Brigham and Women's Hospital
Founding Member, Mass General Brigham

The Next Pandemic: Are We Prepared?

Intensive Review of Internal Medicine

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CONTINUING MEDICAL EDUCATION
DEPARTMENT OF MEDICINE

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

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Disclosures

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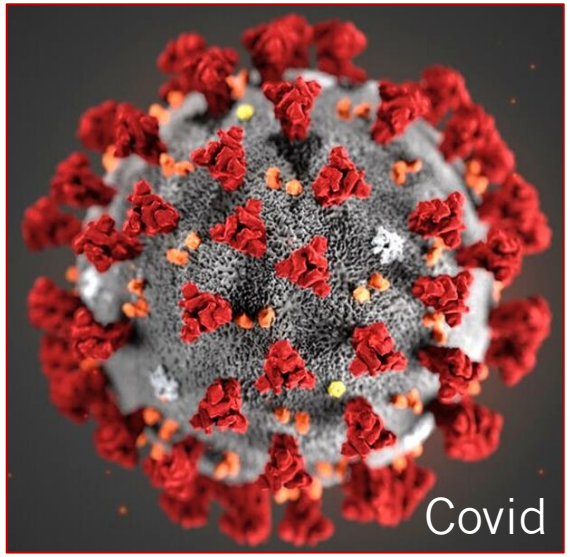
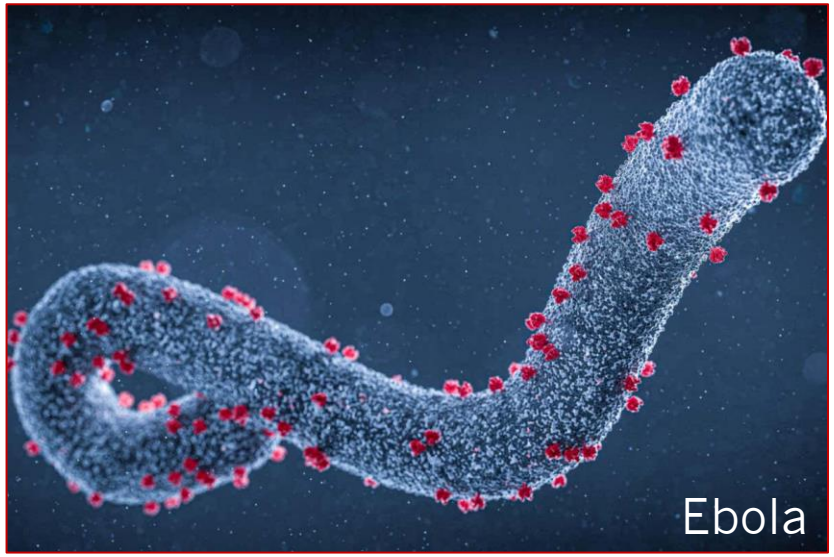
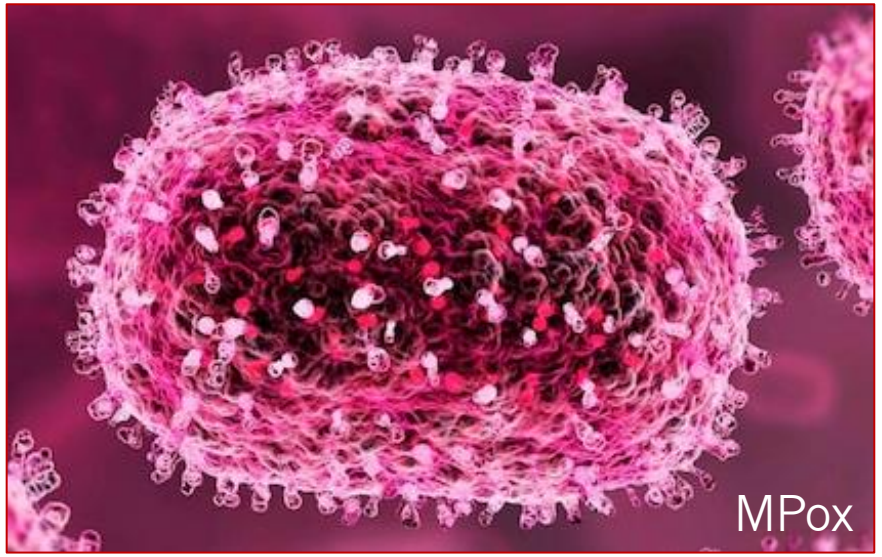
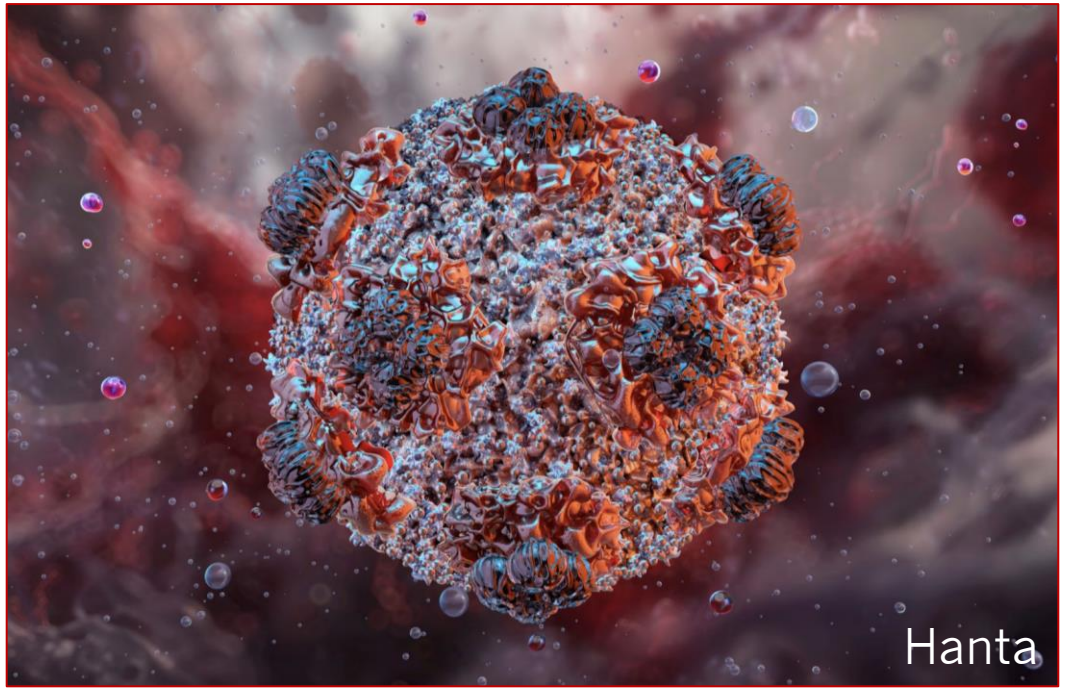
  - Centers for Disease Control and Prevention
  - Massachusetts Department of Public Health
  - Agency for Healthcare Research and Quality

- **Royalties**
  - UpToDate Inc.


