Measles

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Patient information

- 2-year-old male presents with 5 days of fever (Tm101), bilateral conjunctivitis and rash. He was admitted with concern for Kawasaki Disease…
- Day 1: developed fever at daycare (Tm 101)
- Day 2: continued fever
- Day 3-4: continued fever, bilateral eye redness with some crusting, cough, 1 episode of diarrhea
- Day 5: rash which started on his face and spread down his body and included his hands and feet

- Additional history:
  - Term delivery and had a history of febrile seizures
  - Reportedly up to date on immunizations (obtained out of state)
  - Moved to Georgia > 1 year ago
  - No recent travel, no exposures
  - Attends daycare

Case

Physical Exam

- **Gen:** ill-appearing
- **HEENT:** bilateral conjunctivitis (no drainage, red lips
- **Neck:** supple, L > R lymphadenopathy (> 1. 5cm)
- **Chest:** clear
- **CVS:** tachycardic, regular rhythm, no murmur
- **Abdomen:** non-tender, non-distended no HSM
- **Extremities:** mild finger edema
- **Skin:** diffuse, erythematous, blanching nontender maculopapular rash

Labs

- **CMP:** Na 128, BUN 10, Cr 0.29, AST 63, ALT 14, Albumin 3.6
- **CBC:** WBC 4.63, Hgb 10.5, Plt 205,000
- **Differential:** Bands 12%, Neutrophils 55% (3130), Lymphocytes 33% (ALC 1510)
- **CRP:** 0.6 mg/dL (< 1)
- **ESR:** 8 mm/min (< 15)
- **Urinalysis:** normal
- **Echocardiogram:** normal

Patient information

- Mother admitted that child had not had any immunizations since age 9 months
- Still no reported exposures

- Testing
  - Measles IgM: positive
  - Measles IgG: negative
  - Measles RT-PCR (throat): detected
  - Measles RT-PCR (urine): detected

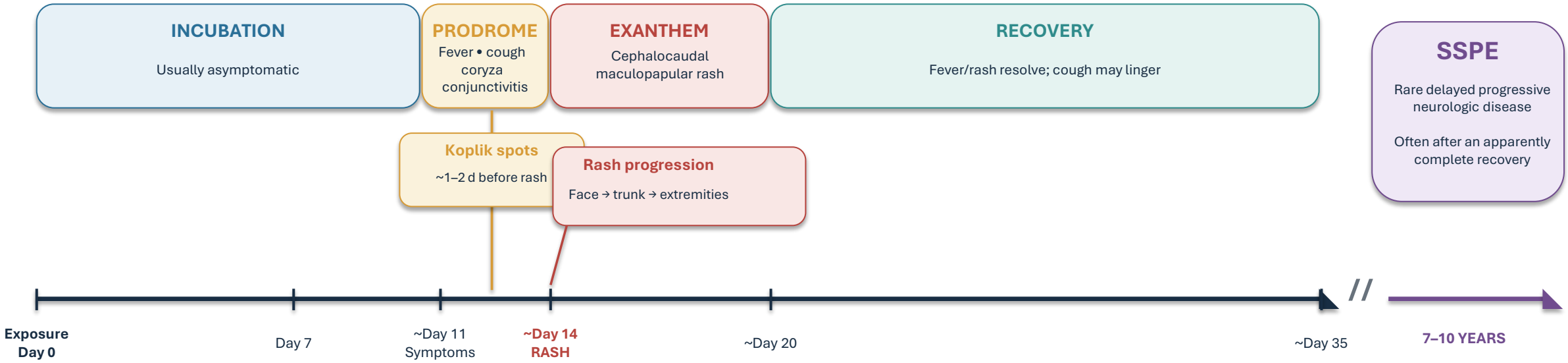
- The mother was very resistant to cooperating with public health due to immigration concerns

Key Takeaways

- The patient was not in Airborne Isolation for ~ 36 hours
  - Over 400 patient exposures
  - No secondary healthcare-related cases
- Patient attended daycare during prodrome
  - There were 5 secondary measles cases from the daycare
- Because of the delay in diagnosis, the ability to provide post-exposure prophylaxis (PEP) was limited.
- Immigration/ICE concerns can have negative impacts on public health efforts.

Measles: Clinical Course from Exposure to Late Complications

Typical timing in an immunocompetent patient • Rash onset is the key clinical anchor



Contagious 4 days before and after onset of the rash (day 0)

COMPLICATIONS

Most acute complications occur during illness or within ~2–3 weeks after rash onset

