COVID-19 Counts in Washington State and Select Other Locations

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Counts of cases and deaths are key metrics of COVID-19 prevalence and burden, and are the basis for model-based estimates and predictions of these statistics. I present here graphs showing these metrics over time in Washington state and a few other USA locations of interest to me. I update the graphs and this write-up weekly. Previous versions are here. See below for caveats and details.

Figures 1a-d show *case* counts per million for several Washington and non-Washington locations. The Washington locations are the entire state, the Seattle area where I live, and the adjacent counties to the north and south (Snohomish and Pierce, resp.). The non-Washington locations are Ann Arbor, Boston, San Diego, and Washington DC.

Figures 1a-b (the top row) show smoothed data (see details below); Figures 1c-d (the bottom row) overlay raw data onto the smoothed. The figures use data from Johns Hopkins Center for Systems Science and Engineering (JHU), described below. When comparing the Washington and non-Washington graphs, please note the difference in y-scale: the highest current Washington rate (about 1100 per million in Pierce) is above the rate in San Diego (about 700 per million), similar to the rates in Ann Arbor and Washington DC (also about 1100 per million), and below the rate in Boston (about 1700 per million).

Figure 1a
Weekly cases per million in Washington locations

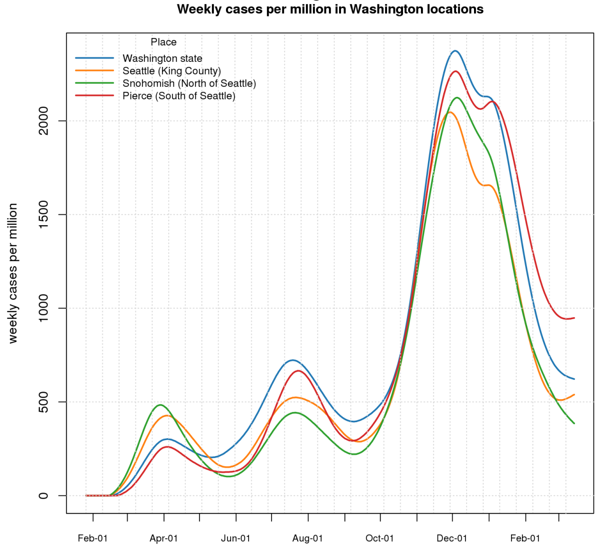


Figure 1b
Weekly cases per million in non-Washington locations

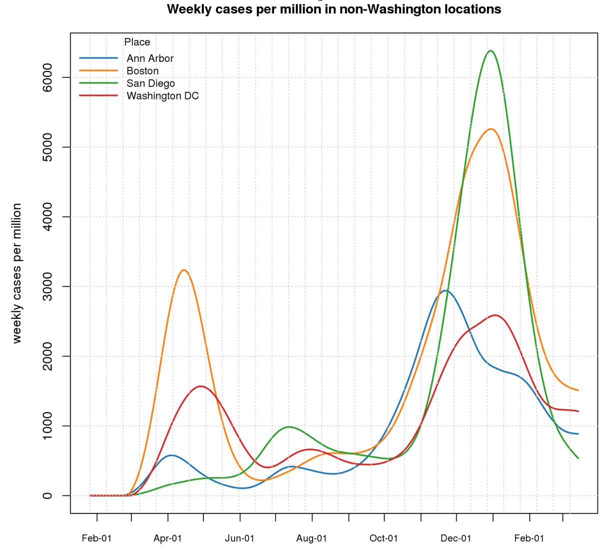


Figure 1c
Weekly cases per million in Washington locations showing raw data

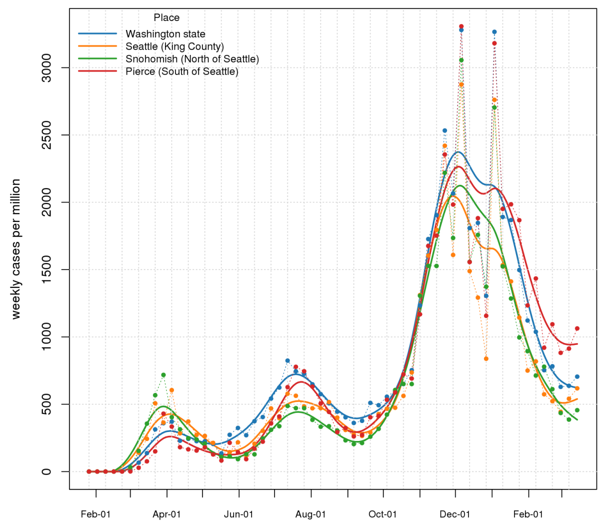
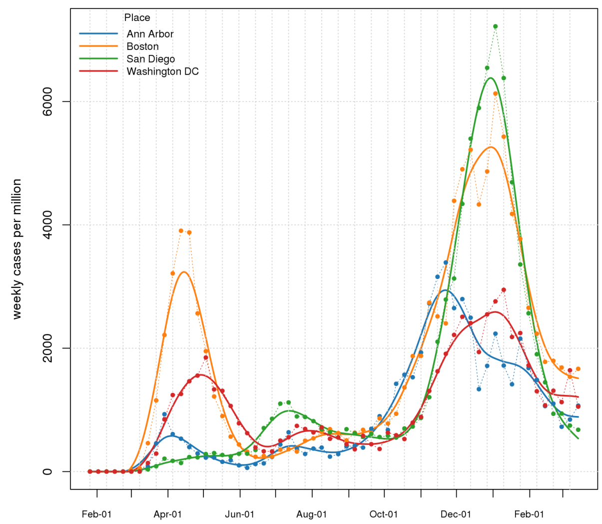


Figure 1d
Weekly cases per million in non-Washington locations showing raw data



The smoothed graphs for Washington (Figure 1a) show that rates though well below their recent peaks are starting to climb again in Seattle (King County) and Pierce, and are best flattening in the state as a whole and Snohomish. The raw data (Figure 1c) and simple trend analysis (described below) indicate that the increase in Seattle and Pierce may be an artifact but the flattening is real. The rates for non-Washington locations (Figures 1b,d) have also fallen dramatically from their peaks but are at best flattening everywhere except San Diego. Trend analysis concurs.

Figures 2a-d show *deaths* per million for the same locations. When comparing the Washington and non-Washington graphs, again please note the difference in y-scale: the current Washington rates are 4-14 per million; the non-Washington rates are 3-20 per million.