Covid


Ebola


MPox

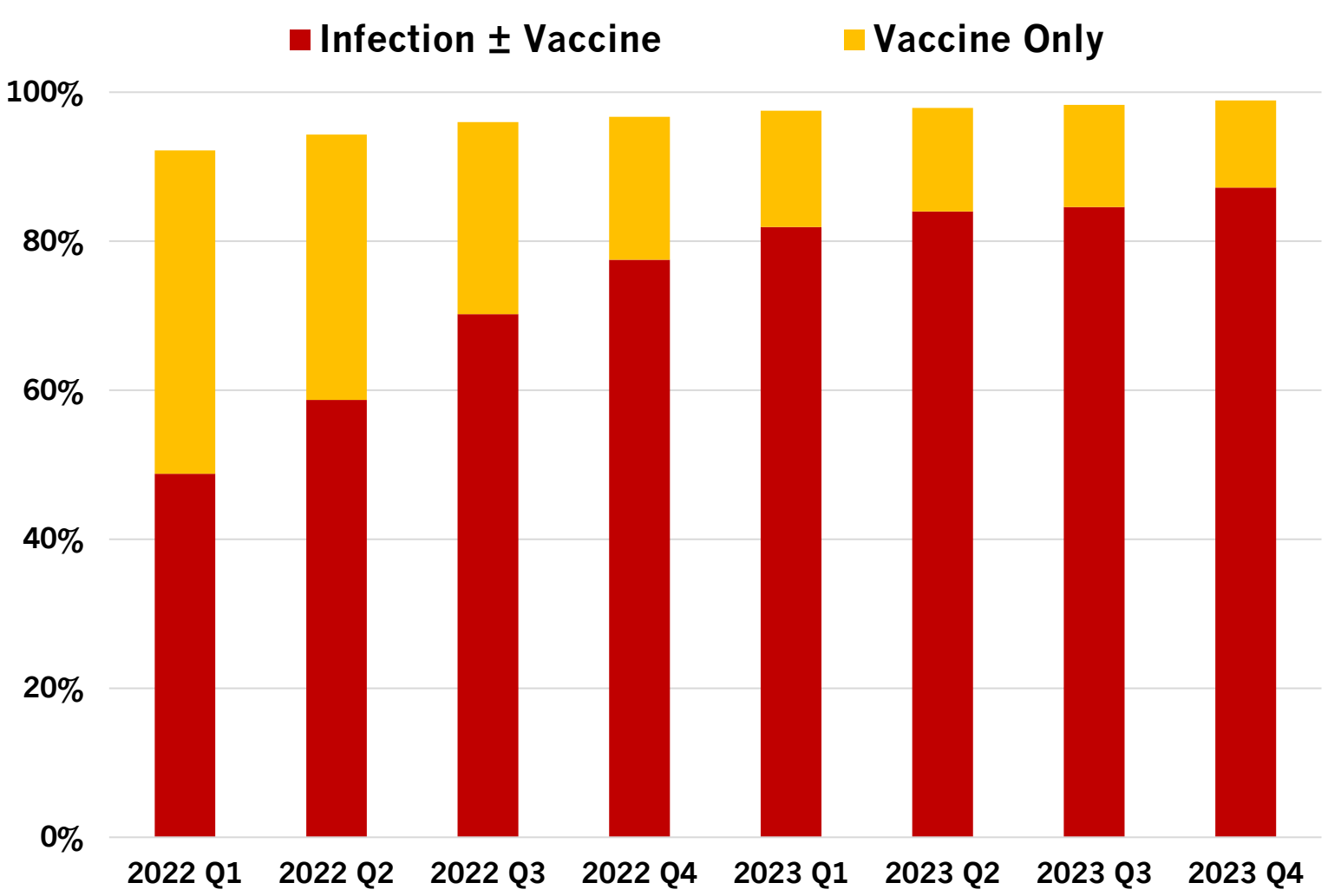

Hanta

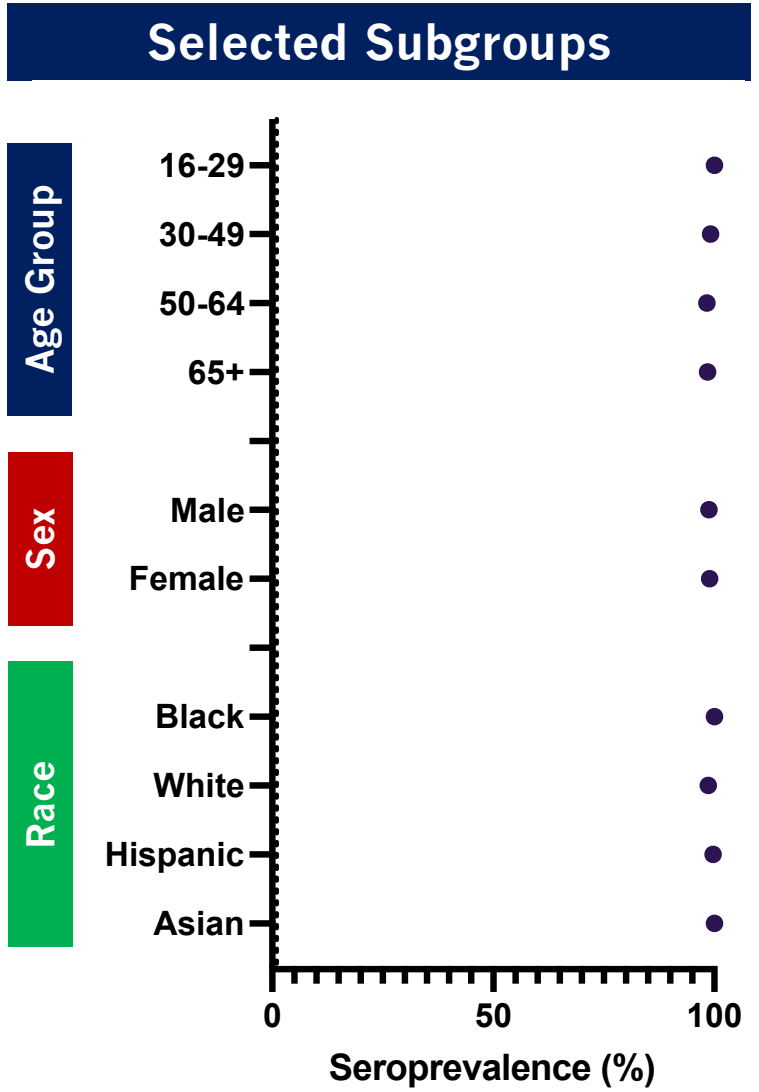

Cyclospora


SARS-CoV-2


1.2 million US deaths
witf.org/2021/10/30/covid-19-memorial-creators-reflect-as-world-nears-5m-deaths/

SARS-CoV-2 Immunity in the US

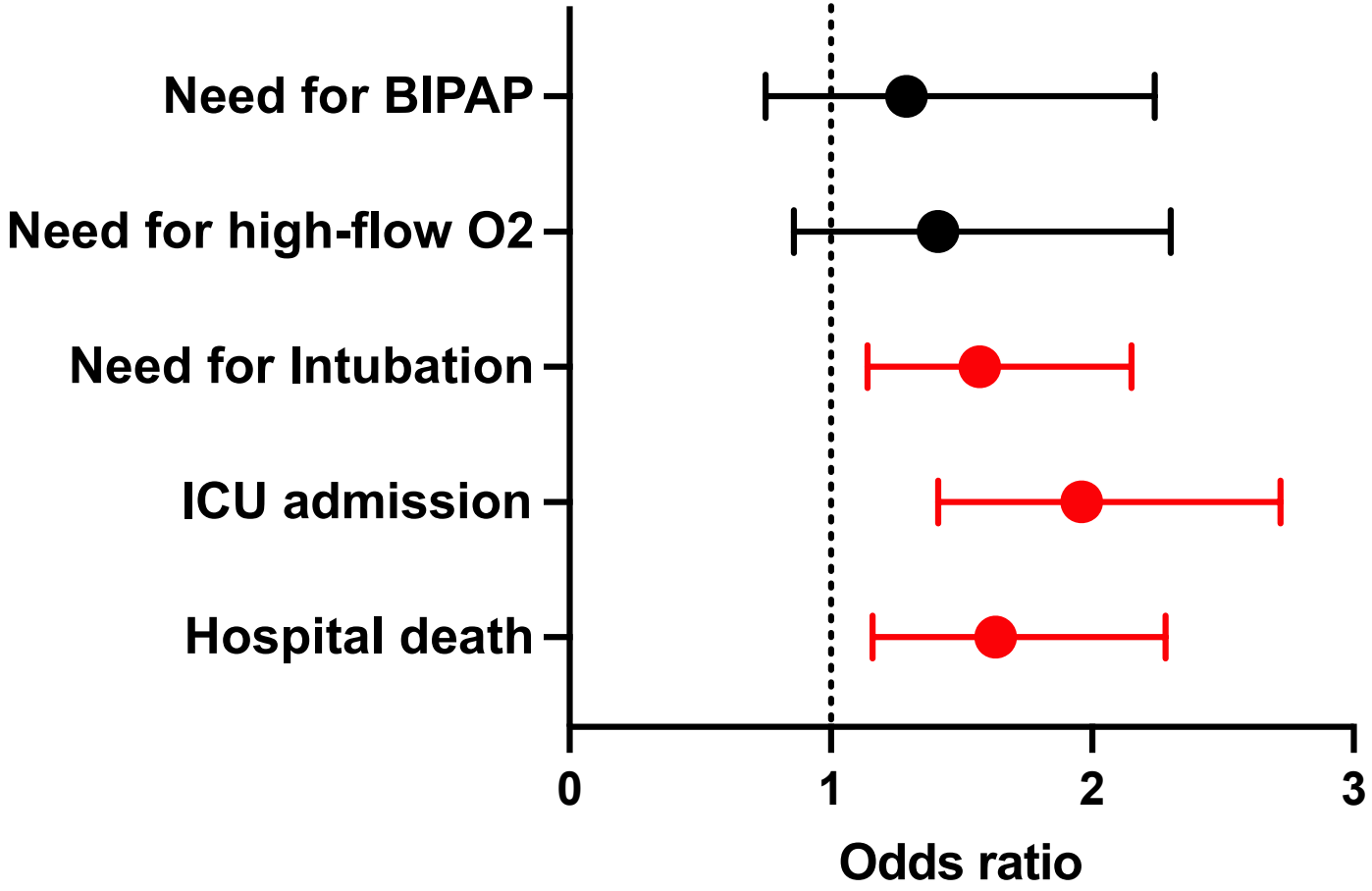




covid.cdc.gov/covid-data-tracker/#nationwide-blood-donor-seroprevalence-2022

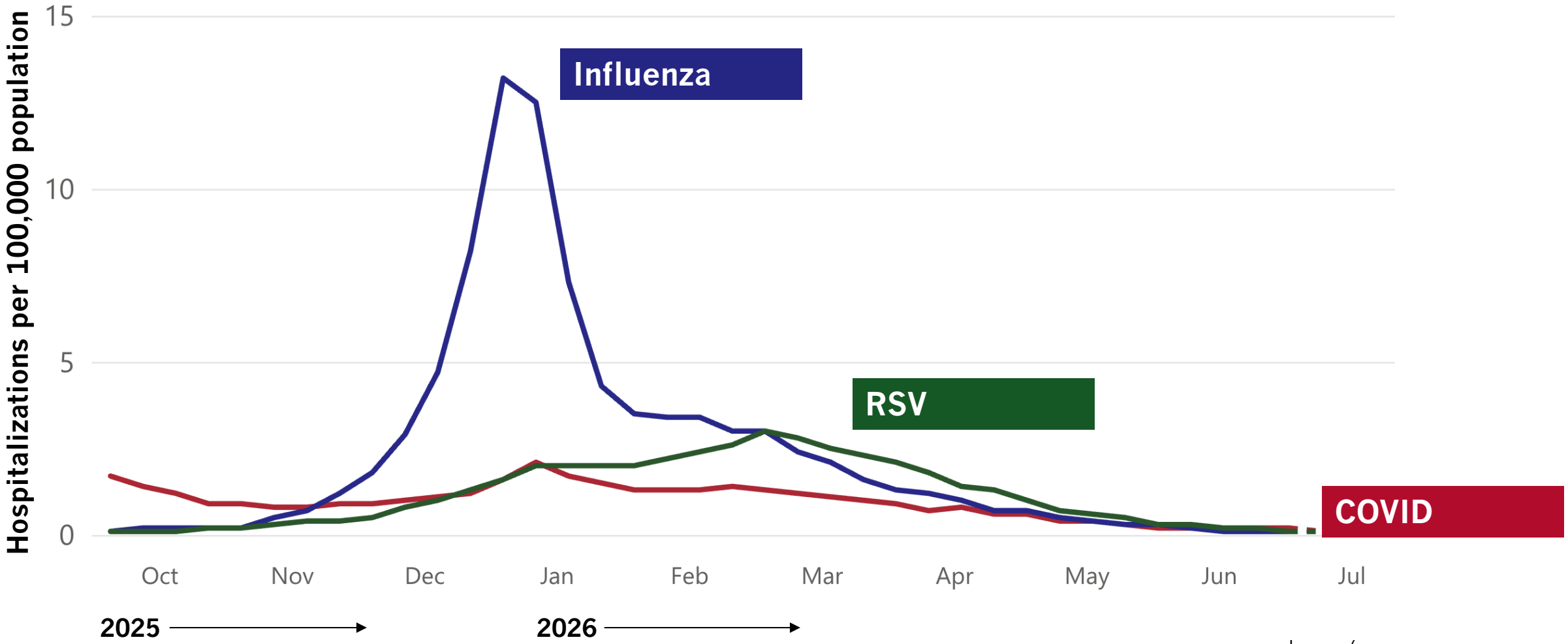
Morbidity and Mortality of Nosocomial Omicron

865 hospital-onset SARS-CoV-2 Omicron infections propensity-matched to 1,730 control patients, 5 hospitals, MA



