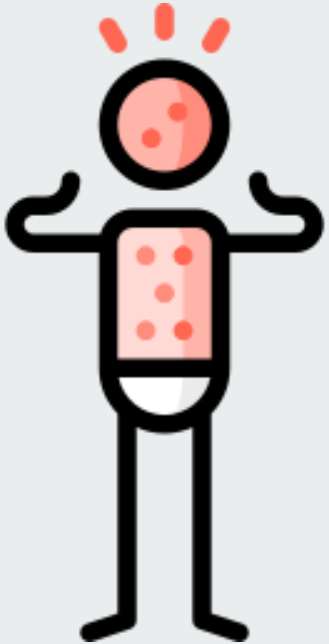
Measles..?



WVU–Jamaica Teleconference
Hunter Ratliff
11/04/2026

Ages, dates, and other identifying information may have been changed
I have no conflict of interest in relation to this presentation

Responsible use of AI

Use of AI

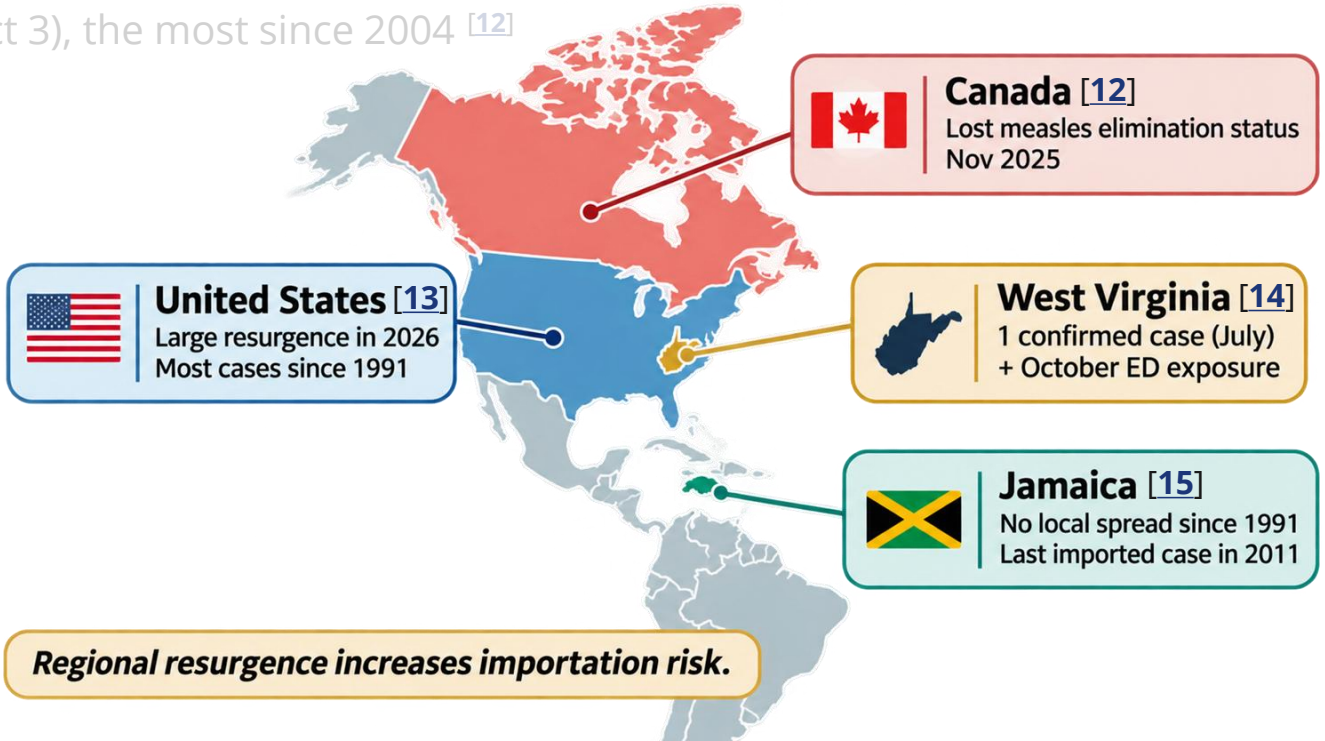
- **Claude** Opus 5.5 (Anthropic) was used for slide design, & first-draft text. ChatGPT 6 (Open AI) created some graphics, but Anthropic is a more ethical choice. Also used Opus 5, since 5.5 downgraded me when I started using immunology & virology prompts
- I chose the content and cases, educational points, and verified the literature search. Hunter is responsible for content and accuracy of this presentation
- No patient identifiers were shared with AI

Why now? Measles in 2026

Americas: 55,792 confirmed cases and 77 deaths in 17 countries (through Oct 3), the most since 2004 [12]

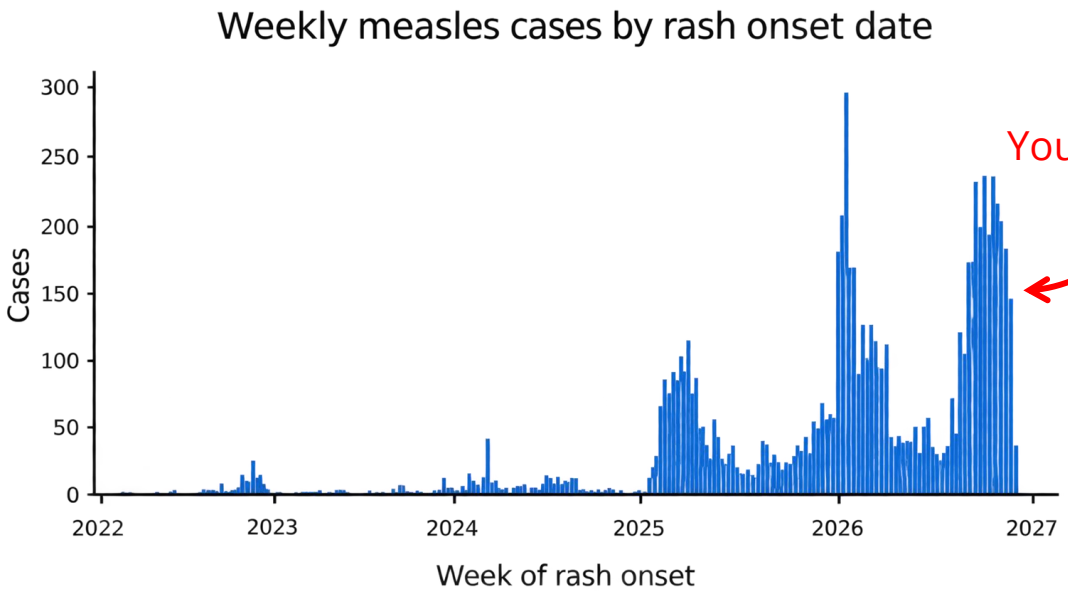
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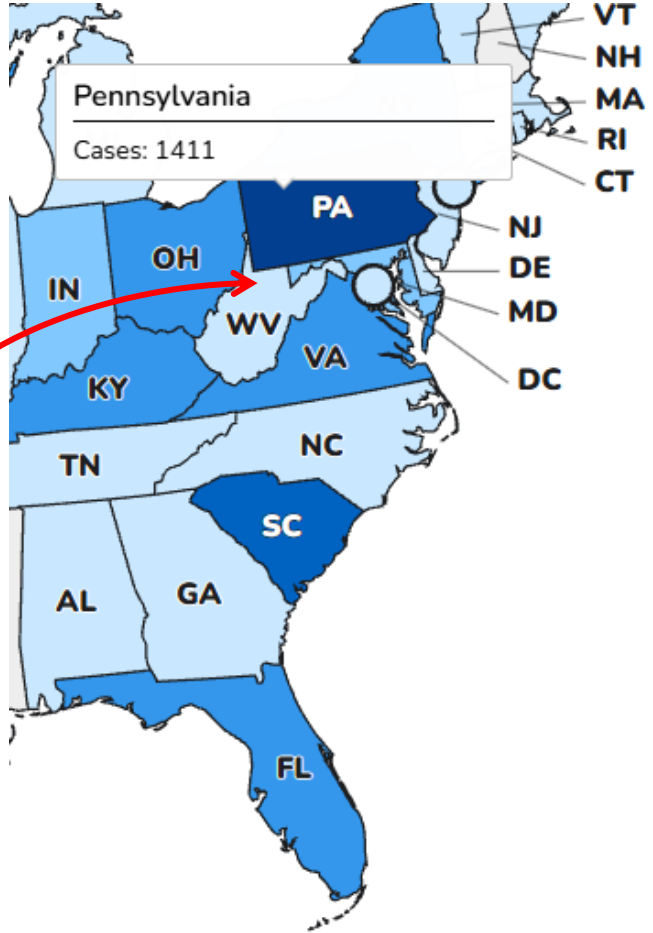


