

# Population Health Modeling: Day 4

# Check-In



# Brief Review

Basic philosophical and ethical principles for public health research and public health modeling

Outbreak Investigations- lots of moving parts in any data collection/analysis process

# Brief Overview

Info dump: *Streptococcus pneumoniae*

Info dump: pneumococcal vaccines

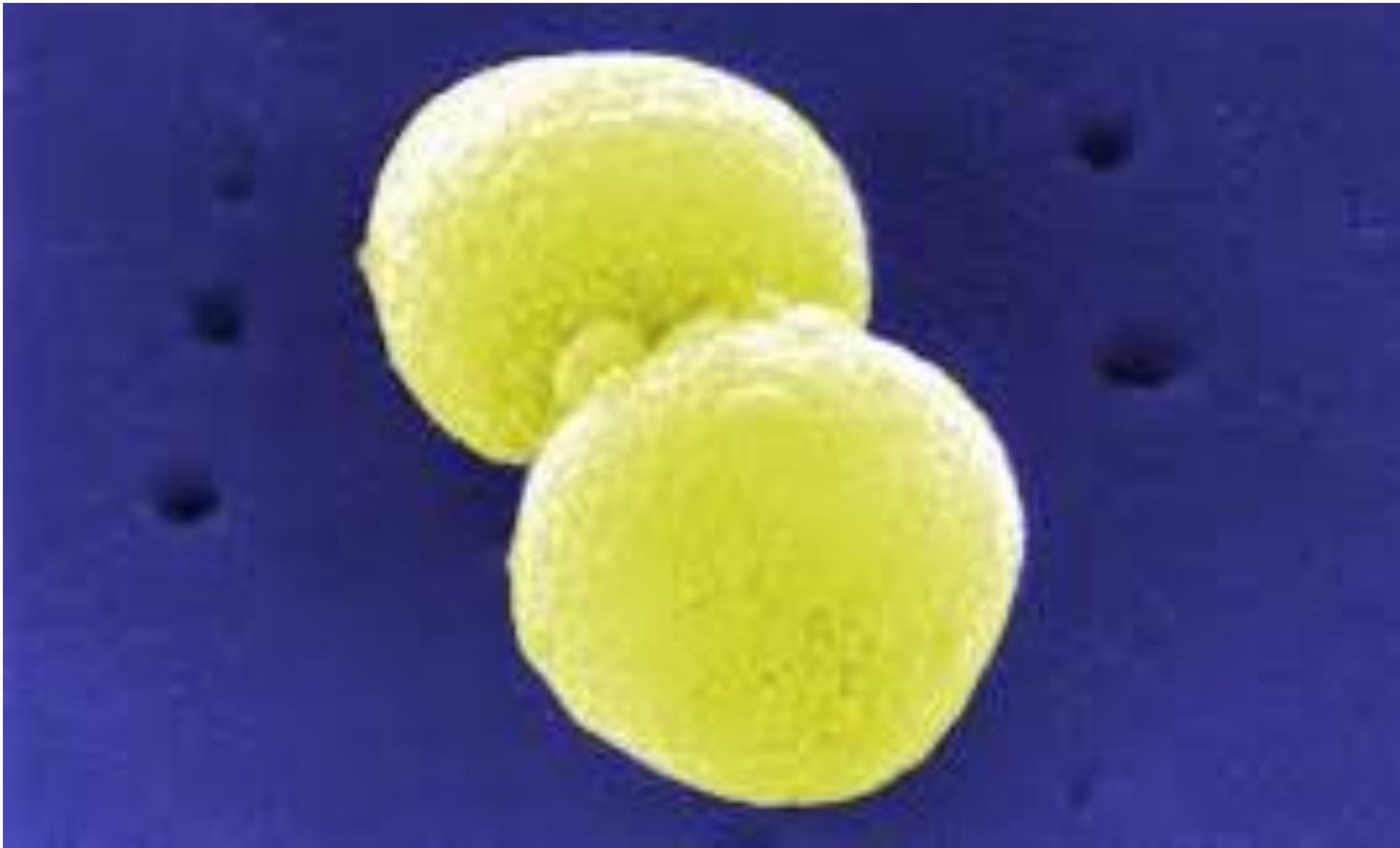
Info smattering: infectious disease surveillance

Small LARP?

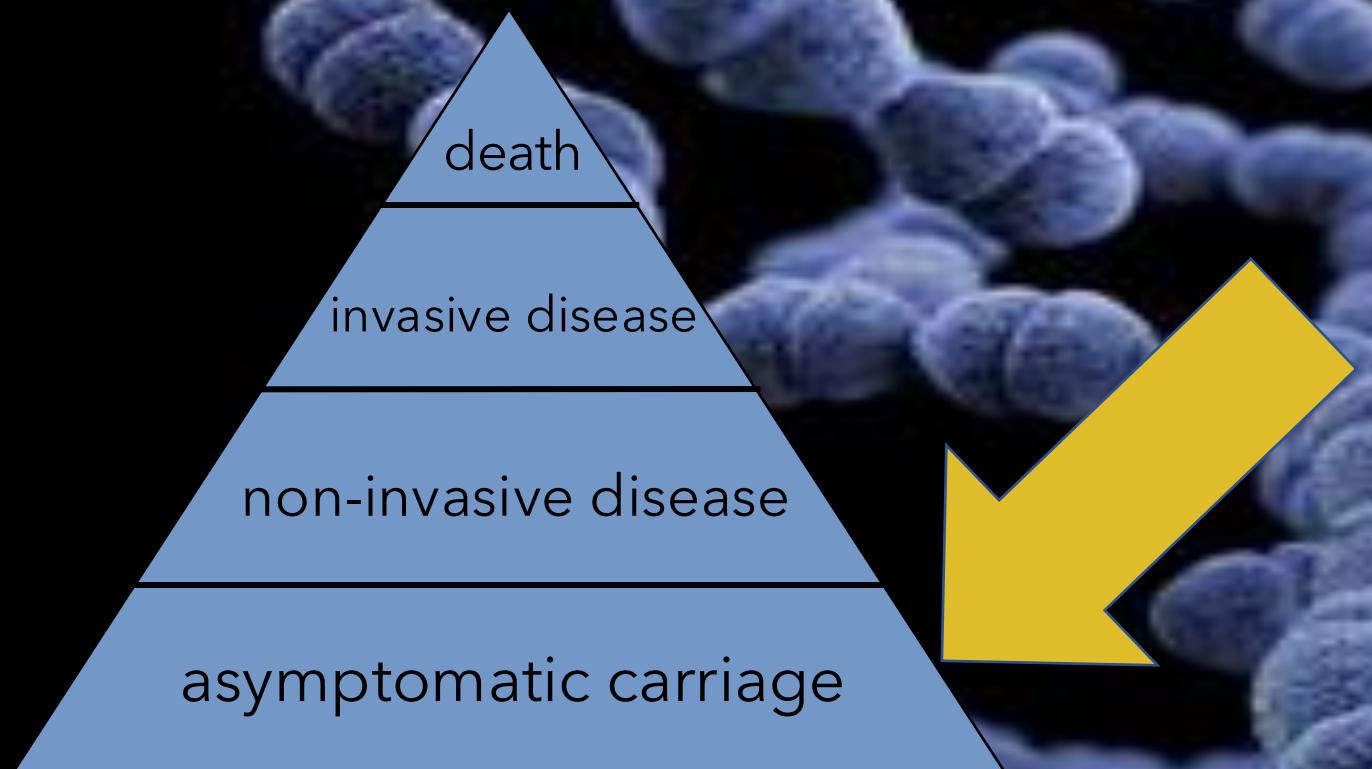
Time series analysis: background and walkthrough

Time series analysis: designing a research question and modifying code

Time series analysis: data viz, prepare presentation and poster materials

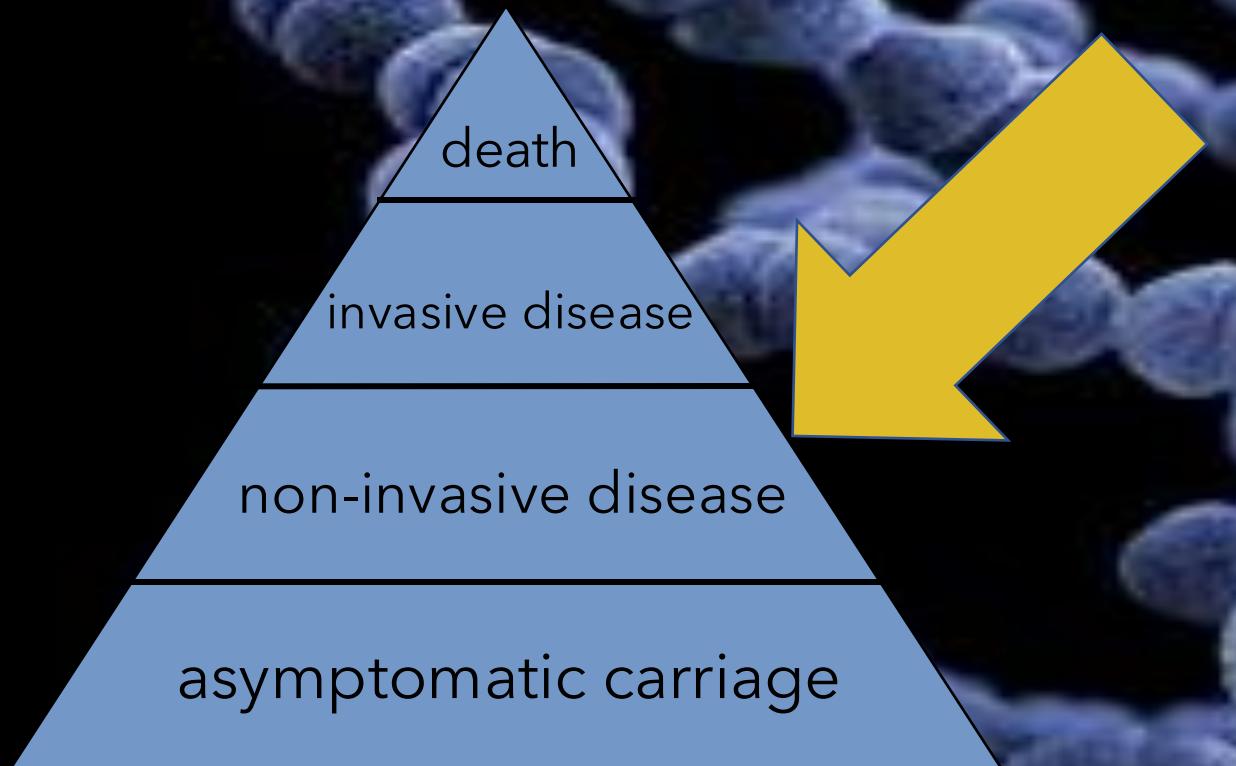


Are you a good witch or a bad witch?



