Comparing Inpatient Emergency Hospital Care in England and Scotland

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Executive Summary

1. This report places the documented growth in emergency inpatient hospital care in England in context, by considering how it compares with the experience in Scotland.

2. Scotland is an interesting and important comparator because whilst it has experienced a very similar pattern of expenditure growth on its NHS, it has adopted a different policy framework. It thus potentially permits the identification of the role of policy reform in determining any differential outcome.

3. A first step of our investigation was to examine the comparability of hospital inpatient activity measures in Scotland and England. We conclude that care is needed due to terminological differences in the two countries. Some existing studies have avoided this issue by comparing a narrow definition of emergency care – admission episodes.

4. We devise a strategy for broadening the measure of activity to include all episodes of care that follow directly on from an emergency admission. In the case of Scotland our approach entails a degree of approximation and in the future we hope to test the sensitivity of our findings to this issue. For the purposes of our comparative study we find that the results from the narrow definition of emergency care are very similar to those for the wider definition.

5. Existing studies have focused on a count of episodes but this measure does not account for the intensity of resource use that is entailed. We therefore consider both episodes and total bed days. This distinction is both conceptually and practically important. Whereas episodes have displayed almost incessant growth in per capita terms, bed days have fallen.

6. In comparing England and Scotland it is necessary to take account of their different populations, differences in the changing structure of those populations, the different mixture of treatments that are provided in each country, and differences in the policies that have been adopted.

7. We adopt a Fixed Effects regression framework that controls for case mix and we deflate activity by population specific measures in order to control for population structure and changes. In regard to this second issue we find little evidence of important differences in the two countries, so that more sophisticated controls for population have no material effect on the results.

8. Whereas the uncorrected data for episodes show much more rapid expansion in England than Scotland some of this is explained by case mix. Accounting for case mix variation also gives a different interpretation of the time path for bed days – rather than strong negative growth, the data is better explained in terms of near constancy over time punctuated by downward shifts coincidental with policy interventions.

9. In regard to emergency episodes we find that England has experienced faster growth than Scotland, but that the difference is more modest than raw data appears to suggest and the difference in trend continues to be offset by the lower propensity for emergency episodes in England relative to Scotland.

10. The key policy interventions we have considered are those associated with PbR and overall we find that these interventions have moderated the overall expansion of

episodes, although we caution against over-interpreting these results since there is a complex combination of policy impact effects and effects of changes in the payment mechanism (tariff).

11. In regard to bed days we find that England has experienced a decline over the period 1998-2011 both absolutely and relative to Scotland. This decline is not a simple trend process – the impact of policy appears to be more substantial and more fundamental than with the episodes measure of activity.

12. We consider simple summary measures of elective activity in the two countries and do not find any prima facie evidence of England having a faster expansion in emergency activity on account of its lower elective activity relative to Scotland. There is more elective activity in England than Scotland over the sample period and as measured by episodes this activity grows faster in England than in Scotland.

13. Our fixed effects regression framework provides a tool for examining and comparing the growth in emergency activity in Scotland and England on an HRG by HRG basis. We present some examples and recommend that a further analysis on this basis is a potentially fruitful avenue of research.

14. Our key conclusions are:

- Care is needed when comparing emergency hospital activity in Scotland and England.
- It is important how activity is measured – episodes of care do not give the same picture as bed days.
- It is important to account for the differences between the two countries in terms of case-mix, population and policy choices.
- After accounting for case-mix, population and policy differences, England has shown faster growth in emergency episodes but has a persistently lower rate of those episodes.
- Using bed days as a measure of activity, England has had persistently lower emergency hospital activity than Scotland.
- Payment by Results is associated with reductions in emergency hospital activity in England.

