

Session 2a:

Goals of an Immunization Program

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Learning Objectives:

- Establishing Medical Need
- Role of epidemiological data in developing and monitoring immunization strategy
- Active & Passive surveillance programs
 - Polio, Influenza, COVID
- Eradication vs. limitation
- Universal vs. targeted immunization

Establishing Medical Need: Key Components

- Epidemiology of the Disease:
 - Asymptomatic infection, illness, severe illness, death?
- Target Population for Vaccination:
 - High-risk group(s) vs. General Public?
 - Children??
- Disease Burden:
 - Death vs. hospitalization vs. long term disability?
 - How do you quantify these outcomes?
 - QALYs and DALYs

QALYs and DALYs

- Quality adjusted life year (QALY):
 - Health status measure used to account for the impact of a health state on both quality and quantity of life.
 - A QALY is valued at 1.0 for perfect health and at 0.0 for death, typically with negative values (fates worse than death) allowed.
 - The loss of one year of QALY is equivalent to losing a year of quality of life in perfect health due to premature mortality.
- Disability-adjusted life years (DALYs).
 - One DALY is the complement of one QALY; i.e., $DALY = 1 - QALY$.

Health Economics

- Cost-benefit analysis:
 - Direct medical costs of the disease vs. direct medical costs of the immunization intervention
 - Indirect costs of the disease vs. the intervention:
 - Lost economic productivity, school absenteeism.....
 - Eradication vs. Control
 - Eradication: costs are time limited, benefits are not
 - Control: costs are ongoing
- Zhou et. al. An economic analysis of the universal varicella vaccination program in the United States. *J Infect Dis.* 2008;197 Suppl 2:S156-S164.

Role of epidemiological data in developing and monitoring immunization effectiveness & safety

- **Passive surveillance programs:**

- Standardized report forms available from state/ local DOHs which are returned when cases are detected & reported by practitioners.

- **Benefits:**

- Less costly than active reporting systems
 - Data collection is not burdensome to health officials
 - Data can be used to identify trends or outbreaks if reporting is robust

Passive surveillance programs:

- **Limitations:**

- Non-reporting/under-reporting → ↓ representativeness of the data, → undetected trends/outbreaks, inappropriate conclusions

- **Reasons for not reporting:**

- Lack of awareness of reporting requirements by health care providers
- Perception by health care providers that nothing will be done with the data
- Lack of interest, burdensome reporting forms, etc.
- Case definitions that are unclear, recently changed, or changes in reporting requirements
- Hardware/software systems that cannot capture the necessary information in databases
- Stigmatization associated with the disease to be reported (i.e. STDs)
- Patient is not willing to provide necessary information

Active surveillance programs

- **Outreach by Public Health Officials, or their designates:**
 - Regular telephone calls/visits to labs, hospitals, providers
 - Elicit/verify case reports and/or review medical records, lab reports and other alternative sources
 - Regular data transfers (e.g. hospitals/ clinic data to NYC Immunization Registry)
 - Identify cases that may not have been reported by passive surveillance systems

Active surveillance programs

- **Benefit: improved & more complete reporting**
 - Rationale for Active Surveillance:
 - Conditions of particular importance
 - Document a suspected outbreak
 - Augment timely disease intervention or epidemiologic investigation (congenital syphilis, intrapartum Hepatitis b)
 - Validation of representativeness of passive reports
 - Enhance accuracy, completeness, and timeliness of reporting
 - Assess impact of immunization programs
 - Vaccine preventable diseases targeted for eradication (smallpox):
 - Reassess strategy: mass immunization → targeted ring immunization
- **Limitation: much higher costs**

How Do You Evaluate Surveillance Programs?

- 1988, Pan American Health Organization polio eradication effort:
- **Required surveillance indicators**
 - **Measures of surveillance infrastructure**
 - Number of reporting units reporting on a weekly basis
 - **Timeliness of notification**
 - The interval between case onset and notification
 - **Adequacy of case investigation**
 - The proportion of cases with appropriate lab specimens
 - **Timeliness of laboratory testing**

Polio

- Active surveillance for acute flaccid paralysis (AFP)
- Lab testing for confirmation of wild-type & vaccine-associated polio isolates
- **Protocol:**
 - **Identify cases clinically consistent** with polio (suspected cases)
 - High sensitivity, lower specificity
 - **Track suspected cases** until lab either confirms or rules out wild-type poliovirus
 - May be performed on only a subset of all cases of AFP
 - **If adequate laboratory testing was not obtained**, the case was classified as “compatible” and considered a failure of case investigation and surveillance

Polio

- In the absence of polio, other causes of AFP in children occur at a fairly constant rate over time:
 - Allows monitoring of the adequacy of ascertainment of suspected cases of polio by tracking the **incidence of AFP among children <15 yrs.**
 - In countries/ regions reporting rates of AFP $\geq 1/100,000$ children <15 yrs and without confirmed/compatible cases of polio → confidence that the absence of reported cases of polio means the absence of polio.
 - However, if AFP rates were $< 1/100,000$ among children <15 yrs , the absence of cases could mean inadequate surveillance rather than the absence of polio.
- *Is there a similar comparison for COVID-19 clinical disease?*

How Do You Confirm That The Absence of Reported Cases = Absence of Disease?

