**Protocol/Analysis plan: CCU024\_02 Intersectional inequality in emergency department (ED) visits, in-hours and out-of-hours, in the last 3 months of life for people who died in England in 2020**

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| Date uploaded to github |  |
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**Background**

**What we know already**

* Our earlier analyses for CovPall\_Connect have shown that: 1) there were notable changes in care for people approaching the end of life that occurred during the Covid-19 pandemic including a shift from hospital to home deaths; 2) socioeconomic inequalities in place of death increased during the pandemic; 3) the rate of ED visits increases steeply as people approach the end of life; 4) end of life ED visits in 2020 demonstrated a clear deprivation gradient, being higher for people who live in more deprived areas.1
* The rate of ED visits in the general population is twice as high for people living in the 10% most deprived neighbourhoods, compared to the 10% least deprived areas, and varies with ethnicity, with ‘other ethnic groups’ having an ED visit rate that is 5 times higher than White, Asian or Asian British and Black or Black British groups.2
* The rate of ED visit may act as a ‘barometer’ for pressures on and access to community-based care.1, 3
* Living in a more deprived area is a risk factor for indicators of poorer care towards the end of life including, increased risk of death in hospital and higher use of hospital care in the last months of life.4-6 Non-white ethnicity is also a risk factor for these indicators of poorer end of life care including more emergency admissions towards the end of life.7, 8
* However, very little is known about how ethnicity and area-based deprivation intersect with each other and with other factors in terms of risk of ED visits towards the end of life.

**What this study adds**

* This study will provide the first analysis of ethnicity, area-based deprivation, geographical location, and morbidity as intersectional risk factors for ED visits in the last 3 months of life.

**Aim**

The aim of this study is to analyse the association between ethnicity, area-based deprivation, geographical location (based on Integrated Care Board (ICB)), morbidity (as indicated by underlying cause of death and count of unique primary care medications), and the rate of ED visits in the last three months of life, separately for men and women.

**Methods**

**Data source:** three linked databases for England available in the NHS Digital BHF TRE: 1) mortality records, 2) ED attendance data from Hospital Episode Statistics (HES), 3) primary care prescription data, 4) primary care data from General Practice Extraction Service (GPES) Data for pandemic planning and research (GDPPR)

**Population:** all deaths in England in 2020 among adults aged ≥18 years old.

**Outcome:** ED visits in the last 3 months of life, in-hours (IO) and out-of-hours (OOH). OOH is defined as visits occurring after 18:00 and before 8:00, at weekends and on bank holidays.

**Exposures:**

**Ethnicity:** based on an established algorithm that selects the most recent non-missing record of ethnicity in the hospital episode statistics (HES) record and from the primary care record, prioritising the primary care record.9

**Area-based deprivation:** Index of Multiple Deprivation rank (1 is most deprived) linked to the patients LSOA based on the most recently recorded postcode of the patient in the HES record or the primary care record.

**Geographical location:** the patient’s Integrated Care Board (ICB).

**Morbidity:** We used underlying cause of death as a proxy for primary diagnosis which is known to be an important factor associated with emergency hospitalisations towards the end of life.10, 11 We also used a count of unique medicines from the primary care record, prescribed over the 4 to 8 months before death, as a proxy for comorbidity. We counted the number of unique British National Formulary (BNF) chapter codes. Each code represents drugs in the same class and so repeat prescriptions for the same or similar drugs were counted once.

A similar approach to measuring multi-morbidity has been used in previous studies and has been shown to be comparable to other measures of multi-morbidity such as the Charlson Comorbidity Index as a predictor of mortality and service use.12-15 In this study, a count of medications has advantages over the Charlson index because a count of medicines does not rely on a hospital admission and can be derived over a specific period of time to predate the outcomes.

**Covariates:** age at death

**Moderator:** sex

**Analysis**

**Descriptive analysis:** we will use counts, proportions and averages to describe the sample and the rate of in-hours (IO) and out-of-hours (OOH) ED visits by categories of the exposure.

**Preliminary analysis:** analysis of the univariate associations between exposures and the outcomes using regression analysis, adjusted for age and sex, to understand the relationships between variables.