Why now? Measles in 2026

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You are here



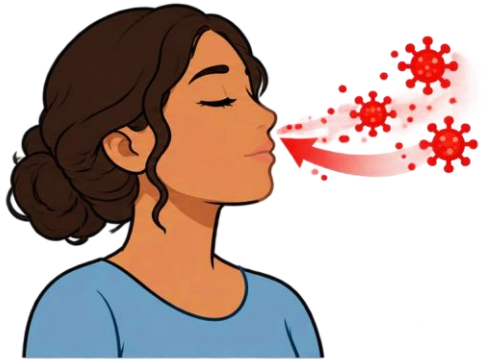
Measles 101 [21, 22]

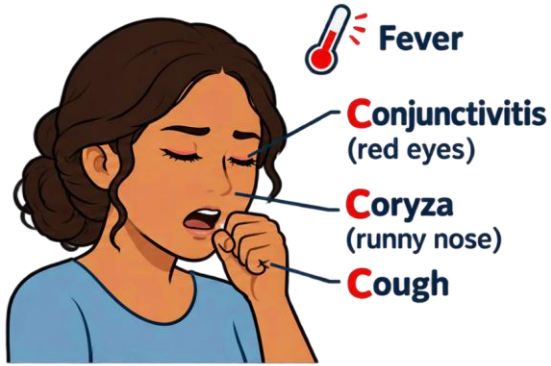
Incubation
7–14 days after exposure, no symptoms

Prodrome (3–5 days)
High fever (up to 40.5 °C), cough, coryza, conjunctivitis, Koplik spots

Rash (~day 14)
Maculopapular; face and hairline, then trunk and limbs over ~3 days; lasts 4–8 days

Contagious: 4 days before to 4 days after rash onset







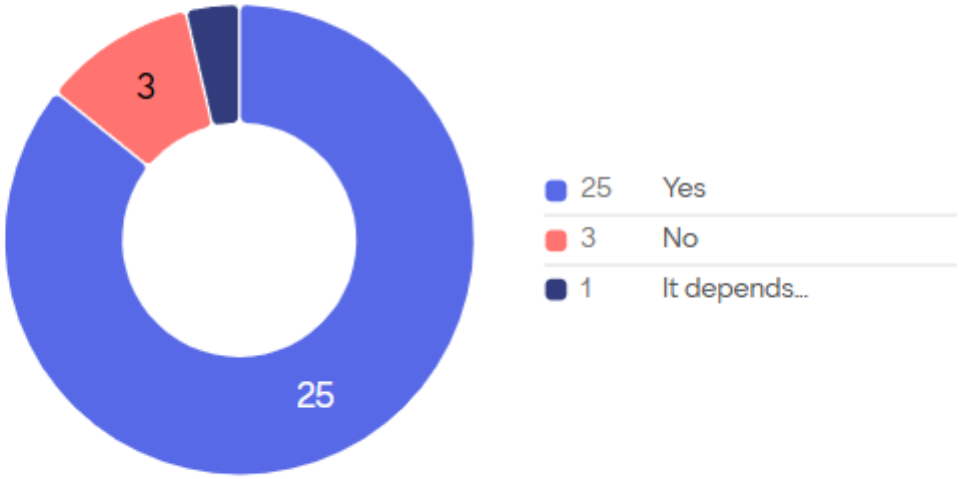
[1] Are Koplik spots pathognomonic for active measles?

Mentimeter



[1] Are Koplik spots pathognomonic for active measles?

Responses are hidden

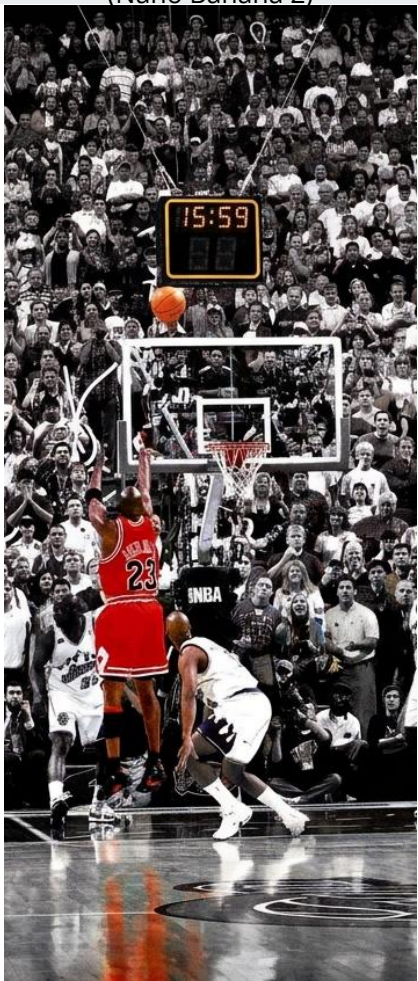


Setting the scene

It’s **Wendsday afternoon** in the ED / urgent care

- The waiting room has been full all day
- You are finishing up for the day, when…

AI generated content
(Nano Banana 2)



Setting the scene

It's **Wendsday afternoon** in the ED / urgent care

- The waiting room has been full all day
- You are finishing up for the day, when...

At **3:59pm**, a new patient checks in...

ED/07	
Chief complaint	**measles r/o**
Hoping to go home today?	**Yes**
Triage callback number	170725

Case 1: HPI (per triage)

A **35 y/o F** with no PMH p/w **concern for measles**

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- ❖ Exposure history (travel, sick contacts, local outbreak): **not asked yet**
- ❖ Recently **received MMR vaccine** because she was not immune

Case 1: HPI (per triage)

A **35 y/o F** with no PMH p/w **concern f**

- Monda
- Tue

Measles PEP guidance (NYC.gov)	
Measles immune status	**Type of PEP**
Non-immune	• Give MMR vaccine
1 dose MMR	• Give 2nd MMR vaccine
Unknown status	• Give MMR vaccine

- ❖ Exposure history (travel, sick contacts, local outbreak): **not asked yet**
- ❖ Recently **received MMR vaccine** because she was not immune

Case 1: HPI - Timeline

A **35 y/o F** with no PMH p/w **concern for measles** due to a rash developing 13 days after MMR