- **External Standards:**
 - Detect cases of non-polio AFP
 - Detect non-type b H. influenzae in invasive disease (bacteremia & meningitis) in kids < 5 years
- **Identification of Imported Cases**
 - Measles, Polio & Congenital rubella
- **Monitor level of reporting of suspected cases that are eventually ruled out**
 - ↓ utility when disease of interest disappears
- **Monitor the diagnostic effort**
 - Track the number of samples submitted for testing over time
- **Monitor circulation of the organism**
 - Use molecular techniques for surveillance/ rubella, pertussis...
- ***What are some similar methods for COVID-19 virus circulation?***

Influenza

Goals of the current surveillance program

- Find out when & where influenza activity is occurring
- Track influenza-related illness
- Determine what influenza viruses are circulating
- Detect changes in influenza viruses
- Measure the impact that influenza & vaccine is having on hospitalizations and deaths

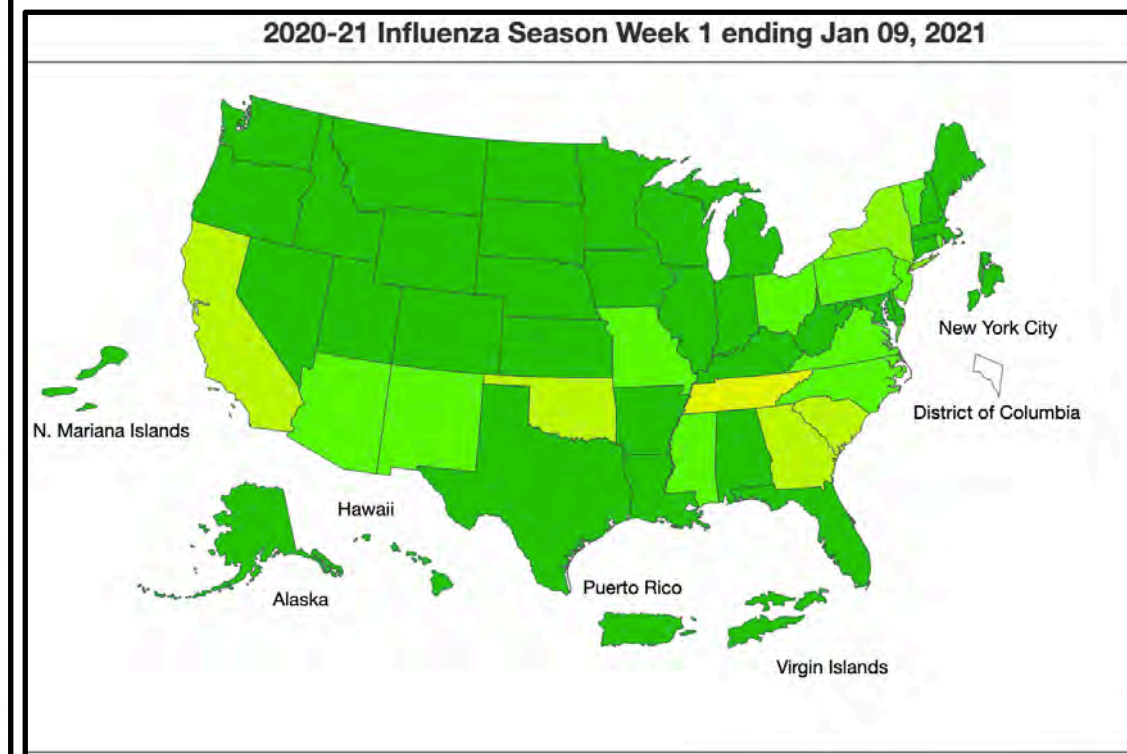
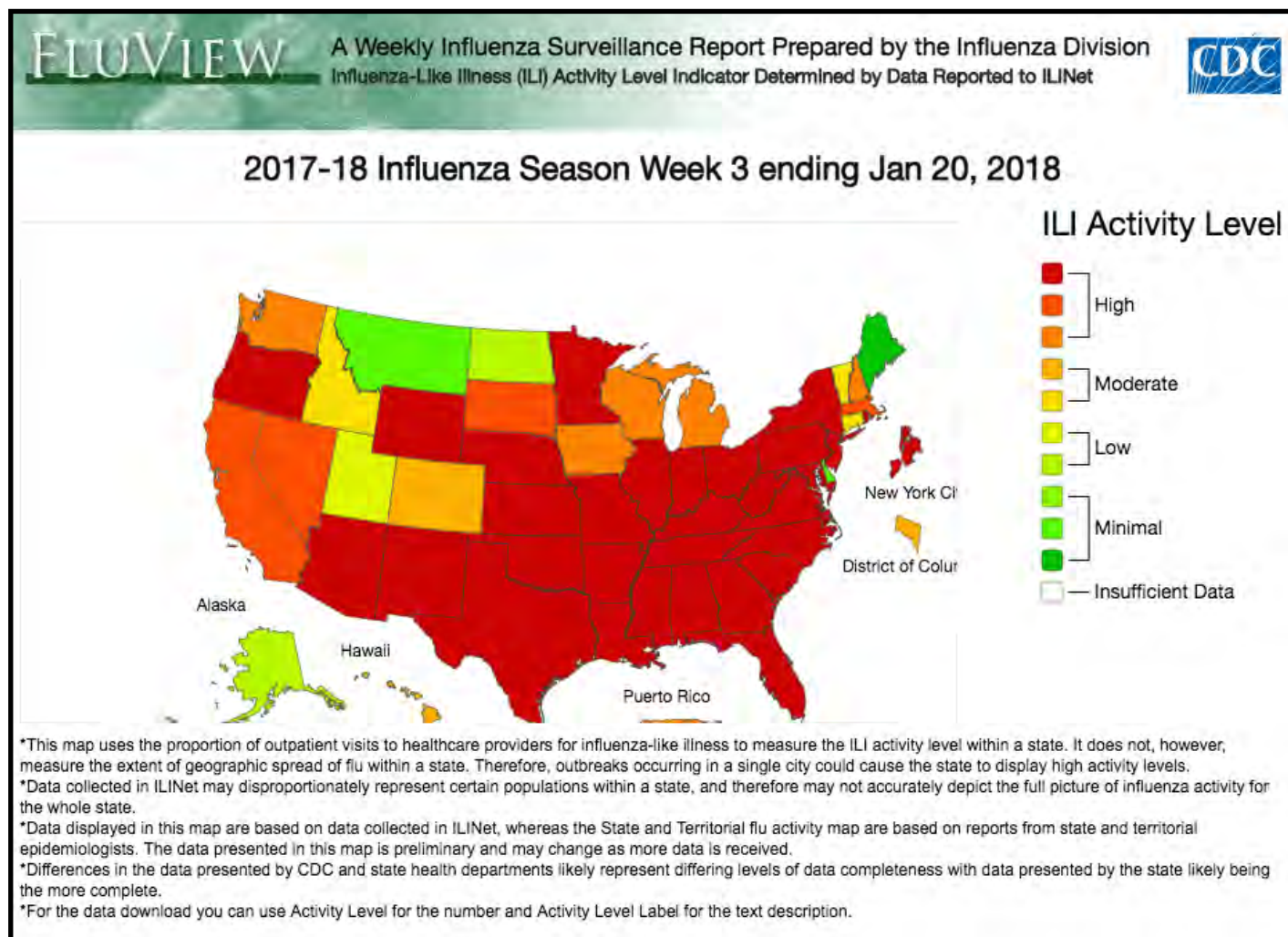
Influenza