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Acknowledgements

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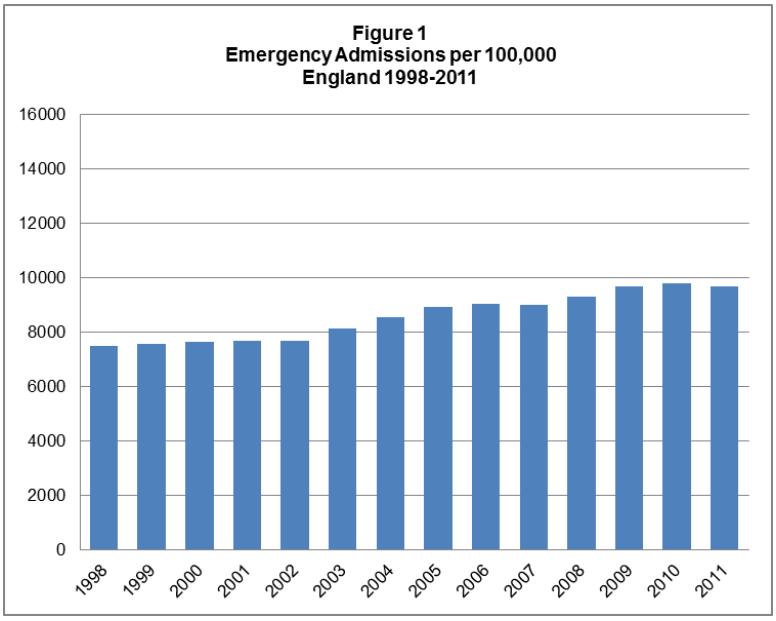
1. Background

The delivery of inpatient hospital services can be differentiated as between planned periods of care, also termed elective care, and unplanned, also termed emergency care. Concern has been expressed regarding the growth in emergency care in hospitals in England and the consequences of that growth for resources (Blunt et al., 2010; Gillam, 2010; Maybin and Thorlby, 2010; NAO, 2013).

There are numerous ways of reflecting changes in emergency care over time but most lead to the conclusion that there has been substantial growth. For example, Figure 1 depicts the number of emergency hospital admissions (per 100,000 of population) in England over the period 1998 to 2011.



The rising trend depicted in Figure 1 leads to concern for different reasons; stemming from the distinction between planned and unplanned care, emergency care has the connotation that it is the result of some failure to foresee and plan for health care needs; emergency admissions are typically more costly and have worse outcomes (higher mortality) than apparently similar elective admissions; and emergency admissions, being unplanned by definition, require hospitals to maintain more capacity than would be necessary if all health care were pre-planned.

It is also inevitable that the health care system will have to deal with the unexpected, and citizens place a large value on the availability of hospital care as and when the need arrives whether foreseen or not.

There is thus a desire to know whether any observed increase in emergency care is a natural consequence of the health needs and requirements of a changing population in a world of improving healthcare technologies – that make ever more complex interventions 'possible' – or whether it is some failure in the health care system. In the latter instance, for example, it might be that pressures on planned care lead to individuals not being treated in a timely fashion and thus becoming emergencies. And given that there was both a substantial growth in resources and a number of policy initiatives in the decade 2000-2010, one concern is that the growth in emergency admissions is an unintended consequence of interventions aimed at improving efficiency.

A number of reports (Blunt et al., 2010; NAO, 2013) have sought to examine this issue. Directly relevant to the present report, (Blunt et al., 2010) examined the time pattern of the growth in emergency admissions in England from 2004-2009 and related this to changes in factors that could explain such growth. A strength of that study is its use of highly detailed administrative data – Hospital Episodes Statistics – allowing the authors to control for both the changing pattern of admissions over time, and the characteristics of the patients being treated. The essence of this approach is to try and infer unexplained growth and to interpret this as circumstantial evidence of some underlying problem and cause for concern.

