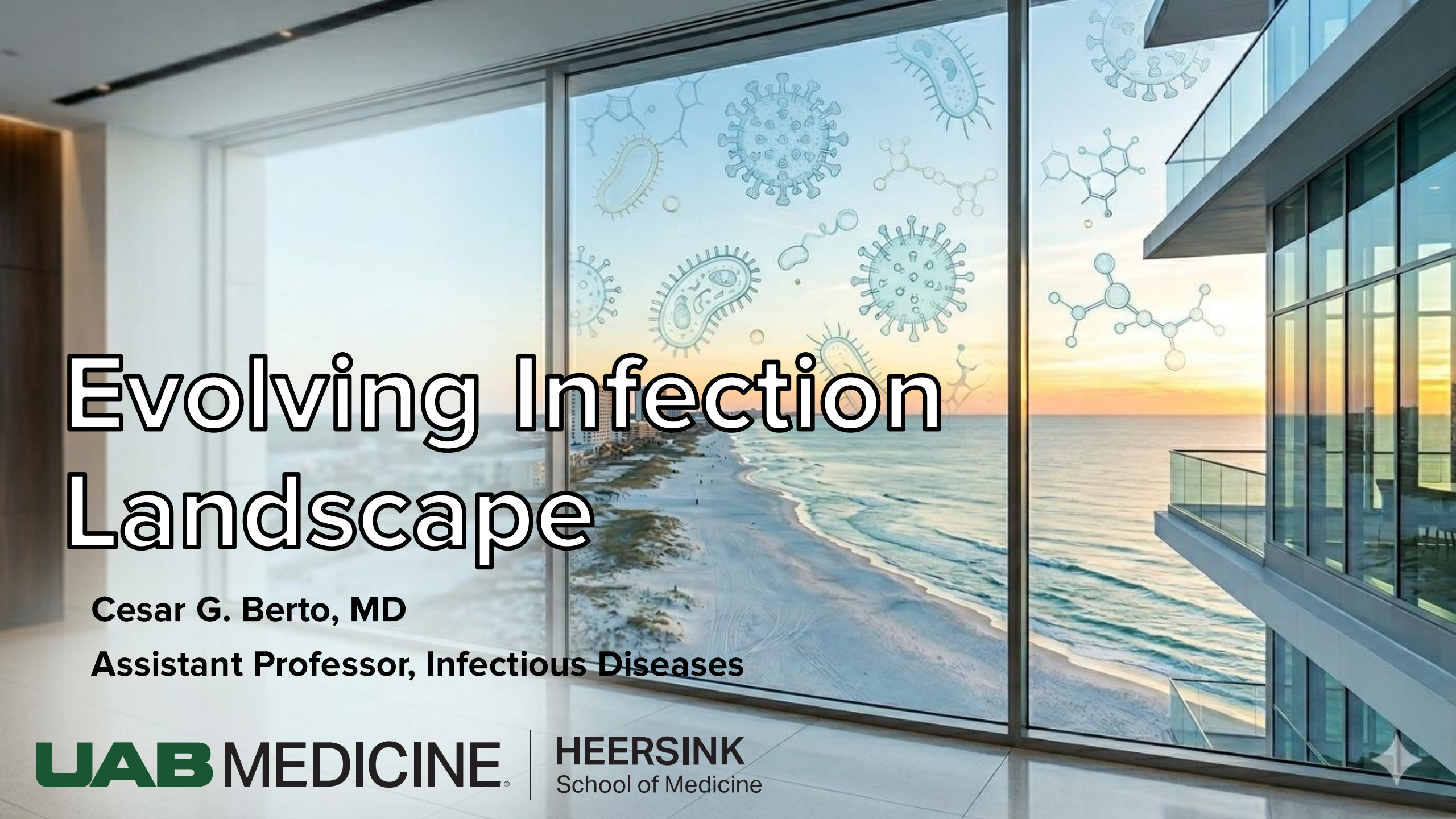

Evolving Infection Landscape

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UAB MEDICINE | HEERSINK School of Medicine

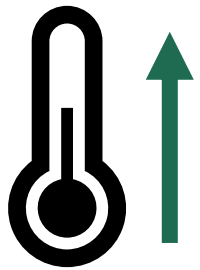
Disclaimers:

Grants/research support/grants pending: Basilea, Cidara, Karius

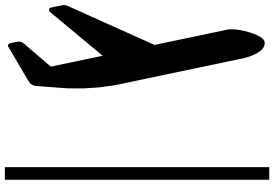
Goals:

- **Recognize** diagnostic work-up differences in patients with immunosuppresion.
- **Identify** organ-specific infectious risks based on transplant anatomy.
- **Assess** the net state of immunosuppression and relevant comorbidities to better estimate infection risk.
- **Monitor** for and manage common drug toxicities and interactions associated with antimicrobial prophylaxis and treatment.
- **Evaluate** the appropriateness and duration of prophylactic regimens in the transplant setting.
- **Differentiate** infectious risk based on the timing post-transplant or post-rejection treatment.

The Changing Landscape of Infections



CLIMATE CHANGE

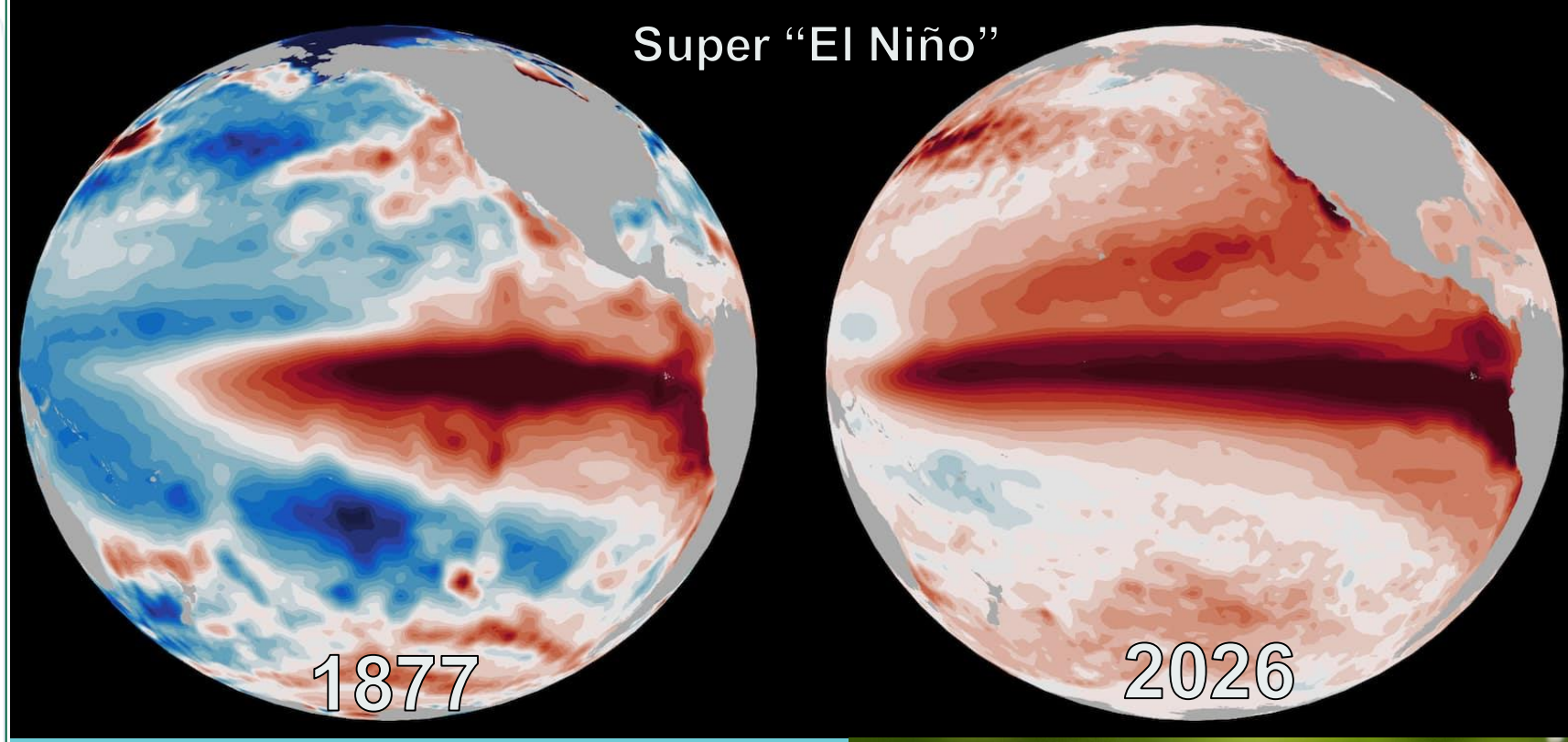


CONNECTIVITY

SELECTIVE PRESSURE

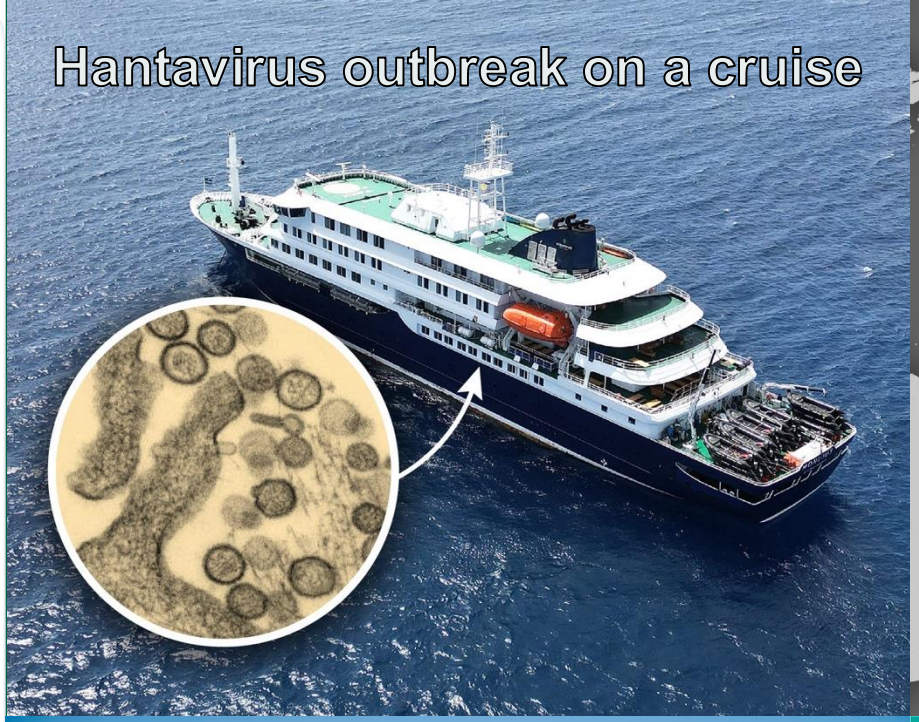
CLIMATE CHANGE

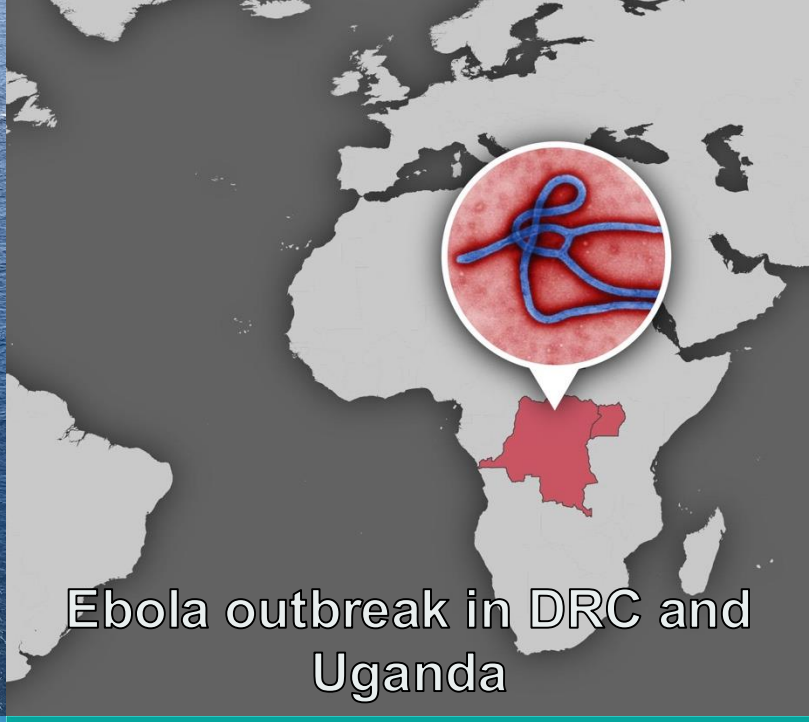
Ecological niche expansion for vectors and fungi.



CONNECTIVITY

Rapid global spread of pathogens and behaviors

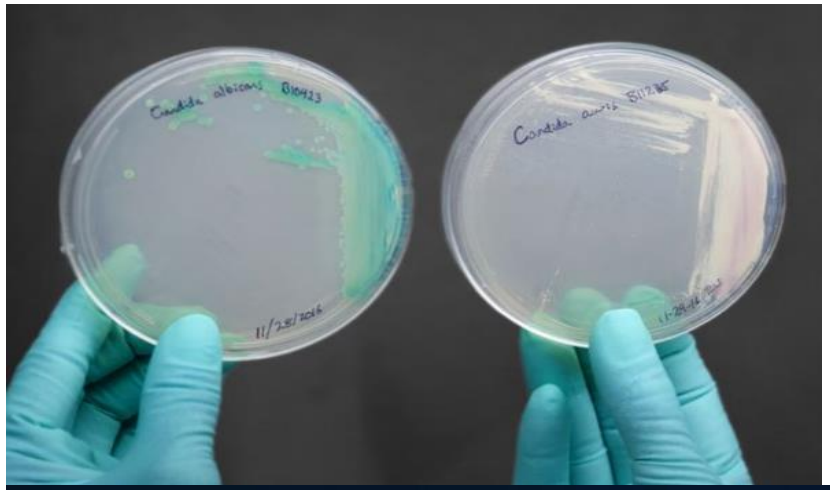




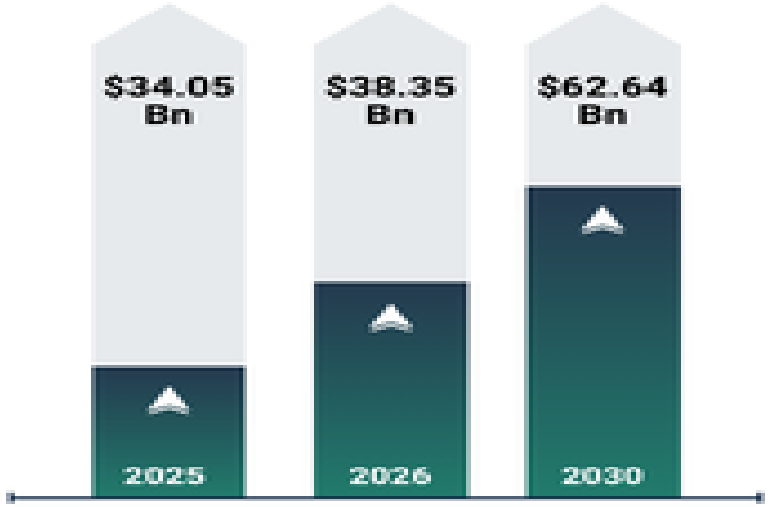
SELECTIVE PRESSURE

Rising of immunosuppression and MDROs.

Superbug hits 28 states, including Alabama: Where the deadly fungus is spreading

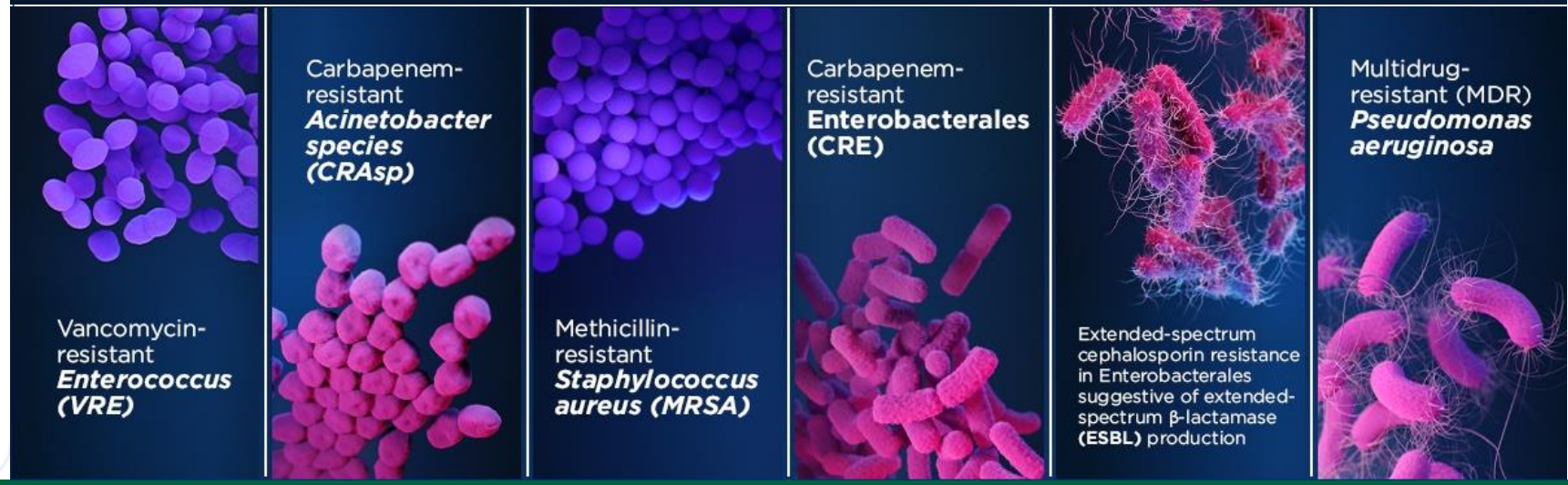


Increasing use of immunosuppression

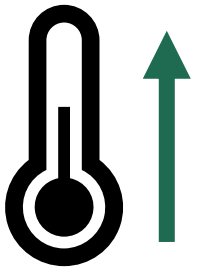


Immunosuppressant market size

6 of the 18 most alarming **antibiotic resistance threats** cost the U.S. more than **$4.6 billion annually**



The Changing Landscape of Infections



CLIMATE CHANGE

Ecological niche expansion for vectors and fungi.

CONNECTIVITY

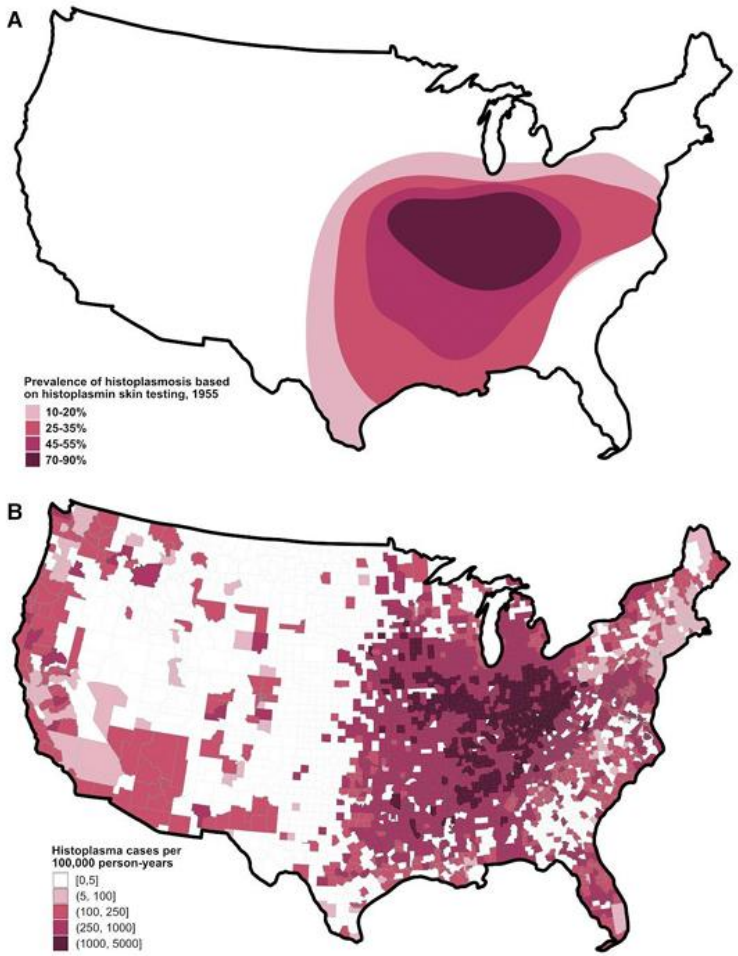
Rapid global spread of pathogens and behaviors

SELECTIVE PRESSURE

Rising of immunosuppression and MDROs.

