COVID-19 Counts in Washington State and Select Other Locations

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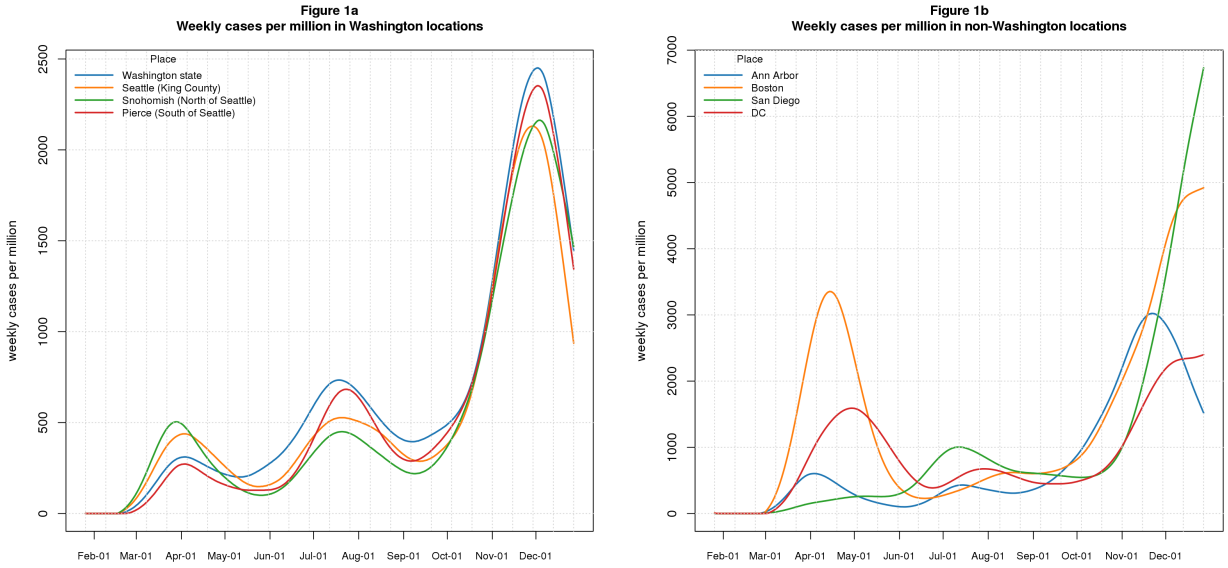
Counts of cases and deaths are key metrics of COVID-19 prevalence and burden, and are the basis for model-based estimates and predictions of these statistics. I present here graphs showing these metrics over time in Washington state and a few other USA locations of interest to me. I hope to update the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

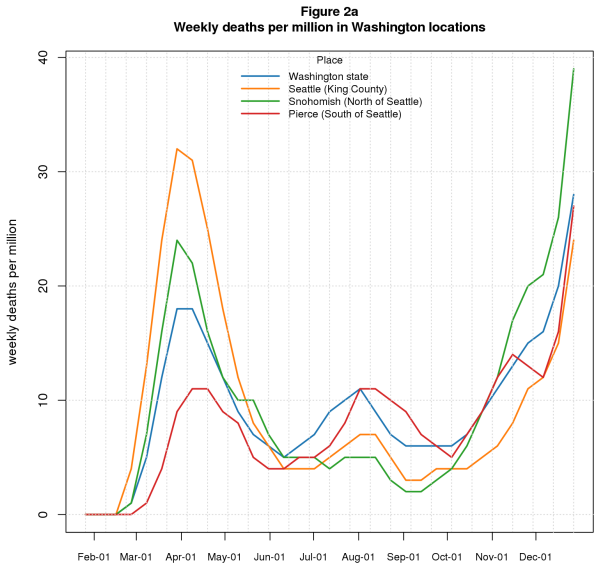
See below for caveats and details. I originally posted updates on Mondays but have switched to Wednesdays to accommodate the recently changed Washington DOH data release schedule.

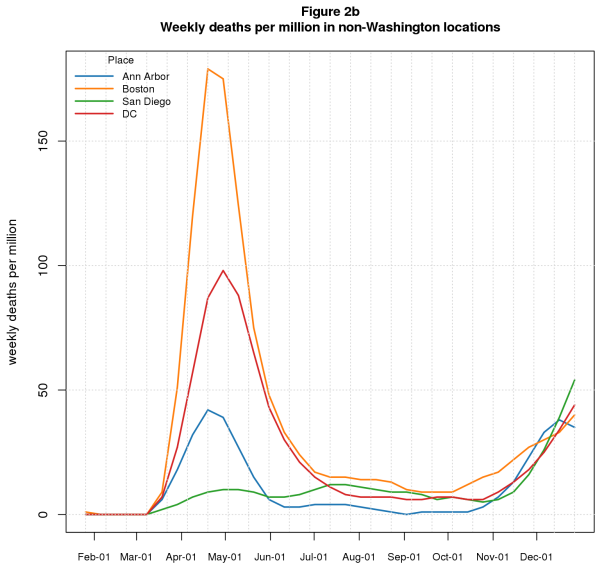
Figure 1a shows *case* counts per million for Washington state as a whole, the Seattle area where I live, and the adjacent counties to the north and south (Snohomish and Pierce, resp.). Figure 1b shows *case* counts for Ann Arbor, Boston, San Diego, and Washington DC. The figures use data from Johns Hopkins Center for Systems Science and Engineering (JHU), described below.



