Estimation of excess mortality associated with COVID-19 for Mexico and the U.S.

Graciela González-Farías, José Ulises Márquez-Urbina, Román Castillo-Casanova, & Carlos Pineda-Antunez.

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Objetive: Compare the total deaths per week during the 2020 pandemic against the expected deaths according to the reported in the previous four years.

Methodology: The excess mortality is defined as the difference between the observed and the expected deaths in a period. Two techniques are employed to compute the excess mortality: *Farrington's method* [1] and the *endemic channel* procedure [2]. In Farrington's method, the expected deaths are given by the upper limit of a 95% prediction interval for the mean of a quasi-Poisson regression with a linear time trend and a seasonal factor for the weekly death count data. In the endemic channel method, the expected deaths correspond to the 90% percentile of the weekly historical mortality data. Both methods are adjusted from all-cause mortality data of the years 2015-2019. The United States Centers for Disease Control and Prevention (CDC) utilizes Farrington's method, while the Mexican government uses the endemic channel procedure.

Results: Farrington's method indicates that in 2020 Mexico and the U.S. exceeded the number of expected deaths by 20% and 12%, respectively. The Endemic Channel method indicates that Mexico exceeded the expected deaths by 39%, while the U.S. by 17%.
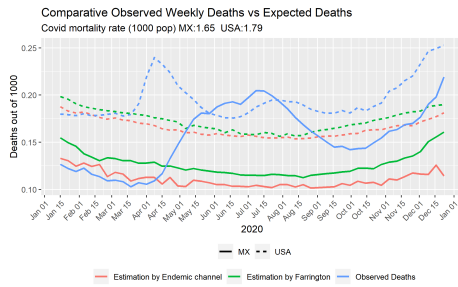
Figure 1a presents the 2020 observed deaths count and the corresponding expected deaths for Farrington's and the endemic channel algorithms for both countries (solid lines for Mexico, dashed lines for the U.S.). The pandemic's effect hit the U.S. in the middle of March. In Mexico, it took until May. By the death counts, the begging of the pandemic hit harder in Mexico, but overall, for 2020, the COVID-19 mortality rate was higher for the U.S. The COVID-19 mortality rate for Mexico and the U.S. was 1.65 and 1.79 (out of 1000), respectively. Besides, the first wave extended longer in Mexico than in the U.S.

Figure 1b shows a comparison between the mortality excess measured in the border states of Mexico and the U.S. Figures 1c and 1d present a higher level of desegregation illustrating Texas and California's expected and observed deaths, respectively, and the corresponding information for their neighboring Mexican states. Texas and California are inspected in more detail because they are the states that report the higher interchanges of people and goods with Mexico. Figure 1b shows that the pandemic's evolution seems to be the same in the border regions of both countries. In this respect, Figure 1c suggests that such similarity is caused by the interaction between Texas and its neighboring Mexican states. Figure 1d shows evidence that the pandemic in California and Baja California has followed different evolutions.
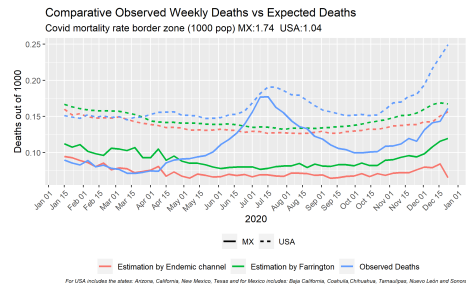
Due to the lag in time in the processes of registering a death, data for 2019 and 2020 are provisional. This condition might produce a sub-estimation of the excess of deaths for the year 2020.
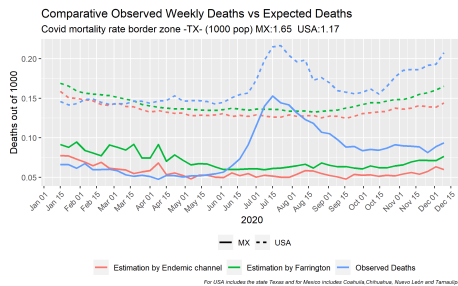
Data:

- **2020 death counts:**
    - **Mexico:** Official database of death counts for excess mortality [3].
    - **USA:** Weekly Provisional Counts of Deaths by State and Select Causes, 2020-2021 [4].

- **2014-2019 death counts:**
    - **Mexico:** Death counts by day and cause [5].
    - **USA:** CDC's weekly counts of deaths by state and select causes, 2014-2019 [6].
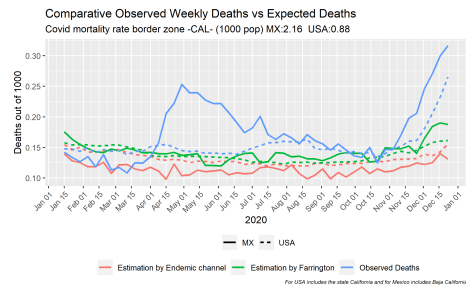
(a) Mexico vs USA

(b) Border states

(c) Texas

(d) California

Figure 1: 2020 observed vs expected deaths

References

[1] Farrington, CP, N.J. Andrews, A.J. Beale, M.A. Catchpole. (1996). A statistical algorithm for the early detection of outbreaks of infectious disease. Journal of the Royal Statistical Society Series A; 159:547–563.

[2] Boletín estadístico sobre exceso mortalidad por todas las causas durante la emergencia por COVID-19. Gobierno de México. Mexico, 2021.
https://coronavirus.gob.mx/wp-content/uploads/2021/02/Boleti%CC%81n_X_Exceso_Mortalidad_SE53_MX_15Feb2021.pdf.

[3] Bases de datos para el análisis de exceso de mortalidad en México. Secretaría de Salud. Mexico.
http://www.dgis.salud.gob.mx/contenidos/basesdedatos/da_exceso_mortalidad_mexico_gobmx.html. Accesed 04/22/2021.

[4] Weekly Provisional Counts of Deaths by State and Select Causes, 2020-2021. Centers for Disease Control and Prevention (CDC). USA.
https://data.cdc.gov/NCHS/Weekly-Counts-of-Deaths-by-State-and-Select-Causes/muzy-jte6. Accesed 05/02/2021.

[5] Mortalidad: Conjunto de datos. Instituto Nacional de Estadística, Geografía e Informática (INEGI). México.
https://www.inegi.org.mx/sistemas/olap/Proyectos/bd/continuas/mortalidad/MortalidadGeneral.asp. Accesed 04/22/2021.

[6] Weekly Counts of Deaths by State and Select Causes, 2014-2019. Centers for Disease Control and Prevention (CDC). USA.
https://data.cdc.gov/NCHS/Weekly-Counts-of-Deaths-by-State-and-Select-Causes/3yf8-kanr. Accesed 05/02/2021