No longer “endemic mycoses”

Histoplasmosis

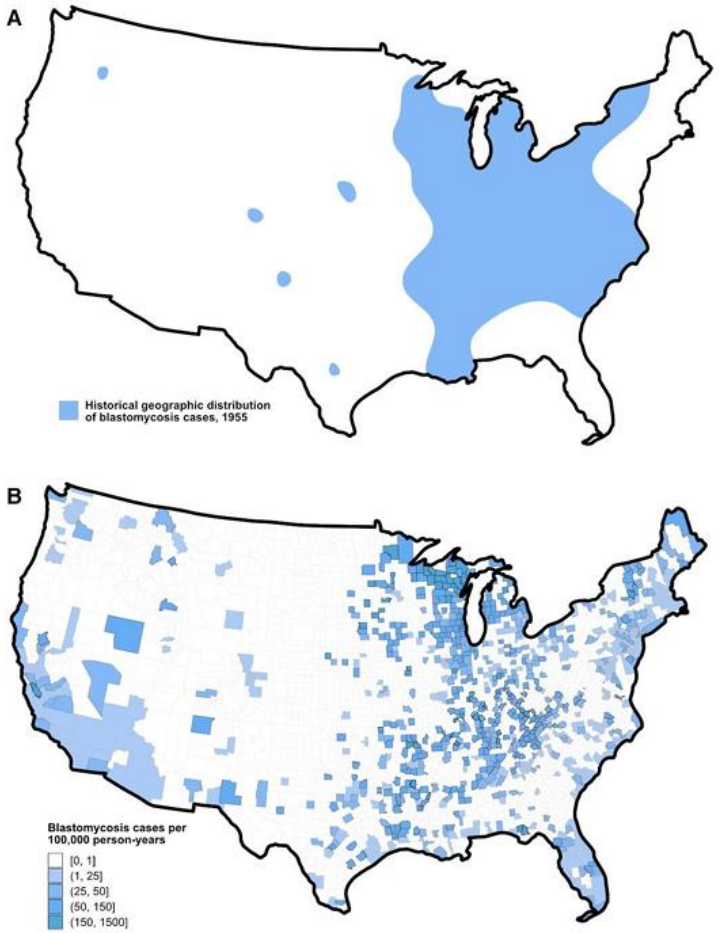


- Historically concentrated in the Ohio and Mississippi River Valleys
- Now, diagnosed in nearly every state.
- Notable increase in Idaho, Montana, Wyoming, Dakotas and Nebraska

- Mazi PB, Sahrmann JM, Olsen MA, Coler-Reilly A, Rauseo AM, Pullen M, Zuniga-Moya JC, Powderly WG, Spec A. The Geographic Distribution of Dimorphic Mycoses in the United States for the Modern Era. Clin Infect Dis. 2023 Apr 3;76(7):1295-1301.

No longer “endemic mycoses”

Blastomycosis

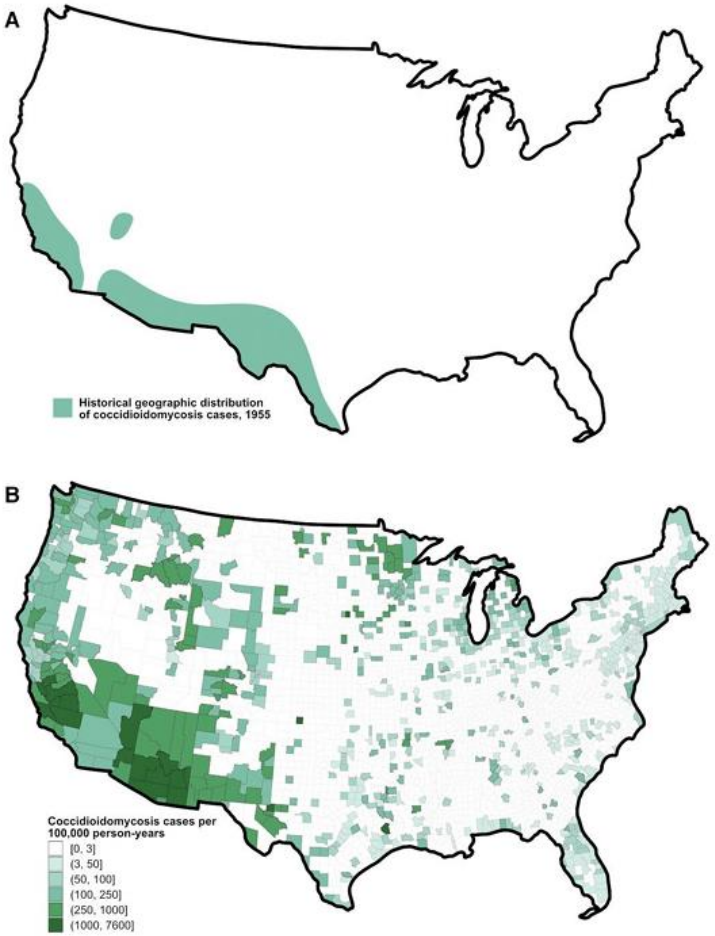


- Historically concentrated in the Upper Midwest and Great Lakes region
- Now, in areas like New York.
- Disproportionately affecting Hispanic/Latino, black and American Indian/Alaska Native,

- Mazi PB, Sahrmann JM, Olsen MA, Coler-Reilly A, Rauseo AM, Pullen M, Zuniga-Moya JC, Powderly WG, Spec A. The Geographic Distribution of Dimorphic Mycoses in the United States for the Modern Era. Clin Infect Dis. 2023 Apr 3;76(7):1295-1301.

No longer “endemic mycoses”

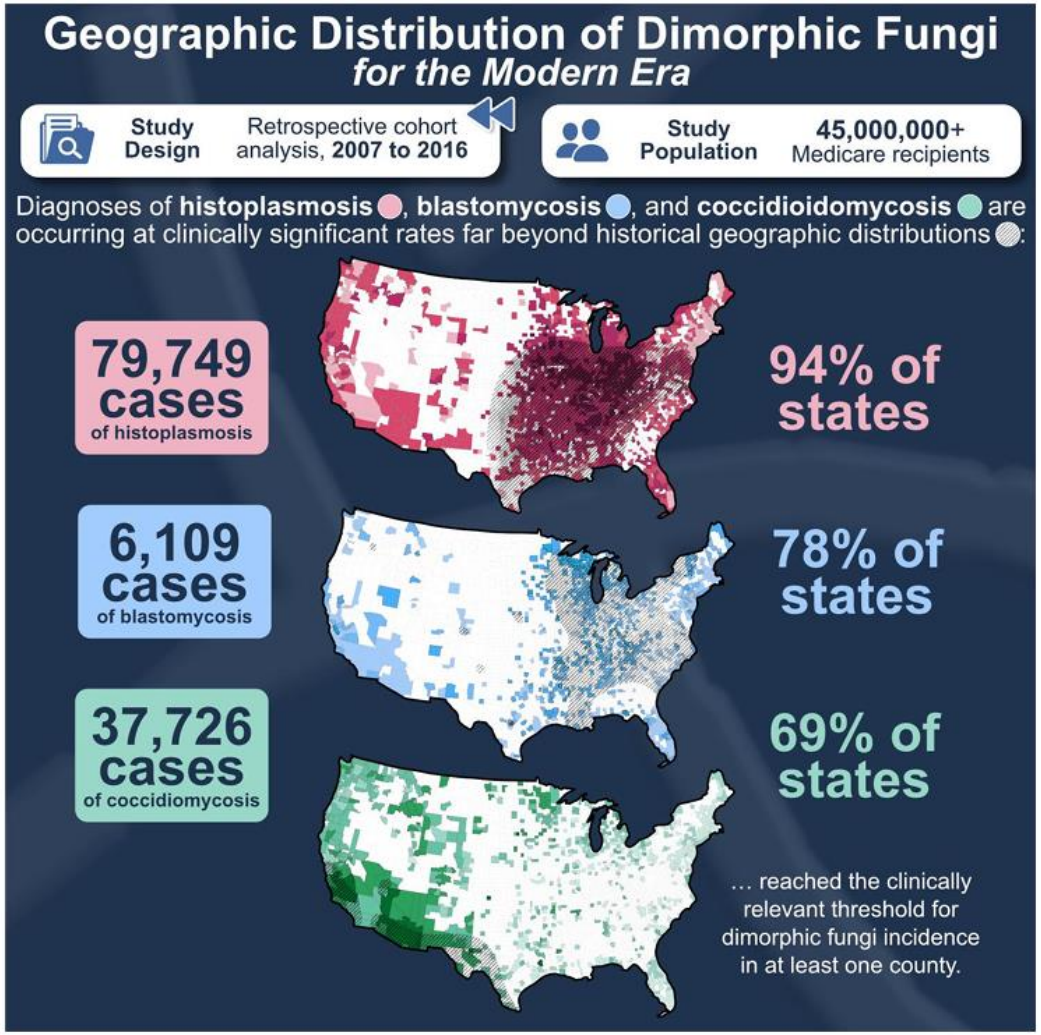
Coccidioidomycosis



- Requires dry/arid soil.
- Largely located in Arizona and California but extended to Utah and Washington.

- Mazi PB, Sahrmann JM, Olsen MA, Coler-Reilly A, Rauseo AM, Pullen M, Zuniga-Moya JC, Powderly WG, Spec A. The Geographic Distribution of Dimorphic Mycoses in the United States for the Modern Era. Clin Infect Dis. 2023 Apr 3;76(7):1295-1301.

No longer “endemic mycoses”

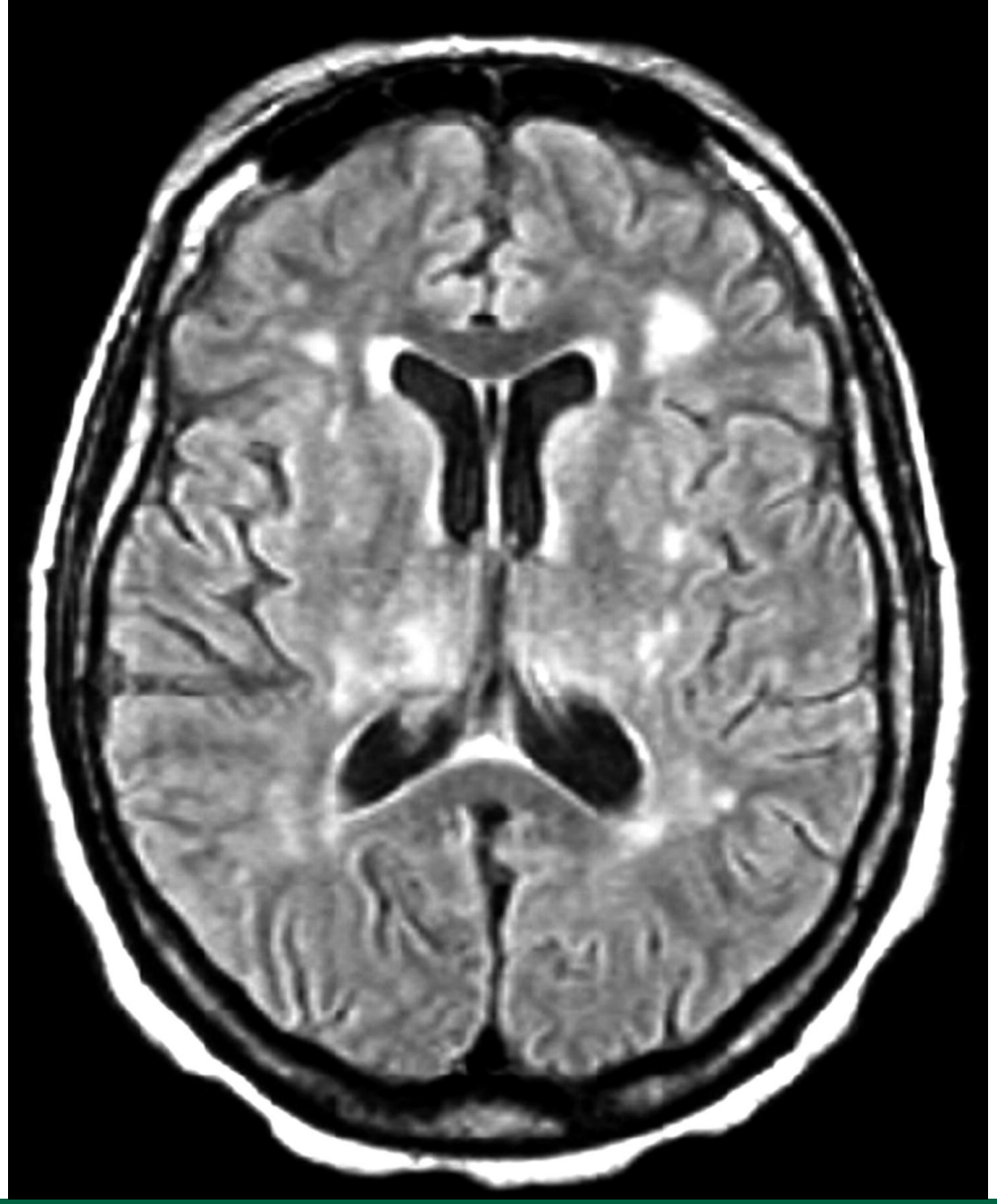


- Climate change
  - Higher temperatures; expanding arid regions; shift in humidity patterns
- Improved testing/disease recognition
- Population migration/Travel
- Immunosuppression

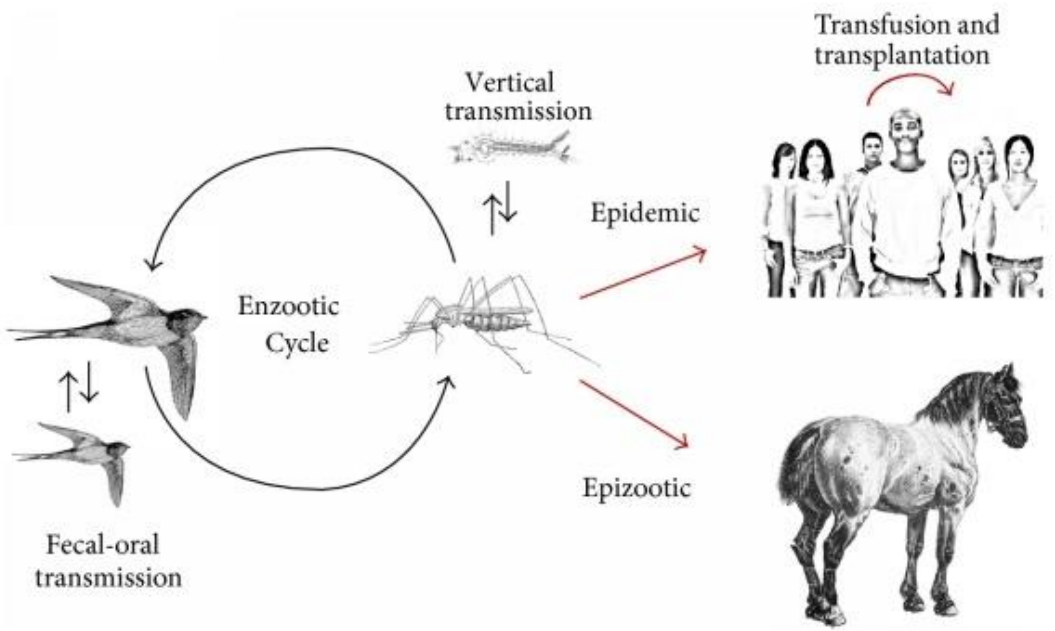
- Mazi PB, Sahrmann JM, Olsen MA, Coler-Reilly A, Rauseo AM, Pullen M, Zuniga-Moya JC, Powderly WG, Spec A. The Geographic Distribution of Dimorphic Mycoses in the United States for the Modern Era. Clin Infect Dis. 2023 Apr 3;76(7):1295-1301.

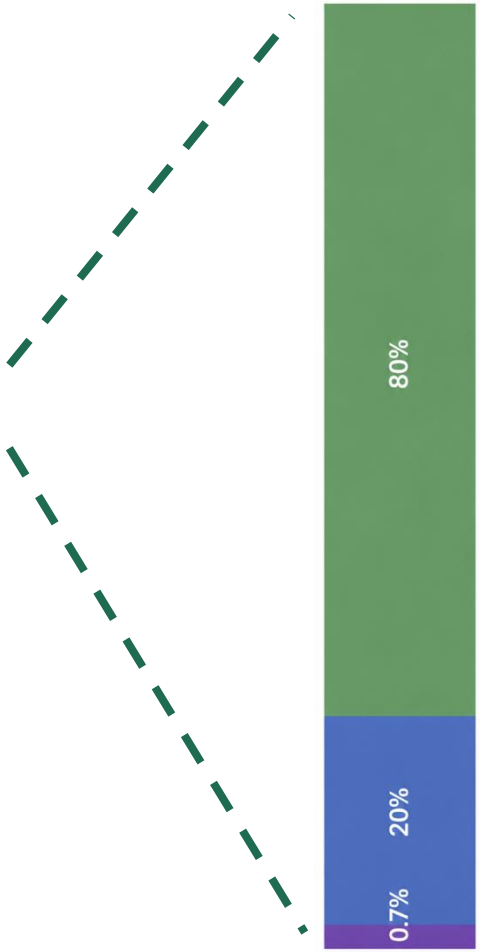
A clinical case

- 62M s/p liver transplant 3 years ago presents in December with 5 days of fever, HA, confusion, and tremor, and gait instability.
- Exam notable for somnolence, tremor and myoclonus jerks.
- CSF: lymphocytic pleocytosis, ↑ protein, nl glucose.
- MRI brain w/ T2/FLAIR hyperintensities involving the bilateral thalami, basal ganglia, and brainstem.



West Nile Virus – Ecology & Presentation





Asymptomatic

West Nile Fever

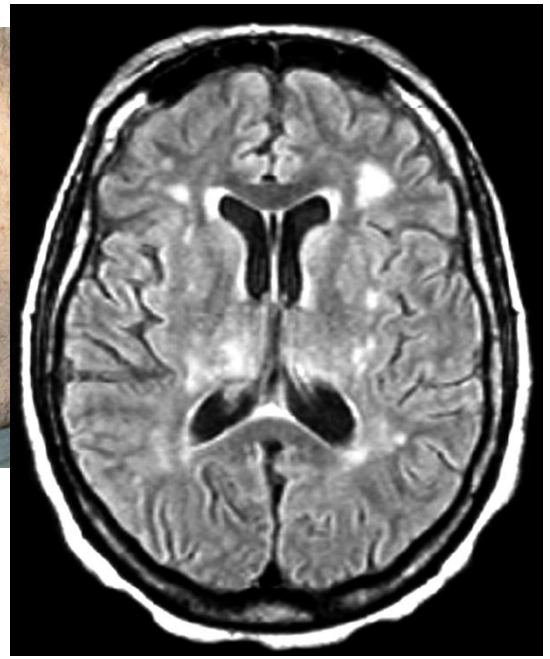
Neuro-invasive disease

- Chancey C, Grinev A, Volkova E, Rios M. The global ecology and epidemiology of West Nile virus. Biomed Res Int. 2015;2015:376230.

