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Understanding the Differences in In-Hospital Mortality Between Scotland and England

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Abstract

Aims: We describe differences in in-hospital mortality between Scotland and England and test whether these differences are robust to controlling for the case-mix of patients. In spite of Scotland and England having much in common in regard to their hospital systems and populations we observe trends in-hospital mortality – the percentage of elective and emergency Continuous Inpatient Spells (CIS) that ended in death – that are different: England's in-hospital mortality rates have decreased faster than Scotland's for both types of admissions.

Data: Individual patient data from England (HES) and Scotland (SMR01) for the period 2003/04 – 2011/12. Episode data is linked into CIS. Sample: Elective and emergency admissions, including day cases and excluding maternity.

Methods: Logit regression of in-hospital death on country and financial year dummies, and their interaction, controlling for age group, gender, deprivation decile, and HRG of the first episode; separately for elective and emergency admissions.

Results: For elective admissions, England has a lower initial in-hospital mortality rate than Scotland, and this rate decreases in both countries but the decrease has been faster in England. For emergency admissions, England starts with a slightly higher in-hospital mortality rate and both countries in-hospital mortality rates reduce throughout the period but England's does so faster.

Conclusions: There are differences in in-hospital mortality between Scotland and England; these differences increase over time and persist when we account for patient characteristics. It is important to understand the causes and consequences of these differences and we make a number of suggestions for future research on this issue.

Introduction

Scotland and England are two jurisdictions of the United Kingdom that have much in common in regard to their hospital systems and populations. There are also important differences and comparing the two countries gives the opportunity for both to learn from each other's experiences.

The present study compares one outcome of hospitalisation, mortality, across the two countries. Mortality in hospital can be viewed as a consequence of the complex interaction of illness and disease, social convention and the decisions of patients and their carers (who respond, for example, to expectations and norms regarding whether to go to hospital to die), and decisions and treatments undertaken by health carers. There is much controversy resulting from comparing mortality between different hospitals in the same health care system, where attempts – often criticised – to adjust for differences in the sickness of patients result in hospital standardised mortality rates. Proponents of such measures hold that by controlling for 'case-mix' observed differences between hospital mortality may be informative regarding the quality of care. Opponents hold that existing methods of case mix adjustment can never properly account for the differences in the complexity of medical needs that patients represent (1).

Our approach is both more general, in regard to the unit of analysis (country rather than hospital), and less concerned with establishing a causal link. We examine how the two countries compare both at a point in time and over time in respect of in-hospital mortality accepting that there may be many underlying reasons for those differences. We do however consider and attempt to control for some obvious potential contributing factors, such as population structure, types of hospital admission and disease profiles. What we find are potentially interesting and increasing differences over time that survive even when we include these controls. We thus seek to establish the rationale for further and more detailed investigation that would seek to attribute these differences to underlying factors.

There is a relatively sparse literature regarding cross-country comparisons of in-hospital mortality for UK countries. A number of papers compare in-hospital mortality amongst other outcomes after specific types of surgery (2,3) or diagnoses (4,5); these articles consider either the UK as a whole or a subset of its countries and do not compare between them. Comparison between UK countries has been performed focusing on children deaths; all three countries in Great Britain have a similar place of death[1] distribution in the period 2003-2010, with approximately two thirds of children dying in hospital (6).

One topic, noted above, that relates to in-hospital mortality is standardised mortality rates at the hospital level. The Health and Social Care Information Centre (HSCIC) publishes the Summary Hospital-level Mortality Indicator (SHMI) for hospitals[2] in NHS England, this indicator is the ratio between the actual number of deaths, in-hospital or within 30 days of discharge, and the expected number based on average England figures, given the characteristics of the patients of the hospital[3] (7). The Information Services Division (ISD) Scotland also publishes a standardised mortality measure, the Hospital Standardised Mortality Ratios (HSMR), that includes deaths within 30 days of admission, which will not include all in-hospital deaths (8). These two measures are not comparable due to methodological differences such as the different time frames they use.

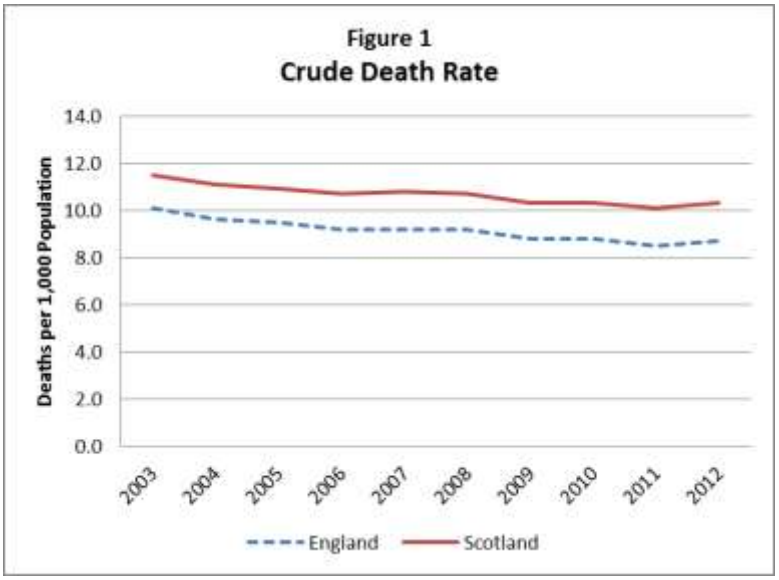
Our study is thus the first of which we are aware to make a direct comparison at country level between Scotland and England in regard to in-hospital mortality.