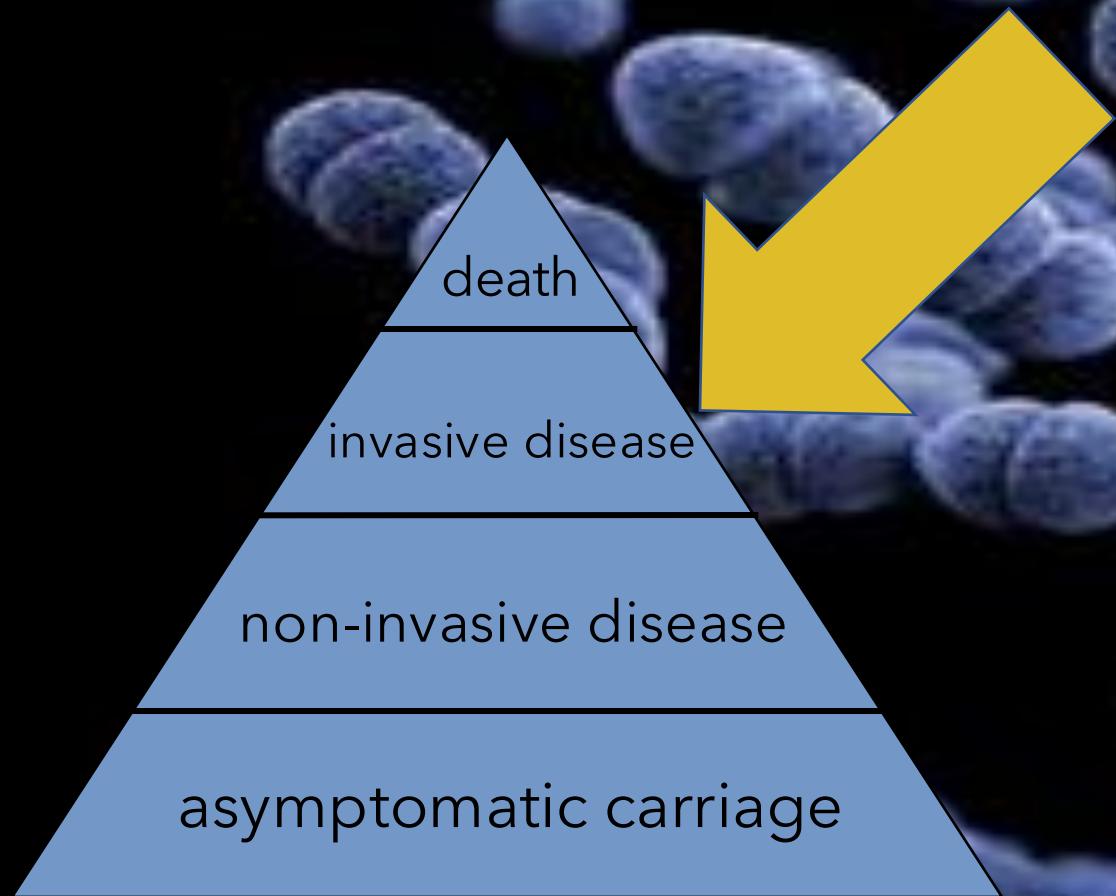
*Streptococcus pneumoniae*

Source: CDC



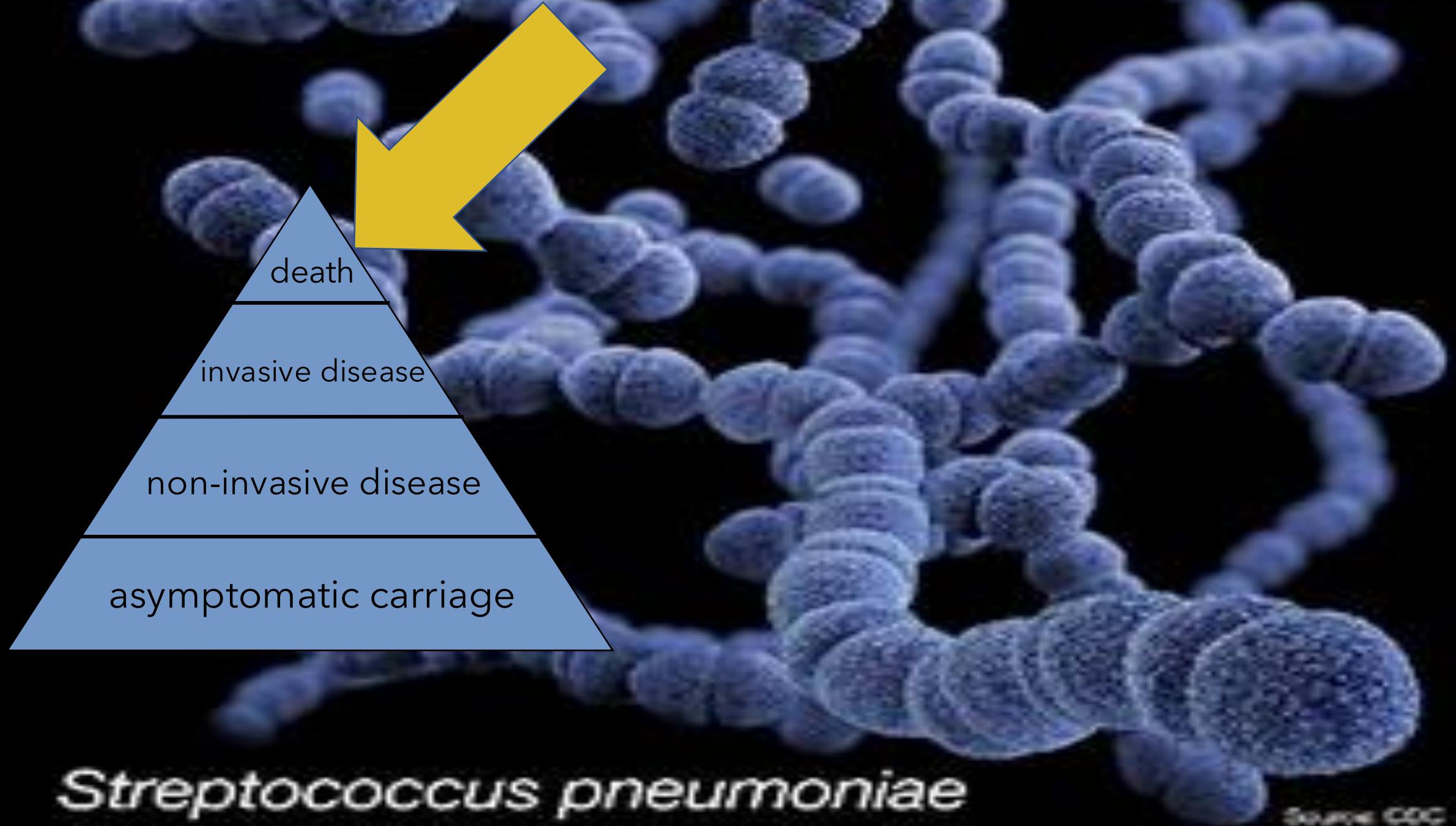
*Streptococcus pneumoniae*

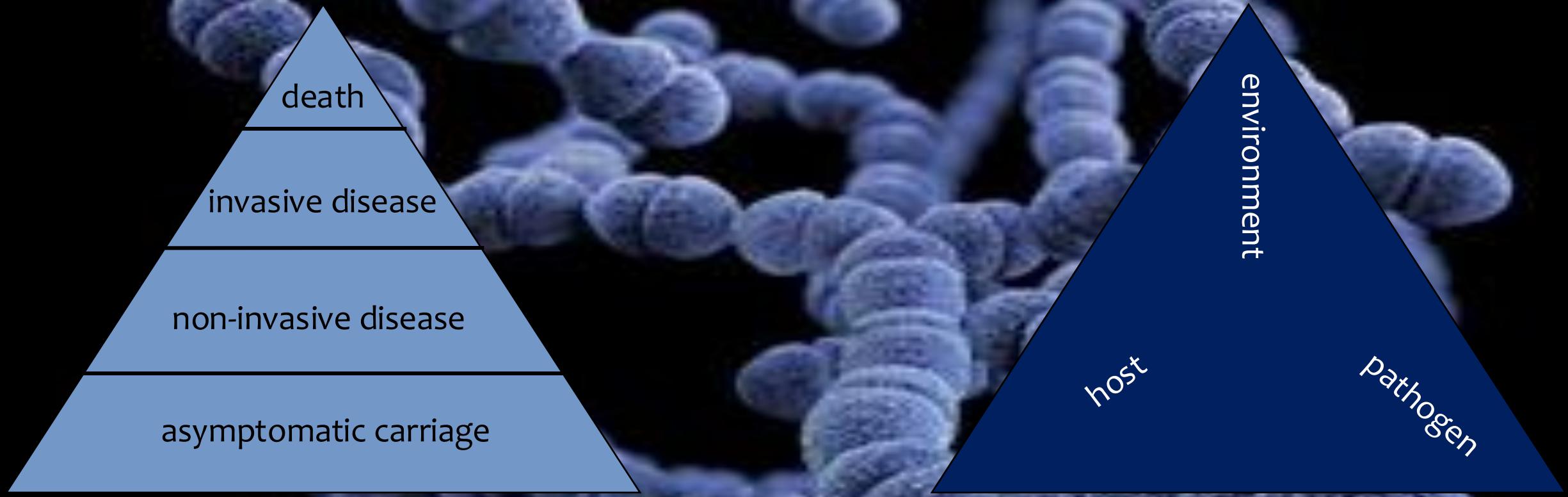
Source: CDC



*Streptococcus pneumoniae*

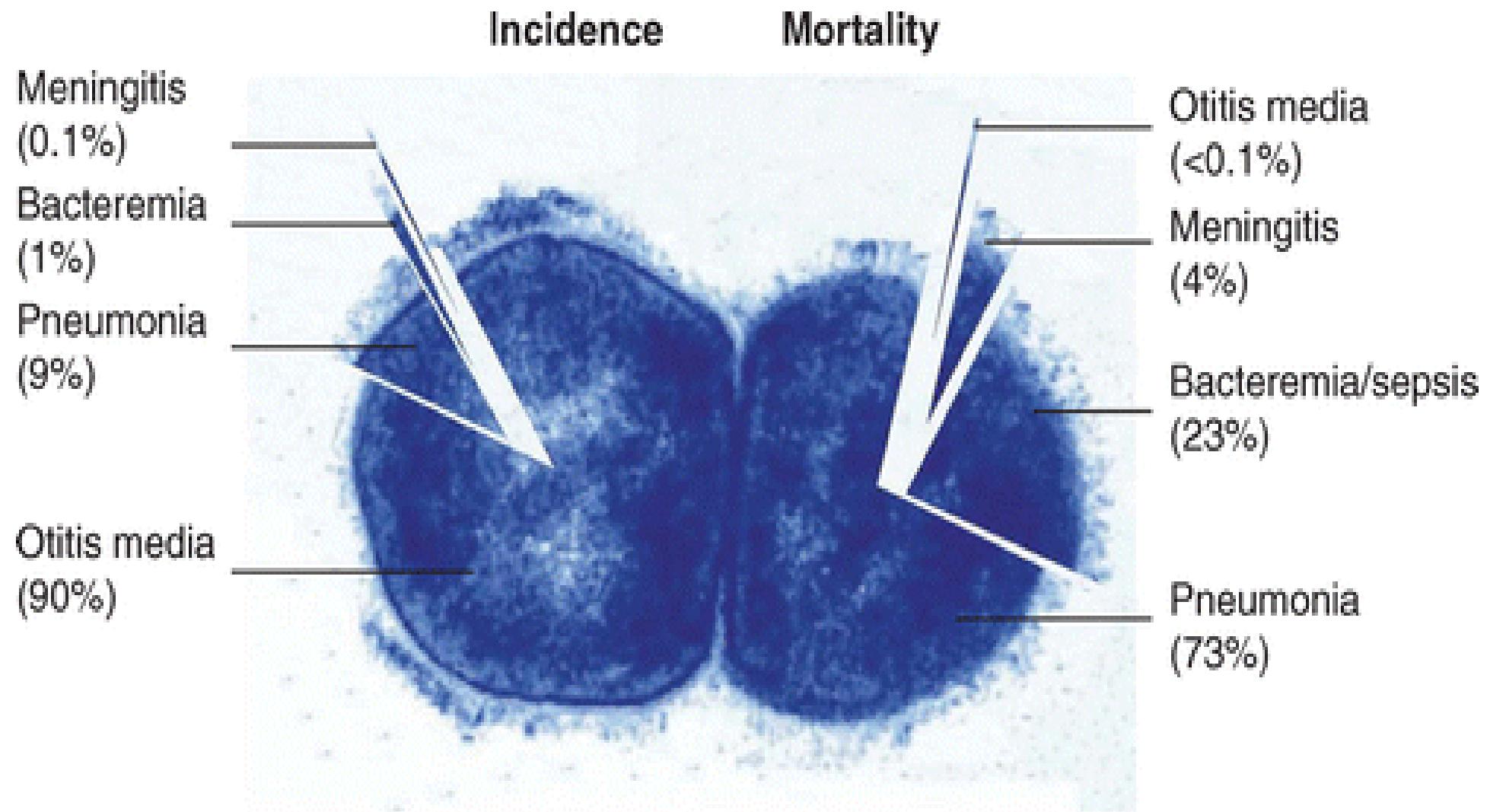
Source: CDC





*Streptococcus pneumoniae*

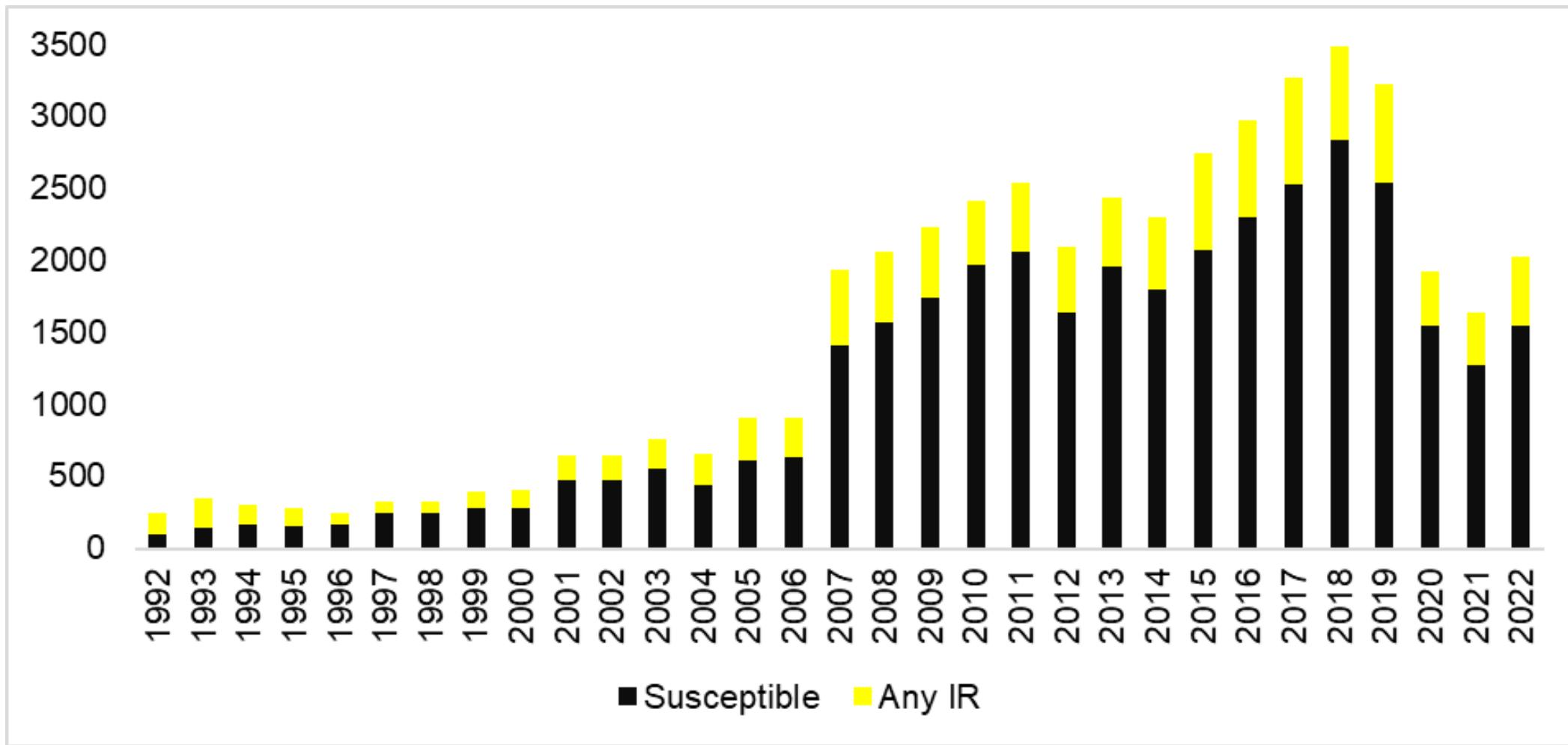
Source: CDC



# Antibiotic Therapy



# Number of isolates classified as intermediate or resistant to AT LEAST ONE antibiotic class



# *Streptococcus pneumoniae* Basic Fact Sheet

- Gram positive, spherical, paired bacteria that commonly colonizes the nasopharyngeal tract.
- Pneumococcal disease occurs when bacteria in the nasopharyngeal tract move on to other spaces in the body.
- Pneumococcal disease is a major cause of morbidity and mortality worldwide, with 14.5 million cases and 826,000 deaths.
- Burden of disease is highest in the very young and the very old, especially in settings with limited resources.

# Pneumococcal Serotypes, Pneumococcal Vaccines,







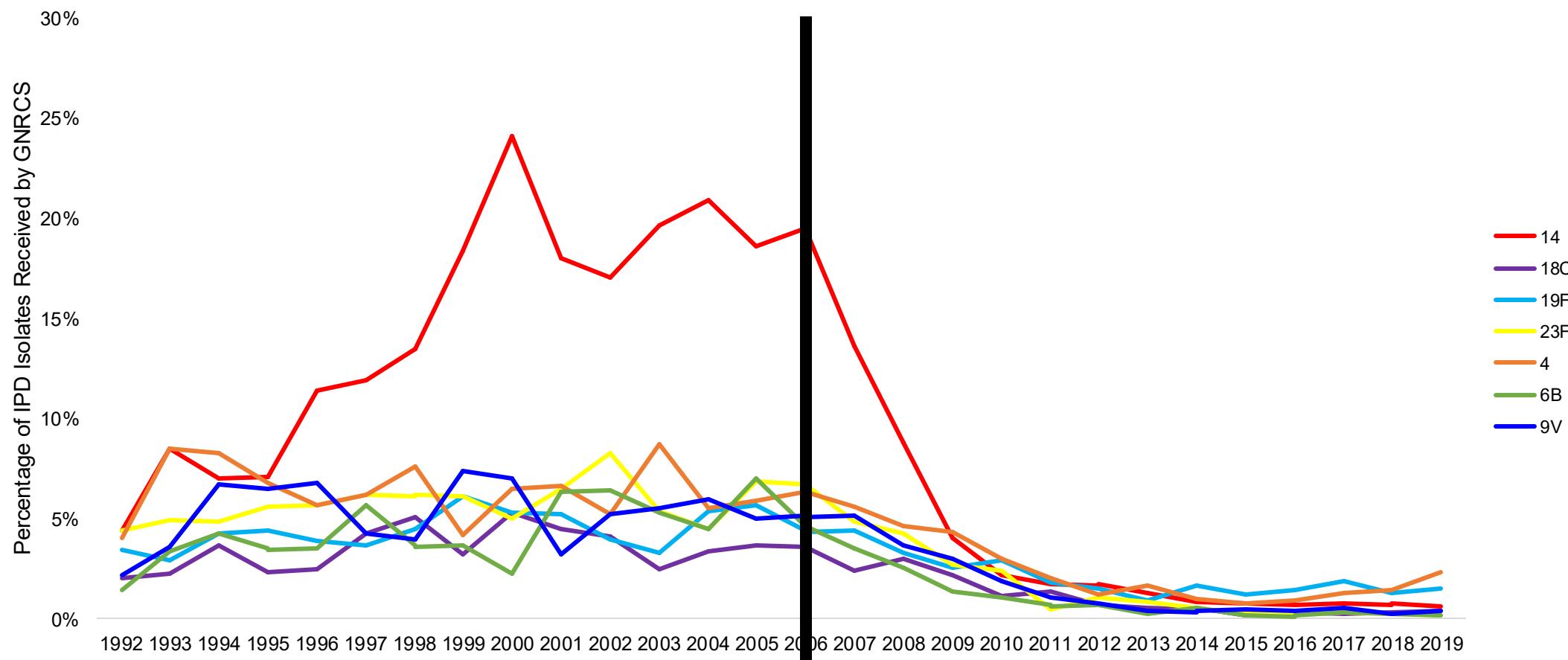


# Pneumococcal Conjugate Vaccines



- First in use in the US in 2000
- Given to infants
- Targeting the pneumos most common in severe disease

# PCV serotypes in Invasive Pneumococcal Disease in Germany, 1992-2019





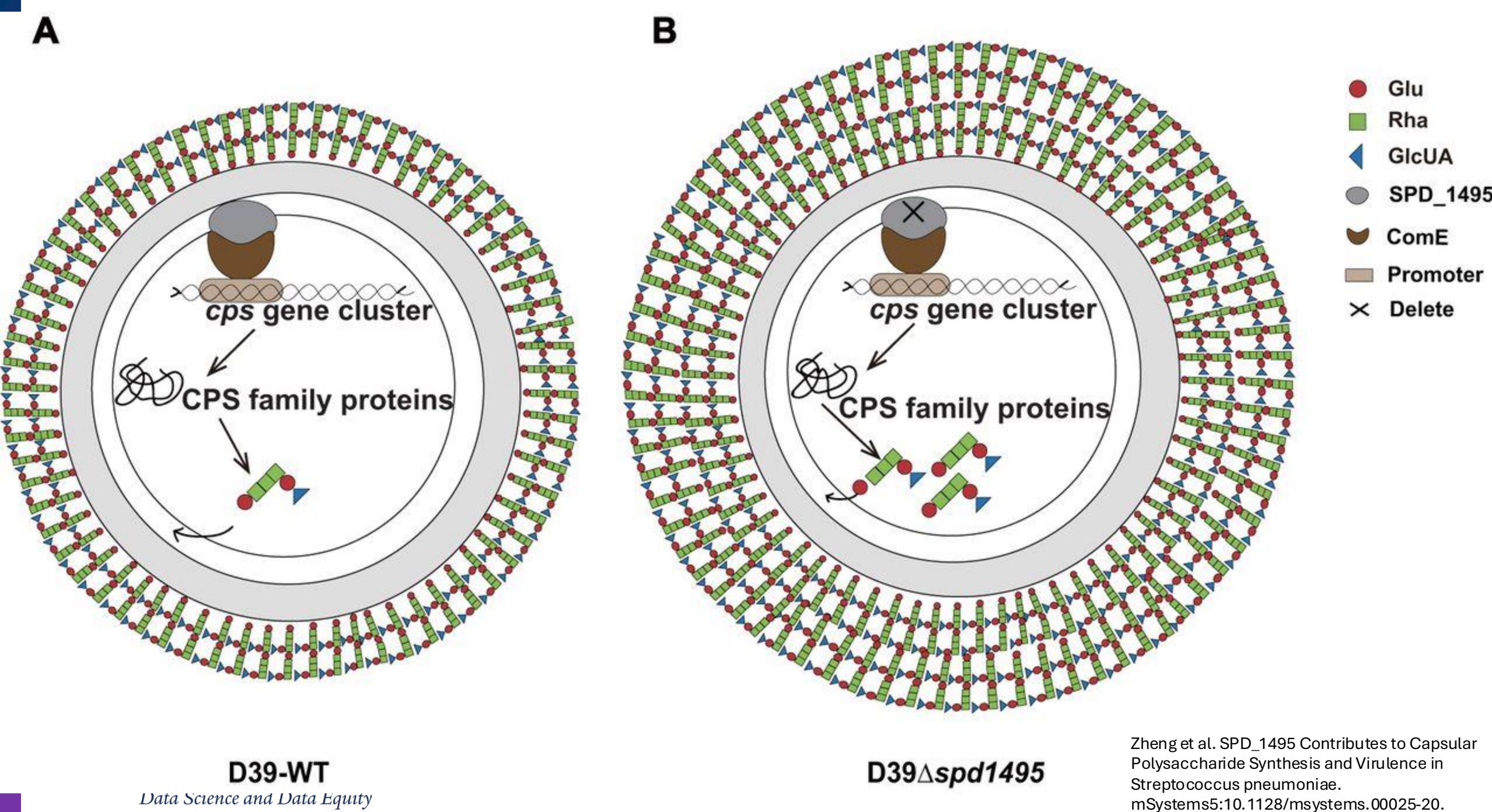






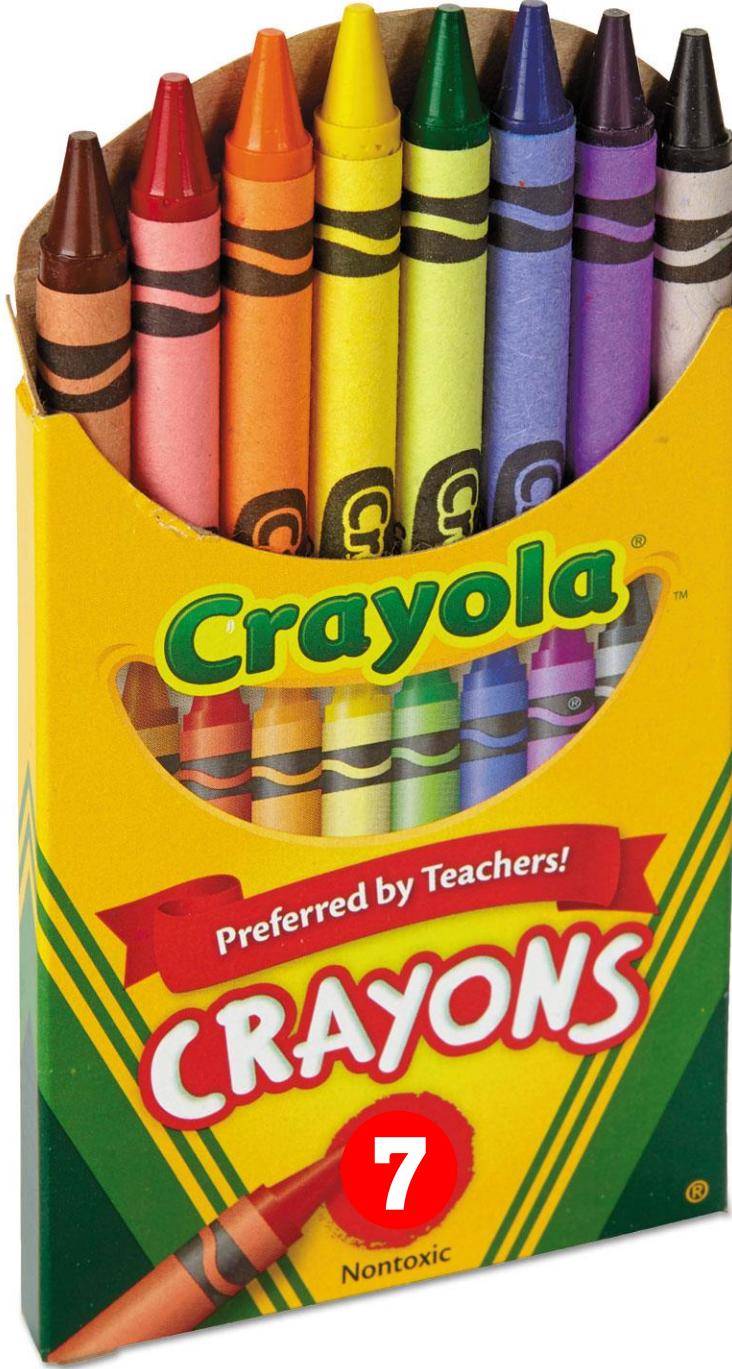






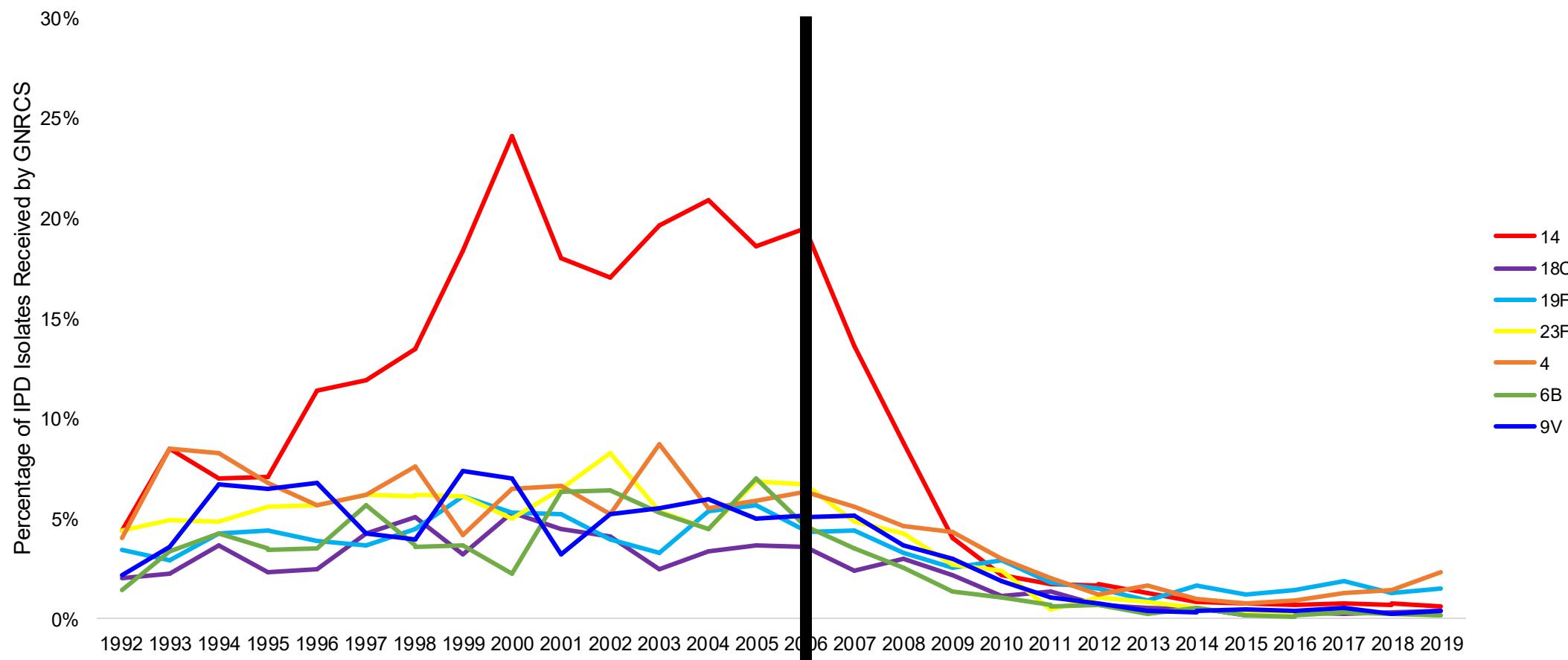
Zheng et al. SPD\_1495 Contributes to Capsular Polysaccharide Synthesis and Virulence in *Streptococcus pneumoniae*.  
mSystems 5:10.1128/msystems.00025-20.