- **Categories of Surveillance**
 - **Viral Surveillance:** 80 W.H.O. & 60 National Respiratory and Enteric Virus Surveillance System (NREVSS) labs in the U.S.
 - All state & some county Public Health labs & some large tertiary care/ academic medical centers
 - # of respiratory samples tested, # positive for influenza A & B, some report subtyping (A/H1N1 vs. A/H3N2), patient age
 - Further subtyping (A/H1N1 vs. A/2009 H1N1), antiviral resistance, sequencing, etc. carried out at the CDC
 - **U.S. Outpatient Influenza-like Illness (I.L.I.):**
 - <http://www.cdc.gov/flu/weekly/fluviewinteractive.htm>
 - ILI defined as **fever + cough and/or sore throat** in the absence of a **KNOWN** cause other than influenza
 - > 3,000 healthcare providers in all 50 states, the District of Columbia and the U.S. Virgin Islands reporting over 25 million patient visits each year.
 - Each week, approximately 1,800 outpatient care sites report to CDC
 - the total number of patients seen
 - the number of those patients with influenza-like illness (ILI) by age

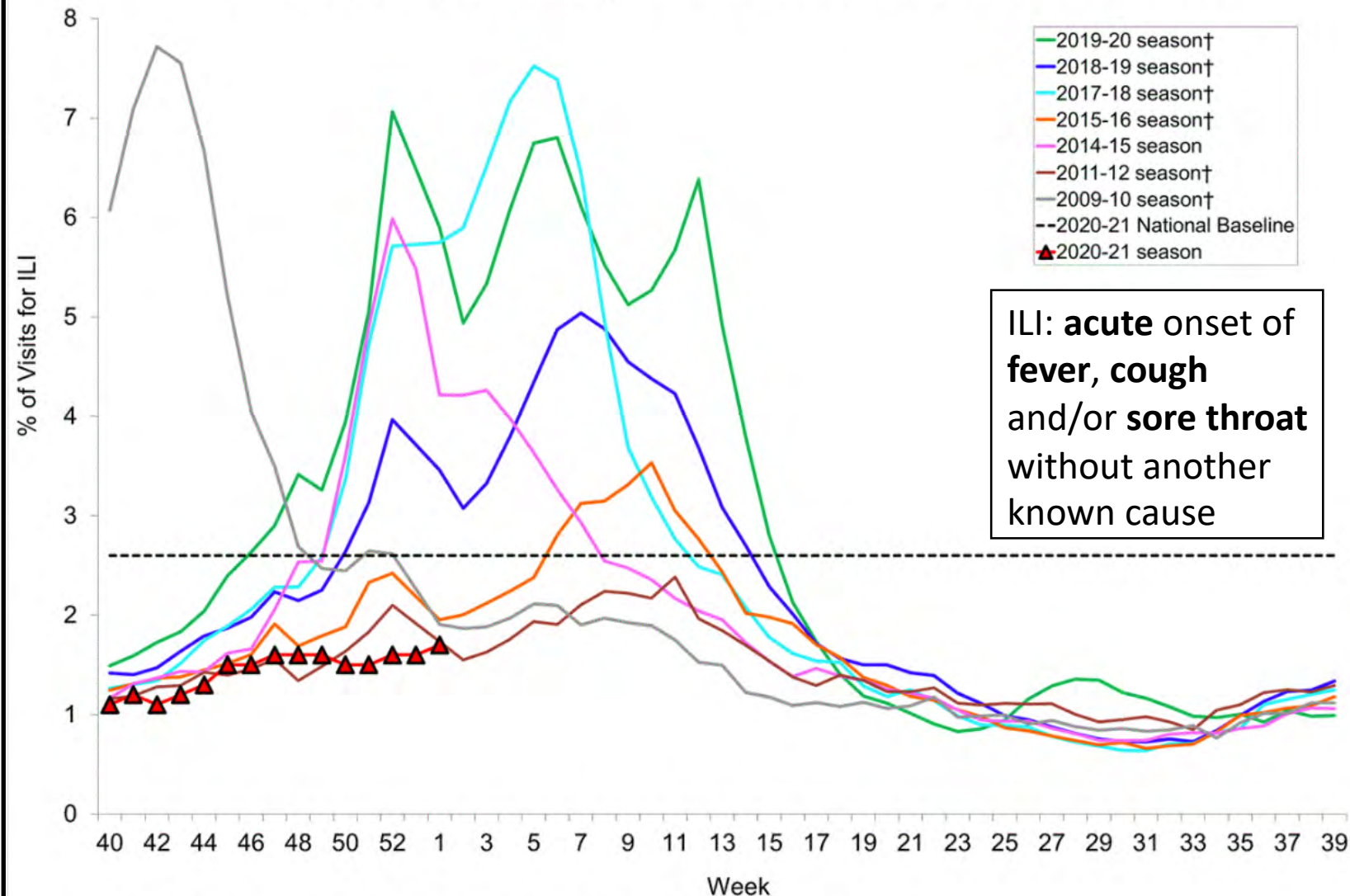
Influenza

- **Categories of Surveillance**
 - **Mortality Surveillance**
 - **122 Cities Mortality Reporting System** — each week, the vital statistics offices of 122 cities across the U.S. report total number of death certificates received & the number for which pneumonia or influenza was listed as the underlying or contributing cause of death by age group
