Near-real time surveillance of COVID-19 mortality using data from the National Vital Statistics System

Paul D. Sutton, Ph.D. and Lauren M. Rossen, Ph.D.
National Center for Health Statistics

2020 FCSM Fall Conference

September 21, 2020

National Vital Statistics System (NVSS)

The NVSS is the mechanism by which NCHS collects and disseminates the Nation's official vital statistics on births, deaths and fetal deaths. These data are provided through contracts between NCHS and the 57 vital registration jurisdictions (50 States, the District of Columbia, New York City and 5 territories).

Final Data

- Annual Final Micro-data files
- Analytic Reports

Provisional Data

- Tabulated counts and estimate based on incomplete data
  - Quarterly Provisional Estimates
  - Weekly Surveillance of Flu and Pneumonia Deaths
  - Monthly Provisional Counts of Drug Overdose Deaths

Provisional COVID-19 Death Counts: Understanding the Numbers

Things to know about the data

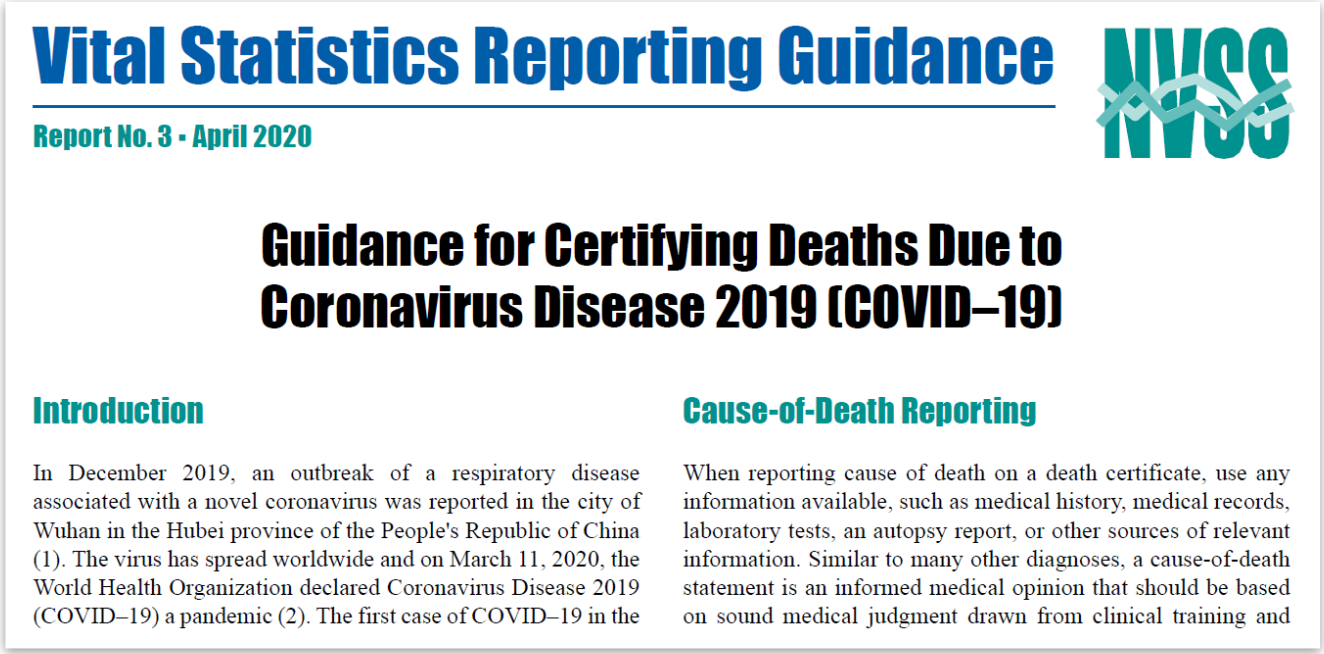
- Provisional counts are not final and are subject to change
- Provisional data are not yet complete
- Death counts should not be compared across jurisdictions

Why these numbers are different

- Death certificates take time to be completed
- States report at different rates
- It takes extra time to code COVID-19 deaths
- Other reporting systems use different definitions or methods for counting deaths

https://www.cdc.gov/nchs/data/nvss/coronavirus/Understanding-COVID-19-Provisional-Death-Counts.pdf

Guidance for Certifying COVID-19 Deaths



Vital Statistics Reporting Guidance

Report No. 3 • April 2020

NVSS

Guidance for Certifying Deaths Due to Coronavirus Disease 2019 (COVID–19)

Introduction

In December 2019, an outbreak of a respiratory disease associated with a novel coronavirus was reported in the city of Wuhan in the Hubei province of the People's Republic of China (1). The virus has spread worldwide and on March 11, 2020, the World Health Organization declared Coronavirus Disease 2019 (COVID–19) a pandemic (2). The first case of COVID–19 in the

Cause-of-Death Reporting

When reporting cause of death on a death certificate, use any information available, such as medical history, medical records, laboratory tests, an autopsy report, or other sources of relevant information. Similar to many other diagnoses, a cause-of-death statement is an informed medical opinion that should be based on sound medical judgment drawn from clinical training and

https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg03-508.pdf

Guidance for Certifying COVID-19 Deaths: Key Points

- If COVID–19 played a role in the death it should be mentioned on the death certificate
- It is acceptable to report COVID–19 on a death certificate as “probable” or “presumed” – certifiers should use their best clinical judgement in determining if a COVID–19 infection was likely and if the infection contributed to death
- Include pre-existing conditions that complicated death in Part 2 of the death certificate

COVID-19 Cause of Death Coding: ICD-10 Code

U07.1 -- COVID-19

***Excludes*:** Coronavirus infection, unspecified site (B34.2) Severe acute respiratory syndrome [SARS], unspecified (U04.9)

The WHO has provided a second code, **U07.2**, for clinical or epidemiological diagnosis of COVID-19 where a laboratory confirmation is inconclusive or not available. Because laboratory test results are not typically reported on death certificates in the U.S., NCHS is not planning to implement U07.2 for mortality statistics.

