shoreland, UpToDate, DynaMed
- Royalties: "*Infectious Diseases: A Geographical Guide*"
- Former member: Advisory Committee on Immunization Practices

Objective

- Provide brief overview of diseases preventable by the main travel vaccines
- Discuss specialized travel vaccines and their characteristics
- Describe current travel vaccine recommendations

Commonly Considered Travel Vaccines

Required for certain travel

- Yellow fever
- Meningococcal
- Polio

Recommended for travel

- Hepatitis A
- Typhoid
- Cholera
- Rabies
- Japanese encephalitis
- Tick-borne encephalitis
- Chikungunya
- Dengue

Routine/other vaccines with travel indications

- COVID-19
- Hepatitis A
- Hepatitis B
- Influenza
- MMR
- Mpox
- Meningococcal
- Polio
- Tdap

JTM Journal of Travel Medicine
International Society of Travel Medicine
Promoting healthy travel worldwide
Journal of Travel Medicine, 2023, 1–14
https://doi.org/10.1093/jtm/taad085
Review

Review

Travel vaccines—priorities determined by incidence and impact … influenced by outbreaks that arise

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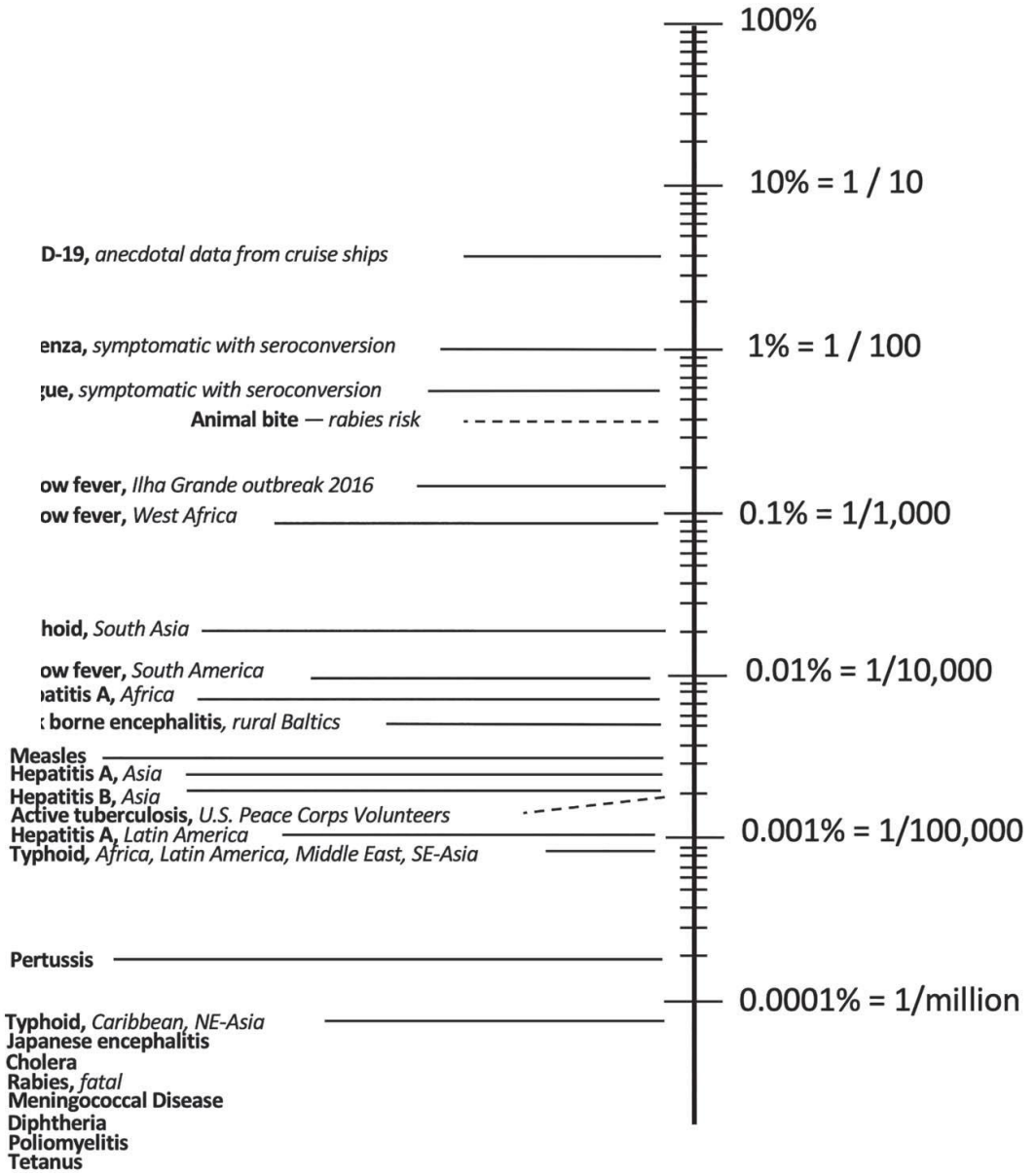
Published literature provide some data on epidemiology of vaccine preventable diseases in travelers … shift over time

Recommendations on travel vaccines should consider impact of disease

Outbreaks modify risk of exposure and risk perception



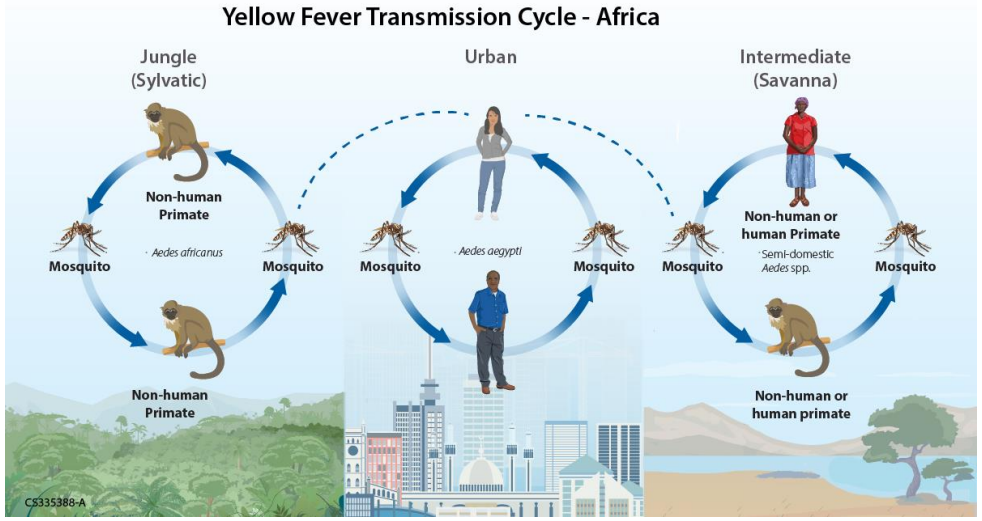
Steffen R, et al. JTM 2023

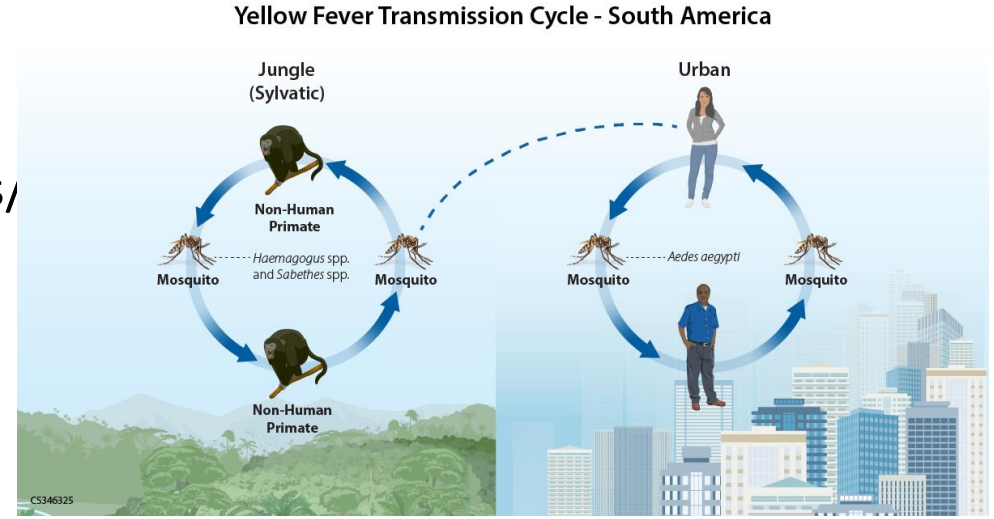
Case 1: 63 yo healthy M, leaving in 1 months to attend niece's wedding in Cartagena, Colombia x3 days, then travel to nearby national parks and islands x7 days. How do you advise him about yellow fever vaccination?

A. No YF vaccine because it is not required by Colombia for entry
B. Get YF vaccine since it does not have any serious side effects
C. Get YF vaccine given the presence of YF risk especially with visits to national parks
D. No YF vaccine due to age ≥60 years, with increased risk for severe adverse events

Yellow fever

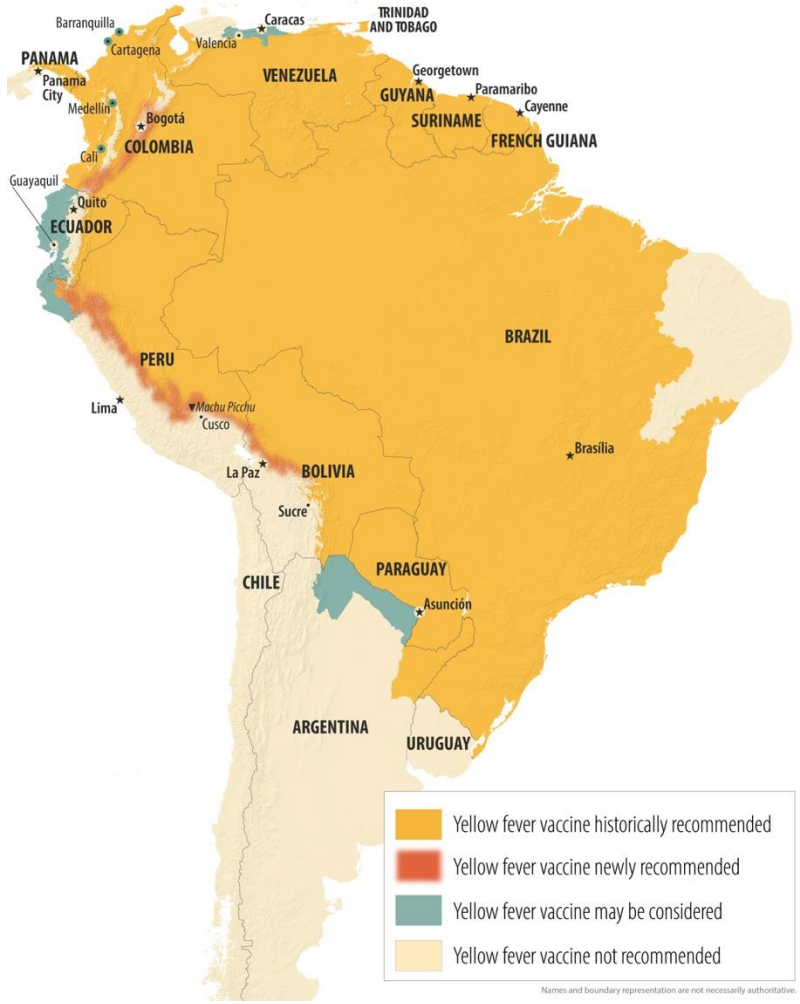
- Agent: single-stranded, enveloped RNA, family *Flaviviridae*, genus *Flavivirus*
- Transmission: mosquitoes
  - *Aedes*
  - *Haemagogus*
  - *Sabethes*
- Epidemiology: sub-Saharan Africa (90% of cases), tropical South America
- Burden: 200,000 cases/year, deaths 30,000-60,000
- Clinical: incubation 3-6 days, fever/chills/headache/myalgias/anorexia/nausea/vomiting/dizzy; viremia x3 days
- Severe in 15%: multi-organ failure, hemorrhagic fever
- Dx/Tx: PCR/serology/IHC stain; supportive
- Case fatality rate: estimated 30-60%





https://www.cdc.gov/yellow-fever/php/transmission/index.html

Yellow fever 2016-2018: >37 travel-associated cases in unvaccinated travelers from nonendemic areas/countries, including ≥15 European travelers and 1 American



https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/yellow-fever.html

Prevention: YF vaccine

- Live-attenuated, derived from 17D virus strain, produced in eggs
- Indication: persons aged ≥9 months living in or traveling to YF risk areas
- Administration: 0.5 mL, subcutaneous
- Immunity: 80-100% by 10 days, 99% by 30 days
- Adverse events:
  - Common 10-30%:
    - Headache, fever, backache, pain at injection site
  - Serious AEs:
    - Anaphylaxis (1.3 cases/100,000 doses); hypersensitivity to eggs or gelatin
    - Neurologic/neurotropic disease (0.8/100,000 doses)
    - Viscerotropic disease (0.3/100,000 doses)

Risk of YF infection vs vaccine SAE for 2-week stay

Illness	Death
• West Africa: 50/100,000 • South America: 5/100,000	• West Africa: 10/100,000 • South America: 1/100,000

- YEL-AND: 0.8/100,000 (2.2 per 100,000 doses in people ≥60 years)
- YEL-AVD 0.3/100,000 (1.2 per 100,000 doses in people ≥60 years years)

YF vaccine contraindications and precautions

Contraindications

- Age <6 months
- Allergy to vaccine component[1]
- HIV infection (symptomatic) or CD4 T lymphocyte counts <200/mL (or <15% of total lymphocytes in children aged <6 years)[2,3]
- Primary immunodeficiencies
- Immunosuppressive and immunomodulatory therapies
- Malignant neoplasms
- Thymus disorder associated with abnormal immune cell function
- Transplantation

Precautions

- Age 6–8 months
- Age ≥60 years
- Breastfeeding
- HIV infection (asymptomatic) and CD4 T lymphocyte counts 200–499/mL (or 15–24% of total lymphocytes in children aged <6 years)[2,3]
- Pregnancy

MMWR 2010;59(RR07); CDC Health Information for International Travel 2026

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Meningococcal disease

- Agent: gram-negative *Neisseria meningitidis;* serogroups A, B, C, W, X, Y
- Transmission: respiratory secretions, close contact
- Epidemiology worldwide: high incidence “meningitis belt”, dry season (December-June), up to 1,000/100,000 population
- Clinical: incubation 1-10 days, 50% present as meningitis, 30% meningococcemia, 15% bacteremic pneumonia… septic arthritis
- Case fatality rate: 10-15% even with antibiotics, up to 20% survivors have long-term sequelae (deaf, necrosis/amputation)
- Dx/Tx: CSF or blood culture/sensitivity, PCR; 3rd generation cephalosporins

Meningococcal vaccine for travel

- Meningococcal ACWY (-CRM or -TT)
- Administration: 0.5 mL IM
- Duration of protection: 5 years

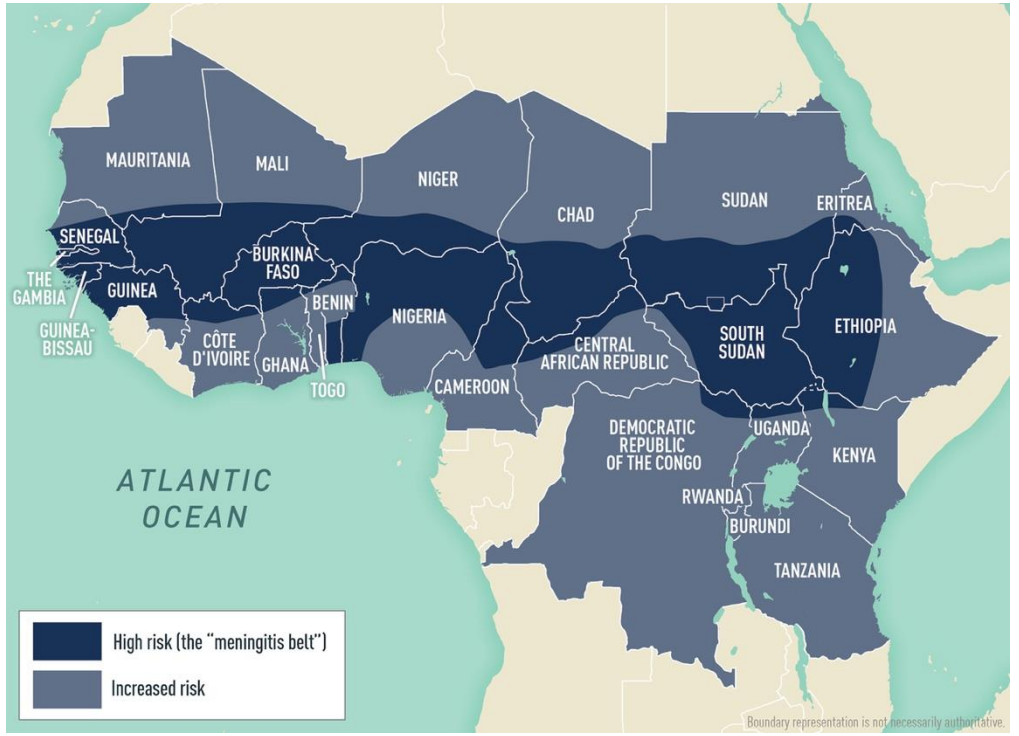
Meningococcal vaccine

Required: Kingdom of Saudi Arabia

- Age >2 years arriving for Umrah, Hajj or for seasonal work in Hajj zones, are required to submit a valid vaccination certificate with a **quadrivalent (ACYW) meningococcal vaccine** administered not less than 10 days prior to the planned arrival to Saudi Arabia.