West Nile Virus – Presentation

West Nile Fever

Fever, headache, myalgia, and rash

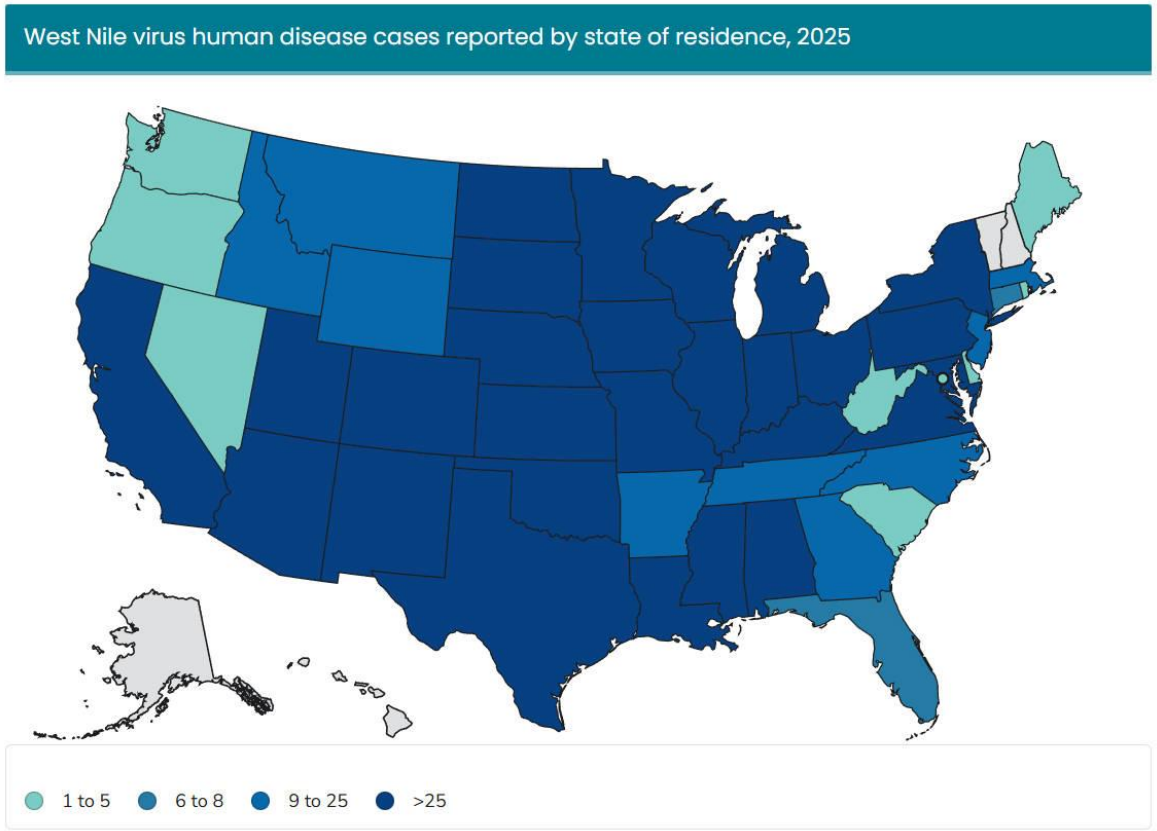


Neuro-invasive disease

- **WNV meningitis**
- **WNV encephalitis:** Confusion → coma
  - **Extrapyramidal sxs -** Tremor, myoclonus, and ataxia.
- **Acute flaccid myelitis**
  - **Asymmetric, areflexic limb weakness** without sensory abn.
- Other: GBS, plexus neuropathy, transverse myelitis, and CN neuropathy.

• Chancey C, Grinev A, Volkova E, Rios M. The global ecology and epidemiology of West Nile virus. Biomed Res Int. 2015;2015:376230.

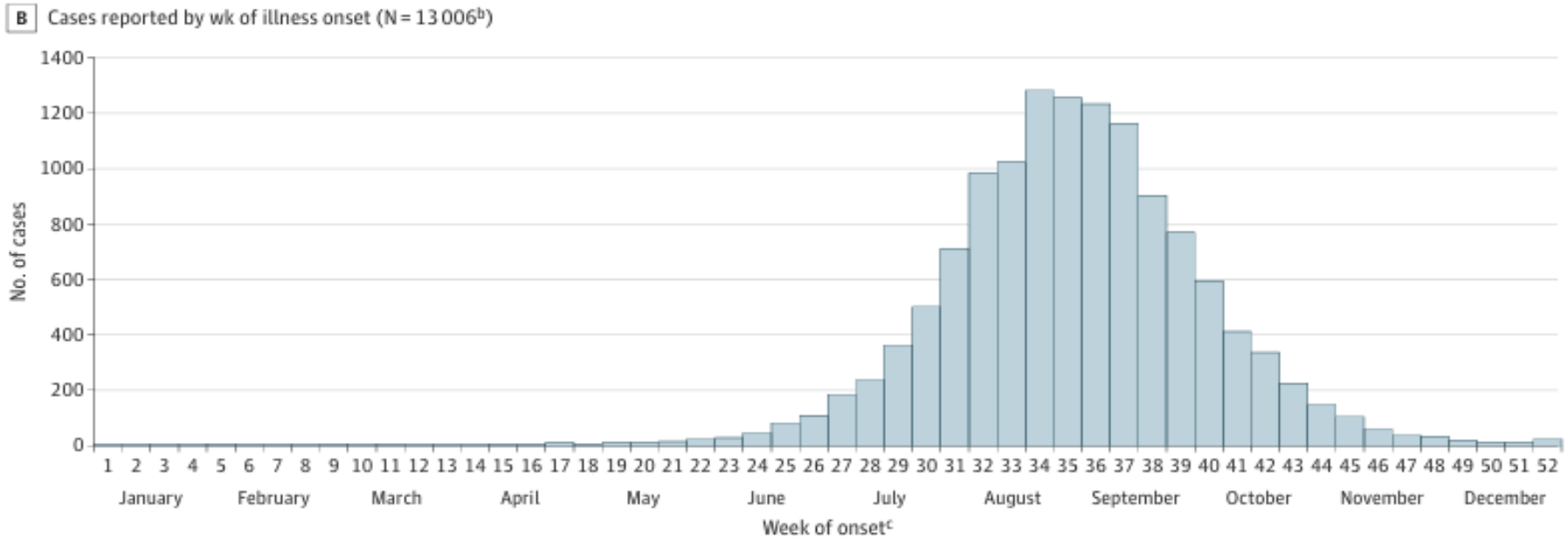
West Nile Virus: Endemic, but Not Static



- In 2025, approximately:
  - 2,000 WNV disease cases
  - 1,400 neuroinvasive disease
  - ~7% deaths
- Identified in 47/50 states.
- Similar to Europe, Northward expansion. Modeling reports increase in cases in NY/CT.
- Outbreaks are possible & difficult to predict.

- Padda H, Jacobs D, Gould CV, Sutter R, Lehman J, Staples JE, Lyons S. West Nile Virus and Other Nationally Notifiable Arboviral Diseases - United States, 2023. MMWR Morb Mortal Wkly Rep. 2025 Jun 12;74(21):358-364.

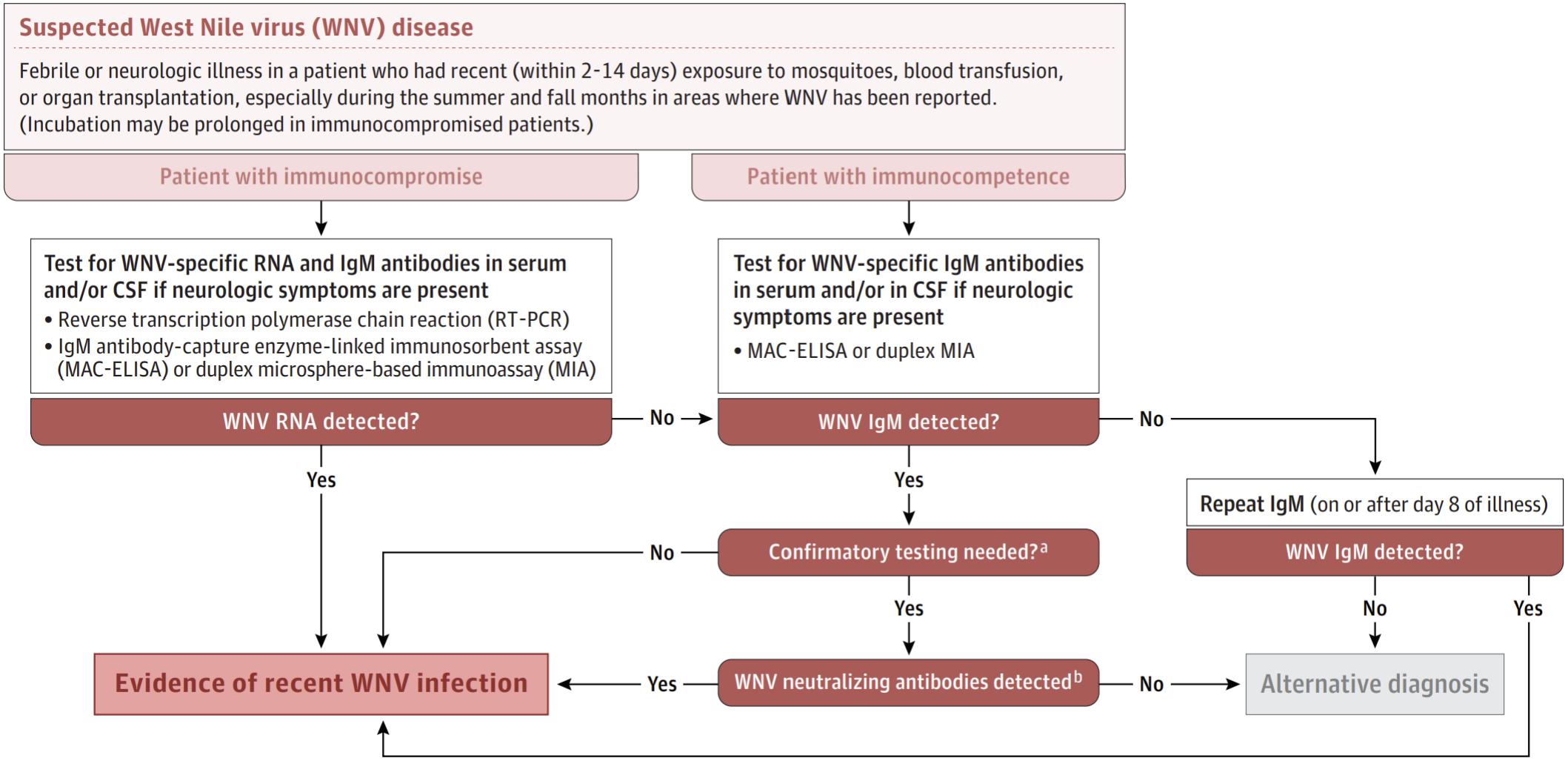
West Nile Virus: Endemic, but Not Static



- **Seasonal extension**
  - July–September include ~90% of cases but they have been reported in **every month of the year**.
- Milder winters, longer summers, and higher precipitation increase vector propagation and longevity.
- Mosquito season has increased worldwide.

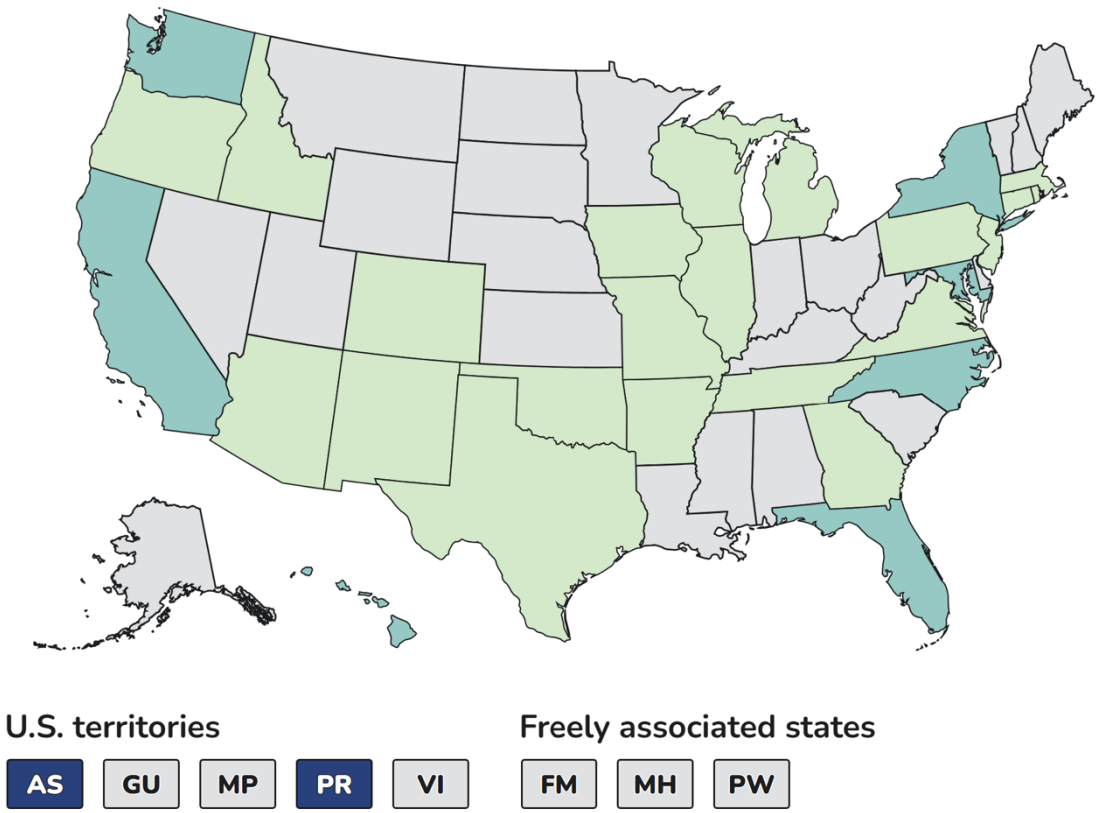
• Gould CV, Staples JE, Guagliardo SAJ, Martin SW, Lyons S, Hills SL, Nett RJ, Petersen LR. West Nile Virus: A Review. JAMA. 2025 Aug 19;334(7):618-628.

West Nile Virus Testing



• Gould CV, Staples JE, Guagliardo SAJ, Martin SW, Lyons S, Hills SL, Nett RJ, Petersen LR. West Nile Virus: A Review. JAMA. 2025 Aug 19;334(7):618-628.

Increase in imported & locally-acquired Dengue



U.S. Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 75 / No. 18
May 14, 2026

Increase in Travel-Associated and Locally Acquired Dengue Cases — United States, 2024

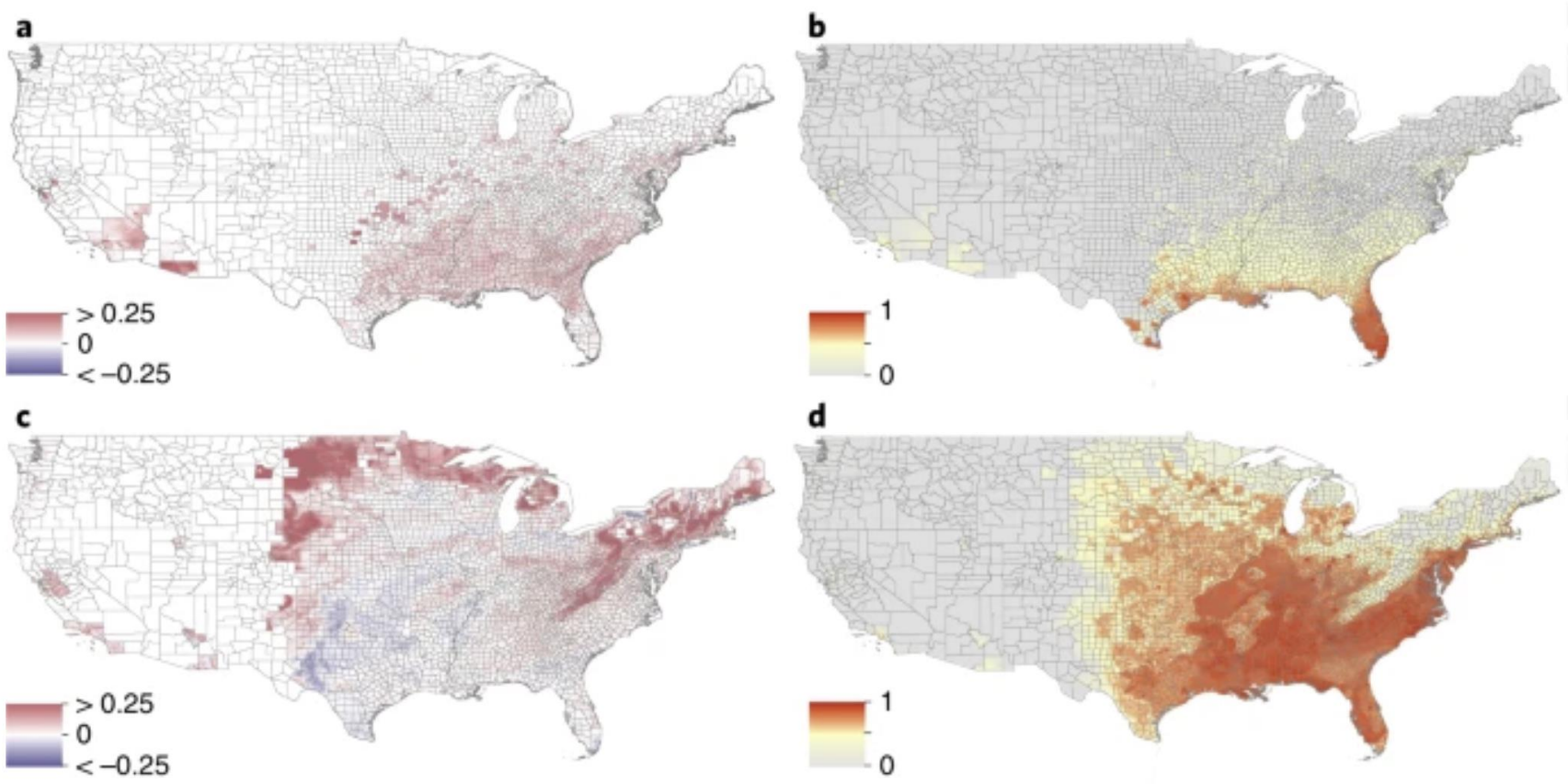
Sandra J. Kiplagat, PhD[1,2]; Dania M. Rodriguez, PhD[2]; Aidsa Rivera, DrPH[2]; Gabriela Paz-Bailey, MD, PhD[2]; Joshua M. Wong, MD[2]; Laura E. Adams, DVM[2]

State	Total Cases	Locally Acquired	Imported
Florida	1,044	85	959
California	720	18	702
Texas	241	2	239

• Kiplagat SJ, Rodriguez DM, Rivera A, Paz-Bailey G, Wong JM, Adams LE. Increase in Travel-Associated and Locally Acquired Dengue Cases — United States, 2024. MMWR Morb Mortal Wkly Rep 2026;75:227–233.

Expanded geographic spread of Aedes mosquitoes

Fig. 2: Predicted future spread of *Ae. aegypti* and *Ae. albopictus* in the United States.

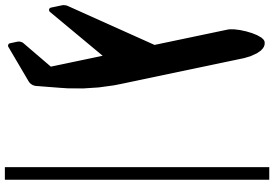


- Kiplagat SJ, Rodriguez DM, Rivera A, Paz-Bailey G, Wong JM, Adams LE. Increase in Travel-Associated and Locally Acquired Dengue Cases — United States, 2024. MMWR Morb Mortal Wkly Rep 2026;75:227–233.

The Changing Landscape of Infections

CLIMATE CHANGE

Ecological niche expansion for vectors and fungi.