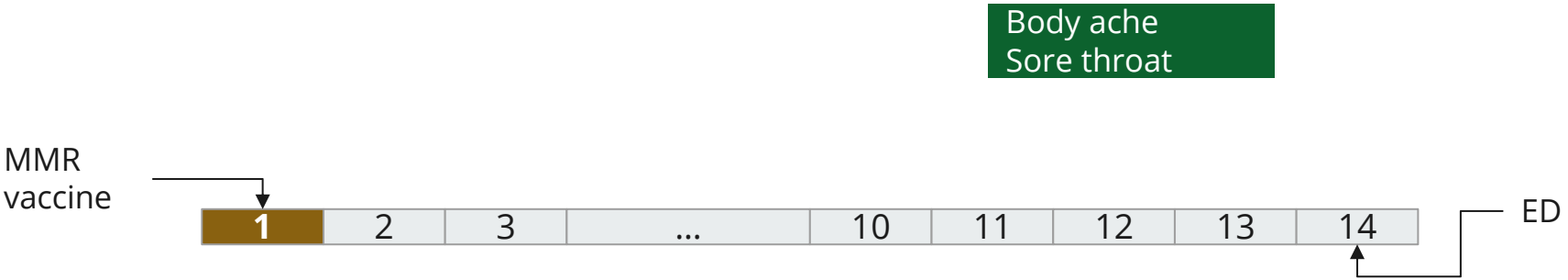
- 14 days ago: Received **MMR vaccine**



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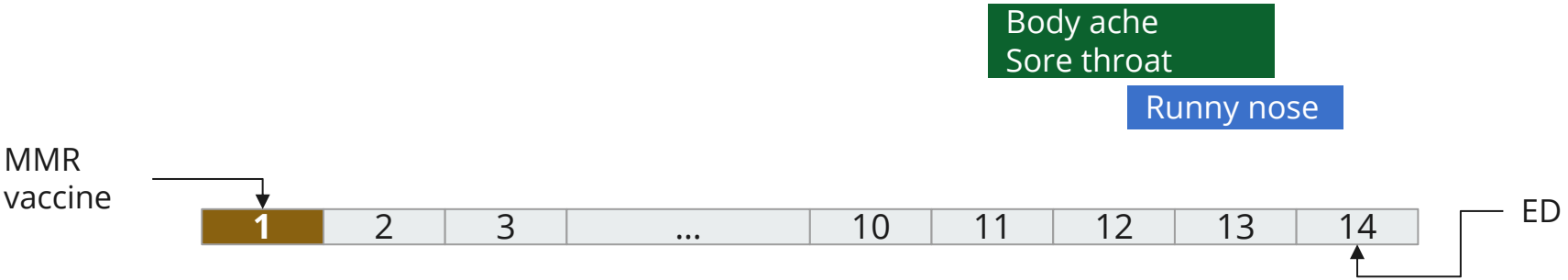
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- Sun/Mon: Developed **body aches**, **headache**, mild **sore throat** (all better now)



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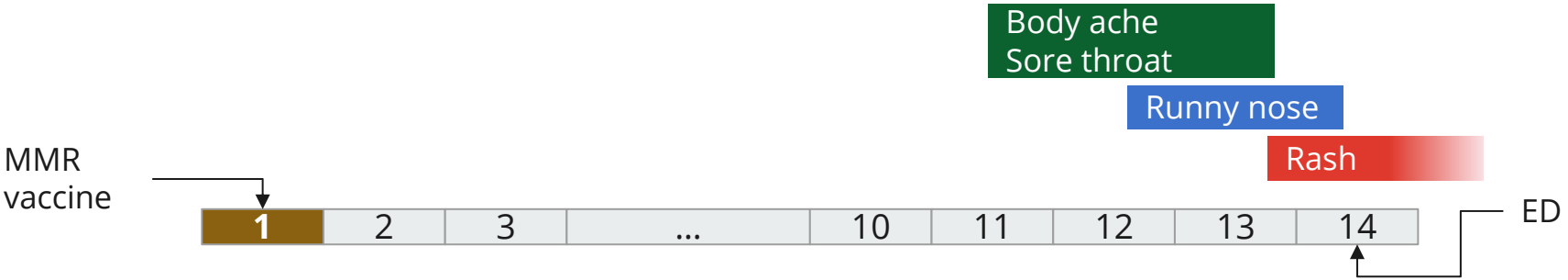
- 14 days ago: Received **MMR vaccine**
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  - Mid Mon: **Runny nose** and **congestion** (almost gone now)



Case 1: HPI - Timeline

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- Tues: Bumps on **face** → **red spots on chest**



Case 1: HPI - Timeline

A **35 y/o F** with no PMH p/w **concern for measles** due to a rash developing 13 days after MMR. Rash prodrome was body aches + sore throat, then runny nose, onset just a few days before rash.

- **No fever** (but did have body aches)
- No *noticeable* cough
- Eyes have not been red or watery

Component	2 yr ago
Ref Range & Units (hover)	
RUBELLA IGG QUALITATIVE	Negative !



What is the MMR vaccine? [23, 24]



- Three live attenuated (weakened) viruses
- Protection against measles:
  - 1 dose: 93%
  - 2 doses: 97%
- Two doses:
  - Jamaica at 12 and 18 months [25]
  - US at 12–15 months and 4–6 years
- Live vaccine: not given in pregnancy or severe immunocompromise

M = Measles

M = Mumps

R = Rubella

Component	2 yr ago
Ref Range & Units (hover)	
RUBELLA IGG QUALITATIVE	Negative !

Also can be given as post-exposure prophylaxis (after measles exposure)

Case 1: HPI - The rash

A **35 y/o F** with no PMH p/w **concern for measles** due to a rash developing 13 days after MMR. Rash prodrome was body aches + sore throat, then runny nose, onset just a few days before rash.

- Last night while brushing her teeth, noticed what appeared to be acne appear on face
- During shower, saw similar lesions on her right shoulder
  - Unclear if these appeared before, after, or at the same time as the rash on her face
- This morning, rash on the **face was more numerous**
  - Also now has some rash on her **forearms**



Case 1: Physical exam

BP	138/87	**Pulse**	90	**SpO2**	98 %
Temp	36.7 °C (98.1 °F)	**RR**	18	**BMI**	26 kg/m²
General	Alert and oriented, NAD, vitals reviewed				
ENT	Buccal mucosa: Normal, no lesions (the flashlight in the room doesn't work)				
Eyes	Anicteric sclerae; No injection				
Skin	Next slide				

Case 1: Physical exam

- Small (<5mm) nonblanching lesions
- Maculopapular (papules/raised > macules)
  - Some do look more acneiform
- Only mild erythema/hyperpigmentation

Distribution:

- Most pronounced on the face but also
  - anterior chest/shoulder > forearms >> back
- Not diffuse, plenty of adjacent skin is uninvolved
  - minimal to no rash on upper arms and neck
  - None on the legs
  - Spares the palms

Unable to take actual pictures due to isolation



Case 1: Labs

CBC	Result
WBC	5.2
Hgb	12.1
Platelets	224
Neut %	49%
Eos %	6%

Chem7	Result
Na	141
K	3.8
HCO3	23
BUN	15
Cr	0.71

Case 1: Summary

A 35 y/o F with no PMH p/w concern for **measles due to a rash** developing 13 days after MMR. Rash prodrome was body aches + sore throat, then runny nose, onset just a few days before rash.

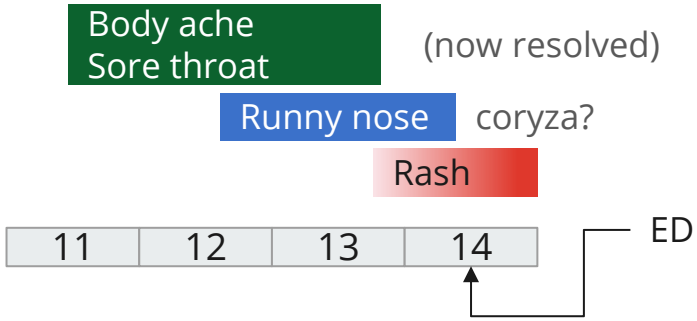
- The rash is certainly worsening
- Seems like it's likely spreading cephalocaudal (head-to-chest)

Component	2 yr ago
Ref Range & Units (hover)	
RUBELLA IGG QUALITATIVE	Negative !

- Small (<5mm) nonblanching lesions
- Maculopapular (papules/raised > macules)
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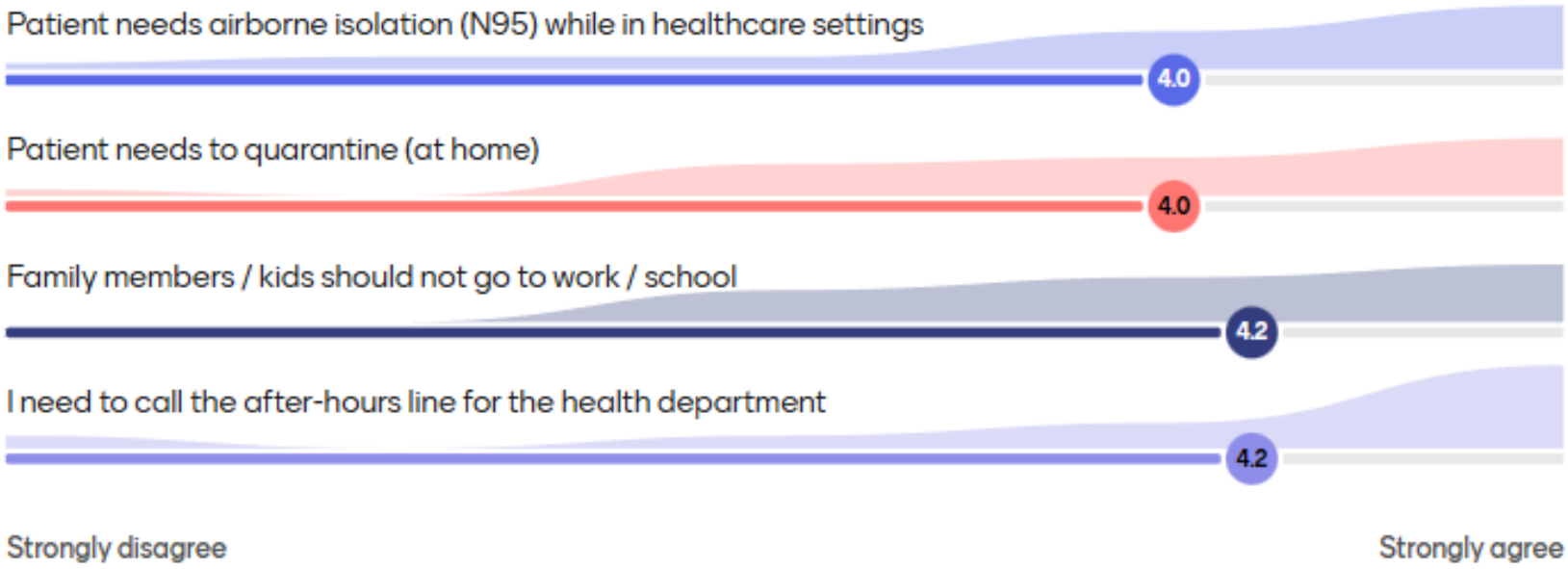


