Green, M. A., Dorling, D., Minton, J., and Pickett, K. E. (2017) Could the rise in mortality rates since 2015 be explained by changes in the number of delayed discharges of NHS patients, Journal of Epidemiology & Community Health, Online First: 02 October 2017.

doi: 10.1136/jech-2017-209403.

Could the rise in mortality rates since 2015 be explained by changes in the number of delayed discharges of NHS patients?

Mark A. Green[1]*, Danny Dorling[2], Jon Minton[3] & Kate E. Pickett[4].

[1] Department of Geography & Planning, University of Liverpool, Roxby Building, Liverpool, L69 7ZT, UK. Email: mark.green@liverpool.ac.uk. Tel: 0151 794 2854.

[2] School of Geography and the Environment, University of Oxford, Oxford, UK.

[3] School of Social and Political Sciences, University of Glasgow, Glasgow, UK.

[4] Department of Health Sciences, University of York, York, UK.

* Corresponding author.

Word count: 1497, for text excluding tables, figures, references, abstract

Abstract

Background: 2015 saw the largest annual spike in mortality rates in in England in almost 50 years. We examine whether these changes in mortality rates are associated with an indicator of poor functioning of health and social care – delay in hospital discharges.

Methods: ONS monthly data of death counts and mortality rates for the period August 2010-March 2016 were compared to delays in discharges from NHS England data on transfers of care for acute and non-acute patients for England. Autoregressive Integrated Moving Average (ARIMA) regression models were used in analysis.

Results: We estimate that each additional day an acute admission was late being discharged was associated with an increase in 0.394 deaths (95% CIs: 0.220-0.569). For each additional acute patient delayed being discharged, we found an increase of 7.322 deaths (95% CIs: 1.754-12.890). Findings for non-acute admissions were mixed.

Conclusion: The increased prevalence of patients being delayed in discharge from hospital in 2015 was associated with increases in mortality, as many as 7,322 (CIs 1,754 to 12,890) deaths in a year in England. Our study provides evidence that a lower quality of performance of the NHS and adult social care as a result of austerity may be having an adverse impact on population health.

Keywords

Mortality; health care; NHS; austerity.

What is already known?

2015 saw the largest annual increase in mortality rates for almost 50 years, and mortality rates have remained high since. During the same period there have been funding crises and poorer quality of care within the NHS and adult social care.

What the paper adds

We demonstrate a positive association between the number of acute patients delayed in being discharged, and the cumulative amount of time acute patients were delayed, to the monthly number of deaths and mortality rate. Our results present evidence that a lower quality of performance between the NHS and adult social care may explain part of the increases in mortality rates experienced in England from at least 2015 and onwards.

INTRODUCTION

The period July 2014 to July 2015 saw an additional 39,074 deaths in England and Wales compared to the same period the previous year (1). While mortality rates fluctuate year-on-year, this was the largest rise for nearly 50 years and the higher rate of mortality has been maintained throughout 2016 and into 2017 (2). These recent trends contrast with the long-term decline in age-specific mortality rates throughout the 20th and 21st Centuries (3). The majority of these additional deaths were in frail elderly individuals(1,4).

The increase in mortality rates has occurred during a crisis in the National Health Service (NHS). The number of NHS trusts with budget deficits has increased sharply since 2014/15 (5), as did waiting periods for elective surgery in 2015 (6). Issues within the NHS are being compounded by problems with the provision of adult social care to support individuals leaving NHS care (7) and pressures of increased demand (8).

We examine whether increases in the number of individuals who are delayed being discharged from hospital are associated with changes in the number of deaths. Delayed discharges may signal worsening health and social care, and influence mortality rates through delaying transfer to appropriate care, and preventing new patients from accessing appropriate care.

METHODOLOGY

Using data on monthly number of deaths (2), we calculated mortality rates. Monthly population counts are not produced so we used mid-year population estimates for England (9). Official estimates are produced for the total population count on 31st June, and were available up to mid-2015 at the time of analysis. We then used population projection estimates for periods outside of this period *pro rata* for month (10).. While mortality rates are our primary outcome, we also test the monthly number of deaths since our population data are estimates and may introduce bias into our results.