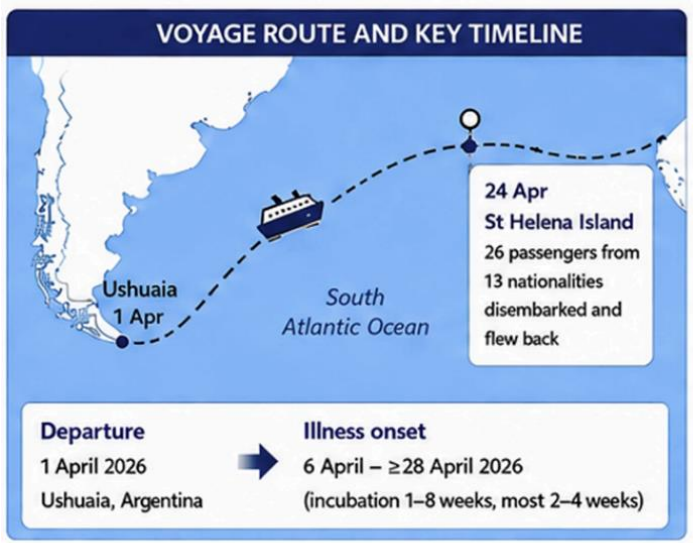
CONNECTIVITY

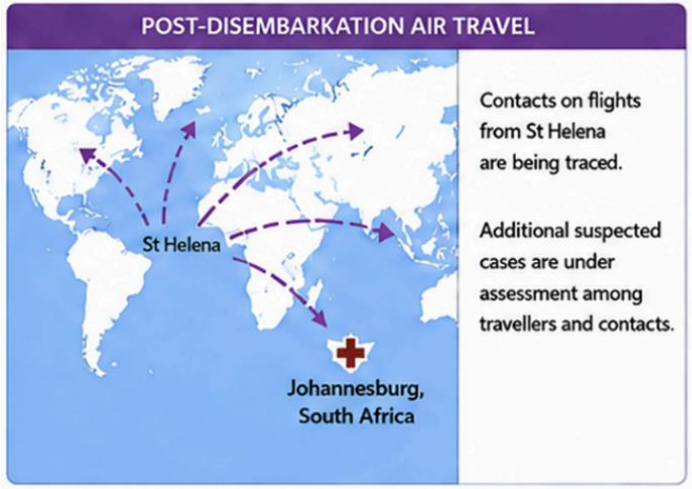
Rapid global spread of pathogens and behaviors

SELECTIVE PRESSURE

Rising of immunosuppression and MDROs.

Hantavirus outbreak on the cruise ship MV Hondius.





CASES OVERVIEW (N = 8)
As of 7 May 2026

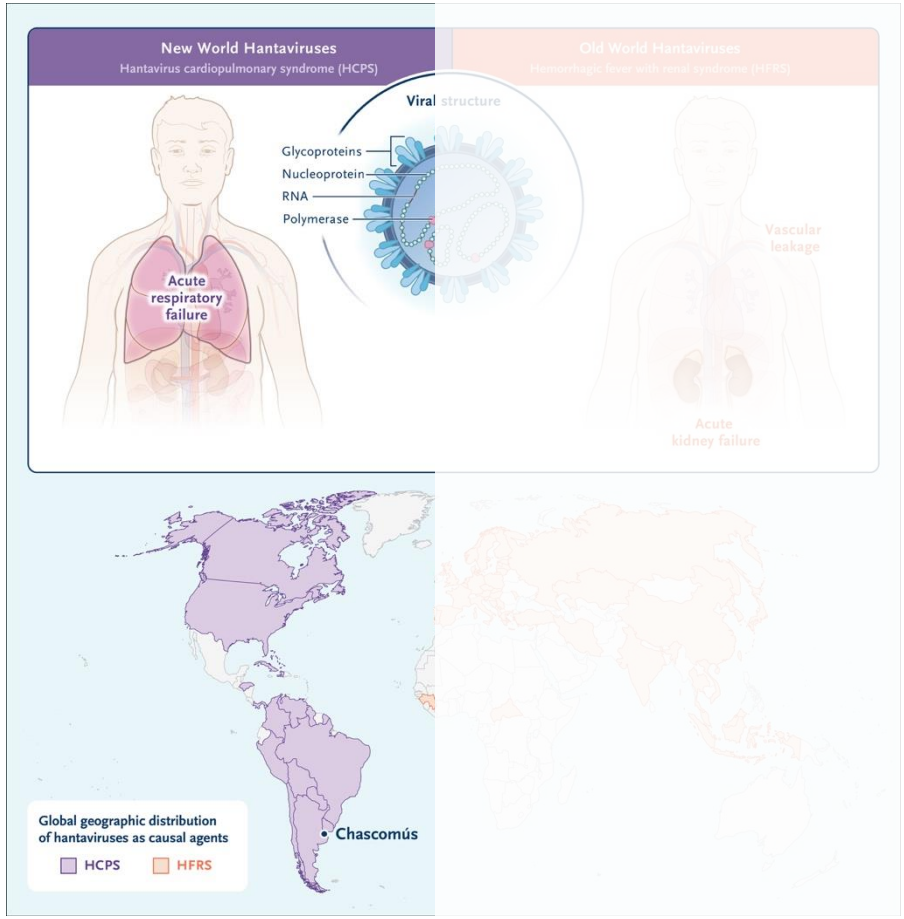
5	3	3	≥1	≥1
Laboratory-confirmed	Suspected	Deaths	Critically ill evacuated for intensive care	Medically evacuated for assessment/ management

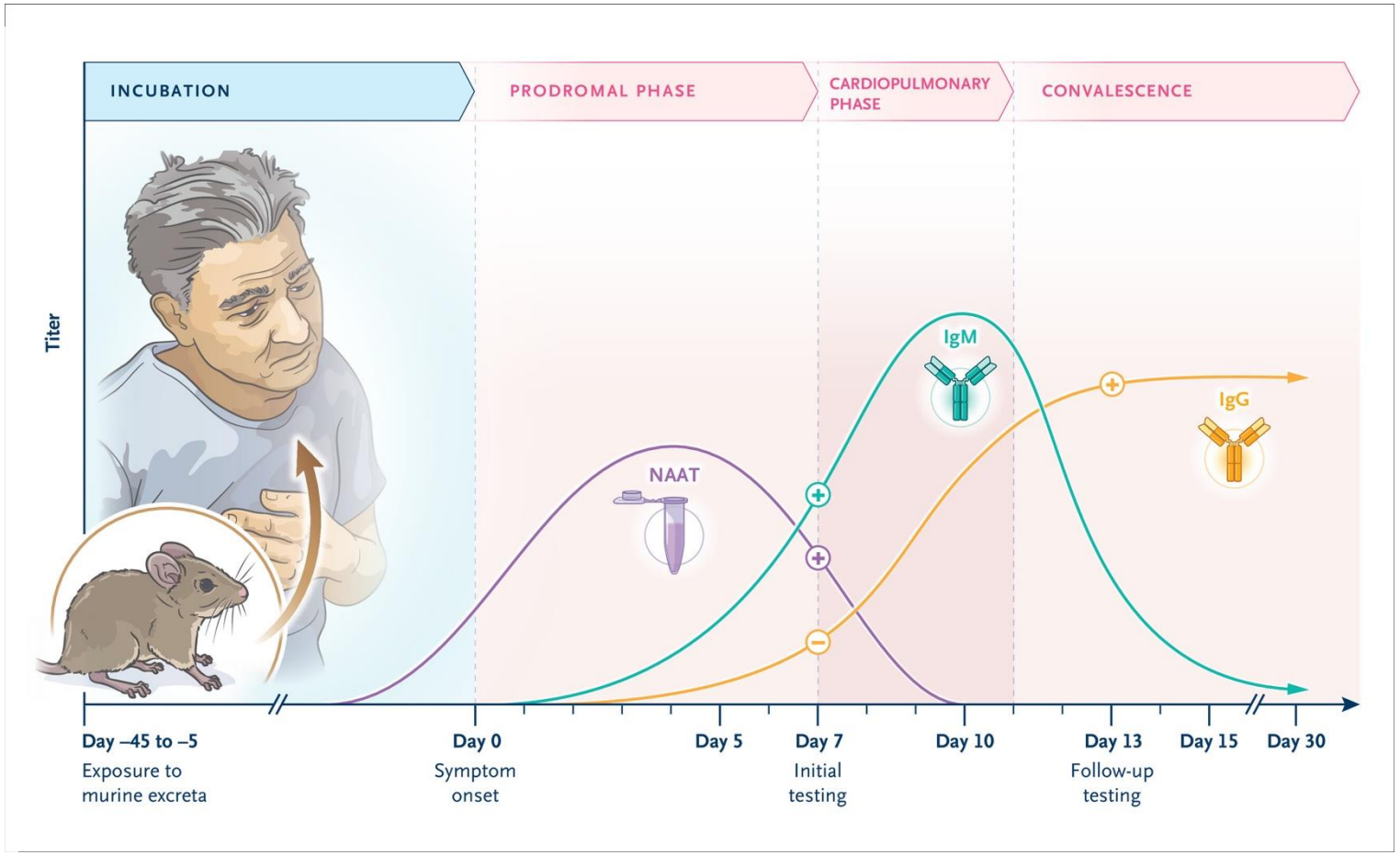
CASE DETAILS
Illness onset from 6 April to ≥28 April 2026. Exposure source for all cases under investigation.

Case	Classification	Onset of illness	Current status / outcome	Notes
Case 1 (index)	Confirmed	6 Apr	Died	First identified case
Case 2	Confirmed	~10–12 Apr	Died	Close contact of Case 1; accompanied body ashore at St Helena, then flew back
Case 3	Confirmed	~18 Apr	Died	—
Case 4	Confirmed	~20 Apr	Critically ill, evacuated to South Africa	—
Case 5	Confirmed	~22 Apr	Medically evacuated for assessment/ management	—
Case 6	Confirmed	~24 Apr	Milder illness	—
Case 7	Suspected	~24–25 Apr	Milder illness	—
Case 8	Suspected	~27–28 Apr	Milder illness	—

Additional suspected cases are being assessed among travellers from the vessel and among contacts identified during subsequent air travel.

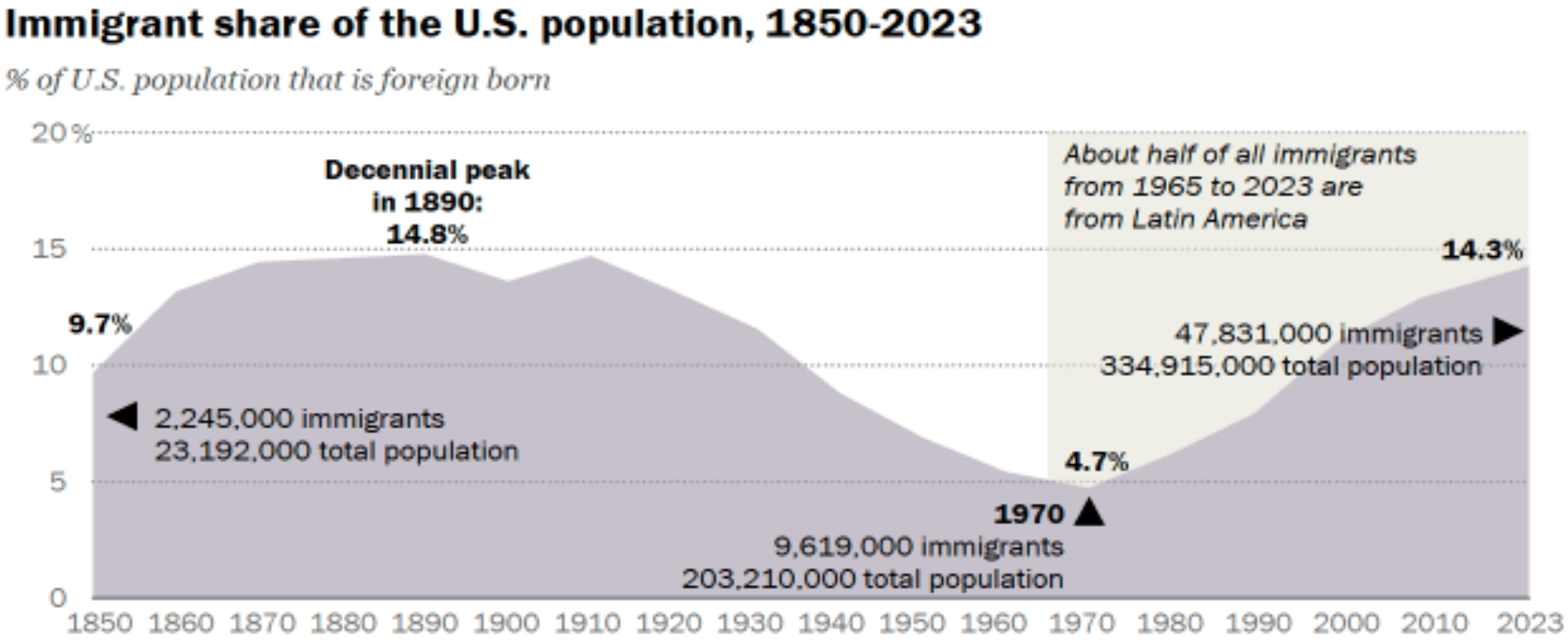
Hantavirus – Clinical Presentation





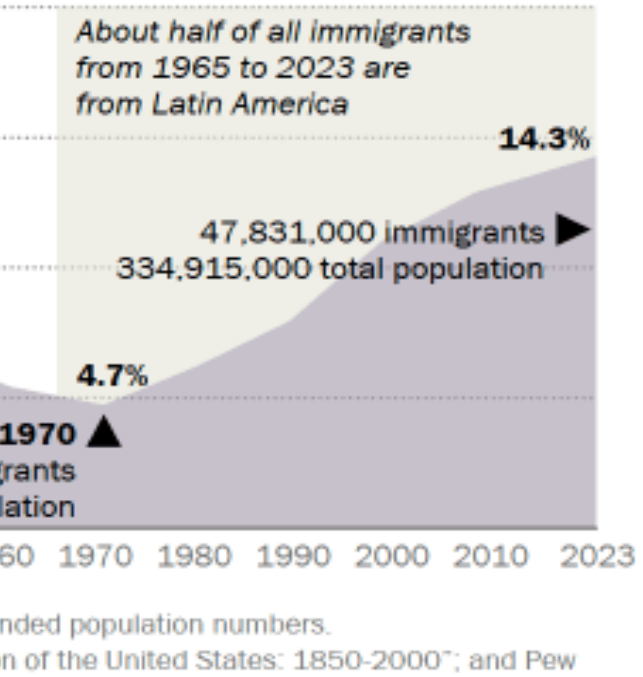
• Hunter M, Saubidet IL, Amerio T, Leone MV. Case 15-2025: A 52-Year-Old Man with Fever, Nausea, and Respiratory Failure. N Engl J Med. 2025 May 29;392(20):2049-2057.

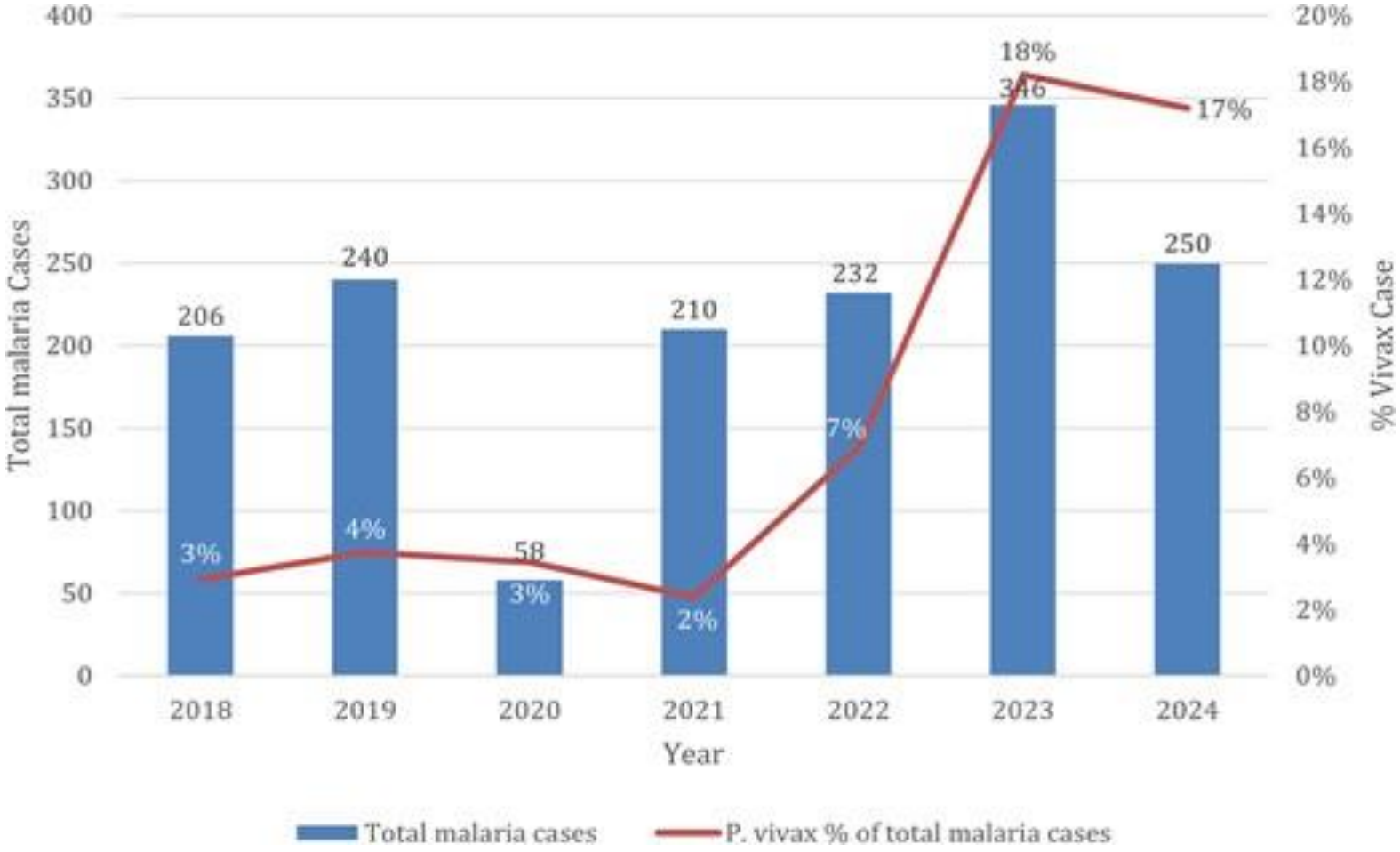
The effect of migration



- Pew Research Center. U.S. immigrant population in 2023 saw largest increase in more than 20 years [Internet]. 2024 Sep 27. Available from: https://www.pewresearch.org/short-reads/2024/09/27/u-s-immigrant-population-in-2023-saw-largest-increase-in-more-than-20-years/

Increase in the proportion of imported *P. vivax*





- Berto CG, Policarpio MA, Vargas-Pena C, Antwi M, Slavinski S, Abdool A, et al. An increase in imported *Plasmodium vivax* malaria in New York City: clinical and demographic trends following recent migration. *Open Forum Infect Dis*. 2026;13(6):ofag293.