Otitis media
Diarrhea • croup

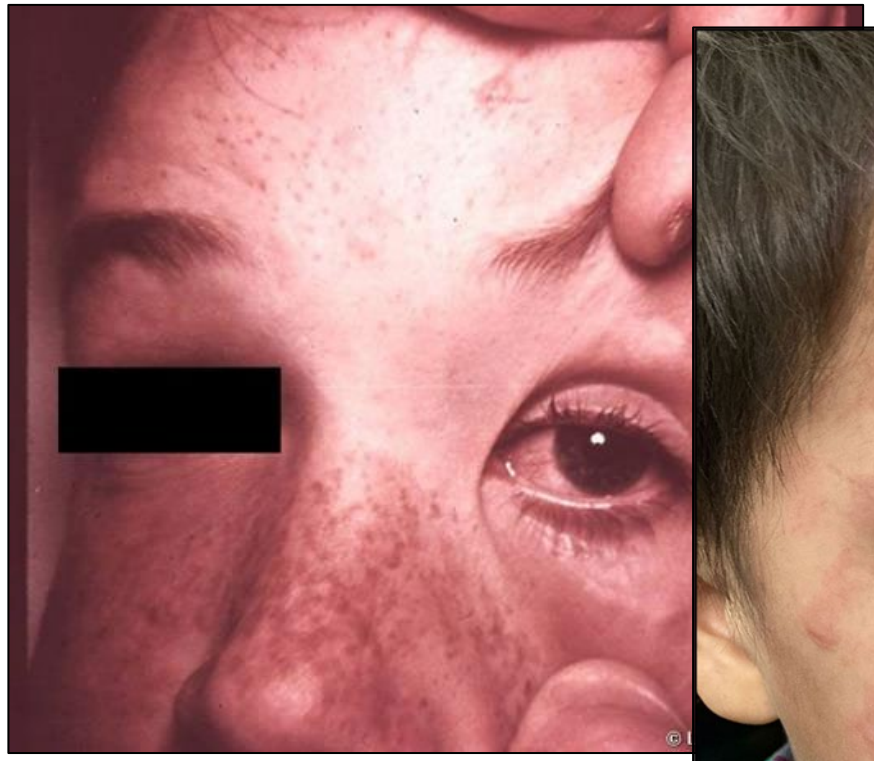
PNEUMONIA
viral or secondary bacterial

Acute encephalitis
~1 per 1,000–2,000 cases

TEACHING PEARL **Pneumonia is an acute/early complication; SSPE is a late complication appearing years after measles.**

Timing synthesized from CDC Pink Book & CDC Manual for the Surveillance of Vaccine-Preventable Diseases. Typical course; timing varies by patient.

Measles





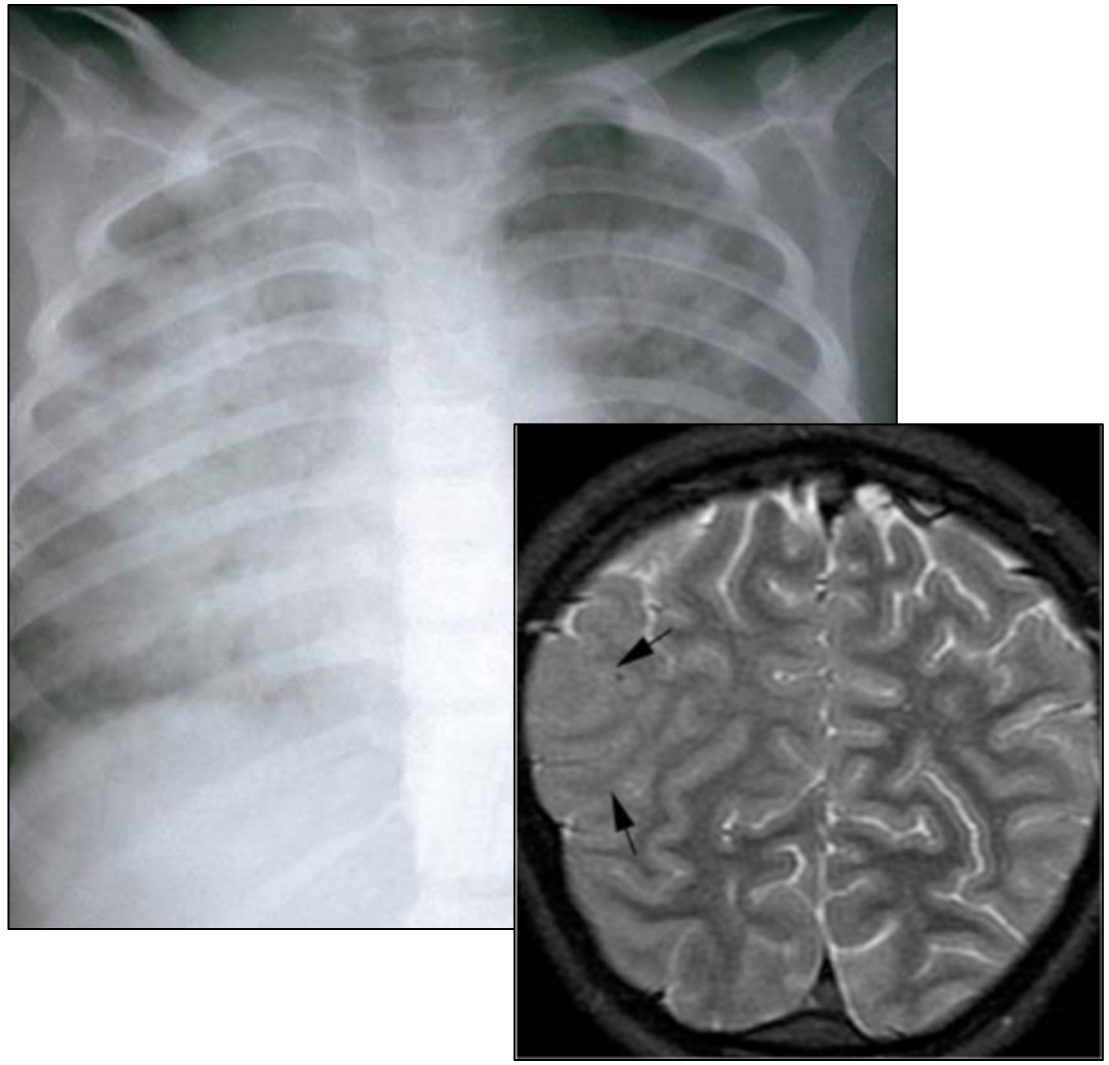




Clinical Overview of Measles | Measles (Rubeola) | CDC
Measles | Red Book: 2024–2027 Report of the Committee on Infectious Diseases | Red Book Online | American Academy of Pediatrics

Complications

- Hospitalization: 11% (17% in children < 5yrs)
  - Dehydration
  - Pneumonia
- Encephalitis: ~ 1/1000 cases
- Death: 1-3/1000 cases
  - Children < 5yrs
  - Immunocompromised persons
  - Pregnant women