Klompas, *Ann Intern Med* 2024;177:1078-1088

US Hospitalizations for Respiratory Viruses, 2025-2026



cdc.gov/resp-

RESP-NET
Respiratory Virus Hospitalization Surveillance Network

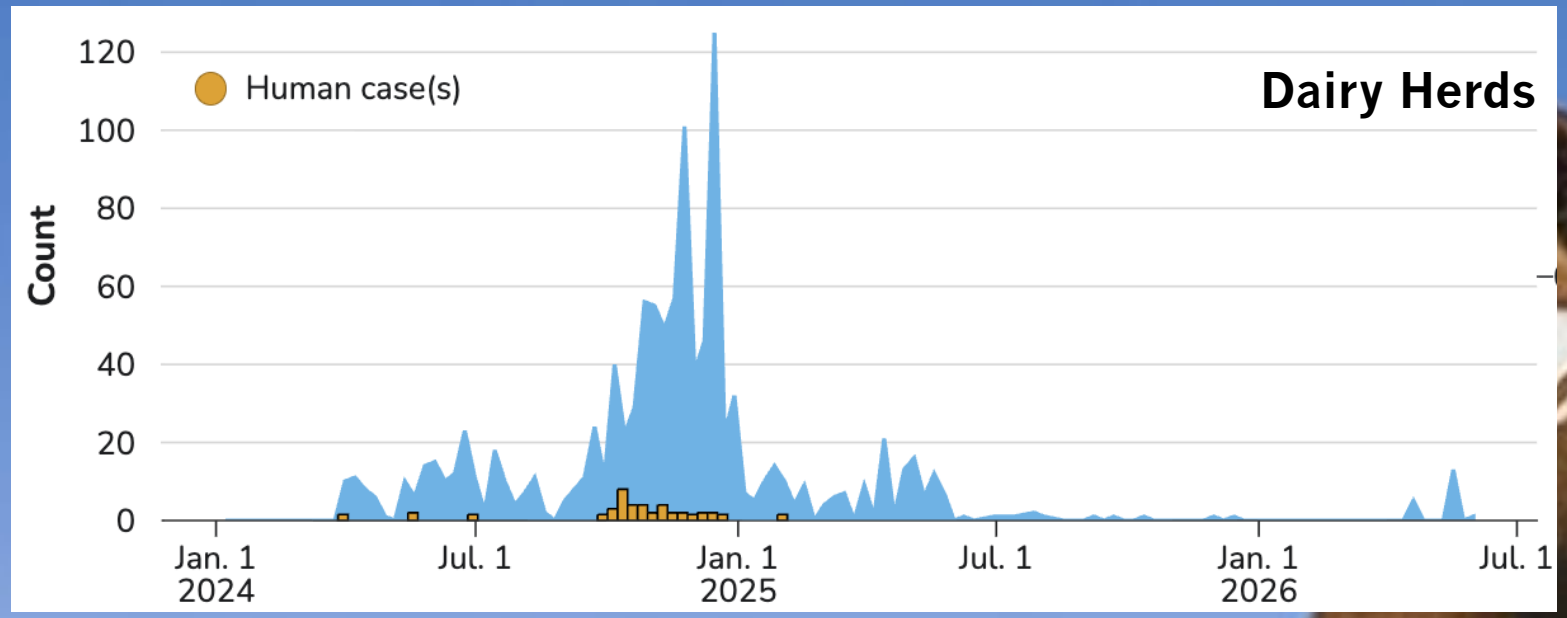
Avian Influenza

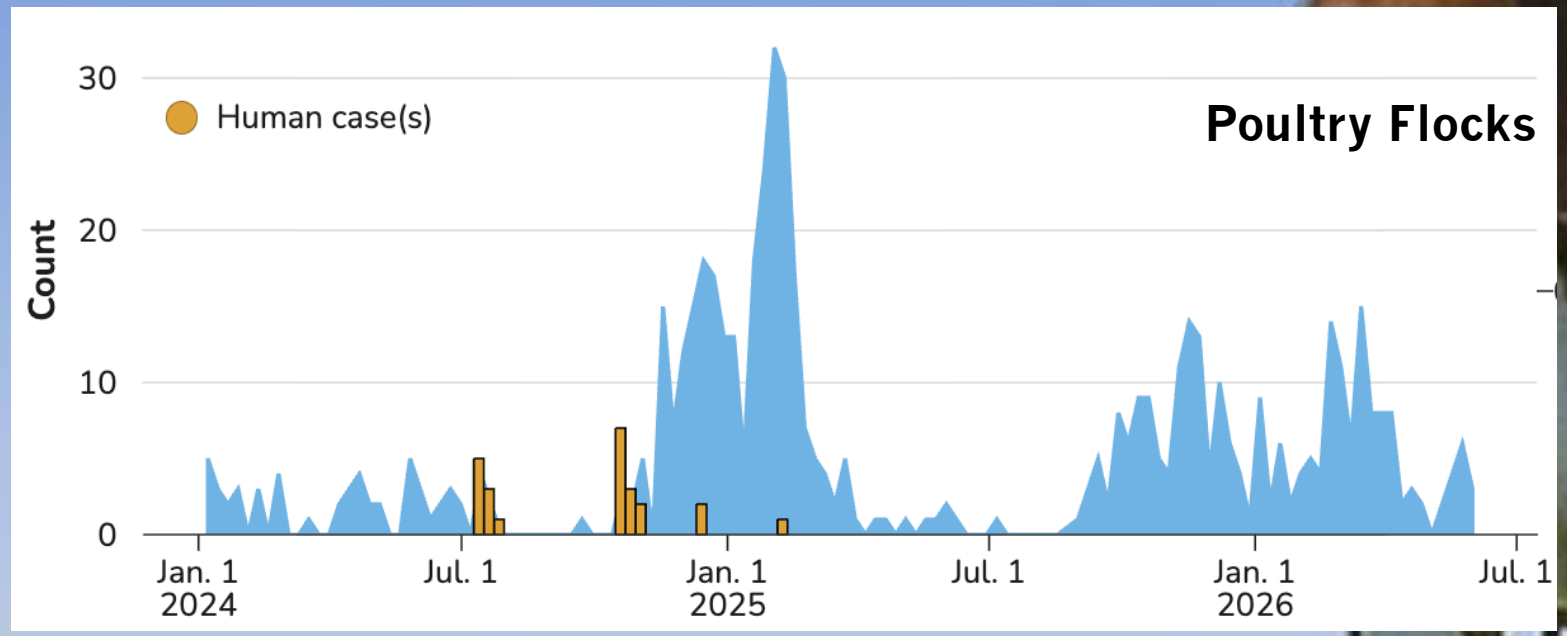
vox.com/science/23793697/bird-flu-avian-influenza-explained-pandemic-potential-wildlife

Avian Influenza in the USA 2024-

- Endemic in wild birds worldwide
- Spread to US domestic poultry & cattle (>175 million birds, >1000 herds thus far)
- Sporadic detections in >20 other mammal species
- 71 human cases in the US
  - Almost all **MILD**; 2 deaths
  - Infected via dairy herds (58%), poultry farms (34%), and other animals (4%)
- No human-to-human spread

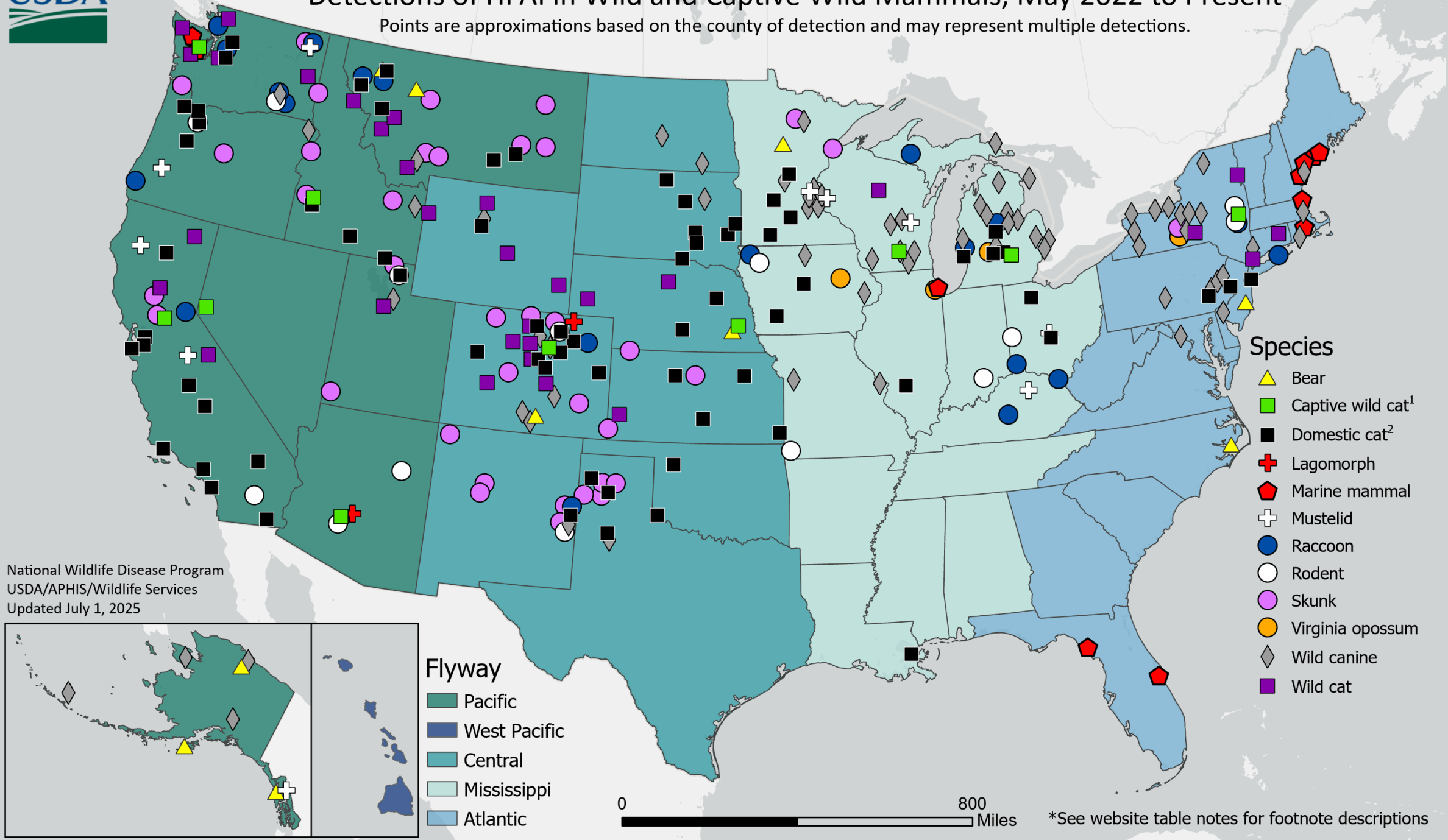
Avian Influenza in the USA 2024-





Detections of HPAI in Wild and Captive Wild Mammals, May 2022 to Present

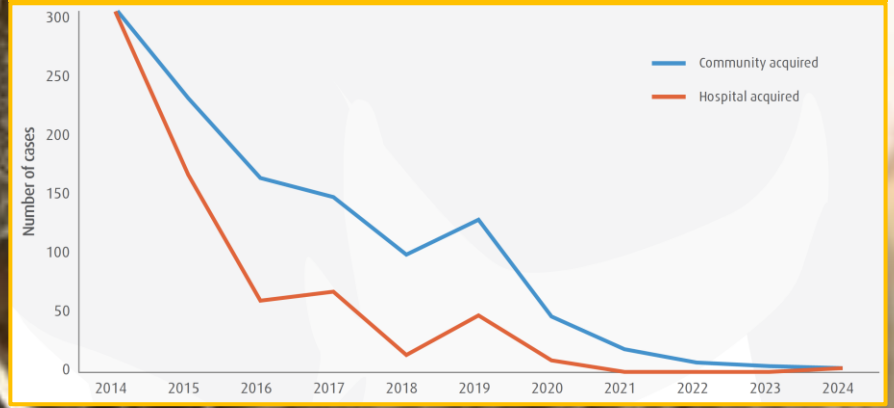
Points are approximations based on the county of detection and may represent multiple detections.