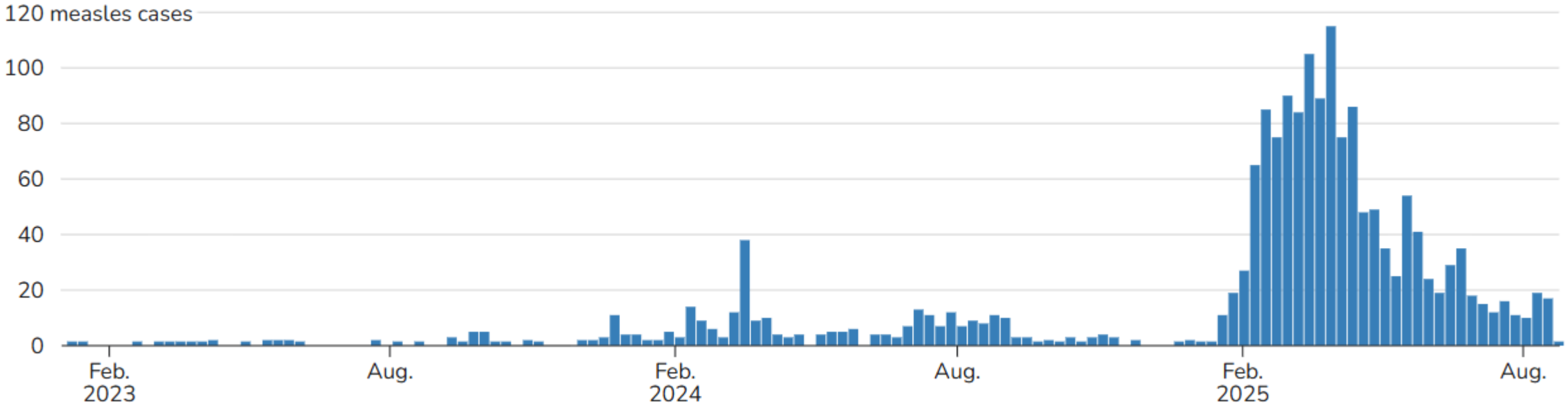
FIRST CASE OF MEASLES SINCE 2002

NORTH ALABAMA

August 25th, 2025

- 5-YEAR-OLD CONFIRMED TO HAVE MEASLES
- CHILD DID NOT ATTEND SCHOOL OR DAY-CARE
- SIBLINGS DO NOT HAVE SYMPTOMS
- ADPH ENCOURAGES PARENTS TO VACCINATE THEIR CHILDREN

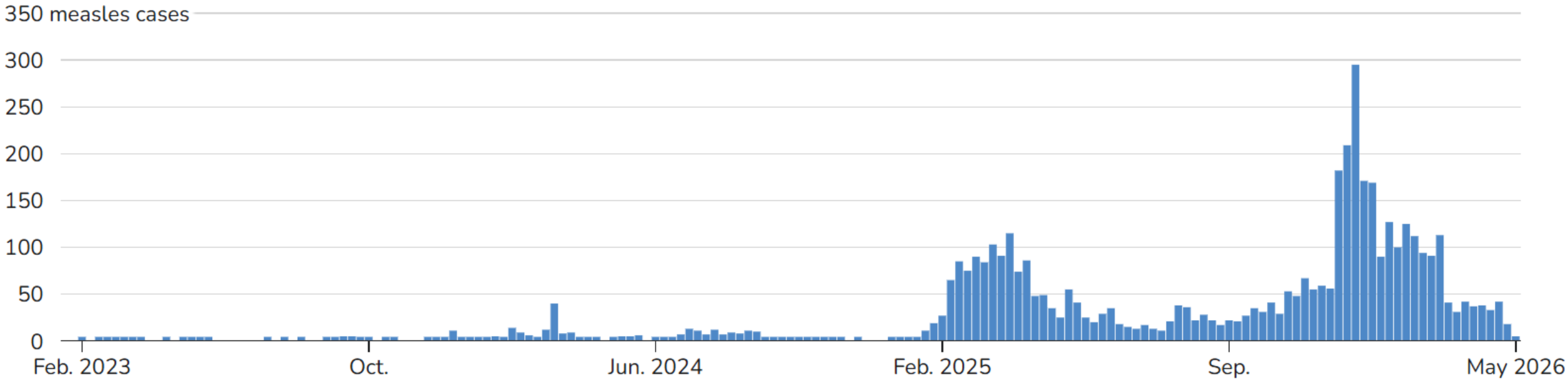
Weekly measles cases (1 year ago)



As of 08/26/2025

- Taken from: https://www.cdc.gov/measles/data-research/index.html; Accessed on 09/01/2025

Weekly measles cases by rash onset date 2023-2026

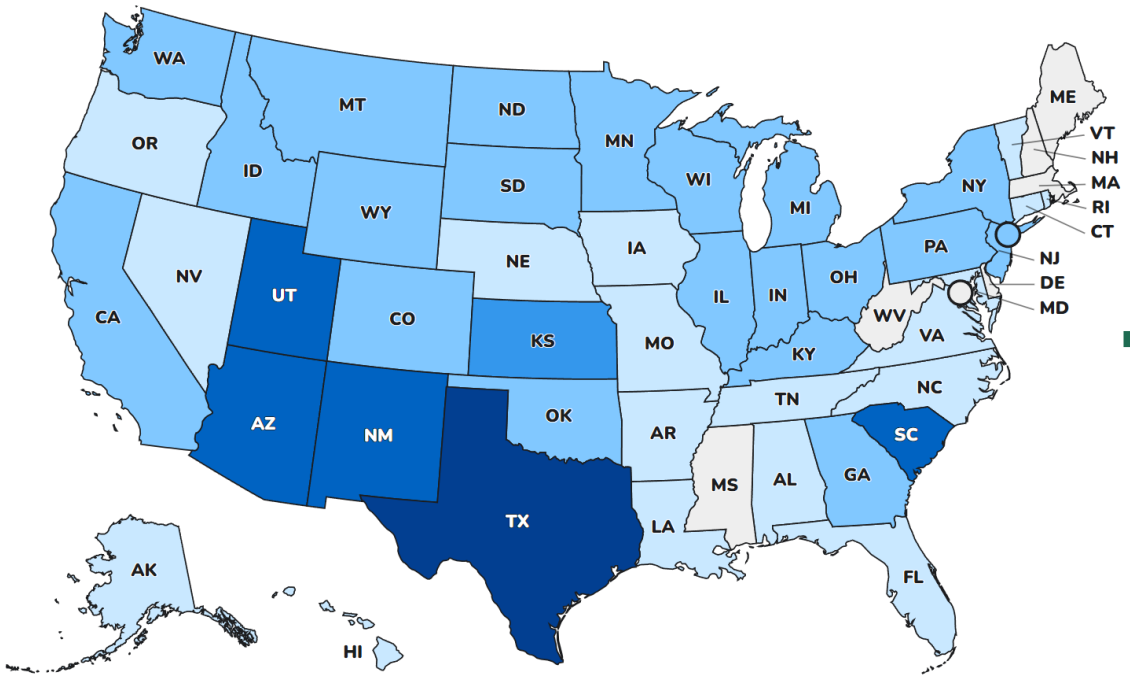


As of 05/28/2025

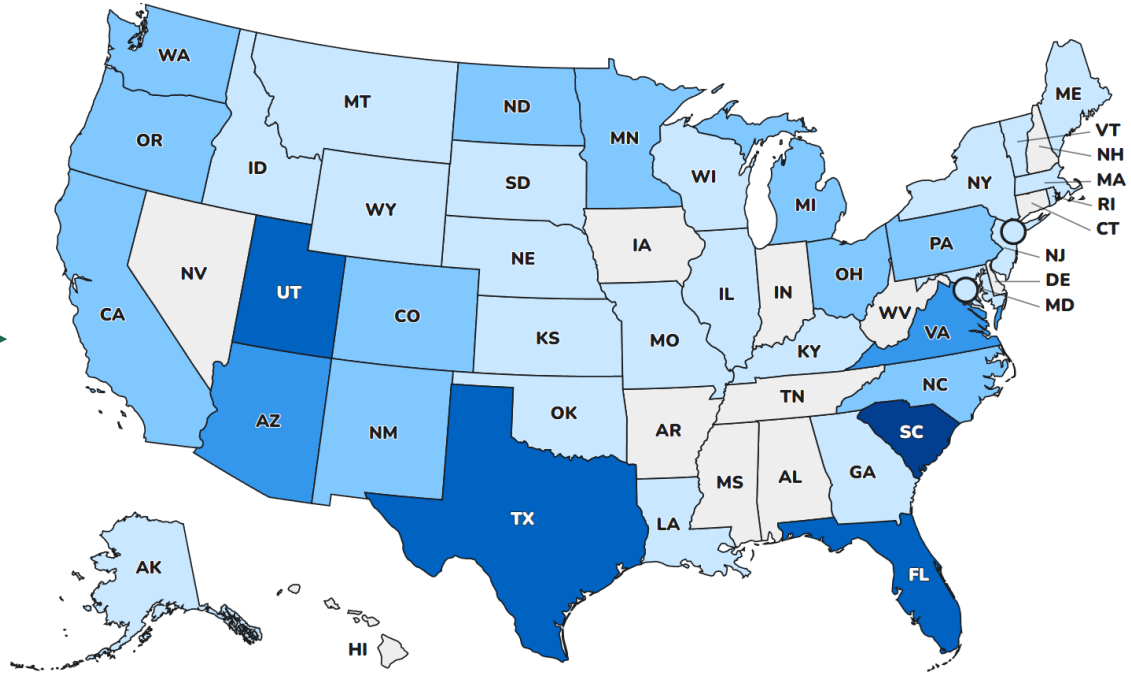
- Taken from: https://www.cdc.gov/measles/data-research/index.html; Accessed on 09/01/2025

Change in the epidemiology of Measles

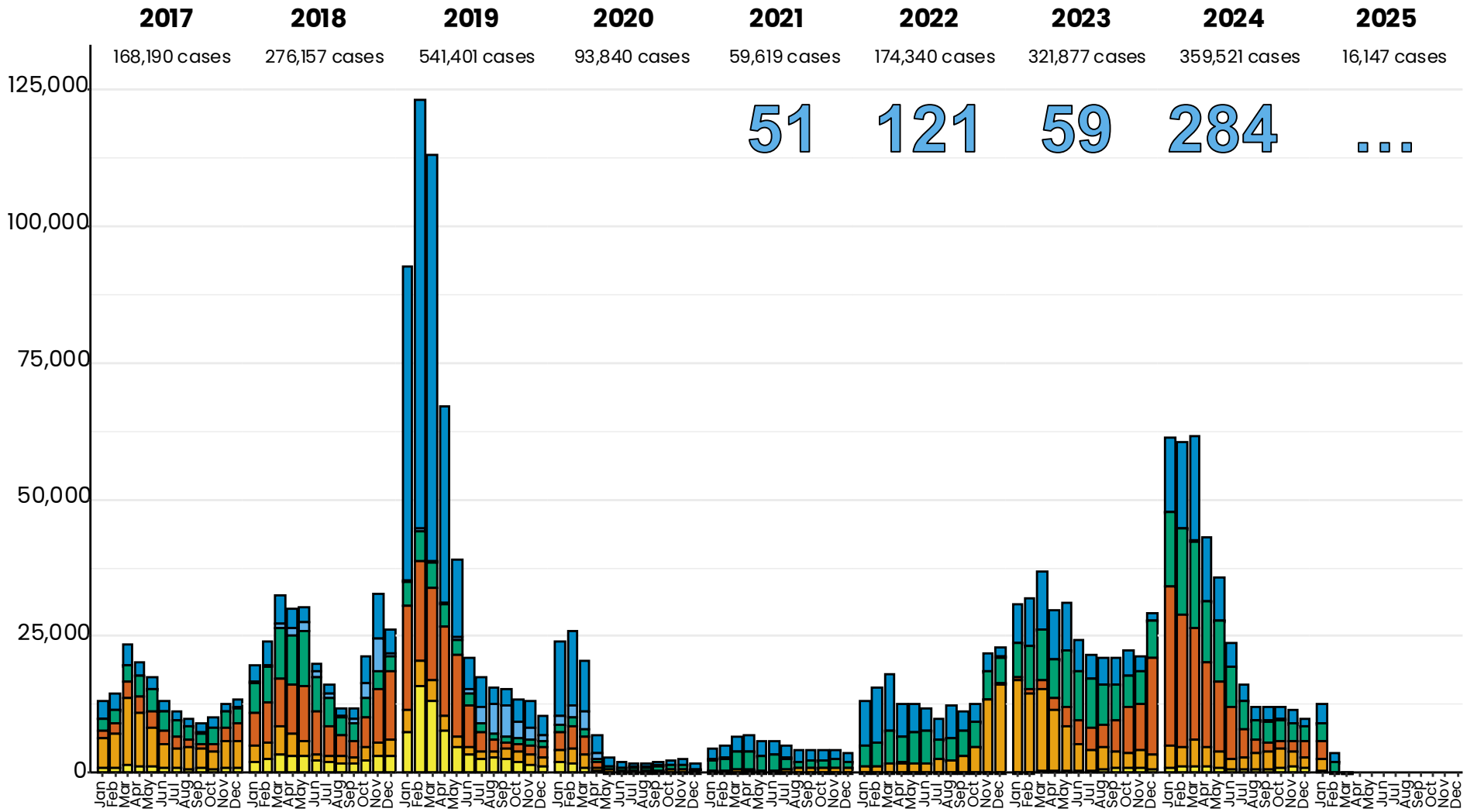
2025

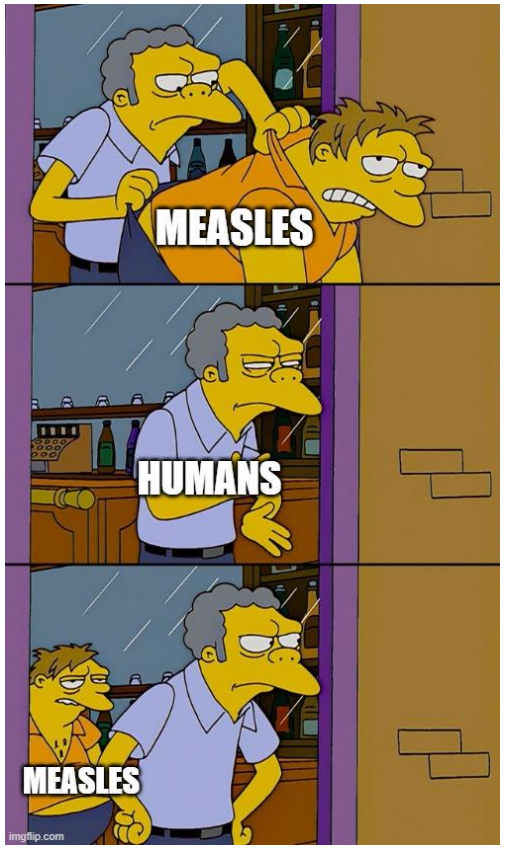


2026



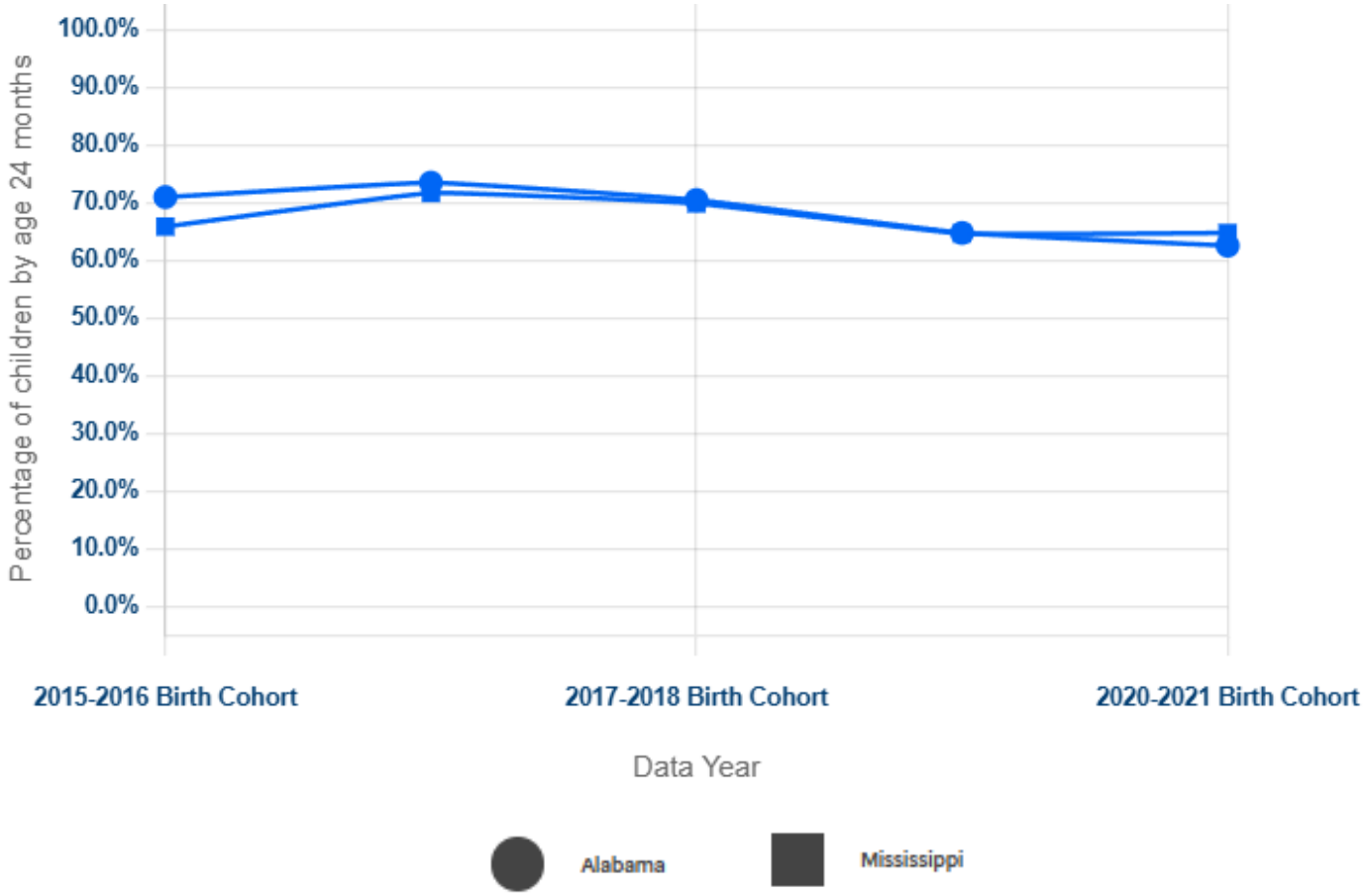
Measles case distribution by month and region





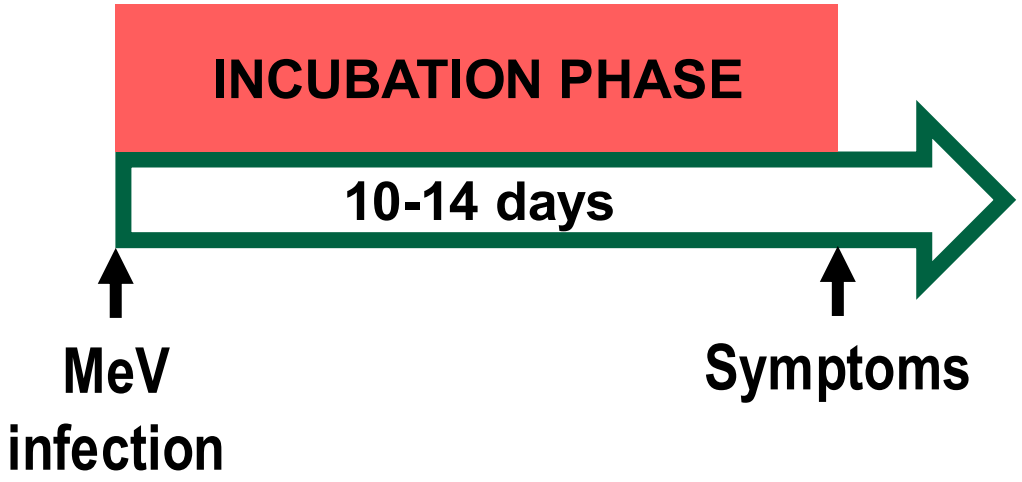
- WHO . 2025. Provisional monthly measles and rubella data. Available from: https://www.who.int/teams/immunization-vaccines-and-biologicals/immunization-analysis-and-insights/surveillance/monitoring/provisional-monthly-measles-and-rubella-data

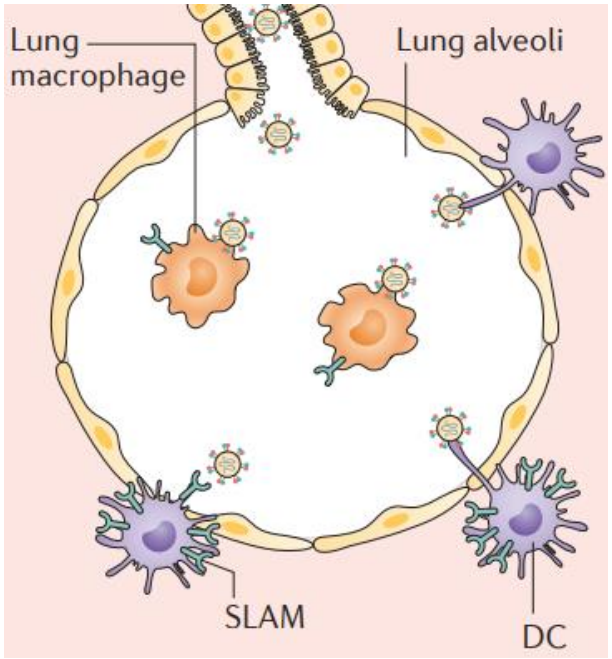
Completed vaccination rate by children at 48 months