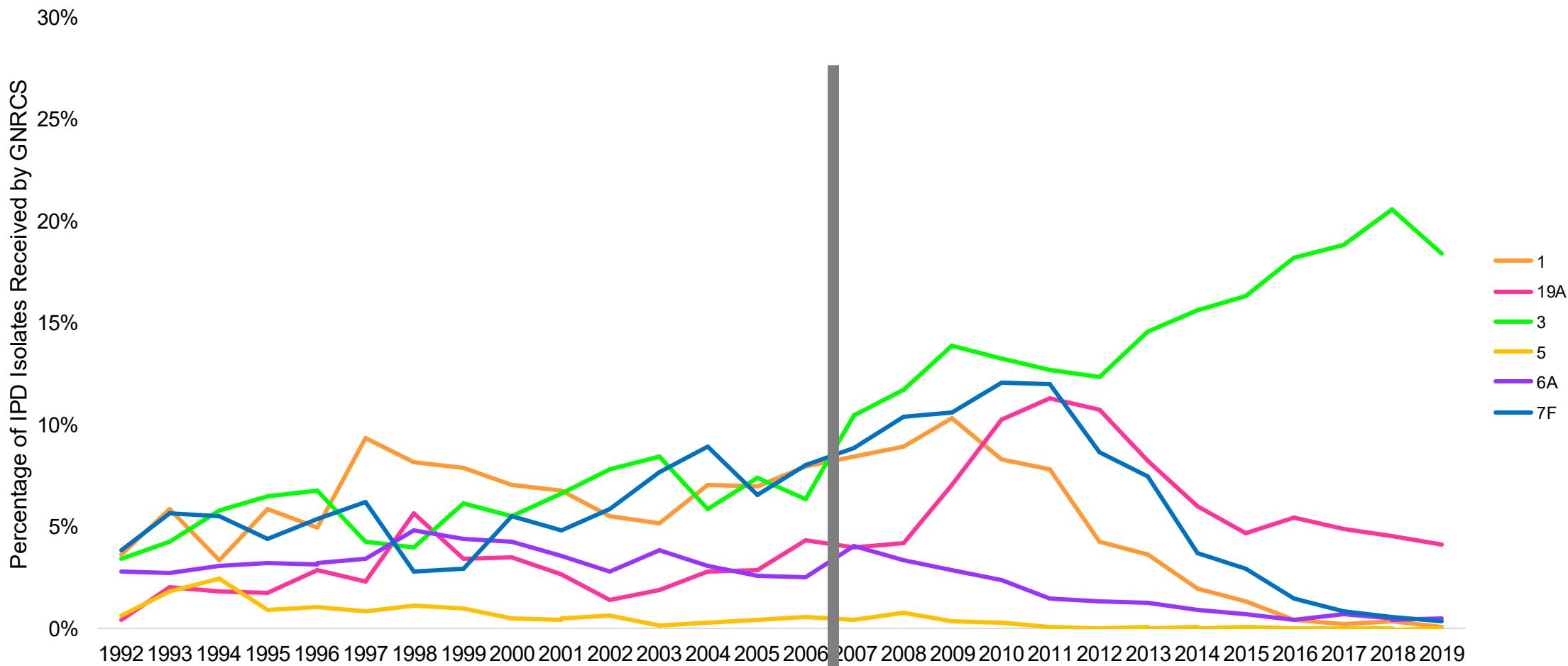
7

# PCV serotypes in Invasive Pneumococcal Disease in Germany, 1992-2019

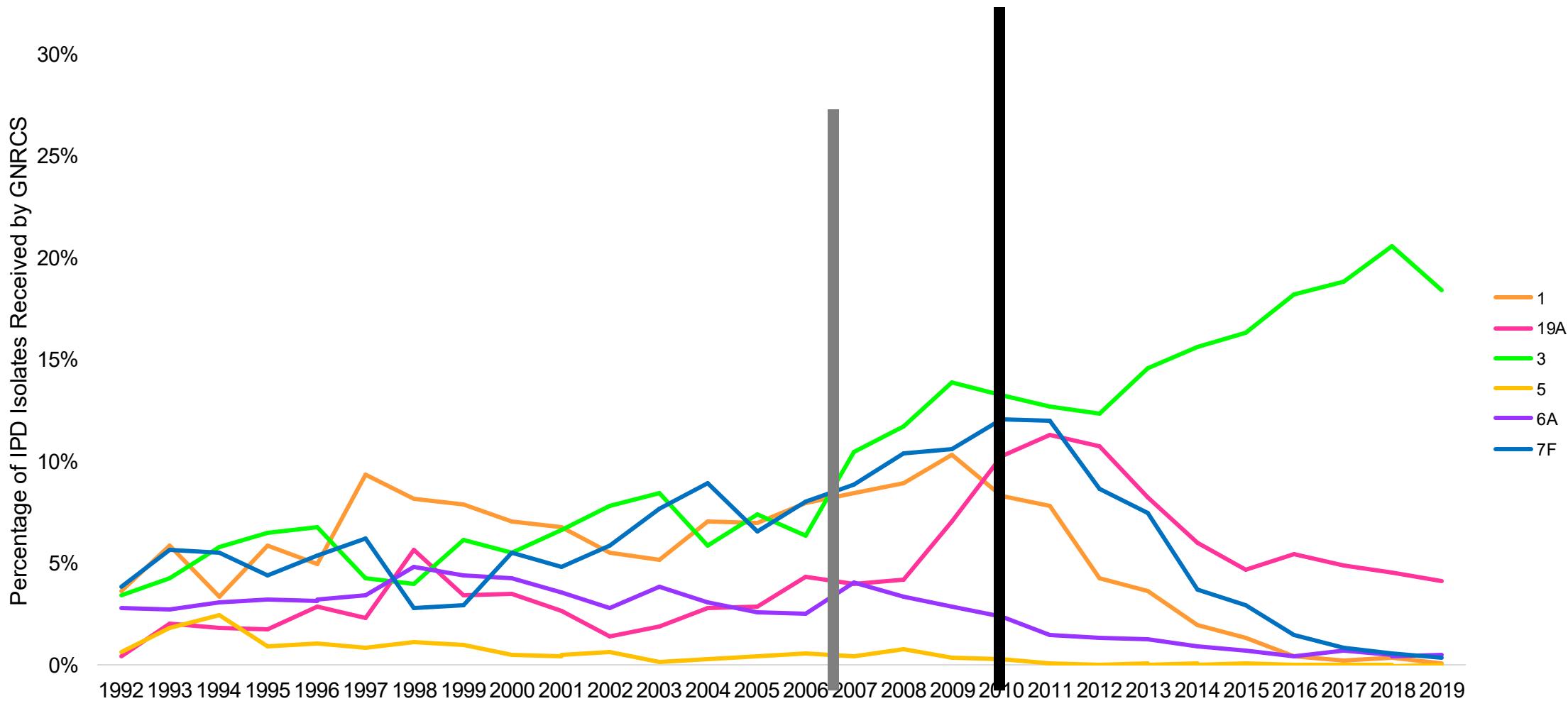




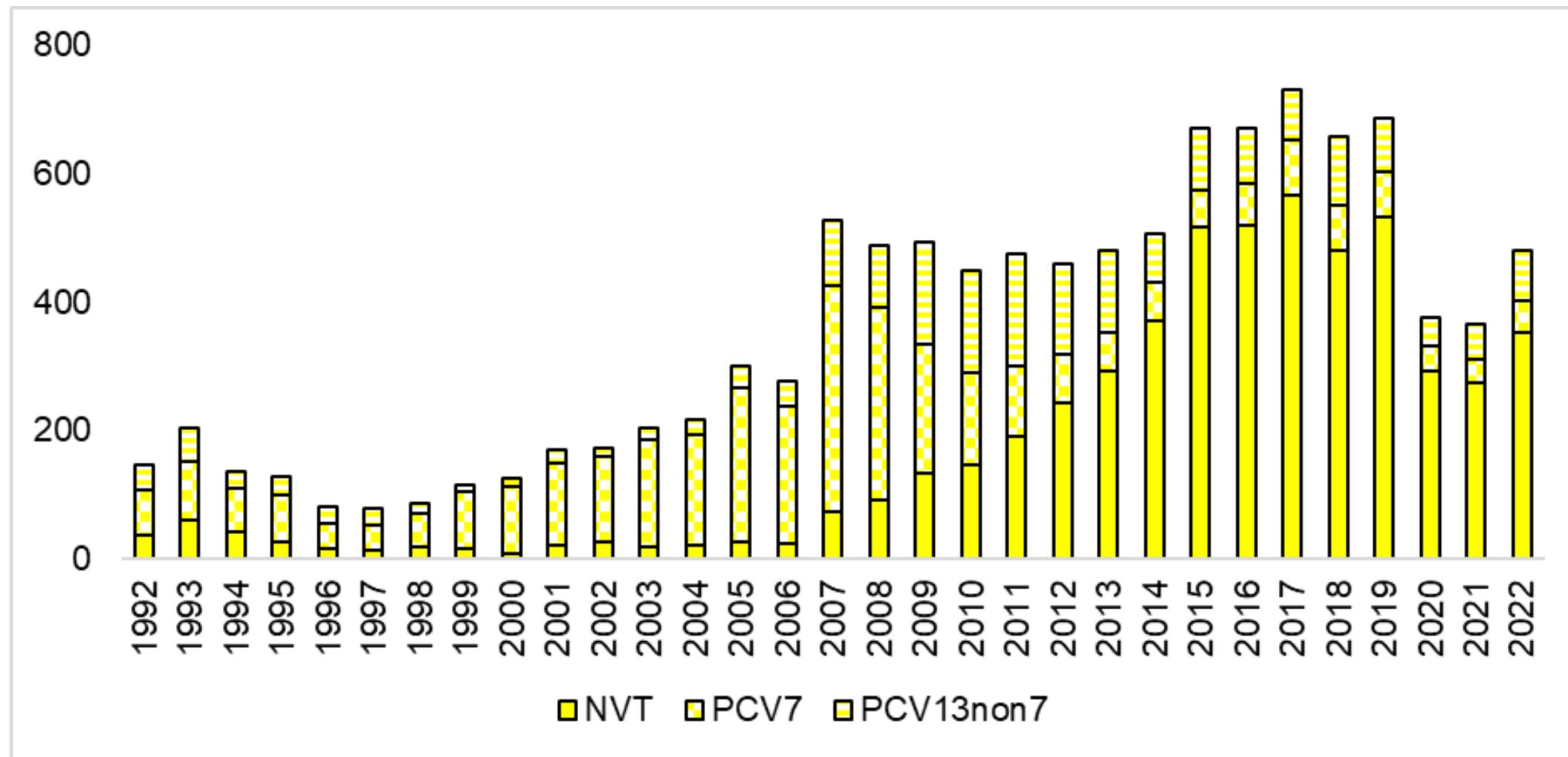
# New PCV serotypes in Invasive Pneumococcal Disease, Germany, 1992-2019



# New PCV serotypes in Invasive Pneumococcal Disease, Germany, 1992-2019



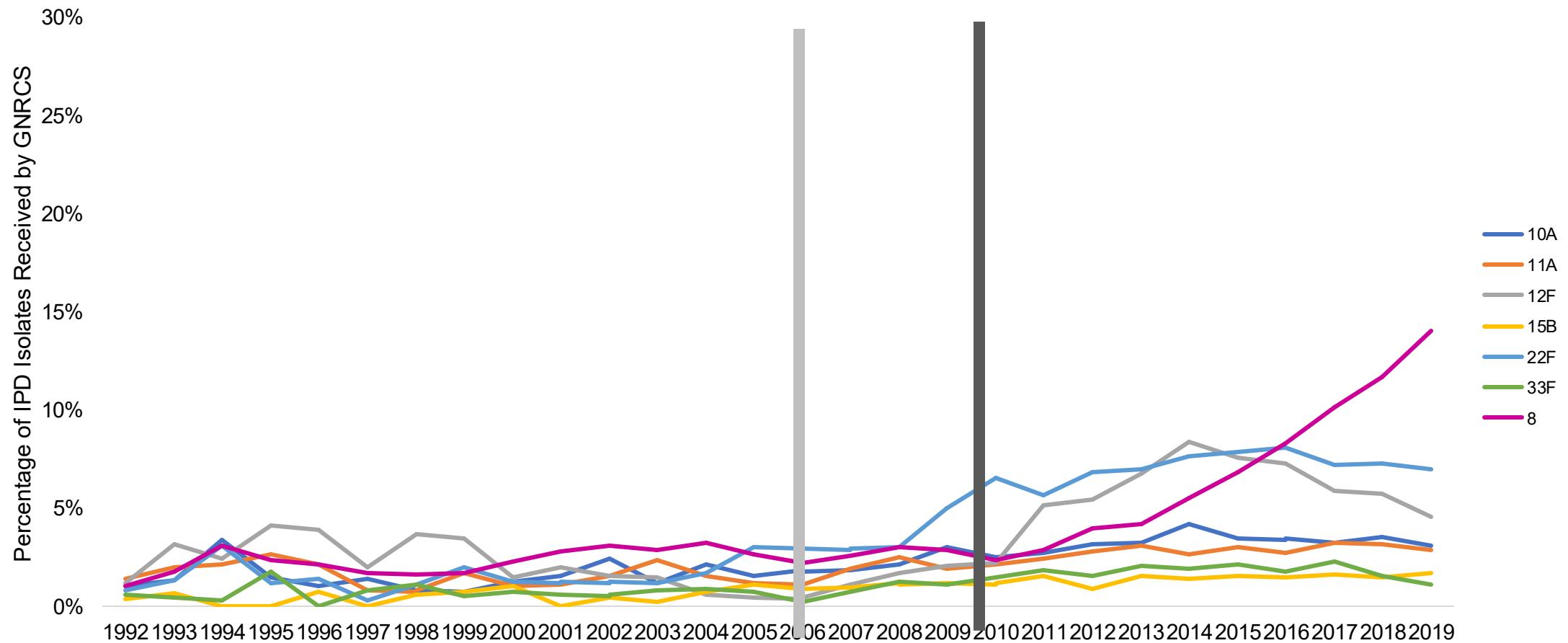
# Number of isolates classified as intermediate or resistant to ANY antibiotic class, by vaccine serotype group

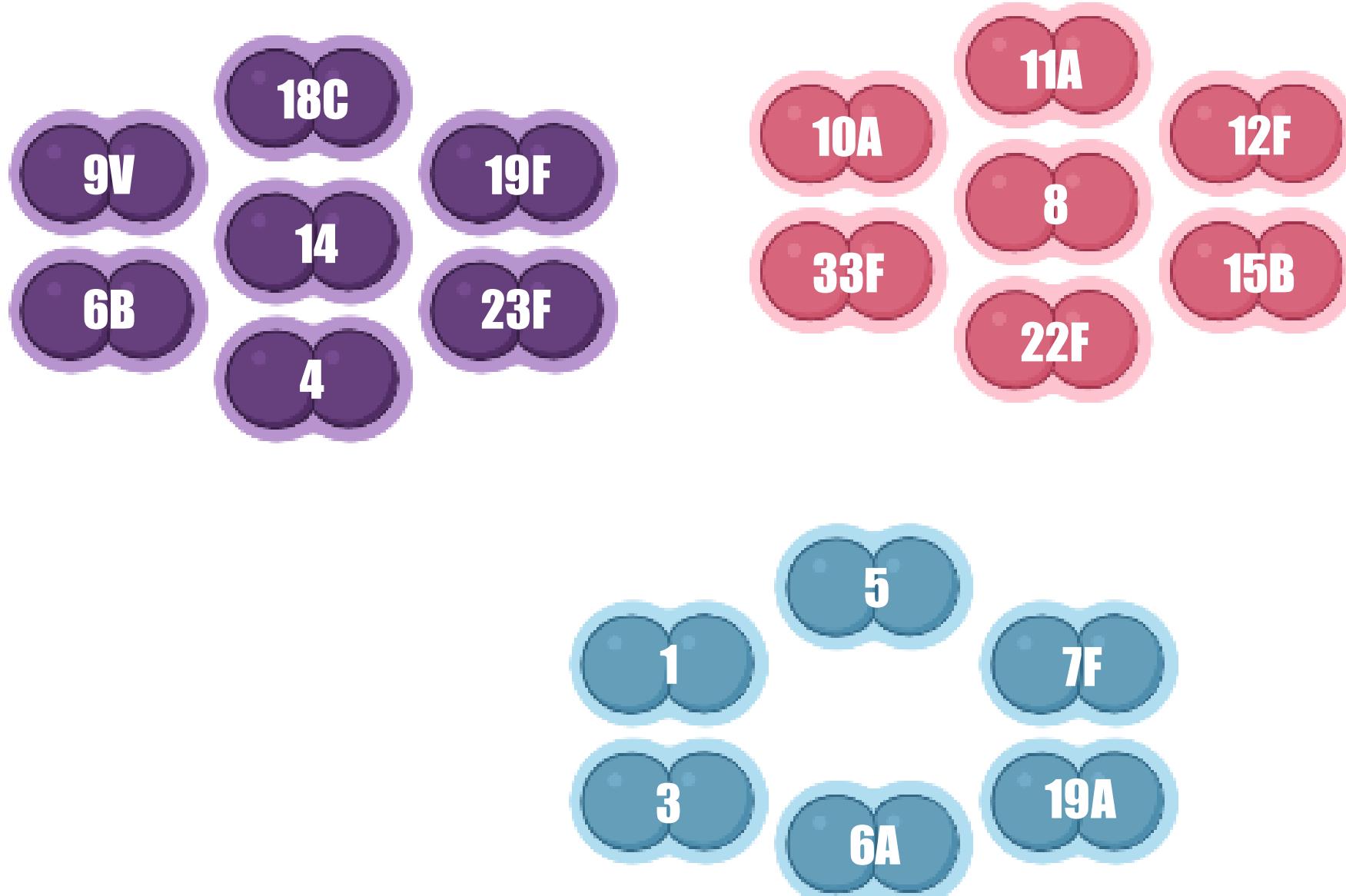




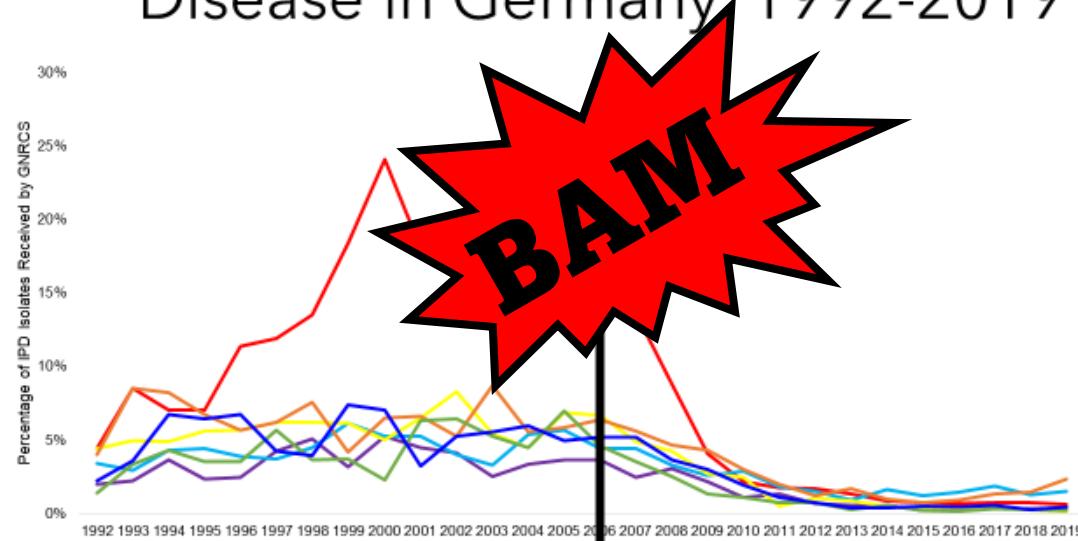


# New vaccine serotypes in Invasive Pneumococcal Disease in Germany, 1992-2019

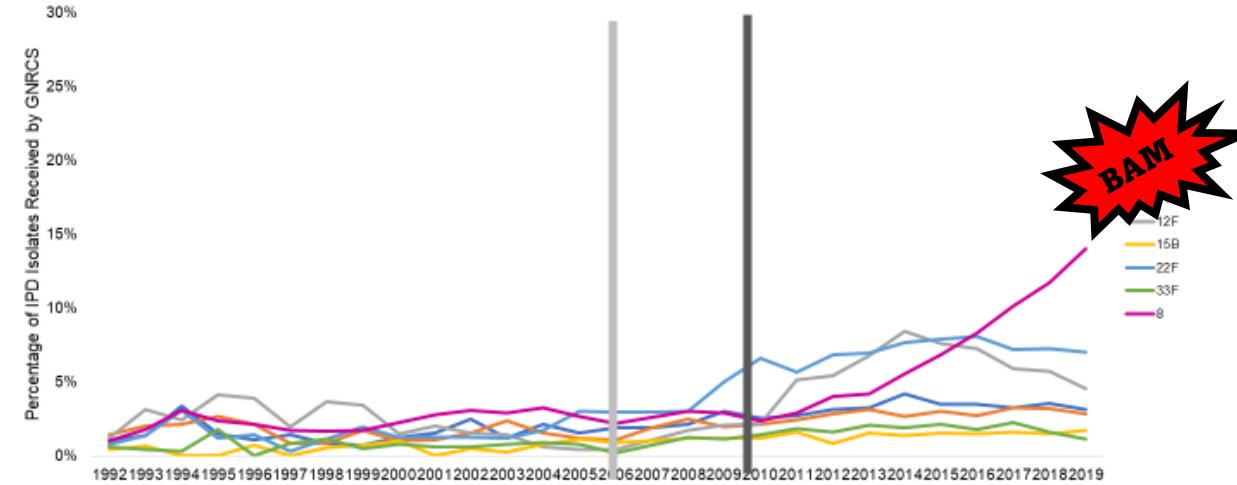




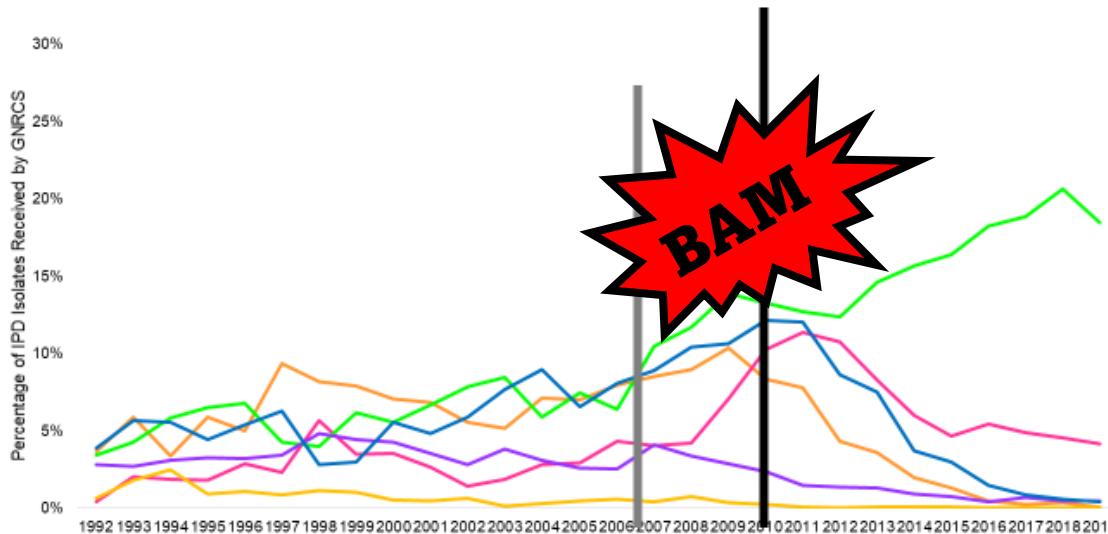
## PCV serotypes in Invasive Pneumococcal Disease in Germany 1992-2019



## New-New vaccine serotypes in Invasive Pneumococcal Disease in Germany, 1992-2019



## New PCV serotypes in Invasive Pneumococcal Disease, Germany, 1992-2019



# Worldwide Index of Serotype Specific Pneumococcal Antibody Responses

[Sign in](#)[PUBLIC DATA DASHBOARDS](#)[Clinical Trials Overview](#)[Outcomes Data](#)[PCV Antibodies](#)

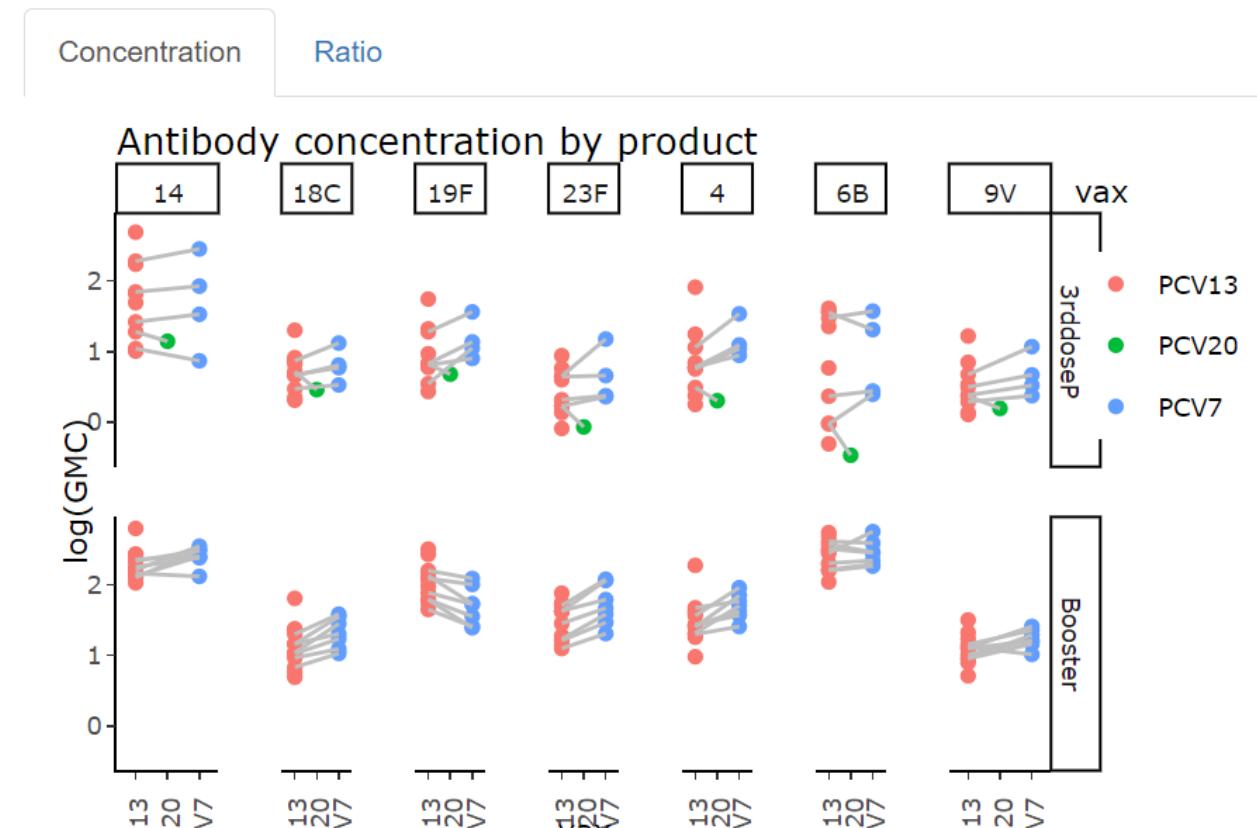
## Comparison of Immunogenicity of PCVs

Vaccine:

PCV13  PCV20  PCV7

Country:

- Italy
- Mexico
- Spain
- UK
- Brazil
- Canada
- France
- Germany
- India
- Japan
- Taiwan