The monthly number of delayed transfers of care was used as our explanatory variable (11). A delayed transfer of care was defined as where an admitted patient was ready to be discharged from the care they were receiving but was still occupying a bed. Two measures were available: the total number of patients (defined as the number of patients currently identified as being delayed on the last Thursday of each month), and the total number of cumulative days per month

patients were delayed. Delayed discharges were also split by acute and non-acute admissions to account for patient mix in severity. We used data for the months August 2010 to March 2016 (n=68), the latest available at the time of analysis.

Due to the time-series nature of the data, we use an Autoregressive Integrated Moving Average (ARIMA) regression model to examine the number of deaths for each month. ARIMA models account for the temporal interdependence of observations using a series of lagged variables of the outcome variable (i.e. one month's observations are predictive of the following month's) and error terms (observations are non-independent). ARIMA thus provides a fairer estimation of the association of mortality rates to our exposures. Models were selected based on the 'auto.arima' R function which selects the model which best fits the data (12). We included a seasonal element in the model to account for the fact that mortality rates are highest in winter, and lowest in summer. The model selected was: ARIMA(0,0,0)$(1,1,0)_{12}$ with drift.

Ethical approval was not required for this analysis of openly available secondary data.

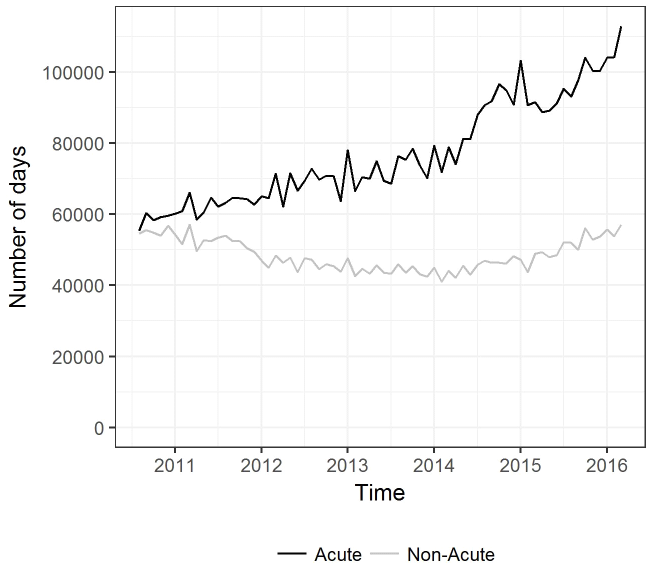
RESULTS

From 2011 there is an upward trend in the total number of days acute patients experienced delays in their discharges, although not for the total number of acute patients (Figure 1). The rate of this increase appears to change in 2014, where both measures begin to trend upwards. The trend for non-acute admissions differs with a 'u'-shaped trend of declines up to 2014 and increases therein after for both measures.

Table 1 presents the results from four separate regression models. Model A uses the total number of deaths within a month as the outcome variable, and examines the total number of days cumulatively patients were late being discharged. We find a positive association with the total number of days delayed which were acute admissions. For each additional day an acute admission was late being discharged, we estimate that the number of deaths increased by 0.394 (95% CIs: 0.220-0.569). We also detect a negative association for non-acute admissions.

Model B repeats the same analysis with a different outcome: the total number of patients who were late being discharged. The results show similar trends to those reported in Model A but with greater uncertainty. Each one unit increase in the number of acute patients who were delayed being discharged was associated with an increase in the total number of deaths of 7.322 (95% CIs: 1.754-12.890). For non-acute admissions, we also find a negative association.