In Washington state (Figure 1a), cases seem to have hit their peak after a prolonged increase and are heading down (but see caveats below). In non-Washington locations (Figure 1b), cases continue to increase everywhere except Ann Arbor. The decline in Ann Arbor has persisted for several weeks: this very good news may be due to the University of Michigan ending on-site teaching for most students. The rate of increase in Boston and DC may be slowing; we'll know in a few weeks whether it's real.

Figures 2a-b show *deaths* per million for the same locations.

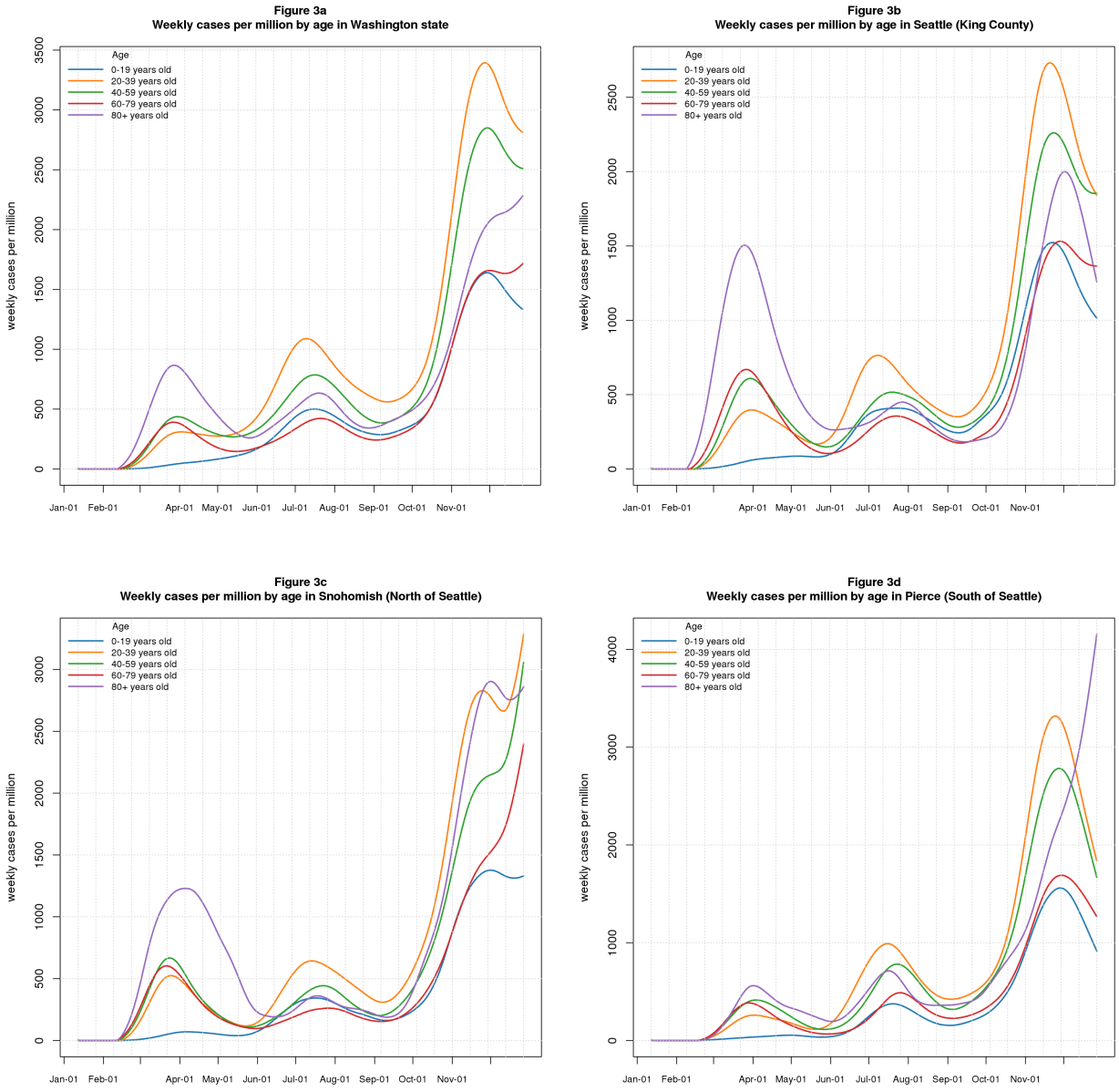




The Washington data (Figure 2a) shows three waves. Last week it seemed that we had reached the peak of the third, but this week's data shows the death rate increasing. The second peak was thankfully lower than the first; the third peak is higher than the first in all areas except Seattle (King County). The non-Washington data (Figure 