[1] Does not include injury deaths.
[2] In the National Health Service (NHS) hospitals are managed by Health Trusts. The SHMI is reported at the trust level.
[3] See Footnote 2.

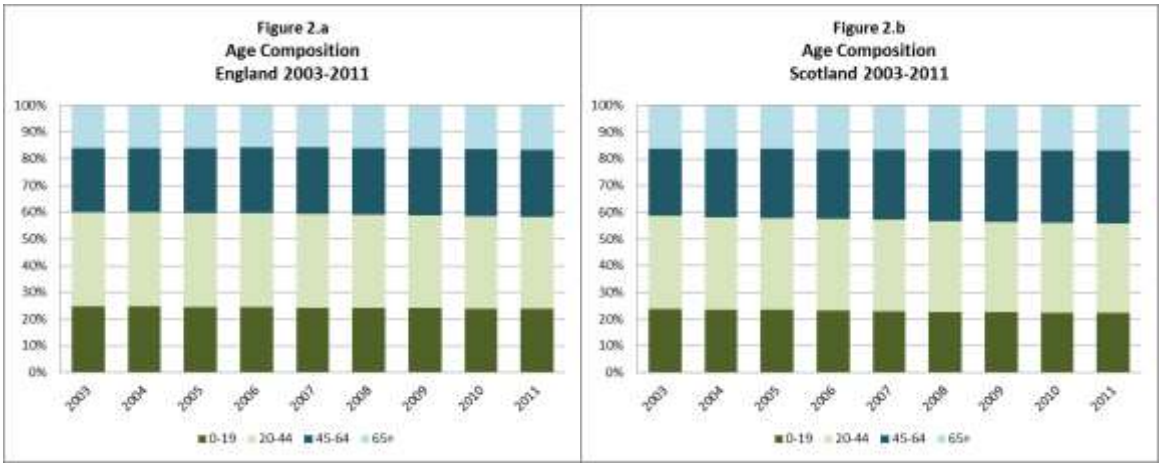
The plan of the paper is as follows. In the next section we set out some background facts and figures for Scotland and England to set the context for our comparison of in-hospital mortality. We also present a graphical depiction of the differences in in-hospital mortality across the two countries. The subsequent sections describe in turn our data, empirical methodology and results. We provide a discussion and suggestions for further research in the final section.

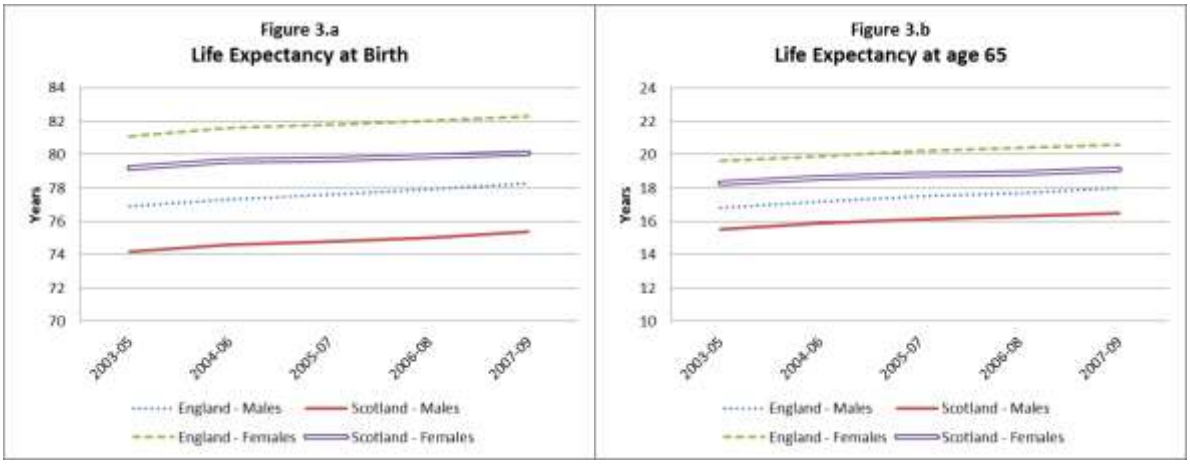
Background

A natural starting point for considering in-hospital mortality is to view it as a proxy of overall mortality. England and Scotland display a similar trend in their crude death rate between 2003 and 2012, as can be seen in Figure 1. There is a persistent difference of approximately 1.5 deaths per 1,000 population, this being the greater in Scotland.



Over the same time period, both countries had a similar age composition (Figure 2) and similar health spending growth, whilst Scotland had a higher level of spending per person (9). Both countries also display similar trends in life expectancy, both at birth (Figure 3.a) and at age 65 (Figure 3.b) for both men and women.