National Wildlife Disease Program
USDA/APHIS/Wildlife Services
Updated July 1, 2025

Middle East Respiratory Virus

MERS Cases 2014-2024



www.natureworldnews.com/articles/13948/20150409/camels-save-mers.htm

Risk Factors for MERS

Risk factors

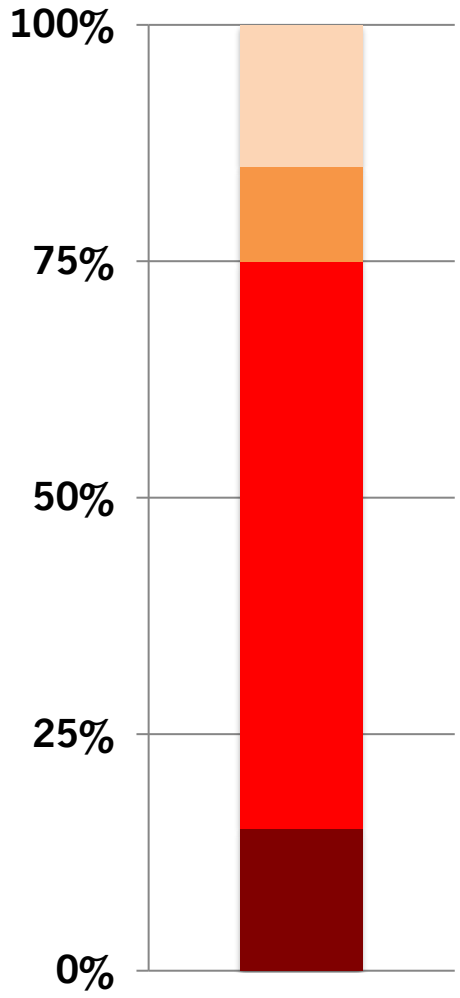
- Physical contact with camels in the two weeks preceding illness
- Milking camels, training camels
- Contact with camels' waste
- Diabetes mellitus, heart disease, smoking

Dromedary camels

- Serum antibodies to MERS in ~70%
- Nasal swabs positive ~15%
- Virus also recovered from milk & feces

Emerg Infect Dis 2016;22:49-55
Lancet Infectious Diseases 2018;18:e217-27

Asymptomatic & Mild Disease Common



Severe (mechanical ventilation)

Moderate (hospitalized)

Mild (outpatient only)

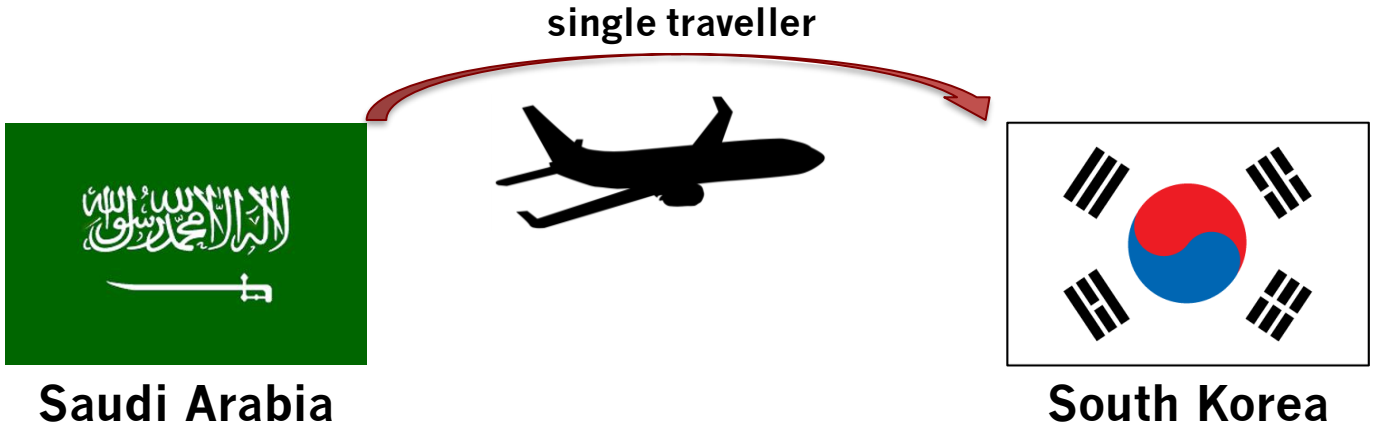
Asymptomatic

Emerg Infect Dis 2016;22:1915-20

Countries with MERS Cases

World Health Organization (Sept 2017)