 - **Influenza-Associated Pediatric Mortality Surveillance System:**
Any lab-confirmed influenza-associated death in a child < 18yrs.
 - **Hospitalization Surveillance**
 - Influenza Hospitalization Network (FluSurv-NET)
 - Aggregate Hospitalization and Death Reporting Activity (AHDRA)
 - **Summary of the Geographic Spread of Influenza**

Influenza Activity, USA: 2017-18 and 2020-21



Percentage of Visits for Influenza-like Illness (ILI) Reported by
the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet),
Weekly National Summary, 2020-2021 and Selected Previous Seasons



ILI: **acute** onset of
fever, cough
and/or **sore throat**
without another
known cause

†These seasons did not have a week 53, so the week 53 value is an average of week 52 and week 1.

COVID-19 Clinical Case Definition

(In the absence of a more likely diagnosis)

- At least **two** of the following symptoms:

- ***fever**** (measured or subjective)
- chills
- rigors
- myalgia
- headache
- ***sore throat****
- nausea or vomiting
- diarrhea
- fatigue
- congestion or runny nose

OR

- Any **one** of the following symptoms:

- ***cough****
- shortness of breath
- difficulty breathing
- new olfactory disorder
- new taste disorder

OR

- Severe respiratory illness with at least **one** of the following:

- Clinical or radiographic evidence of pneumonia,
- Acute respiratory distress syndrome (ARDS).

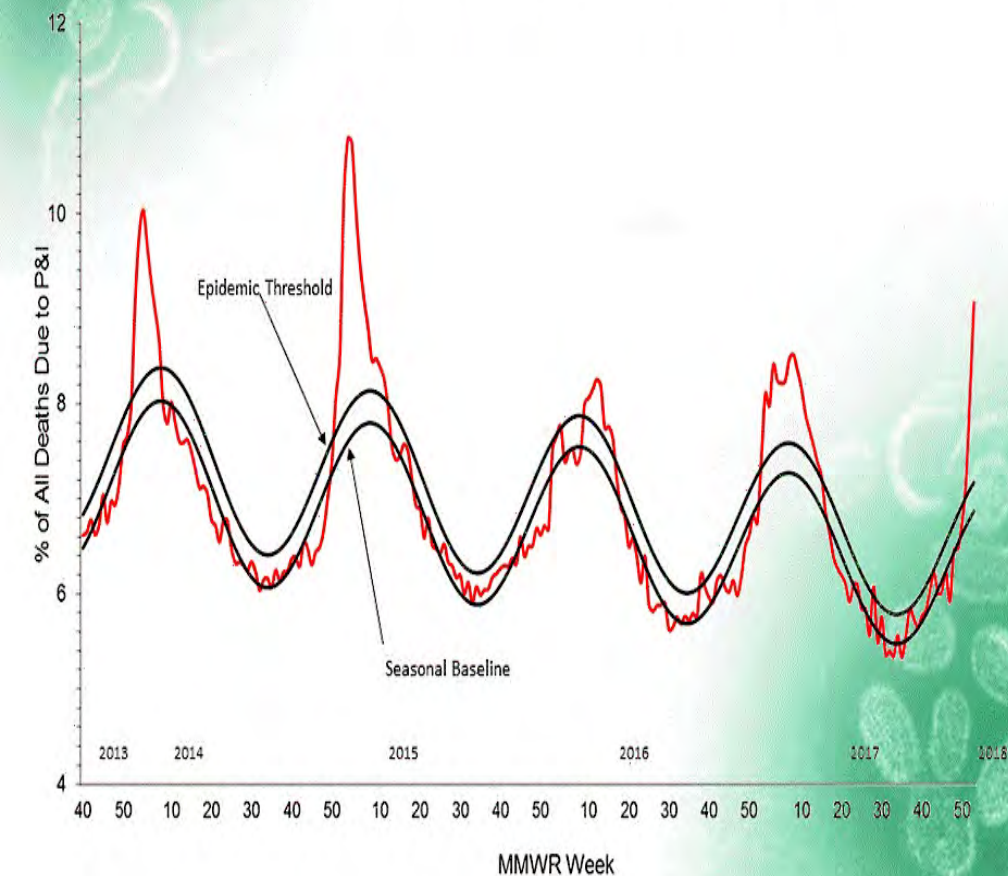
****Influenza-like illness criteria (ILI)***