https://www.saudia.com/pages/before-flying/travel-information/hajj-and-umrah/health-requirements

Recommended: Meningitis Belt



https://wwwnc.cdc.gov/travel/yellowbook/2024/infections-diseases/meningococcal-disease

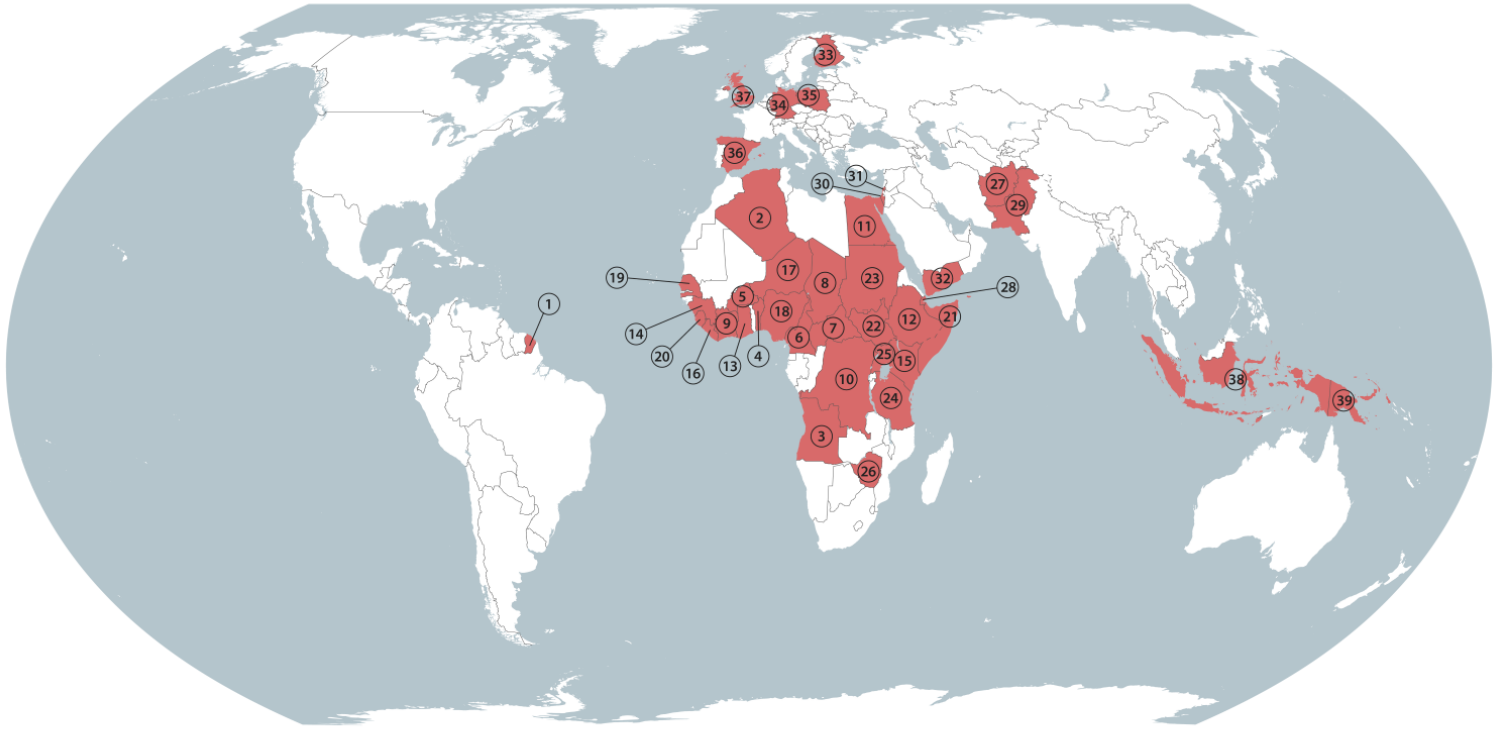
Polio PHEIC: extended 28 July 2025 (WHO IHR EmergencyComm)

- 1988: polio paralyzed 350,000 children annually across 125 countries.
- Polio vaccination is estimated to have prevented 20 million people from paralysis.
- 3 billion children have been vaccinated against polio.

cVDPV = circulating vaccine derived polio virus

https://polioeradication.org;
https://www.cdc.gov/mmwr/volumes/74/wr/mm7407a4.htm;
https://www.who.int/news/item/03-12-2024-statement-of-the-fortieth-meeting-of-the-polio-ihr-emergency-committee

Countries Where Poliovirus Has Been Detected within Last 12 Months



Polio THN

AMERICAS
1. French Guiana

AFRICA
2. Algeria
3. Angola
4. Benin
5. Burkina Faso
6. Cameroon
7. Central African Republic
8. Chad
9. Côte d'Ivoire
10. Dem. Rep. of the Congo
11. Egypt
12. Ethiopia
13. Ghana
14. Guinea
15. Kenya
16. Liberia
17. Niger
18. Nigeria
19. Senegal
20. Sierra Leone
21. Somalia
22. South Sudan
23. Sudan
24. Tanzania
25. Uganda
26. Zimbabwe

EASTERN MEDITERRANEAN
27. Afghanistan
28. Djibouti
29. Pakistan
30. Gaza
31. Israel
32. Yemen

EUROPE
33. Finland
34. Germany
35. Poland
36. Spain
37. United Kingdom

SOUTH-EAST ASIA
38. Indonesia

WESTERN PACIFIC
39. Papua New Guinea

Poliovirus detected within the last 12 months

Names and boundary representation are not necessarily authoritative.

CDC: Adult travelers may get an inactivated polio vaccine booster if they:

- Are going to a destination that has circulating poliovirus
- Have completed their routine polio vaccine series
- Have not already received one adult booster dose

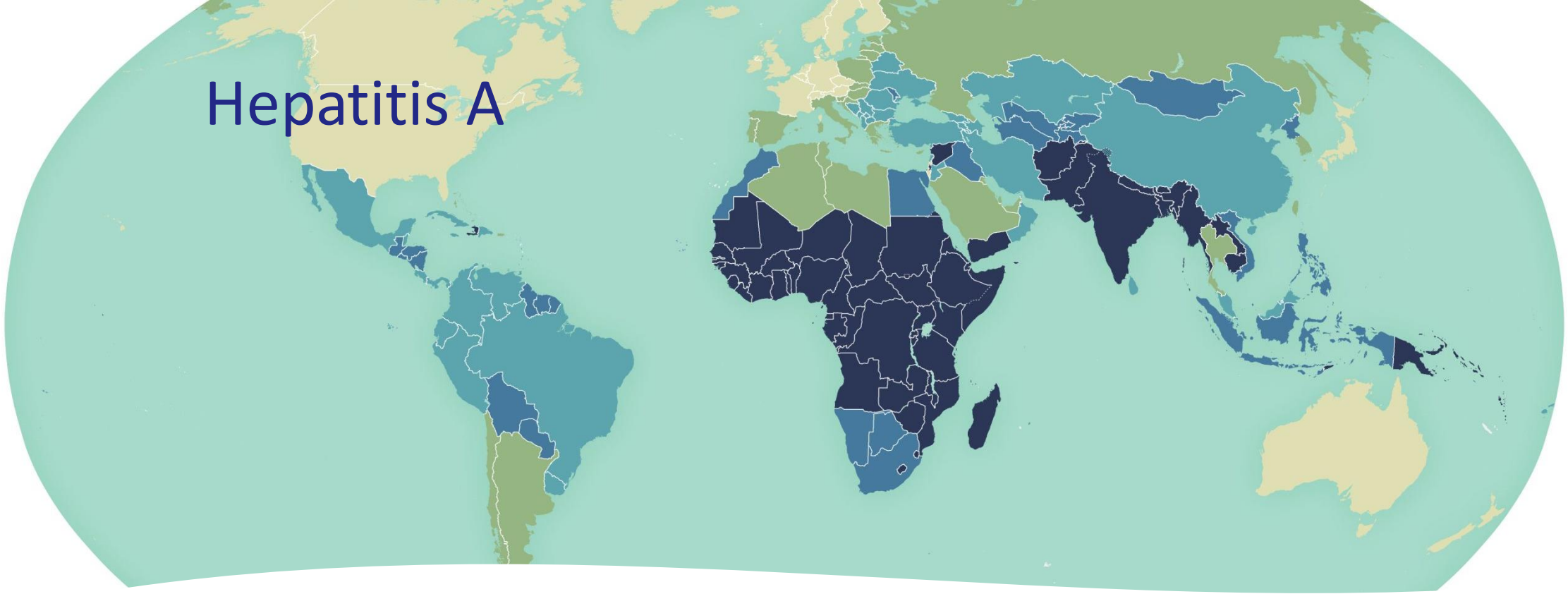
https://wwwnc.cdc.gov/travel/notices/level2/global-polio

Recommended vaccine: transmission via food and drinks

Case 2. 40 yo F with Crohn's will leave in 10 days for a 2-week office work in Lusaka, Zambia, stay in hotel. Which vaccine(s)should be recommended to prevent food- and water-borne infections?

A. Hepatitis A only
B. Hepatitis A, typhoid oral, cholera
C. Typhoid oral, cholera
D. Hepatitis A, typhoid polysaccharide

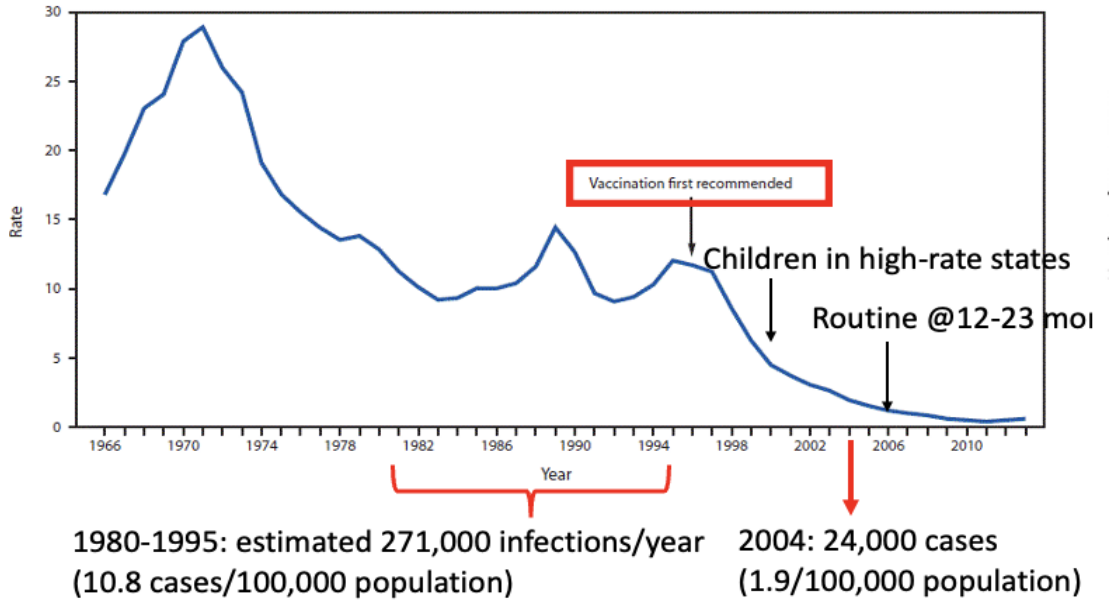
Hepatitis A



- Agent: picornavirus, non-enveloped RNA virus
- Transmission: fecal-oral, ingestion of contaminated food/water
- Clinical: incubation 28 days (15-50 d), fever/malaise/anorexia/nausea/abdominal pain
- Sequelae: 10-15% have prolonged or relapsing x6-9 months; fulminant hepatitis rare
- Dx/Tx: serology; supportive care
- Vaccine: inactivated 2-dose series, 1 mL IM Day 0, >6 month

https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/hepatitis-a.html

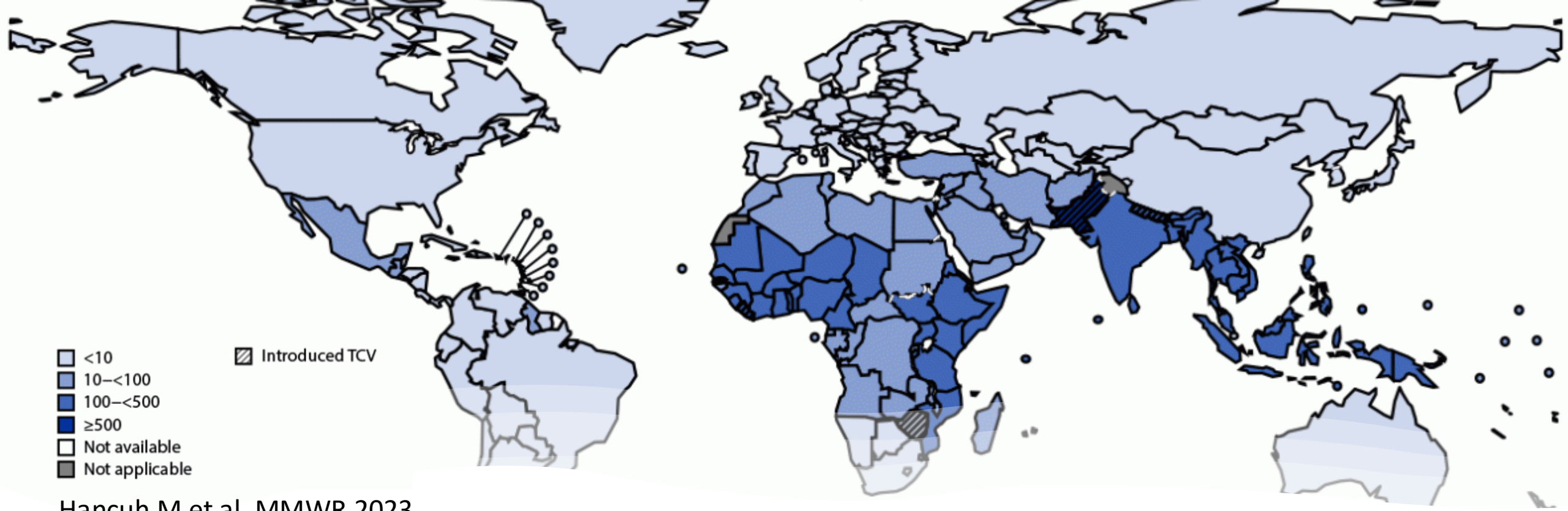
Hepatitis A: incidence declined in US 95.5% 1996-2011; Higher impact on infected persons aged ≥40 Years



- **WHO:** "consider for people age ≥1 year who are traveling to countries or areas of intermediate or high endemicity"
- **Low-endemicity countries (U.S., Canada, Europe, Australia)** generally have similar recommendations

- **Last-minute travel:** still benefit from vaccination; 1 dose provides good protection for the upcoming travel; dose 2 at >6 months completes the series (>30 years protection)

cdn.who.int/media/docs/default-source/travel-and-health/9789241580472-eng-chapter-6.pdf?sfvrsn=8c1a400c_14
www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/hepatitis-a.html