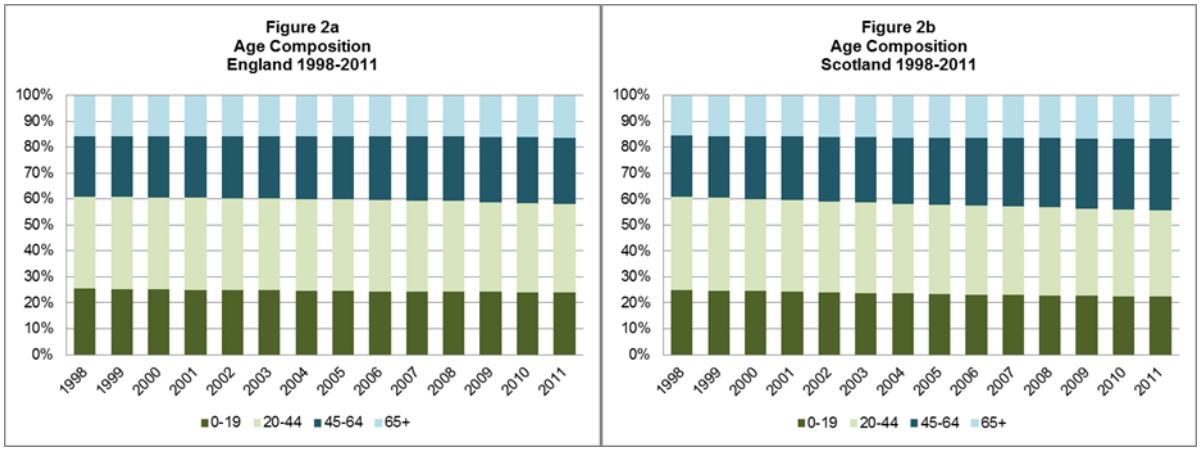
Some key conclusions of the Nuffield study included that:

- "The number of emergency admissions in England rose by 11.8 per cent over the five-year period 2004/05 to 2008/09.
- The rise in emergency admissions was not associated with any one particular type of illness or age group.
- Central policy initiatives and targets … do not seem to have had an obvious effect"

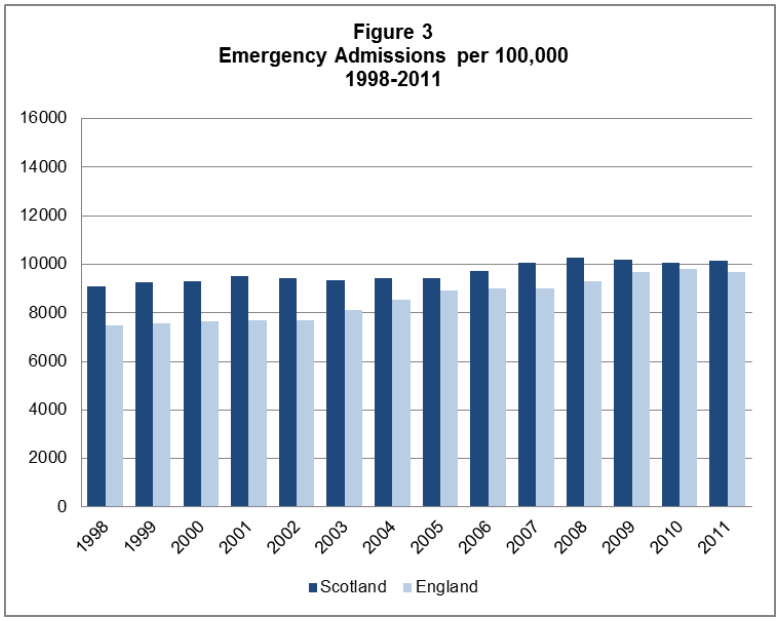
One difficulty in drawing conclusions from such a method is that there are many factors that could have affected the growth of emergency care, not all of which can be known or observed. This is an issue of not observing a counterfactual – what would have happened had there not been the policy interventions. In terms of experiments, we are observing only one subject – the NHS in England – before and after treatment (policy interventions).