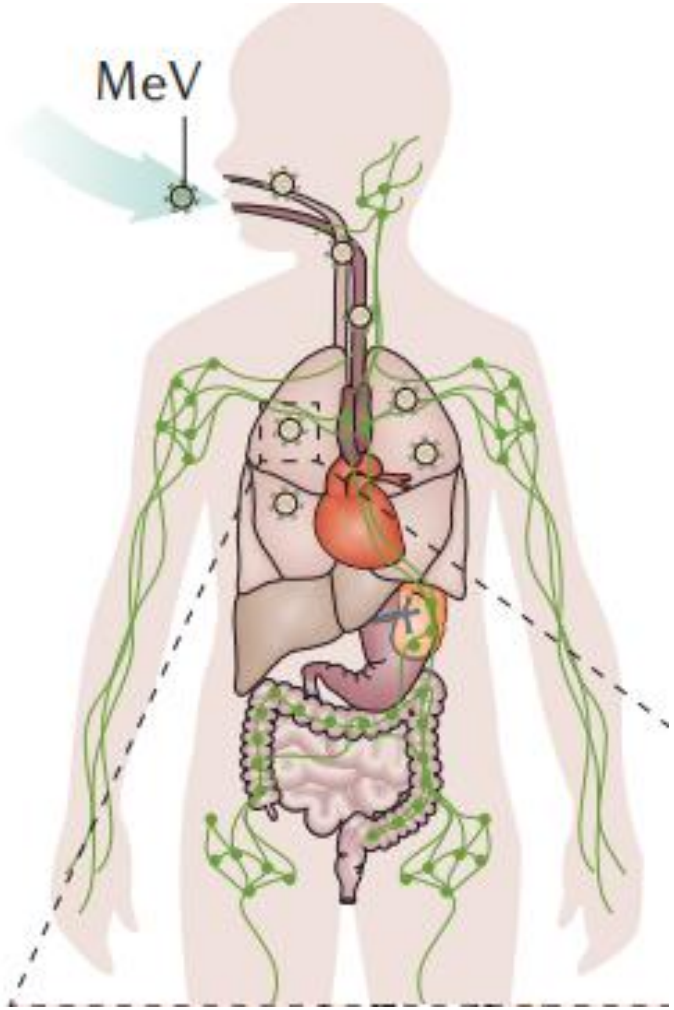


- Source: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Immunization and Respiratory Diseases, National Immunization Survey-Child

NATURAL HISTORY OF MEASLES







- Hübschen JM, Gouandjika-Vasilache I, Dina J. Measles. Lancet. 2022 Feb 12;399(10325):678-690.
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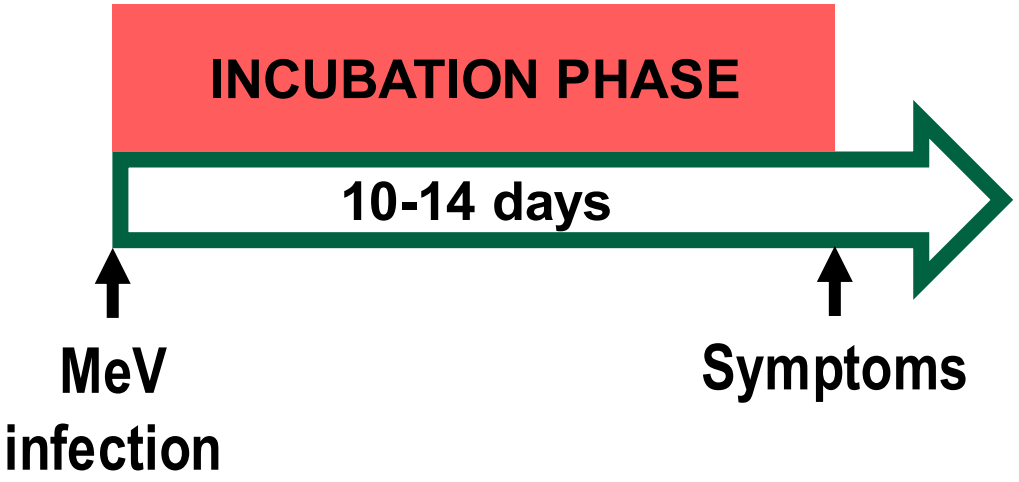

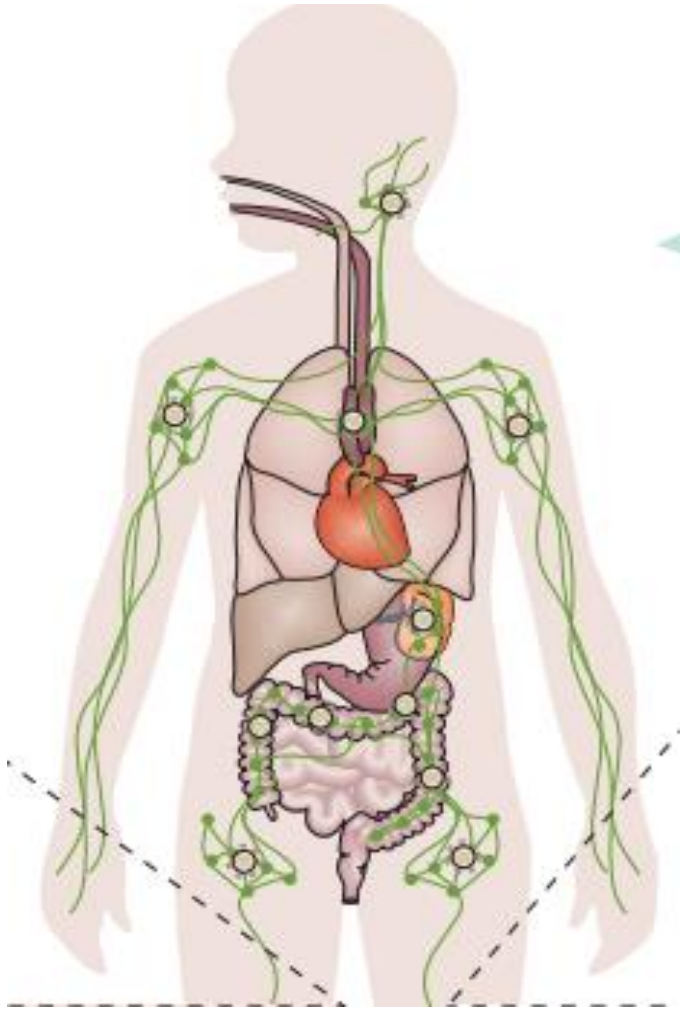

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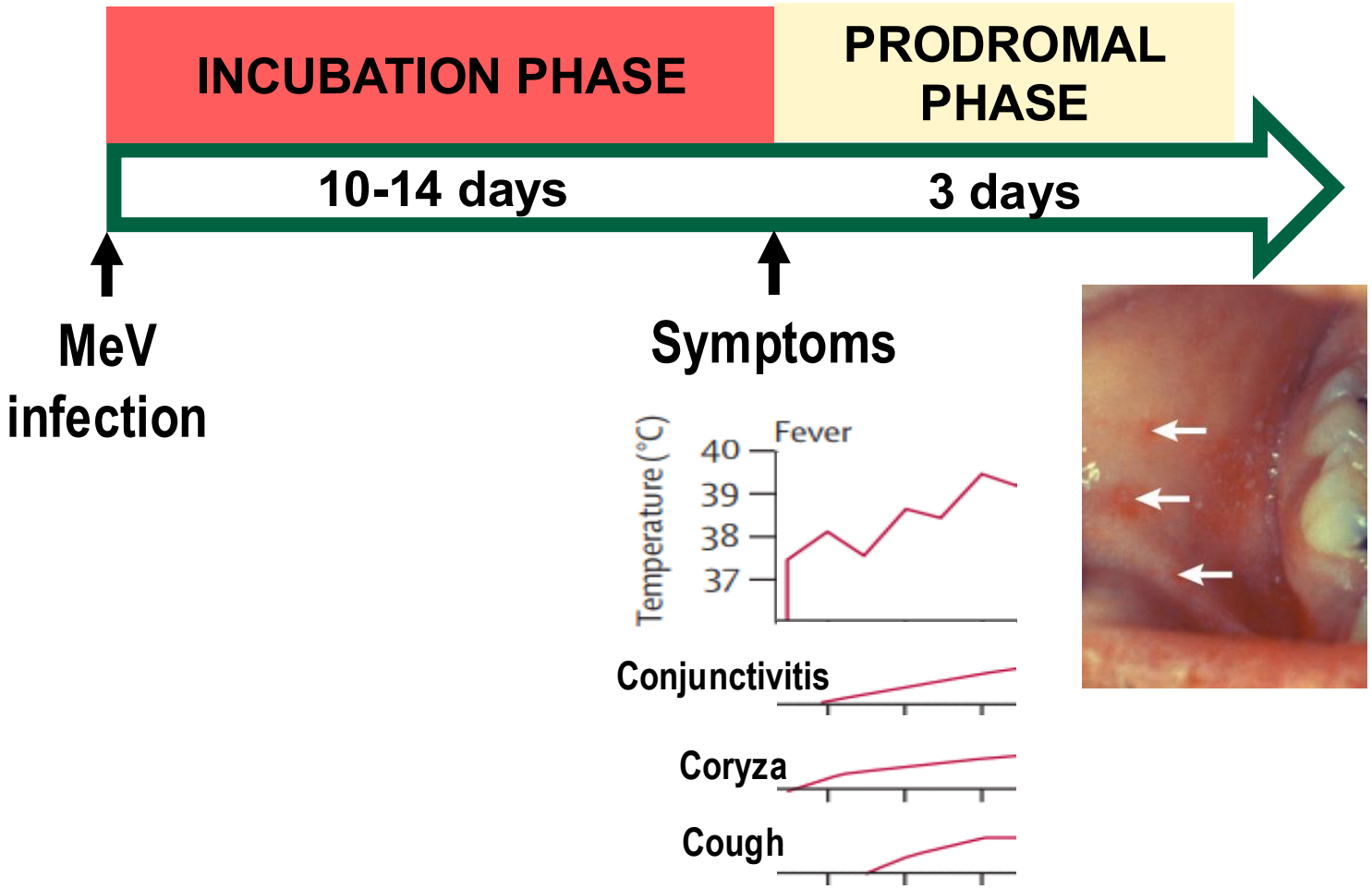

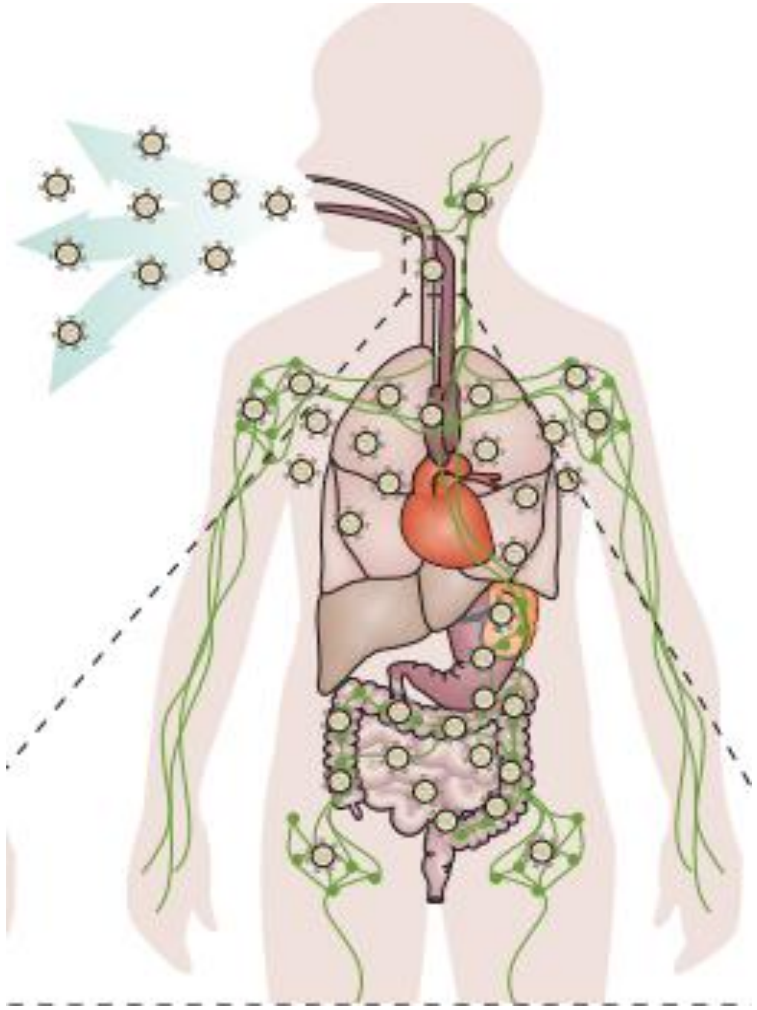

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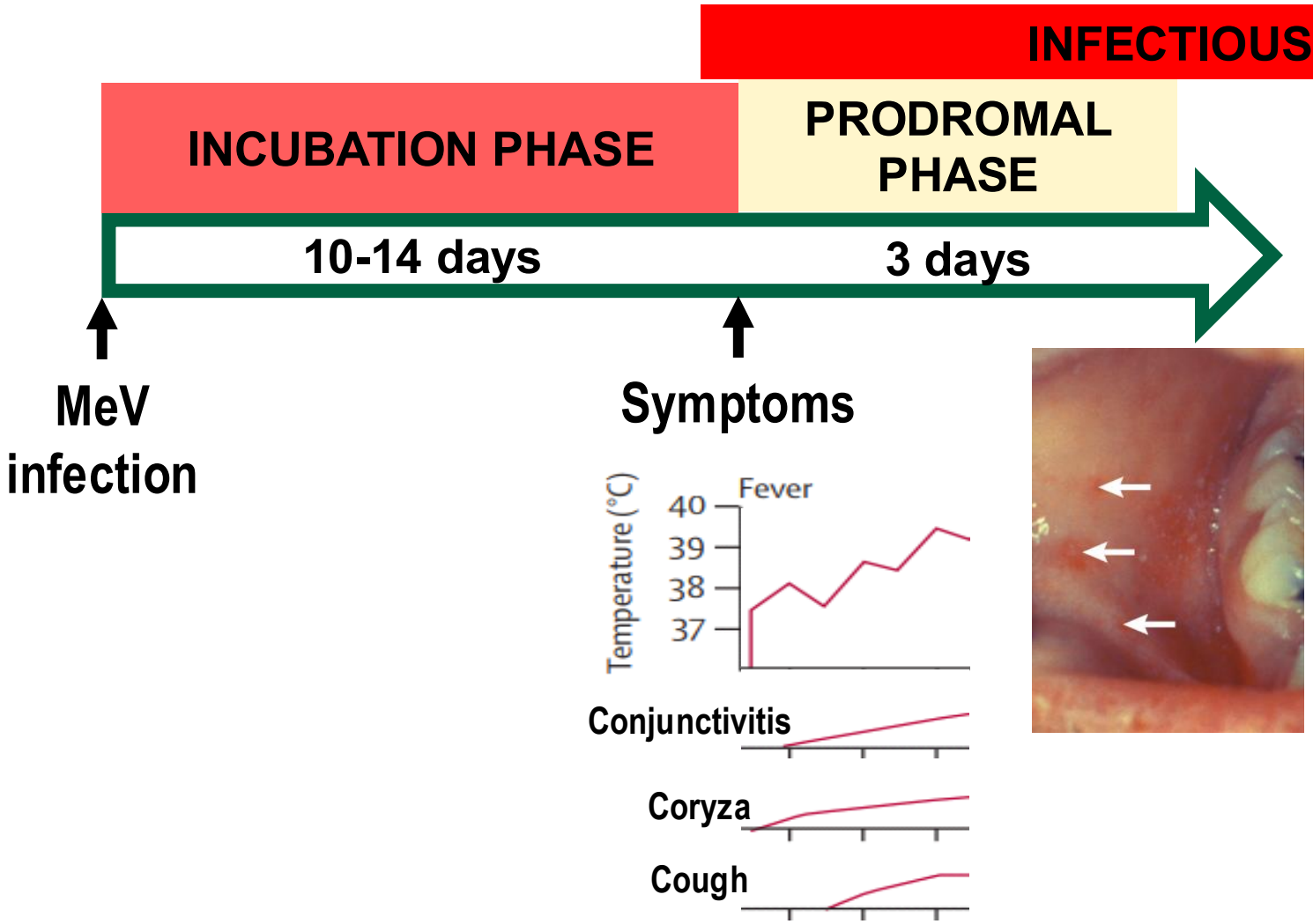
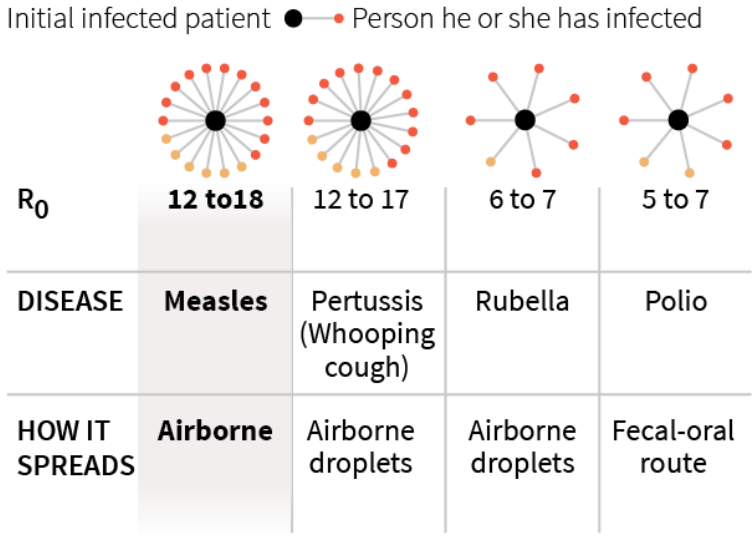
NATURAL HISTORY OF MEASLES





R_0	**12 to18**	12 to 17	6 to 7	5 to 7
DISEASE	**Measles**	Pertussis (Whooping cough)	Rubella	Polio
HOW IT SPREADS	**Airborne**	Airborne droplets	Airborne droplets	Fecal-oral route

- Hübschen JM, Gouandjika-Vasilache I, Dina J. Measles. Lancet. 2022 Feb 12;399(10325):678-690.
- Rota PA, et al. Measles. Nat Rev Dis Primers. 2016 Jul 14;2:16049.
- Measles outbreak. Available from: https://graphics.thomsonreuters.com/15/measles/index.html