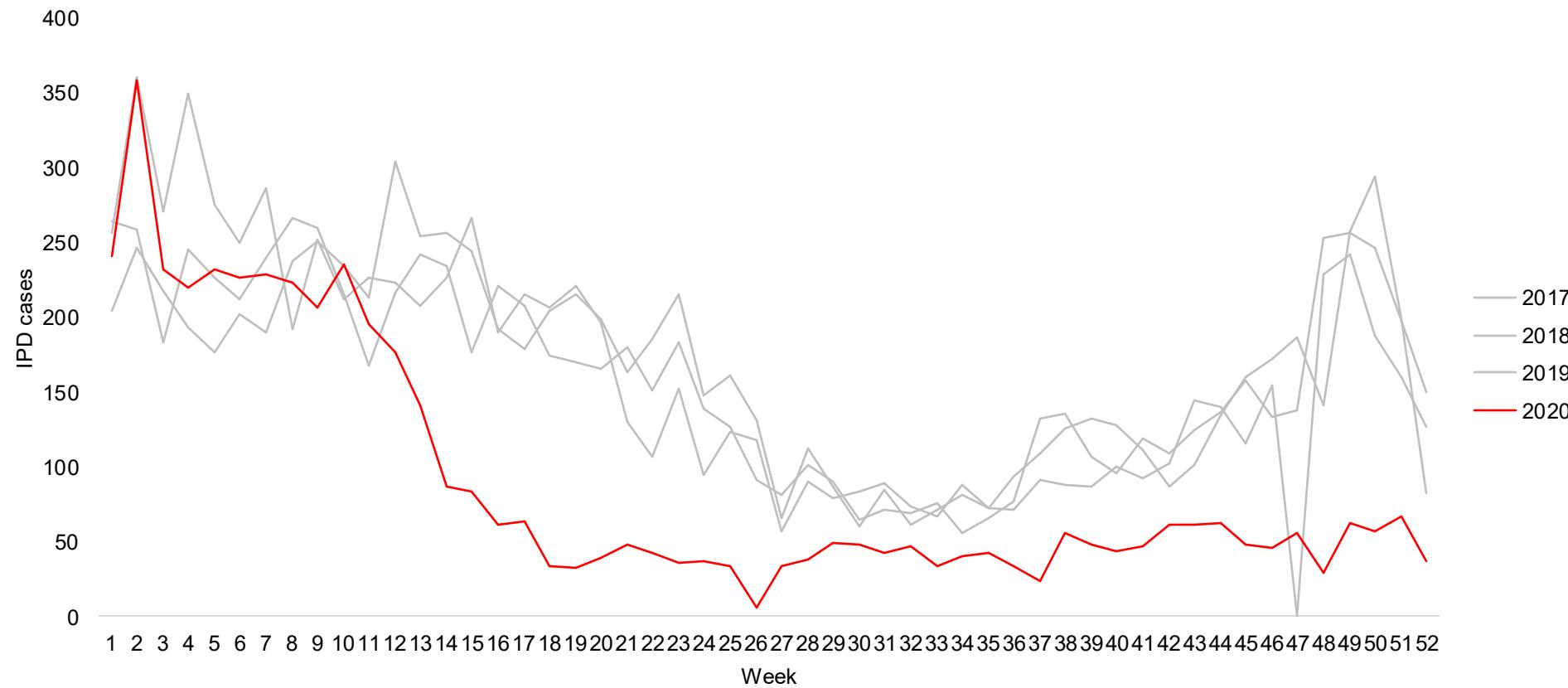
## Antibody concentration by product



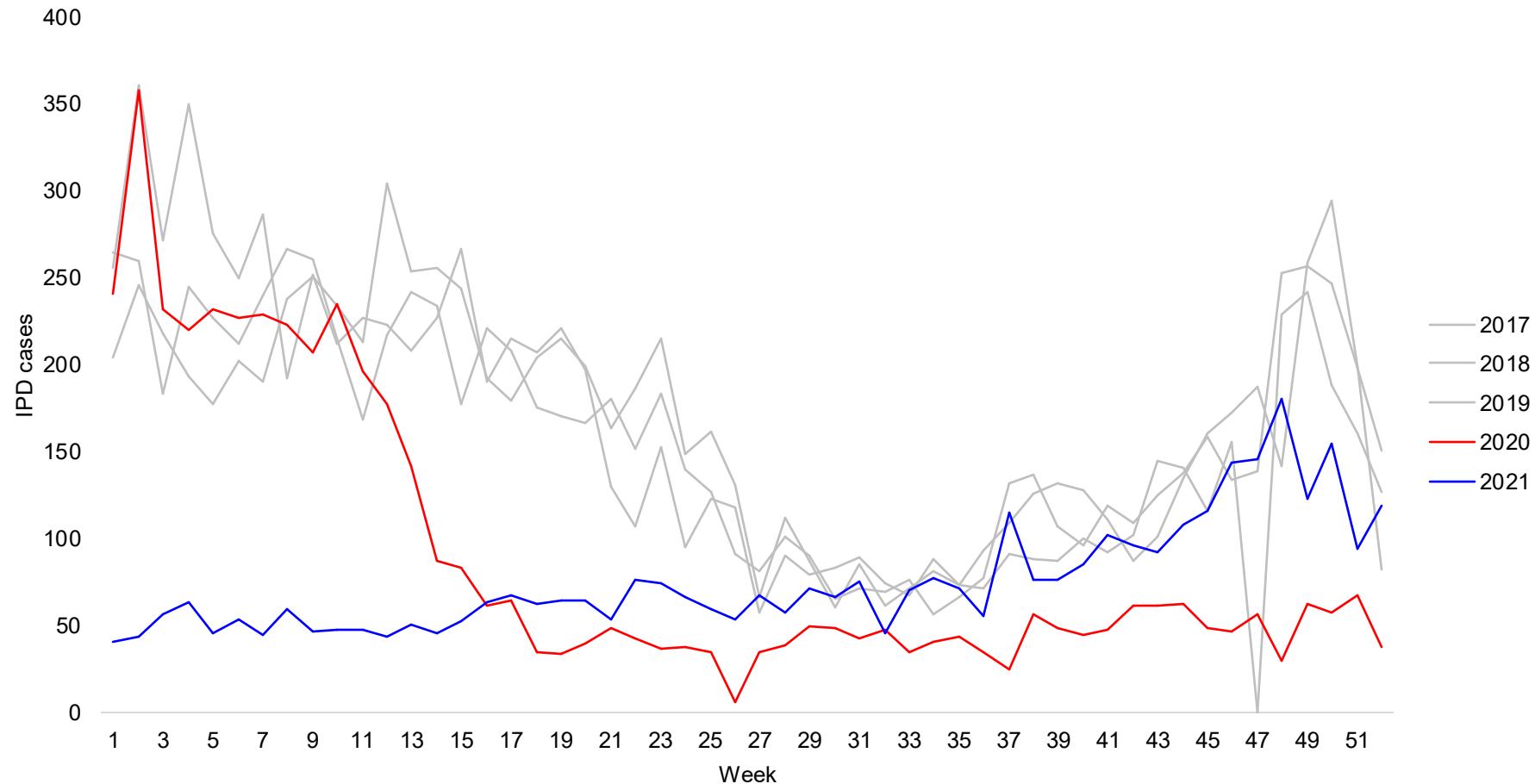
# Viruses and Pneumococci

- Flu
- RSV
- SARS-CoV-2

# What happened to IPD in 2020?



# What happened to IPD in 2021?



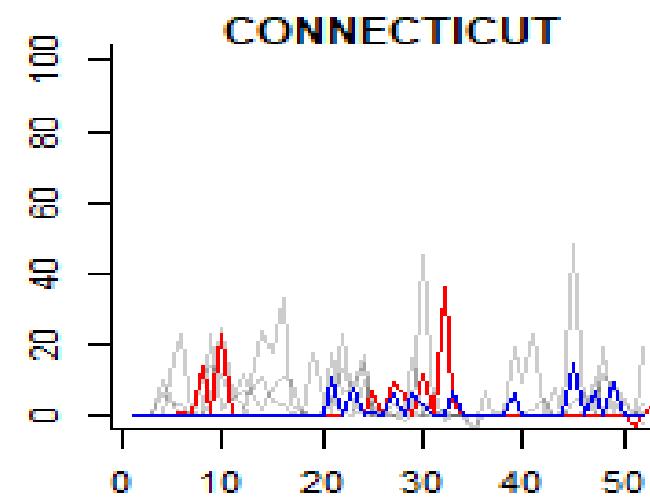
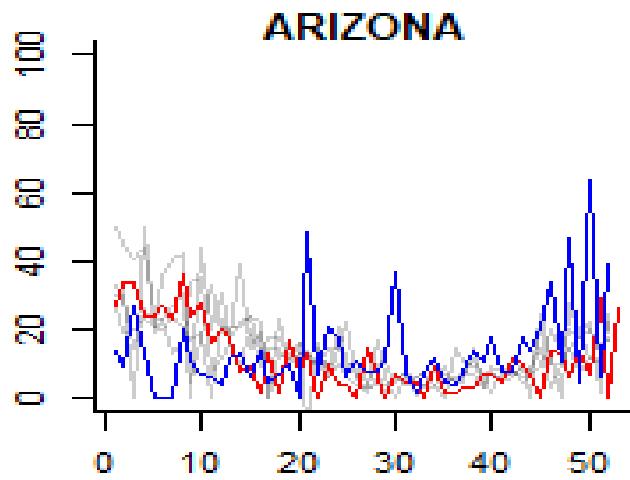
# But Why?

- Artefactual
  - Clinical System Overtaxed
  - Surveillance System Overtaxed
- Actual
  - Changing Dynamics of Respiratory Pathogens
  - Nonpharmaceutical interventions

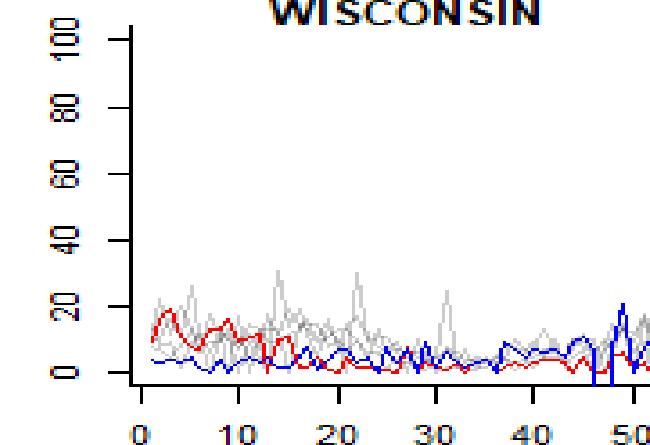
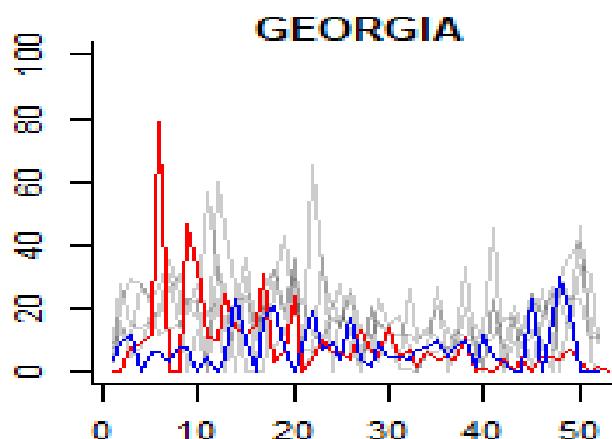
# Artefactual

- Clinical Systems
  - Point of Care
  - Medical Laboratories
- Surveillance Systems
  - Health Departments
  - Federal Agencies

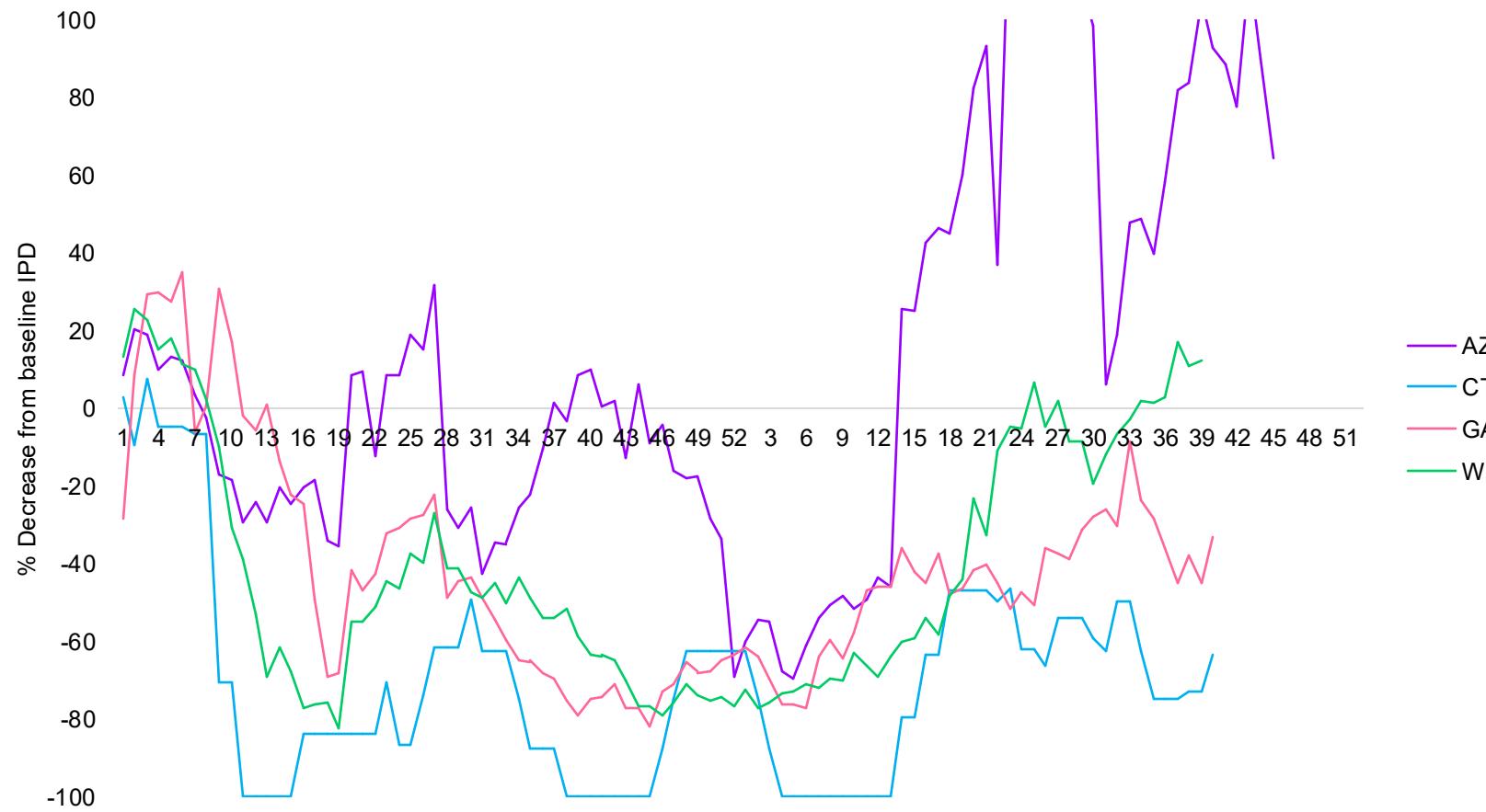
# NNDSS IPD, 2016-2021



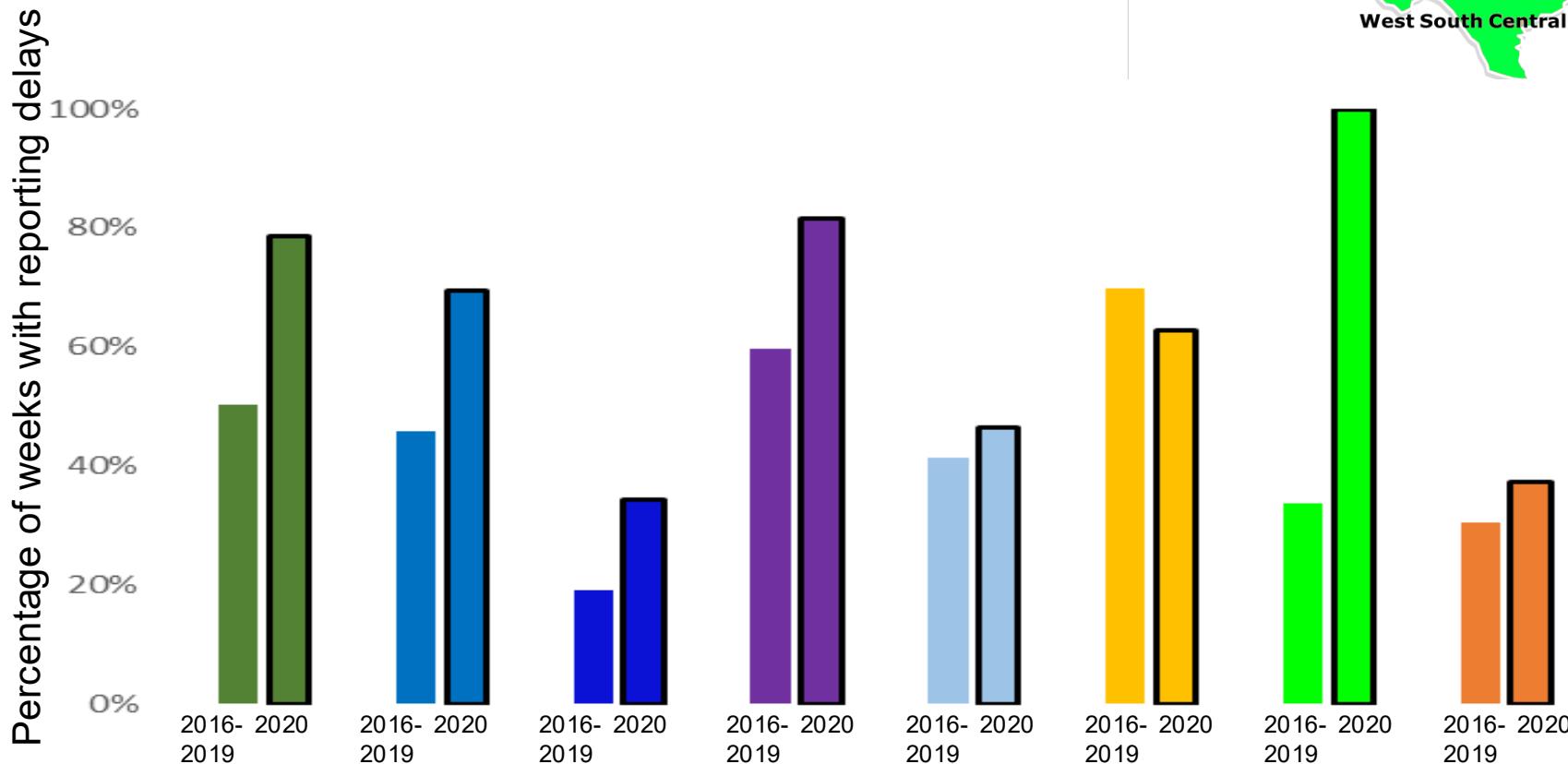
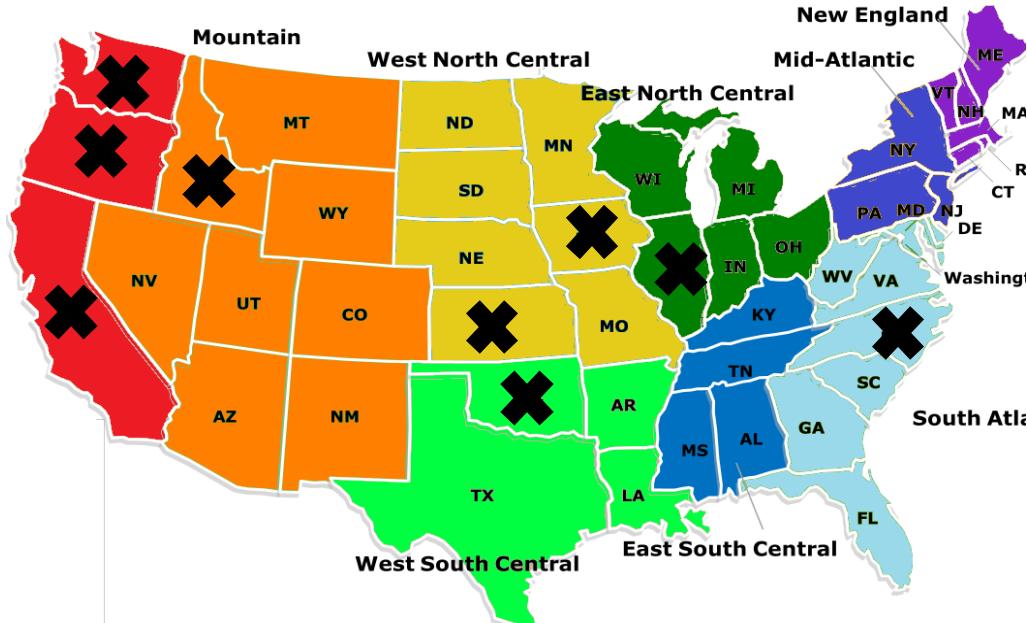
■ 2016-2019  
■ 2020  
■ 2021



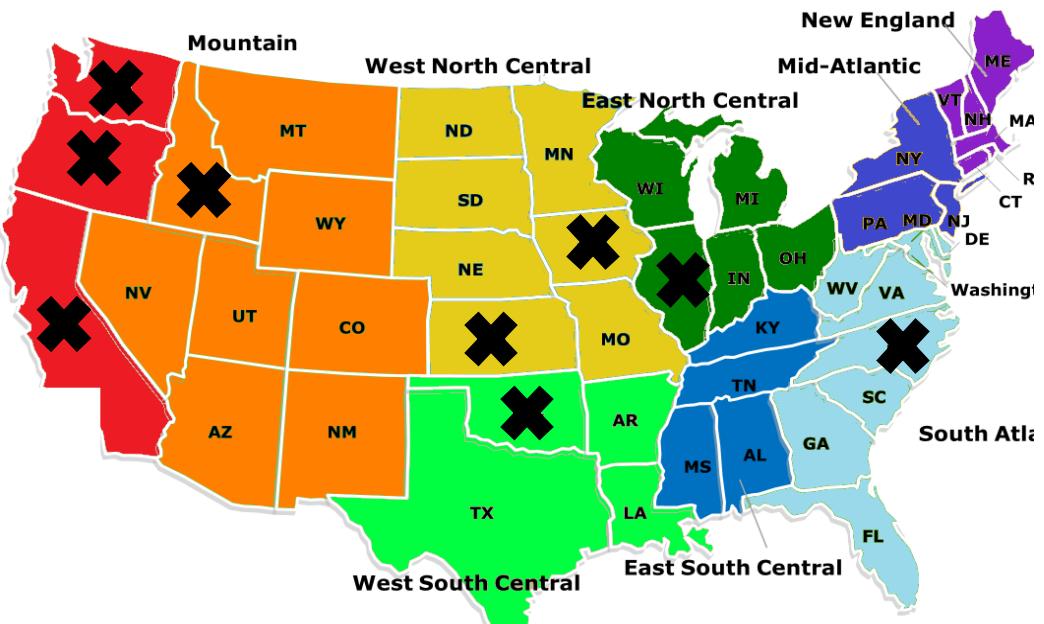
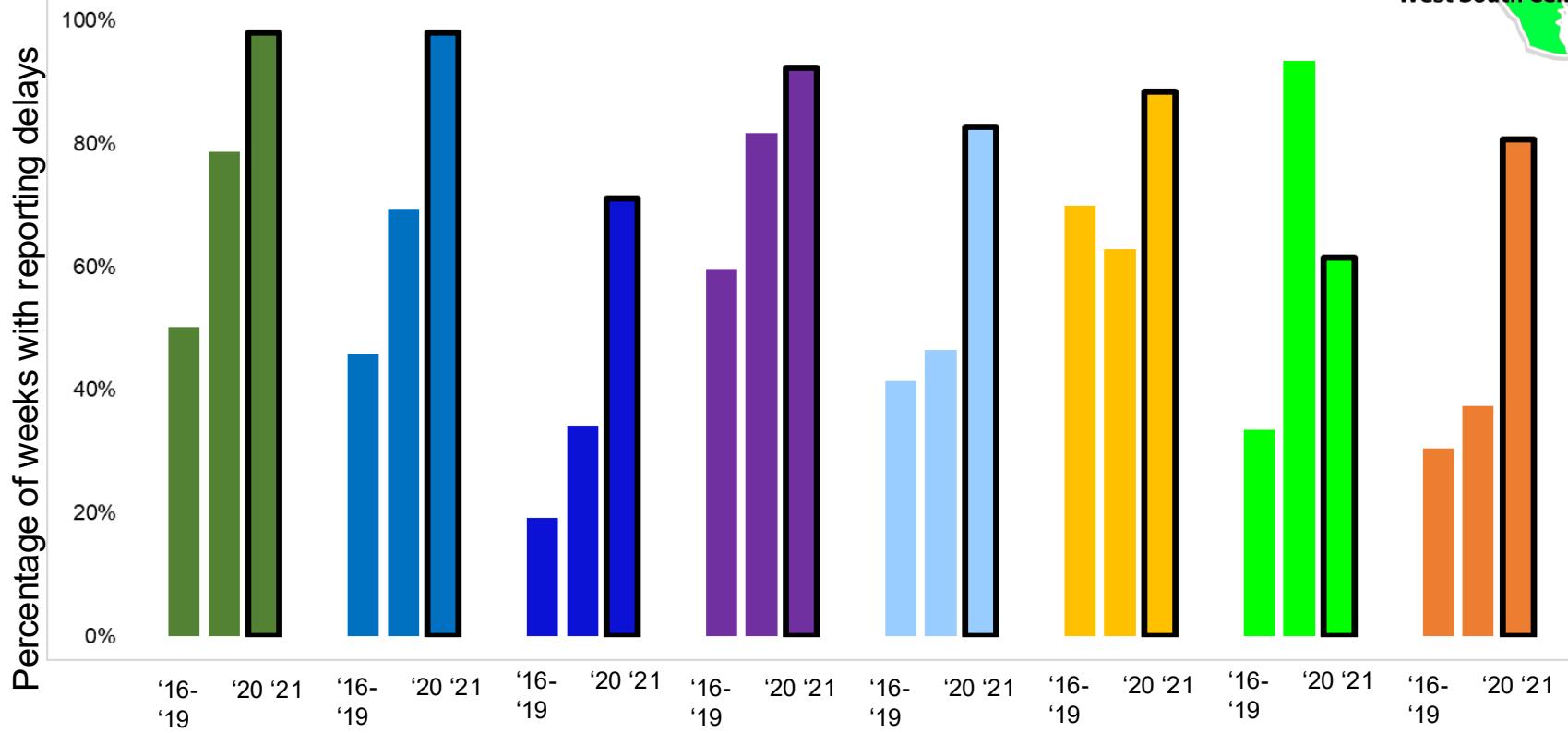
# NNDSS IPD, change from baseline