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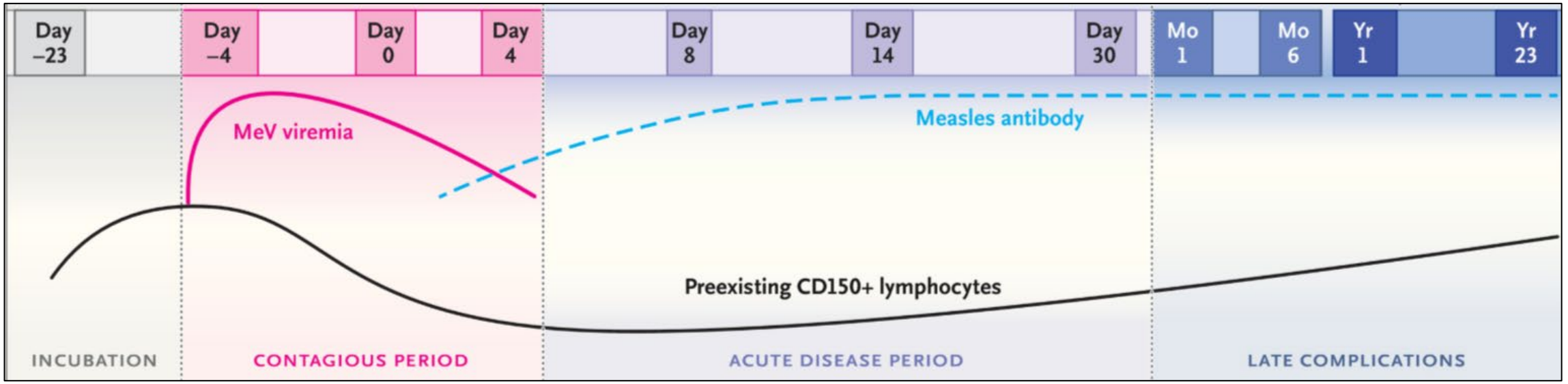
Outcomes among Pregnant Women with Measles and Their Infants in the United States — Preliminary Analysis, 2025–2026

- **Measles during pregnancy**
  - Severe maternal infection
  - Preterm delivery
- **Neonatal infection**
  - Not teratogenic
  - Congenital measles infection can be severe
- **Study of 112 confirmed cases of measles during pregnancy (Jan 2025- Sept 2026)**
  - 98% unvaccinated of vaccine status was unknown
  - Hospitalization 23% (non-labor reasons)
  - Pneumonia 10%
  - Out of 21 pregnancy outcomes within 14 days of the rash: 8 preterm, 2 pregnancy losses
- **Congenital measles**
  - Positive measles RT-PCR within 10 days of birth
  - 13 cases (1 cases meningoencephalitis)

Lewis EL, et al. NEJM Evidence. Nov 16, 2026.
https://doi.org/10.1056/EVIDpha2600416

Immune Amnesia



- Measles virus targets CD150+ memory T and B cells
- Measles eliminates 11–73% of the antibody repertoire, including from vaccines
- Recovery occurs only after natural re-exposure—not spontaneously
- In a study in DRC, comparing Tetanus Ab levels among fully-vaccinated children with and without a h/o measles. A h/o measles was associated with sub-protective Ab levels.
- Responsible for the relative increased risk for secondary infections
- Last for 5 months to 1 year after infection

Do LA, et al. NEJM. 2025;393:2447-2458
Mina MJ, et al. Science. 2019;366(6465):599 606.

Subacute Sclerosing Panencephalitis (SSPE)

- Rare complication of measles
- Occurs ~ 7-10 years after a measles infection
- Highest risk in children infected under 2 years
- Progressive degenerative disorder of the central nervous system
  - Cognitive decline and behavioral changes
  - Periodic generalize myoclonic jerks
  - Progressive motor and cognitive decline
  - Coma and death in 1-4 years

Clinical Overview of Measles | Measles (Rubeola) | CDC
Cole AJ, et al. NEJM. 2007;357:589-600
Aziz-Sulaiman S, et al. Journal of Child Neurology. 2024;39(3-4):89-97

Testing for Measles

- NP/throat swab for real-time RT-PCR
- Urine for real-time RT-PCR
- Serum IgM

Clinical Overview of Measles | Measles (Rubeola) | CDC

Vitamin A

- **Vitamin A is recommended for all children with measles** regardless of hospitalization or severity of illness
- Dose **once daily for 2 consecutive days** at age-specific doses
- Based on large-scale, community-based randomized trials conducted across Asian and African countries (1983- 1992), which showed **vitamin A reduced measles mortality** (34% - 50%) among children 1 to 5 years of age
- Although vitamin A deficiency is rare in the US, measles significantly lowers levels even in well-nourished children
- **Low serum vitamin A levels correlates with measles severity**

Table 3. U.S. Recommendations for Vitamin A Supplementation in Patients with Measles.*

Age Group	Dose	Frequency
Children		
<6 mo	50,000 IU (15,000 μg RAE)	Daily for 2 days
6–11 mo	100,000 IU (30,000 μg RAE)	Daily for 2 days
>12 mo	200,000 IU (60,000 μg RAE)	Daily for 2 days
Previous vitamin A deficiency or eye complications caused by measles	Third dose	2–4 wk after the second dose
Adults†	No recommendation	No recommendation

* Adapted from Stinchfield PA and Orenstein WA.[41] IU denotes international unit, and RAE retinol activity equivalents.

† The U.S. recommendation aligns with the World Health Organization (WHO) recommendation.[42] However, the WHO recommends a dose of 5000 to 10,000 IU daily for 4 weeks in adult measles patients. Women of reproductive age should receive only lower, but more frequent, doses of vitamin A (e.g., a daily oral dose of 5000 to 10,000 IU of vitamin A for at least 4 weeks) owing to possible teratogenic effects.