[2] Is this measles?



Mentimeter

[2] Is this measles?



Before they reach the waiting room [16]

- If they call ahead: tell them **which entrance to use** and to wear a mask
- **Mask the patient at triage** and separate them from other patients
- **Airborne isolation** room if available; otherwise a private room, door closed, patient masked
- Only staff with evidence of immunity go in, **wearing an N95**
- Leave the room empty for up to 2 hours after the patient leaves

Notify public health on suspicion, not on confirmation [15]

[3] How should we manage this?

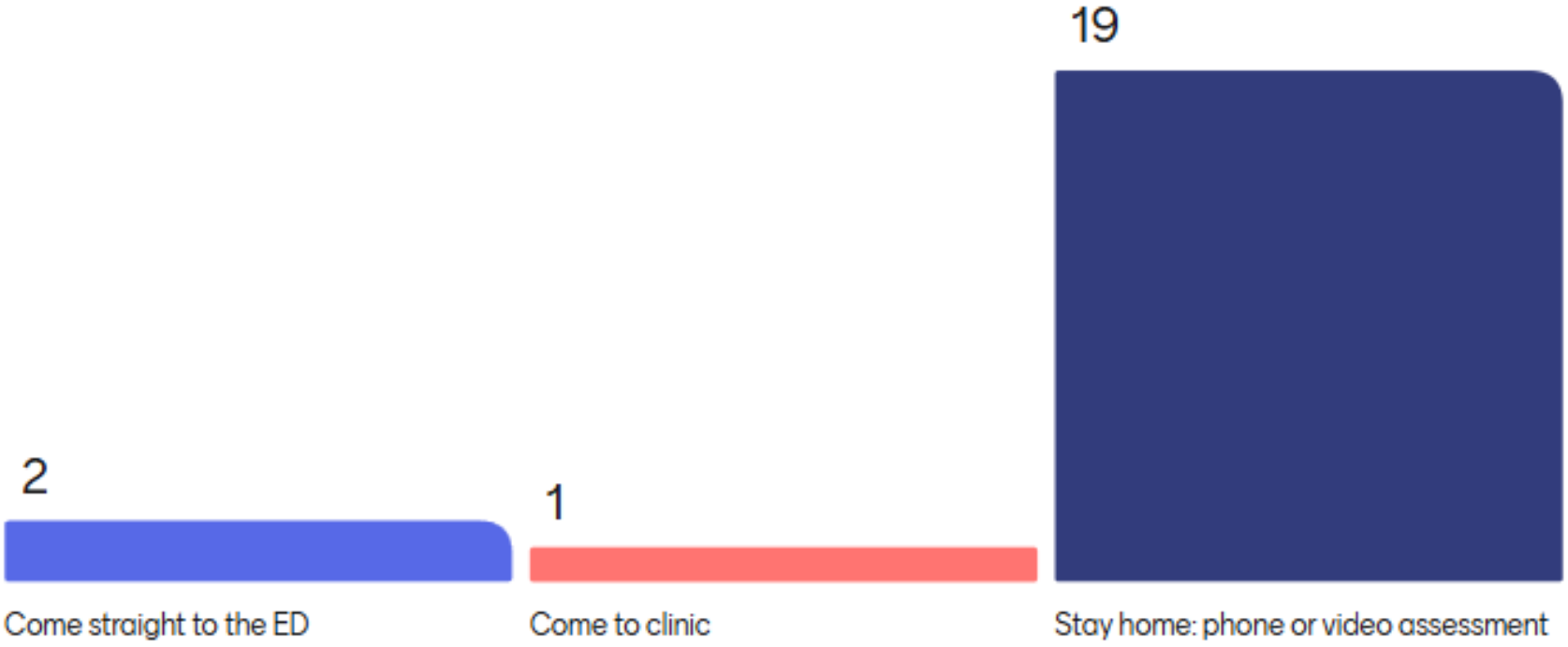
Mentimeter

She calls ahead. What do you tell her?

Options:

- Come straight to the ED
- Come to clinic
- Stay home: phone or video assessment
- Stay home: call public health

[3] How should we manage this?



Disaster case

An unvaccinated patient had a possible measles exposure

They were given the MMR vaccine for **post exposure prophylaxis**

...now they develop a rash

Is the rash from:

1. The vaccine --or--
2. Wild type measles (that was not prevented by PEP)

Does MMR “cause” ‘measles’?

My journey through **the weirdest literature search** I’ve done in awhile…

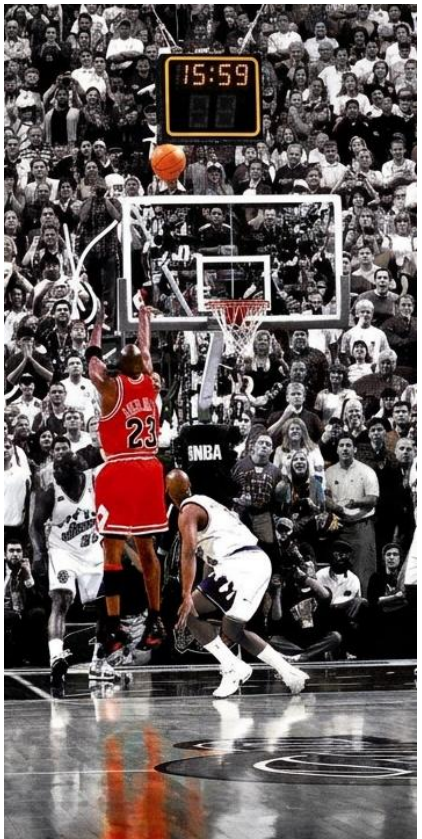


Links to articles discussed here

Follow me along my journey

Doesn't the MMR vaccine cause a rash..?

Do I really need to deal with this at 4pm?



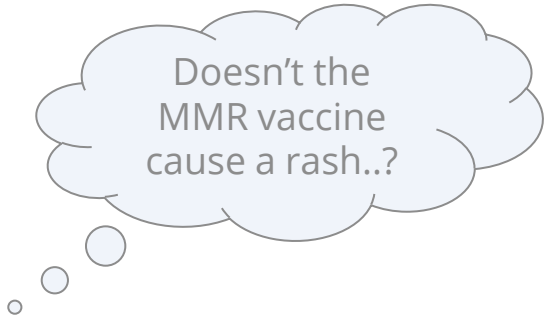
Measles that broke through MMR PEP?

Why are they in the ED? **They might be spreading measles**!