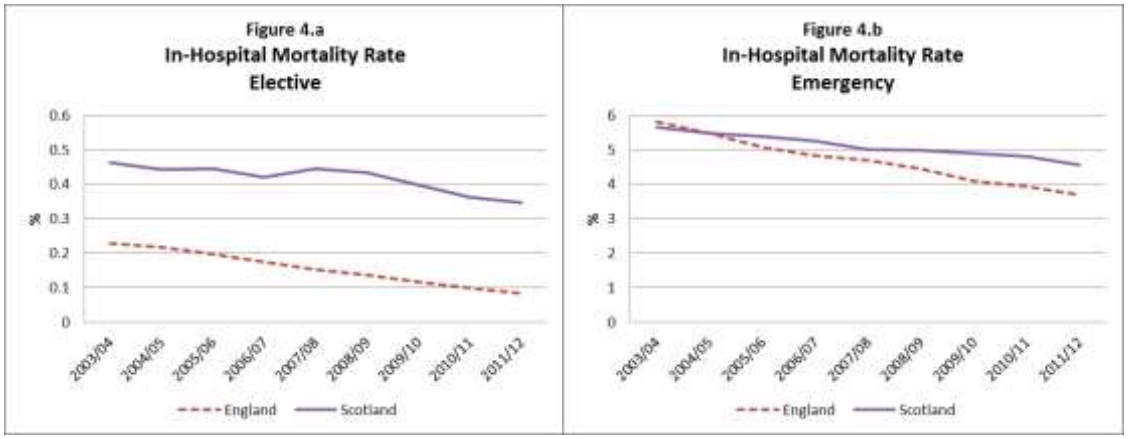




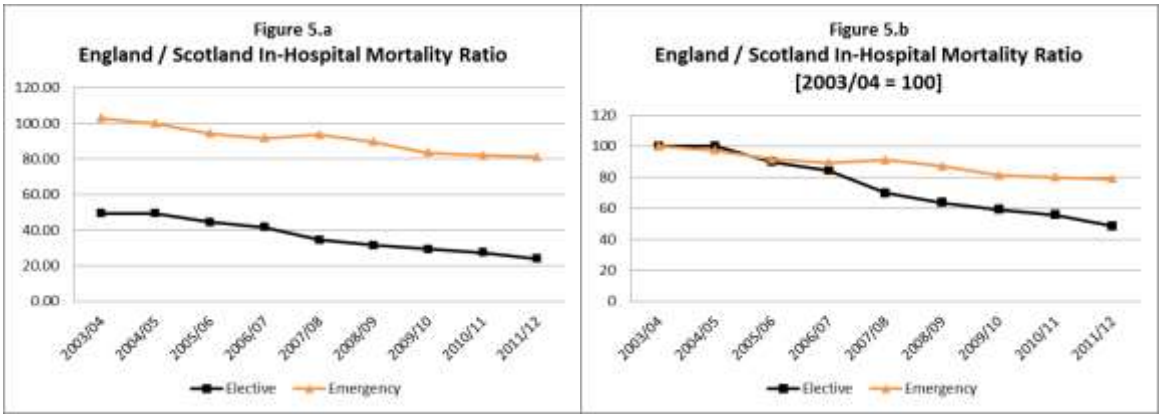
In 2004, 2006, 2007 and 2008, the main three underlying causes of deaths, considering men and women together, were the same in both countries: diseases of the circulatory system, neoplasms, and diseases of the respiratory system; the order was as listed except for England in 2008, where neoplasms had a slightly higher standardised rate per 1,000 population than diseases of the circulatory system. (10–13)

The proportion of patients suffering a healthcare associated infection has reduced in both countries when comparing 2011 with 2005/06. (9)

Despite these similar trends, when we focus on in-hospital mortality, measured by the percentage of elective and emergency Continuous Inpatient Spells (CIS) that ended in death, we observe that it is decreasing in both countries but the trends are different. Figure 4 shows the elective (4.a) and emergency (4.b) in-hospital mortality rate in each financial year in the period 2003/04 to 2011/12 for both countries. The Figure shows that England's in-hospital mortality rates are decreasing faster than Scotland's in both types of admissions.



The difference in the scale of the vertical axis in Figure 4 (the axis for emergency is ten times that for elective) makes it hard to discern the comparative trends for elective care. Over the period graphed the rate in England more than halved, whilst that in Scotland declined 25 percent. To make the relative trends clearer, Figure 5.a shows the ratio of in-hospital mortality rate between the two countries in each financial year in the period 2003/04 to 2011/12, separated by elective and emergency care and Figure 5.b shows the same ratio for elective and emergency but normalising the initial year as 100. The Figure shows that England's in-hospital mortality rates are decreasing faster than Scotland's in both types of admissions, and relatively more so for electives.



Our empirical strategy is designed to determine whether these crude, unadjusted differences persist once we account for the different characteristics of the patients that are being treated in the two countries, specifically; age, sex and disease proxies.