The underlying cause depends upon what and where conditions are reported on the death certificate. However, the rules for coding and selection of the underlying cause of death are expected to result in COVID-19 being the underlying cause more often than not.

COVID-19 Cause of Death Coding: Coding Process

- Coding systems not set up to code COVID-19 or to accept U07.1
- Establish coding rules
- Initially all COVID-19 records had to be manually coded
- Managing manual coding
  - Prioritization
  - Increase manual coding capacity
- Systems modified to automatically code some COVID-19 deaths
- Adjust coding rules

Provisional COVID-19 Death Counts by week

Data as of September 8, 2020

Week ending date in which the death occurred	COVID-19 Deaths (U07.1)	Deaths from All Causes
Total	**174,626**	**1,881,375**
2/1/2020	0	58,568
2/8/2020	1	59,282
2/15/2020	0	58,688
2/22/2020	5	58,723
2/29/2020	9	59,149
3/7/2020	35	59,507
3/14/2020	52	58,303
3/21/2020	571	58,966
3/28/2020	3,151	62,853
4/4/2020	10,007	72,108
4/11/2020	16,160	78,837
4/18/2020	17,039	76,505
4/25/2020	15,401	73,569
5/2/2020	13,114	68,960
5/9/2020	11,141	66,521
5/16/2020	9,143	64,162
5/23/2020	7,136	61,266
5/30/2020	6,090	59,283
6/6/2020	4,961	58,406
6/13/2020	4,163	57,481
6/20/2020	3,771	57,301
6/27/2020	3,728	57,683
7/4/2020	4,383	58,557
7/11/2020	5,518	59,842
7/18/2020	6,820	60,431
7/25/2020	7,676	60,670
8/1/2020	7,393	59,372
8/8/2020	6,799	57,887
8/15/2020	5,535	54,280
8/22/2020	3,504	46,411
8/29/2020	1,192	30,152
9/5/2020	128	7,652

Comparison of Cumulative COVID-19 Death Counts by Data Source (as of 9/8/2020)

Provisional COVID-19 Death Counts: Demographic and Geographic Detail

Causes of Death

- COVID-19
- Pneumonia and Influenza (with and without COVID-19)
- Other Selected Causes of Death (with and without COVID-19)

Demographic Detail

- Sex
- Age
- Race/Hispanic origin

Time Detail

- Cumulative for pandemic
- Monthly
- Weekly

Geographic Detail

- National
- HHS Region
- Jurisdiction/state
- County

} Counts 1-9 suppressed

Provisional COVID-19 Death Counts: Where to Find Them

NCHS webpages

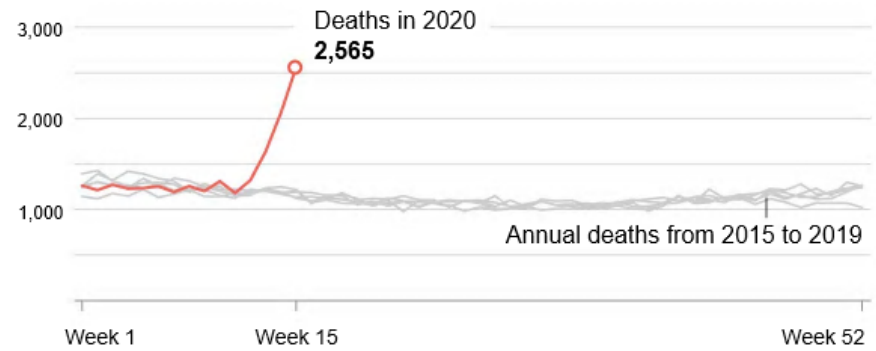
- Coronavirus Disease (COVID-19) Death Data and Reporting Guidance https://www.cdc.gov/nchs/nvss/covid-19.htm
  - Daily Updates of Totals by Week and State
  - Weekly Updates by Select Demographic and Geographic Characteristics
  - Health Disparities: Race and Hispanic Origin
  - Excess Deaths Associated with COVID-19

Download and API Access

- All data is simultaneously posted on data.cdc.gov
  - Export in a variety of formats
  - API Access - provides programmatic access to this dataset including the ability to filter, query, and aggregate data

Excess Mortality

The metric that could tell us when it's safe to reemerge



"Excess mortality is the number of deaths from any cause that both occur in a given time period and surpass the expected number. Deaths in the United States have been carefully counted for more than a century. These "all-cause mortality" numbers are extraordinarily stable. We know to a remarkable extent how many Americans are expected to die every day."