A further limitation of existing studies is that they have treated emergency care in the aggregate, whereas it is the summation of many different treatments and interventions, the balance of which – the case mix – may change over time and may vary between the observed and the counterfactual.

The present study uses the fact that hospital admissions are recorded in a similar (but not identical) way in Scotland as they are in England to conduct the first detailed analysis of the comparative growth in emergency admissions in England and Scotland. Whilst the NHS in Scotland has benefitted from a similar increase in resources as England (NAO, 2012), it has not been the subject of policy initiatives such as Payment by Results, Patient Choice or the introduction of NHS Foundation Trusts. Additionally, both countries show a similar age structure throughout the analysed period, as can be seen in Figures 2a and 2b. It therefore provides a natural comparator, or more formally a 'control' with which to assess the effect of England's 'treatment'. We additionally use the designation of hospital care into a large number of different categories – Healthcare Resource Groups (HRGs) (National Casemix Office, 2012) – to account for case mix variation.



Informally comparing the pattern of emergency care across two countries over time provides a context for understanding either – for example, giving a basis for understanding whether the growth in England has been large or small. For example, reporting on a comparison across the National Health Services in different parts of the UK the National Audit Office (NAO, 2012) noted the substantially higher percentage growth in emergency admissions in England than in Scotland. Figure 3 illustrates what a simple counting of emergency admissions in England and Scotland appears to show regarding their comparative growth with England appearing to exhibit faster growth over the whole period from 1998 to 2011.



A more formal analysis involves accounting for the variation in emergency hospital activity both between Scotland and England and over time after accounting for factors such as case-mix and differing policy interventions.

Where there are specific factors that differ over time in one jurisdiction but are constant in the other the standard framework for this is regression analysis invoking difference-in-differences estimators and this forms the core of our own analysis.

We have collated data covering the period 1998 to 2011 for both England and Scotland and we address specific questions:

- Do statistics of the kind reported by National Audit Office reflect a like-with-like comparison? If not, what does a like for like comparison reveal?
- To what extent do case-mix factors explain any differences in the pattern of emergency hospital care between Scotland and England?
- To what extent do policy interventions, specifically Payment by Results (PbR) (Department of Health Payment by Results Team, 2012), changes in tariffs and waiting time targets explain any differences in the emergency care between Scotland and England?
- What is the extent of any unexplained difference in emergency care between England and Scotland?

A focus on admissions does not necessarily capture what may be most relevant regarding hospital care that is precipitated as an emergency. There have been substantial changes in the duration of hospital care, reflected in declining lengths of stay. Thus another measure of

activity is the number of bed days that result from emergency admissions. We therefore additionally examine:

- Do the answers to the questions above continue to hold when considering emergency bed days?

As noted above emergency hospital care is an alternative to elective care and whilst a comprehensive study of elective care is beyond our remit for this report we also consider at the level of aggregate data:

- Are aggregate differences in growth of emergency admissions or bed days between Scotland and England offset or augmented by corresponding differences in growth of elective admissions or bed days?

Finally, we draw together our findings to consider

- What can we learn from a comparison of England and Scotland about the possible future patterns of emergency admissions and bed days?

There are numerous difficulties in comparing data across jurisdictions and direct comparison of reported published figures across countries can result in erroneous conclusions. We specify the issues that we encountered in detail in the main sections of the report but there are some terminological and reporting conventions that it is important to highlight beforehand.

First, the terms emergency and unplanned are often used synonymously but their precise meaning differs across the administrative data systems in England (Hospital Episodes Statistics – HES) and Scotland (Scottish Morbidity Record – SMR). We henceforth use the term emergency to qualify either an admission, or a stay in hospital, or a part of that stay (an episode) that begins as an unplanned admission to hospital. This corresponds to designation that is given in HES, but differs from that which might be inferred from SMR.