# Reporting Delays, 2020



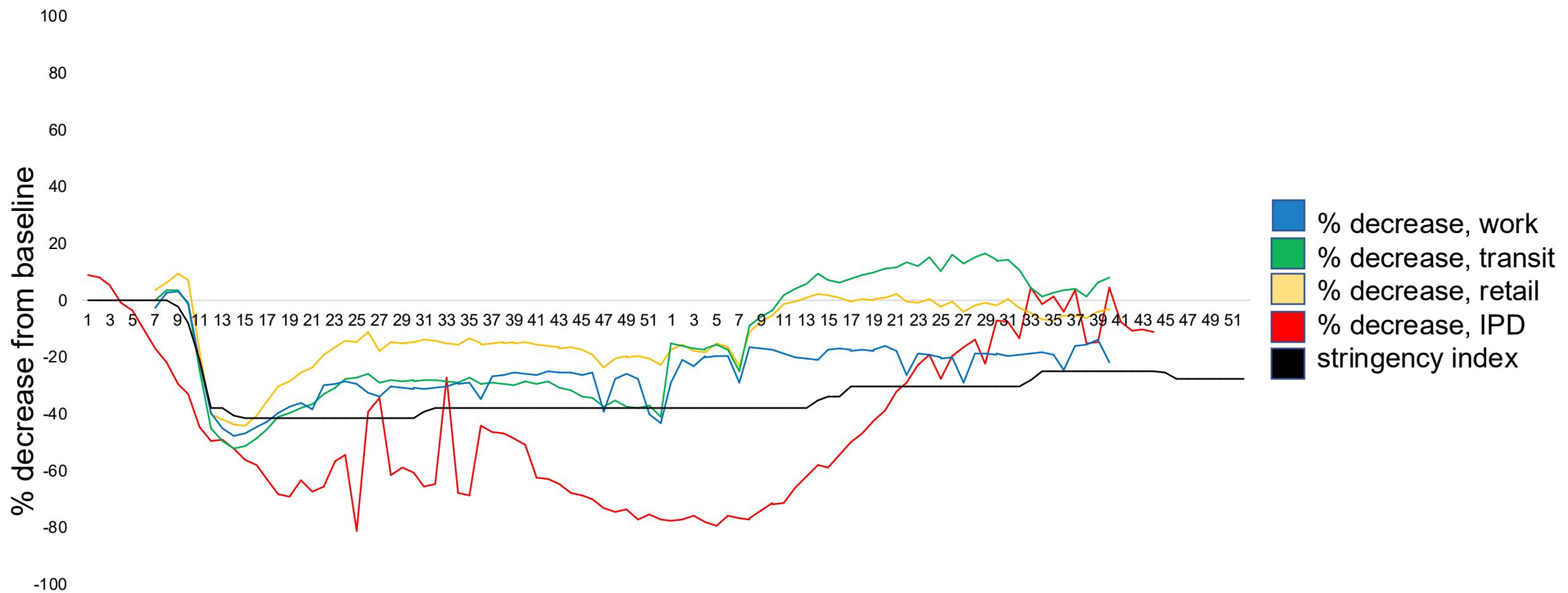
# Reporting Delays, 2021



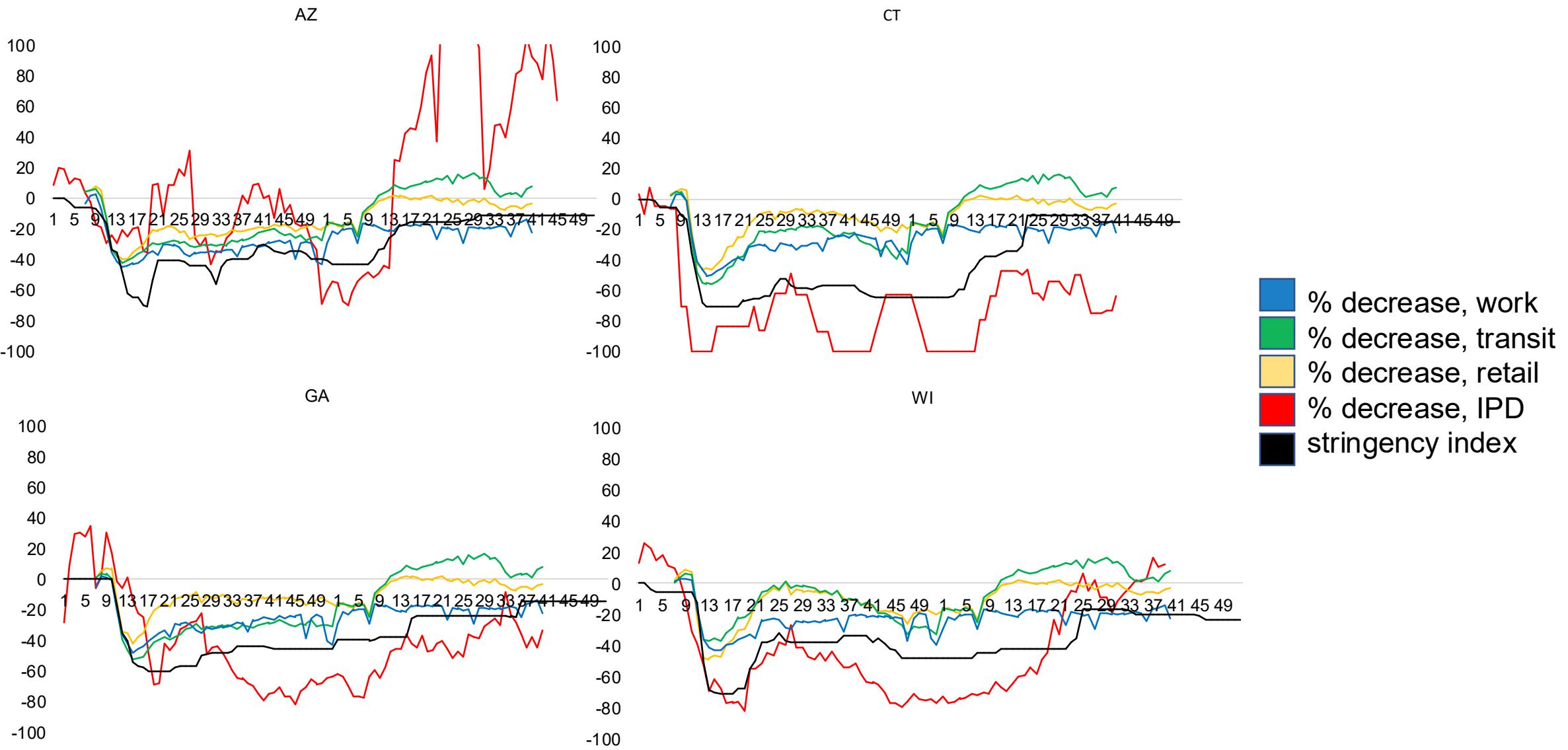
# Actual

- Changing dynamics of respiratory pathogens
- Nonpharmaceutical interventions

# United States Mobility, Overall



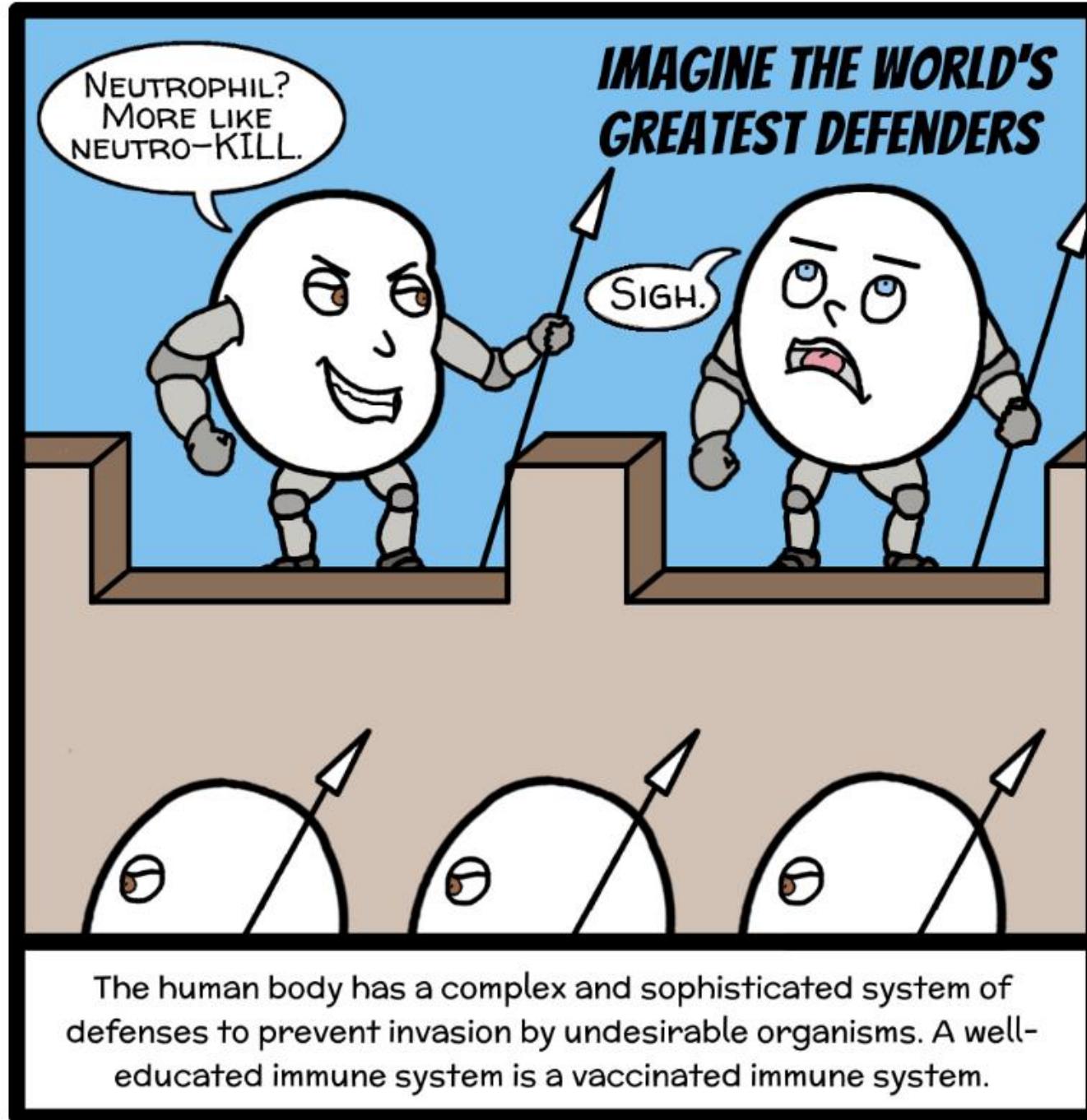
# US Mobility, State Level

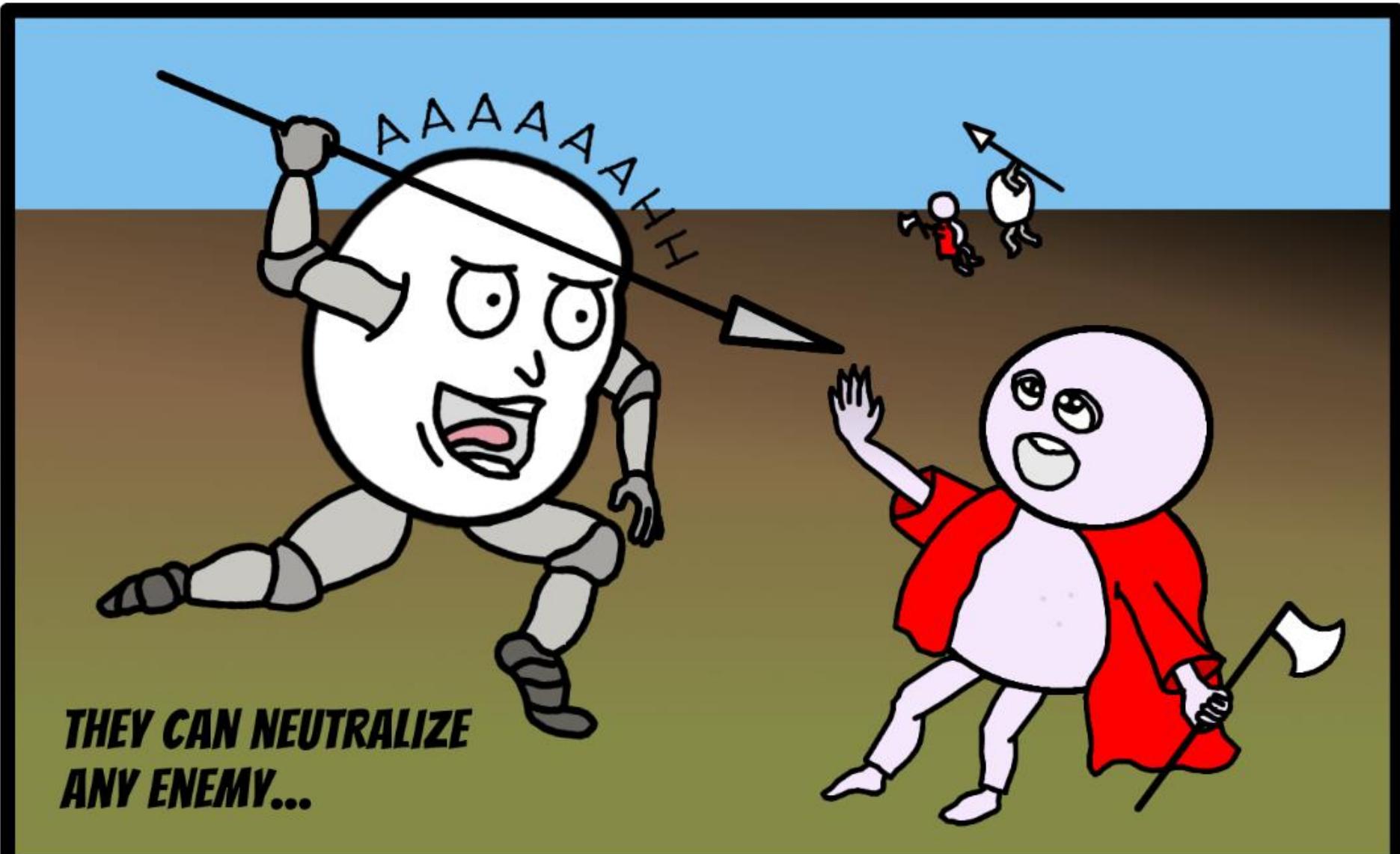


# But Why?

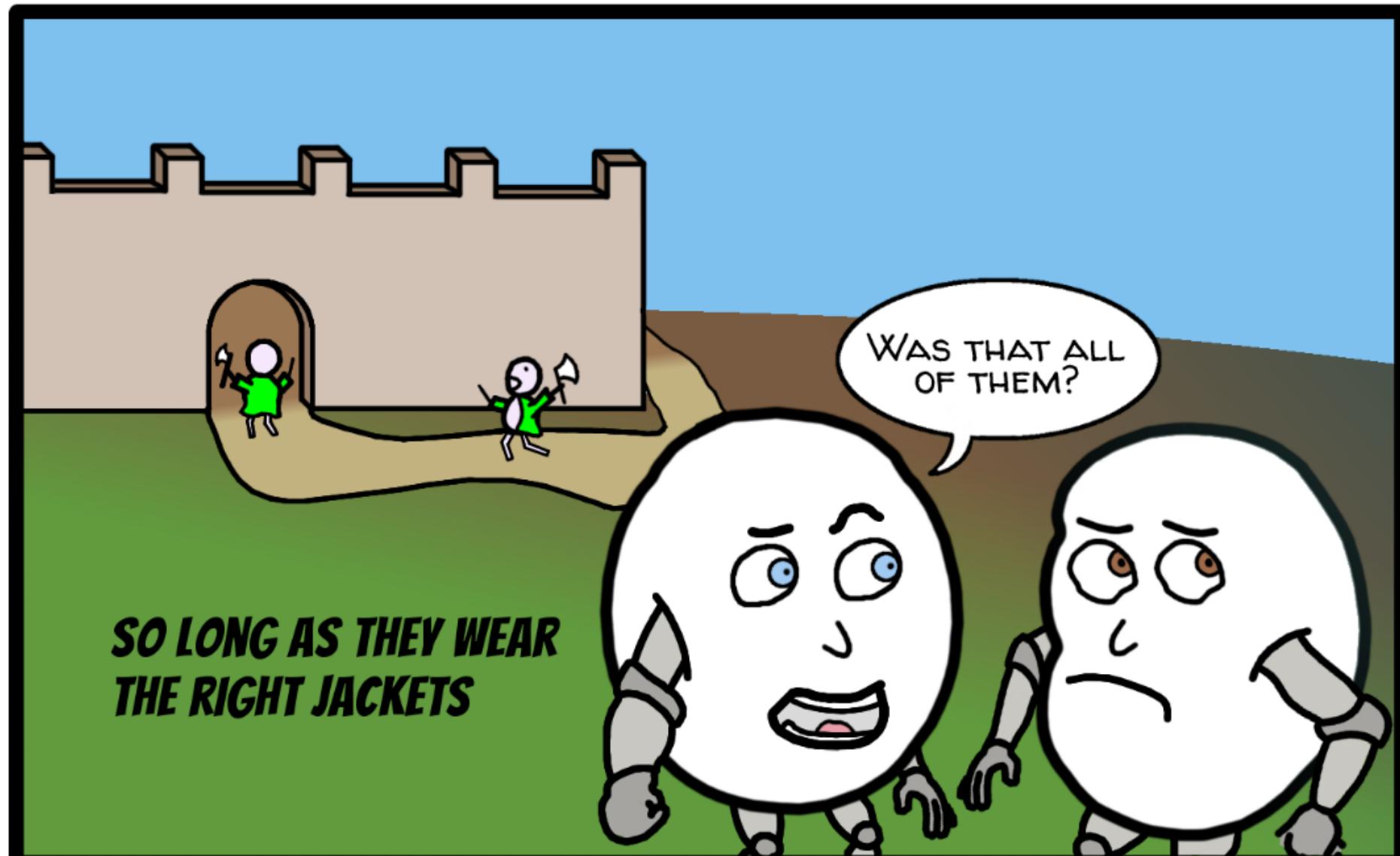
- Artefactual
  - Clinical System Overtaxed
  - Surveillance System Overtaxed
- Actual
  - Changing Dynamics of Respiratory Pathogens
  - Nonpharmaceutical interventions