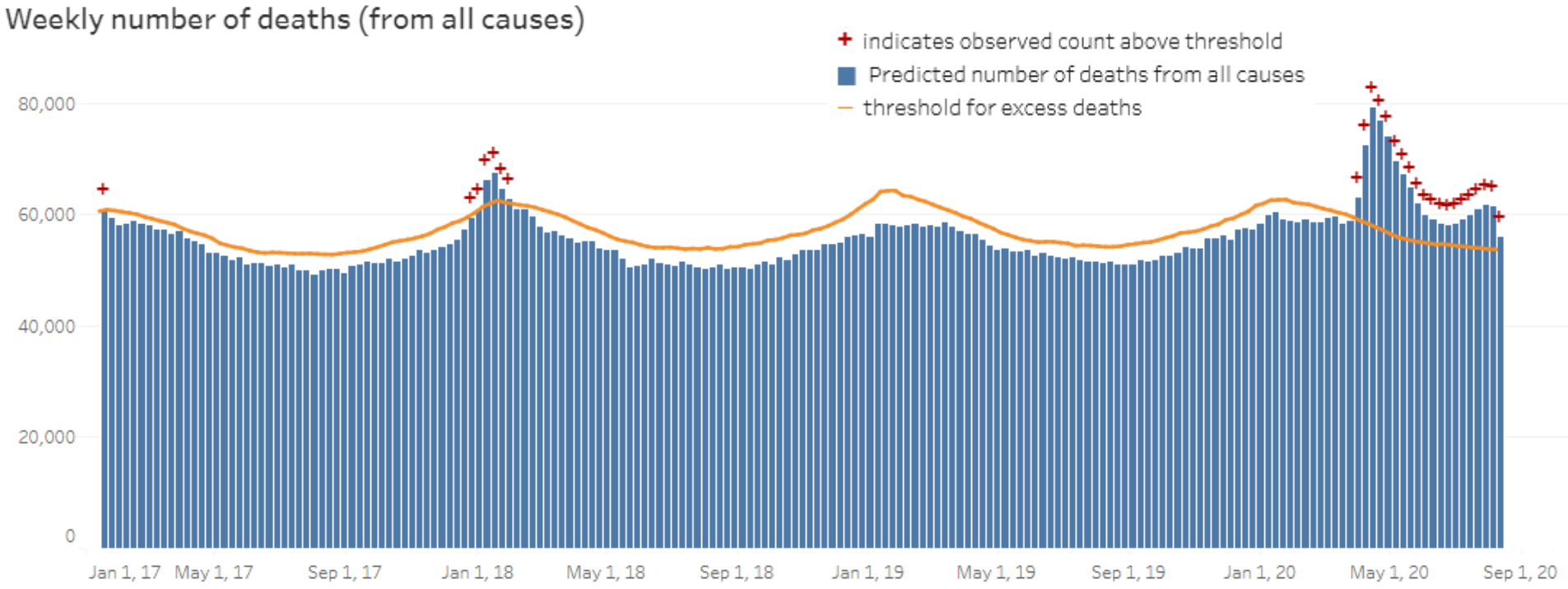
SOURCE: https://www.washingtonpost.com/opinions/2020/05/04/metric-that-could-tell-us-when-its-safe-reemerge/

Methods

- Use existing algorithm (R package ‘surveillance’)* to model the expected weekly number of deaths
  - Weekly counts of deaths from 2013 to date
  - Over-dispersed Poisson regression models with spline terms to account for seasonal patterns
- Generate the expected number(s) of deaths by jurisdiction and week
  - The average expected number
  - The upper bound of the 95% prediction interval
- Excess = observed - expected

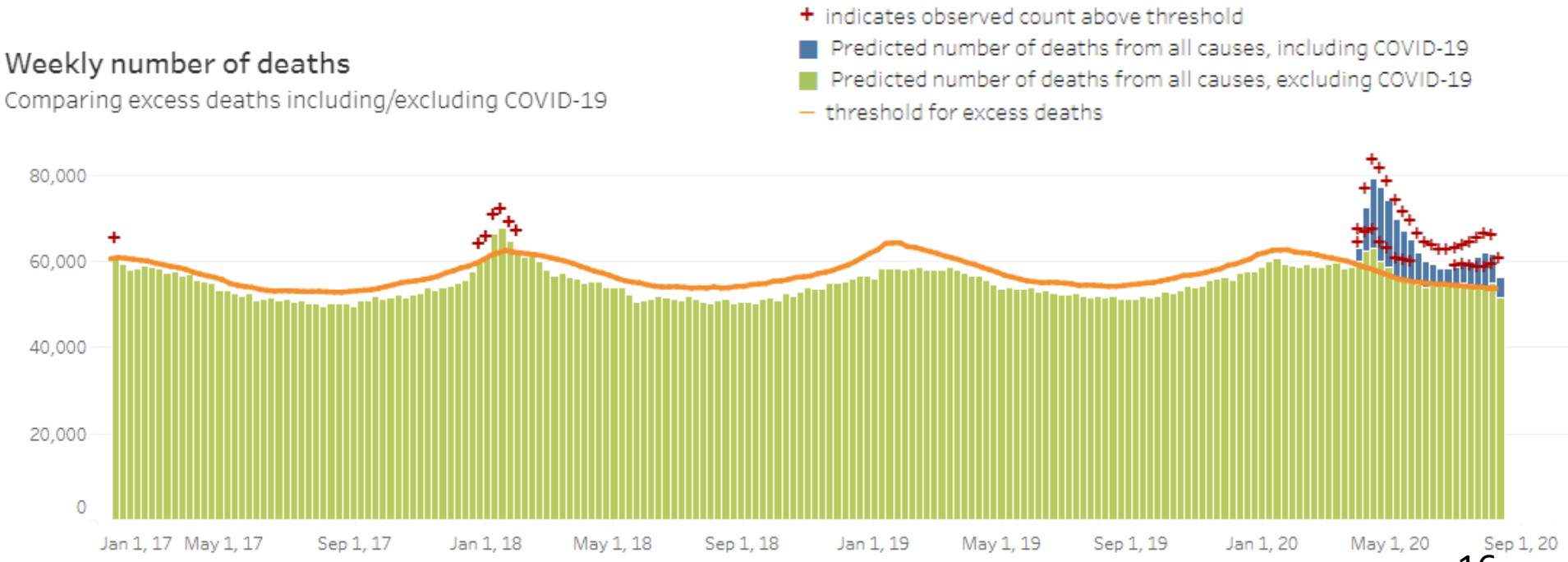
* Noufaily et al., 2012 (https://onlinelibrary.wiley.com/doi/pdf/10.1002/sim.5595) and Salmon, Schumacher, Hohle, 2016 (https://www.jstatsoft.org/article/view/v070i10)