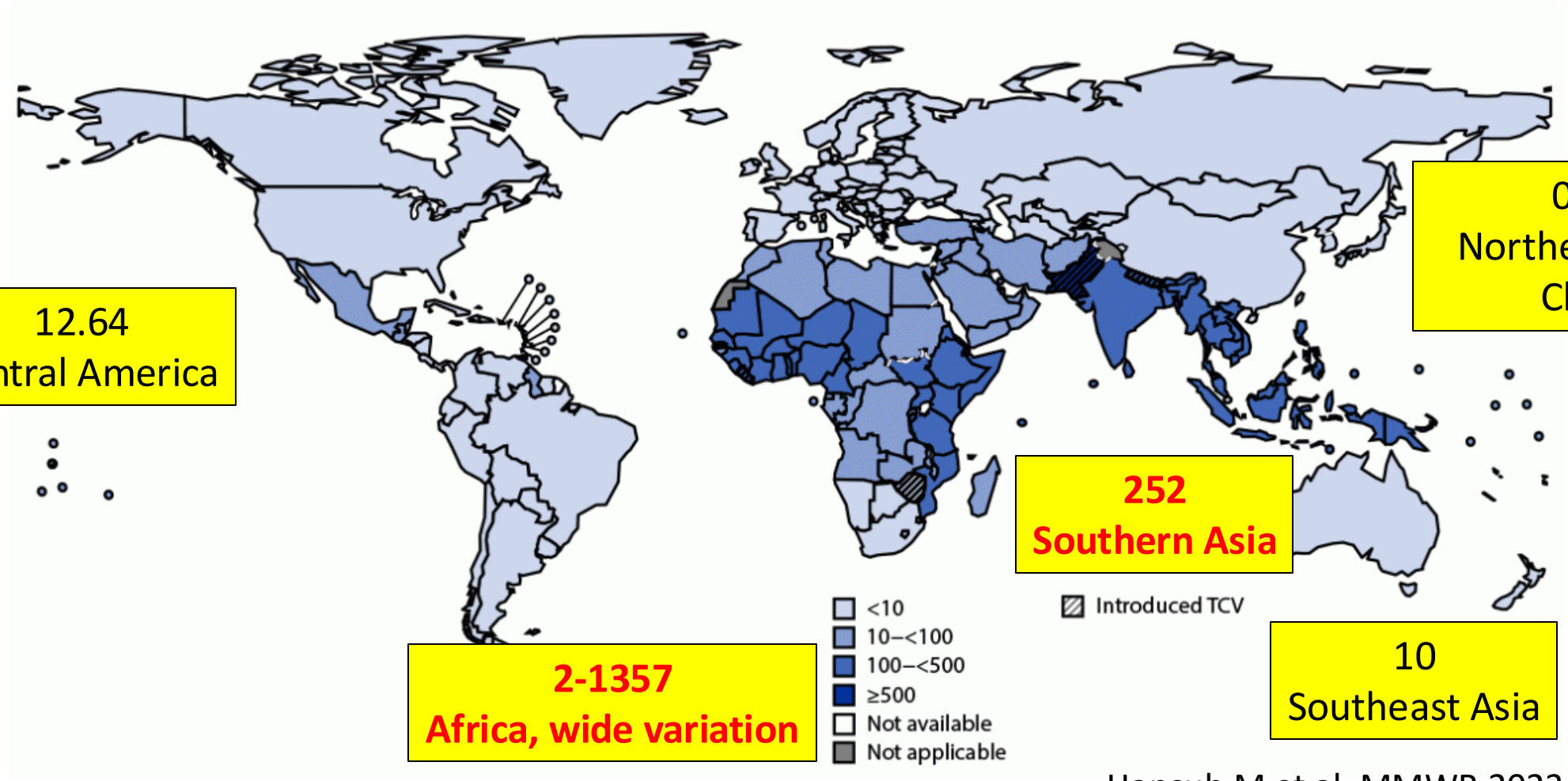


Hancuh M et al. MMWR 2023

Typhoid fever:
estimated national incidence - worldwide, 2019 and 2022

- Agent: Gram-negative bacterium *Salmonella enterica* serotype *Typhi*
- Transmission: ingestion of food/water, fecal-oral
- Epidemiology/burden: 9.2 million cases/year worldwide, 133,000 deaths; US 450 confirmed/year
- Clinical: incubation 6-30 days; gradual fatigue/fever, abdominal pain, constipation, diarrhea, hepatosplenomegaly, rose spots
- Dx/Tx: culture of blood, bone marrow, stool; antibody tests not specific; MDR - azithromycin or ceftriaxone, XDR – azithromycin or carbapenem; chronic carriage in 1-4%

Typhoid Fever: incidence rates in travelers (estimated cases per 100,000 person-year)



12.64
Central America

2-1357
Africa, wide variation

252
Southern Asia

0.35
Northeast Asia, China

342
Samoa

10
Southeast Asia

Hancuh M et al. MMWR 2023;
Forster DP & Leder K. JTM 2021

Typhoid fever — impact in travelers

- US: 400 laboratory-confirmed annually (most imported), but estimated 5,700/ year.
- GeoSentinel acute/life-threatening disease: most common conditions were falciparum malaria (76.9%), typhoid fever (11.7%), paratyphoid fever (6.4%), and leptospirosis (2.4%).

  Jensenieus M et al. AJTMH 2013; 88:397-404.
- Concern about XDR: n = 186 *S. typhi* (GeoSentinel)
  - 43 recent ex. Pakistan → 8 XDR (Resistant to amoxicillin, ceftriaxone, ciprofloxacin, TMP-SMX)

  Posen HJ et al. J Travel Med 2023; 30:taac086.
- Hospitalization rate: about 60%

  Hagmann SHF et al. Antimicrob Agents Chemother 2020; 64:e01084-20.
- CFR in travelers 0 – 2%
- Fatalities in travelers (n = 2) published by:

  Boggild AK et al. Vaccine 2010; 28:7389-95.

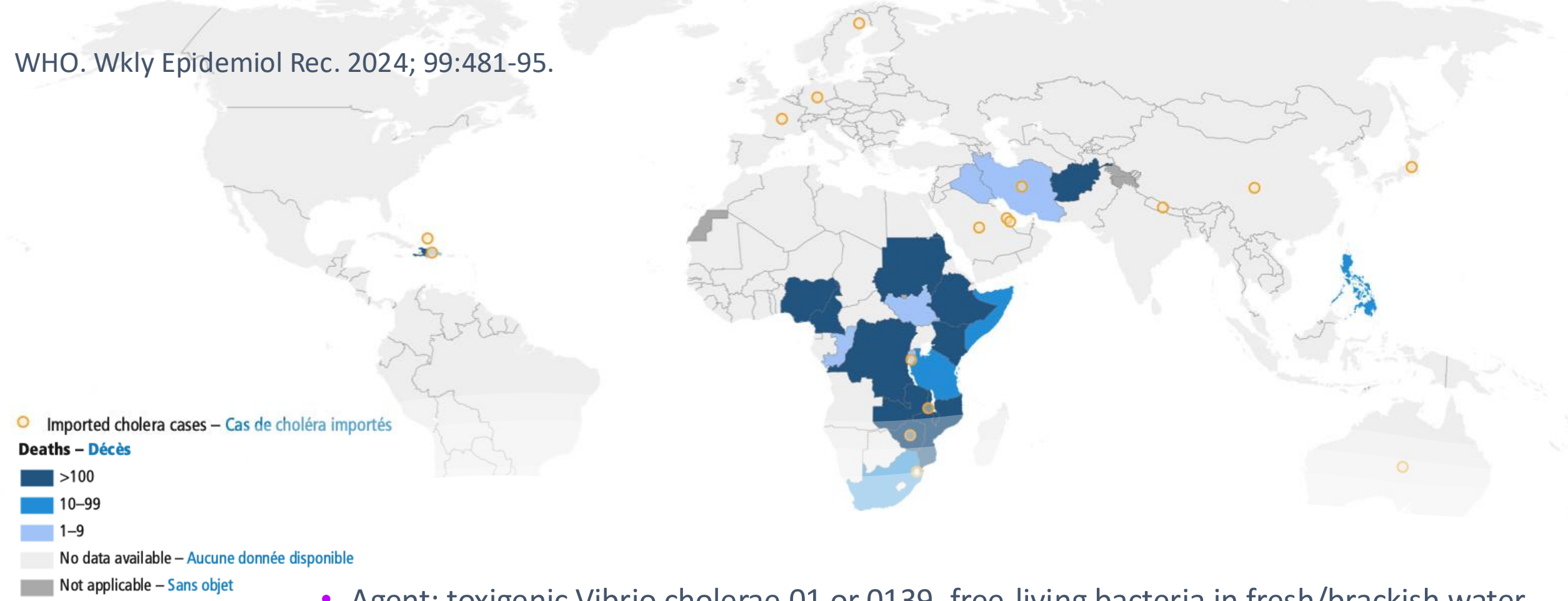
  Ackers ML et al. JAMA 2000; 283:2668-73.

Typhoid fever vaccines

Vaccine	Approved Ages	Dose/Route of Administration	Number of Doses	Dosing Interval	Protective duration
VI Capsular polysaccharide vaccine (ViCPS)—Typhim Vi	≥2 years	0.5 mL, IM injection	1	N/A	2 years
Live attenuated Ty21a vaccine—Vivotif	≥6 years	1 capsule, orally every other day	4	48 hours	5 years

https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/typhoid-and-paratyphoid-fever.html

WHO. Wkly Epidemiol Rec. 2024; 99:481-95.



Cholera

- Agent: toxigenic Vibrio cholerae 01 or 0139, free-living bacteria in fresh/brackish water
- Epidemiology: in 2023, 535,321 cases, 4007 deaths from 45 countries (10 only imported cases); Africa, Americas, South and SE Asia
- US: 11 reported cases in 2019; 35 reported cases 2020-2024, mostly VFR
- Clinical: acute watery diarrhea, 10% severe +/- naursea/vomiting
- Dx/Tx: stool culture, PCR; RDTs in endemic settings; doxycycline or azithromycin
- Overall CFR 0.7% (1.3-1.4% in Africa and Haiti/DR)

Cholera vaccines

Licensed sites	Vaccine	Brand	Type	Age	Dosing	Note
US, Australia, Canada, Europe, UK	CVD 103-HgR	Vaxchora	Live attenuated	2-64 years	Oral, reconstitute active and buffer components	Co-admin– wait 8 hours before 1st oral typhoid
Australia, Canada, Europe, UK… >60 countries	Whole cell V. cholerae 01 (Inaba and Ogawa, classical, and El Tor) + recombinant cholera toxin B subunit (monovalent, WC-rCTB)	Dukoral	Inactivated	≥ 2 years	Oral, single dose vial (active component) and sachet (buffer)	Co-admin– wait 8 hours before 1st oral typhoid ETEC activity
South Korea	Bivalent whole cell	Euvichol-Plus and Euvichol-S	Inactivated	≥ 1 year	Oral suspension, 1.5 mL vial	

Vaxchora and Dukoral should be administered ≥8 hours before 1st dose of oral typhoid vaccine capsules (Vivotif) to decrease potential interference of Vaxchora's buffer with the Vivotif capsule.

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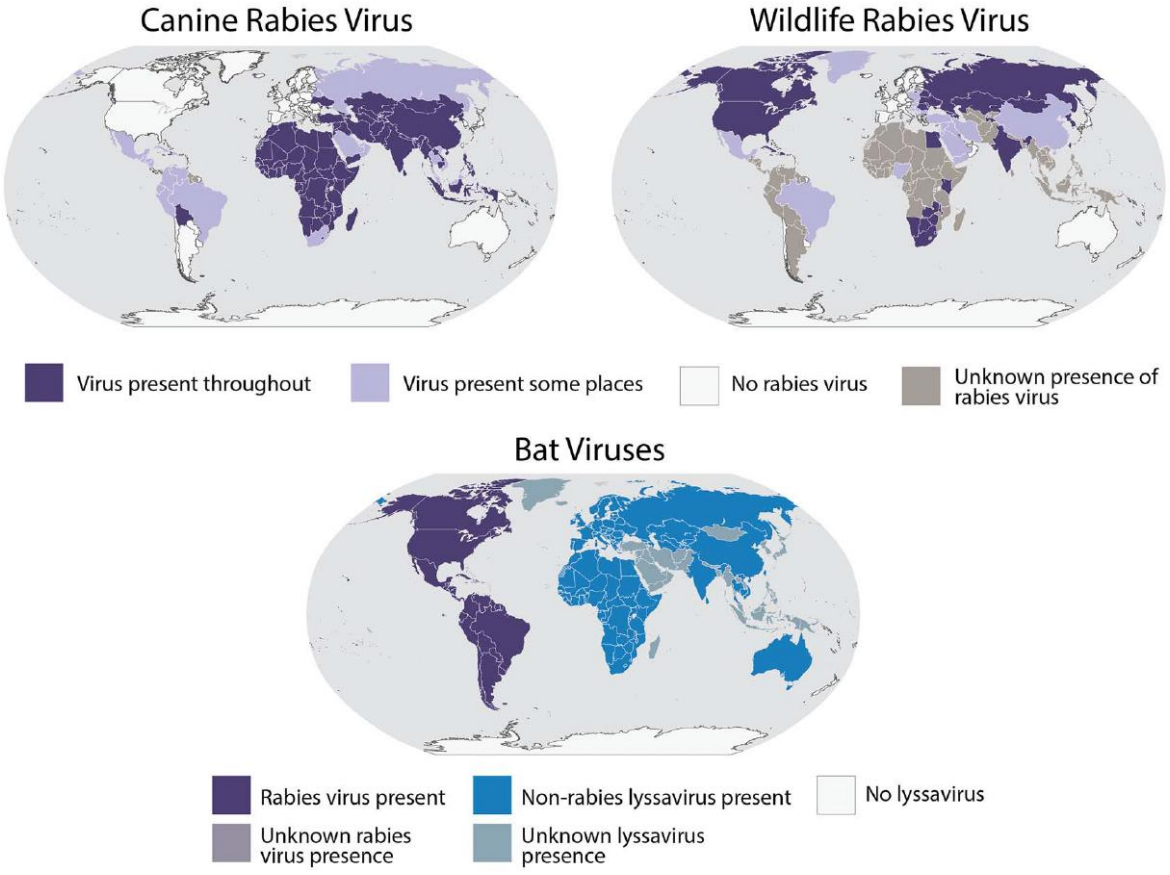
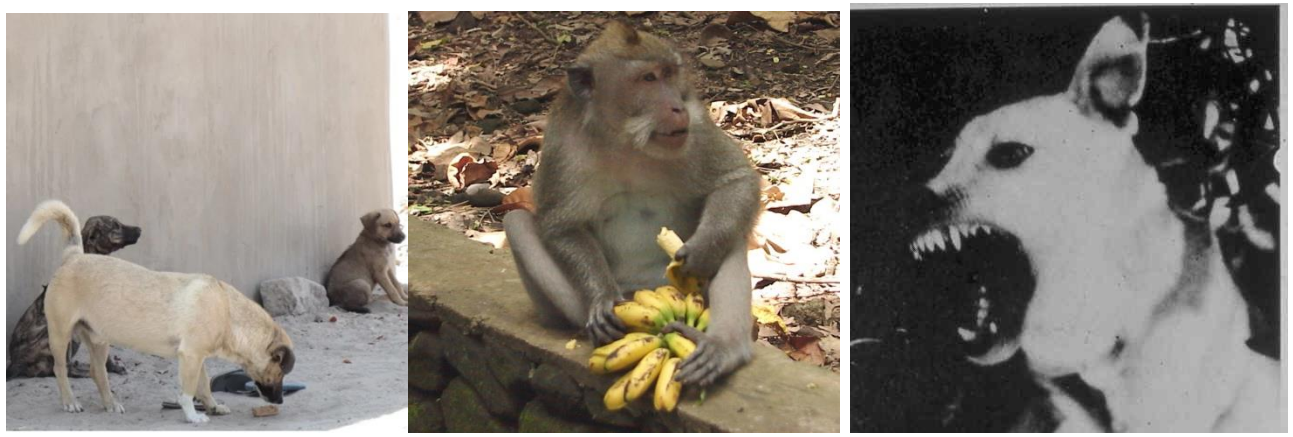
A. Hepatitis A only
B. Hepatitis A, typhoid oral, cholera
C. Typhoid oral, cholera
D. Hepatitis A, typhoid polysaccharide