(A)



(B)

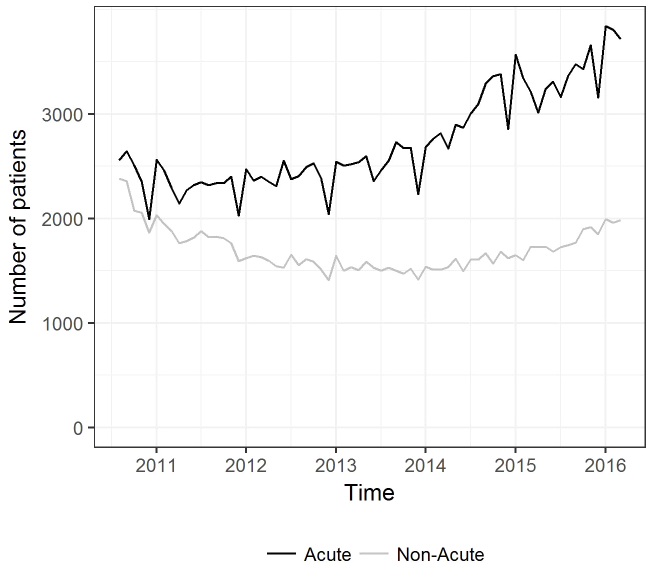


Figure 1: Time-series data of hospital admissions that had delayed discharges by acute and non-acute (monthly data 2010-2016): (A) Total number of days experienced by patients, (B) Total number of patients.

Models C and D repeat the same analyses presented in Models A and B but with mortality rate used as the outcome variable. Both models (C and D) demonstrate positive associations for acute admissions. While the associations for non-acute admissions were also negative, the 95% CIs cross a value of 0 and hence were non-significant.

(A)

Outcome: Total number of deaths

Exposure: Total number of days patients were late being discharged

	Coefficient	Lower CI	Upper CI
Acute admissions	0.394	0.220	0.569
Non-acute admissions	-0.244	-0.433	-0.056
SAR1	-0.468	-0.720	-0.215
Drift	-238.806	-372.365	-105.248
AIC	1060.67		

(B)

Outcome: Total number of deaths

Exposure: Total number of patients who were late being discharged

	Coefficient	Lower CI	Upper CI
Acute admissions	7.322	1.754	12.890
Non-acute admissions	-6.020	-12.025	-0.015
SAR1	-0.495	-0.738	-0.252
Drift	-118.677	-252.577	15.224
AIC	1071.46		

(C)

Outcome: Mortality rate (per 100,000)

Exposure: Total number of days patients were late being discharged

	Coefficient	Lower CI	Upper CI
Acute admissions	0.0007	0.0003	0.0011
Non-acute admissions	-0.0005	-0.0010	0.0001
SAR1	-0.4648	-0.7208	-0.2087
Drift	-0.4845	-0.7401	-0.2290
AIC	356.45		

(D)

Outcome: Mortality rate (per 100,000)

Exposure: Total number of patients who were late being discharged

	Coefficient	Lower CI	Upper CI
Acute admissions	0.013	0.003	0.024
Non-acute admissions	-0.011	-0.022	0.000
SAR1	-0.494	-0.737	-0.251
Drift	-0.264	-0.513	-0.016
AIC	366.92		

Table 1: Results from our time-series regression analyses analysing whether delayed discharges were associated with the total number of deaths.

DISCUSSION

Our analysis shows that changes in the numbers of delayed discharges were associated with changes in mortality trends for England. Delays in the discharges of acute patients were consistently positively associated with a higher monthly number of deaths and overall mortality rates across each of our models; associations for non-acute delayed discharges were mixed.

We hypothesise two possible mechanisms through which delayed discharges may lead to increases in mortality rates: Firstly, patients who are delayed being discharged may be postponed in accessing the correct type of care. Delays may also result in stress and anxiety among individuals who wish to be discharged. One criticism of this hypothesis is that individuals are still receiving care, although this does not account for the wider context of cuts to services that may limit quality of care. Longer stays within hospital may expose patients to inadequate care, although they may equally delay exposure to inadequate social care due to cut backs.

Secondly, delays in discharging patients out of hospital may have knock-on effects on individuals outside of hospitals. A lack of available beds in hospitals due to blockages in discharging patients will harm those who have yet to be admitted and are in need of medical care. Given that we observe a stronger association for discharge delays among acute patients compared to non-acute patients, the hypothesis appears plausible since acute patients are likely to require urgent care.