Do LA, et al. NEJM. 2025;393:2447-2458

One dose of MMR vaccine is:	• 93% effective against measles • 72% effective against mumps • 97% effective against rubella
Two doses of MMR vaccine are:	• 97% effective against measles • 86% effective against mumps

Mumps Vaccination | Mumps | CDC

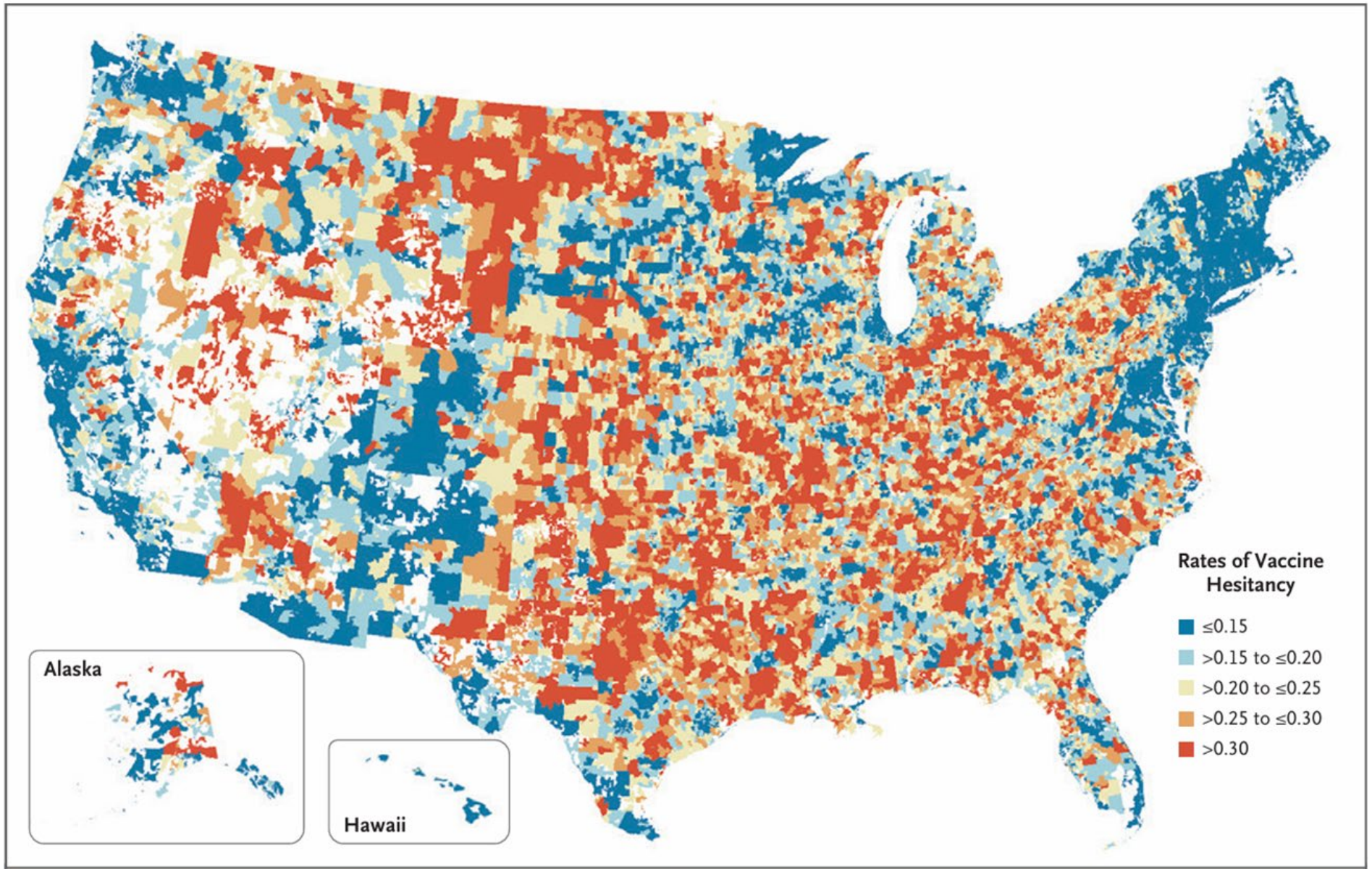
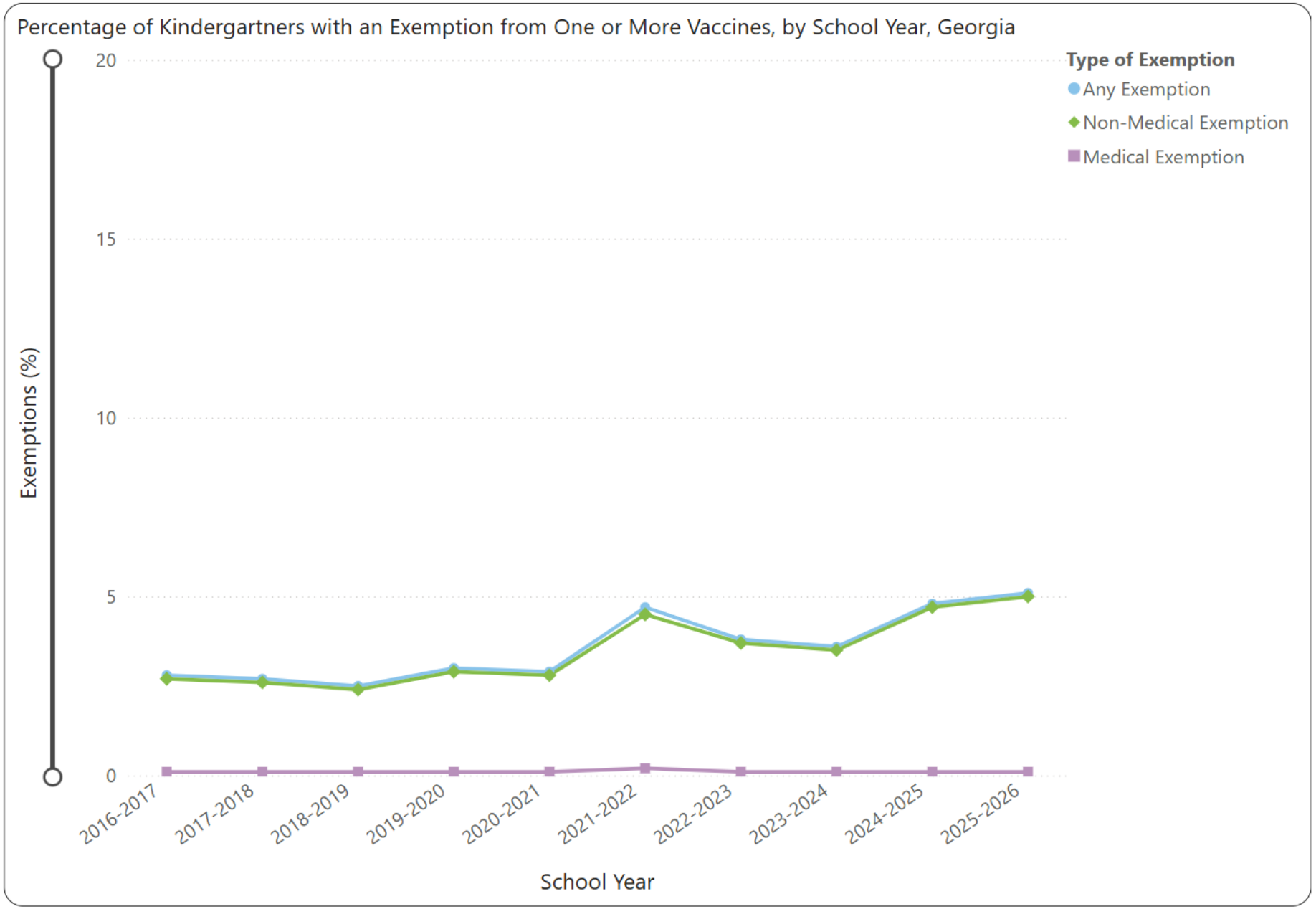