Excess deaths associated with COVID-19

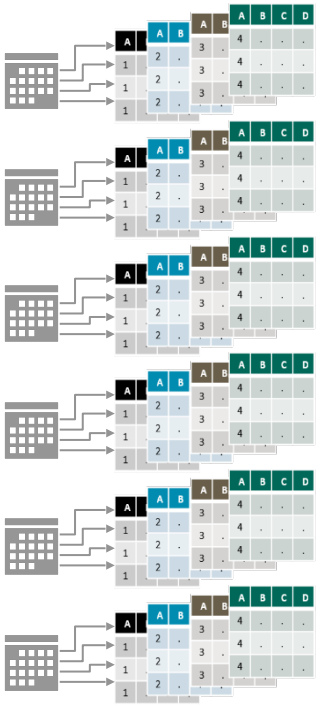


https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm

Excess deaths with and without COVID-19

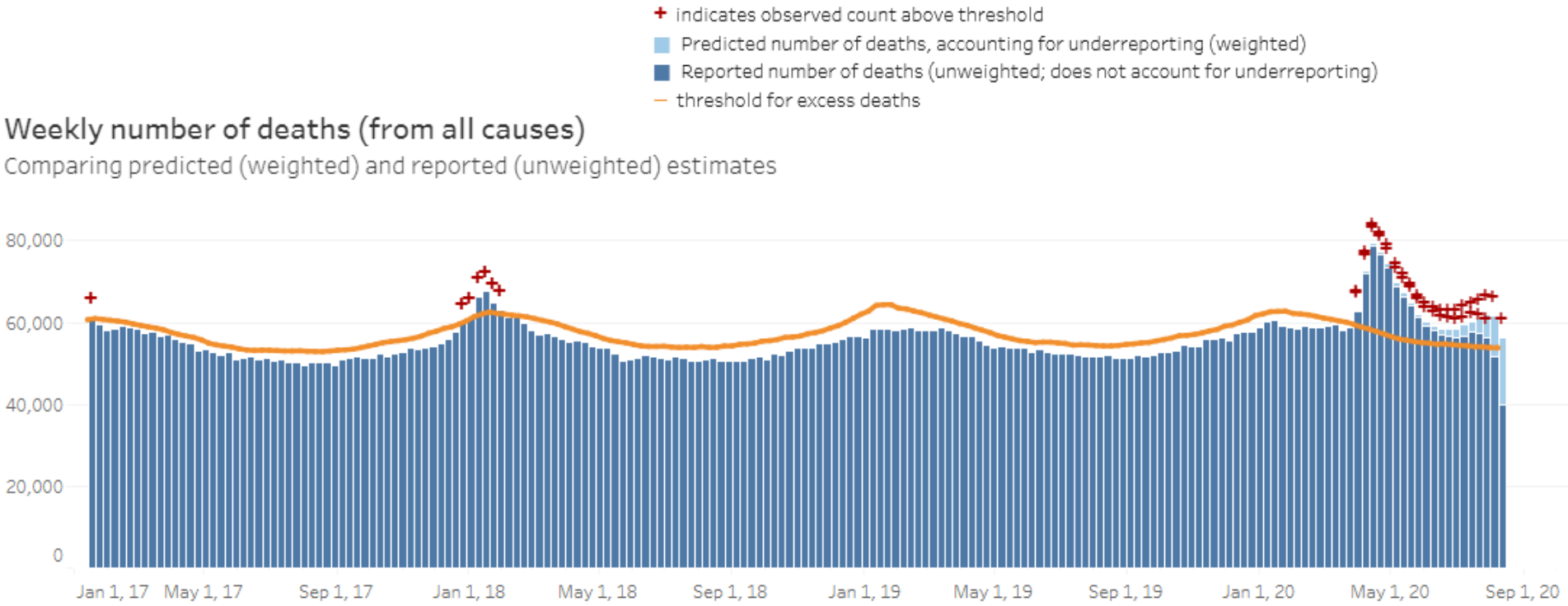


Weighting to account for incomplete data

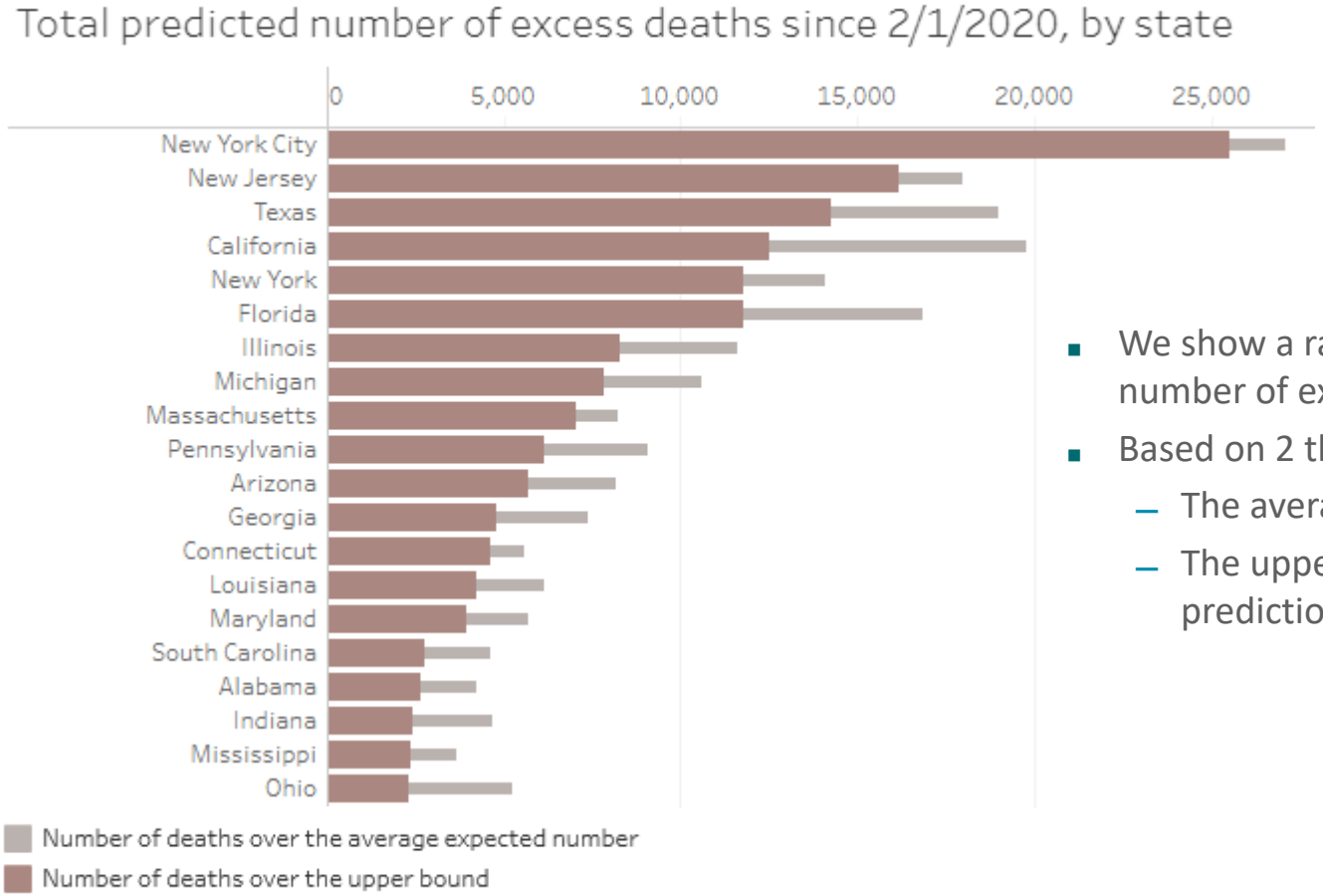


- Used weekly ‘snapshots’ of provisional data (from 2018-2019) to model underreporting relative to final data
- Predict completeness of provisional data within 1 week of death, 2 weeks, 3 weeks, etc.
- Weights calculated as 1/completeness for each jurisdiction
  - For example, if provisional data was historically 50% complete within 1 week of death, then the weight for that jurisdiction would be 2