Data and empirical method

Data

Hospital inpatient activity is reported in the Admitted Patient data set of the Hospital Episode Statistics (HES) in England and the Scottish Morbidity Record 01 (SMR01) for Scotland. These data provide individual records on each episode of hospital care, which can be linked into continuous inpatient spells (CIS).

The Health and Social Care Information Centre (HSCIC), defines a CIS as 'a continuous period of care within the NHS, regardless of any transfers which may take place. It can therefore be made up of one or more provider spells', and a provider spell as 'the time that a patient stays in one hospital' (14).

CIS in HES are constructed using the algorithm developed in CHE for that end, while in SMR CIS are constructed using an individual identifier and a continuous inpatient stay marker. There is a small difference in the definitions, while in England the HSCIC methodology (and therefore the CHE algorithm) allows for a gap between the end of one provider-spell and the beginning of the next of up to two days, in Scotland it is defined as an *unbroken* period as inpatient. To make them comparable, we modified the procedure to obtain CIS in HES as not to allow for gaps within a CIS; hence in both countries we will be using *unbroken* hospital stays (including transfers between hospitals).

CIS is classified as elective or emergency using the information about type of admission from its first episode, which is identified by ordering the start and end date of the episodes within each CIS. The first episode also provides the date of admission and the Healthcare Resource Group (HRG, version 3.5) for the CIS.

Using the dates an episode started and ended it is possible to calculate the duration of each episode. This information is aggregated at CIS level to obtain the length of the hospital stay for each CIS.

CIS ending in death are identified using the discharge information of the episodes in the CIS.

The sample includes elective and emergency admissions, including day cases and excluding maternity, from the period 2003/04 to 2011/12.

Empirical Methods

We observe whether a CIS ends with the death of the patient or not, the characteristics of the patient (e.g. age) and of the CIS (e.g. HRG). We relate the outcome of the CIS (death or not) with the characteristics of the patient and of the CIS using:

$$D_i = f(X_{it}), \quad [1]$$

where D_i is the outcome, X_{it} represents the set of explanatory variables, which we discuss in detail in the following subsection and $f(.)$ is a link function.

The index i denotes the unit of observation, which in this case corresponds to the CIS.

The analysis is conducted separately for elective and emergency CIS, as the mortality rates observed in them differ both in level and trend substantially.

The dependent variable in equation [1] can only take two values: 1 when the patient dies in hospital and 0 if the patient leaves the hospital alive. We want to estimate the probability of dying in hospital given the characteristics of the patient and of the CIS, p_i = Pr[D_i = 1 | X_i]. This probability can be estimated using logit or probit or complementary log-log models; these models differ in the cumulative distribution function (cdf) they use to model p: the cdf of the logistic, standard normal and extreme value distribution, respectively, the last one differs from the first two in not being symmetric around zero and it is recommended when one of the outcomes is rare. We do not use Ordinary Least Squares (OLS) as the predicted probabilities will not be restricted to the interval [0,1]. (15)

Variables

Our dependent variable is created using the discharge information from the episodes in the CIS, for each episode it is possible to know whether it ended in death or not, therefore the CIS will end in death when it is recorded as such for one of its episodes.

The explanatory variables include the patient and CIS characteristics recorded on the first episode of the CIS. For each CIS we use the age at admission, sex, and deprivation decile[4] of the patient and the HRG of admission. All variables are included as a set of dummy variables, e.g. age is a set of five-year age categories: 0-4, 5-9, etc.

To be able to determine whether there are differences between countries, we include a country dummy variable, a set of (financial) year dummy variables and the interaction of country and year. The country dummy variable shows the initial difference in in-hospital mortality rates between the two countries; the financial year dummy variables show the difference between each financial year

[4] The deprivation deciles in England are determined by the Index of Multiple Deprivation 2004 (IMD 2004), which is defined at the Super Output Area (SOA) level. The deprivation index includes a 'Health Deprivation and Disability Domain', with a weight of 13.5% and it is based on years of potential life lost, comparative illness and disability ratio, measures emergency admissions to hospital, and adults under 60 suffering from mood or anxiety disorders. [The English Indices of Deprivation 2004: Summary (revised). http://webarchive.nationalarchives.gov.uk/20100410180038/http://www.communities.gov.uk/documents/communities/pdf/131206.pdf].
In Scotland, the Scottish Index of Multiple Deprivation (SIMD, version 2012) is used to identify multiple deprivation in Data Zones. In this index the 'Health Domain' has a weight of 14% and is based on the following indicators: standardised mortality ratio; hospital stays related to alcohol use; hospital stays related to drug use; comparative illness factor; emergency admissions to hospital; proportion of population being prescribed drugs for anxiety, depression or psychosis; proportion of live singleton births of low birth weight. [Scottish Index of Multiple Deprivation 2012. http://simd.scotland.gov.uk/publication-2012/]

and the first year in the analysed period for the reference country (in this case, Scotland); and the interaction shows whether the countries' trends in in-hospital mortality rates differ over time.