FLUVIEW

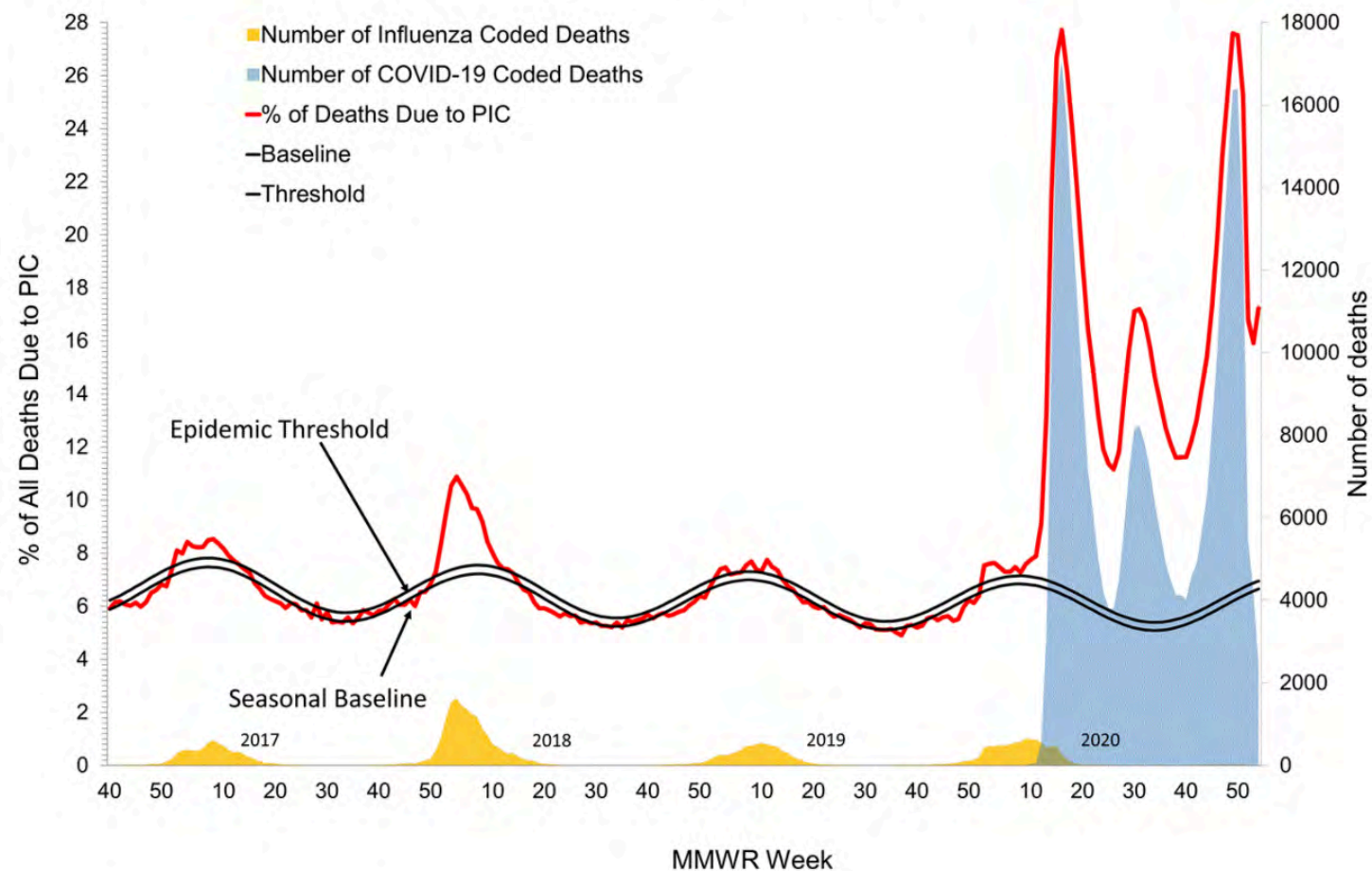
A Weekly Influenza Surveillance Report Prepared by the Influenza Division



Pneumonia and Influenza Mortality from the National Center for Health Statistics Mortality Surveillance System Data through the week ending January 6, 2018, as of January 25, 2018