Comparing weighted and unweighted estimates

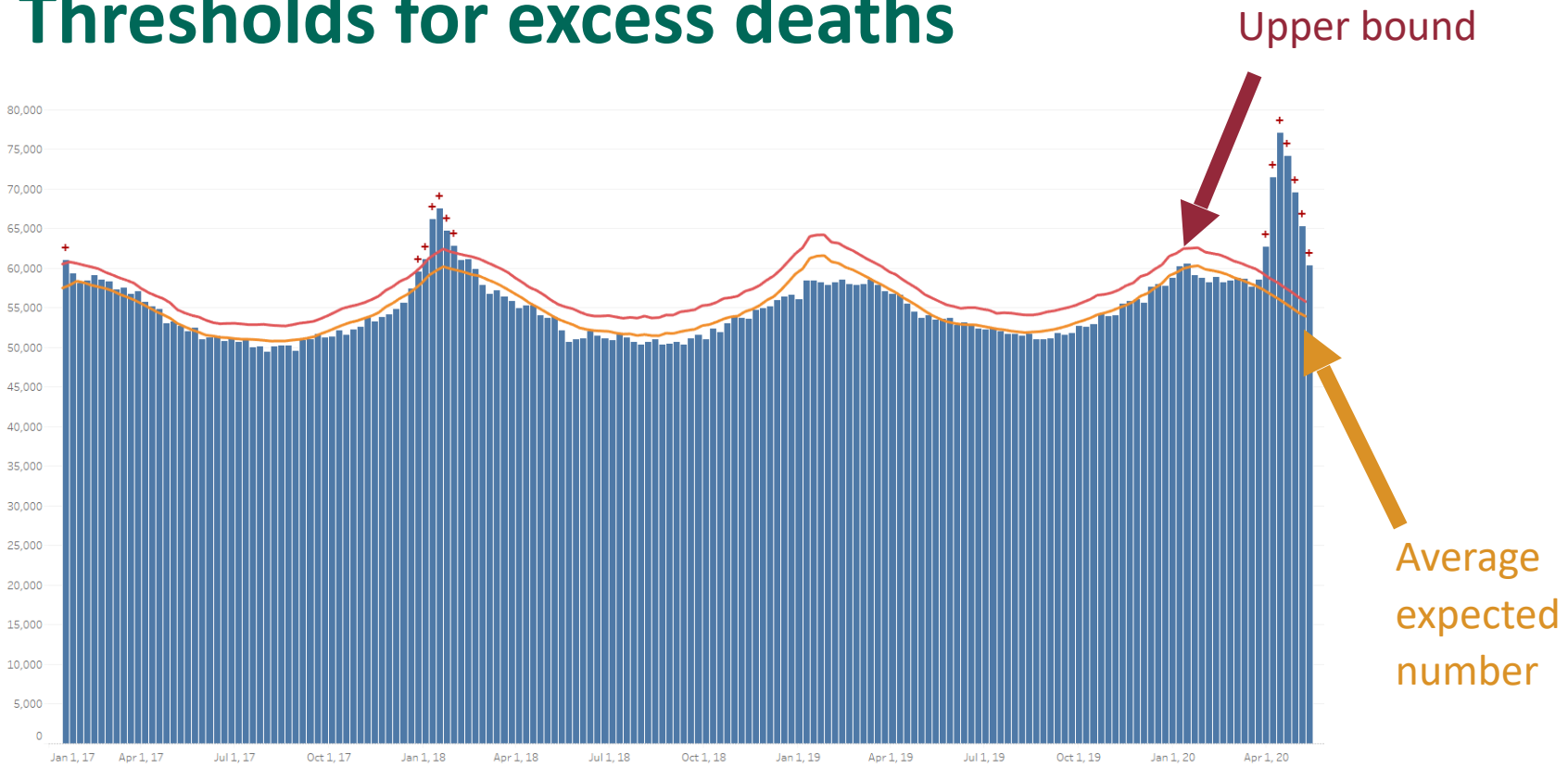


Total predicted number of excess deaths since 2/1/2020 across the United States: 192,767 – 252,307



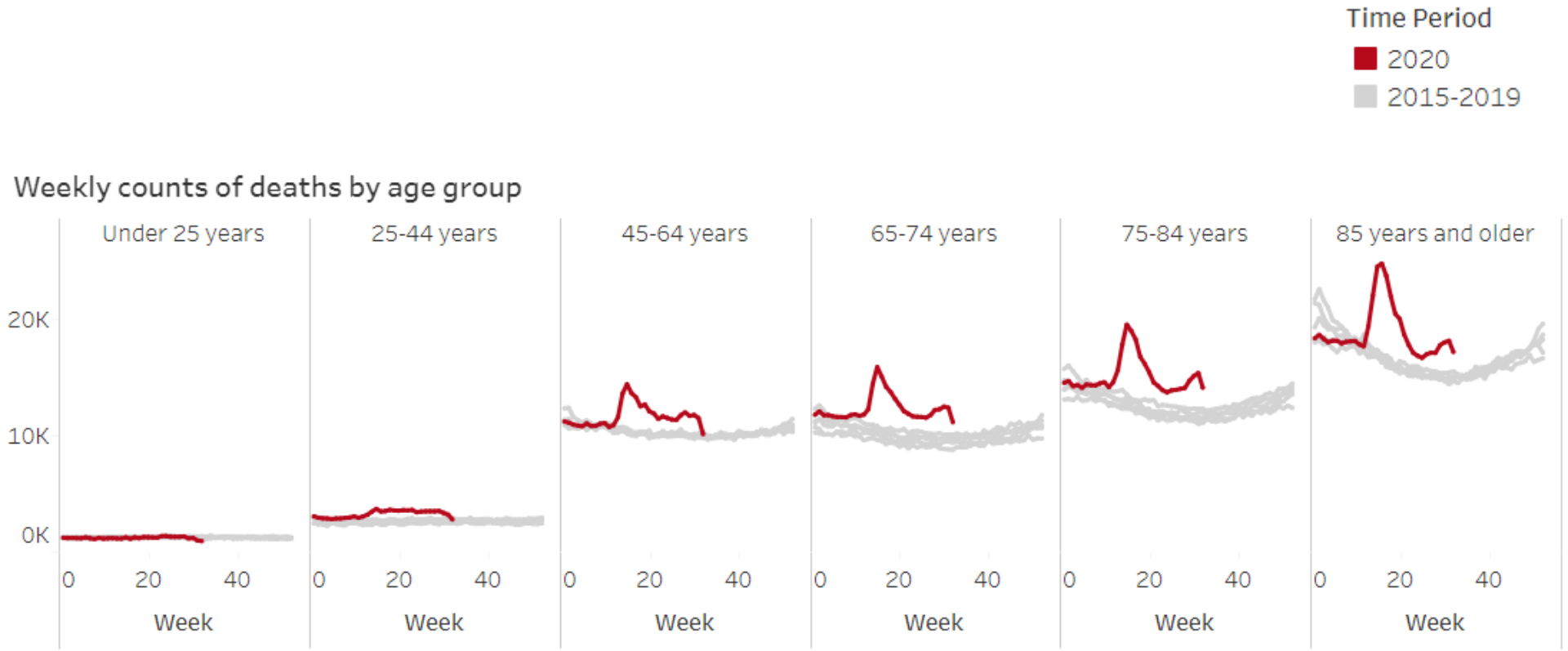
- We show a range for the predicted number of excess deaths
- Based on 2 thresholds:
  - The average expected #
  - The upper bound of the 95% prediction interval