Preliminary results

Tables 1 and 2 show the Logit regression results for elective and emergency CIS, respectively. The results are reported as odd ratios. The tables include only the variables that would reflect differences between the countries as this is the focus of our analysis.

In the case of electives (Table 1) the estimation results confirm what we observe in Figure 4.a, England has a lower (odd-ratio less than 1 for the country dummy) in-hospital mortality rate than Scotland at the beginning of the period, this difference is reduced once we take into account differences in case mix (HRG). The results also show a decrease in the in-hospital mortality rate in Scotland (odd-ratios less than 1 for the financial year dummies), that is only present in the last few years once we take in to account HRGs, and that the decrease in England has been faster than in Scotland (odd-ratios less than 1 for the interaction terms) since 2005/06.

The results for emergencies (Table 2) also confirm what is described in Figure 4.b, England starts with slightly higher in-hospital mortality than Scotland, this difference is larger when we consider case mix, and both countries reduce their in-hospital mortality rate throughout the period but England does so faster.

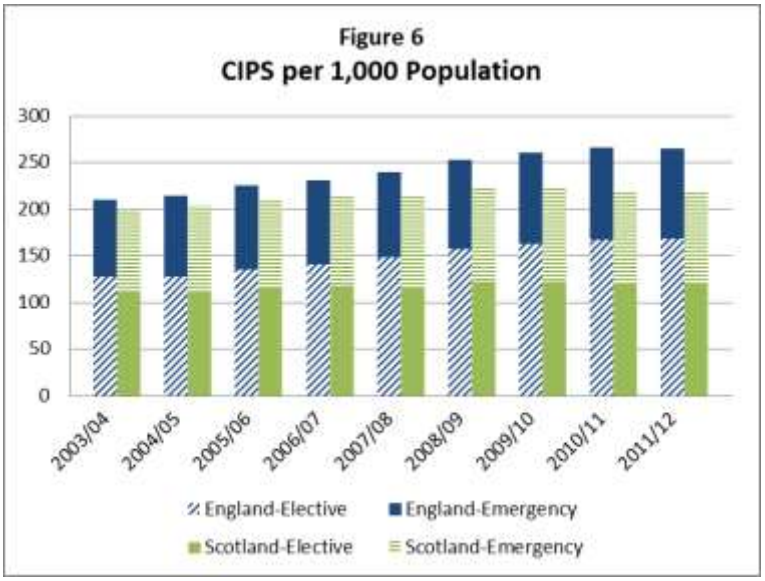
Tables 3 and 4 are based on the results reported in Tables 1 and 2, respectively, and show the odd-ratio of England relative to Scotland for each year. These tables again show that England's reduction of in-hospital mortality has been faster than that of Scotland throughout the period, and the results confirm what we observe in Figure 5.a.

Discussion

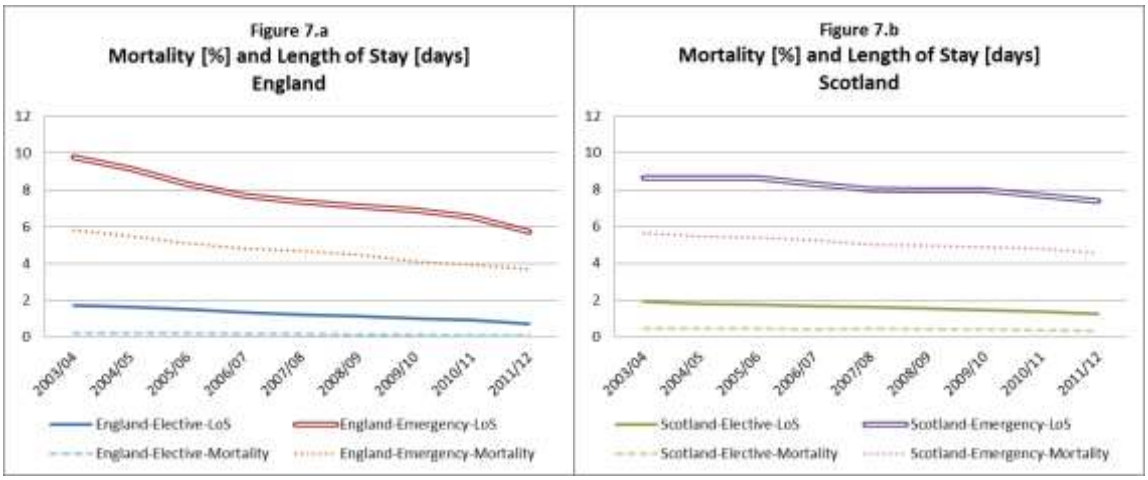
Our non-linear regression models confirm that; there are differences in in-hospital mortality between Scotland and England; these differences increase over time and the differences persist when we account for changing (and different) patterns of patient characteristics across the two countries. Whereas it is not difficult to account for initial or persistent differences, because as we show in the Background section there are persistent differences between the two countries in terms of population characteristics, the divergence over time is more challenging. Put simply most of the differences we do observe between Scotland and England in terms of their underlying populations are constant over time.

Accounting for the different trends in in-hospital mortality is beyond the scope of this paper but we suggest here some possible avenues of investigation.