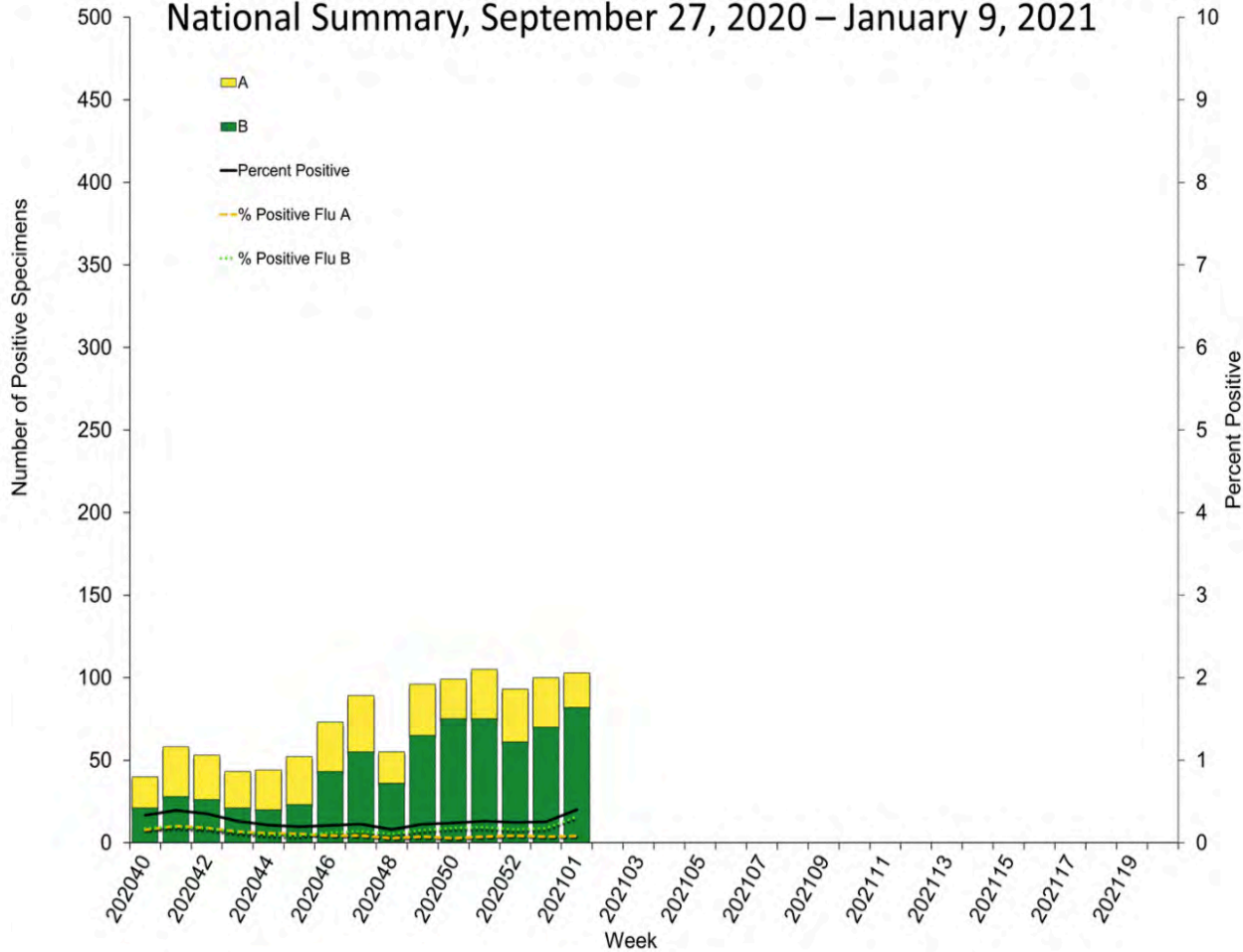


Pneumonia, Influenza, and COVID-19 Mortality from the National Center for Health Statistics Mortality Surveillance System Data through the week ending January 9, 2021, as of January 14, 2021

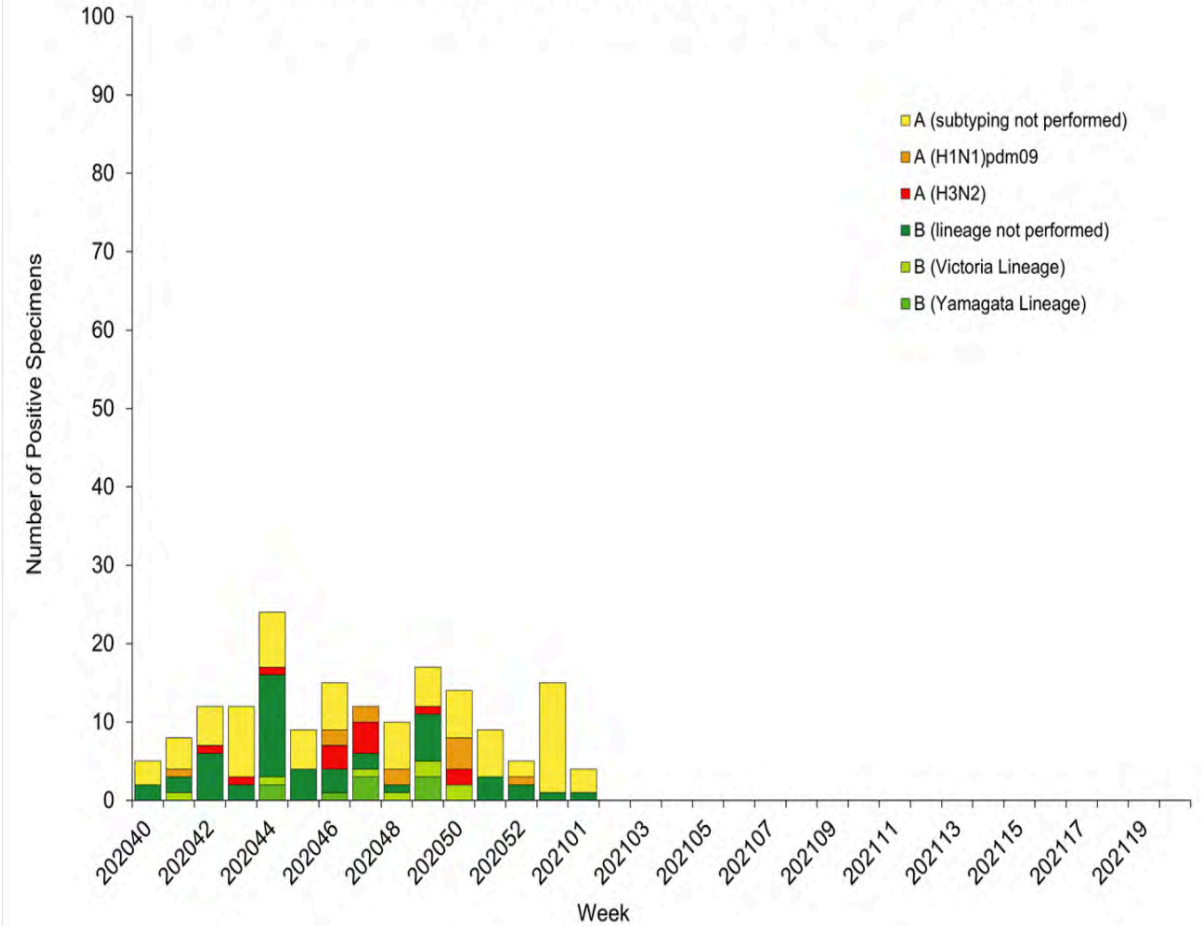


Influenza Positive Tests: 2020

Influenza Positive Tests Reported to CDC by U.S. Clinical Laboratories,
National Summary, September 27, 2020 – January 9, 2021



Influenza Positive Tests Reported to CDC by U.S. Public Health Laboratories,
National Summary, September 27, 2020 – January 9, 2021