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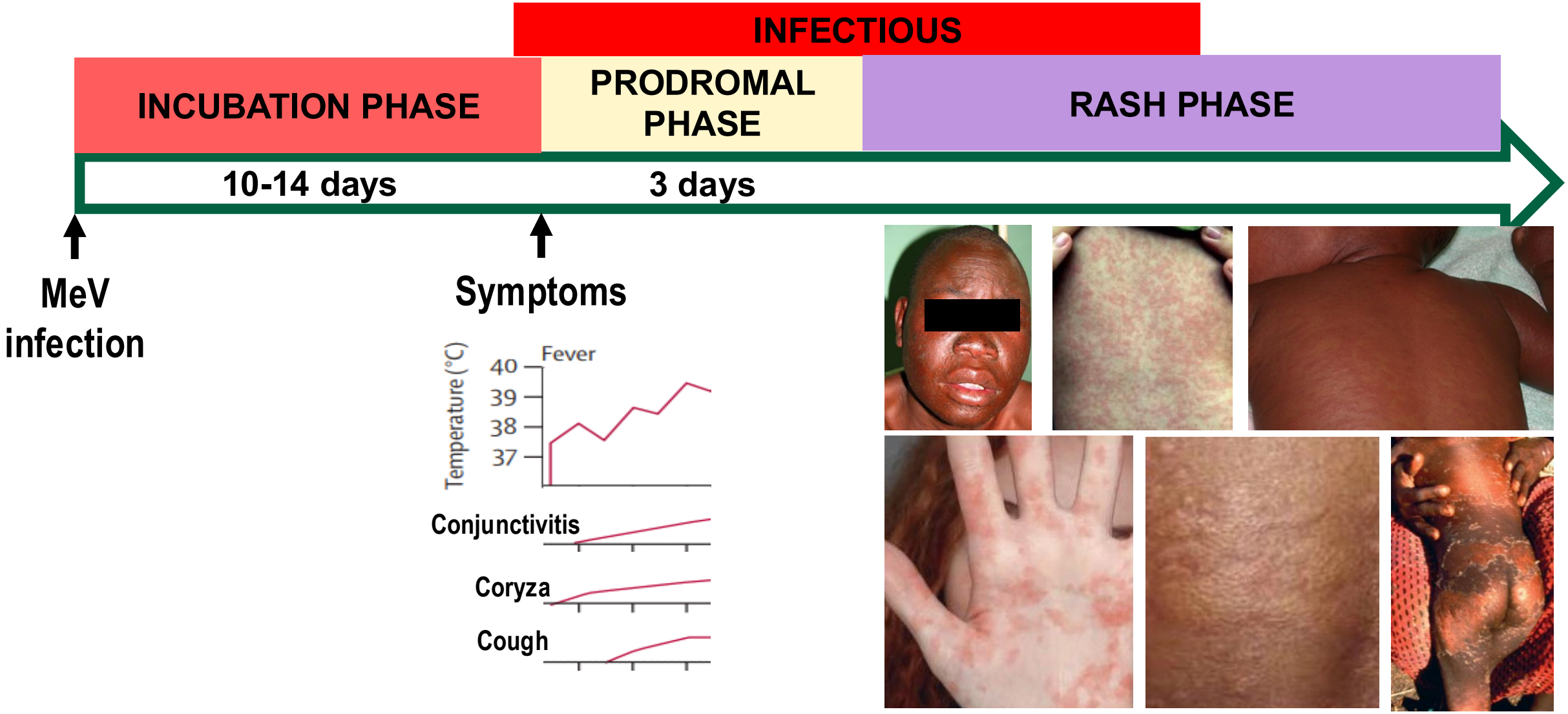

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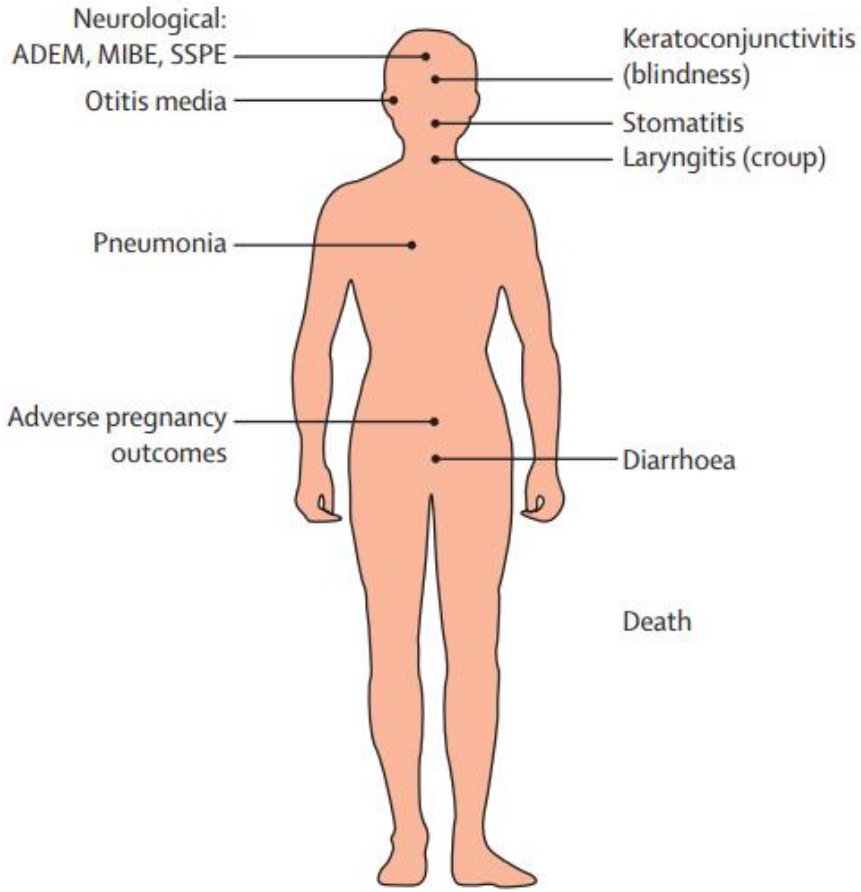
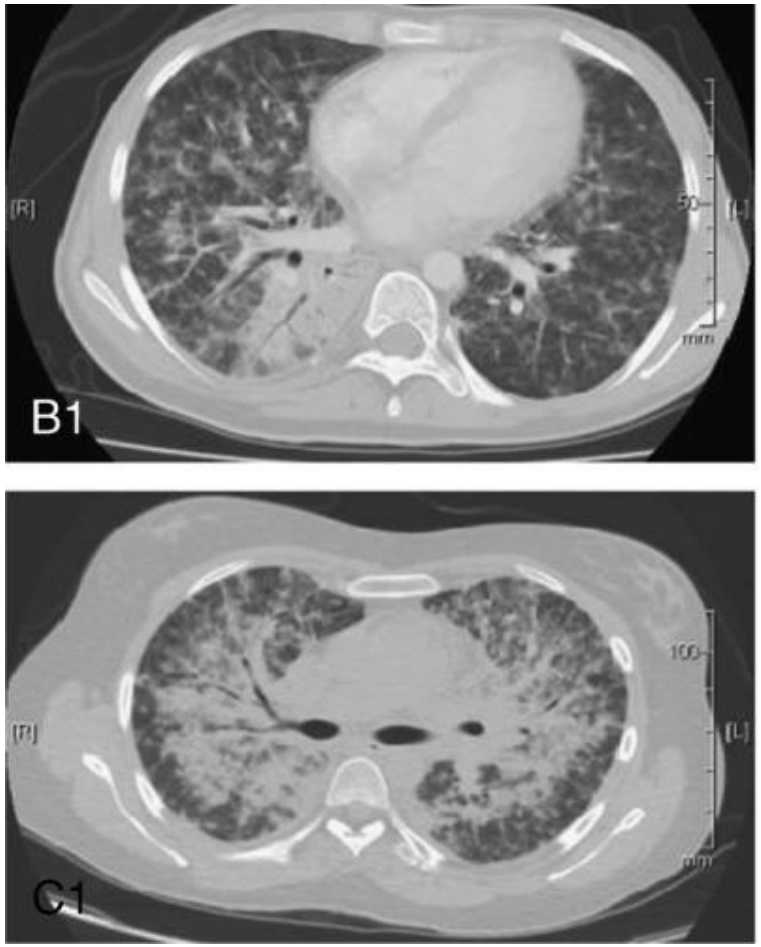
- Rota PA, et al. Measles. Nat Rev Dis Primers. 2016 Jul 14;2:16049.
- Pictures courtesy of Dr. Camilla Rothe. Pictures taken from: https://whitswood.nhs.uk/news/measles-outbreak/ AND https://www.bramhallhealthcentre.co.uk/news/worried-about-measles

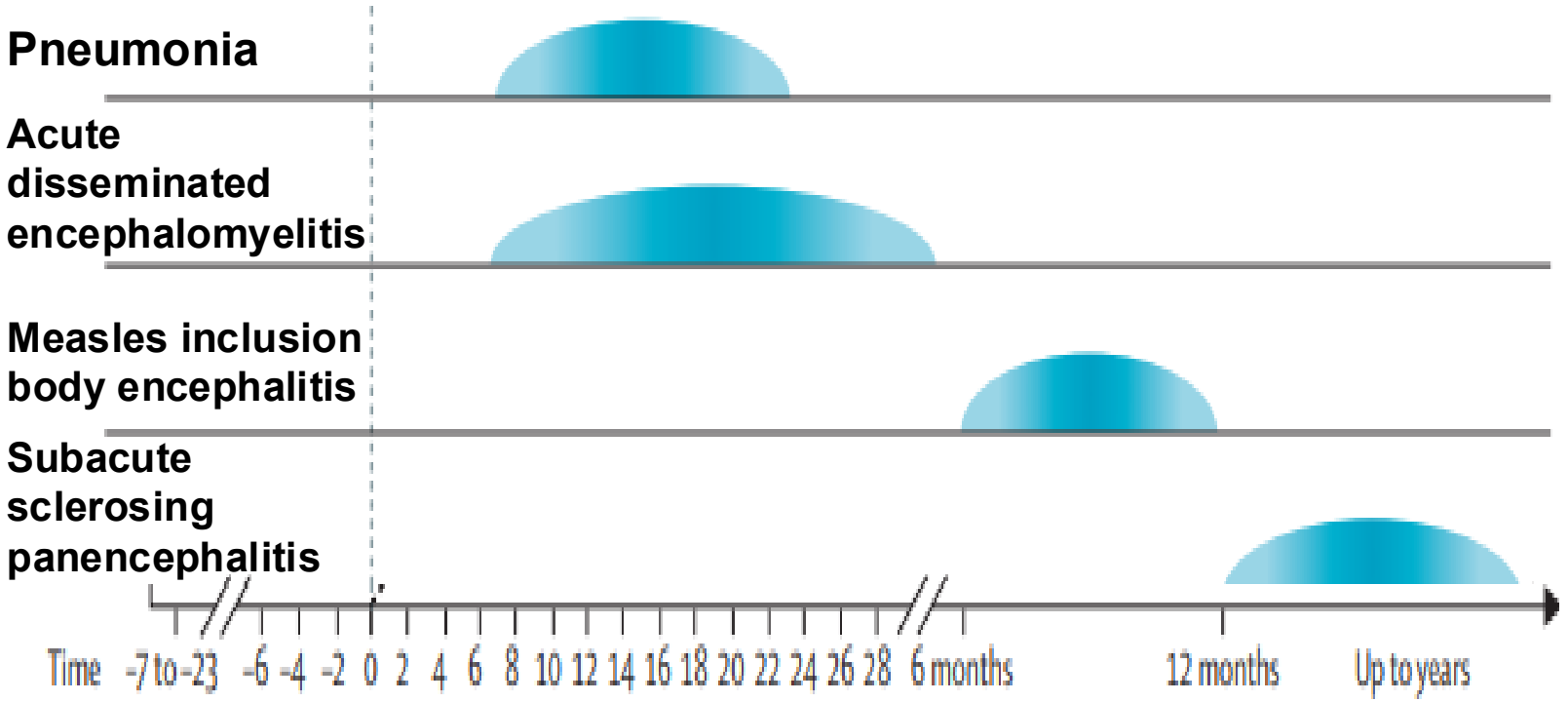
MORE THAN JUST A RASH





Rota PA, et al. Measles. Nat Rev Dis Primers. 2016 Jul 14;2:16049.
Rafat C, et al. Severe Measles Infection: The Spectrum of Disease in 36 Critically Ill Adult Patients. Medicine (Baltimore). 2013 Sep;92(5):257-272.

MORE THAN JUST A RASH



0.1% cases
~ 20% mortality

Immunosuppressed
~ 100% mortality

0.065-0.11% cases
~ 100% mortality in 1-3 years

Moss WJ. Measles. Lancet. 2017 Dec 2;390(10111):2490-2502. doi: 10.1016/S0140-6736(17)31463-0.
Ferren M, Horvat B, Mathieu C. Measles Encephalitis: Towards New Therapeutics. Viruses. 2019 Nov 2;11(11):1017.

Infection control – First steps

- IDENTIFY: Take immediate action as soon as measles is suspected.

- ISOLATE: Giving them a surgical mask and move to **Airborne Isolation**.
  - HCW: **N95 respirator**.
  - Only HCW with **documented immunity** should care for these patients.

- INFORM:
  - Call healthcare epidemiologist on call.
  - Contact infectious diseases.
  - Contact ADPH - 800-469-4599.

Measles diagnosis

RT-PCR	• RT-PCR can be performed on NP or throat swabs and on urine. • RT-PCR is most sensitive within 3 days of rash onset and up to 10 days. Ideally, **RT-PCR and serology should be performed together**.	Measles NAAT Quest 39306
Ig M	• IgM is most sensitive 3 or more days after rash onset and peak within the first week. • Can be detected for up to 6-8 weeks. • False-positive IgM can be common . Ideally, **RT-PCR and serology should be performed together**.	Measles serology Quest 34166
Ig G	• Appropriate to test for evidence of immunity.	Measles IgG

Measles (Rubeola). CDC. Available on : https://www.cdc.gov/measles/hcp/clinical-overview/index.html#:~:text=Measles%20is%20a%20mandatory%2C%20immediately%20notifiable%20disease.&text=CDC%20recommends%20that%20either%20a,clinical%20features%20compatible%20with%20measles.

Measles treatment

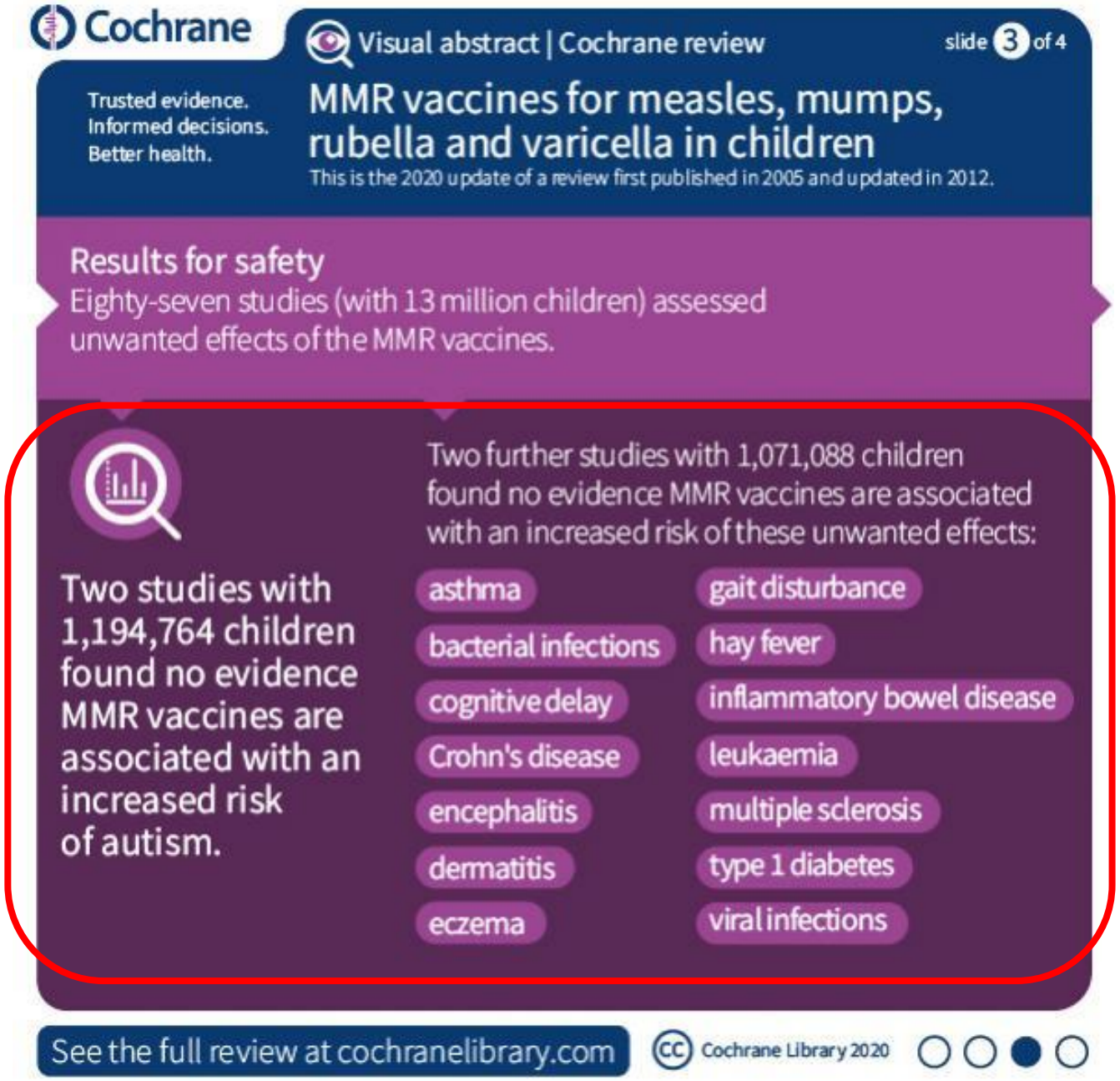
- Supportive only; no effective treatment.
- Vitamin A – Extrapolated from pediatric studies in resource limited settings.
  - Even in pediatric, results are contradictory.
  - Unclear role in adults; likely no benefit if well nourished.
- Ribavirin – Limited data; medication with many toxicities. Probably to limit for immunosuppressed patients and those with end-organ damage.

Measles (Rubeola). CDC. Available on : https://www.cdc.gov/measles/hcp/clinical-overview/index.html#:~:text=Measles%20is%20a%20mandatory%2C%20immediately%20notifiable%20disease.&text=CDC%20recommends%20that%20either%20a,clinical%20features%20compatible%20with%20measles.

MMR Vaccine safety

Di Pietrantonj C, Rivetti A, Marchione P, Debalini MG, Demicheli V. Vaccines for measles, mumps, rubella, and varicella in children. Cochrane Database Syst Rev. 2020 Apr 20;4(4):CD004407.

MMR Vaccine safety



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The Changing Landscape of Infections

CLIMATE CHANGE

Ecological niche expansion for vectors and fungi.

