

Supplementary file

Appendix A

Table 1: ICD10 codes selected for creating the proportion of people admitted for a long-term health condition

Long-term condition	ICD10 codes	ICD10 category
Cardiovascular disease	I10-I15	Hypertensive diseases
	I20-I25	Ischaemic heart diseases
	I26-I28	Pulmonary heart disease and diseases of pulmonary circulation
	I30-I52	Other forms of heart disease
	I60-I69	Cerebrovascular diseases
Chronic respiratory disease	J40-J47	Chronic lower respiratory diseases
Diabetes	E10-E14	Diabetes mellitus
Chronic kidney disease	N18	Chronic renal failure

Table 2: Variance inflation factor results for measuring plausible existence of multicollinearity in the model.

Vulnerability measures	GVIF	Df	GVIF ^{(1/(2*Df))}
Long-term health conditions	1.92	1	1.39
Overcrowding.	5.38	1	2.32
Care home beds	1.14	1	1.07
Black, Asian and Minority Ethnic group	4.97	1	2.23

Appendix B - Model & calculation of the SAVI

The SAVI is calculated from the regression model estimates on the data:

$$\log(Y_i) = \beta_0 + \beta_1 \text{Long-termHealthConditions}_i + \beta_2 \text{Overcrowding}_i + \beta_3 \text{BAME}_i + \beta_4 \text{CareHomeBeds(UpTo3SD)}_i + \beta_5 \text{CareHomeBeds(>3SD)}_i + \log(\text{ExpectedDeaths_Age-adjusted}_i)$$

Where Y_i is the number of COVID19 deaths occurring in hospital for MSOA i . *Long-termHealthConditions* is the percent of the population who admitted to hospital in the past 5 years for a long-term health condition (Cardiovascular disease, Chronic respiratory disease, Diabetes, Chronic kidney disease). *Overcrowding* is the percent of the population who living in overcrowded housing. *BAME* is the percent of the population who classify their ethnic group as: Black, Asian, Mixed or Other. *CareHomeBeds(UpTo3SD)* is the percent of the care home beds in each MSOA up to 3SD. *CareHomeBeds(>3SD)* is the percent of the care home beds in

each MSOA over 3SD. *ExpectedDeaths_Age-adjusted* is an offset variable which adjusts for the impact of the age profile of the population in each MSOA.

The predicted deaths in MSOA i is:

$$P_i = \exp(0.17 \cdot \text{Long-termHealthConditions}_i + 0.10 \cdot \text{Overcrowding}_i + 0.07 \cdot \text{BAME}_i + 0.25 \cdot \text{CareHomeBeds(UpTo3SD)}_i - 0.14 \cdot \text{CareHomeBeds(>3SD)}_i + \log(\text{ExpectedDeaths_Age-adjusted}_i) - 2.3)$$

The final vulnerability index in MSOA i is:

$$\text{SAVI}_i = P_i / \text{Pop}_i \times [\sum_{i=1}^n P_i] / [\sum_{i=1}^n \text{Pop}_i]$$

Where SAVI_i is the relative increase in crude COVID-19 mortality risk for MSOA i . P_i is the predicted deaths in MSOA i . Pop_i is the mid-year (2018) population estimates for MSOA i .