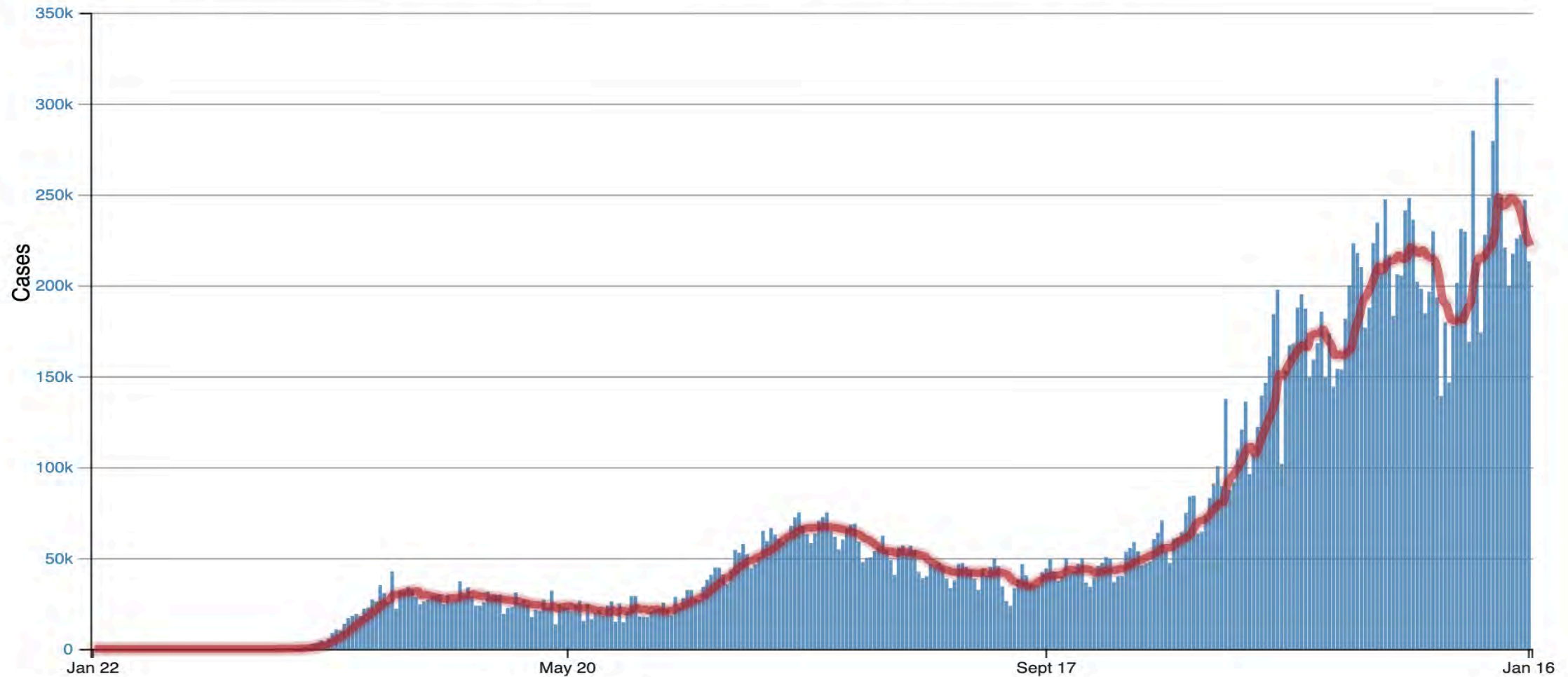
TOTAL CASES
23,653,919
+213,145 New Cases

CASES IN LAST 7 DAYS
1,551,850

TOTAL DEATHS
394,495
+3,557 New Deaths

CDC | Updated: Jan 17 2021 12:16PM

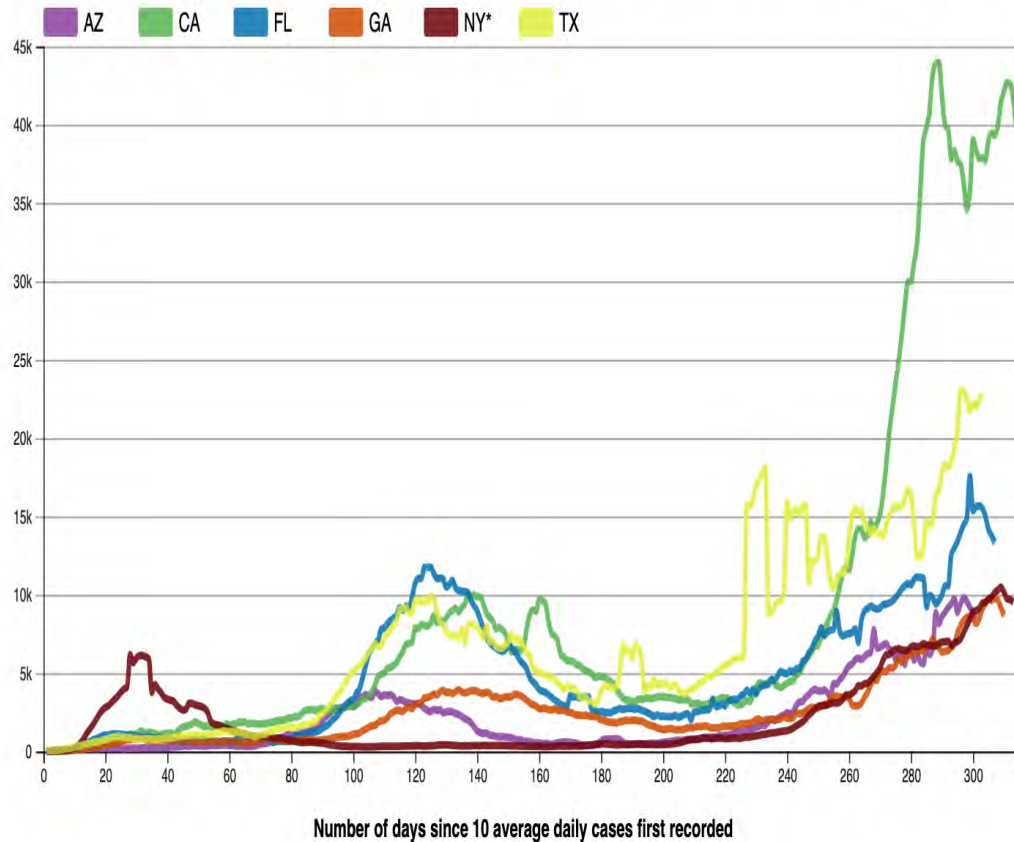
Daily Trends in Number of COVID-19 Cases in the United States Reported to CDC