2b) is dominated by the early peak in Boston making it hard to see details later on, but the rates are heading up everywhere except Ann Arbor. Last week we saw a hint of a flattening in Boston, but it now seems that was wishful thinking. When comparing Figures 2a and 2b, please note the difference in y-scale: the current Washington rates (30-40 per million) are similar to the non-Washington rates.

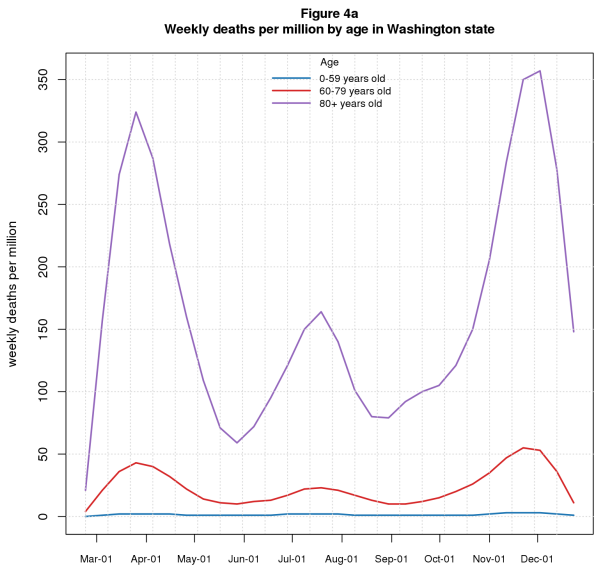
The next graphs show the Washington results broken down by age. This data is from Washington State Department of Health (DOH) weekly downloads, described below. An important caveat is that the DOH download systematically undercounts events in recent weeks due to manual curation. I extrapolate data for late time points as discussed below.

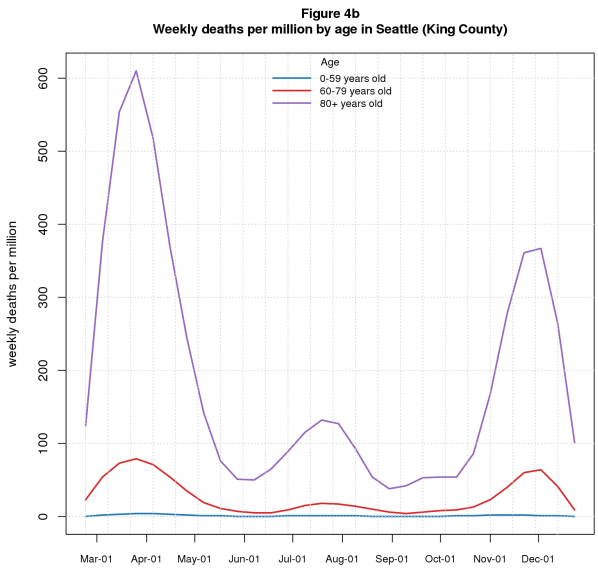
Figures 3a-d are *cases*. The graphs are split into 20-year age ranges starting with 0-19, with a final group for 80+.