Reactions to MMR vaccine

MMR vaccine is well tolerated, but it does have **some predictable side effects** *

* I'm using the term "**side effects**" for self limiting reactions, which is distinct from any long lasting sequela, i.e. neurologic changes (see this Cochrane review)



Reactions to MMR vaccine

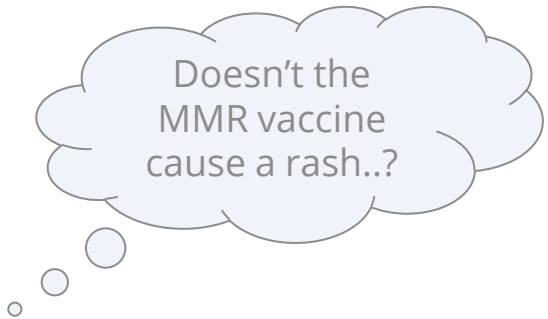
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MMR vaccine is well tolerated, but it does have **some predictable side effects** *

Most common systemic† side effects [2]

- **Fevers** (5 - 15%)
- **Rash** (around 5%)

† excludes injection site reactions



Reactions to MMR vaccine

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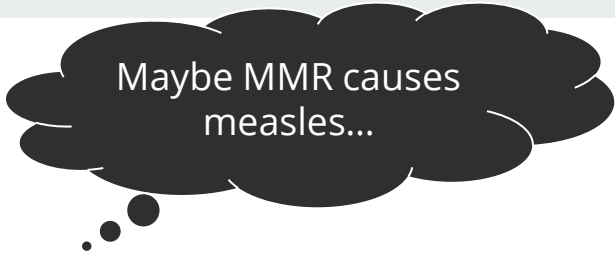
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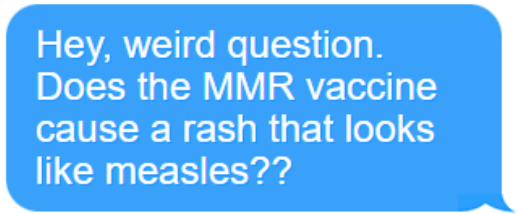
When do these reactions happen?

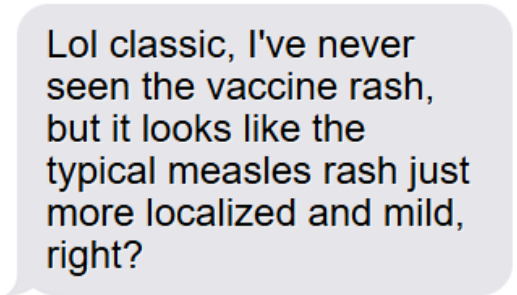
- **5 to 12 days** [2,4,6]

...am I starting to flirt with anti-vax?



Then I talked to my friend who is a **general pediatrician**...





…am I starting to flirt with anti-vax?

Then I talked to my friend who is a **general pediatrician**…

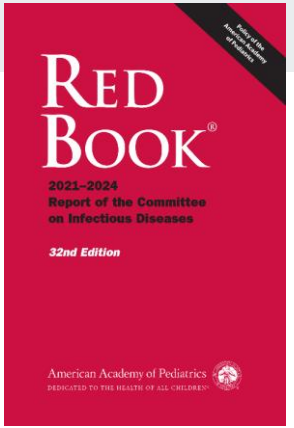
- Rash after the MMR vaccine is one of those "*clinical experience*" things that you learn
  - **Kids like to get rashes** (pediatrics doesn't get as excited for rashes as we do)
  - She thinks the rash looks like "**mild measles**" but she's not peds-ID

But I was able to find the **"pubmed" terms** describing the rash following the MMR vaccine:

- **MMR vaccine exanthem**
- **Vaccine-associated rash illness** (**VARI**)

Refined search strategy
No more searching "**does the MMR vaccine cause measles?**"

What does the Red Book say? [6]



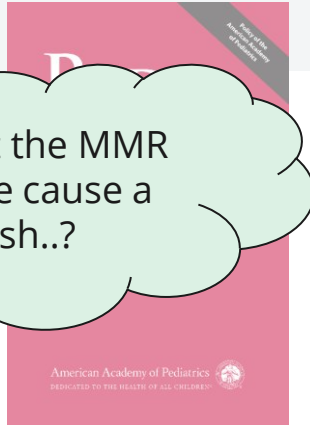
Adverse Events. … Transient rashes have been reported in approximately **5% of vaccine recipients**.

Receives MMR ⇢ Develops fever &/or rash



The more common situation

Doesn't the MMR vaccine cause a rash..?



MEASLES

Adverse Events. ... Transient rashes have been reported in approximately **5% of vaccine recipients**.



Routine / elective MMR

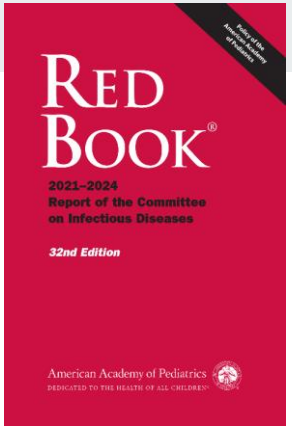
Receives MMR

VARI

Develops fever &/or rash



What does the Red Book say? [6]



MEASLES 581

Adverse Events. ... Transient rashes have been reported in approximately **5% of vaccine recipients**. Although recipients who develop fever and/or rash are not considered contagious and are not at risk for long-term sequelae of measles, **suspicion for wild-type measles may be high**, especially if vaccine was administered as part of an outbreak response.

Receives MMR ⇢ Develops fever &/or rash



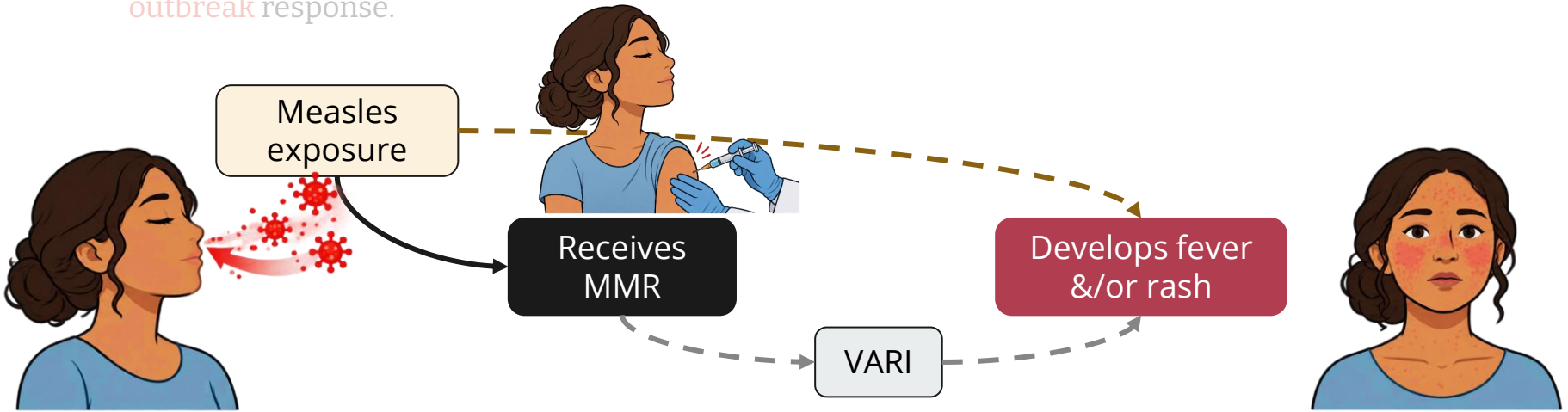
The scary situation

Measles *despite* MMR PEP?



MEASLES

Adverse Events. ... Transient rashes have been reported in approximately **5% of vaccine recipients**. Although recipients who develop fever and/or rash are not considered contagious and are not at risk for long-term sequelae of measles, **suspicion for wild-type measles may be high**, especially if vaccine was administered as part of an outbreak response.



Distinguishing VARI from “real measles”

	Wild-type measles	Vaccine
Fever	✓	✓
Rash	✓	✓
Symptoms	???	???
Timing	???	???

[4] How to distinguish VARI from wild type measles?

Mentimeter

- Distribution of the rash
- Timing of the rash
- The three C's
- Koplik spots
- Sequencing

[4] How to distinguish VARI from wild type measles?