First we note there are differences in the elective/emergency composition of hospital activity and that these differences also change over time. Overall activity, measured as the total number of CIS per 1,000 population, has increased in both countries, and in both types of activity, elective and emergency. England's increase in overall activity has been greater than Scotland's. In England there are, proportionally, more elective CIS than in Scotland; they increase over the period and represent over 60% of the total number of CIS in the analysed period, while in Scotland they represent around 55% of the activity throughout the period (see Figure 6). Within electives, the proportion of day cases has increased in both countries, reaching around 70% of electives in Scotland and around 66% of electives in England in 2011/12.



There are also differential changes on the duration of treatments. Both countries have reduced lengths of stay in elective and in emergencies, but England has done so more quickly than Scotland. This to some extent mirrors the different trend in in-hospital mortality. Figure 7, for example, shows in the same graph for each country, the trends in length of stay and mortality.



Furthermore, the two countries have evolved different policies towards their hospital sectors. NHS Scotland has set targets in different areas of performance that had to be delivered since 2006/07 (16), and the achievement of some of these targets would lead to a reduction of the average length of stay. The performance relative to these targets is available online for each financial year[5]. From the summary of performance for the 2010/11 targets we can see that the average length of stay for emergency episodes was reduced from 4.5 days in 2004/05 to 3.3 in 2010/11, the number of emergency bed days per 100,000 population occupied by patients aged 65 and over was reduced from 3,400 in 2006/07 to 3,200 in 2010/11, and the number of bed days per 100,000 population devoted to some long-term conditions (chronic obstructive pulmonary disease, asthma, diabetes or coronary heart disease) was reduced from 9,300 in 2006/07 to 8,000 in 2010/11.

In England there are no specific targets regarding length of stay, but adjustments to the Payments by Results (PbR) tariff for stays that are shorter or longer than some HRG-specific cut off points. (17)

[5] http://www.scotland.gov.uk/About/Performance/scotPerforms/partnerstories/NHSScotlandperformance

The number of available beds per 1,000 population was higher in Scotland than in England in 2004/05, 2005/06 and 2008/09 (10,11,13). In 2008/09 (13) Scotland had 5.0 NHS hospital beds per 1,000 population and England had 3.1. This total number of available NHS hospital beds includes geriatrics, but geriatrics is defined differently in both countries, so the figures are not directly comparable; it also includes maternity, which it is not considered in our analysis. If we exclude maternity, 0.2 beds per 1,000 in each country, and geriatrics, 1.1 in Scotland and 0.4 in England, the figures are 3.7 and 2.5 NHS hospital beds per 1,000 population. In the period 2000/01 – 2009/10 bed occupancy rates for all specialties did not change, in 2009/10 they were 85% for England and 80% for Scotland (9). Taken together, the higher number of available NHS hospital beds and similar bed occupancy rates, mean that, proportionally, more people could be in hospital at a given time in Scotland than in England, and, with similar overall mortality rates, more deaths would be recorded in hospital in Scotland.

Hence there are a number of potential explanations for our empirical findings, but which of these can account for the differential trend in in-hospital mortality is of considerable importance for patients, policy-makers and health care managers in both countries. For example, if making extra capacity available induces more patients or their health carers to opt for terminal care in hospital, there are important resource implications for the health care sector. Similarly if some policy interventions have unintended consequences for in-hospital mortality, those need to be understood in order to correctly evaluate interventions.

Using the data and framework we have set out above there are many opportunities to explore these issues further. Many of the potential explanatory factors naturally vary either across time, or across specific aspects of hospital care, or across different patients. Such natural variation provides a mechanism for establishing a link between cause and effect as exemplified in many studies of ‘natural experiments’. We hope in part that our analysis can serve as a stimulus to identify and analyse the natural experiments that have a bearing on differences in in-hospital mortality.

Table 1
Elective CIS 2003/04 - 2011/12
Dependent Variable: Prob(Death)
Logit Regressions - Odds Ratios