# Pneumococcal Serotype Replacement

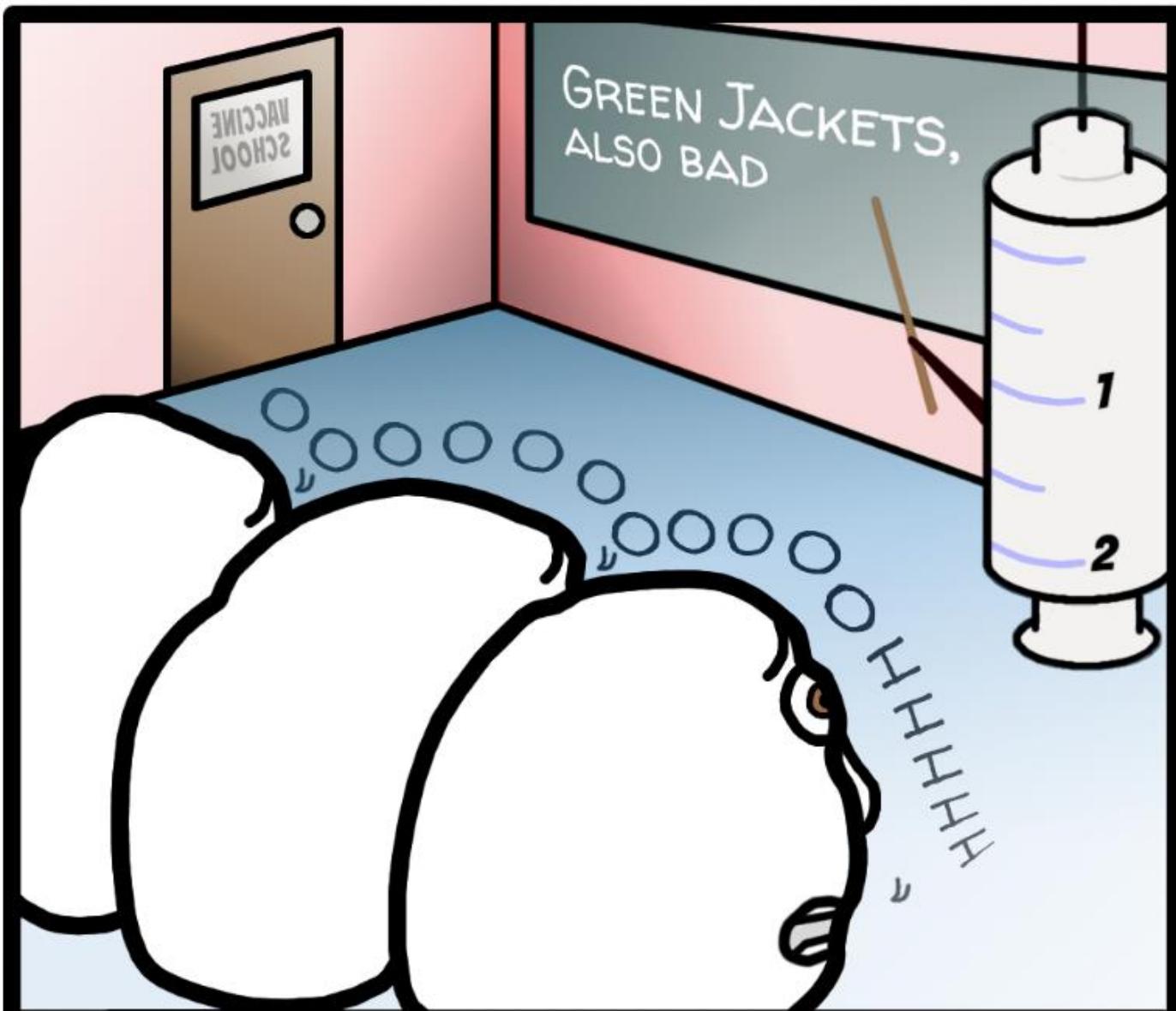




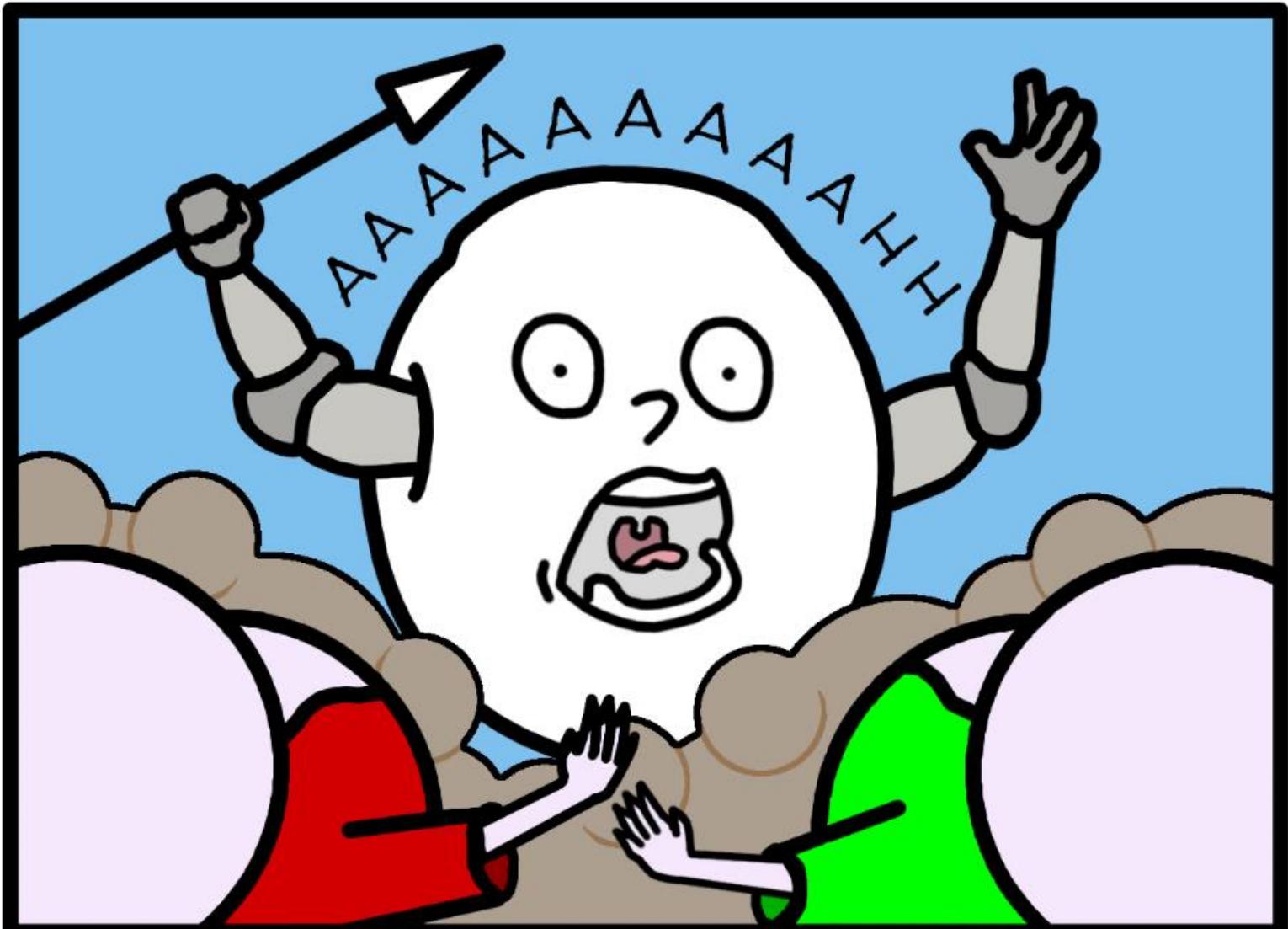
A specific immune response can respond to specific "enemies", in this case, pneumococci.  
Pneumococci wearing red jackets.



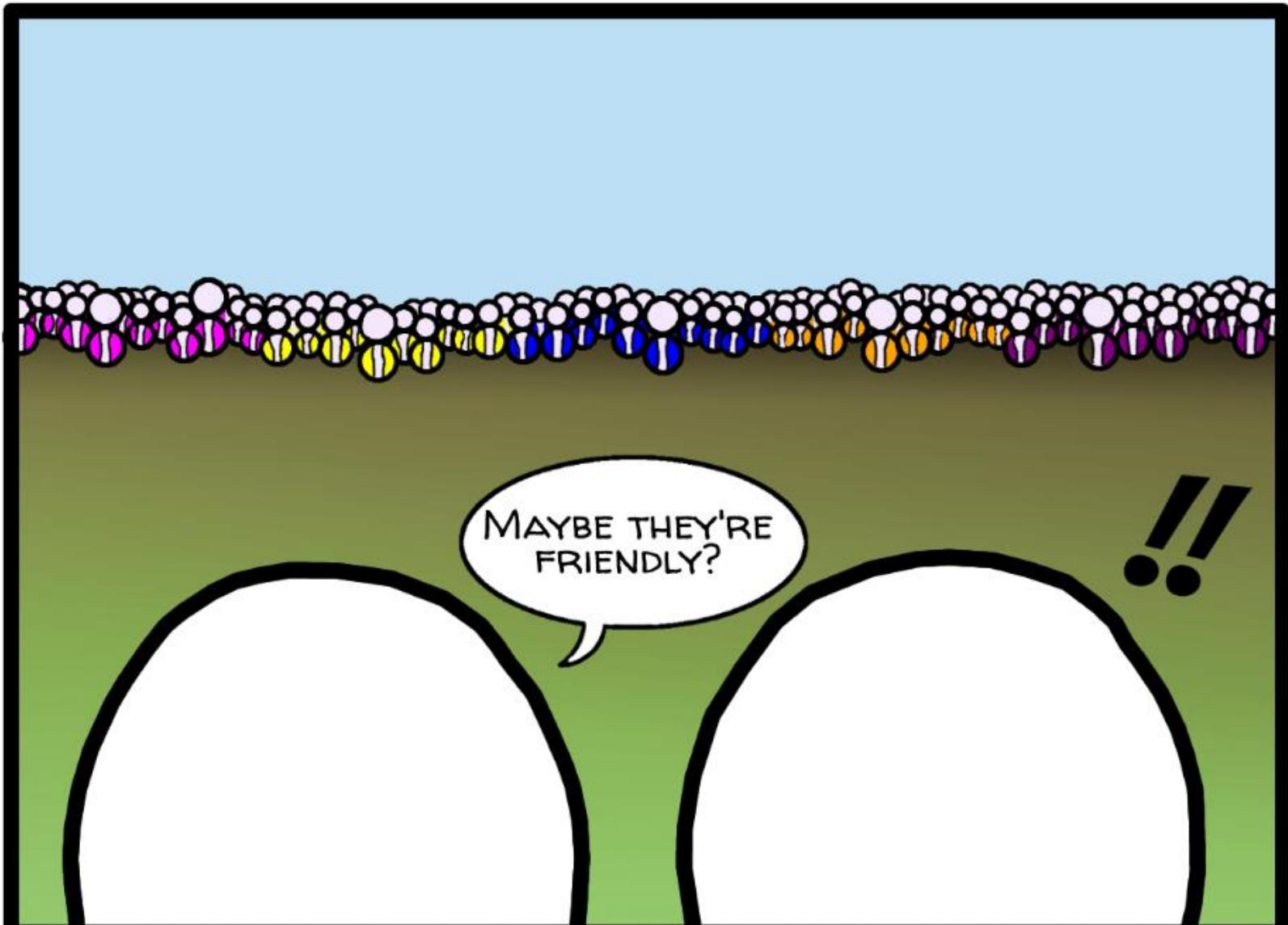
Jackets represent the polysaccharide capsule of the pneumococci, one of the things that help the bacteria live inside the human body. Red jackets represent a group of seven types of pneumococci, which were included in the first-generation vaccine for children.



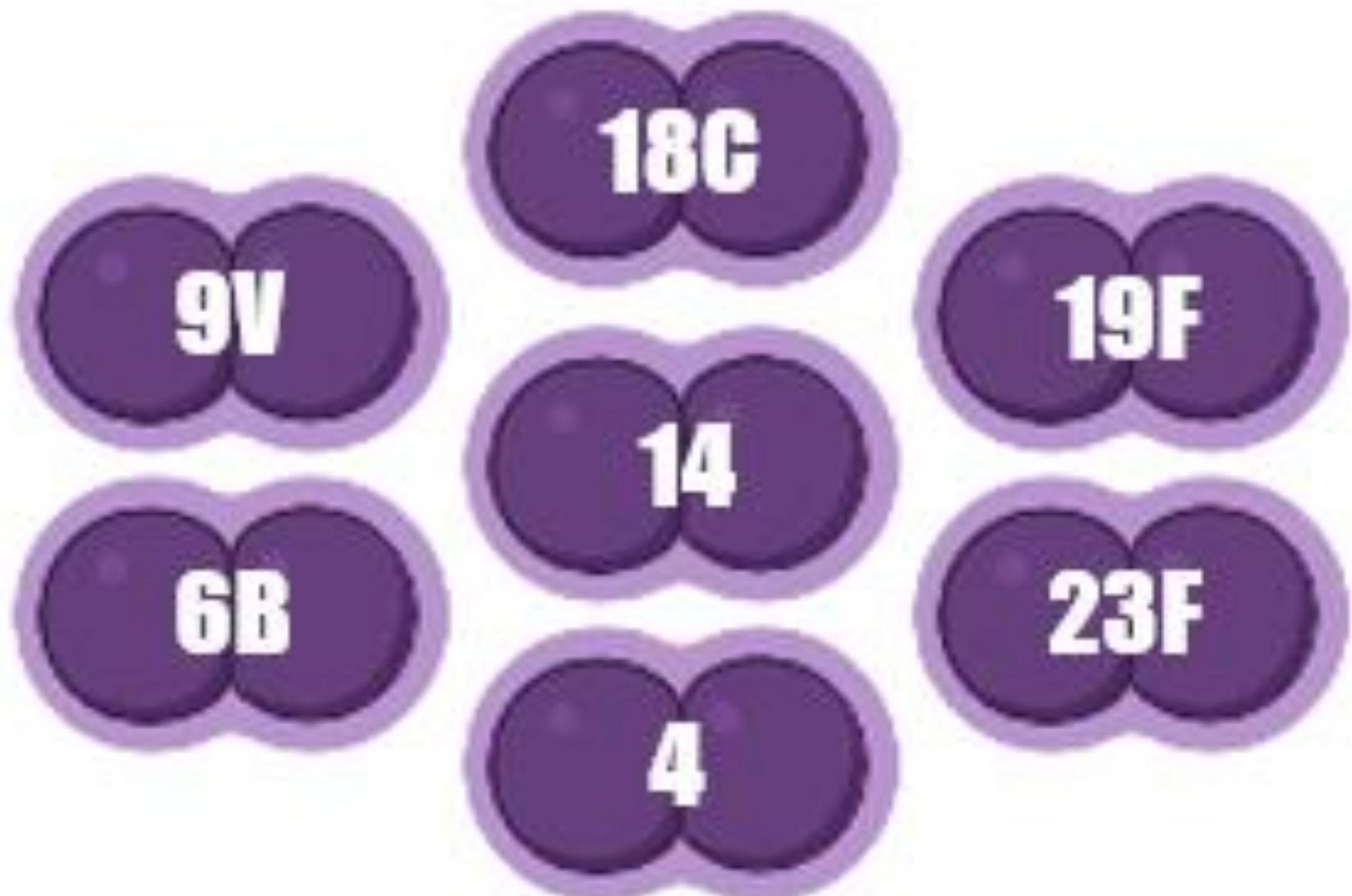
The immune system can be further educated (by new vaccines) to recognize additional types of pneumococci, for example, those wearing green jackets.

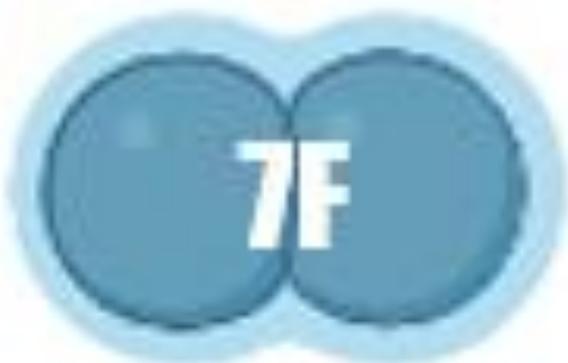


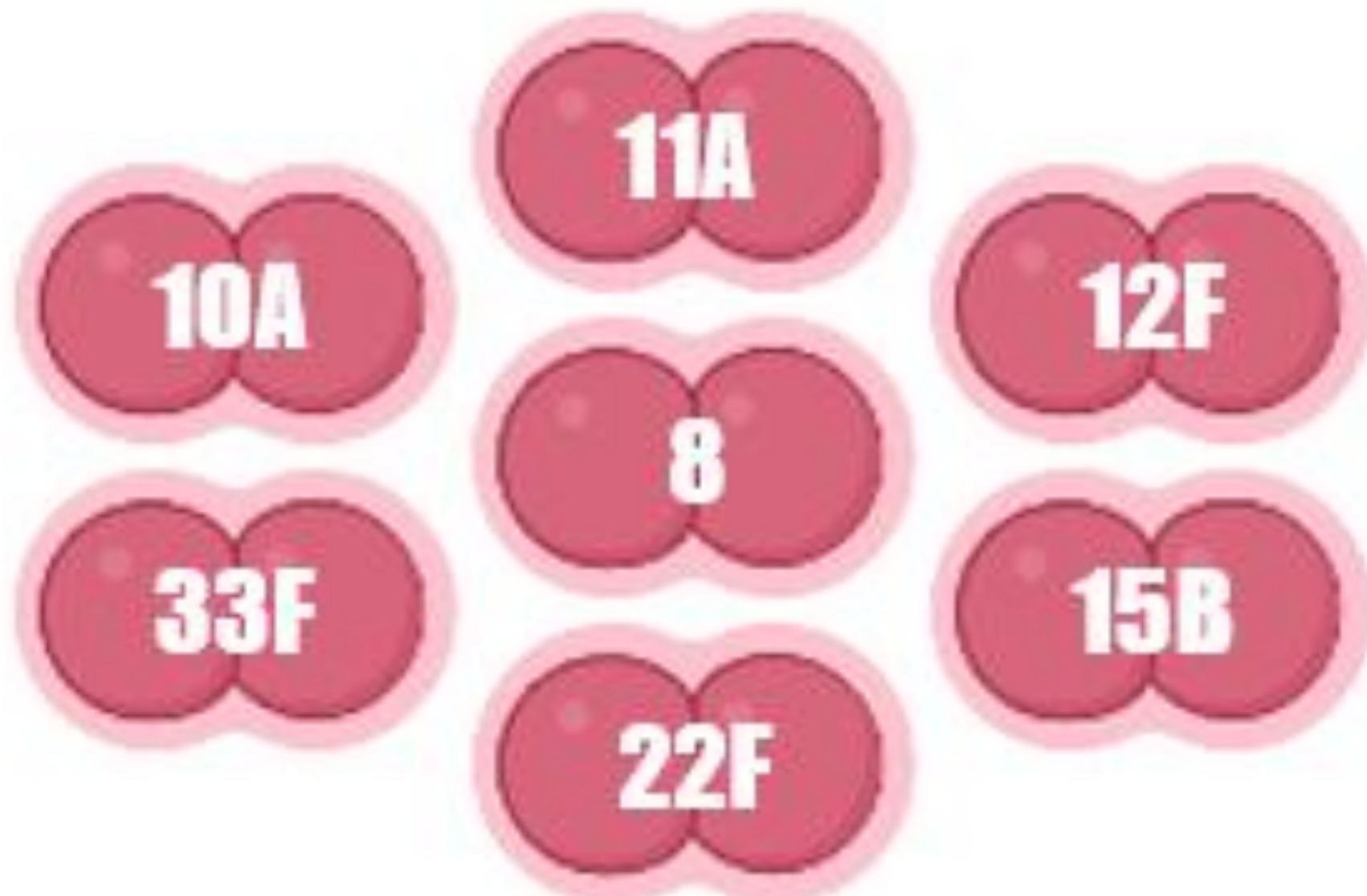
This broader, but still specific, immune response can respond to both red-jacketed and green-jacketed pneumococci now.



Even with red and green jackets mostly out of the picture, there are still plenty of shades in the pneumococcal disease rainbow.



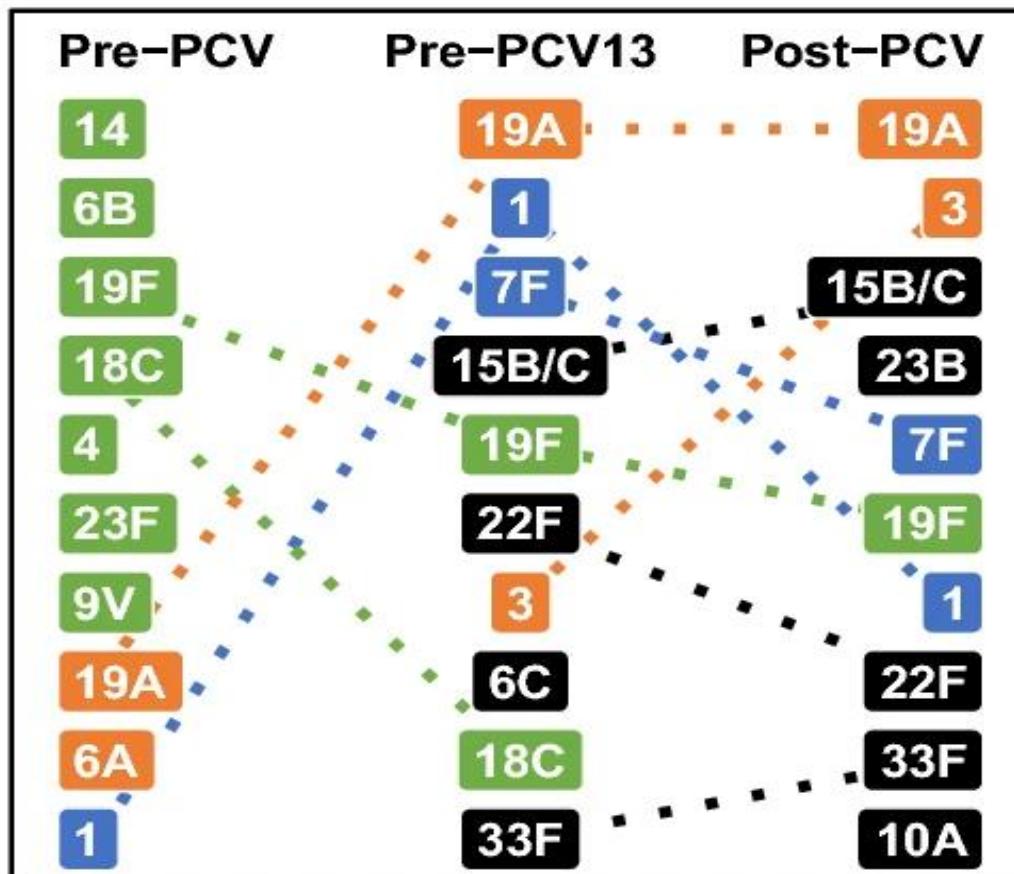




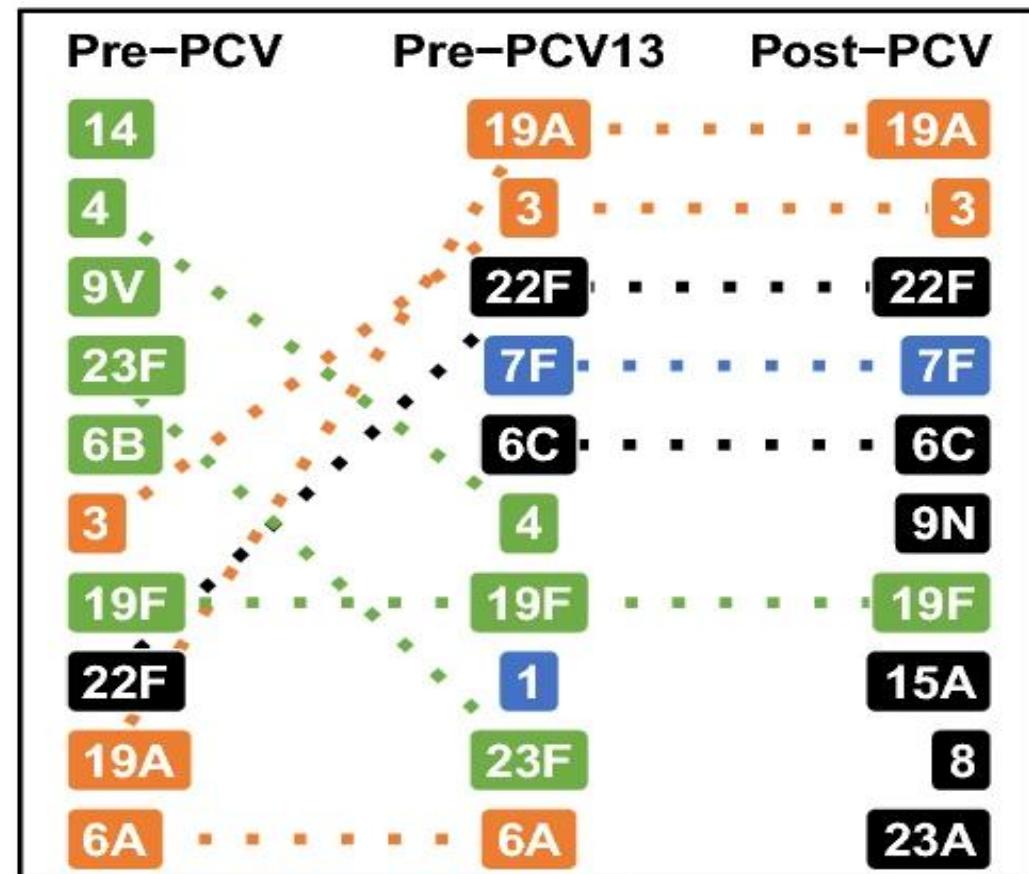
# Serotype Replacement Differences by Age