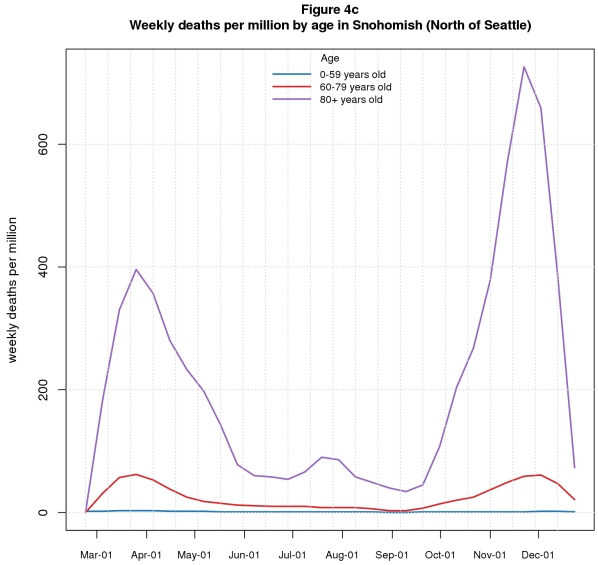


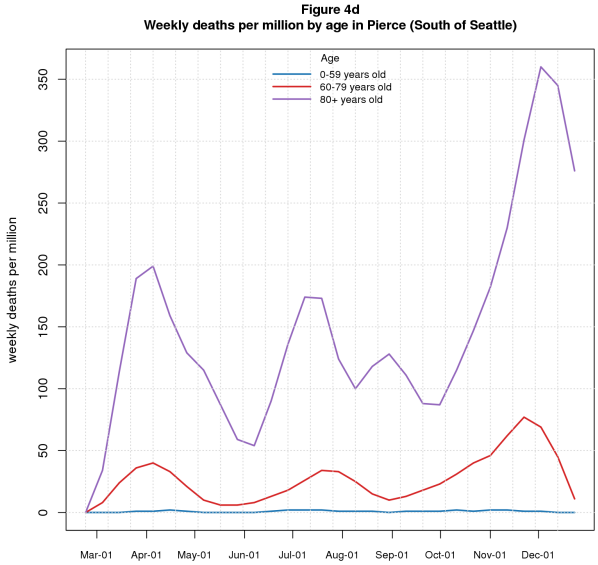
Early on, the pandemic struck older age groups most heavily. Over time, *cases* spread into all age groups, even the young. During the second wave, older groups did better in most locations with young adults (20-39 years) becoming the most affected group. The third wave swept into all age groups with young and middle aged adults (20-39 and 40-59 years) leading the surge.

Figures 4a-d are *deaths*. These graphs aggregate 0-59 into a single group, since the death rate in these ages is near 0.









The shocking devastation of the 80+ age group early in the pandemic jumps off the page. The early death rate for this group in Seattle (King County) reached over 600 per million reflecting the early outbreak at a long term care facility in the area. Statewide, the death rate in the 80+ group shows three waves. Deaths in Snohomish (north of Seattle) for the 80+ group peaked early in the pandemic, then declined and stayed fairly low but now have climbed above the first peak; some of the increase reflects an outbreak in a long term care facility in the county. Deaths in Pierce (south of Seattle) for this group are more variable than elsewhere, possibly reflecting delays in reporting deaths to DOH and political turmoil in the county department responsible for reporting this data. The overall rate was fairly steady until recently at a level near or slightly below the second and third King County peaks but now has now surged to its highest level ever. The low counts at the latest time points in all locations are probably due to reporting lags caused by new DOH procedures as discussed below.

Caveats

1. As of approximately December 20, 2020, Washington State Department of Health (DOH) changed its criteria for reporting cases and deaths resulting in reduced counts. Some of the reduction is due to lags in updating the database for the new procedure. It's unclear when the database will catch up and whether the final updated counts will revert to the levels reported in the previous database. Other data sources, including JHU, ultimately rely on DOH for their Washington state data, and errors in the DOH data affect them all.
2. The term *case* means a person with a detected COVID infection. Until the recent reporting change, Washington DOH data limited this to "confirmed cases", meaning people with positive molecular COVID tests, but going forward they plan to separate out "probable cases". Other states already do this, but the data source I use here only includes "confirmed cases" (or so I believe based on the name of the file I download).
3. Detected *cases* undercount actual cases by an unknown amount. As testing volume increases over time, it's reasonable to expect the detected count to get closer to the actual count. Some of the increase in *cases* we see in the data is due to this artifact. Modelers attempt to correct for this. I don't include any such corrections here.
4. The same issues apply to *deaths* to a lesser extent, except perhaps early in the pandemic.
5. 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".
6. The date granularity in the graphs is weekly. The underlying JHU data is daily; I sum the data by week before graphing.
7. I truncate the data to the last full week prior to the week reported here. Thus, data for the January 6 update includes counts through the last week of December and first few days of January, ending January 2.
8. 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. In versions of the document prior to last week, I used a 3-week rolling mean for this purpose.

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).

In past, DOH updated the weekly data on Sundays, but as of December 22, 2020 they switched to Mondays

The weekly downloads lag behind the daily feed causing data for the last few weeks to be incomplete. I attempt to correct this undercount through a linear extrapolation function (using R's `lm`). I have tweaked

the extrapolation repeatedly, even turning it off for a few weeks. The current version using a linear model that combines date and recentness effects.

The weekly DOH download reports data by age group: 20-year ranges starting with 0-19, with a final group for 80+.

The DOH download includes data on hospital admissions in addition to *cases* and *deaths*, although I don't show this data here.

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.

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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