Recommended vaccine: transmission via animal contact



Henry RE et al. JTM 2022

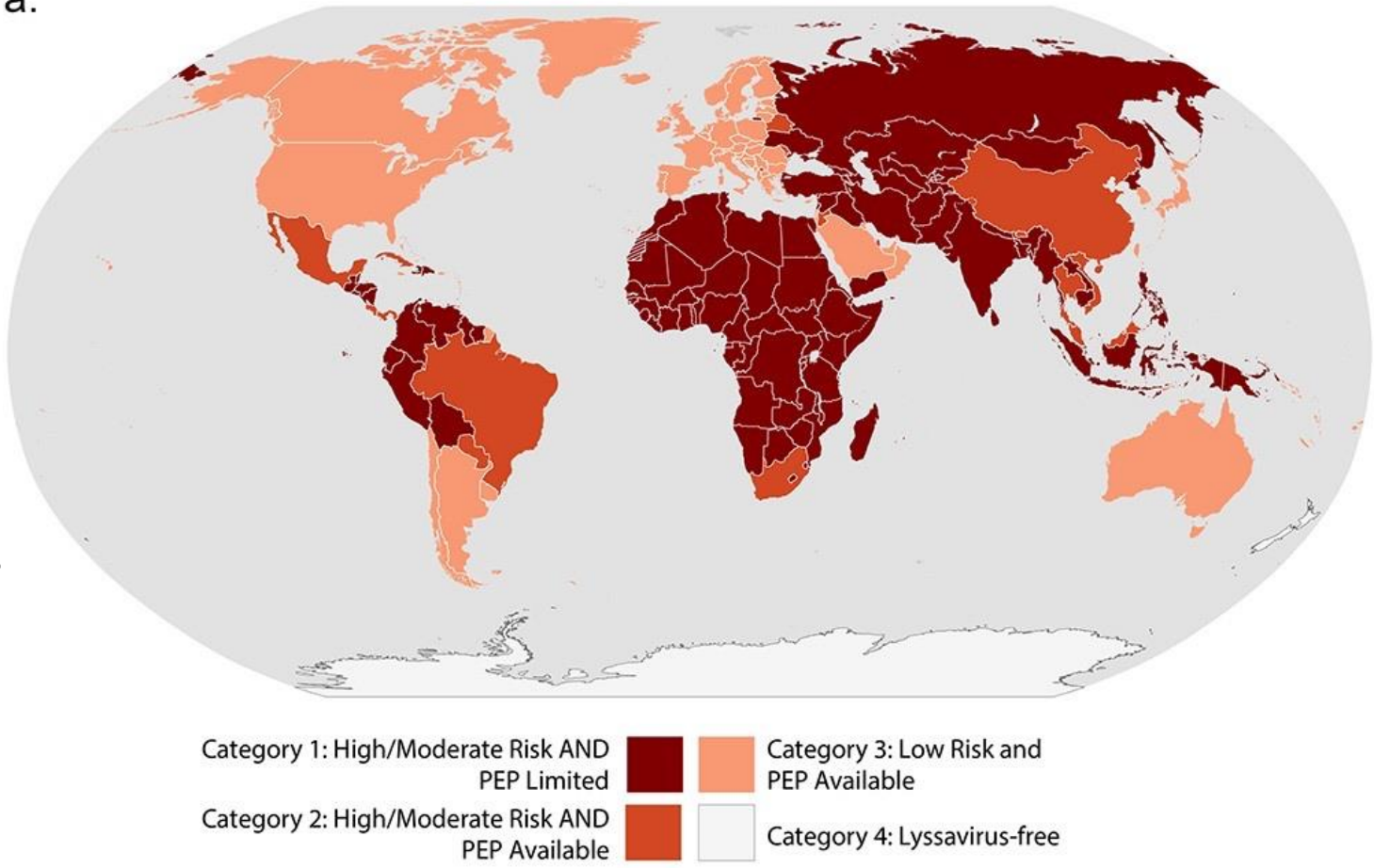


- Agent: family *Rhabdoviridae*, genus *Lyssavirus*
- Transmission: saliva (bite/scratch/lick on nonintact skin), or contact with CNS & PNS tissue/tears
- Epidemiology: dogs, wildlife, bats
- Travel exposures: 16-200/100,000 travelers; 2 deaths/yr
- Clinical: variable incubation weeks-months; pain/paresthesia, then neurologic phase with anxiety, paralysis, paresis, encephalitis, hydrophobia/aerophobia, autonomic dysfunction, encephalitis, coma
- Dx/Tx: clinical, virus nucleic acid in CSF, saliva, serum, skin; rabies antibody in CSF
- CFR: 99.99%

Geographic Distribution of Assessed Rabies Risk Levels for Travel Health Guidance

- Exposure: 0.01–2.3% of travelers are bitten by a rabies-suspect animal per month of stay in a rabies endemic area
- 23 cases of travel-associated rabies reported since 2013, 3 US residents

a.



Gautret P et al. Vaccine 2012 and Travel Med Infect Dis 2020

Henry RE et al. JTM 2022

Updated rabies PrEP schedule for travelers

Rabies vaccines: WHO position paper – April 2018

Wkly Epidemiol Record- 2018; 92:201-220.

WHO-recommended PrEP: 2-site ID vaccine administered on days 0 and 7.

If IM administration is used, WHO recommends a 1-site IM vaccine administration on days 0 and 7.

Morbidity and Mortality Weekly Report

Use of a Modified Preexposure Prophylaxis Vaccination Schedule to Prevent Human Rabies: Recommendations of the Advisory Committee on Immunization Practices — United States, 2022

Agam K. Rao, MD[1]; Deborah Briggs, PhD[2]; Susan M. Moore, PhD[2]; Florence Whitehill, DVM[1,3]; Doug Campos-Outcalt, MD[4]; Rebecca L. Morgan, PhD[5]; Ryan M. Wallace, DVM[1]; José R. Romero, MD[6]; Lynn Bahta, MPH[7]; Sharon E. Frey, MD[8]; Jesse D. Blanton, DrPH[1]

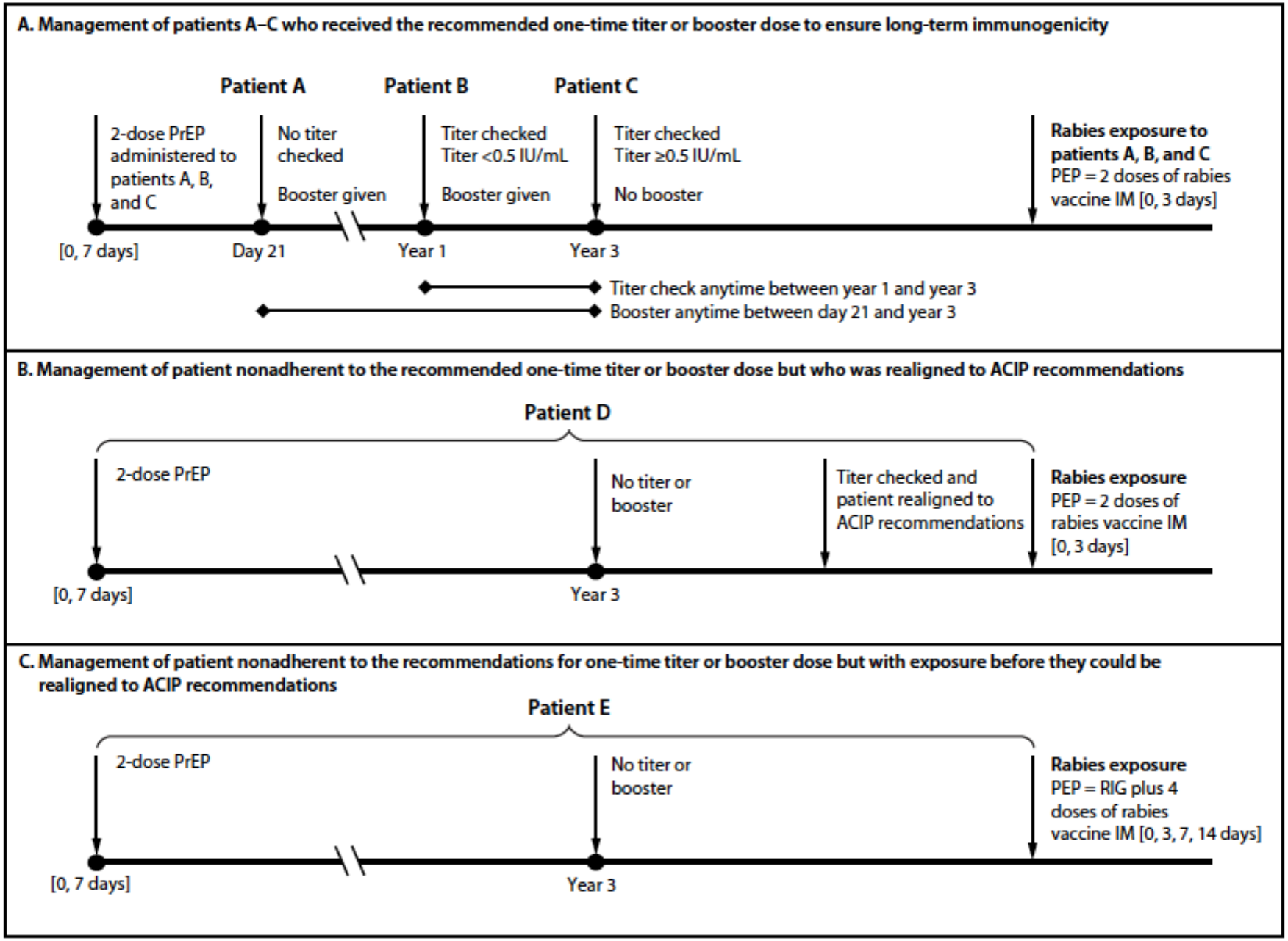
1. A new minimum rabies antibody titer (0.5 IU/mL)
2. Redefined risk categories
3. **2 doses in the primary vaccination schedule**
4. **Flexible options for ensuring long-term protection, or immunogenicity (dose 3 or titer 1-3 yrs)**
5. Less frequent or no antibody titer checks for some risk groups
6. Clinical guidance, including for ensuring effective vaccination of certain special populations

MMWR 2022 May 6;71(18):619-627.

Rabies pre-exposure prophylaxis recommendations

Risk Category	Exposure Type[2]	Typical Population[2]	PrEP 2-dose and Booster[5]
Category 1 Elevated risk for unrecognized[6] and recognized[7] exposures, including unusual or high-risk exposures	Often high viral concentration exposures Could be recognized or unrecognized Could be unusual (e.g., aerosolized)	Work with live rabies virus in research or vaccine production Performing test for rabies in diagnostic laboratories	Day 0, 7; Check titers q6 months Provide booster for titers <0.5 IU/mL[8]
Category 2 Elevated risk for unrecognized[6] and recognized[7] exposures	Typically recognized Could be unrecognized Unusual exposures unlikely	Frequent bat contact[9] Perform animal necropsies	Day 0, 7; Check titers q2 years Provide booster for titers <0.5 IU/mL[8]
Category 3 Elevated risk for recognized[7] exposures or sustained risk[10]	Exposure nearly always recognized Exposure risk exceeds that of the general population Duration of risk >3 years after primary 2-dose PrEP vaccine series	Interact with animals that could be rabid[11] Occupational or recreational activities involve contact with animals[12] Selected travelers[13]	Day 0, 7; One-time titer check years 1–3 after the primary PrEP Provide booster for titers <0.5 IU/mL[8.] OR Provide booster ≥21 days but <3 years after primary 2-dose PrEP vaccine series[14]
Category 4 Elevated risk for recognized[7] exposure, no sustained risk[10]	Exposure nearly always recognized Exposure risk exceeds that of the general population Duration of risk expected to be ≤3 years after primary 2-dose PrEP vaccine series	Same at-risk populations as category 3 **but** Risk duration ≤3 years[15]	Day 0, 7; None
Category 5 Low risk for exposure	Exposure uncommon	Typical resident of the United States	None; None

Long-term immunogenicity for hypothetical patients who received 2-dose rabies PrEP and have sustained risk for recognized exposures (risk category 3) --2022



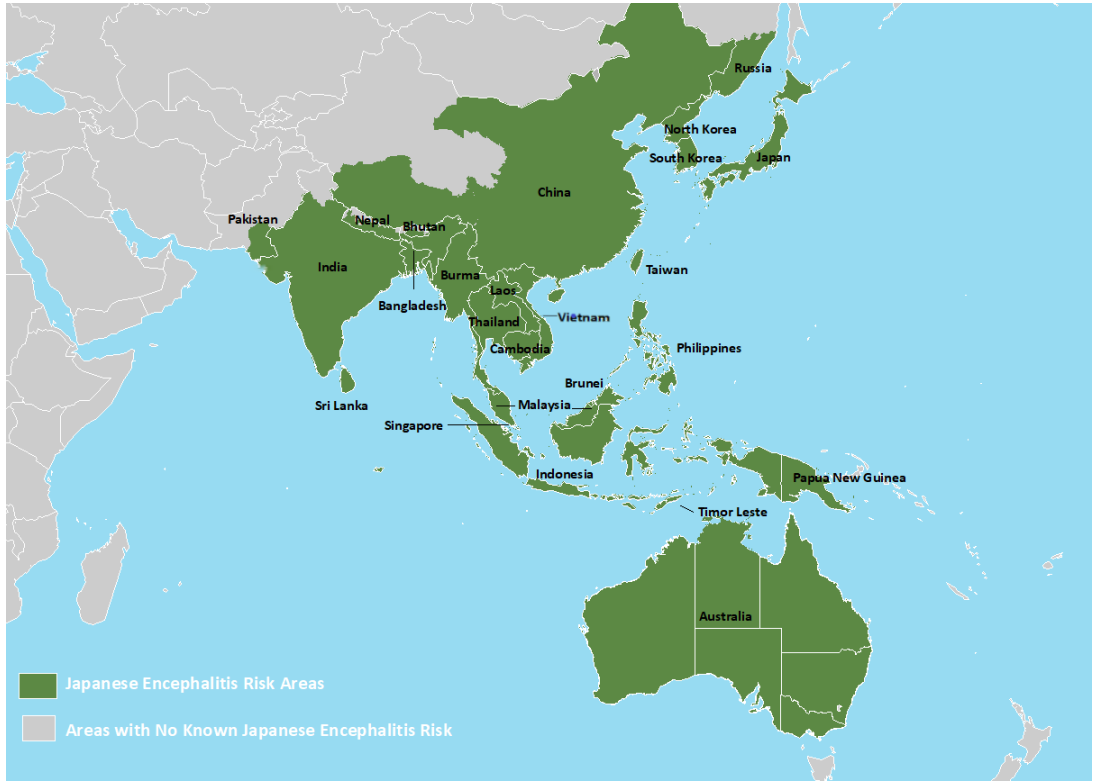
Rao AK et al. MMWR 2022 May 6;71(18):619-627.

Recommended vaccines: transmission via mosquitoes

Case 3. 25 yo healthy M grad student plans to go backpacking in Thailand, Vietnam, Sri Lanka x3 months during summer with friends. His routine vaccines are up to date, and he has had hepatitis A and typhoid vaccines. Which VBD vaccine would you recommend?

A. Japanese encephalitis only
B. Dengue, chikungunya, Japanese encephalitis (if available)
C. Dengue only
D. Chikungunya only

Japanese encephalitis: rare cases in travelers but devastating long-term sequelae



- Agent: single-stranded RNA, genus *Flavivirus*
- Transmission: *Culex* mosquitoes
- Epidemiology: most common vaccine-preventable encephalitis in Asia, also occurs in western Pacific, expanded especially in Australia
- Clinical: incubation 5-15 days; mostly asymptomatic, 1% neurologic disease; fever/headache/vomiting; acute encephalitis, meningitis, flaccid paralysis
- Dx/Tx: IgM-capture ELISA on CSF or serum, PRNT
- CFR: 20-30%, 30-50% of survivors have neuropsych sequelae

www.cdc.gov/japanese-encephalitis/data-maps/index.html;
McGuinness SL, et al. J Travel Med. 2023
Hills SL, Lindsey NP. JE in Yellow Book 2026.

Japanese encephalitis: risk to travelers

- Pre-1973: >300 cases among soldiers from US, UK, Australia, and Russia.
- 1973–2022: 90 cases travelers/expatriates from non-endemic countries reported.
- 1993-2024 (JE vaccine available in US): 16 cases among US travelers reported to CDC.
- Risk estimate: overall <1 case/1 million.
- **Increased in expatriates/long-stay travelers who stay in rural areas with active JE virus transmission: risk similar to pediatric resident population = 6–11 cases/100,000 children per year.**

- Duration: long stay or cumulative exposures
- Agricultural areas, outdoor activities
- Accommodations: no AC, screen, bednet
- Seasonality?
- Open itinerary

Lau CI et al. J Travel Med. 2023; 30:taad113.
Hills SL et al. MMWR Recommendations and Reports 2019.
Hills SL, Lindsey NP. JE in Yellow Book 2026.