Figure 2a
Weekly deaths per million in Washington locations

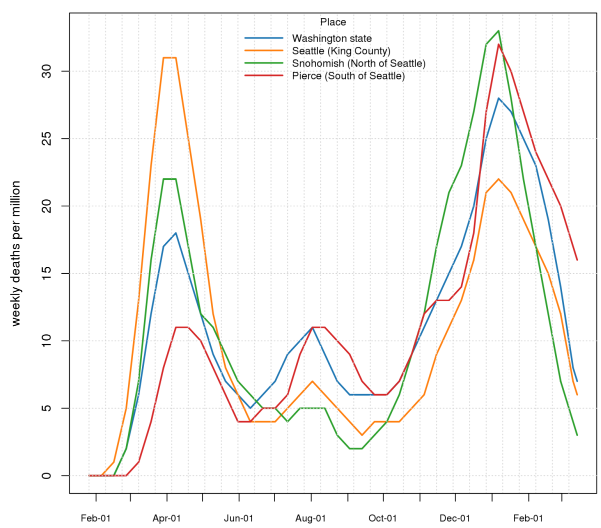
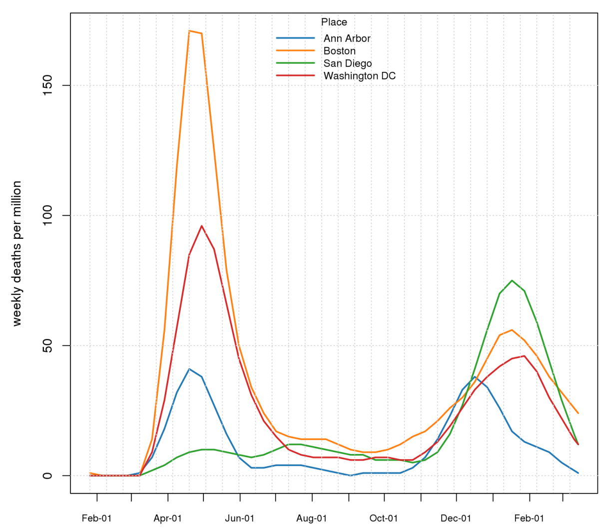
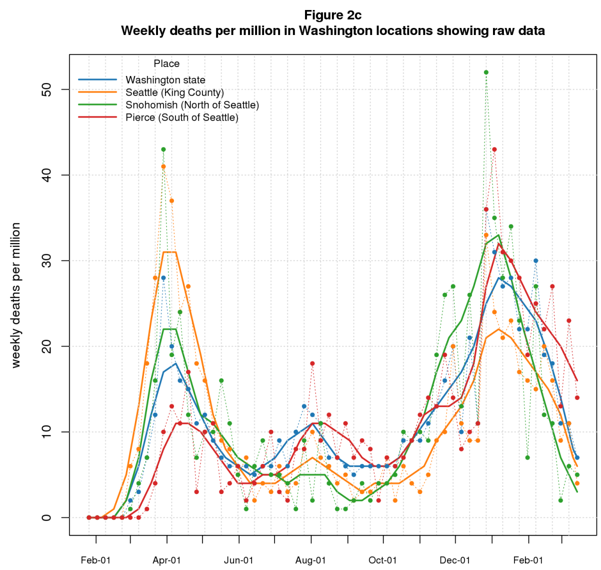
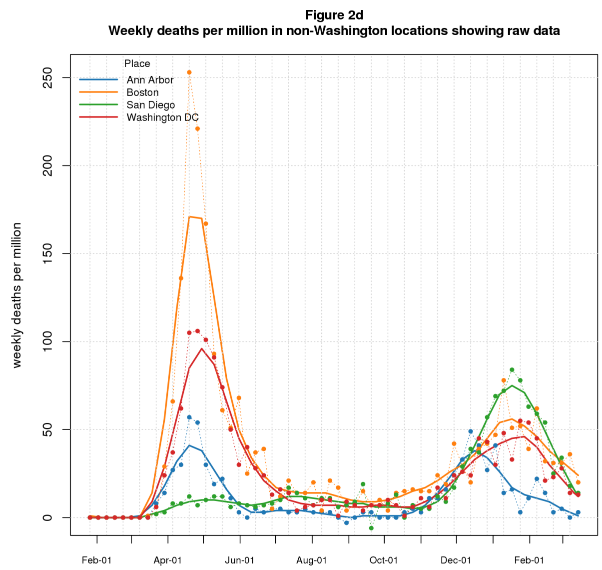


Figure 2b
Weekly deaths per million in non-Washington locations







The smoothed Washington data (Figure 2a) shows three waves. The second peak was thankfully lower than the first; the third wave exceeded the first in all areas except Seattle (King County). The graphs are well down from their recent peaks and are finally down to the level of the second peak in most locations. The raw data (Figure 2c) remains quite variable; trend analysis (described below) indicates that looking back 6-8 weeks, the decline is clear except in Pierce where the trend is almost flat.

The smoothed non-Washington data (Figure 2b) shows early peaks in most locations, followed by a long trough, followed by a second wave starting in November. The graphs are well down from their recent peaks and seem to be continuing down. The raw data, though variable, broadly supports this view; trend analysis (described below) indicates that looking back 6 weeks, the decline is clear in all locations; going back 8 weeks, the decline is strong everywhere except Ann Arbor. For Ann Arbor the rates for the past 4 weeks are quite low (0-5), but too variable to be confident in the direction.