These explanations are unlikely to completely account for the rise in mortality rates, and delayed discharges could be a symptom of the broader funding crises in the NHS and adult social care (5,7), which have resulted in cutbacks to: the availability and quality of service provision including; declining ambulance response times (13); increased GP workloads (14); and increased waiting times (6,15,16). Such issues may have begun to have a knock-on effect on population health.

Alternative explanations for the rise in mortality rates include; the effects of an ageing population, influenza, and random fluctuations. None of these explanations appear to fully explain trends in mortality (1,15). It is also plausible that the wider context of austerity has created conditions for enabling or compounding their impacts. For example, having a large population share of elderly people may put greater pressure on health and social care, but issues will only arise if these services are underfunded or operate inefficiently.

Limitations of our study include: our analyses being observational and associational, so limited in their ability to draw out causal inferences; and lack of adjustment for other covariates in our model due to a lack of available data. Our results should be interpreted cautiously; the study was exploratory in nature, but offers a useful starting point for further analysis.

We have shown that the increasing prevalence of delayed discharges within hospitals occurred as mortality rates rose in England. Despite the exploratory nature of our study, the implications of our findings are important and require urgent attention. Greater investment in the NHS and adult social care to address the rising levels of delayed discharges may be needed to tackle the rapid rise in mortality rates.

The rise in delayed discharges may have resulted in *as many as* an additional 7,322 (CIs 1,754 to 12,890) deaths in a year in England, roughly a fifth of the total rise.

REFERENCES

1. Green MA, Dorling D, Minton J. The Geography of a rapid rise in elderly mortality in England and Wales, 2014-15. Health Place. 2017;44:77–85.
2. ONS. Monthly figures on deaths registered by area of usual residence [Internet]. 2017. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/monthlyfiguresondeathsregisteredbyareaofusualresidence
3. Minton J, Vanderbloemen L, Dorling D. Visualizing Europe's demographic scars with coplots and contour plots. Int J Epidemiol. 2013;42:1164–76.
4. Hiam L, Dorling D, Harrison D, McKee M. Why has mortality in England and Wales been increasing? An iterative demographic analysis. J R Soc Med. 2017;110(4):153–62.
5. Dunn P, McKenna H, Murray R. Deficits in the NHS 2016 [Internet]. 2016. Available from: http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/Deficits_in_the_NHS_Kings_Fund_July_2016_1.pdf
6. Patients Association. Feeling the Wait [Internet]. 2016. Available from: https://www.patients-association.org.uk/wp-content/uploads/2016/11/Waiting-Times-Report-2016-Feeling-the-wait.pdf

7. ADASS. ADASS Budget Survey 2016 [Internet]. 2016. Available from: https://www.adass.org.uk/media/5379/adass-budget-survey-report-2016.pdf

8. Care Quality Commission. The state of health care and adult social care in England 2015/16 [Internet]. 2016. Available from: http://www.cqc.org.uk/sites/default/files/20161019_stateofcare1516_web.pdf

9. ONS. Population Estimates for UK, England and Wales, Scotland and Northern Ireland [Internet]. 2016. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland

10. ONS. Table A1-4, Principal Projection - England Summary [Internet]. 2015. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/tablea14principalprojectionenglandsummary

11. England N. Delayed Transfers of Care. 2017.

12. Hyndman R, Khandakar Y. Automatic Time Series Forecasting: The forecast Package for R. J Stat Softw. 2008;27:3.

13. NHS England. Ambulance Quality Indicators. 2017; Available from: https://www.england.nhs.uk/statistics/statistical-work-areas/ambulance-quality-indicators/

14. Iacobucci G. GPs' workload climbs as government austerity agenda bites. BMJ. 2014;349:g4300.

15. Hiam L, Dorling D, Harrison D, McKee M. What caused the spike in mortality in England and Wales in January 2015? J R Soc Med. 2017;110(4):131–7.

16. House of Commons. Briefing paper. NHS Indicators: England [Internet]. 2017. Available from: http://researchbriefings.files.parliament.uk/documents/CBP-7281/CBP-7281.pdf