Figure 2. Rates of Vaccine Hesitancy across U.S. ZIP Codes, December 2021.

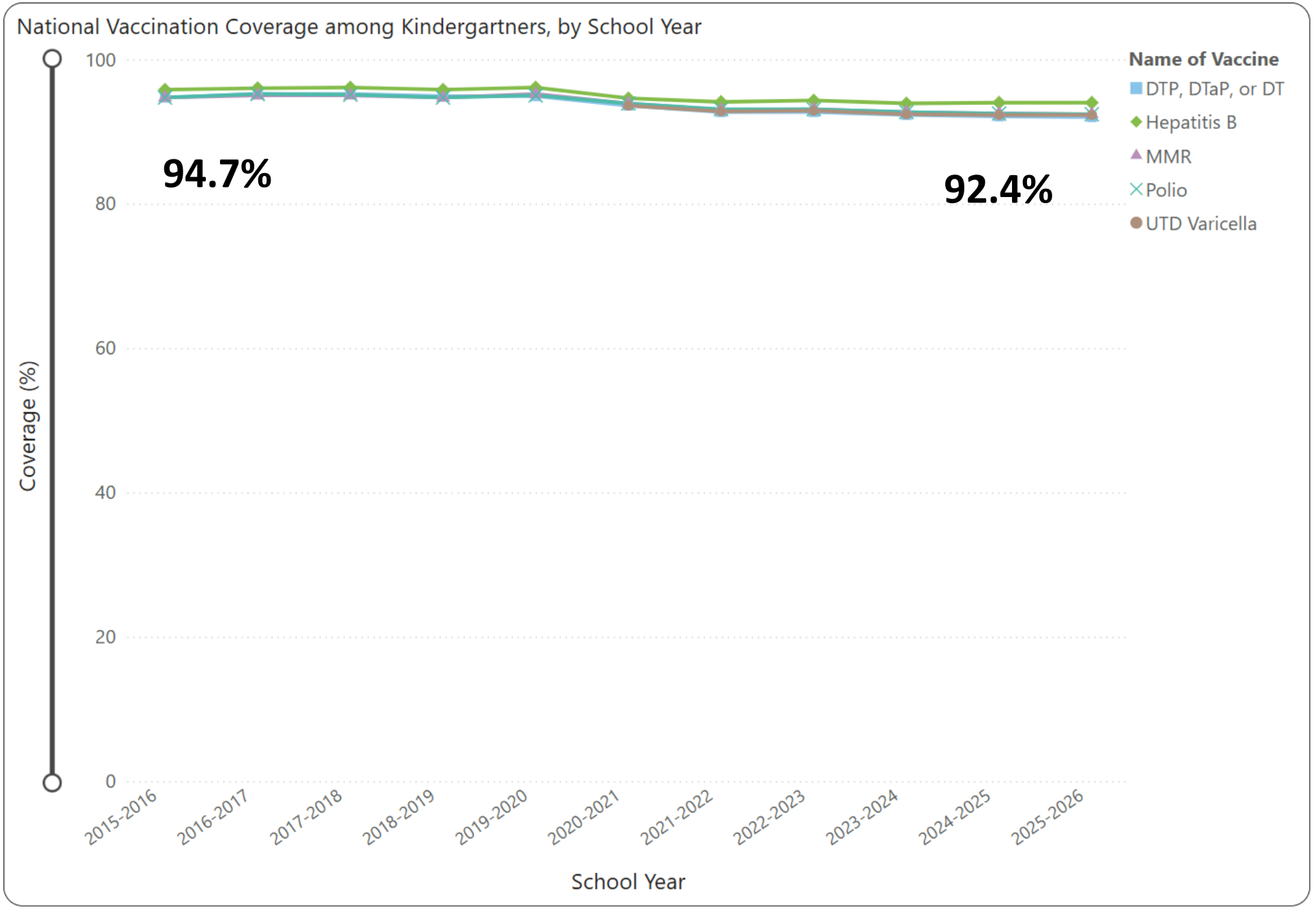
The data are based on responses to the U.S. Covid-19 Trends and Impacts Survey.[74]