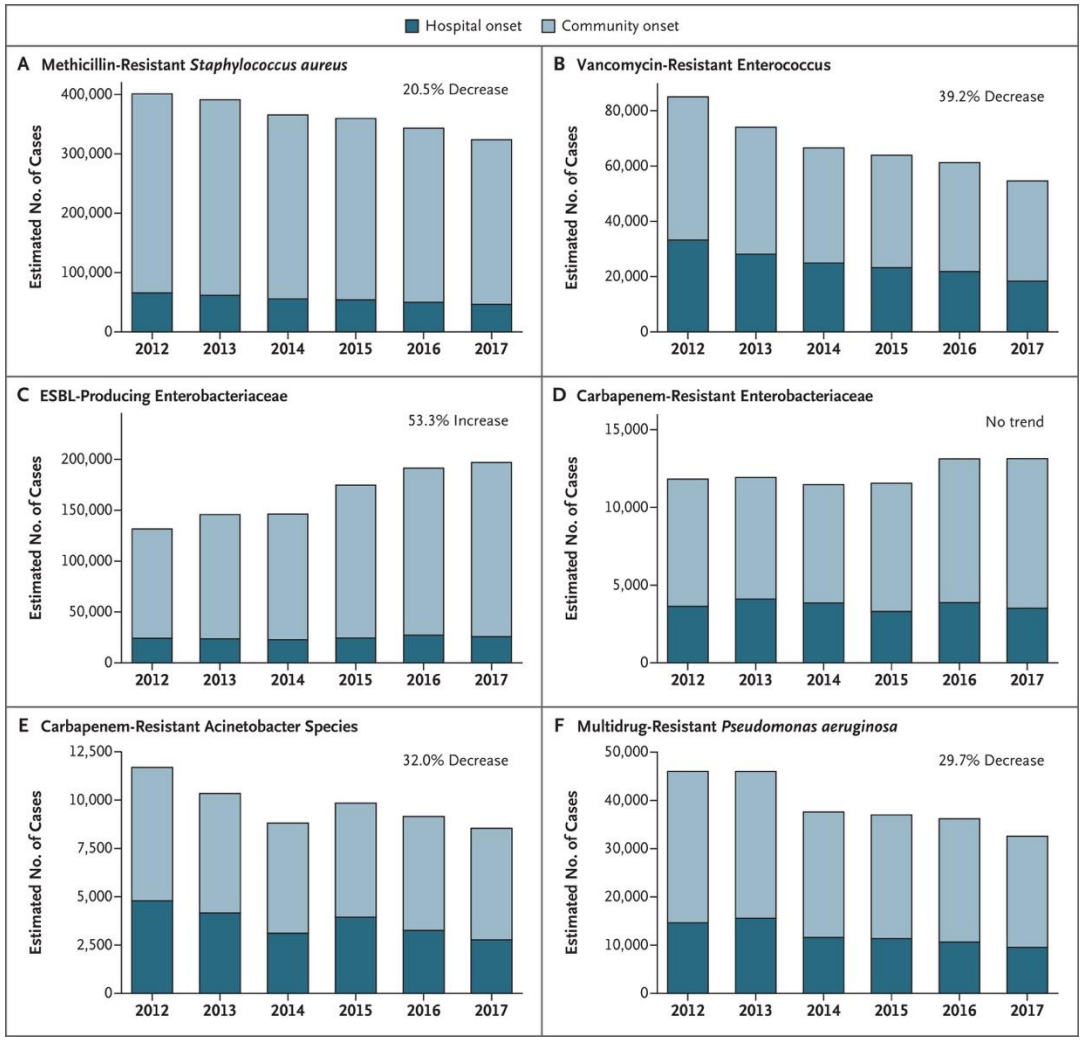
CONNECTIVITY

Rapid global spread of pathogens and behaviors

SELECTIVE PRESSURE

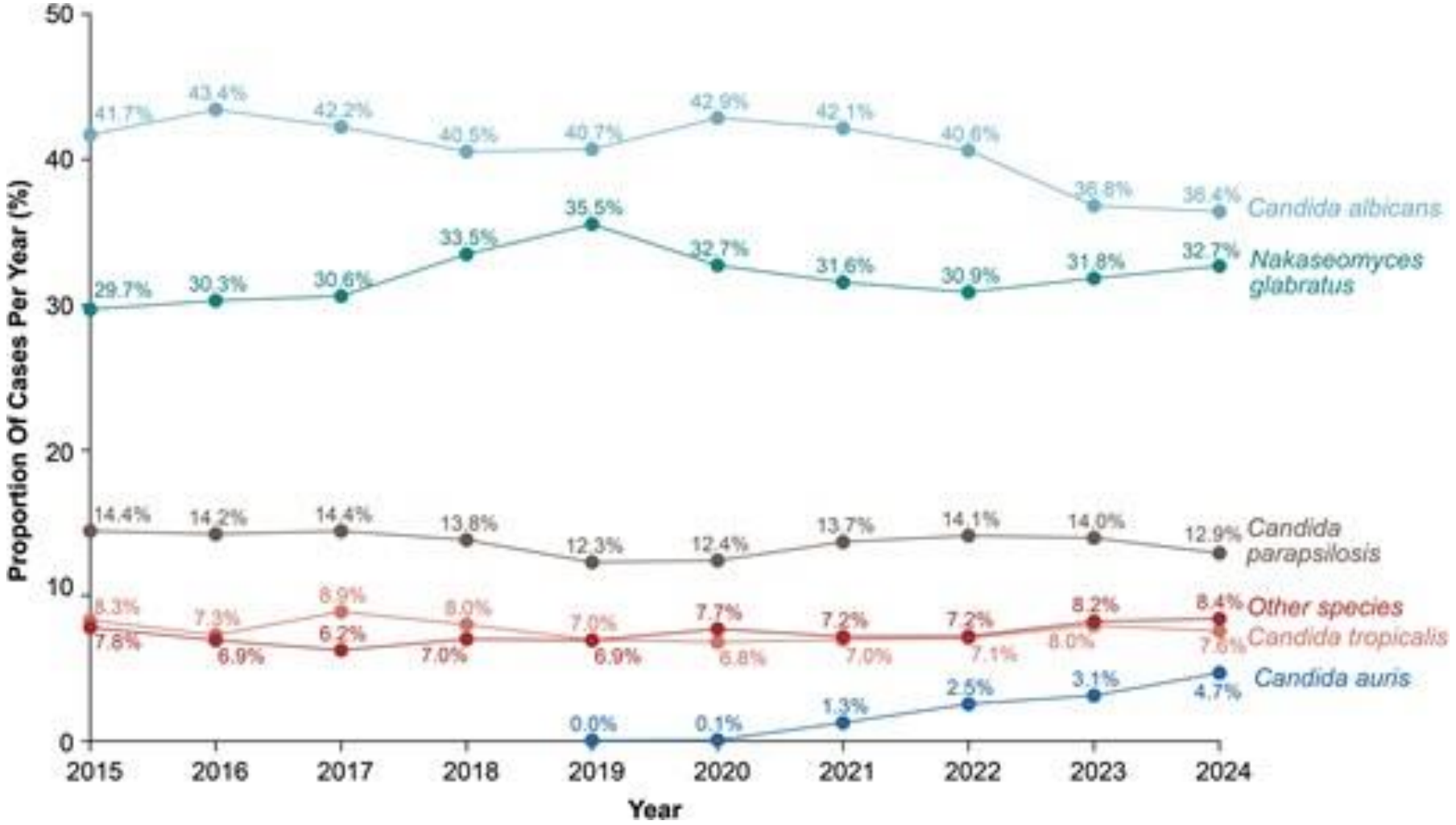
Rising of immunosuppression and MDROs.

Changing epidemiology of MDR organisms



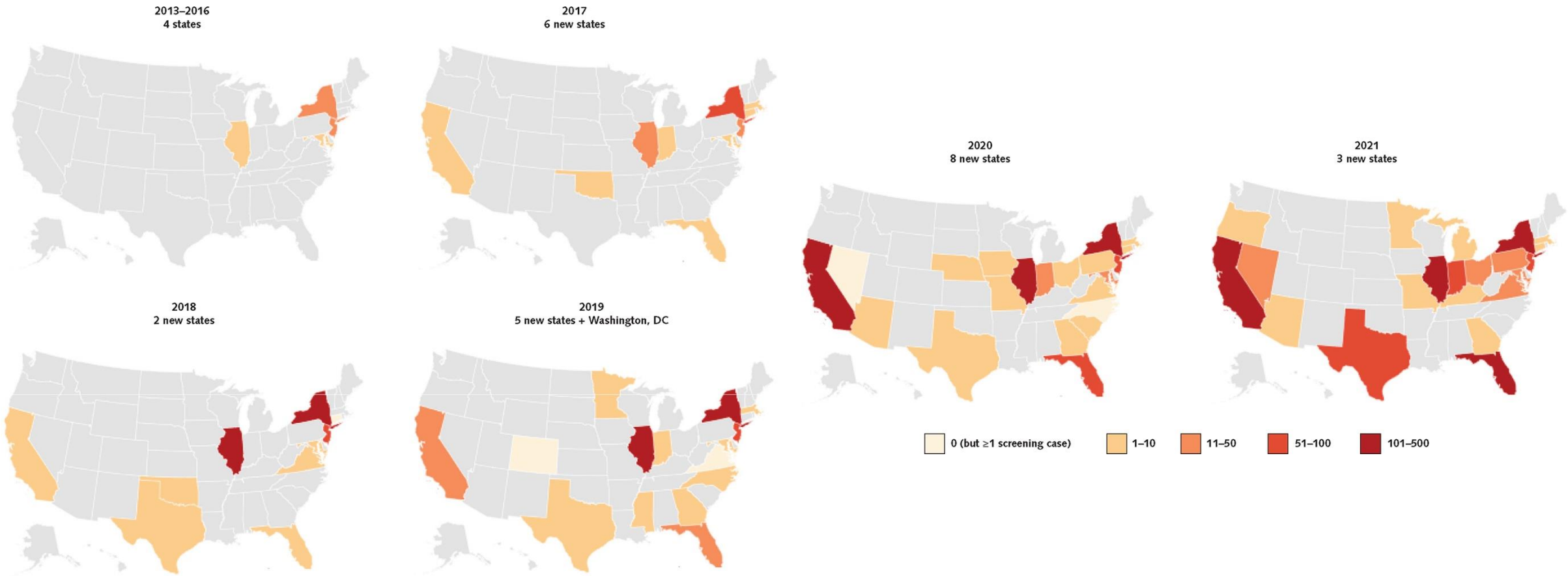
Jernigan JA, Hatfield KM, Wolford H, Nelson RE, Olubajo B, Reddy SC, McCarthy N, Paul P, McDonald LC, Kallen A, Fiore A, Craig M, Baggs J. Multidrug-Resistant Bacterial Infections in U.S. Hospitalized Patients, 2012-2017. N Engl J Med. 2020 Apr 2;382(14):1309-1319.

Changing epidemiology of Candida sp.



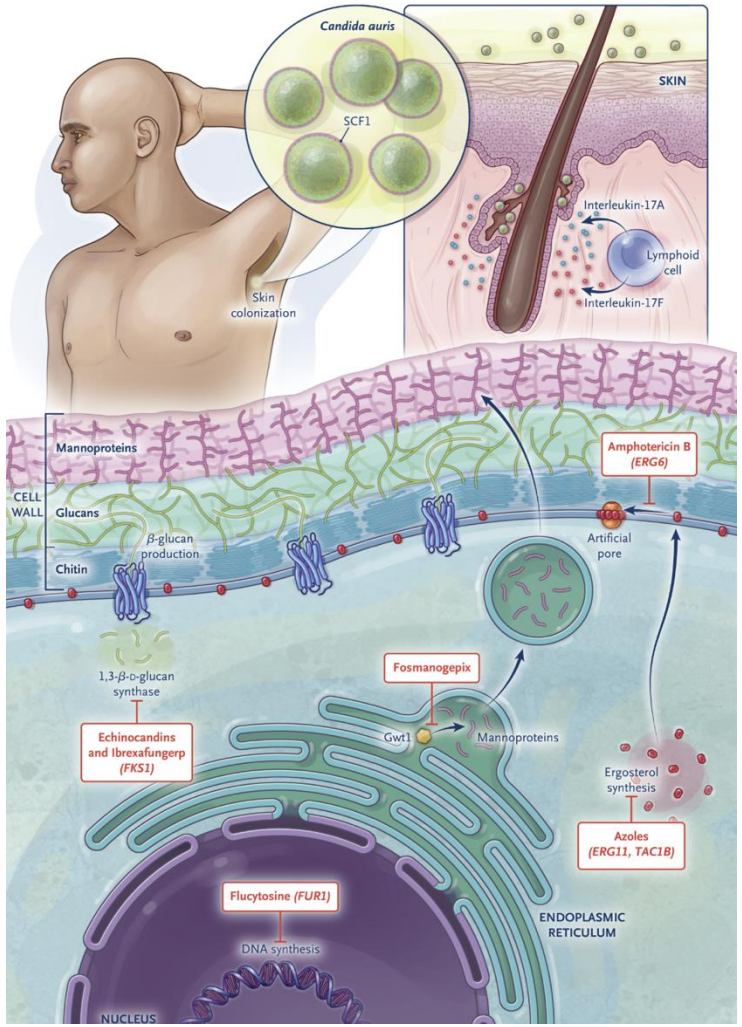
Pérez MA, Patel KA, Rasmy L, Yoshida H, Arias CA, Nigo M, Adelman MW. Changes in Epidemiology of Candidemia in the United States with a Focus on Candida auris. Clin Infect Dis. 2026 May 11:ciag312.

Changing epidemiology of Candida auris



Lyman M, Forsberg K, Sexton DJ, Chow NA, Lockhart SR, Jackson BR, Chiller T. Worsening Spread of Candida auris in the United States, 2019 to 2021. Ann Intern Med. 2023 Apr;176(4):489-495.

Why Candida auris is a problem?



Antifungal Class	Resistance Rate
Fluconazole	~90% (excluding clade II)
Amphotericin B	~18% (SENTRY data)
Echinocandins	~5% overall; incidence tripled in 2021
Pan-resistance	Rare but increasingly reported

Lionakis MS, Chowdhary A. Candida auris Infections. N Engl J Med. 2024 Nov 21;391(20):1924-1935.

Increased population at risk

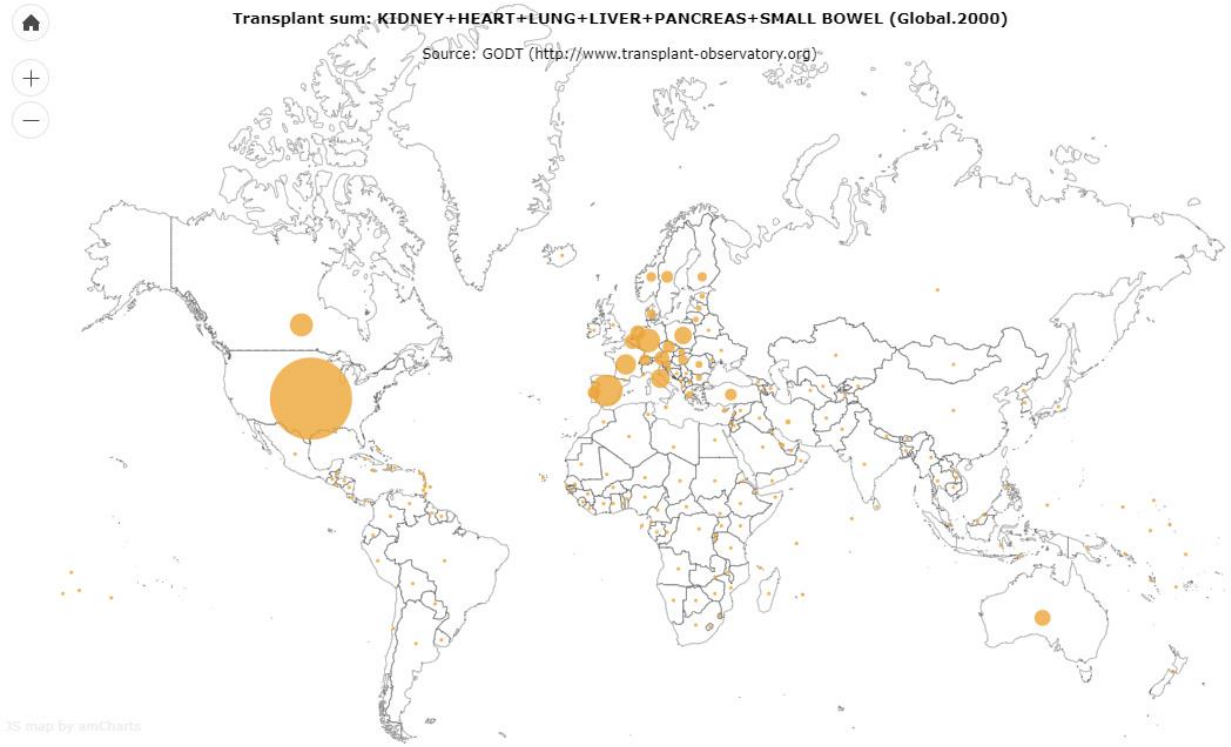
Table. Self-Reported Status of Immunosuppression for 2021

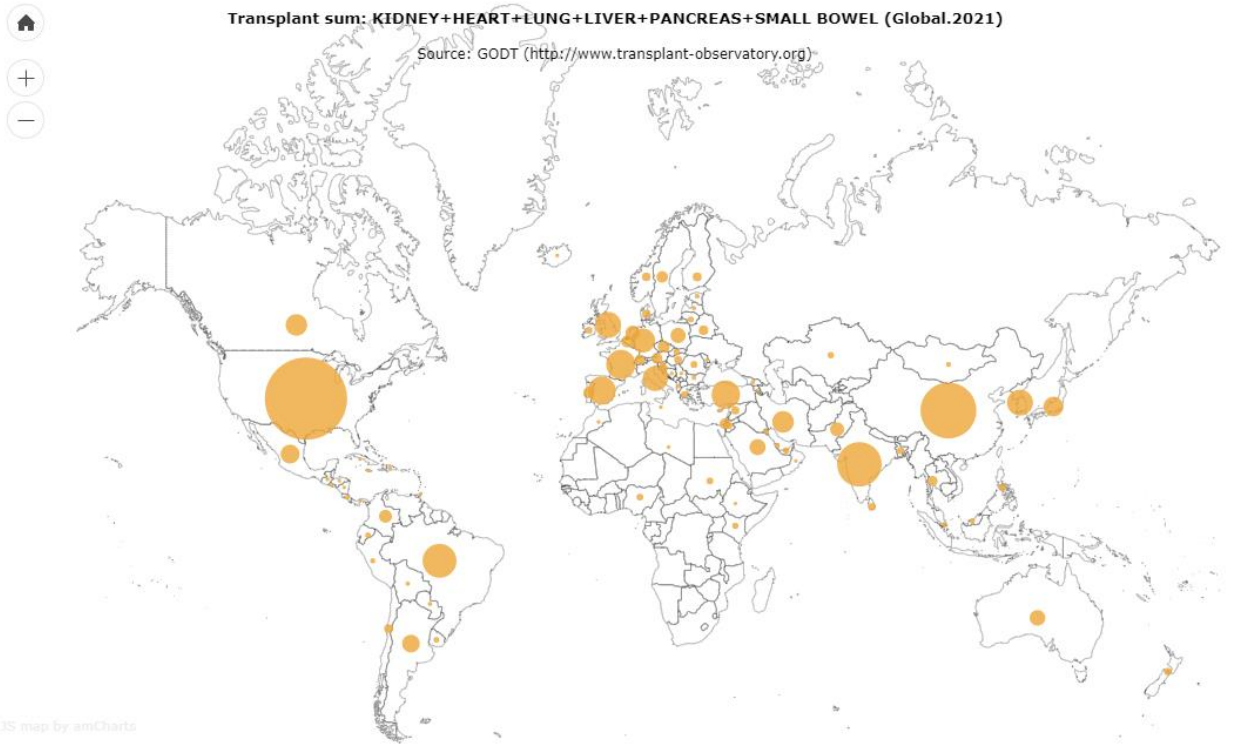
	Unweighted data, No. (%)		
	Total sample (N = 29 164)	Had immunosuppression (n = 2123)	Weighted prevalence per 100 US population, % (95% CI)
Had immunosuppression		2123 (7.2)[a]	6.6 (6.2-6.9)
Sex			
Male	13 246 (45.4)	737 (35.3)	5.2 (4.8-5.7)
Female	15 918 (54.6)	1351 (64.7)	7.9 (7.4-8.4)
Age group, y			
18-29	3836 (13.2)	141 (6.8)	3.3 (2.8-4.0)
30-39	4713 (16.2)	224 (10.7)	4.5 (3.8-5.2)
40-49	4341 (14.9)	300 (14.4)	6.6 (5.8-7.4)
50-59	4731 (16.2)	422 (20.2)	8.7 (7.8-9.6)
60-69	5341 (18.3)	514 (24.6)	9.5 (8.6-10.5)
70-79	4059 (13.9)	355 (17.0)	8.9 (7.9-10.0)
≥80	2143 (7.3)	132 (6.3)	6.6 (5.4-8.1)

6.6%
vs.
National estimate
of 2.7% in 2013

- Martinson ML, Lapham J. Prevalence of Immunosuppression Among US Adults. JAMA. 2024 Mar 12;331(10):880-882.

Increased number of transplants





- Taken from: https://www.transplant-observatory.org/data-charts-and-tables/chart/; Accessed on 8/28/2024

Key concepts in TID

- **Identify** key drivers underlying shifts in the epidemiology of infectious diseases.
- **Explain** how rising temperatures and changing weather patterns influence the epidemiology of dimorphic fungi and vector-borne diseases.
- **Describe** the recent outbreak of hantavirus and characterize its clinical presentation, including the impact of travel and migration on disease distribution.
- **Describe** the clinical features of measles and predict expected changes in its epidemiology and prevention strategies.
- **Understand** the evolving epidemiology of MDR organisms, including Candida auris, and the impact of the expanding population of immunocompromised hosts

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM