

Appendix

A1. Variance Estimate of Difference from Reference Average

$$Diff = Deaths_{2020} - \frac{Deaths_{2019} + Deaths_{2018}}{2}.$$

If death counts follow independent Poisson process, then the variance of the difference becomes,

$$Var(Diff) = Deaths_{2020} + \frac{Deaths_{2019} + Deaths_{2018}}{4}.$$

A2. Definitions of Panel Column Cells (Tables 2-3)

$(MCOD_{ik} | UCOD_{jk})$ = Indication (0 or 1) that the i^{th} condition is mentioned at least once in the record, given j^{th} condition is the underlying cause of death of k^{th} decedent.

1. Total deaths from the j^{th} cause (e.g. COVID-19) (column 2),

$$UCOD_j.$$

2. Percent the i^{th} cause represents out of all deaths (column 3),

$$\%UCOD_i = \frac{UCO_i}{\sum UCOD_j} \times 100.$$

Total mention of indication of the i^{th} condition given the j^{th} underlying cause of death (column 8),

$$(MCOD_i | UCOD_j).$$

A2. Definitions of Panel Column Cells (Tables 2-3)

3. Percent of the i^{th} condition mentioned given j^{th} cause across all j^{th} deaths (column 9)

$$\%(MCOD_i | UCOD_j) = \frac{MCOD_i | UCOD_j}{UCOD_j} \times 100$$

Matrix of condition mention given underlying cause,

$$UCOD$$

$$MCOD \left[MCOD_i | UCOD_j \right].$$

4. Matrix of proportion of condition indication given underlying cause

$$UCOD$$

$$MCOD \left[\frac{MCOD_i | UCOD_j}{UCOD_j} \right].$$

We draw the percentages of all listed conditions-as-morbidities from the COVID-19 column of this matrix. See Table S5 for the citywide array.