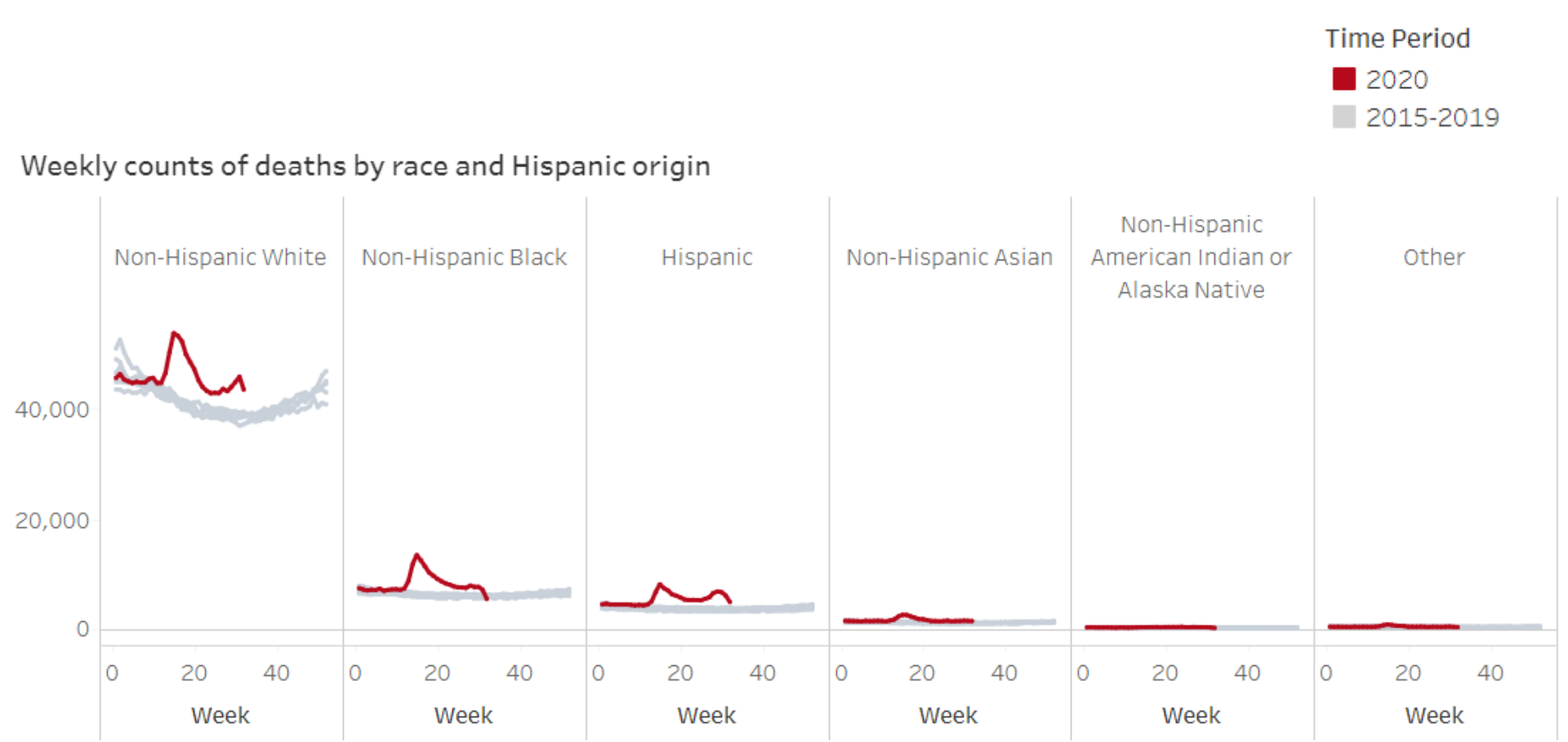
Thresholds for excess deaths



New(er) dashboards and data

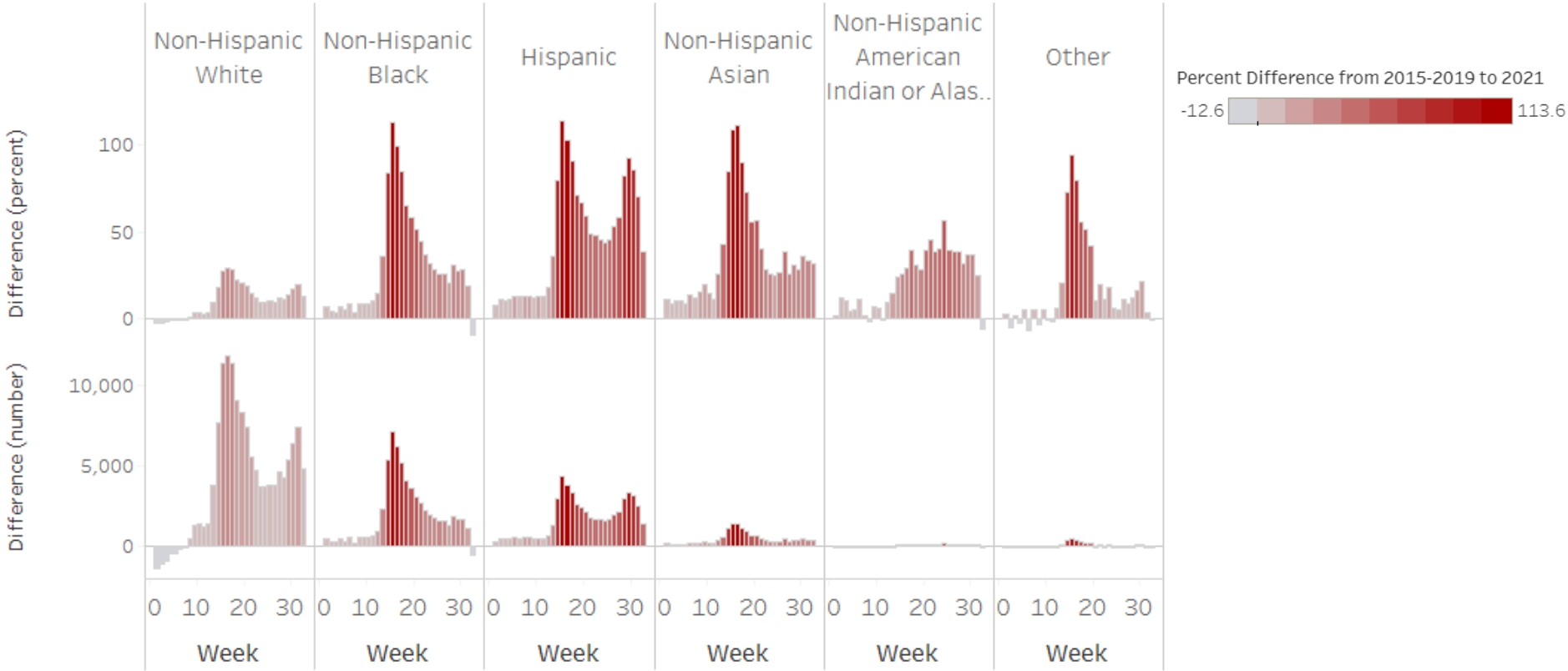
- Weekly counts of death by age group
- Weekly counts of death by race and ethnicity
- Weekly counts of death by underlying cause of death
  - Determined based on comorbidities on COVID-19 death records
    - Respiratory diseases*
    - Circulatory diseases*
    - Malignant neoplasms
    - Alzheimer disease and dementia
    - Residual (other select natural causes)*
  - * indicates specific causes within those categories also shown