Second, in referring to hospital care, the terms admission, episode and stay are sometimes inadvertently used interchangeably. Hospital inpatient stays are a natural reporting unit in England where the definition of a stay is inherent in the reimbursement system but are not prevalent in Scotland. A stay refers to possibly several consecutive periods in hospital termed episodes. Hospital episodes are the underlying data element in both HES and SMR and thus we make our comparisons in terms of episodes. An episode may start with the individual patient being admitted to hospital – an admission – or may start with the patient being transferred either within the admitting hospital or from another admitting hospital; both of which are termed transfers. It is useful to distinguish these and for clarity we used the term admission episode to refer to the former (and thus distinguish this from the term admission that could relate to either a spell or an episode).

In the following section of this report we discuss the data that we use and set out the conceptual and empirical frameworks. The following section sets out our results and findings and the final section summarizes and discusses these.

2. Data and Methods

2.1. 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 (SMR) for Scotland. These are the sources for our study. These data provide individual records on each episode of hospital care, and in the case of HES consecutive episodes of care can be easily linked into continuous inpatient spells. Whilst it is possible using identifiers of patients to link episodes in SMR into spells we use as our unit of analysis the episodes themselves. This obviated the need to request individual patient identifiers, and thus seek Privacy Advisory Committee approval for our data request from the Information Services Division (ISD). It should be noted that whereas spells are a natural unit of analysis for the NHS in England, where reimbursement under Payment by Results (PbR) is determined in terms of spells, they are not a natural measure of activity in Scotland and episodes represent a unified measure of activity across the two jurisdictions.

The nature of both data sources, descriptions of variables and summary statistics are available via the web and are not discussed further here.

Central to our investigation is the designation of hospital activity into emergency and elective care. There are important differences between HES and SMR in this regard. Whereas in HES activity is recorded in episodes it is usually utilized by being merged into spells and the designation of emergency or elective occurs at the first episode of a spell, i.e. at admission to a hospital. Thus all episodes that have as their origin an emergency admission are classified as emergency episodes. An emergency admission is an unplanned admission to hospital. In SMR episodes are recorded according to whether they are planned or not. Where an episode begins with the arrival of a patient to the hospital and that arrival is unplanned this equates to an emergency admission in HES. However, where an episode begins with a transfer either within a given hospital or from another hospital it is designated a planned transfer a terminology which is suggestive of an elective episode in HES, but which may have originated as an emergency.

We adopt two strategies to dealing with this administrative difference in designating non-admission episodes. First we restrict analysis to only the first episode in each spell, which can usefully be called the admission episode, and second we impute for marker for emergency for planned transfers in SMR. Where, for example, we can observe an immediately preceding episode that is an emergency admission, we impute an episode to be an emergency as it would in HES. Otherwise we use the expected proportionality between emergency and elective admission episodes to randomly assign some planned transfers to emergency status. Throughout we report analysis in regard to pursuing both strategies and note here that in terms of parameters of importance to our research questions they generate the same results.

Each episode has an associated number of days for which the patient resided in hospital. This is termed length of stay and because it entails occupation of a hospital bed and all of the associated resources provides a measure of the intensity of resource use associated with an episode. In order to provide an alternative picture of emergency care we aggregate over lengths of stay to provide a measure of emergency bed-days.

Our analysis is conducted in terms of aggregations of episodes within particular categories of care as defined by Healthcare Resource Groups (HRGs). Further details of the variables

used, the grouping of episodes into HRGs for both England and Scotland and the further transformation and cleaning of the data are contained in the Appendix, Section 6.1.

2.2. Methods

2.2.1. Conceptual Framework

We observe activity – either the number of episodes or the bed-days associated with those episodes – that is the outcome of a complex decision making process. Our approach does not attempt to unravel that process, but needs to account for changes taking place over time that will influence it, so that we can isolate any differences between the experiences of Scotland and England in regard to emergency admissions.