Japanese Encephalitis Vaccine

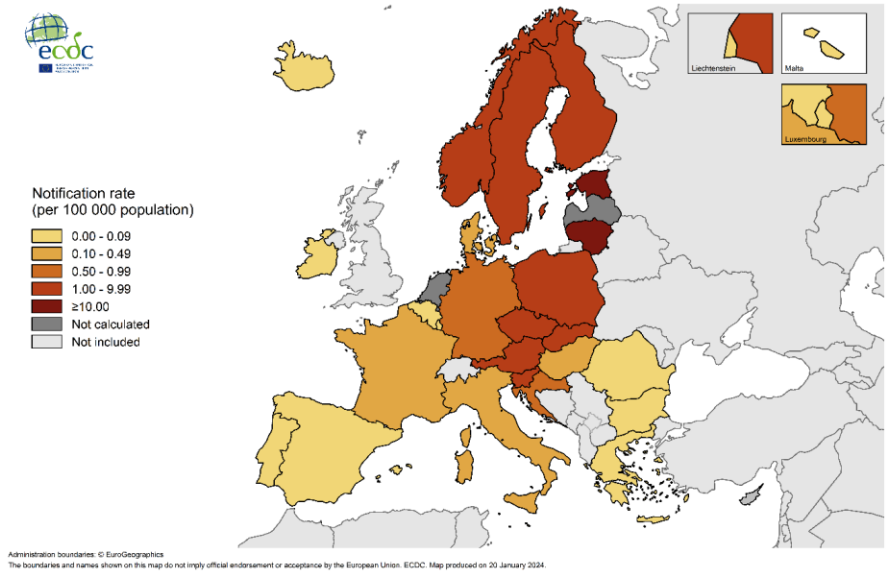
- Inactivated vero-cell culture derived vaccine (IXIARO) available in US, Canada, Europe
- 2 dose series typically spaced 28 days apart; available for ages 2 months and over
  - Accelerated schedule (7-28 days between doses) approved October 2018 for ages 18-65
  - Single dose does not provide reliable protection
- Booster dose approved for all ages at $\geq$ 1 year after completing initial series for those remaining at risk (provides > 6 years protection)

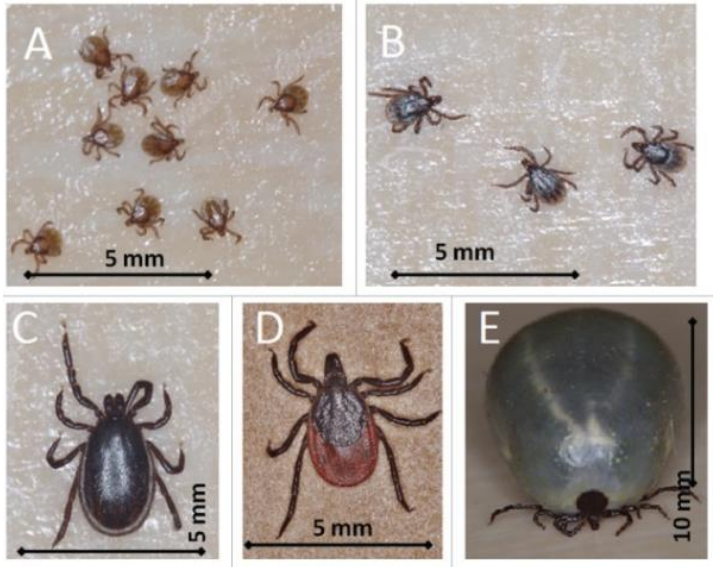
2019 ACIP JE Vaccine Recommendations

- Recommended for persons
  - Moving to reside in JE risk areas
  - Longer-term (≥ 1 month) or frequent travel to risk areas
- Consider for
  - Shorter-term travel with increased risk due to season, location, activities, and accommodations
  - Uncertain duration of travel, destination, or activities

Tickborne encephalitis

- Agent: genus *Flavivirus*; 3 subtypes
- Transmission: *Ixodes ricinus*, *Ix. persulcatus*
- Epidemiology: 5000-10,000/yr; western & northern Europe to northern & eastern Asia
- Clinical: incubation 7-14 days (range 2-28 days); 3/4 asymptomatic; nonspecific fever, some biphasic with neuroinvasive
- Dx/Tx: PCR, IgM capture ELISA
- CFR: European 1-2%/Far Eastern 20%; Neuro sequelae 30% European/80% Far Eastern





https://www.ecdc.europa.eu/en/tick-borne-encephalitis/surveillance-and-disease-data

Tick-Borne Encephalitis Vaccine: Recommendations of the Advisory Committee on Immunization Practices, United States, 2023

Tick-Borne Encephalitis Vaccine: Recommendations of the Advisory Committee on Immunization Practices, United States, 2023

Susan L. Hills, MBBS[1]; Katherine A. Poehling, MD[2]; Wilbur H. Chen, MD[3]; J. Erin Staples, MD, PhD[1]

[1]Division of Vector-Borne Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC, Fort Collins, Colorado; [2]Wake Forest School of Medicine, Winston-Salem, North Carolina; [3]University of Maryland School of Medicine, Baltimore, Maryland

- TBE is rarely reported in US travelers:
  - 12 civilian cases confirmed 1979-2021
  - 12 military/dependents 2012-2021
- Onset April-November
- Vaccine efficacy after ≥3 doses of vaccine: 91%–99%
- 2-dose seropositivity rates among healthy adults at 3–4 weeks: 83%-100%
- 1-dose seropositivity rate at 12 days: 52% age 16-49 years, 27% 50-79 years

Day after dose 2	Seropositive#
3	89%
14	98%
21	100%
42	100%

Hills SI et al. MMWR Recomm Rep. 2023 Nov 10;72(5):1-29.
Loew-Baselli A et al. Int J Med Micro 2006.

ACIP recommendations for travelers (endemic areas in Europe may differ in guidance):

- Persons who are moving or traveling to a TBE-endemic area and will have extensive exposure to ticks based on their planned outdoor activities and itinerary
- May be considered for persons traveling or moving to a TBE-endemic area who might engage in outdoor activities in areas ticks are likely to be found

	PRIMARY VACCINATION SCHEDULE			
	DOSE 1	DOSE 2	DOSE 3	BOOSTER
ADULTS (≥ 16 YEARS)	Day 0	14 days–3 months*	5–12 months*	A fourth dose may be given at least 3 years after completion of the primary vaccination schedule if ongoing exposure or re-exposure to tick-borne encephalitis is expected
CHILDREN (1–15 YEARS)	Day 0	1–3 months*	5–12 months*	

*After the previous vaccination

Ticovac contraindications and precautions

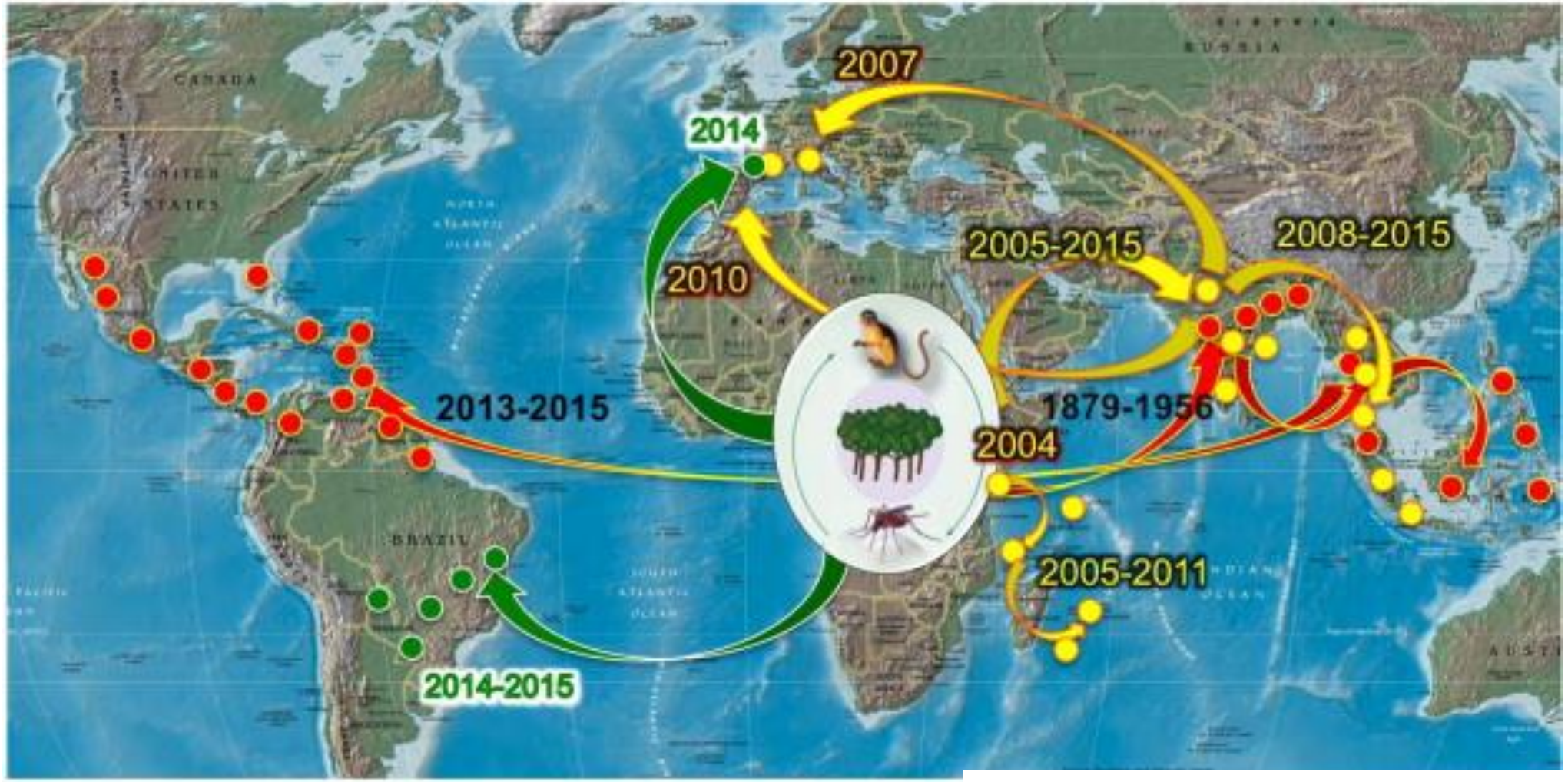
Contraindications

- Severe allergic reaction to any component of TICOVAC

Precautions: Altered Immunocompetence

- Some individuals with altered immunocompetence may have reduced immune responses to TICOVAC.
- Human Albumin - extremely remote risk for transmission of viral diseases and variant Creutzfeldt-Jakob disease (vCJD).

Emergence and Spread of Chikungunya Asian and Indian Ocean Lineages From Africa



Weaver SC, Forrester NL. Antiviral Research 2015.
https://doi.org/10.1016/j.antiviral.2015.04.016

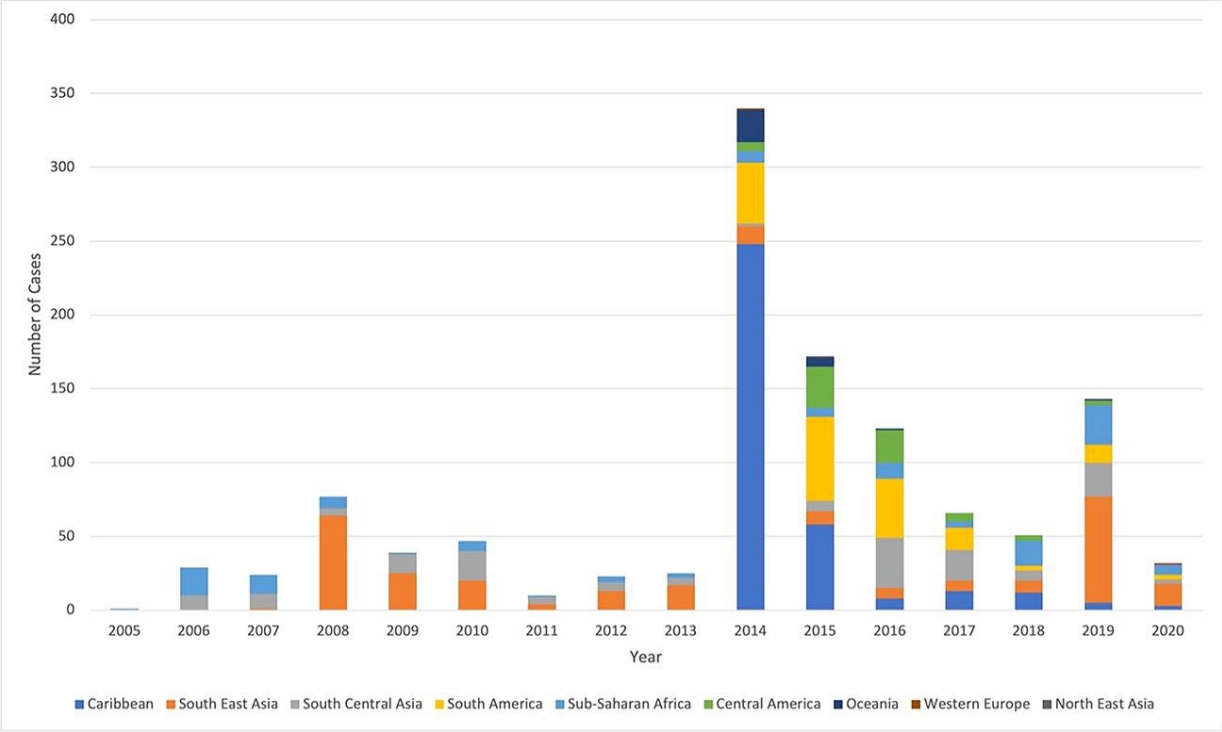
Chikungunya

- Agent: single-stranded RNA, family *Togaviridae*, genus *Alphavirus*
- Transmission: *Aedes* spp*,* mainly *Ae. aegypti, Ae. albopictus*; blood; maternal-fetal
- Epidemiology: explosive outbreaks infect up to 75%; Americas >2.6 million 2013-2017; Paraguay 2023 160,000; La Reunion 2024-–Indian Ocean countries
- Clinical: incubation 3-7 days (1-12d); 15-35% asymptomatic; fever, arthralgias, headache, conjunctivitis, rash; severe includes hepatitis, myocarditis, neuro e.g. GBS, myelitis, meningoencephalitis; persistent or relapse of rheumatologic disorders (5-80%)
- Dx/Tx: PCR, IgM
- CFR: <1%

GeoSentinel: travel-related chikungunya illustrate circulation in nearly 100 destinations (n=1,202)

GeoSentinel

The Global Surveillance and Research Network



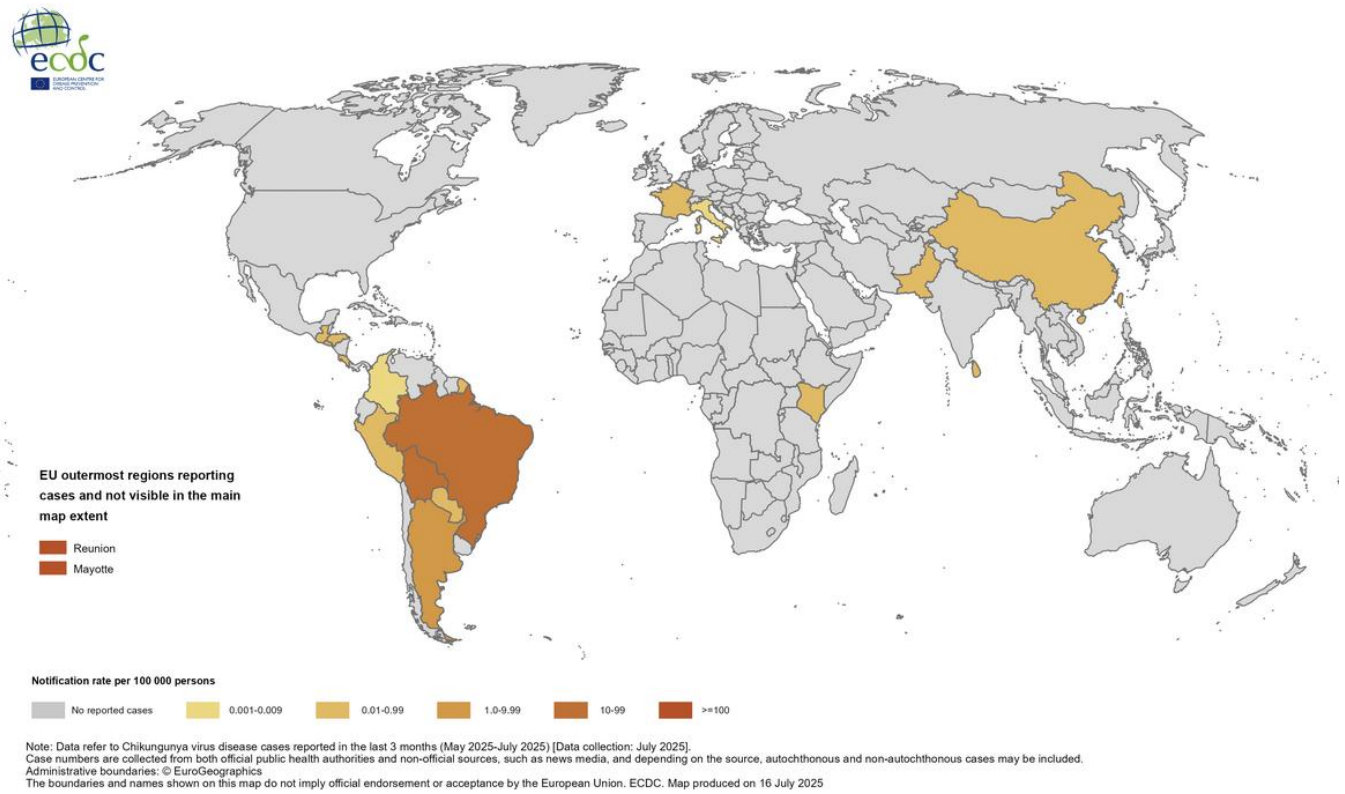
Chikungunya reported 2005-2020:

- Median age 43 years
- 89% age 18 – 64 y; 59% female
- Median trip duration 23 days
- 50% tourists, 27% VFR, 14% business, 6% missionary/volunteer/aid
- 32% had pretravel consultation
- **Hospitalization 10.3%**

Bierbrier R et al. J Travel Med 2024

Recent chikungunya reports

Three-month Chikungunya virus disease case notification rate per 100 000 population, May 2025 - July2025



CHIKUNGUNYA (08): GERMANY ex SRI LANKA
Symptom onset January 14, 2025
Diagnosis (IgM+/IgG+) MUN March 7, 2025
****
*
A ProMED-mail post
http://www.promedmail.org
Date: Wed 12 Mar 2025
From: Dr. Camilla Rothe

GeoSentinel

CDC: Chikungunya Risk for Travelers

Chikungunya in the Region of the Indian Ocean

- Level 4 - Avoid All Travel
- Level 3 - Reconsider Nonessential Travel
- **Level 2 - Practice Enhanced Precautions**
- Level 1 - Practice Usual Precautions

Key points

- There are outbreaks of chikungunya in Kenya, Madagascar, Mauritius, Mayotte, Réunion, Somalia, and Sri Lanka (see map).
- Mosquitoes spread the virus that causes chikungunya.
- You can protect yourself by preventing mosquito bites, which includes using insect repellent; wearing long-sleeved shirts and pants; and staying in places with air conditioning or that have screens on the windows and doors.
- Vaccination is recommended for travelers who are visiting an area with a chikungunya outbreak. Two chikungunya vaccines are approved for use in the United States.
- If you are pregnant, reconsider travel to the affected areas, particularly if you are close to delivering your baby. Mothers infected around the time of delivery can pass the virus to their baby before or during delivery. Newborns infected in this way or

Map: Countries in the region with chikungunya outbreaks (see larger map)

What is chikungunya?

Elevated risk for US travelers: Brazil, Colombia, India, Mexico, Nigeria, Pakistan, Philippines, Thailand

www.cdc.gov/chikungunya/data-maps/index.html

wwwnc.cdc.gov/travel/notices#level2

Single-dose chikungunya vaccines licensed

Type (manufacturer)	
Live attenuated (Valneva) FDA suspended	Day 29: 99% seroprotective; Day 180: 96% seroprotection
Virus-like particles (Bavarian Nordic)	Day 22: 98% seroresponse (87% in older adults) Day 180: 85% seroresponse (76% in older adults)

<u>Need post-licensure studies</u>:

- Safety in children, pregnant, older adults, immunocompromised
- Impacts of preexisting CHIKV immunity on safety/ immunogenicity
- Long-term immunity
- Efficacy in persons previously exposed to other alphaviruses

Schneider M et al. Safety and immunogenicity of a single-shot live-attenuated chikungunya vaccine: a double-blind, multicentre, randomised, placebo-controlled, phase 3 trial. Lancet. 2023;401:2138-2147.
Bennett SR et al. Safety and immunogenicity of PXVX0317, an aluminium hydroxide-adjuvanted chikungunya virus-like particle vaccine: a randomised, double-blind, parallel-group, phase 2 trial. Lancet Infect Dis. 2022;22:1343-1355.

Recommendations for chikungunya vaccines for travelers

ACIP April 16, 2025

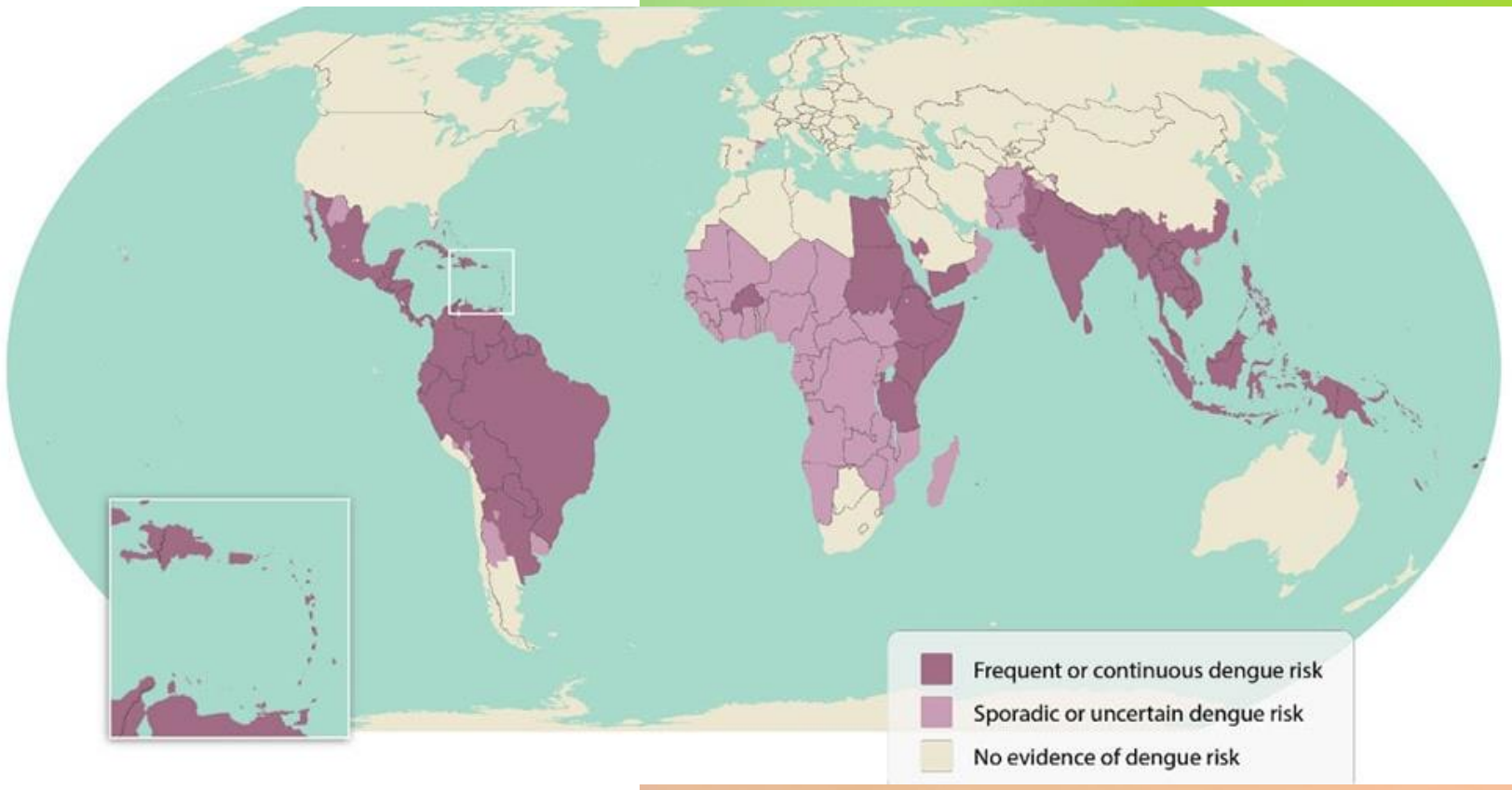
ACIP recommends virus-like particle chikungunya vaccine for persons aged ≥12 years traveling to a country or territory where there is a chikungunya outbreak.

In addition, virus-like particle chikungunya vaccine may be considered for persons* traveling or taking up residence in a country or territory without an outbreak but with elevated risk for US travelers if planning travel for an extended period of time e.g., 6 months or more.

Dengue burden: estimated 390 million/year

WHO: Increase in reported cases: 505,430 (2000) → **14 million (2024)**

In the Americas: >13 million cases in 2024, 0.17% severe



https://www.cdc.gov/dengue/areas-with-risk/index.html

Dengue

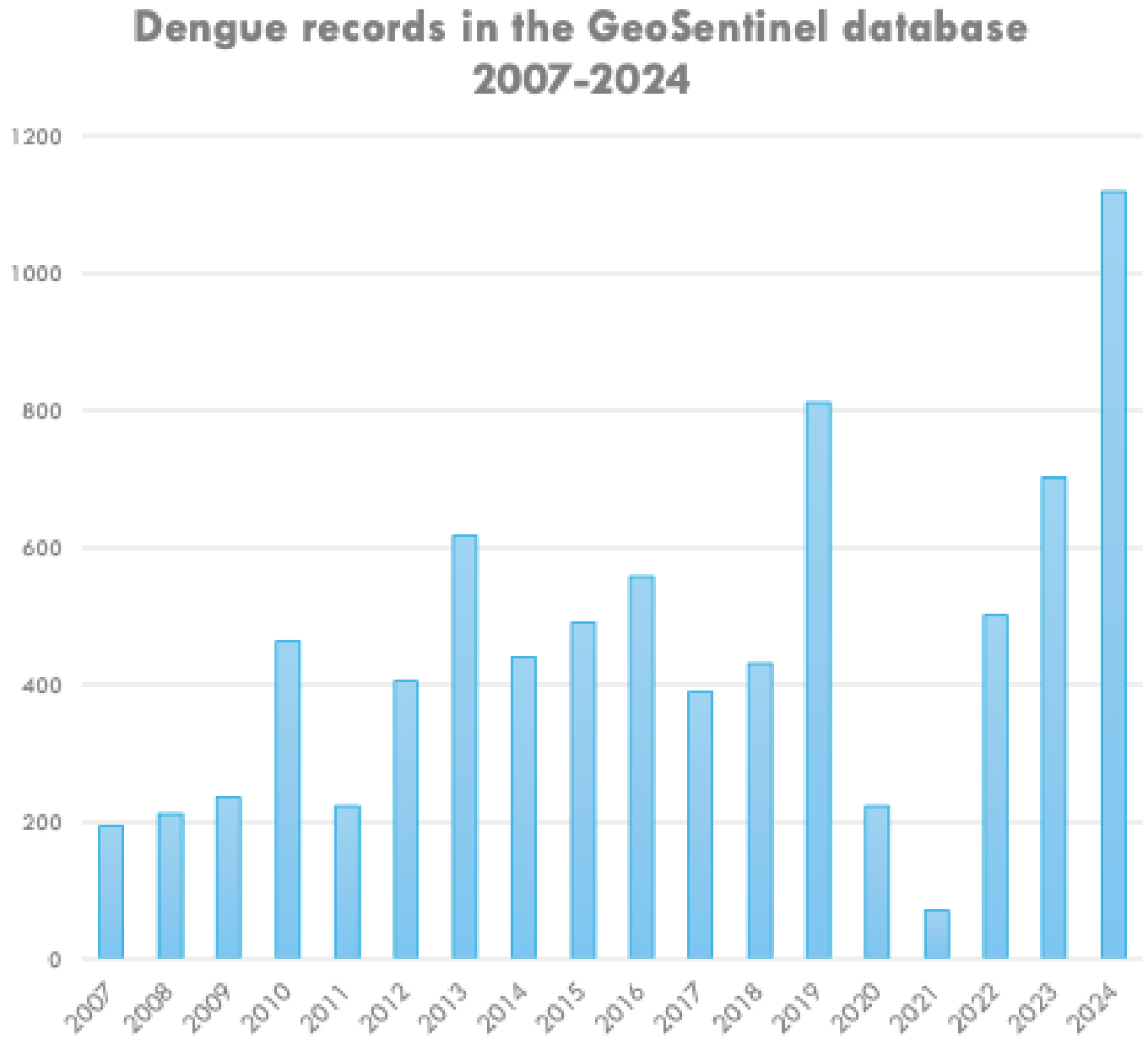
- Agent: single-stranded RNA, *Flavivirus* DENV1-4
- Transmission: *Aedes* spp.; mainly Aedes aegypti and *Aedes albopictus*
- Epidemiology: tropics/subtropics; modeling estimate: 390 million/year of which 96 million manifest clinically
- Clinical: incubation 5-7 days (3-10d); febrile (2-7d), critical (1-2d), convalescent phases; fever/HA/retro orbital pain, myalgias, rash, hemorrhage…plasma leakage=severe, hemoconcentration, hypoproteinemia, hypotension… rash (islands of white)
- Dx/Tx: NS1, PCR 1st week, IgM after day 4 lasting 14-20 days (sometimes 90d)
- CFR: overall 0.17% severe

GeoSentinel Network

2025 Q1: N=169 dengue

- 90.5 % uncomplicated
- 7.7 % warning signs
- 1.8 % severe

GeoSentinel Network Data April 2025

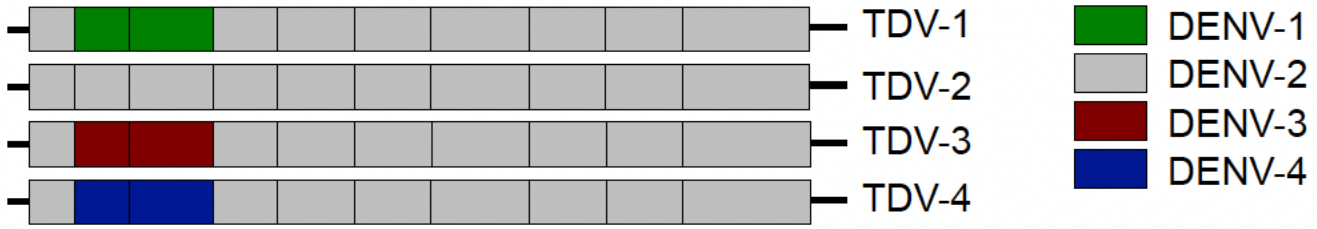


Dengue impact on travelers

	Rates	Comment	References
Incidence based on seroconversion	2.9-6.8%	Incidence rate 14/1000 person-month	Overbosch PLoSOne 2018; Olivero AJTMH 2016
Cases that are symptomatic	25%	CDC Health Alert Network	CDC HAN
Hospitalization during travel	10-22%	Netherlands; GeoSentinel	Overbosch 2018; Tozan AJTMH 2019
Hospitalized upon return	26.7-42%	GeoSentinel; CDC	Duvignaud JTM 2024; Wong MMWR 2023
Complicated or severe dengue	1.6-5%	GeoSentinel; Health Alert Network	Duvignaud JTM 2024; CDC HAN
Case fatality rate	<1%	GeoSentinel; CDC	Duvignaud JTM 2024; Wong MMWR 2023

Overbosch FW et al. PLoS One. 2018; 13:e0192193; Olivero RM et al. Am J Trop Med Hyg. 2016; 95:1130-6; https://www.cdc.gov/han/2024/han00511.html; Tozan Y et al. Am J Trop Med Hyg. 2019; 100:1525-33; Duvignaud A et al. J Travel Med. 2024; 31:taae089; Wong JM et al. MMWR 2023;72:821–826.

Dengue vaccine with indication for travelers: TAK-003
Not licensed in US



- Live-attenuated chimeric tetravalent vaccine
- Based on attenuated DEN-2 backbone (contains DENV-2 NS proteins only)

- 2 doses, day 0, 3 months
- VE @11 months: 80%
- VE @17 months: 73%
  - Seropositive 76% / Seronegative 66%
  - 90% vs hospitalization / 86% vs severe
- VE @1-3 months (1 dose): 82%

Biswal S et al. NEJM 2019;381:2009-2019;
Biswal S et al. Lancet 2020; 395: 1423–33.