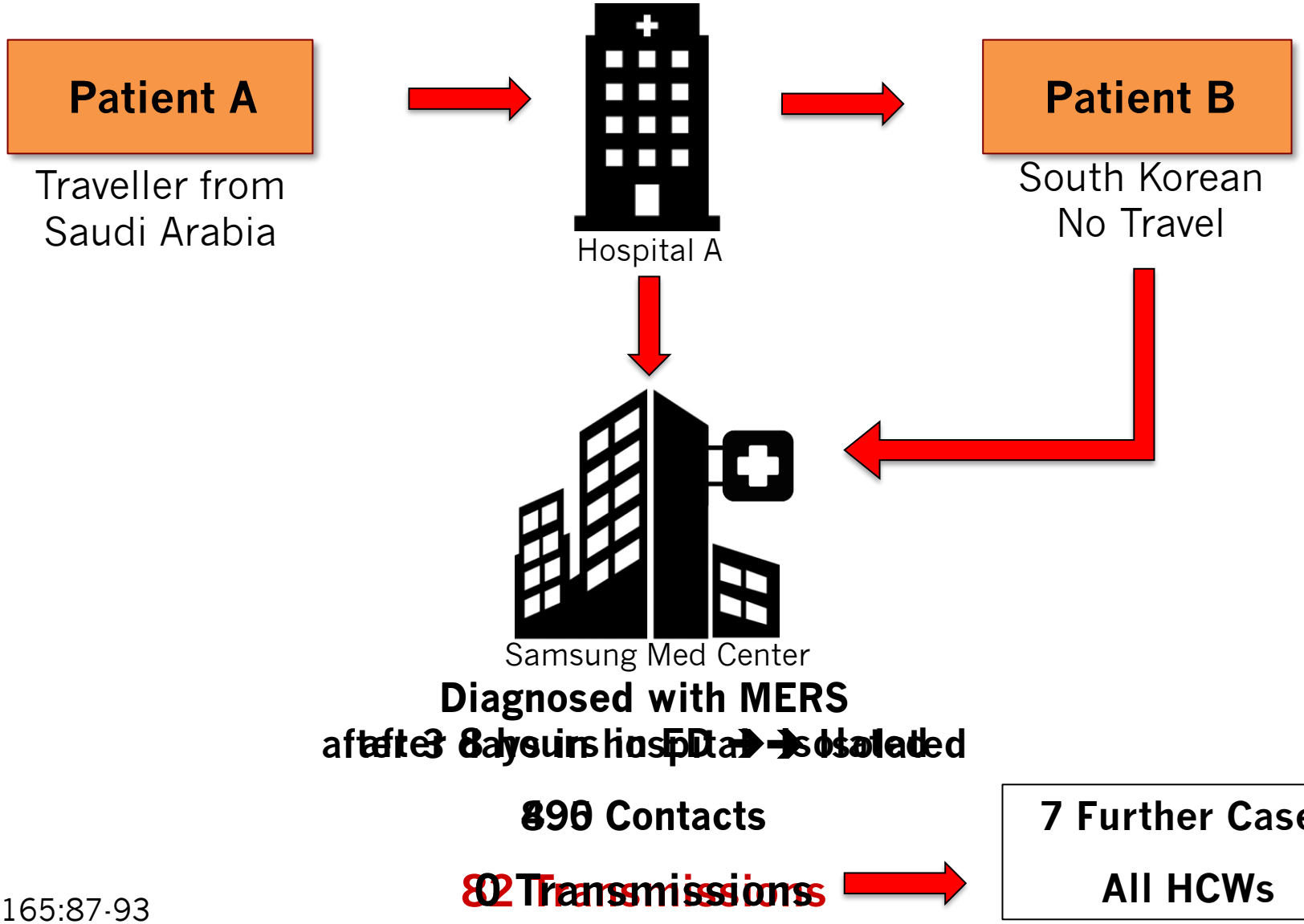
MERS Outbreak in South Korea



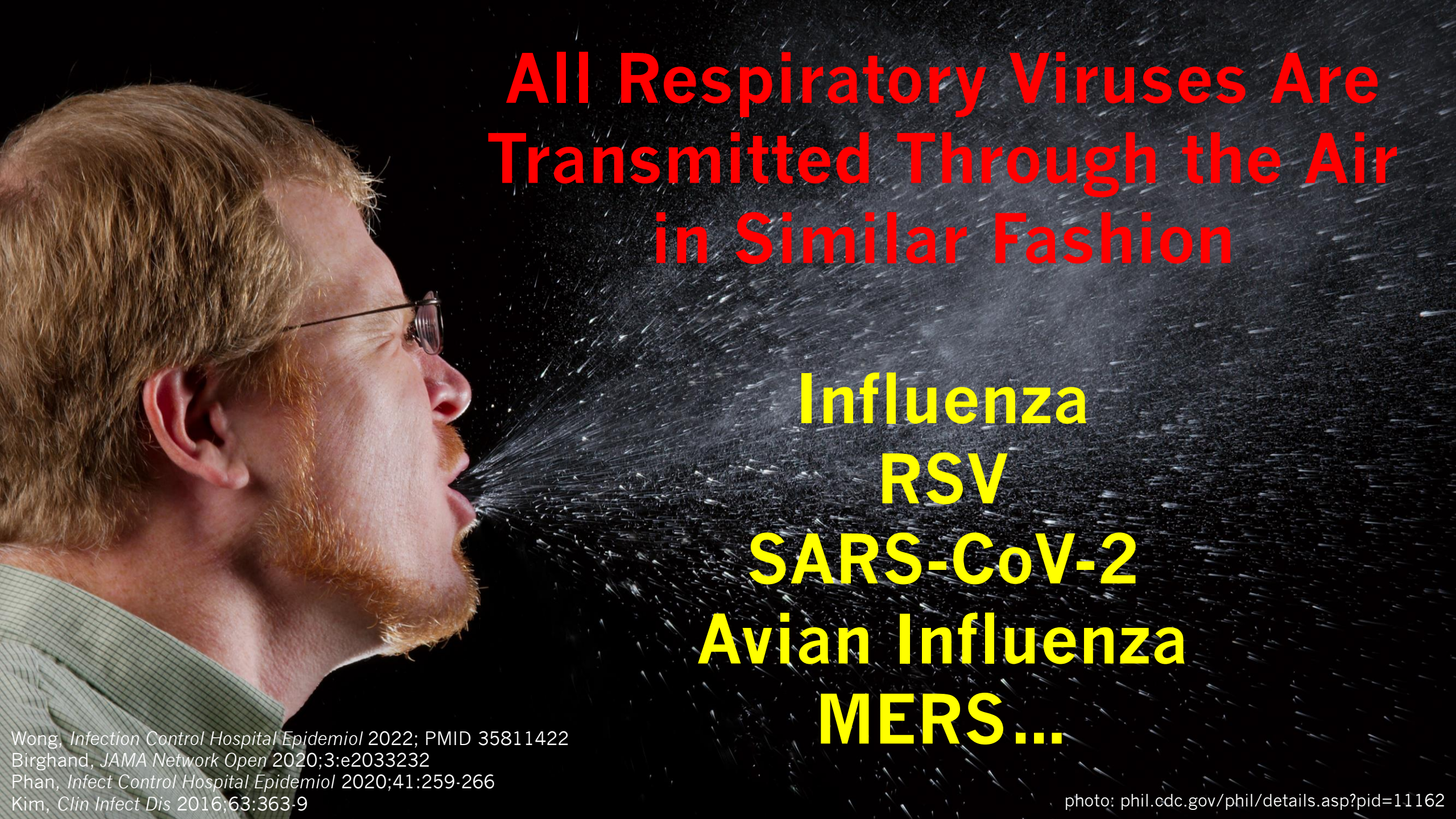
186 cases
38 deaths

Samsung Medical Center

1950 bed Tertiary Care Center: 92 MERS Cases



Ann Intern Med 2016;165:87-93



Wong, *Infection Control Hospital Epidemiol* 2022; PMID 35811422
Birghand, *JAMA Network Open* 2020;3:e2033232
Phan, *Infect Control Hospital Epidemiol* 2020;41:259-266
Kim, *Clin Infect Dis* 2016;63:363-9

photo: phil.cdc.gov/phil/details.asp?pid=11162

Risk & Protection Against Respiratory Viruses

Factors That Increase Risk

- High community incidence
- Higher viral load
- Symptoms
- Proximity
- Longer exposure
- Poor ventilation
- Lack of masking
- Lack of vaccination

Factors That Decrease Risk

- Low community incidence
- Lower viral load
- Lack of symptoms
- Distance
- Brevity
- Good ventilation
- Mask on patient
- Mask on provider
  - N95 > KN95 > facemask
- Vaccination

Hantavirus

Hondius Cruise Ship
12 confirmed cases, 1 probable case, 3 deaths
Index patient presumed infected in Argentina then virus spread person-to-person on ship

Most hantavirus infections attributable to inhalation of aerosolized rodent excreta (urine, stool, saliva)

Deer mouse is the classic reservoir in Western US (Sin Nombre Virus)

Longtailed pygmy rat in Argentina and Chile (Andes Virus)

Other rodents possible

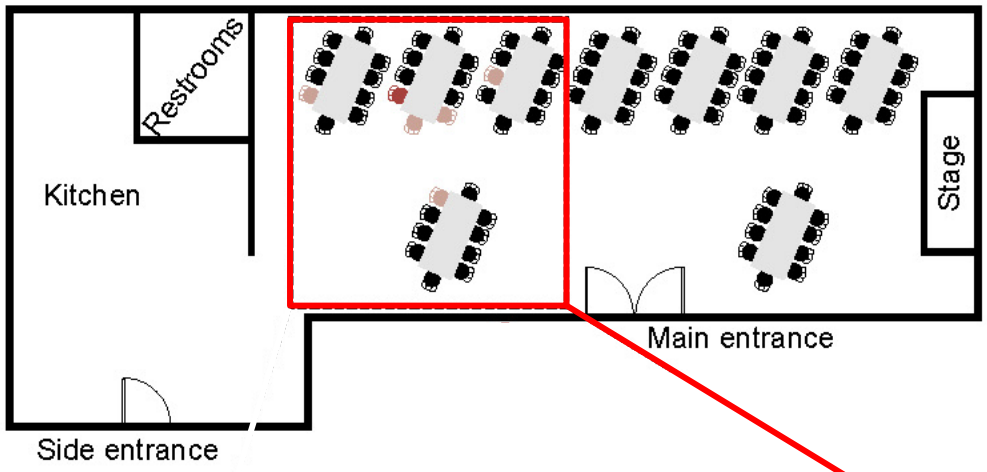
Flu-like illness that progresses to severe respiratory failure

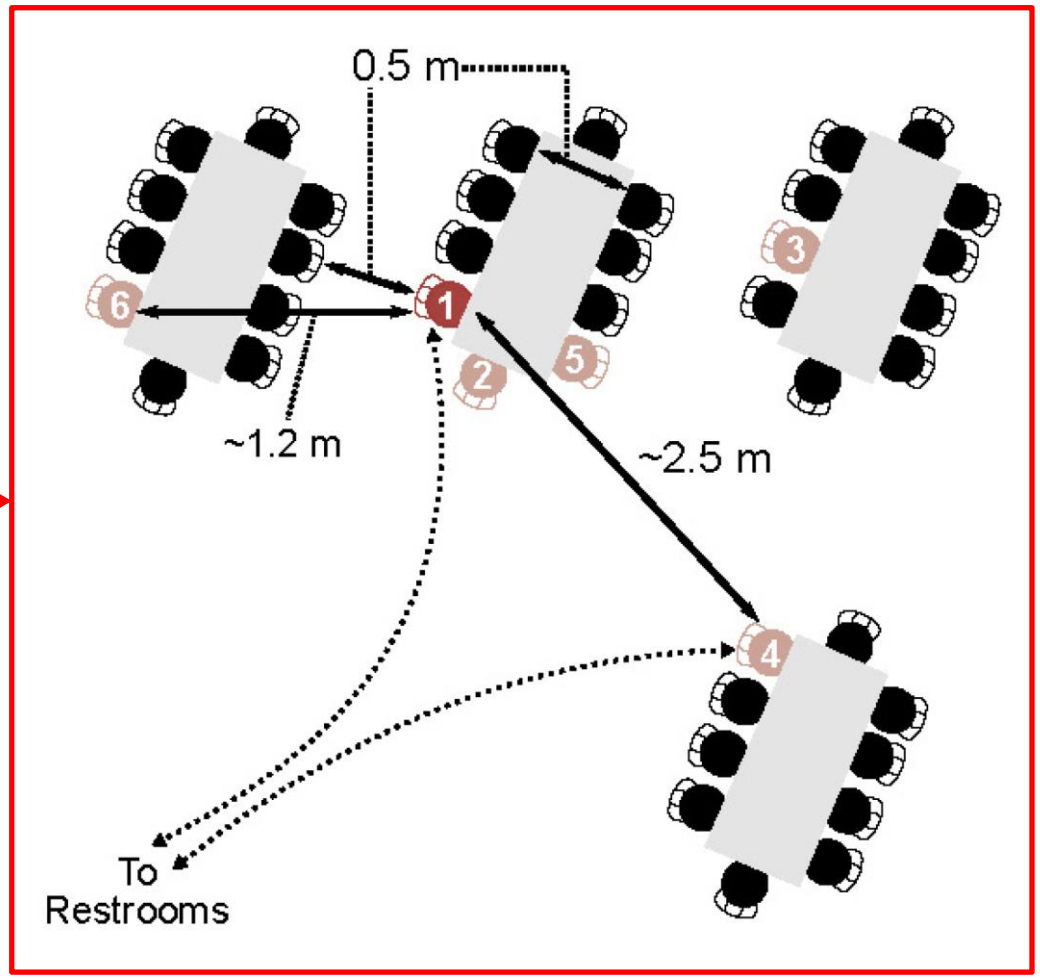
Supportive care

nps.gov/chis/planyourvisit/hantavirus.htm

Person-to-Person Spread of Hantavirus ANDES Strain

Birthday party attended by 100 people, 1 symptomatic with Hantavirus, spread to 5 others, Epuyén, Chile 2018
Presumptive evidence of person-to-person airborne spread given distances between infected individuals





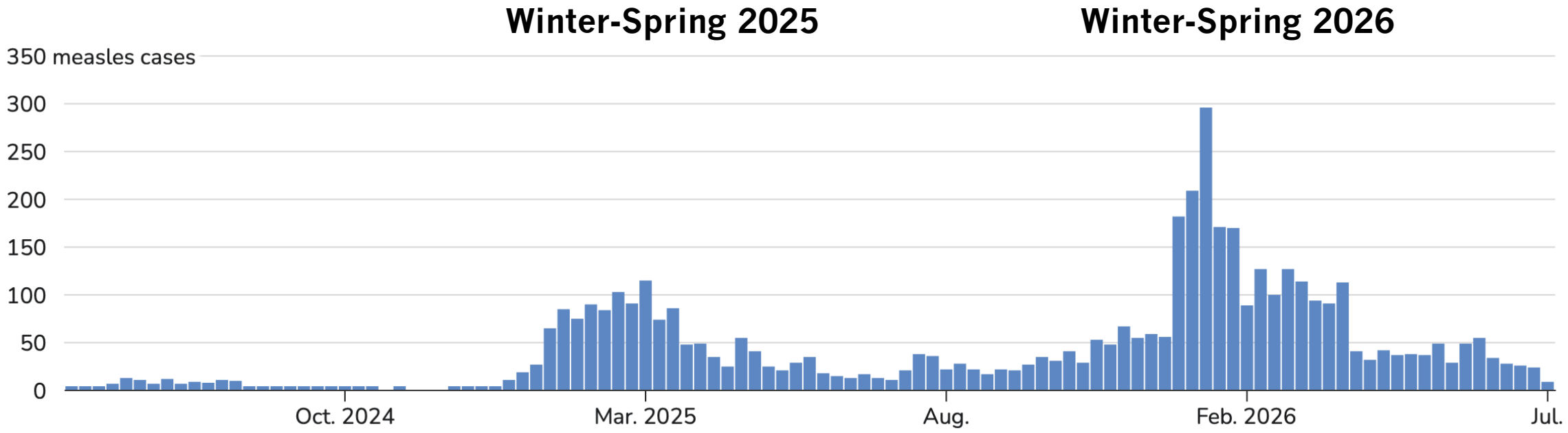
Incubation period ~3 weeks
(median 18 days, range 7-39 days)

Martinez, *N Engl J Med* 2020;383:2230-41

Measles

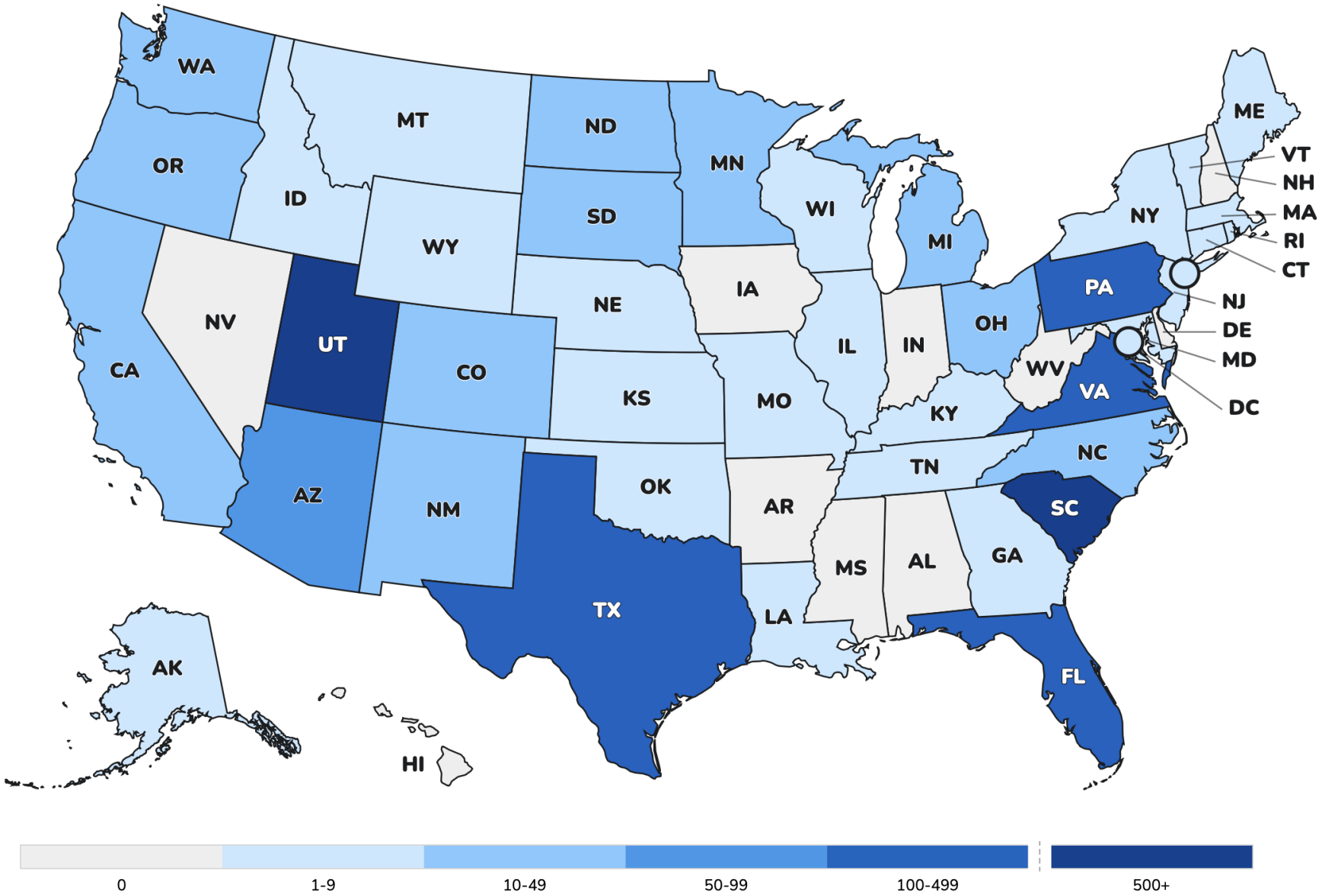

MEASLES
TESTING
MEMORIAL HOSPITAL
SEMINOLE HOSPITAL DISTRICT
EMERGENCY

US Measles Cases, 2025-2026



4,549 cases **8.5% hospitalized** **3 deaths**

US Measles Cases, 2026



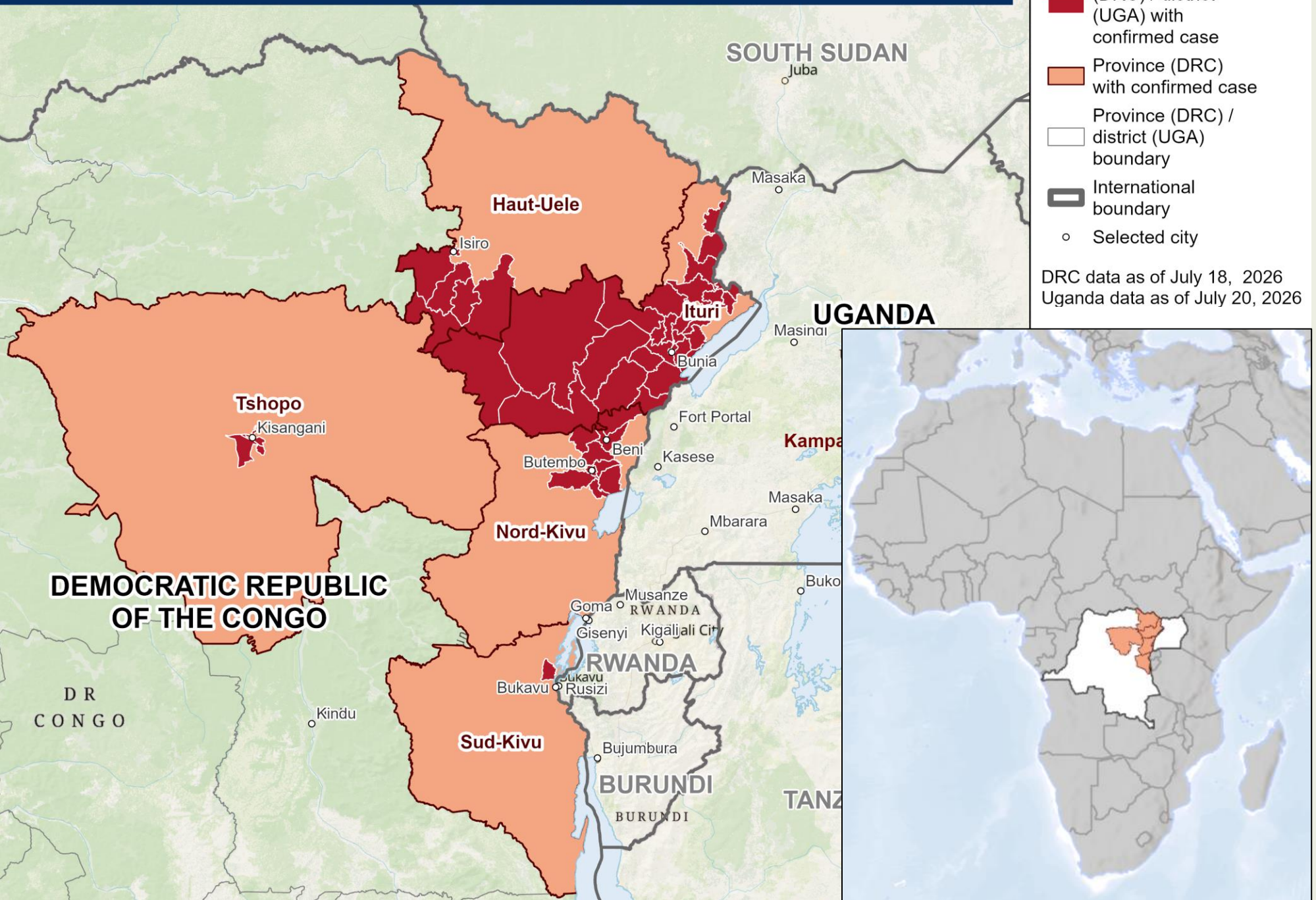
US Measles Cases 2026

nbcnews.com/health/health-news/measles-outbreak-texas-vaccines-kids-cases-what-know-rcna194216