A

Australia < 18 yrs



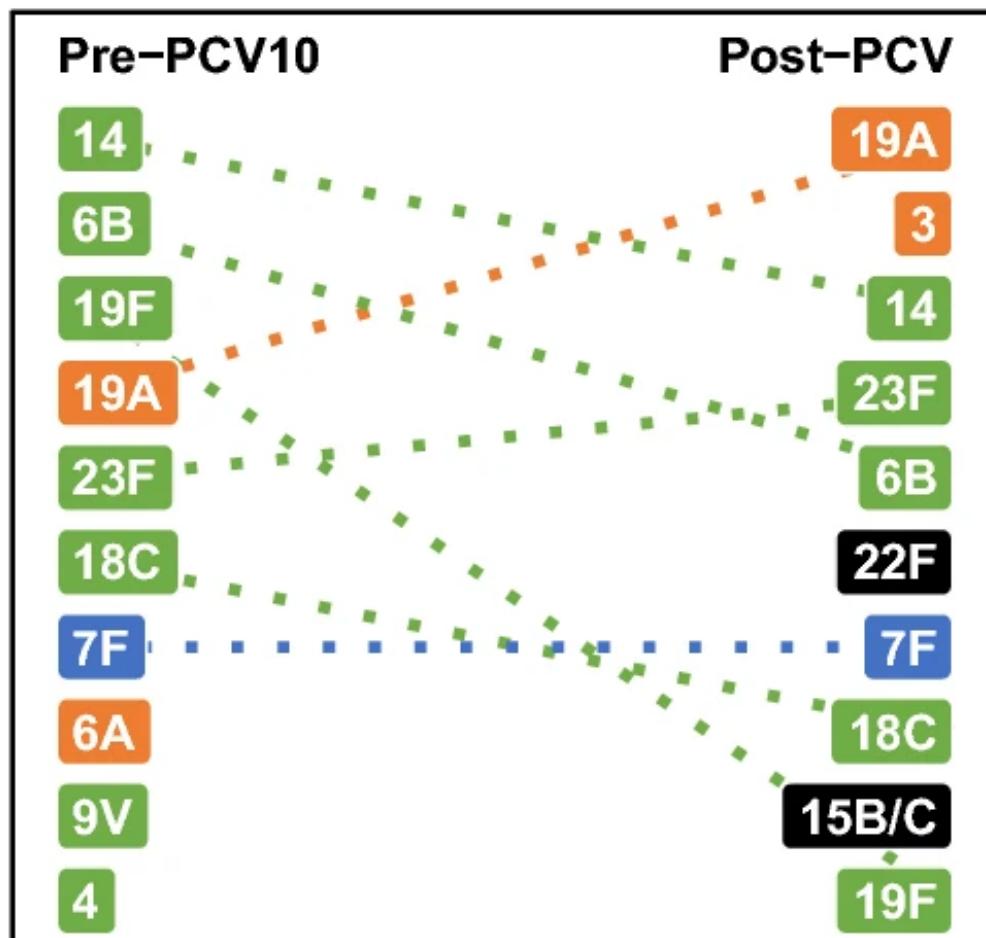
Australia > 18 yrs



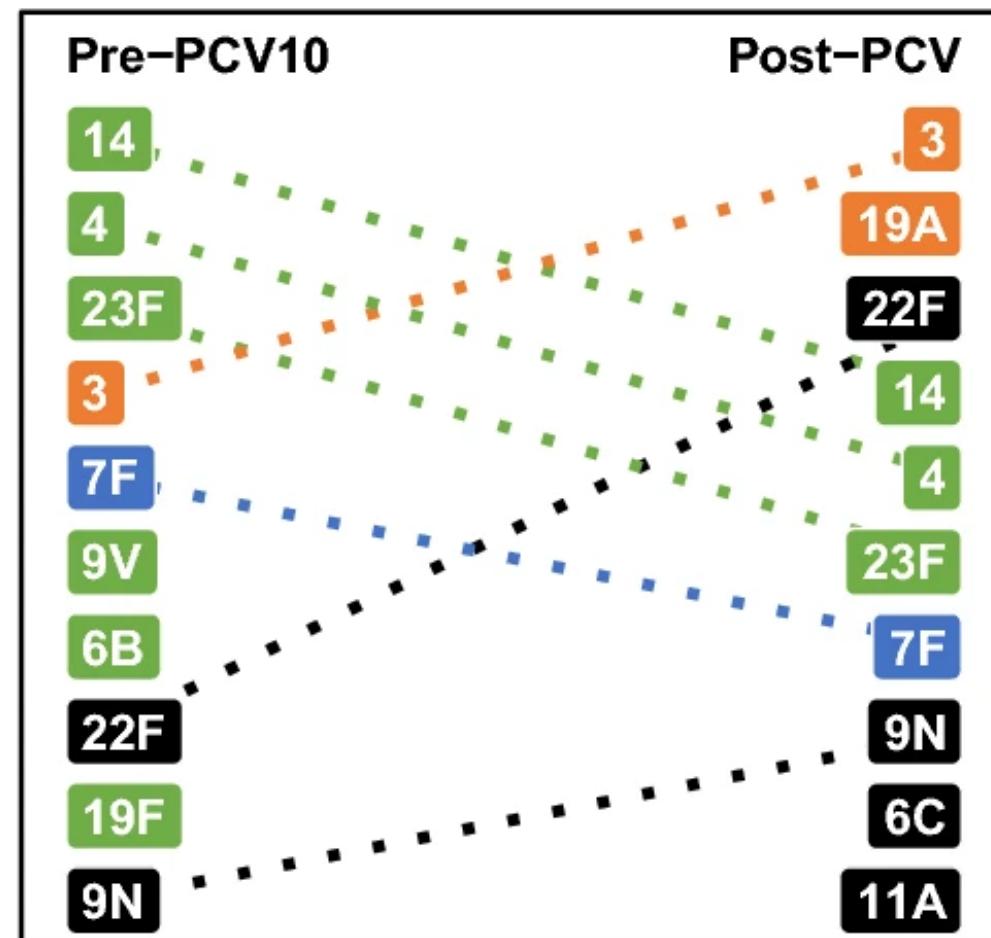
# Serotype Replacement Differences by Age

B

Finland < 18 yrs



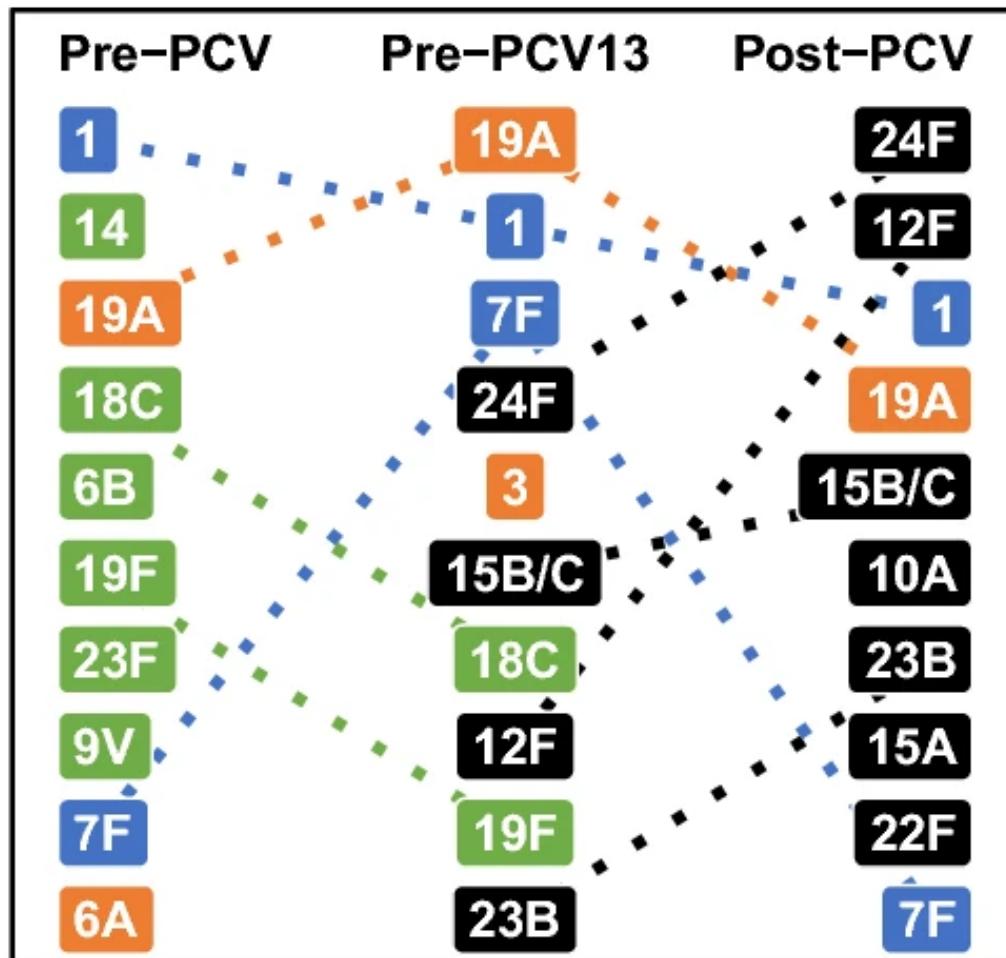
Finland > 18 yrs



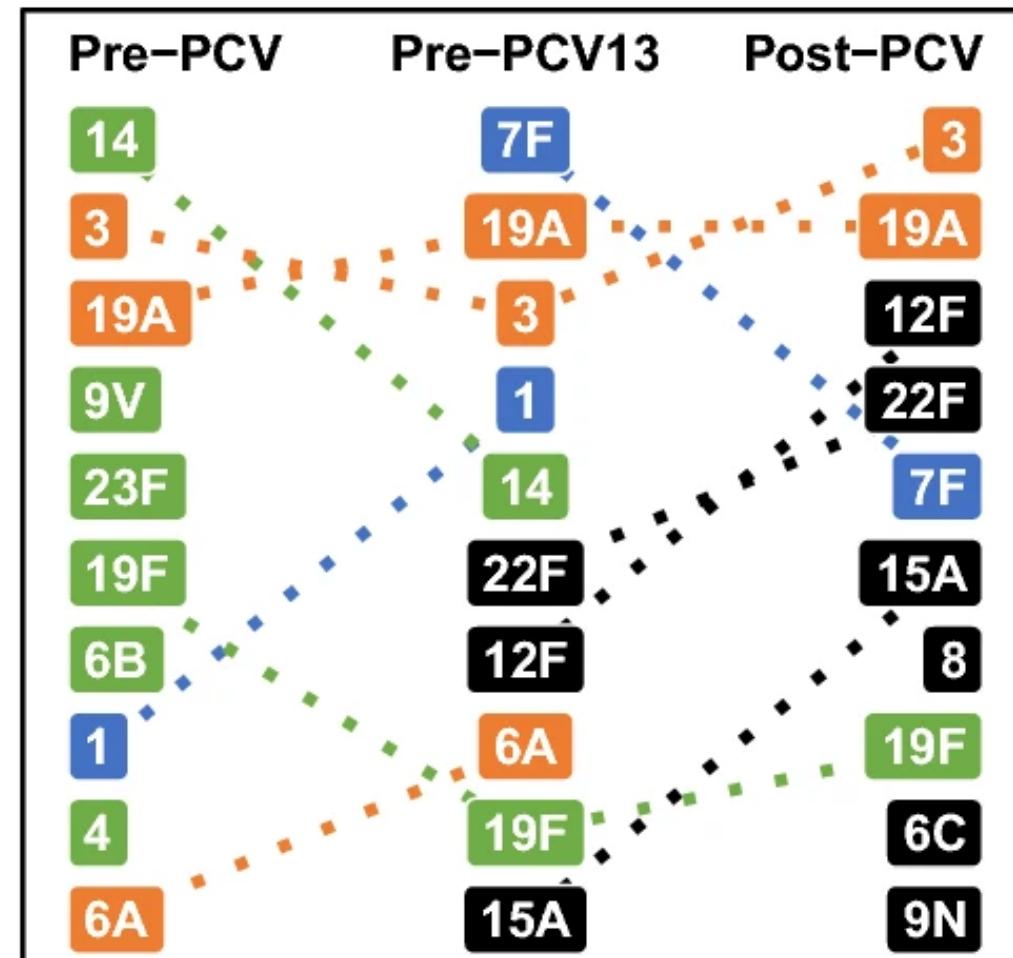
# Serotype Replacement Differences by Age

C

France <16 yrs



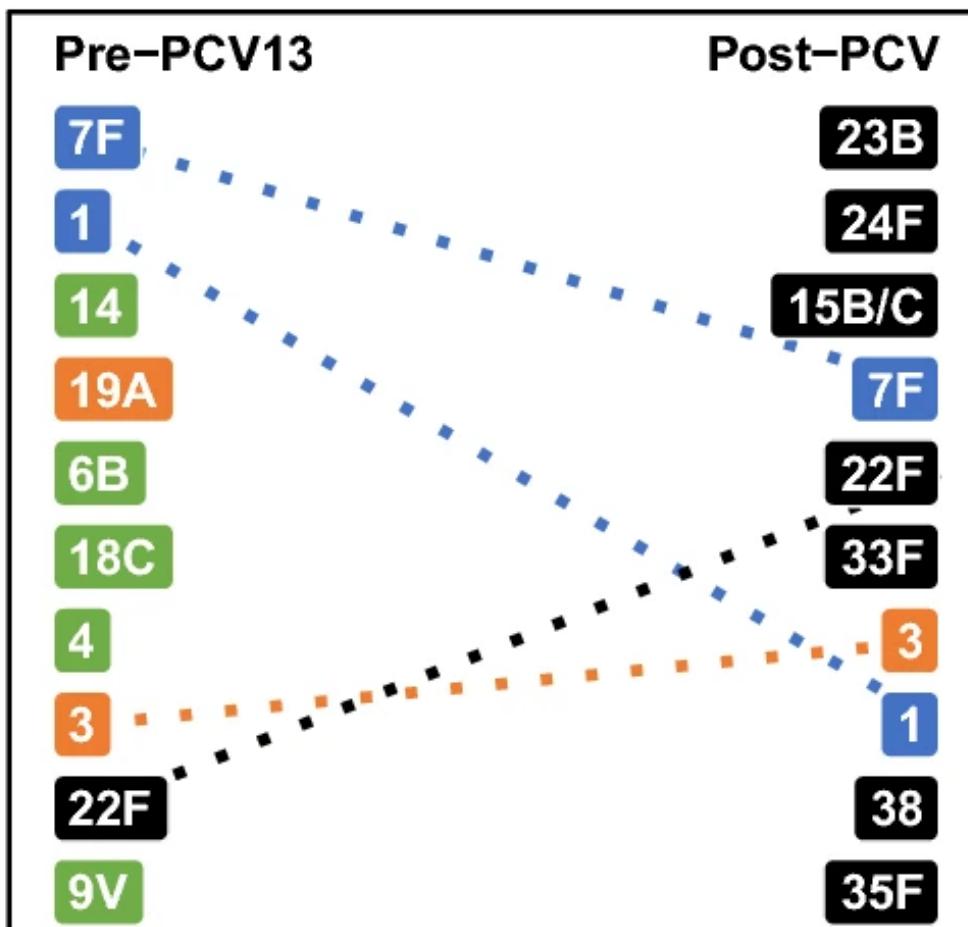
France >16 yrs



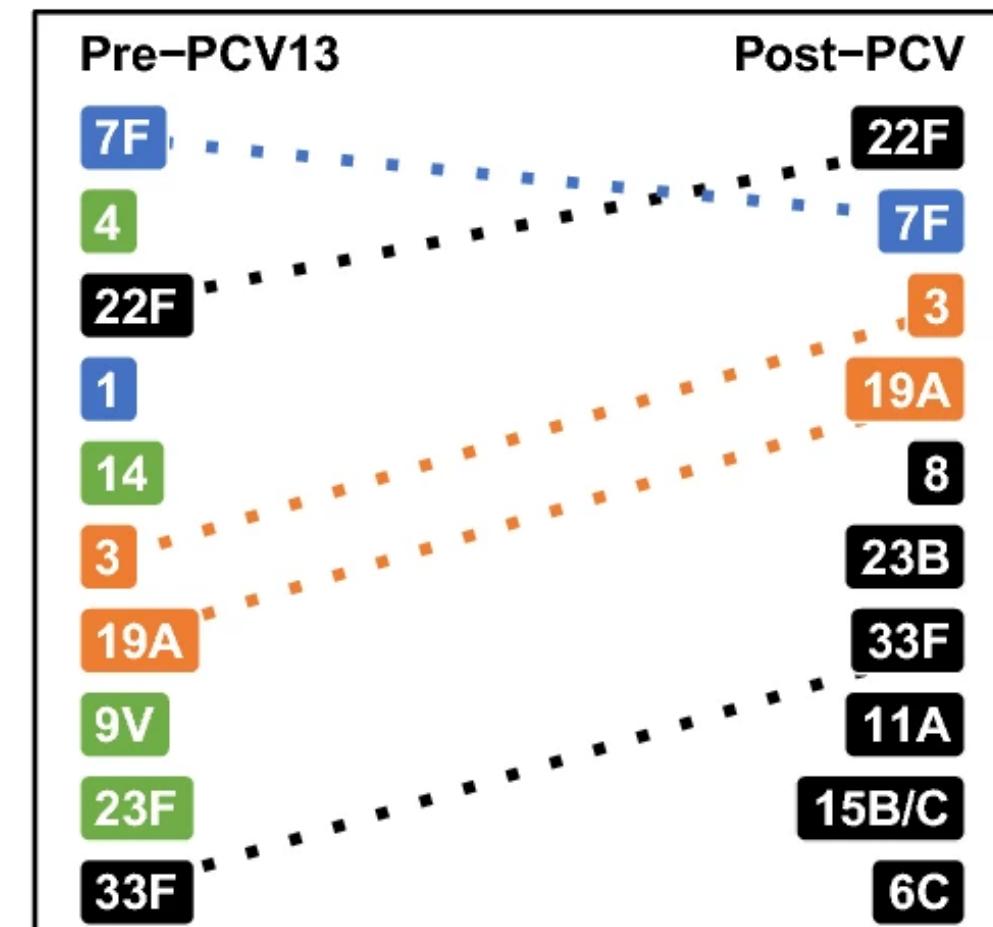
# Serotype Replacement Differences by Age

D

Norway < 18 yrs



Norway > 18 yrs

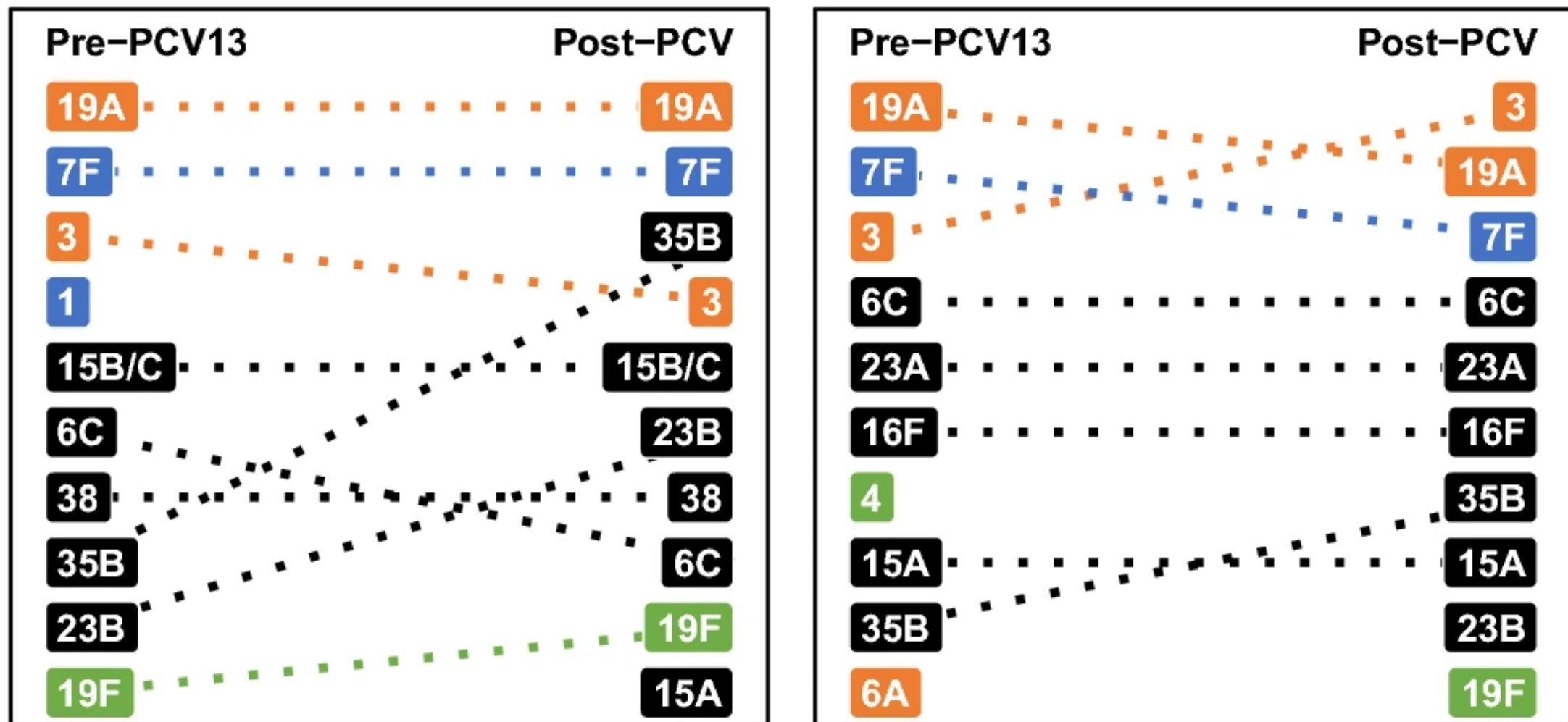


# Serotype Replacement Differences by Age

E

USA < 18 yrs

USA > 18 yrs



# Example: Surveillance of non-Invasive Pneumococcal Pneumonia (SnIPP)

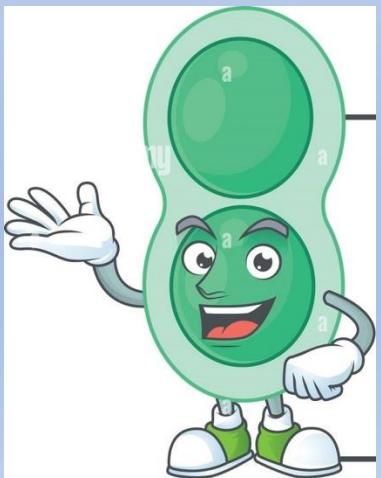
# Why pneumococcal pneumonia?