	(1)	(2)	(3)	(4)
2004/05	0.938	0.938	0.938	0.976
	(0.026)	(0.026)	(0.027)	(0.029)
2005/06	0.931	0.931	0.932	0.994
	(0.026)	(0.026)	(0.026)	(0.029)
2006/07	0.867 ***	0.867 ***	0.868 ***	0.971
	(0.024)	(0.024)	(0.024)	(0.029)
2007/08	0.901 ***	0.901 ***	0.905 ***	1.007
	(0.025)	(0.025)	(0.025)	(0.029)
2008/09	0.876 ***	0.876 ***	0.877 ***	0.992
	(0.024)	(0.024)	(0.024)	(0.029)
2009/10	0.799 ***	0.798 ***	0.801 ***	0.939
	(0.022)	(0.022)	(0.023)	(0.028)
2010/11	0.725 ***	0.724 ***	0.725 ***	0.859 ***
	(0.021)	(0.021)	(0.021)	(0.026)
2011/12	0.685 ***	0.684 ***	0.687 ***	0.825 ***
	(0.020)	(0.020)	(0.020)	(0.025)
England	0.457 ***	0.454 ***	0.457 ***	0.656 ***
	(0.010)	(0.010)	(0.010)	(0.015)
2004/05 * England	1.006	1.005	1.004	0.998
	(0.031)	(0.031)	(0.031)	(0.032)
2005/06 * England	0.907 ***	0.903 ***	0.900 ***	0.887 ***
	(0.027)	(0.027)	(0.027)	(0.028)
2006/07 * England	0.843 ***	0.836 ***	0.836 ***	0.810 ***
	(0.026)	(0.026)	(0.026)	(0.026)
2007/08 * England	0.708 ***	0.707 ***	0.703 ***	0.691 ***
	(0.022)	(0.022)	(0.021)	(0.022)
2008/09 * England	0.633 ***	0.631 ***	0.630 ***	0.641 ***
	(0.019)	(0.019)	(0.019)	(0.020)
2009/10 * England	0.584 ***	0.582 ***	0.578 ***	0.617 ***
	(0.018)	(0.018)	(0.018)	(0.020)
2010/11 * England	0.544 ***	0.542 ***	0.536 ***	0.572 ***
	(0.017)	(0.017)	(0.017)	(0.019)
2011/12 * England	0.473 ***	0.472 ***	0.468 ***	0.486 ***
	(0.015)	(0.015)	(0.015)	(0.016)
Age Group Dummies	YES	YES	YES	YES
Gender Dummy	NO	YES	YES	YES
Decile Dummies	NO	NO	YES	YES
HRG Dummies	NO	NO	NO	YES
Number of Observations	73837076	73823669	73129579	71954212
Log-Likelihood	-859418.5	-857799.6	-846375.9	-628670.5
Chi-Squared	131927.6	132875.4	133262.7	564661.8

Notes: *** indicates 1% significance.
All regressions include a constant.

Table 2
Emergency CIS 2003/04 - 2011/12
Dependent Variable: Prob(Death)
Logit Regressions - Odds Ratios

	(1)	(2)	(3)	(4)
2004/05	0.960 ***	0.960 ***	0.960 ***	0.961 ***
	(0.009)	(0.009)	(0.009)	(0.010)
2005/06	0.939 ***	0.939 ***	0.940 ***	0.940 ***
	(0.009)	(0.009)	(0.009)	(0.010)
2006/07	0.900 ***	0.900 ***	0.900 ***	0.898 ***
	(0.008)	(0.008)	(0.008)	(0.009)
2007/08	0.856 ***	0.855 ***	0.855 ***	0.870 ***
	(0.008)	(0.008)	(0.008)	(0.009)
2008/09	0.837 ***	0.836 ***	0.836 ***	0.847 ***
	(0.008)	(0.008)	(0.008)	(0.009)
2009/10	0.816 ***	0.814 ***	0.815 ***	0.816 ***
	(0.008)	(0.008)	(0.008)	(0.008)
2010/11	0.780 ***	0.778 ***	0.779 ***	0.765 ***
	(0.007)	(0.007)	(0.007)	(0.008)
2011/12	0.726 ***	0.724 ***	0.725 ***	0.698 ***
	(0.007)	(0.007)	(0.007)	(0.007)
England	1.019	1.018	1.023 ***	1.055 ***
	(0.007)	(0.007)	(0.007)	(0.008)
2004/05 * England	0.975	0.975	0.975	0.981
	(0.010)	(0.010)	(0.010)	(0.010)
2005/06 * England	0.923 ***	0.922 ***	0.922 ***	0.933 ***
	(0.009)	(0.009)	(0.009)	(0.010)
2006/07 * England	0.905 ***	0.904 ***	0.904 ***	0.909 ***
	(0.009)	(0.009)	(0.009)	(0.010)
2007/08 * England	0.912 ***	0.911 ***	0.912 ***	0.887 ***
	(0.009)	(0.009)	(0.009)	(0.009)
2008/09 * England	0.863 ***	0.862 ***	0.862 ***	0.830 ***
	(0.009)	(0.009)	(0.009)	(0.009)
2009/10 * England	0.801 ***	0.800 ***	0.800 ***	0.766 ***
	(0.008)	(0.008)	(0.008)	(0.008)
2010/11 * England	0.793 ***	0.792 ***	0.787 ***	0.726 ***
	(0.008)	(0.008)	(0.008)	(0.008)
2011/12 * England	0.786 ***	0.784 ***	0.783 ***	0.717 ***
	(0.008)	(0.008)	(0.008)	(0.008)
Age Group Dummies	YES	YES	YES	YES
Gender Dummy	NO	YES	YES	YES
Decile Dummies	NO	NO	YES	YES
HRG Dummies	NO	NO	NO	YES
Number of Observations	46874291	46870775	46192293	46134293
Log-Likelihood	-7430772.3	-7421478.5	-7346056.0	-6158480.8
Chi-Squared	2835917.7	2853065.1	2825806.2	5195367.4

Notes: *** indicates 1% significance.
All regressions include a constant.