- 93% unvaccinated
  - 3% one dose MMR
  - 4% two doses MMR

Ebola

2026 Ebola - Confirmed Cases by Provinces and District



Health zone (DRC) / district (UGA) with confirmed case

Province (DRC) with confirmed case

Province (DRC) / district (UGA) boundary

International boundary

Selected city

DRC data as of July 18, 2026
Uganda data as of July 20, 2026

Confirmed Cases

- 2365

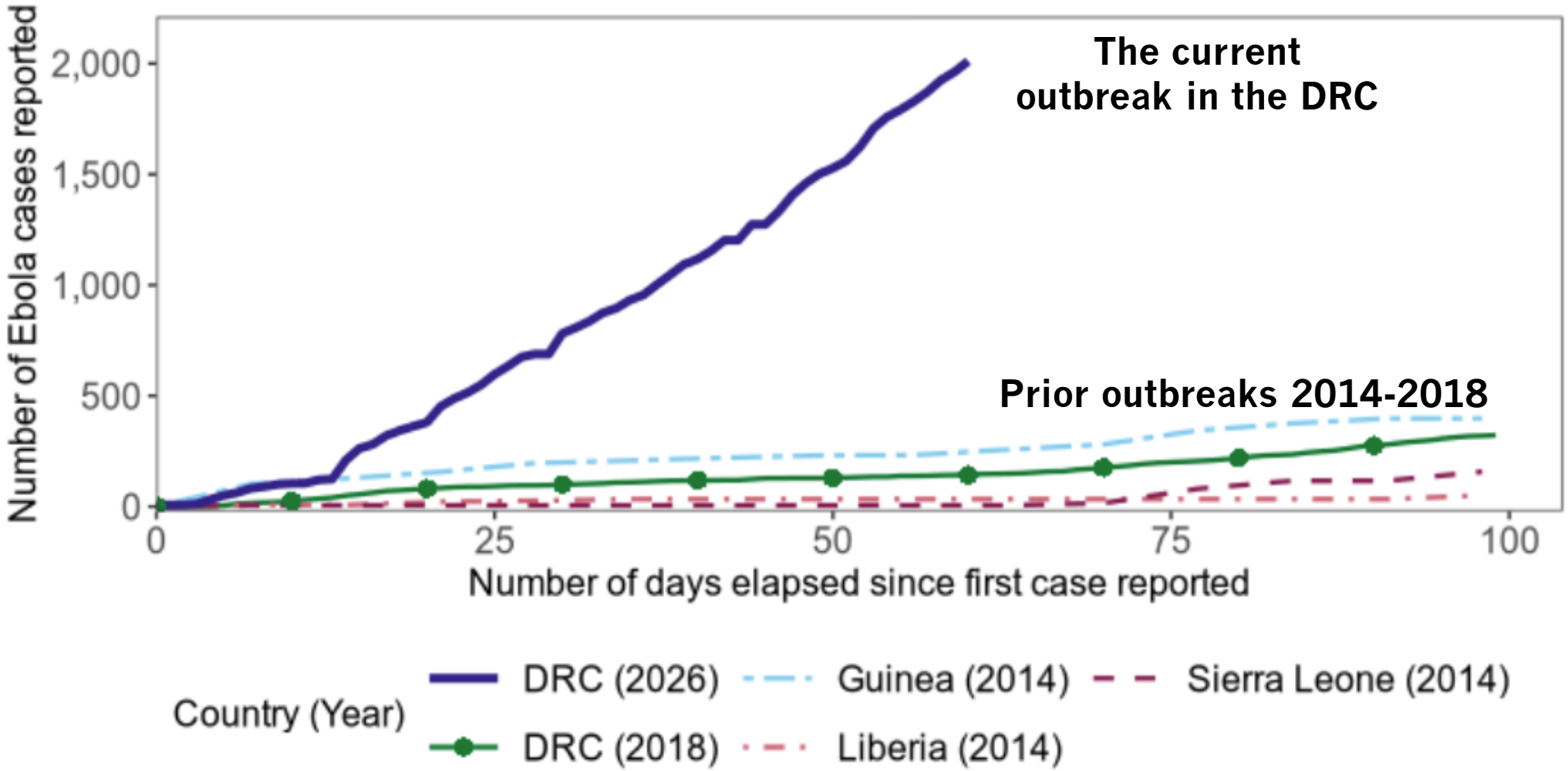
Confirmed Deaths

- 932

Countries with Cases

- DRC (2344)
- Uganda (20)
- France (1)

Ebola Case Counts in the First 100 Days, 2014-2026

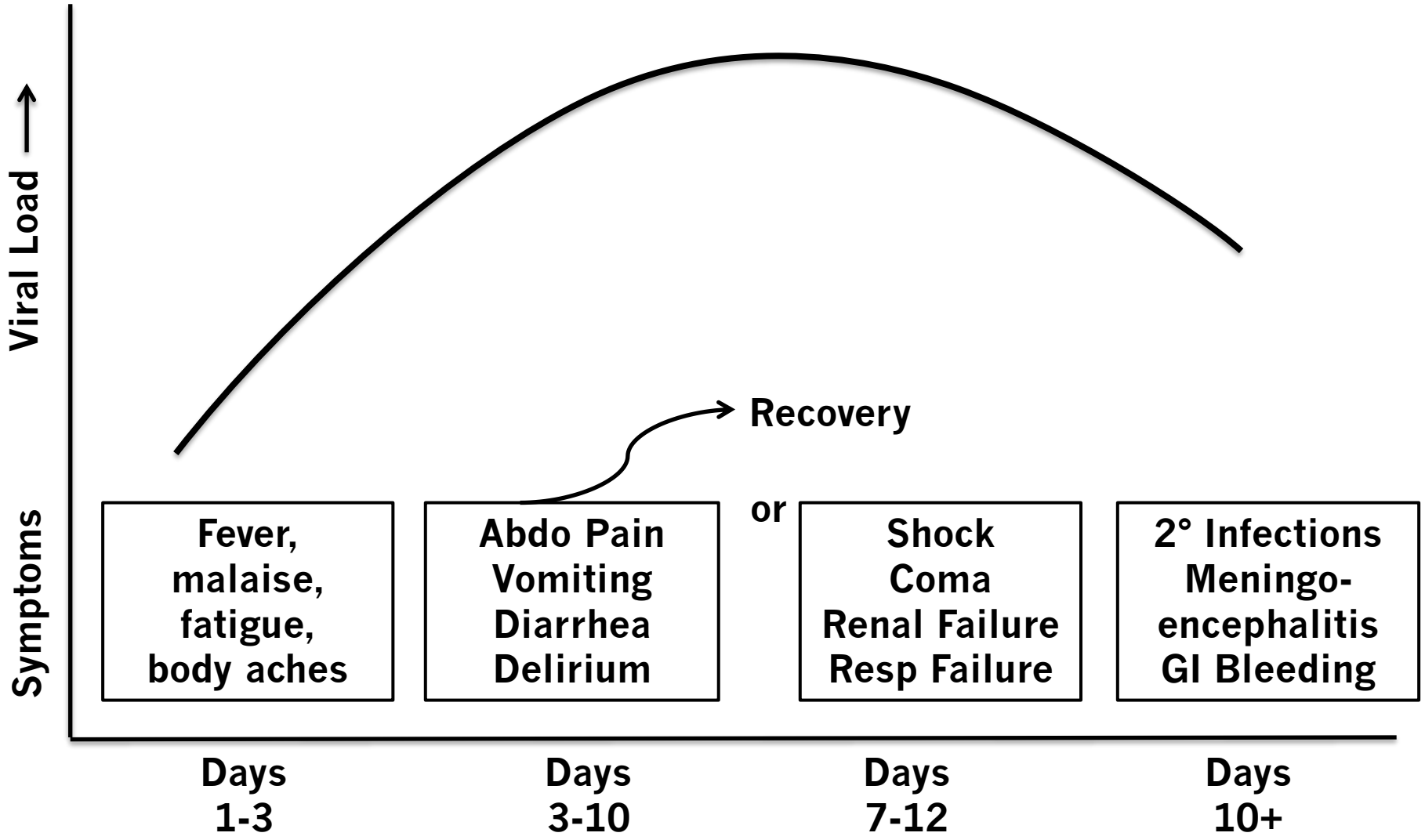


*Cases shown based on date reported. Data sources: DRC INSP, WHO. Data for DRC (2026) are as of Jul 13, 2026.

https://www.nytimes.com/2026/07/08/world/africa/ebola-congo-m23-rebels.html

Dominique Faget / Agence France-Presse – Getty Images – NY Times Oct 3, 2014

Clinical Evolution



Chertow, NEJM 2014;371:2054-2057

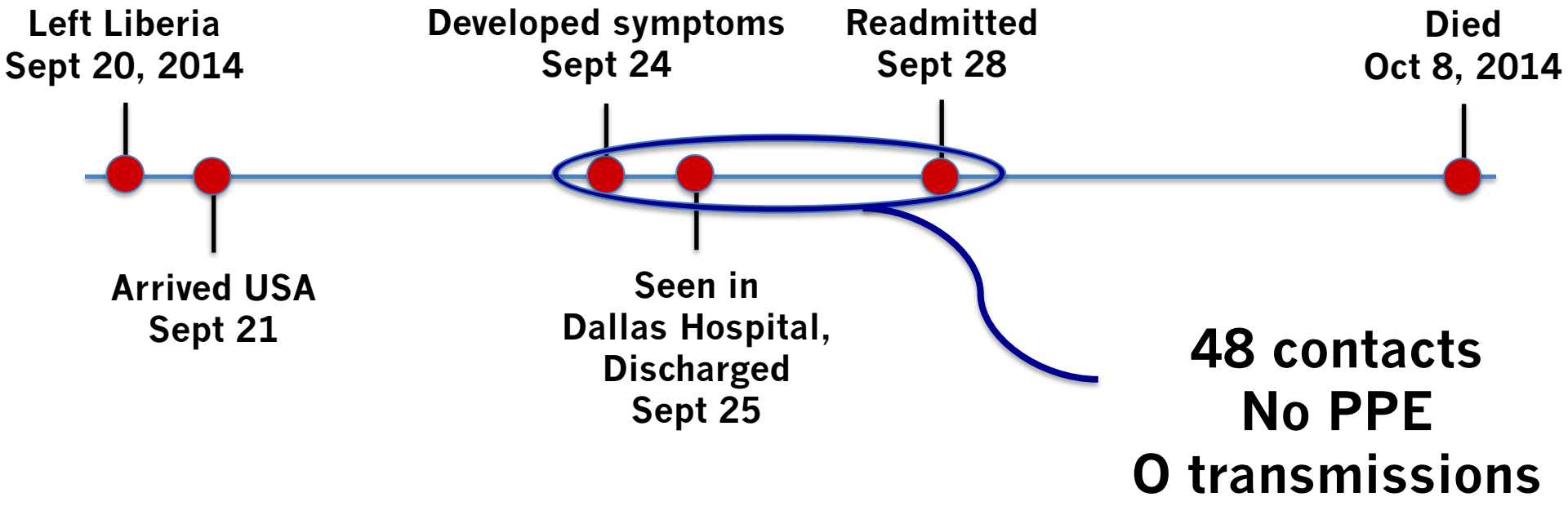
Massive Volume & Electrolyte Loss

- Severe diarrhea
  - 5-10 liters/day
- Massive third spacing of fluids
  - protein wasting (diarrhea), vascular permeability (endothelial damage)
  - body weight increases of 15-20kg yet still intravascularly dry
- Heavy electrolyte loss
  - Low K^+, Ca^{++}, Na^+ → arrythmias
- Acute renal failure

N Engl J Med 2016;374:636-46
Bruce Ribner, IDWeek 2014, www.idweek.org/ebola_idweek_2014