2024, 99, 203–224 No 18

World Health Organization
Organisation mondiale de la Santé

Weekly epidemiological record
Relevé épidémiologique hebdomadaire

3 MAY 2024, 99th YEAR / 3 MAI 2024, 99e ANNÉE
No 18, 2024, 99, 203–224
http://www.who.int/wer

Contents

WHO position paper on dengue vaccines – May 2024

Note de synthèse: position de l'OMS sur les vaccins contre la dengue – mai 2024

- WHO recommends for travellers: age 6-60 years: h/o previous dengue infection, frequent travellers, long-term travellers, migrants, expats
- Variations in license:
  - Age ≥4 years (EMA, UK); age 6-65 years (Indonesia)
  - Upper age limit 60 years (Israel, Spain, Sweden; also Thailand initially)
  - Only seropositives (Belgium, Germany STIKO, Israel, Sweden, Switzerland, UK)
  - Seropositives and high-risk seronegatives (Austria, Finland, Netherlands, Norway)
  - Unrestricted, no testing: Some groups in Germany (incl. STIKO), Italy, Spain

Case 3. 25 yo healthy M grad student plans to go backpacking in Thailand, Vietnam, Sri Lanka x3 months during summer with friends. His routine vaccines are up to date, and he has had hepatitis A and typhoid vaccines. Which VBD vaccine would you recommend?

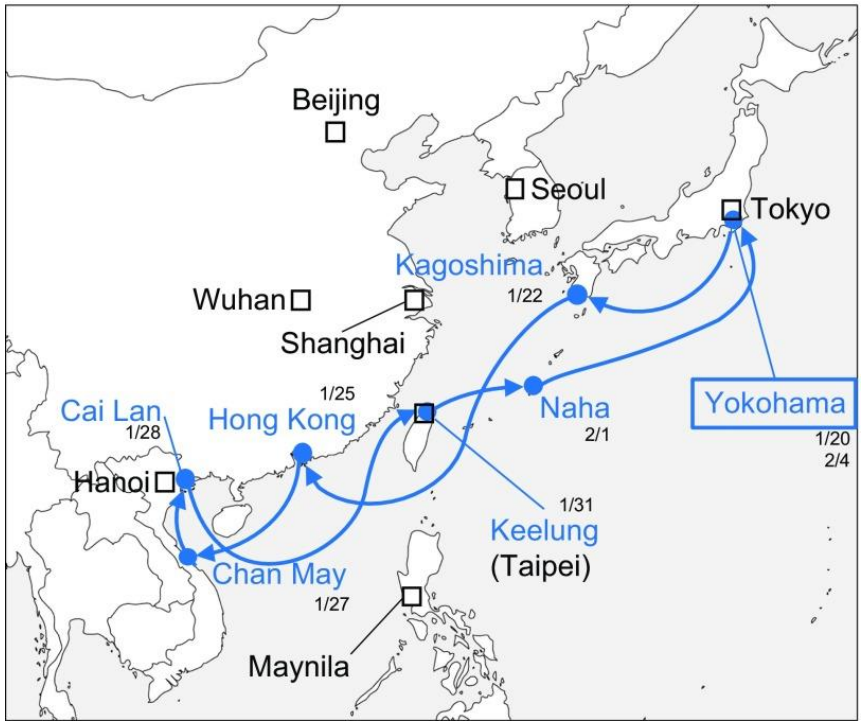
A. Japanese encephalitis only
B. Dengue, chikungunya, Japanese encephalitis (if available)
C. Dengue only
D. Chikungunya only

Routine vaccines: many have trave-related indications; prevent exportation and protect traveler

- Pre-travel consultation presents an opportunity to update/catch up on routine immunizations -especially Covid-19, influenza, MMR, Tdap

SARS-CoV-2 international spread via travel

International flight connections from mainland China are shown by the lines. Blue circles indicate the number of international confirmed cases. Size of circles is proportional to confirmed cases with travel history to China as of Feb 15, 2020.



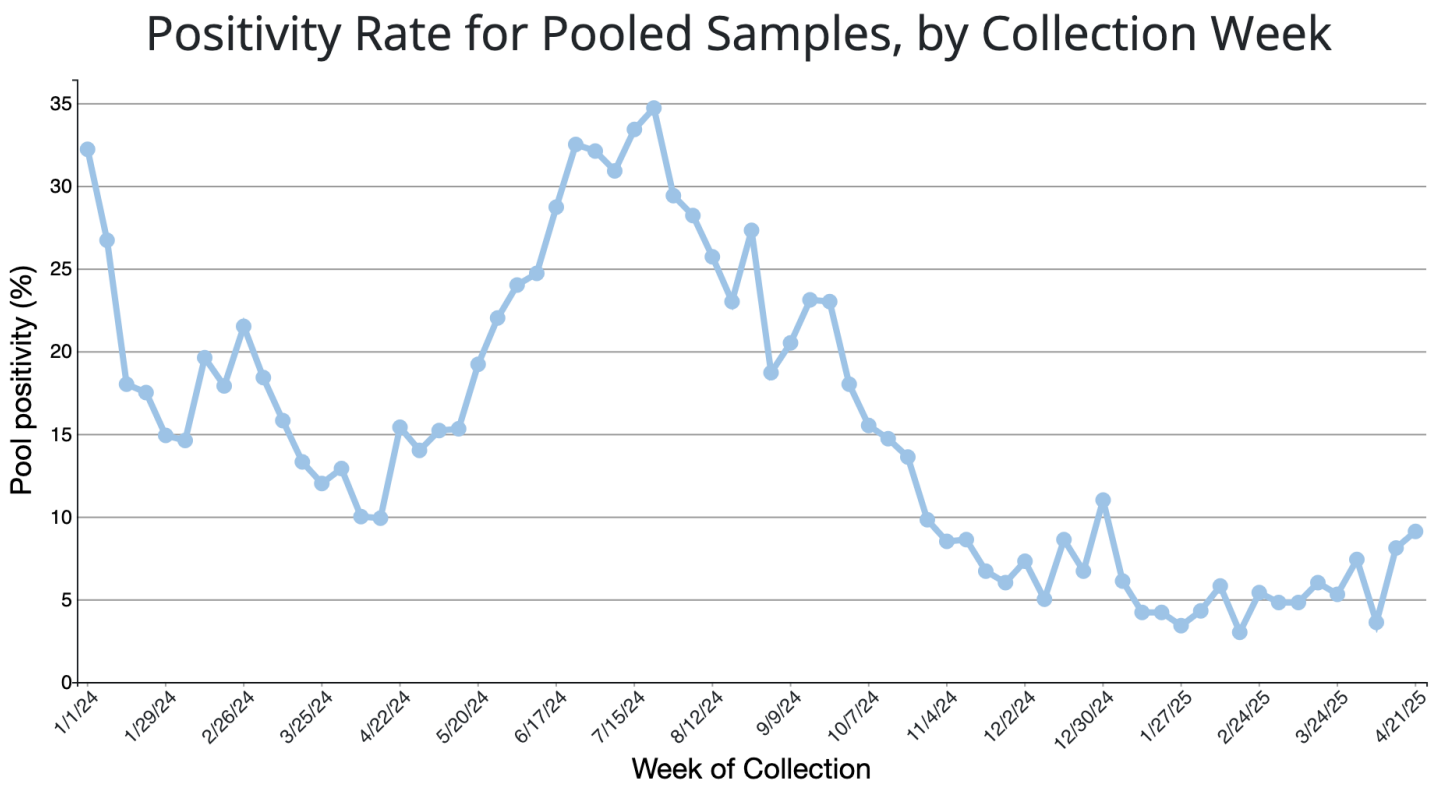
The Diamond Princess cruise ship all tested:

- 19% +
- 10% needed intensive care
- 1.3% died (all >70 years old)

Wells CR et al. PNAS 2020; Moriarty LF et al. MMWR 2020; Nakazawa E et al. Disaster Med Public Health Prep. 2020

Covid-19 and travelers: continues to evolve

Traveler-based genomic surveillance



Centers for Disease Control and Prevention. COVID Data Tracker. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2025, May 10. https://covid.cdc.gov/covid-data-tracker

https://covid.cdc.gov/covid-data-tracker/#traveler-genomic-surveillance;
https://www.cdc.gov/media/releases/2023/s0526-eis.html

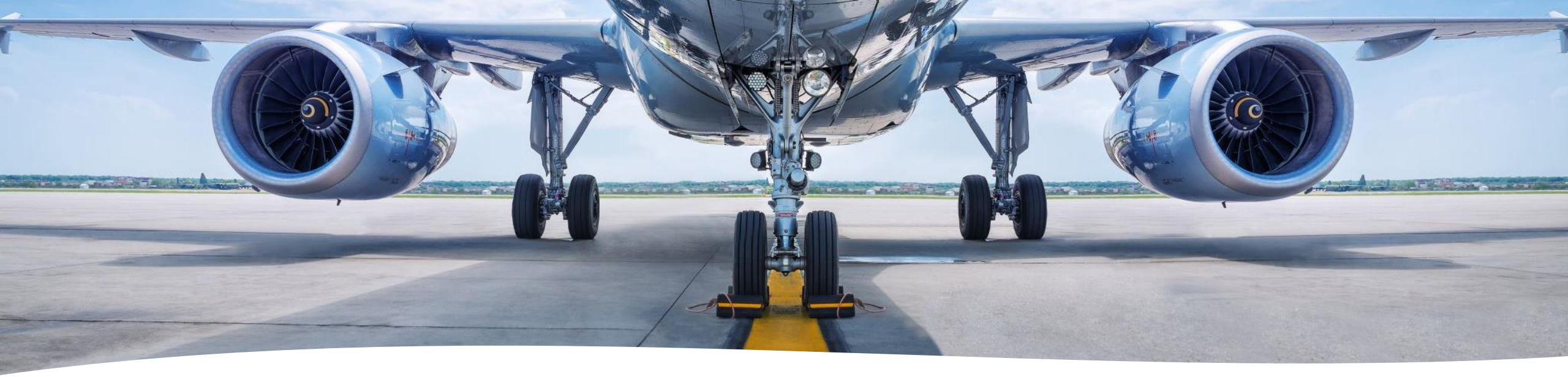
Need systematically studied incidence rates <u>on travelers</u> relative to:

- Vaccination – last dose
- Immunity from COVID-19 infection
- Variant-specific rate
- Unvaccinated/infection-naïve

CDC EIS Conference 04/2023:

- Among 1,443 respondents: **13% test+**
- Vaccinated ≥ 1 dose: 99.4%
- Personal history: 52% no prior infection

Rates likely will continue to change



Air travel-related influenza

- May occur at start of trip, at airport, or via direct/indirect human contact
- 2009 H1N1 influenza pandemic: serologically-confirmed influenza occurred following flights, and in-flight transmission occurred among passengers sitting up to 2 rows from an index case
- Transmission could have occurred before/after flight during check-in, security screening, boarding/disembarking, immigration, or in crowded bus to or from aircraft …

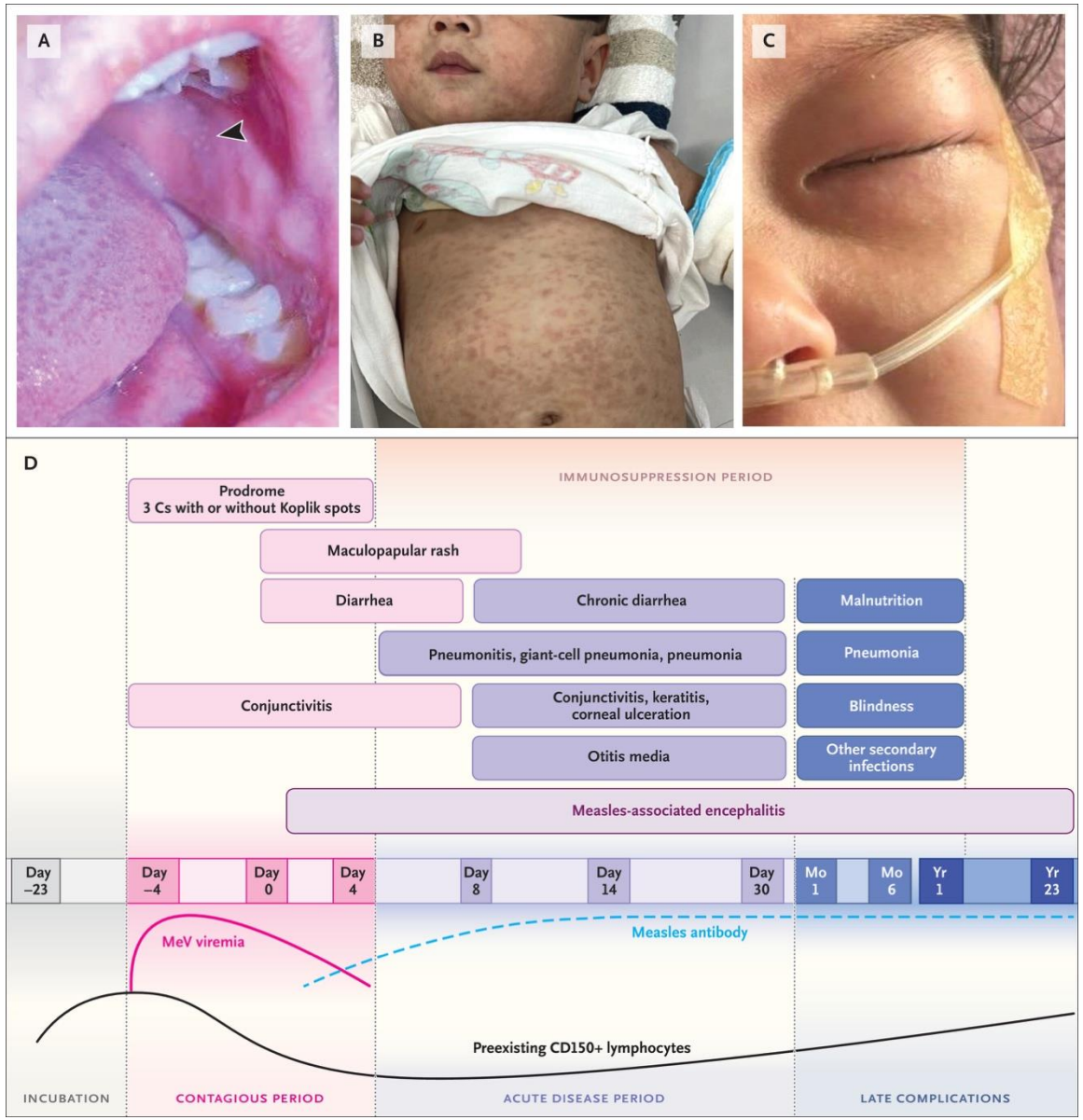
Kakoullis L et al. J Travel Med 2023; Goeijenbier M et al. J Travel Med 2017; Baker MG et al. BMJ 2010; Hertzberg VS et al. PNAS 2018; Young N et al. Influenza Other Resp Viruses 2014; ICAO. Aircraft Module 2021.