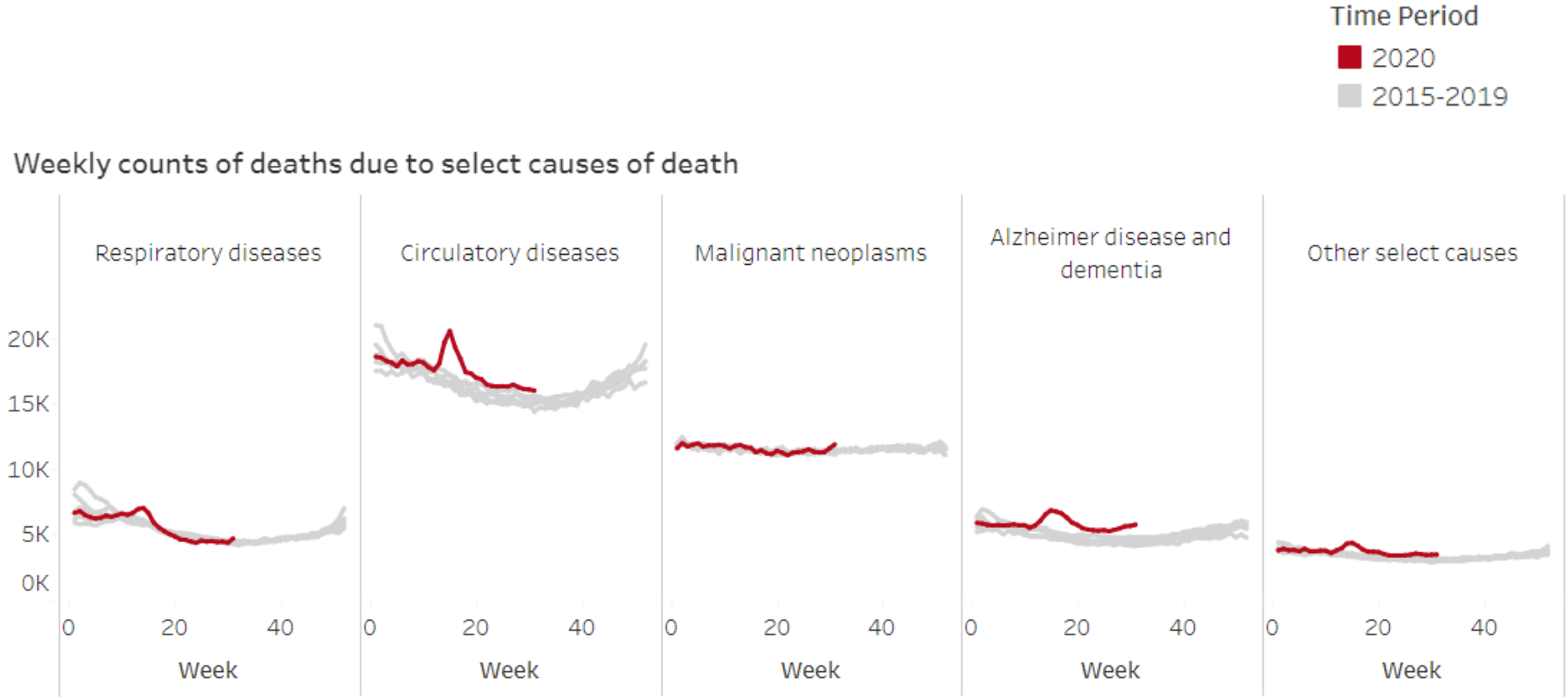

Time Period
2020
2015-2019
Weekly counts of deaths by age group
Under 25 years
25-44 years
45-64 years
65-74 years
75-84 years
85 years and older
20K
10K
0K
0
20
40
Week


Time Period
2020
2015-2019
Weekly counts of deaths by race and Hispanic origin
Non-Hispanic White
Non-Hispanic Black
Hispanic
Non-Hispanic Asian
Non-Hispanic American Indian or Alaska Native
Other
40,000
20,000
0
0
20
40
Week

Change and percent change in the weekly number of deaths in 2020 compared with the average number from 2015-2019

By race and Hispanic origin




Time Period
2020
2015-2019
Weekly counts of deaths due to select causes of death
Respiratory diseases
Circulatory diseases
Malignant neoplasms
Alzheimer disease and dementia
Other select causes
20K
15K
10K
5K
0K
0
20
40
Week

Thank you