Thomas Duncan

Photo: NYT



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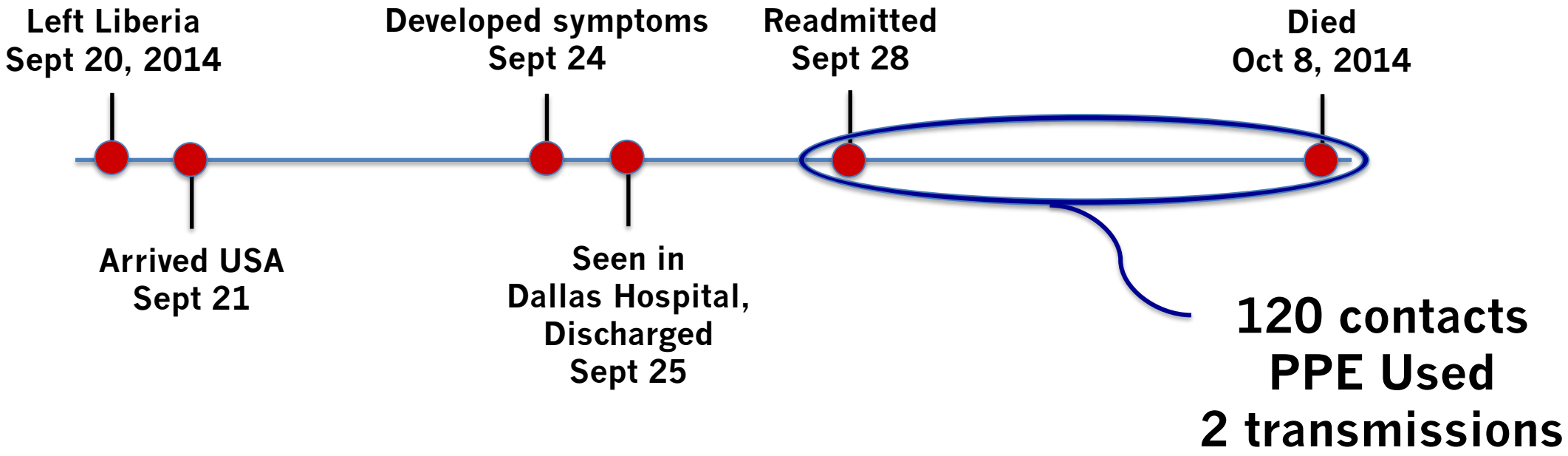
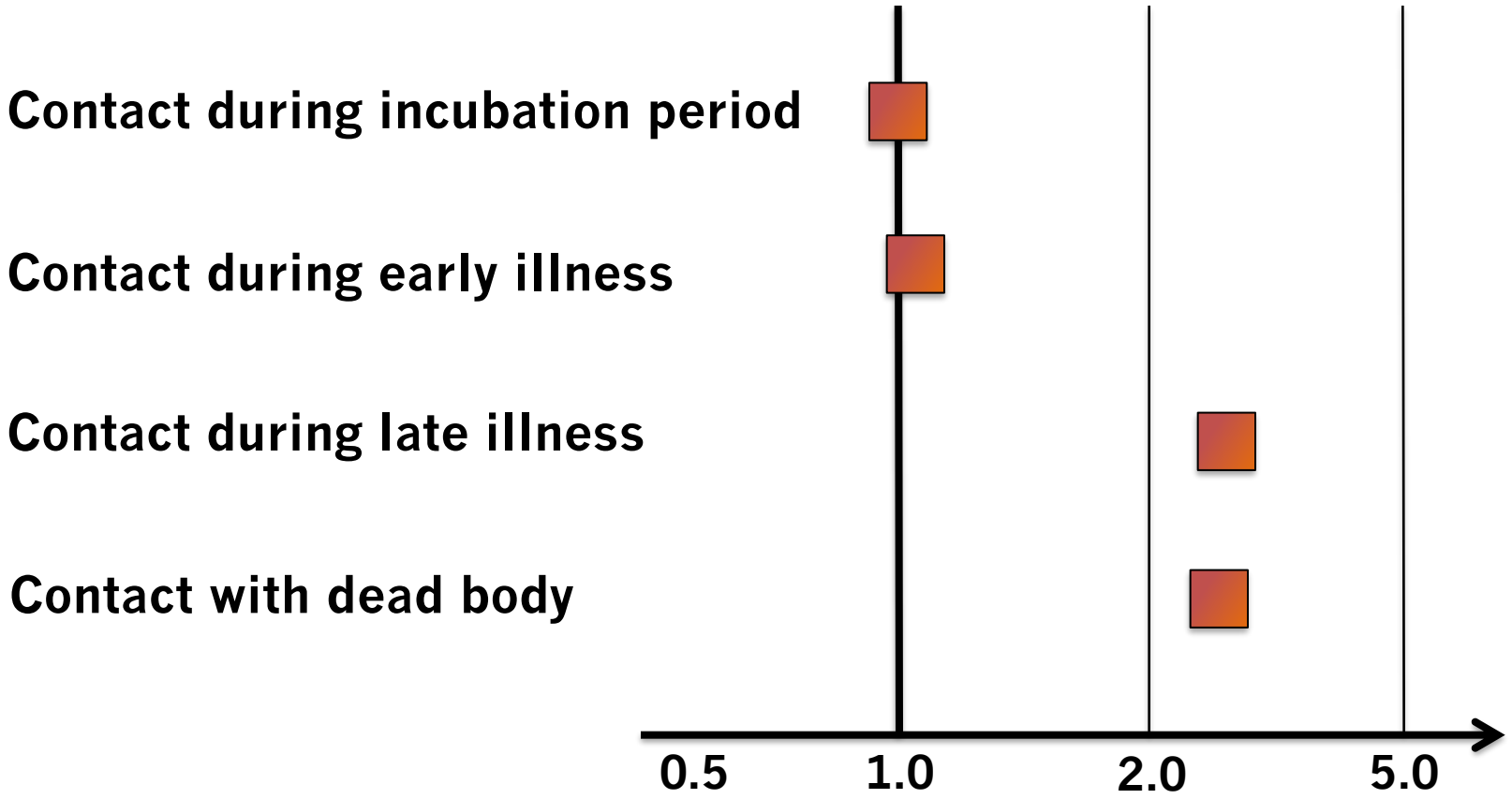


Risk Factors for Transmission

Amongst Patients With Direct Contact



J Infect Dis 1999;179 Suppl 1;S87

CDC
Centers for Disease Control and Prevention

JOHNS HOPKINS MEDICINE

EBOLA

PREPAREDNESS: PPE GUIDELINES

Produced in collaboration with:

APIC

SHEA

MIAMI UNIVERSITY

Personal Protective Equipment

“Dry” Patient

- Fluid impermeable gown
- Double gloves
- Surgical mask
- Face shield

“Wet” Patient

- Jump suit with integrated boots
- Double gloves
- PAPR with disposable hood
- Apron
- Boot covers

Marburg

Viral hemorrhagic fever similar to Ebola

- Recent outbreaks Rwanda and Tanzania
- Rwanda (2024): 66 cases, 15 deaths
- Tanzania (2025): 114 cases, 10 deaths
- Ethiopia (2025):L 14 cases, 9 deaths

Nipah Virus

- Reported in Bangladesh, India, Malaysia, Philippines, Singapore
- Transmission via direct contact with infected animals (bats, pigs, horses) or contaminated fruit products (esp. raw date palm juice)
- Presents with fever, headache, cough, pharyngitis, dyspnea
- Complications: encephalitis, pneumonia. Case fatality 45-76%

CDC
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JOHNS HOPKINS MEDICINE

NIPAH

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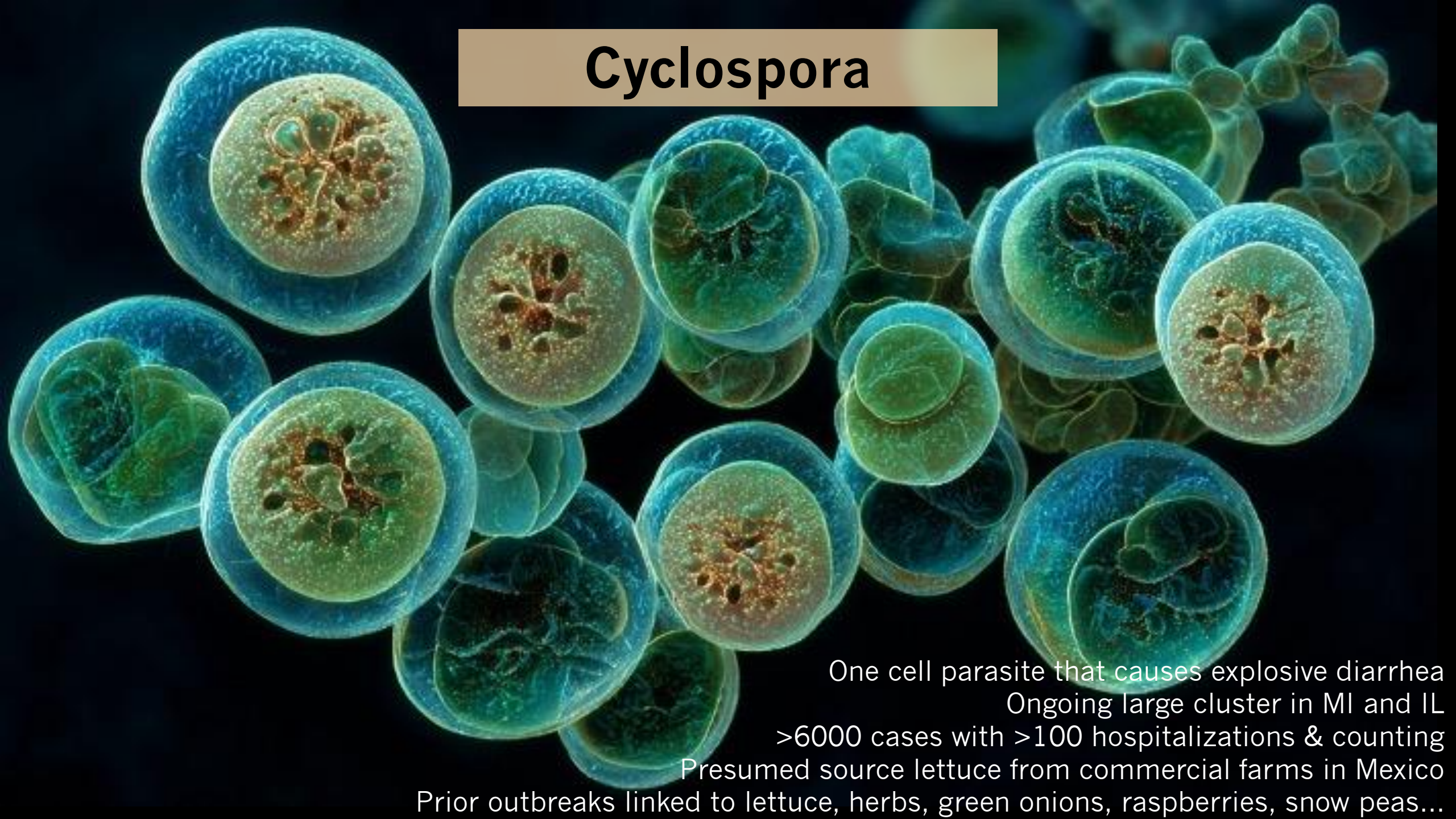
Cyclospora



One cell parasite that causes explosive diarrhea
Ongoing large cluster in MI and IL
>6000 cases with >100 hospitalizations & counting
Presumed source lettuce from commercial farms in Mexico
Prior outbreaks linked to lettuce, herbs, green onions, raspberries, snow peas...

Summary

- **Old and new pathogens with epidemic potential are a fact of life – new outbreaks will always occur**

- **Recognize the parallels between pathogens**
  - SARS-CoV-2, avian influenza, seasonal influenza, MERS, Hantavirus…
  - Ebola, Marburg, Nipah…
  - Cyclospora, Norovirus, Shigella…

- **Use “standard pathogens” to prepare for emerging pathogens**

Thank You!

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