Larsen, et al. NEJM. 2022

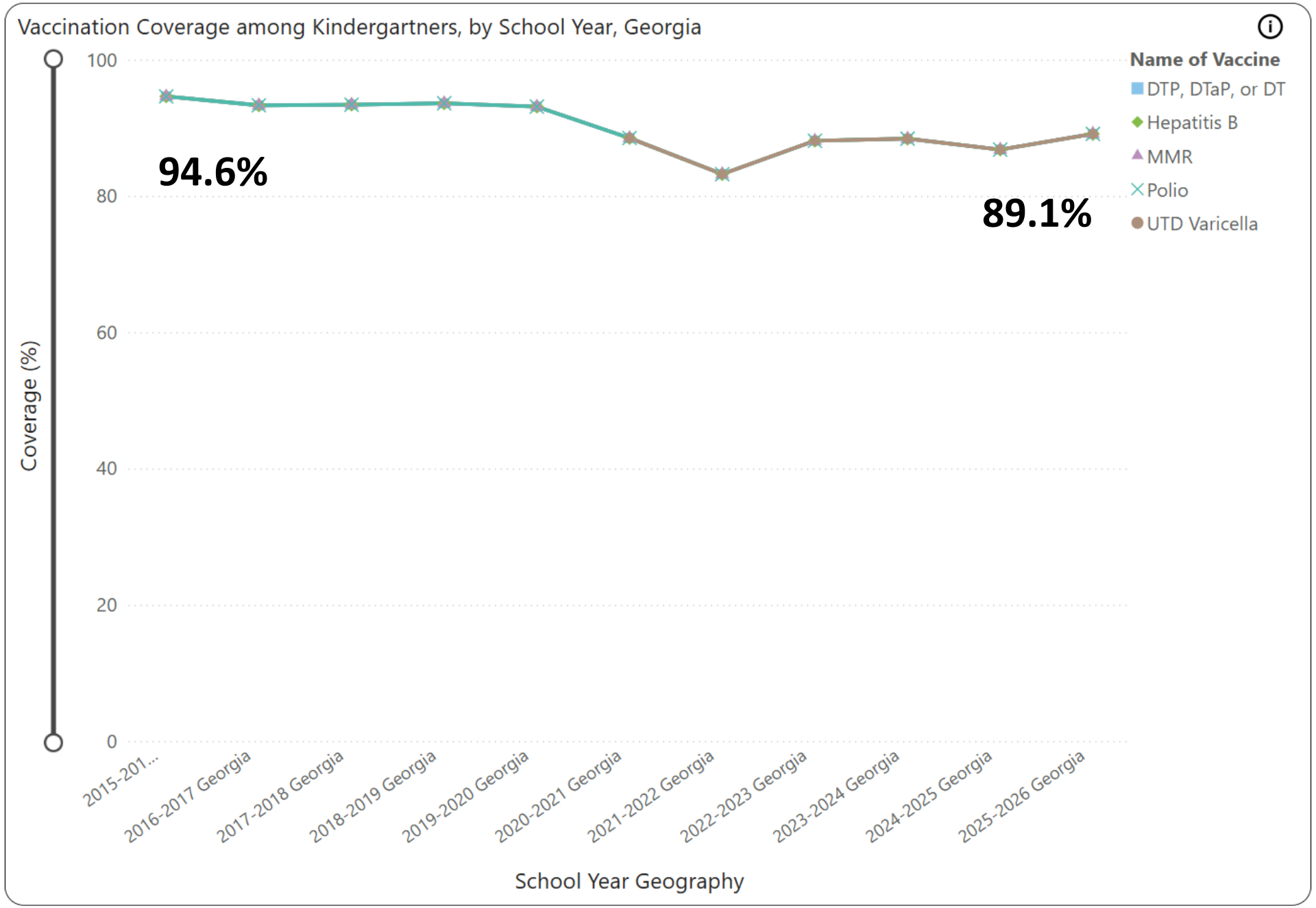


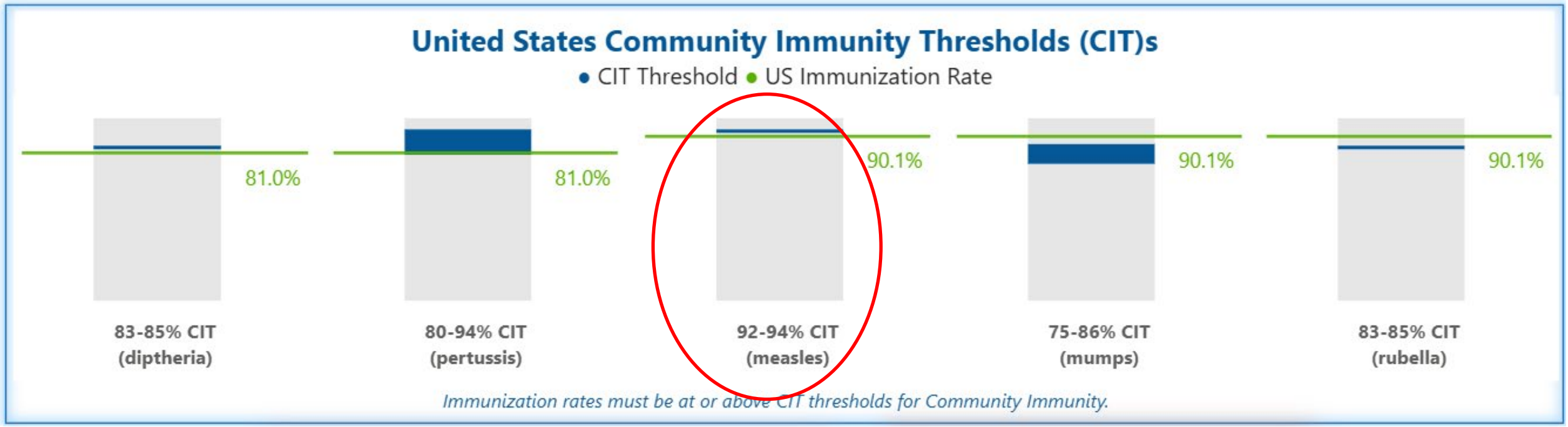


[Vaccination Coverage and Exemptions among Kindergartners | SchoolVaxView | CDC]



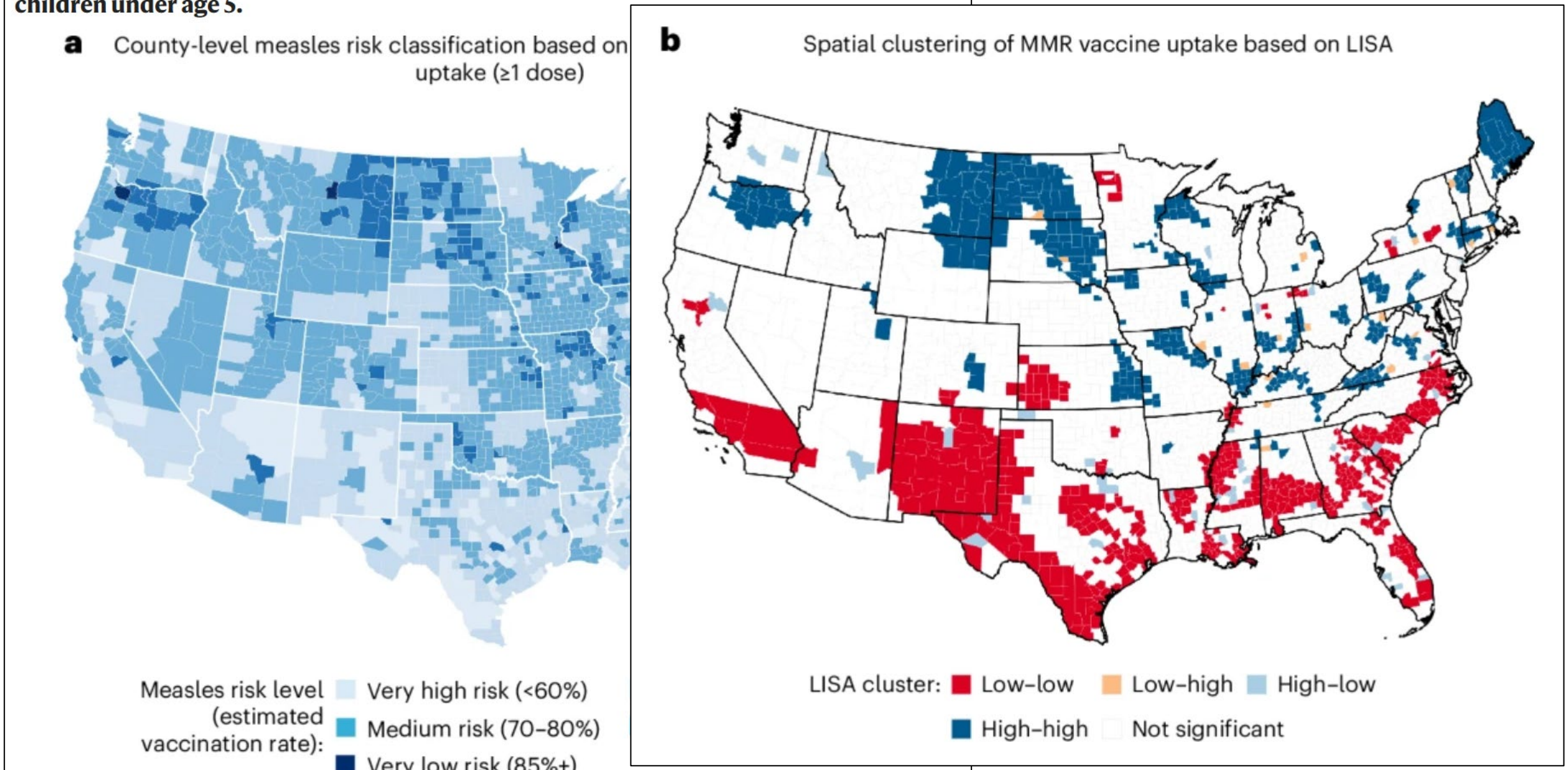
Vaccination Coverage and Exemptions among Kindergartners | SchoolVaxView | CDC


Vaccination Coverage among Kindergartners, by School Year, Georgia
Coverage (%)
100
80
60
40
20
0
94.6%
89.1%
Name of Vaccine
DTP, DTaP, or DT
Hepatitis B
MMR
Polio
UTD Varicella
2015-201...
2016-2017 Georgia
2017-2018 Georgia
2018-2019 Georgia
2019-2020 Georgia
2020-2021 Georgia
2021-2022 Georgia
2022-2023 Georgia
2023-2024 Georgia
2024-2025 Georgia
2025-2026 Georgia
School Year Geography



https://www.aap.org/en/patient-care/immunizations/immunizations-across-america/

Fig. 1: County-level estimates of MMR vaccine uptake and spatial clustering among US children under age 5.