1 Distribution of the rash



5 Timing of the rash



2 The three C's

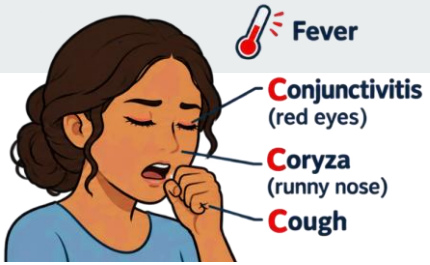


7 Koplik spots

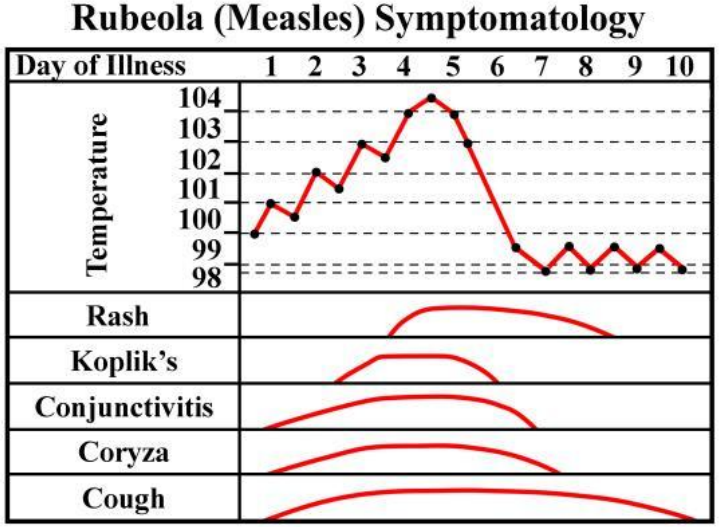


10 Sequencing

Symptoms & timing of measles



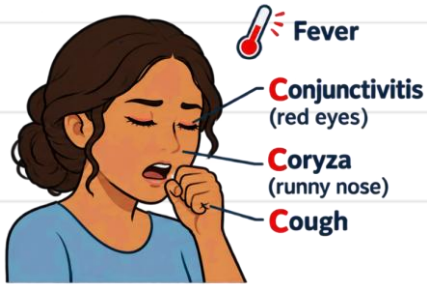
Plenty of variation is the duration of symptoms, but data/experience is consistent that **rash in not the first symptom**



From: Saul Krugman and Robert Ward, *"Infectious Diseases of Children, 4th ed."*

https://wwwn.cdc.gov/phil/Details.aspx?pid=16475

Hagelloch measles outbreak (1861–1862)





Prodrome

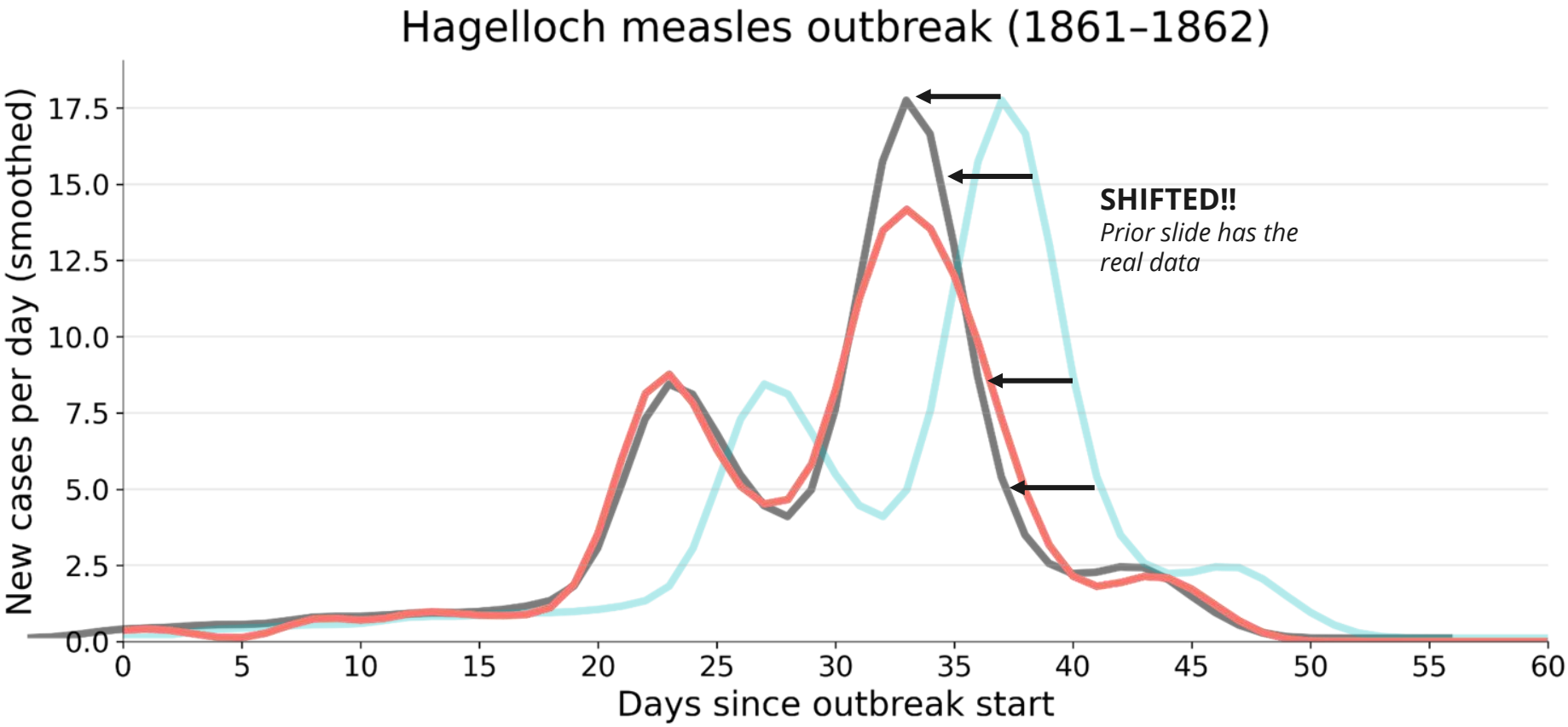
Rash

New cases per day (smoothed)

0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

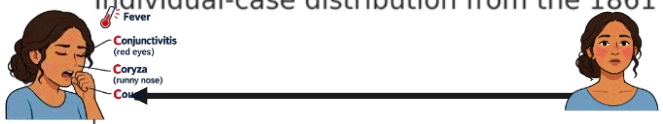
0
5
10
15
20
25
30
35
40
45
50
55
60

Days since outbreak start


Hagelloch measles outbreak (1861–1862)
New cases per day (smoothed)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0
5
10
15
20
25
30
35
40
45
50
55
60
Days since outbreak start
SHIFTED!!
Prior slide has the real data

Time from prodromal symptoms to measles rash

Individual-case distribution from the 1861 Hagelloch outbreak (n = 188 children)



Median: 4 days | IQR: 3–5 days
Mean: 3.95 days | SD: 1.74 days

Measles cases (%)

Days between prodrome onset and rash onset

Data: Pfeilsticker (1863)/Oesterle (1992); distributed in R surveillance and UofU EpiBio.
Replotted from case-level dates; historical pediatric cohort, not a modern population estimate.

Reactions to MMR - Timing of reactions [5]



MMR vaccine is well tolerated, but it does have **some predictable side effects** *

Most common systemic† side effects [2]

- **Fevers** (5 - 15%)
- **Rash** (around 5%)

Normally develops 5 to 12 days after the vaccine [2,4,6]

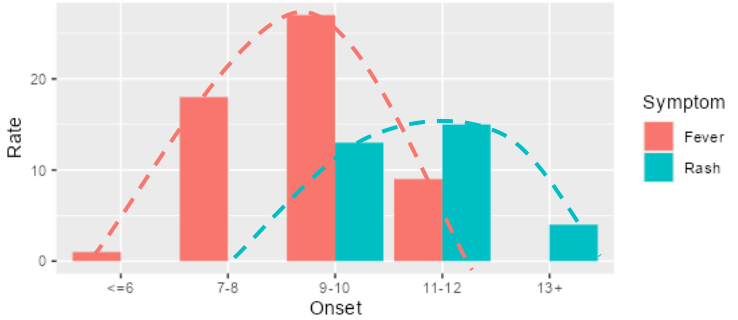
When *exactly* do reactions occur?