- #
- \$

**Death**

Invasive  
Pneumococcal  
Disease

**Non-invasive Disease**



# Clinical Presentations: IPD

- **Invasive** Pneumococcal Disease
  - bacteria isolated from a normally sterile site within the body
    - blood
    - cerebrospinal fluid
    - synovial fluid
- Severe, high mortality illnesses
  - meningitis
  - sepsis
  - bacteremic pneumonia

# Surveillance of IPD

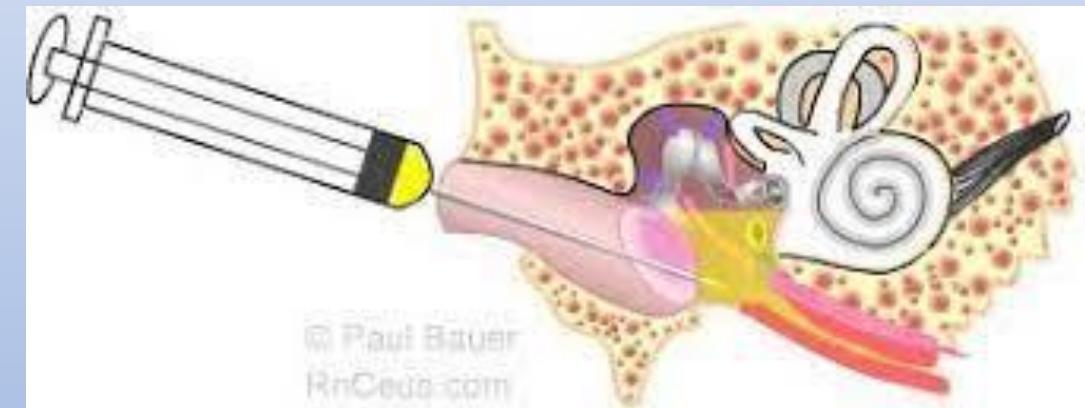
- 109 countries have an IPD surveillance system
- IPD is hard to miss, but not impossible

# Clinical Presentation: NIPD

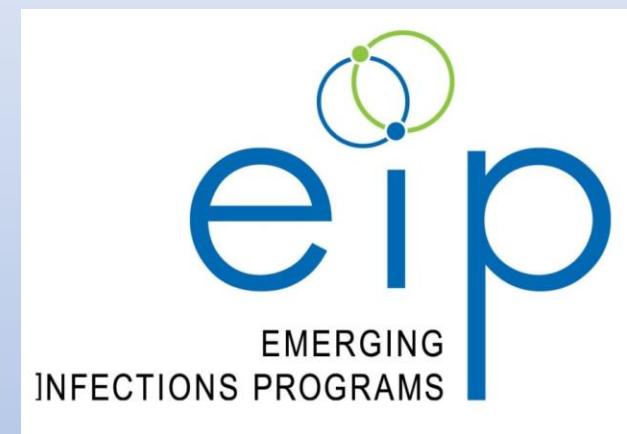
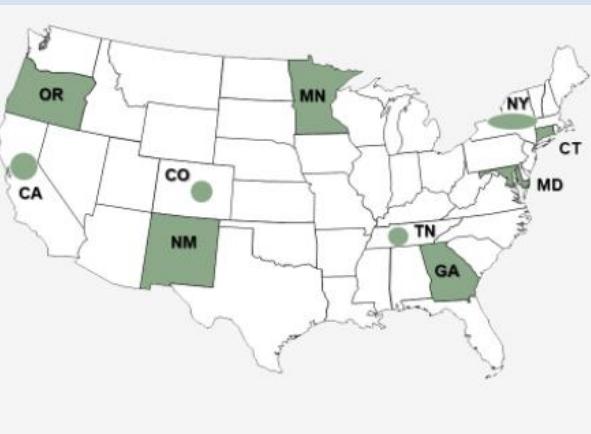
- Non-invasive Pneumococcal Disease
  - bacteria overgrow and infect tissue, causing disease
    - Middle ear fluid
    - Sputum
    - Urine
  - Less severe, but can be clinically serious and can lead to IPD and death
  - HUGE burden of disease
    - Hospitalizations
    - Primary care visits
    - Antibiotic use

# Surveillance of Non-invasive Disease

- Patchy, syndromic
- Etiology of NIPDs not often ascertained
  - Treat empirically
  - Sample collection issues
- NIPDs are easy to miss
  - But if missed
    - underestimated burden of disease
    - underestimate cost-effectiveness of vaccines



# Surveillance System Participants



# Surveillance System Participants

- Physician/APRN- clinical suspicion of pneumonia, trust in PUAT
- Clin Micro Lab- timely result, sufficient sample volume
- CT DPH staff- receive faxes of Case Report Forms
- Yale EIP personnel- verify cases and submit them to CDC
- CDC- use compiled case data for analyses and to inform recommendations for pneumococcal vaccine policy

# Surveillance System Technology



# **So Why Bother?**

# Why pneumococcal pneumonia?

- #
- \$

# Pneumococcal Vaccines

- Costs of IPD + NIPD warrant costs of vaccines
  - Costs of vaccines are high
- Pneumococcal vaccines were in use in 145 countries (as of 2020)
- Vaccines are highly effective at protecting against included serotypes
  - Other serotypes rise in prevalence and replace vaccine serotypes

# CT SNiPP goals

- Contribute to national analyses of non-invasive pneumococcal pneumonia trends
- Inform adult vaccine recommendations
- Save money, improve clinical management, reduce antibiotic use, etc.

# CDC → ABC → CT SNiPP



# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

### How to count SNiPP cases?

- Does a case get identified?
- Does a case reported?
- Does a case get verified?

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

Does a case get identified?

- Decision point hub 0: Patients
  - Access to care
  - PCP vs ED

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

Does a case get identified?

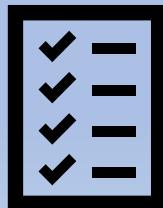
- Decision point hub 1: Point of care
  - Clinical suspicion (EMR)
  - PUAT
  - CXR or CT

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

Does a case get reported?

- Decision point hub 2: Lab to Lab
  - Clinical microbiology
  - Administrative staff
  - System compatibility



# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

Does a case get verified?

- Decision Point hub 3: Data Quality
  - System compatibility
  - Inclusion/exclusion criteria

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

### Inclusion/Exclusion Criteria

- Has pneumococcal pneumonia
  - Positive UAT
  - Clinically confirmed inpatient pneumonia
- Is  $\geq 18$  years old
- Resident of New Haven County or Resident of Fairfield County
- Non-invasive disease
- No prior hospitalization for pneumococcal pneumonia within 30 days

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

DATE: 02/09/21 @ 0738  
USER: [REDACTED]

Stamford Hospital LAB \*LIVE\*  
LIS SPECIMEN MARKER REPORT  
ACTIVITY DATES: 10/01/20 - 01/31/21  
MARKERS: S

STAMFORD HOSPITAL (HP0243)  
REPORTABLE DISEASES

MODULE: LAB

Pt Addr: [REDACTED] 41/F <DIS IN 01/09> [REDACTED] 626C-01 60NC [REDACTED]  
0104:S00510R STAMFORD, CT 203 [REDACTED]  
Subm Dr: [REDACTED] COMP, Coll: 01/04/21-1350 Recd: 01/04/21-1715  
Ordered: LEGIONELLA AG, S PNEUMO UR AG  
Markers: S

Test	Result	Flag	Reference
LEGIONELLA AG	NEGATIVE		NEGATIVE
STREP PNEUMO AG	POSITIVE	*	NEGATIVE
# Results called to: [REDACTED] RN/   # by: [REDACTED] at 1047 on 01/05/21			

Reportable Laboratory Findings  
Diseases Relating to Public Health - Form OL-15C  
For information or to order forms call (860) 509-7994. (rev. 01/01/2021)

Connecticut Department of Public Health  
410 Capitol Avenue, MS #11FDS  
P.O. Box 340308  
Hartford, CT 06134-0308

FEB 5 2021

Patient Last Name: [REDACTED] First: [REDACTED] D.O.B: 1955 Age: 65  
Street Address: [REDACTED] City: BRIDGEPORT State/Zip Code: CT [REDACTED]  
Patient Phone: (203) [REDACTED] Gender: Male Female Other specify: [REDACTED]  
Race: White Black/African Amer. Asian Amer. Indian/Alaska Nat. Nat. Hawaiian/Other Pacific Islander  
Other specify: Unknown If patient resides in a LTC facility please check: Yes  
Occupation: [REDACTED] Name and address of workplace: [REDACTED]  
Attending Physician Last Name: Wolff, Armand John, MD First: [REDACTED] Phone: (203) 384-5009

Dr. [REDACTED]  
Bridgeport Hospital  
Pathology Dept, Microbiology Lab  
267 Grant Street  
Bridgeport CT 06610  
203-384-3068

Specimen collection date: 01/30/2021  
Date laboratory finding reported to physician: 01/30/2021  
Date OL-15C completed: 01/30/2021  
Hospital Chart No.: [REDACTED] Lab Specimen No: T3866946  
Source/Type specimen: Urine  
Submitted to state lab (see reverse): Yes No

*Babesia*  IFA IgM (iter)  IgG (iter)  PCR  Other  microfl  divergans  duncanii  Unspecified  
 *Bordetella pertussis* (iter)  Culture <sup>1</sup>  Non-pertussis *Bordetella* <sup>1</sup> (specify)  DFA  PCR  
 *Borrelia burgdorferi* <sup>2</sup>  *Borrelia miyamotoi*  
 *Campylobacter* spp.  Culture  PCR  EIA  
 *Candida auris* (report samples from all sites) <sup>1,3</sup>  *Candida* spp. [blood isolates only] <sup>1,3</sup>  
 *Carbenepenem-resistant Acinetobacter baumannii* (CRAB) <sup>1,4</sup>  *Carbenepenem-resistant Enterobacteriaceae* (CRE) <sup>1,4</sup>  
 *Catapeltis* spp.  Carboxyhemoglobin ≥ 5% <sup>2</sup>  % COHb  
 *Chikungunya virus*  Chlamydia trachomatis (test type)  Clostridium difficile <sup>5</sup>  
 *Corynebacterium diphtheriae* <sup>1</sup>  *Cryptosporidium* spp. <sup>3</sup>  PCR  DFA  EIA  
 *Cyclospora* spp.  Microscopy  Other   
 *Dengue virus*  *Eastern equine encephalitis virus*

*Legionella* spp. <sup>1</sup>  Culture  DFA  IgG positive  PCR  
 *Listeria monocytogenes* <sup>1</sup>  Culture  PCR  
 *Mercury poisoning*  *Methicillin resistant Staphylococcus aureus* (MRSA) <sup>1</sup>  *Methicillin resistant Staphylococcus epidermidis* (MRSE) <sup>1</sup>  *Murphy's virus* <sup>1,2</sup>  PCR  
 *Mycoplasma leprae*  *Mycobacterium tuberculosis* Related Testing <sup>1</sup>  AFB Smear  Positive  Negative  Numerous NAAT  Mycobacterium tuberculosis  Non-TB mycobacterium (specify M)  Non-TB mycobacterium (specify M)  
 *Neisseria gonorrhoeae* (test type)  *Neisseria meningitidis*, Invasive <sup>1,4</sup>  Culture  Other  *Neonatal bacterial sepsis* <sup>1,3</sup> spp.  
 *Parvovirus* <sup>1</sup>  *Pseudomonas* spp.  *Powassan virus*  *Rabies virus*  *Rickettsia rickettsii*  PCR  IgG ≥1:128 only  Culture  
 *Respiratory syncytial virus* <sup>2</sup>  *Rubella virus* <sup>1</sup> (iter)  *Rickettsia* spp. <sup>1</sup>  PCR  
 *Salmonella* spp. <sup>1</sup> (serotype & type)  *St. Louis encephalitis virus*  *Salmonella* 1,2 (serotype & type)  Culture  PCR

YALE-NEW HAVEN HOSPITAL  
Clinical Microbiology Laboratory  
20 York Street - PS 656, New Haven, CT 06504  
Telephone (203) 688-2460  
Laboratory Manager: Jacqueline Nadeau

JAN 25 2020

To: Connecticut Department of Public Health  
410 Capitol Avenue, MS #11FDS  
P.O. Box 340308  
Hartford, CT 06134-0308

### LABORATORY REPORT OF SIGNIFICANT FINDINGS

Disease Description: *Streptococcus pneumoniae* Antigens

Patient Name: [REDACTED] DOB: [REDACTED] 1974 Sex: F  
Street Address: [REDACTED] City: West Haven State/Zip Code: CT [REDACTED]  
Patient Telephone: (475) [REDACTED] Hispanic? Unk Race: Black

Attending Physician Name: [REDACTED] Telephone: (203) [REDACTED]  
Address: YNH, 20 York Street, New Haven, CT 06510

Specimen Collection Date: 1/19/2021  
Date Reported to Physician: 1/20/2021  
Date Report Completed: 1/19/2021  
Hospital Chart Number: [REDACTED]  
Hospital Lab Number: 21Y-019MI0453

SPFILT\_20220106\_3cf21736-b06d-48bd-a58f-bbe43a7b5692 - Notepad

File Edit View

PatientLastName PatientFirstName PatientMiddleName PatientGender PatientDOB PatientAddress1 PatientAddress2 PatientCity PatientState PatientPostalCode PatientPhone  
ntityIdentifier FillingLabEntityIdentifier PerformingOrganizationCLIA Result ResultUnits ResultReferenceRange ResultStatus ResultNotes AbnormalFlags LOINC LOINCT  
[REDACTED] Male 1942-01-01 [REDACTED] New Britain CT 24027-5 S pneum Ag Ur Q1 10828004 Positive SPFILT CWE URINE Urine  
PRESNG  
Presumptive Negative  
F Positive for pneumococcal pneumonia A

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

Connecticut Electronic Disease Surveillance System



Enter Case ID

Search

Stephanie Perniciaro ▾



### Workflows

Workflow Queue	Events
ABCs ELR Lab Reports	383 (0)
ABCs Report Notification	23 (0)
Legionella - Health Care Exposure	213 (0)
Legionella Case Not Interviewed workflow	33 (0)
Legionella ELR Lab Reports	3 (0)
<a href="#">More ...</a>	

### Tasks

Type	Priority	Name	Disease OR Condition
No tasks to display			
			<a href="#">More ...</a>

### Recent Cases

Event ID	Name	Disease OR Condition
100781387		Streptococcus pneumoniae
105325748		Streptococcus pneumoniae
105325311		Streptococcus pneumoniae Streptococcus

### CTEDSS System Support and Contact Information

When you are finished working in CTEDSS, please **make sure you LOG OUT of the system** before closing the browser window. Simply closing the window does not end your CTEDSS session and continues to tie up system resources.

#### Contact information for CTEDSS:

- During regular business hours (M-F, 8:30 am - 4:30 pm) Phone: 860-509-7994 Email: [dph.ctedss@ct.gov](mailto:dph.ctedss@ct.gov)
- If using email, please send a detailed description of the problem and include screen shots if possible. If you see an error message, please include that in your description.
- For CTEDSS after hours, weekends or holiday **outages only**, call **860-509-7777** (the DPH IT HelpDesk). Please leave your name, a contact phone number and a brief description of the problem.

### CTEDSS System News and Tips

- To return to this "**Splash Screen**" from your event dashboard, click on your name at the top right portion of the screen and select **Close Record**, or click on the 'X' to the far right of the Event Summary title bar.
- **A CTEDSS Training Course:** All users of the CTEDSS program are required to complete an on-line CTEDSS training course. To obtain training information for new staff, please e-mail [dph.ctedss@ct.gov](mailto:dph.ctedss@ct.gov) and we will provide details on how to register for this training.
- **Animal Rabies Search:** Before searching for cases of Animal Rabies, the State field must be set to blank.
- **HASS data:** HASS information is no longer collected here. If you have questions, please email [DPH.Syndromic@ct.gov](mailto:DPH.Syndromic@ct.gov).
- **Case Definitions** for CDC Nationally Notifiable Diseases and Other conditions: [www.cdc.gov/nndss/conditions/](http://www.cdc.gov/nndss/conditions/)

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

The image displays two side-by-side screenshots of a computer application interface, likely a Microsoft Windows program, used for managing SNiPP surveillance data.

**Left Screenshot:** This window shows a detailed view of a patient record. The main panel contains a large amount of text describing symptoms, medical history, and treatment plans. Key text includes:

- Initial presentation: "Initial presentation: Acute onset of fever and chills, productive cough with purulent sputum, and right-sided chest pain."
- Medical history: "Medical history: Past history of chronic obstructive pulmonary disease (COPD) with frequent exacerbations, hypertension, and type 2 diabetes mellitus."
- Treatment: "Treatment: Empirical antibiotic therapy with ciprofloxacin 500 mg twice daily, oral fluids, and oxygen saturation monitoring."

A sidebar on the left lists "Past Medical History" and "Medications". At the bottom, a "Patient List" section shows several entries.

**Right Screenshot:** This window displays a list of patients in a grid format. The columns are labeled: "ID", "Name", "Date of Birth", "Gender", "Race", "Ethnicity", and "Address". The data for the first few rows is as follows:

ID	Name	Date of Birth	Gender	Race	Ethnicity	Address
0000123456	John Doe	1980-01-01	Male	White	Caucasian	123 Main Street
0000123457	Jane Doe	1985-01-01	Female	White	Caucasian	123 Main Street
0000123458	David Smith	1970-01-01	Male	White	Caucasian	456 Elm Street
0000123459	Sarah Smith	1975-01-01	Female	White	Caucasian	456 Elm Street
0000123460	Michael Johnson	1965-01-01	Male	White	Caucasian	789 Oak Street
0000123461	Emily Johnson	1980-01-01	Female	White	Caucasian	789 Oak Street

# SNiPP

## Surveillance of Non-invasive Pneumococcal Pneumonia

Logged in as 748603 | Log out

My Projects

**Project Home and Design**

- Project Home · Codebook
- Project status: **Production**

**Data Collection — CT**

- Record Status Dashboard
- Add / Edit Records
- Show data collection instruments

**Applications**

- Calendar
- Data Exports, Reports, and Stats
- Data Import Tool
- Logging
- Field Comment Log
- File Repository
- CDC REDCap Resource Center

Reports    [Search](#)    [Organize](#)    [Edit](#)

### Data Exports, Reports, and Stats

[VIDEO: How to use Data Exports, Reports, and Stats](#)

[+ Create New Report](#)

[My Reports & Exports](#)

[Other Export Options](#)

[View Report: 2019 case counts CT](#)

**Number of results returned: 238**

Total number of records queried: 957

Report execution time: 0.1 seconds

[Stats & Charts](#)

[Export Data](#)

[Print Page](#)

[Edit Report](#)

### 2019 case counts CT

Table not displaying properly [?](#)

State ID: pstateid	7a. Hospital/Lab I.D. Where UAT Identified? hospid	4a. Date first positive urine antigen test collected (Date Specimen Collected) uatdt	Complete? piidemographics_complete	5. CRF Status status
<a href="#">CT11002</a>			Unverified (1)	Not a case (5)
<a href="#">CT11069</a>		01-24-2020	Complete (2)	Complete (1)
<a href="#">CT11070</a>			Complete (2)	
<a href="#">CT11071</a>			Complete (2)	
<a href="#">CT11072</a>			Complete (2)	
<a href="#">CT11073</a>			Complete (2)	

# Your Turn



# CT SNiPP goals

- Contribute to national analyses of non-invasive pneumococcal pneumonia trends
- Inform adult vaccine recommendations
- Save money, improve clinical management, reduce antibiotic use, etc.

# Preview

- Time series analysis!

[ysph.yale.edu](http://ysph.yale.edu)  
[sph.yale.edu/dsde](http://sph.yale.edu/dsde)

@YaleSPH

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**Data Science and Data Equity**  
**Yale School of Public Health**  
**60 College Street, New Haven, CT 06510**

# Pneumococcal Diagnostics

# How do we find IPD?



# Blood culture guidelines for CAP

**Table 2. Differences between the 2019 and 2007 American Thoracic Society/Infectious Diseases Society of America Community-acquired Pneumonia Guidelines**

Recommendation	2007 ATS/IDSA Guideline	2019 ATS/IDSA Guideline
Sputum culture	Primarily recommended in patients with severe disease	Now recommended in patients with severe disease as well as in all inpatients empirically treated for MRSA or <i>Pseudomonas aeruginosa</i>
Blood culture	Primarily recommended in patients with severe disease	Now recommended in patients with severe disease as well as in all inpatients empirically treated for MRSA or <i>P. aeruginosa</i>
Macrolide monotherapy	Strong recommendation for outpatients	Conditional recommendation for outpatients based on resistance levels

# Criteria for severe CAP

**Table 1. 2007 Infectious Diseases Society of America/American Thoracic Society Criteria for Defining Severe Community-acquired Pneumonia**

Validated definition includes either one major criterion or three or more minor criteria

**Minor criteria**

Respiratory rate  $\geq$  30 breaths/min

$\text{Pa}_{\text{O}_2}/\text{F}_{\text{I}_{\text{O}_2}}$  ratio  $\leq$  250

Multilobar infiltrates

Confusion/disorientation

Uremia (blood urea nitrogen level  $\geq$  20 mg/dl)

Leukopenia\* (white blood cell count  $<$  4,000 cells/ $\mu\text{l}$ )

Thrombocytopenia (platelet count  $<$  100,000/ $\mu\text{l}$ )

Hypothermia (core temperature  $<$  36°C)

Hypotension requiring aggressive fluid resuscitation

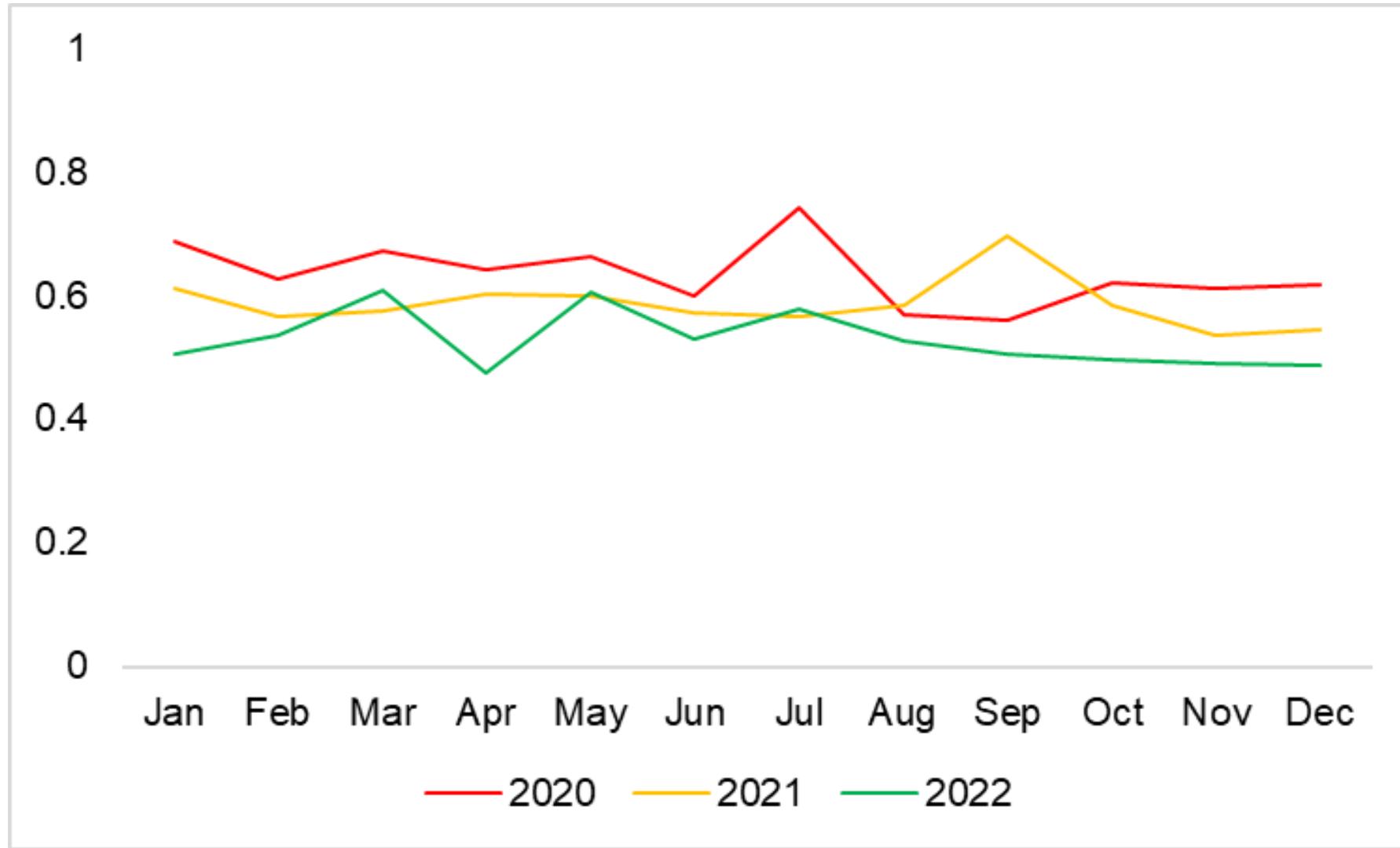
**Major criteria**

Septic shock with need for vasopressors

Respiratory failure requiring mechanical ventilation

\*Due to infection alone (i.e., not chemotherapy induced).

# YNHH Admissions with a primary diagnosis of pneumonia, proportion of cases with blood culture



# YNHH Admissions with a primary diagnosis of sepsis, proportion of cases with blood culture