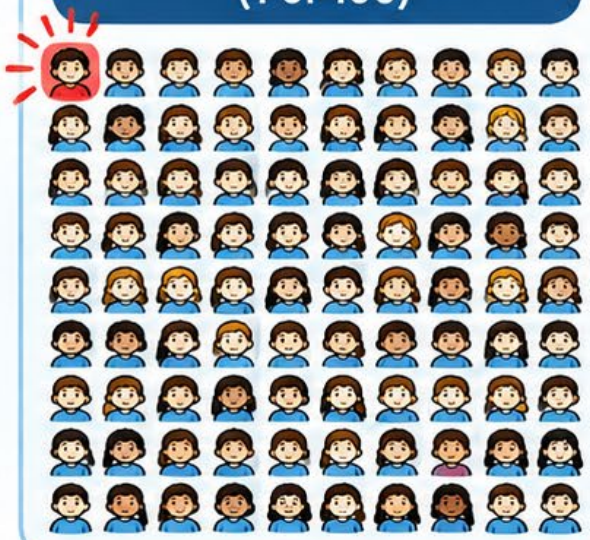


[Assessing MMR vaccination coverage gaps in US children with digital participatory surveillance | Nature Health]

Measles: How Fast It Can Spread in a Population of 100

Measles is highly contagious. In a group of 100 people with no immunity (not vaccinated or never infected), one case can lead to about 90 total cases.

Day 0:
1 infected person
(1 of 100)



Day 7:
Early spread
(~10 of 100 infected)



Day 14:
Rapid increase
(~50 of 100 infected)



Day 21:
Widespread outbreak
(~90 of 100 infected)





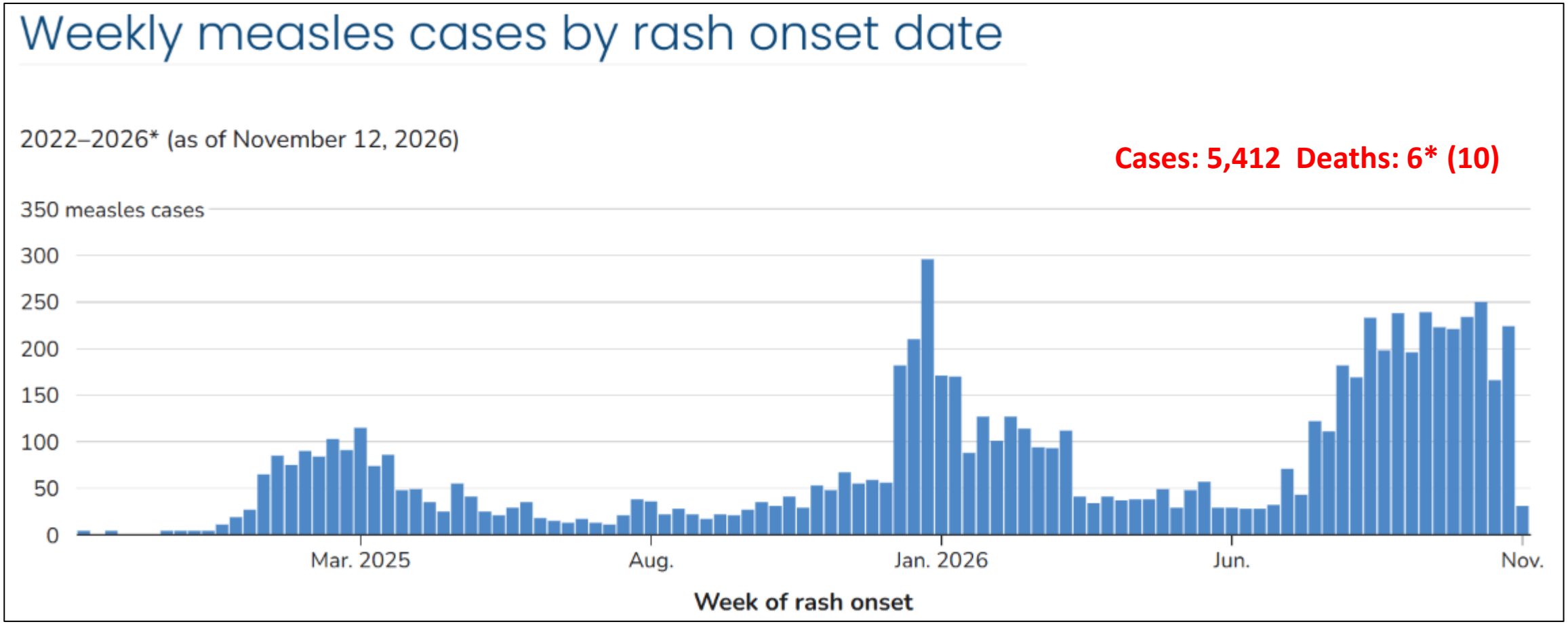
Infected with measles
(can spread the virus)



Not infected
(susceptible)

Bottom line: In a group of 100 **susceptible** people, measles can spread to about **90 people (≈90%)** within 3 weeks.

Weekly measles cases by rash onset date



On November 17, 2026, after 26 years, the US lost its measles elimination status.

Measles Cases and Outbreaks | Measles (Rubeola) | CDC

Summary

- Fever and rash are common
  - Prodrome: cough, conjunctivitis, coryza
  - Rash appearance and progression
- Immunization status
- Exposures: domestic or international travel, contacts
- Airborne isolation
- Vitamin A if hospitalized
- Immune amnesia
- Vaccine coverage is not uniform across the US
- Regaining elimination status will be a challenge