From an old study in 1986 [5]

- **Robust design**
  - Double blinded, **placebo controlled**
  - Matched **581 pairs of twins**
- Might be **unethical** to do now
  - Ironically, based out of **Helsinki**, Finland
  - Done during their rollout of MMR (1982-83)

Reactions to MMR - Timing of reactions [5]





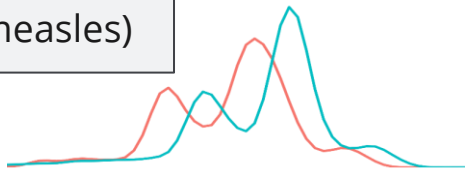
	Days after injection									
	1–6		7–8		9–10		11–12		13–21	
—	No	Rate	No	Rate	No	Rate	No	Rate	No	Rate
Moderate fever (38·6–39·5°C rectal):										
MMR	9	8	34	29	42	36	21	18	7	6
Placebo	9	7	13	11	10	9	10	9	9	8
Difference	0	1	21	18	32	27	11	9	−2	−2
Generalised rash:										
MMR	22	19	28	24	49	43	56	48	27	24
Placebo	23	20	29	25	35	30	39	33	24	20
Difference	−1	−1	−1	−1	14	13	26	15	3	4

When *exactly* do reactions occur?

Placebo vs **MMR** matched study [5]

- **Moderate fever** peaked at **day 9**
  - 38.6 - 39.5 C (101.5 - 103.1 F)
- **Generalized rash** peaked at **day 11**

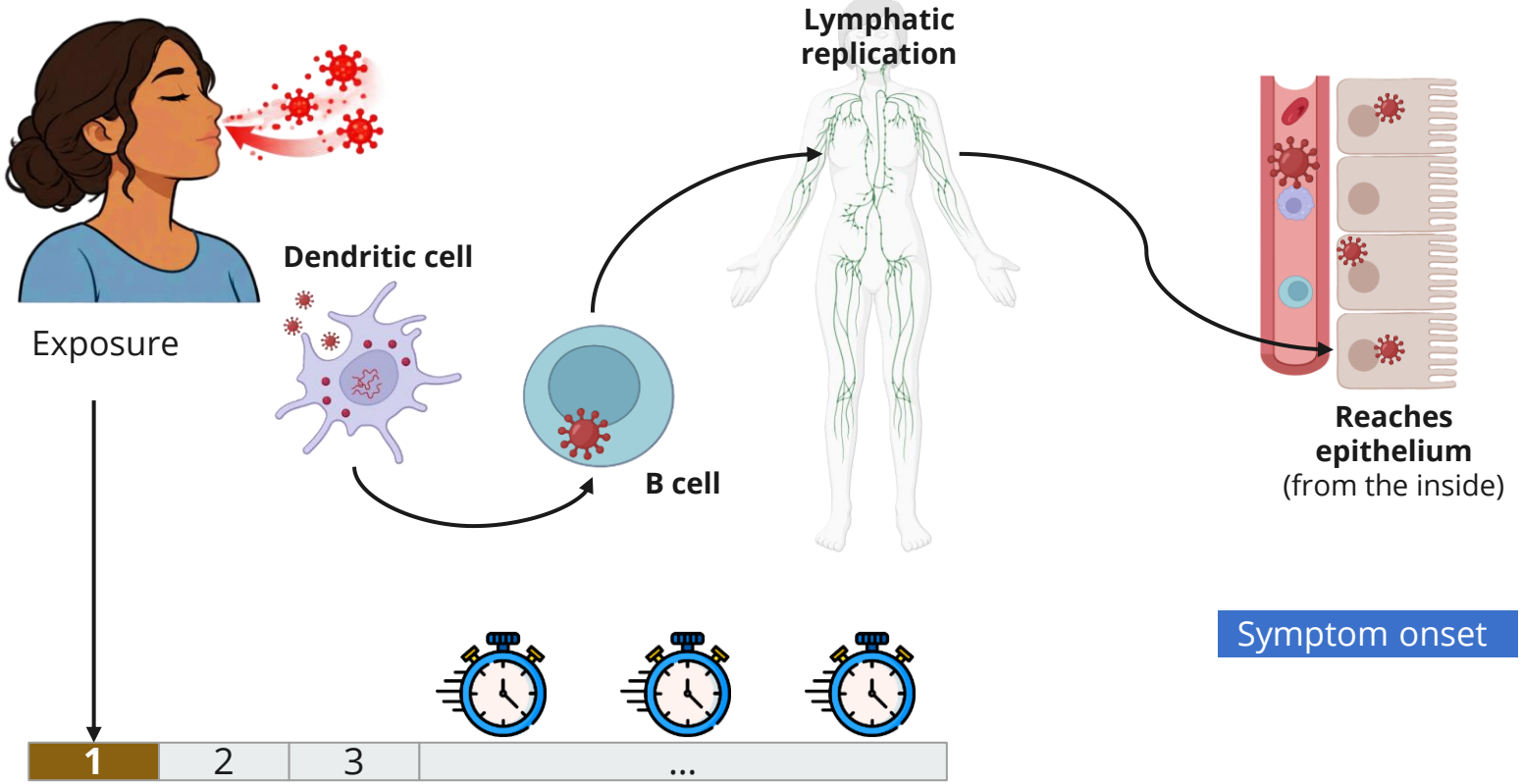
The distribution of symptom onset *implies* that **fever comes before rash** (similar to wild type measles)



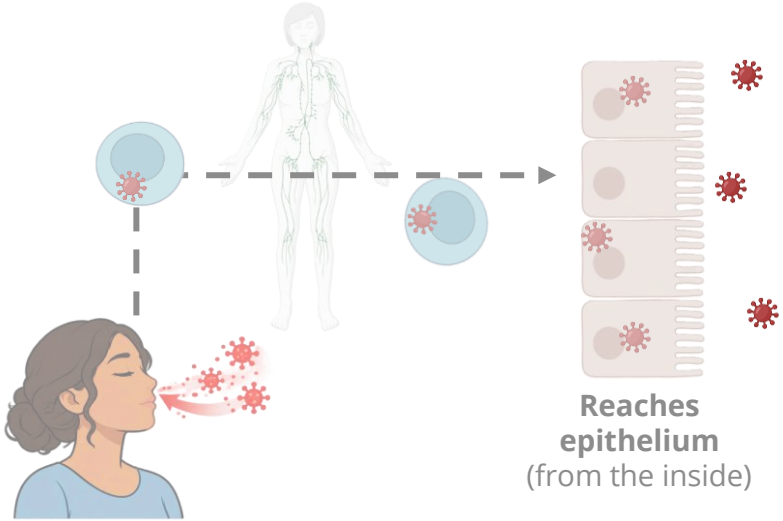
Multiple mechanisms

	Wild-type measles	Vaccine
Fever	✓	✓
Rash	✓	✓
Fever, then rash	✓	✓
Symptoms	???	???
Similar timing	???	???

How measles moves through the body [16, 18–20]



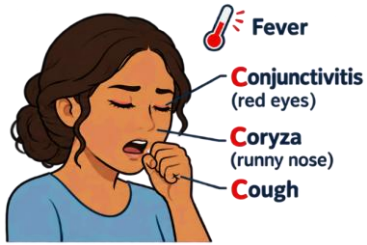
How measles moves through the body [16, 18–20]



Prodrome

- Fever
- Upper (nose) & lower (lungs) respiratory mucosa
- Eyes

Direct manifestation of the virus



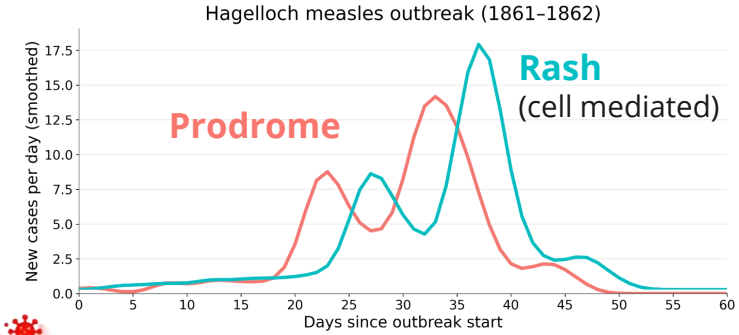


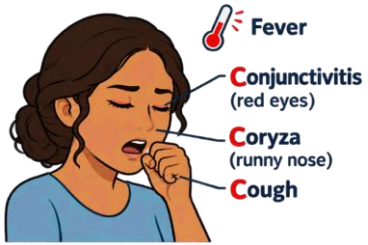
Rash [18]

Adaptive immune response (**T cells**) to the *dermal* endothelium

1	2	3		11	12	13	14	15	16	17

Similar timelines, distinct mechanisms [16, 18–20]









Prodrome | Rash [18]

Exposure

Rash onset

(contagious rash -4 to +4 days)

Contagious, but no symptoms yet

Rash → viral "clearance"



1	2	3		11	12	13	14	15	16	17

Do tropical viral rashes work the same way?