In most previous versions of the document before March 17, 2021, I presented Washington results broken down by age using data from Washington State Department of Health (DOH) weekly downloads, described below. I'm unable to use this data at present, because DOH changed its age groups; this change breaks my code in ways big and small and it may be several weeks before I'm able to incorporate the age data again.

Caveats

1. The term *case* means a person with a detected COVID infection. In some data sources, this includes "confirmed cases", meaning people with positive molecular COVID tests, as well as "probable cases". I believe JHU only includes "confirmed cases" based on the name of the file I download.
2. Detected *cases* undercount actual cases by an unknown amount. When testing volume is higher, it's reasonable to expect the detected count to get closer to the actual count. Modelers attempt to correct for this. I don't include any such corrections here.
3. The same issues apply to *deaths* to a lesser extent, except perhaps early in the pandemic.
4. The geographic granularity in the underlying data is *state* or *county*. I refer to locations by city names reasoning that readers are more likely to know "Seattle" or "Ann Arbor" than "King" or "Washtenaw".
5. The date granularity in the graphs is weekly. The underlying JHU data is daily; I sum the data by week before graphing.

6. I truncate the data to the last full week prior to the week reported here.

Technical Details

1. I smooth the graphs using a smoothing spline (R's `smooth.spline`) for visual appeal. This is especially important for the *deaths* graphs where the counts are so low that unsmoothed week-to-week variation makes the graphs hard to read.
2. The trend analysis computes a linear regression (using R's `lm`) over the most recent four, six, or eight weeks of data and reports the computed slope and the p-value for the slope. In essence, this compares the trend to the null hypothesis that the true counts are constant and the observed points are randomly selected from a normal distribution. After looking at trend results across the entire time series, I determined that p-values below 0.1 indicate convincing trends; this cutoff is arbitrary, of course.

Data Sources

Washington State Department of Health (DOH)

DOH provides three COVID data streams.

1. Washington Disease Reporting System (WDRS) provides daily "hot off the presses" results for use by public health officials, health care providers, and qualified researchers. It is not available to the general public, including yours truly.
2. COVID-19 Data Dashboard provides a web graphical user interface to summary data from WDRS for the general public. (At least, I think the data is from WDRS - they don't actually say).
3. Weekly data downloads (available from the Data Dashboard web page) of data curated by DOH staff. The curation corrects errors in the daily feed, such as, duplicate reports, multiple test results for the same incident (e.g., initial and confirmation tests for the same individual), incorrect reporting dates, incorrect county assignments (e.g., when an individual crosses county lines to get tested).

The weekly DOH download reports data by age group. In past, the groups were 20-year ranges starting with 0-19, with a final group for 80+. As of March 14, 2021, they changed the groups to an initial 20-year range (0-19), then several 15 year ranges (20-34, 35-49, 50-64, 65-79), with a final group for 80+. My code cannot yet handle this change.

Johns Hopkins Center for Systems Science and Engineering (JHU)

JHU CSSE has created an impressive portal for COVID data and analysis. They provide their data to the public through a GitHub repository. The data I use is from the csse_covid_19_data/csse_covid_19_time_series directory: time_series_covid19_confirmed_US.csv for *cases* and time_series_covid19_deaths_US.csv for *deaths*.

JHU updates the data daily. I download the data the same day as the DOH data (now Tuesdays) for operational convenience.

Other Data Sources

I use two other COVID data sources in my project although not in this document.

- New York Times COVID Repository. The file I download is us-counties.csv. Like Washington DOH and JHU, NYT has county-level data. Unlike these, it includes "probable" as well as "confirmed" cases and deaths; I see no way to separate the two categories.

- COVID Tracking Project. This project reports a wide range of interesting statistics (negative test counts, for example), but I only use the *case* and *death* data. It does not provide county-level data so is not useful for the non-Washington locations I show. The file I download is https://covidtracking.com/data/download/washington-history.csv. I use this only as a check on the state-level Washington data from the other sources. As of March 7, 2021, the project ended its data collection efforts.

The population data used for the per capita calculations is from Census Reporter. The file connecting Census Reporter *geoids* to counties is the Census Bureau Gazetteer.

Comments Please!

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