New Cases of COVID: 2020

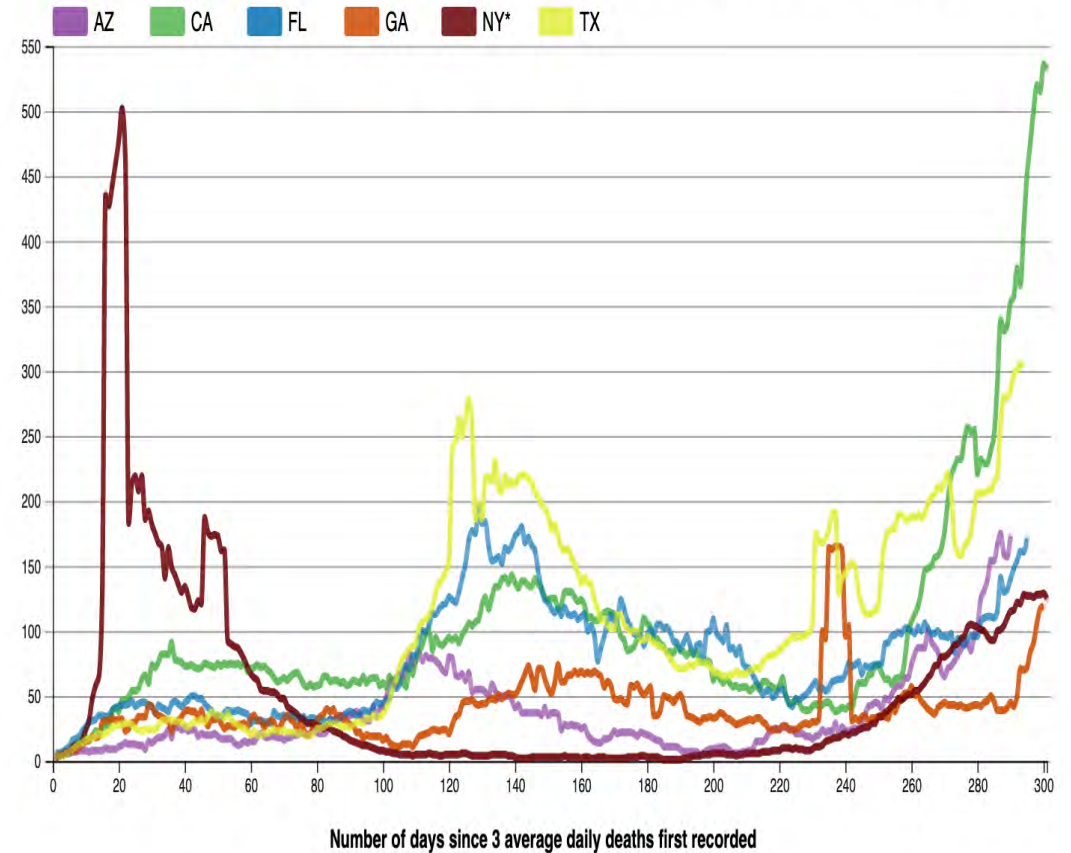
New cases of Covid-19, reported to CDC, in AZ, CA, FL, GA, NY, and TX

Seven-day moving average of new cases, by number of days since 10 average daily cases first recorded.



New deaths attributed to Covid-19, reported to CDC, in AZ, CA, FL, GA, NY, and TX

Seven-day moving average of new deaths, by number of days since 3 average daily deaths first recorded.



Eradication vs. limitation

- **Prerequisites:**
 - No sustainable animal or environmental reservoirs
 - No latent state
 - Highly effective & safe vaccine
 - Active surveillance is feasible
- **Designated candidates:** Smallpox, Polio, Measles
- **Possible candidates:**
 - **Hepatitis b:** carrier state, intrapartum transmission
 - **Varicella:** latency & zoster
- **Not possible:**
 - **Diphtheria, tetanus:** spores that survive in the environment:
 - **H. influenzae b, Pneumococcus:** Nasopharyngeal carriage not eradicated by immunization
 - **Pertussis:** vaccine is moderately effective
 - **HIV:** latency state, no effective vaccine

Universal vs. Targeted immunization

- Universal Immunization (Polio, Rubella, Varicella in USA)
- High-Risk Groups Only (ex: Rabies, Varicella in some countries)
- How relevant are these two approaches to the COVID pandemic?
 - Hybrid risk/ public health approach : recommendations were made with these goals in mind:
 - Decrease death and serious disease as much as possible.
 - Preserve functioning of society.
 - Reduce the extra burden COVID-19 is having on people already facing disparities.

When Supply is Limited, Who Should Get Vaccinated First?

- **1a: Healthcare personnel and residents of long-term care facilities** should be offered the first doses of COVID-19 vaccines
- **1b: Frontline essential workers** (fire fighters, police officers, corrections officers, food and agricultural workers, United States Postal Service workers, manufacturing workers, grocery store workers, public transit workers, and those who work in the educational sector (teachers, support staff, and daycare workers.)
- **1c: People aged 75 years and older**

As vaccine availability increases, vaccination recommendations will expand to include more groups:

- 65-74 years of age?
- Other essential workers?
- Adults <65 years with certain conditions?
- All healthy adults?
- Children?

Questions?