Dengue [26]

May work like measles

Rash biopsies after dengue vaccine or challenge infection show perivascular lymphocytes and almost no virus

Similar mechanism to measles, but not exactly the same

Zika [29] & chikungunya [28]

Less likely

- Zika: within 3 days of onset, when viral load is highest
- Chikungunya: at about day 3–4, while viral load is still at its peak

Timing is the clue: measles rash arrives as the virus is being cleared; Zika and chikungunya rashes arrive while viral load is still high

Distinguishing them clinically

	Wild-type measles	Vaccine
Fever	✓	✓
Rash	✓	✓
Fever, then rash	✓	✓
Symptoms	???	???
Similar timing	???	???

Clinical Infectious Diseases
BRIEF REPORT

Martin et al [7]

During 2017, Minnesota experienced a **major measles outbreak**

- This population had low MMR **vaccination rates** (the **2014 birth cohort** had **42% MMR uptake**)
- As part of the public health response, they **administered over 51,000 MMR doses** (beyond expected)

Unintended consequences

They experienced a **surge in VARI**
(while measles was also surging)

Clinical Infectious Diseases
BRIEF REPORT

Martin et al [7]

When they compared **wild-type measles cases** to **VARI** cases:

- Both cases had **high rates of fevers**
  - And by definition, **everyone had rashes**
- Measles cases presented more **"C"lassically**

	Measles n=71	**VARI** n=34
Fever	100%	94%
Cough	**94%**	41%
Coryza	**83%**	47%
Conjunctivitis	**66%**	24%

Clinical Infectious Diseases
BRIEF REPORT

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But wait... How do I tell the difference?

	Measles n=71	**VARI** n=34
Fever	100%	94%
Cough	94%	41%
Coryza	83%	47%
Conjunctivitis	66%	24%
Any of the 3 C's	96%	**74%**
All three C's	58%	**6%**

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Measles cases presented with **more severe disease**

- Higher rates of hospitalization

	Measles n=71	**VARI** n=34
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Contact with a known case	99%	0%

Clinical Infectious Diseases
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Measles cases presented with **more severe disease**

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All **VARI cases still needed isolation** for 4 days from rash onset (or until wild-type infection was ruled out)

- But this was in the context of an outbreak (unlike our patient)

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Who else has experienced this problem before?

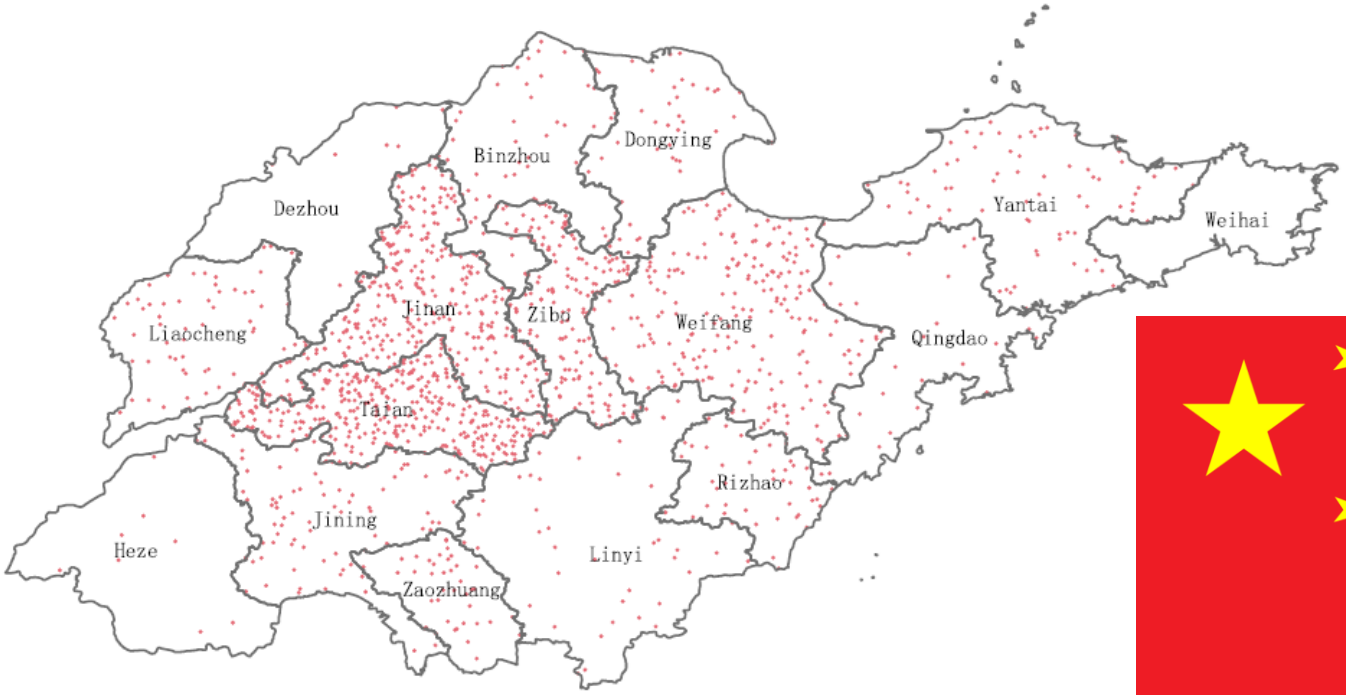




Figure 2: Wang et al [11]

Cui et al [10]

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Large study from China from 2011 to 2018

- **Surveillance Data**: The study utilized data from the **Measles Surveillance System** (MSS) and the Chinese Measles Laboratory Network (CMLN)
- **Case Identification**: identified 15,169 cases **confirmed by genotyping**
  - **14,902 wild-type** measles cases
  - Only **101 VARI** cases



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11 to 2018

ptom	VARI Cases (n=76)	Wild-Type (n=9,533)	P-Value
	99%	99%	0.516
	100%	99%	1.000
"3Cs" (any)	49%	92%	<0.001
Cough	39%	91%	<0.001
Coryza	26%	67%	<0.001
Conjunctivitis	18%	64%	<0.001
Koplik Spots	**25%**	47%	<0.001

/stem (MSS)

Case 1: Hospital course

Patient was able to access her vaccination records

- Vaccinated for measles (one vaccine) in childhood, but it wasn't the MMR
- **No known exposures** or risk factors for wild type exposure

Component	2 yr ago
Ref Range & Units (hover)	
RUBELLA IGG QUALITATIVE	Negative !



	Measles n=71	VARI n=34
Fever	100%	94%
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Conjunctivitis	66%	24%
Any of the 3 C's	96%	74%
All three C's	58%	6%
Contact with a known case	99%	0%

VARI: Looks like measles, but doesn't spread

Mimics measles

Triggers a real immune response (the point of the vaccine)

Fever (5–15%) and rash (~5%) [2]

Positive standard measles RT-PCR [8]

But doesn't spread

Attenuated vaccine strain (genotype A) [10]

No documented person-to-person spread [10]

Not considered contagious [6]

A positive PCR after recent MMR needs vaccine-specific PCR or genotyping [8]

At the first visit: collect, notify, then wait [17]

- Collect a throat or NP swab for RT-PCR (preferred over urine) plus serum IgM as soon as measles is suspected [17]
- Swab early: in one Chinese study, only 30% of VARI swabs could be genotyped, likely because of late collection [11]
- Standard RT-PCR can't tell vaccine from wild type; genotyping or vaccine-specific PCR can, through your public health lab [8]

Notify public health now; don't wait for results [15]

Take-home points

- A rash 5–12 days after MMR is common (about 1 in 20) and is not contagious [2, 6]
- What to tell patients: it's an expected vaccine reaction, not measles disease
- After PEP or in an outbreak, treat it as measles until proven otherwise: isolate and notify
- The 3 Cs, Koplik spots, and a known exposure favor wild type, but none rules it out [7, 10]

Slides at hunterratliff1.com/talk/; citations via the “citations” button on the website

Questions?



Links to articles discussed here