Cruise ships: influenza is 2nd most frequently reported infectious illness after acute gastroenteritis

- >20 million cruise passengers/year; many older
- Systematic review of 41 studies on respiratory virus transmission in transportation hubs and during transportation: influenza outbreaks on cruise ships affect 2-7% of passengers on board
- Rates of ARI or ILI vary between 0.2-37.1%
- Older passengers at highest risk

Kakoullis L et al. J Travel Med 2023; Pavli A et al. TMAID 2016; Marshall CA et al. BMC Public Health 2016; Browne A et al. JTM 2016

Measles



Cases in 2025 as of Sept 9: 1,454 cases

Age

Under 5 years: 404 (28%)
5-19 years: 554 (38%)
20+ years: 489 (32%)
Age unknown: 7 (<1%)

Vaccination Status

Unvaccinated or Unknown: 92%
One MMR dose: 4%
Two MMR doses: 4%

Hospitalizations

12% of cases hospitalized (178 of 1431)

Deaths

3

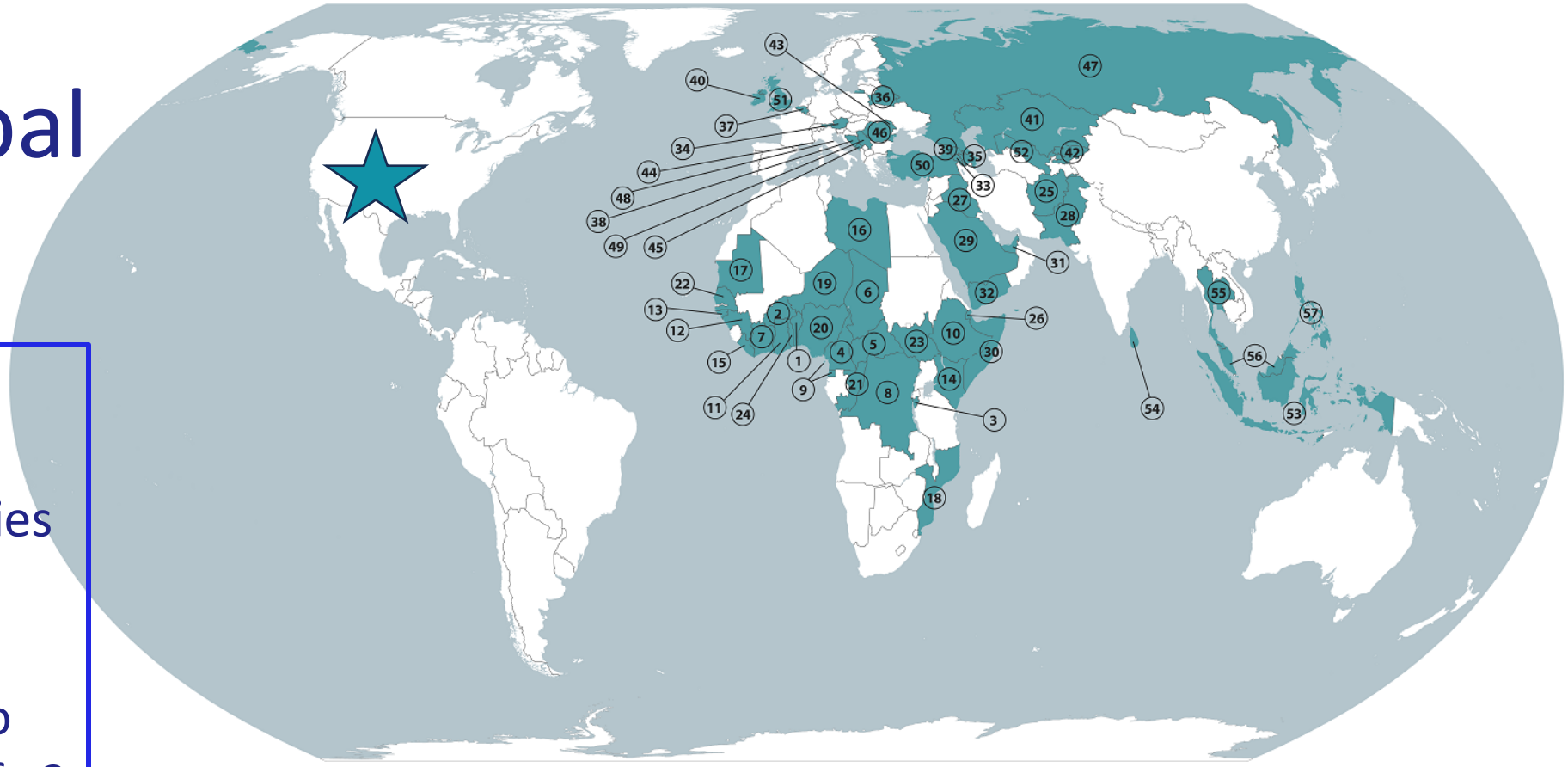
Do LAH, Mulholland K. Measles 2025. N Engl J Med. 2025 Jun 25.
https://www.cdc.gov/measles/data-research/index.html

Measles: global outbreaks

USA 2025: 142 imported

Outbreaks in >57 countries

➢ Assess pretravel:
Vaccinate infants <12 mo
Birth 1957 & later – verify 2 doses



Measles THN

AFRICA
1. Benin
2. Burkina Faso
3. Burundi
4. Cameroon
5. Central African Republic
6. Chad
7. Cote d'Ivoire
8. Dem. Rep. of the Congo
9. Equatorial Guinea
10. Ethiopia
11. Ghana
12. Guinea
13. Guinea-Bissau
14. Kenya
15. Liberia
16. Libya
17. Mauritania
18. Mozambique
19. Niger
20. Nigeria
21. Rep. of the Congo
22. Senegal
23. South Sudan
24. Togo

EASTERN MEDITERRANEAN
25. Afghanistan
26. Djibouti
27. Iraq
28. Pakistan
29. Saudi Arabia
30. Somalia
31. United Arab Emirates
32. Yemen

EUROPE
33. Armenia
34. Austria
35. Azerbaijan
36. Belarus
37. Belgium
38. Bosnia and Herzegovina
39. Georgia
40. Ireland
41. Kazakhstan
42. Kyrgyzstan
43. Moldova
44. Monaco
45. Montenegro
46. Romania
47. Russia
48. San Marino
49. Serbia
50. Türkiye (Turkey)
51. United Kingdom
52. Uzbekistan

SOUTH-EAST ASIA
53. Indonesia
54. Sri Lanka
55. Thailand

WESTERN PACIFIC
56. Malaysia
57. Philippines

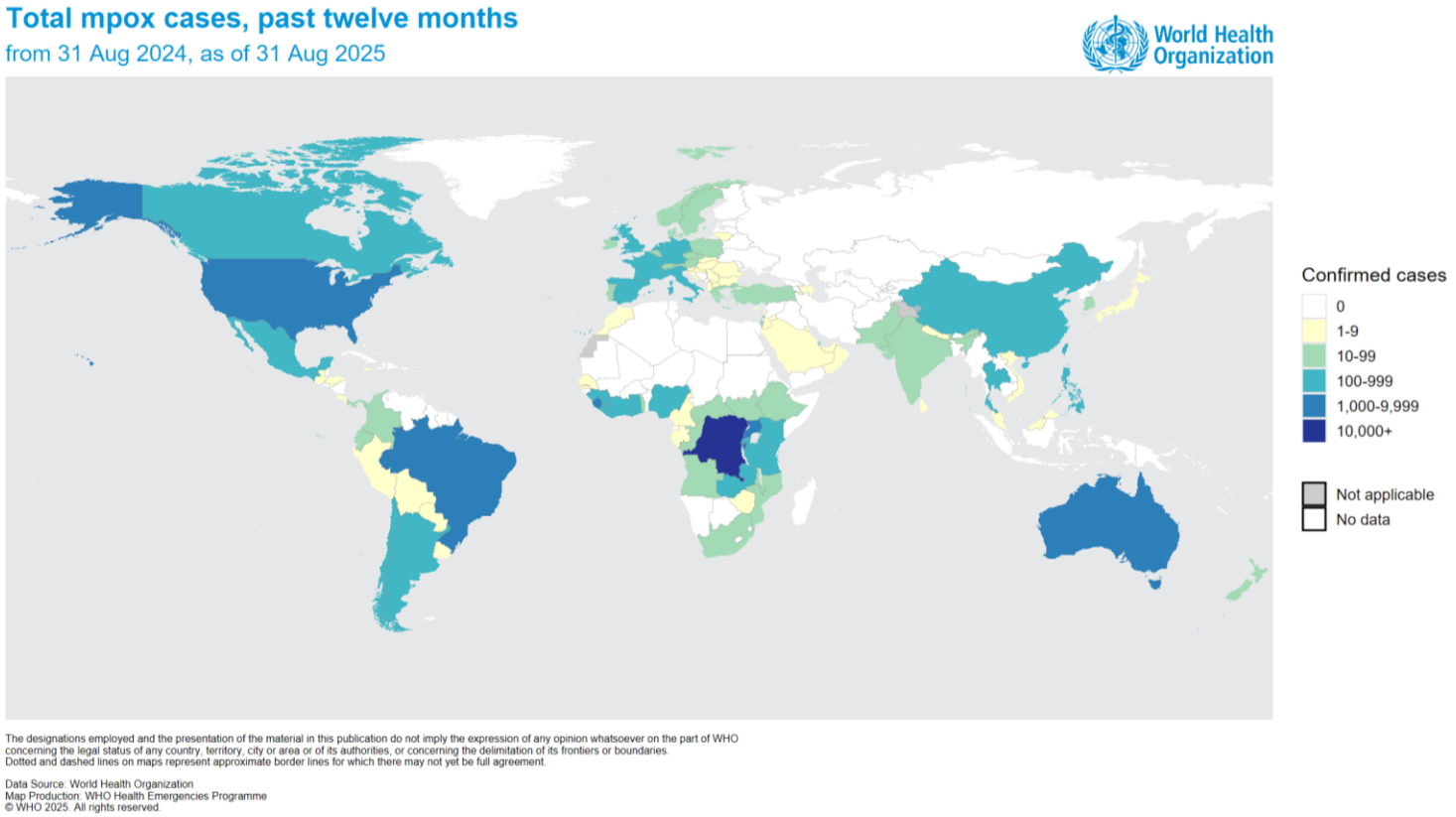
Measles Travel Health Notice

Names and boundary representation are not necessarily authoritative.

https://wwwnc.cdc.gov/travel/notices/level1/measles-globe
4/25/25

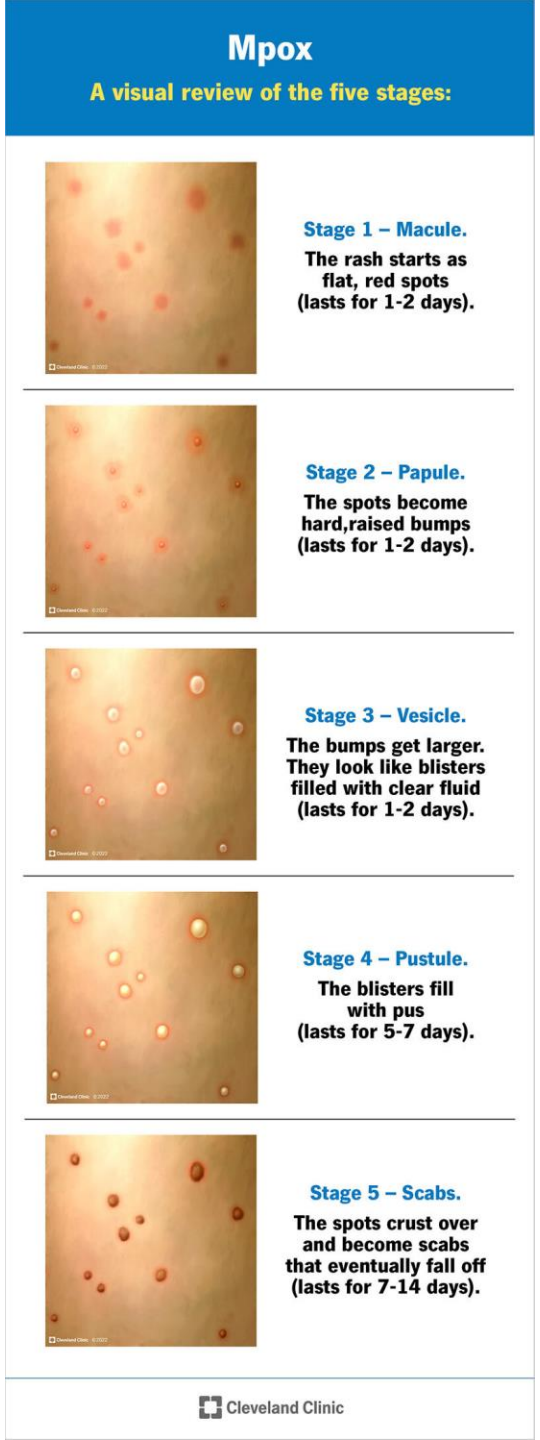
Mpox 1/1/22-8/31/25: 159,623 lab-confirmed cases, clade IIb continued, clade Ib spread further

Globally: 38,671 cases in 2025



Year	Total Cases	Total Deaths	Countries reporting cases
2022	84 880	138	108
2023	9697	45	76
2024	26 375	78	85
2025	38 671	163	92

https://worldhealthorg.shinyapps.io/mpx_global/#key-figures



Mpox vaccine consideration

- CDC: 2-dose mpox vaccine series for travelers age ≥18 years if:
  - Gay, bisexual, other MSM
  - They are traveling to a country with sustained human-to-human transmission of clade I MPXV, AND
  - They anticipate experiencing sex with new partner/commercial venue/large event
  - SCDM: health care personnel, laboratorians
- US 2022–2023 study showed vaccine effectiveness against clade IIb mpox: 75% after 1 dose and 86% after 2 doses.

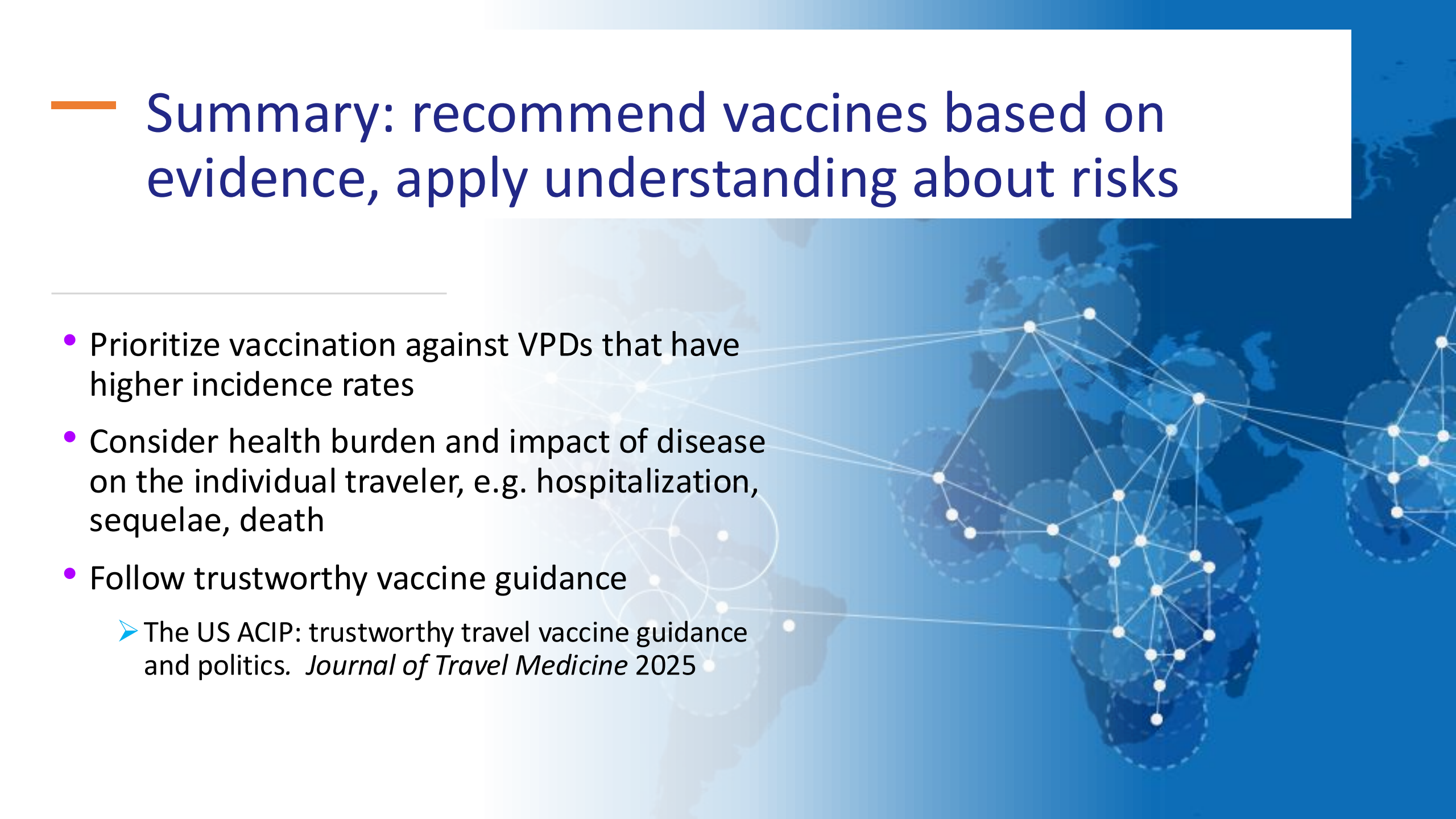
Rao AK, et al. Use of JYNNEOS (Smallpox and Mpox Vaccine, Live, Nonreplicating) for Persons Aged ≥18 Years at Risk for Mpox During an Mpox Outbreak: Recommendations of the Advisory Committee on Immunization Practices - United States, 2023. MMWR Morb Mortal Wkly Rep. 2025 Jun 19;74(22):385-392.

Key principle: consider travel vaccines based on individual's potential risks

- Epidemiology of VPD shifts over time
- Recommend vaccines based on individual need
- Consider Required, Recommended, Routine vaccines for travel
- Also consider cumulative exposure of the traveler – long-term benefit
- Traveler's risk perception critical in shared decision making
- Cost may influence uptake

Summary: recommend vaccines based on evidence, apply understanding about risks

- Prioritize vaccination against VPDs that have higher incidence rates
- Consider health burden and impact of disease on the individual traveler, e.g. hospitalization, sequelae, death
- Follow trustworthy vaccine guidance
  - The US ACIP: trustworthy travel vaccine guidance and politics. *Journal of Travel Medicine* 2025




Thank you!