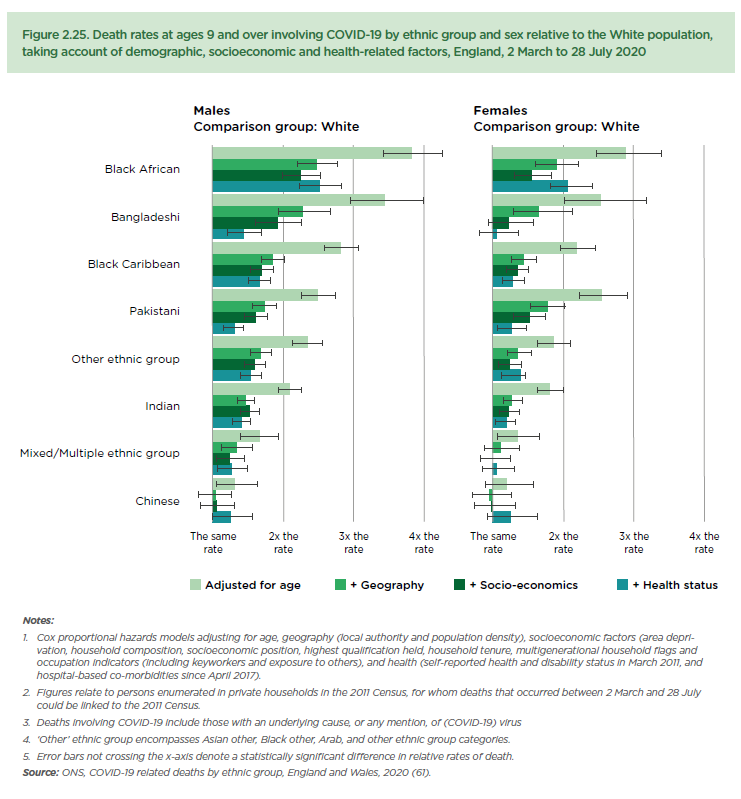
**Modelling:** Poisson models of the incident rate ratio (IRR) of ED visits in the last 3 months of life, with robust standard errors (SE) to account for violations of model assumptions.16 Models will be run separately for men and women and separately for IO and OOH ED visits.

Model 1 will include ethnicity and age; Model 2 will additionally include geographical location (ICB), Model 3 will additionally include area-based deprivation, Model 4 will additionally include morbidity (underlying cause of death and count of primary care medications).

We will display the IRR for each ethnic group (compared to White British) for each of the models (separately for men and women and for IO and OOH) to evaluate attenuation of the ethnicity effects (model 1) by geography (model 2), area-based deprivation (model 3) and morbidity (model 4).

This analysis follows an approach used elsewhere to display intersectional inequalities in covid-19 mortality rates (figure 1).17

**Figure 1: From ‘Build back fairer: the Covid-19 Marmot Review’, p43**



**Sensitivity analysis:** in a sensitivity analysis we will run the analysis excluding sudden causes of death and compare the main effects. This restricts the sample to causes of death that are more likely to have benefited from palliative care and other community-based care that could potentially prevent ED visits towards the end of life.

Non-sudden causes are defined following an approach used to estimate the need for palliative care on a population level, by identifying deaths that could have benefited from palliative care based on the underlying cause of death.18, 19

**Table 1: International Classification of Disease-10 (ICD-10) codes: conditions that could benefit from palliative care, used to estimate palliative care need, source18**

Graphical user interface, text, application

Description automatically generated

In a second sensitivity analysis we will exclude people who died in a care home to test whether being resident in a care home is a potential moderator of the effects.

All analysis will be carried out in Stata MP v16.1.

**Limitations**

* Count of medications is unlikely to fully capture comorbidities; three possible limitations: 1) no capture of prescriptions issued in hospital, 2) people approaching the end of life may have medicines reduced leading to under-representation of comorbidity, 3) bias in patterns of prescriptions, for example prescribing rates tend to be lower in more deprived areas, leading to an under-representation of comorbidity.20
* Care home admission may reduce ED visits – there is some evidence to suggest that this reduction happens for all residents regardless of socioeconomic position.21 We do not have a reliable way to identify care home residents in our sample, the indicator of care home in HES is known to be poor quality. In a sensitivity analysis we can exclude those who died in a care home and compare main effects, however, care home residents who die in hospital will remain in the sample.

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