Table 3
Elective CIS 2003/04 - 2011/12
Dependent Variable: Prob(Death)
Logit Regressions - Odds Ratios
Relative OR England vs. Scotland

	(1)	(2)	(3)	(4)
2003/04	0.457 ***	0.454 ***	0.457 ***	0.656 ***
	(0.010)	(0.010)	(0.010)	(0.015)
2004/05	0.460 ***	0.457 ***	0.459 ***	0.655 ***
	(0.010)	(0.010)	(0.010)	(0.015)
2005/06	0.415 ***	0.410 ***	0.411 ***	0.582 ***
	(0.009)	(0.009)	(0.009)	(0.013)
2006/07	0.386 ***	0.380 ***	0.382 ***	0.532 ***
	(0.008)	(0.008)	(0.008)	(0.012)
2007/08	0.324 ***	0.321 ***	0.321 ***	0.454 ***
	(0.007)	(0.007)	(0.007)	(0.010)
2008/09	0.290 ***	0.287 ***	0.288 ***	0.421 ***
	(0.006)	(0.006)	(0.006)	(0.009)
2009/10	0.267 ***	0.264 ***	0.264 ***	0.405 ***
	(0.006)	(0.006)	(0.006)	(0.009)
2010/11	0.249 ***	0.246 ***	0.245 ***	0.376 ***
	(0.006)	(0.006)	(0.006)	(0.009)
2011/12	0.216 ***	0.215 ***	0.214 ***	0.319 ***
	(0.005)	(0.005)	(0.005)	(0.008)
Age Group Dummies	YES	YES	YES	YES
Gender Dummy	NO	YES	YES	YES
Decile Dummies	NO	NO	YES	YES
HRG Dummies	NO	NO	NO	YES
Number of Observations	73837076	73823669	73129579	71954212
Log-Likelihood	-859418.5	-857799.6	-846375.9	-628670.5
Chi-Squared	131927.6	132875.4	133262.7	564661.8

Notes: *** indicates 1% significance.
All regressions include a constant.

Table 4
Emergency CIS 2003/04 - 2011/12
Dependent Variable: Prob(Death)
Logit Regressions - Odds Ratios
Relative OR England vs. Scotland

	(1)	(2)	(3)	(4)
2003/04	1.019	1.018	1.023 ***	1.055 ***
	(0.007)	(0.007)	(0.007)	(0.008)
2004/05	0.994 ***	0.992 ***	0.998 ***	1.035 ***
	(0.007)	(0.007)	(0.007)	(0.008)
2005/06	0.941 ***	0.939 ***	0.944 ***	0.984 ***
	(0.007)	(0.007)	(0.007)	(0.007)
2006/07	0.922 ***	0.920 ***	0.925 ***	0.959 ***
	(0.007)	(0.006)	(0.007)	(0.007)
2007/08	0.930 ***	0.927 ***	0.933 ***	0.936 ***
	(0.007)	(0.007)	(0.007)	(0.007)
2008/09	0.880 ***	0.877 ***	0.882 ***	0.876 ***
	(0.006)	(0.006)	(0.006)	(0.007)
2009/10	0.816 ***	0.814 ***	0.819 ***	0.808 ***
	(0.006)	(0.006)	(0.006)	(0.006)
2010/11	0.808 ***	0.806 ***	0.806 ***	0.766 ***
	(0.006)	(0.006)	(0.006)	(0.006)
2011/12	0.801 ***	0.798 ***	0.801 ***	0.757 ***
	(0.006)	(0.006)	(0.006)	(0.006)
Age Group Dummies	YES	YES	YES	YES
Gender Dummy	NO	YES	YES	YES
Decile Dummies	NO	NO	YES	YES
HRG Dummies	NO	NO	NO	YES
Number of Observations	46874291	46870775	46192293	46134293
Log-Likelihood	-7430772.3	-7421478.5	-7346056.0	-6158480.8
Chi-Squared	2835917.7	2853065.1	2825806.2	5195367.4

Notes: *** indicates 1% significance.
All regressions include a constant.

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Appendix 1: data sources

Figure 1

- Office for National Statistics (ONS). Vital Statistics: Population and Health Reference Tables (May 2014 Update)

Figure 2

- Office for National Statistics (ONS). Population Estimates Total Persons for England and Wales and Regions - Mid-1971 to Mid-2011, Table B.
- Office for National Statistics (ONS). Population Estimates Quinary Age Groups for UK Constituent Countries - Mid 1971 to Mid-2010.
- Office for National Statistics (ONS). 2011 Census: Age structure, local authorities in the United Kingdom.

Figure 3

- Office for National Statistics (ONS). Life expectancy at birth and at age 65 for health areas in the United Kingdom, 2003–05 to 2007–09. http://www.ons.gov.uk/ons/rel/subnational-health4/life-expectancy-at-birth-and-at-age-65-for-health-areas-in-the-united-kingdom/2003-05-to-2007-09/index.html

Figures 4 to 7

- Hospital Episode Statistics (HES), Inpatients, 1997-98 to 2011-12.
- Scottish Morbidity Records (SMR), SMR01 - General / Acute Inpatient and Day Case.