A standard distinction is between factors that influence the needs of the population (the demand side) and factors that reflect the capacity of the health care system and decisions to treat (the supply side). How exactly the competing influences of supply and demand are moderated is subject to debate especially where, as in the NHS, there is no market based (price) rationing mechanism. Nevertheless, it is useful to consider the separation of demand and supply side influences in determining observed activity. In addition there have been a number of policy interventions.

On the demand side, issues such as population ageing, age specific morbidity, social and economic deprivation and the availability of other health care services (especially GP and community services) can all be expected to influence the demand for hospital emergency care. On the supply-side technological advance means that it becomes possible to deliver new treatments and interventions, and changes in medical practice and efficiency make more or less treatments possible within given resources (capacity). A key set of policy interventions are those associated with resourcing hospitals according to the volume and type of their activity – Payment by Results. These arrangements applied in England form 2003 but have not been adopted in Scotland and their impact on hospital care has previously been examined by (Farrar et al., 2009). Demand-side, supply-side and policy influences on emergency care are discussed in greater detail in (Hurst et al., 2013).

To reflect these various influences we model the log of emergency activity (either episodes or bed-days) in both England and Scotland as a function of time (to capture growth or contraction due to technology, capacity change or other time varying influences), treatment specific influences (HRG effects, which will capture variation in case mix), policy shifts and jurisdiction specific effects, interacting these variables with a linear time trend where appropriate to capture the influence of variables on the growth in activity.

2.2.2. Empirical Framework

As detailed above we consider the emergency activity, measured as episodes or as bed days, to be a function of case mix variation, policy changes and country characteristics. This relationship can be expressed by the following equation:

$$\log(Y_{it}) = f(X_{it}) \tag{1}$$

where X_{it} represents the set of explanatory variables, which will be discussed in detail in Section 2.2.2.1.

The index i denotes the unit of observation. Previous studies have used the country as the unit of observation so that Y_{it} represents the number of admissions, or total bed days, in a particular year (t) in country i.

Both HES and SMR record episodes of care according to the Healthcare Resource Groups (HRG) and providing hospital. It is thus possible to define the observational unit as an HRG, a provider or a provider-HRG combination. The advantage of defining more disaggregated units of observation is substantial in that it permits variation across these smaller units to be accounted for. Thus for example if Scotland has experienced faster growth overall in emergency admissions, but has also experienced a change in HRGs towards more emergency intensive illnesses, we could separate out the overall effect from the HRG specific influence. This can be described as estimating country specific effects 'whilst controlling for changing case mix'.

Whereas it is possible to disaggregate to the level of provider-HRG combinations and we have established the means for doing that, the results that we report are all based on disaggregation to HRGs alone. The combinations of HRGs and providers are many and reorganisation of providers makes it difficult to track consistent provider codes. Finally, controlling for case mix requires only that we disaggregate to HRGs and thus henceforth i is to be interpreted as an HRG.

The simplest way to estimate Equation (1) is to use Ordinary Least Squares (OLS). OLS treats the data from different years as independent observations, but activity is measured each year at the HRG-level in each country and therefore is likely to be correlated over time, which will lead to inconsistent OLS estimators. It is necessary to use a regression method that takes into account that the data represent the same individuals (HRGs) observed over time, i.e. it is a panel.

The panel under consideration has an extra 'dimension' which is the country in which the activity occurs; each year there is data on the activity of each HRG in both England and Scotland and we are interested in the potential differences between the two countries.

One way to incorporate the country into the analysis would be to define HRG-country combinations as the units of observation. In panel data terms each HRG-country combination would be an individual and we have repeated observations on those individuals. In most panel data studies fixed-effects specifications are preferred over random-effects on account of the fewer assumptions that are required to obtain consistent estimates. A fixed-effects (FE) model would allow for each HRG-country combination to exhibit a different (constant) growth rate in emergency activity. However this type of model cannot estimate coefficients for variables that do not change over time, such as the country, which is the focus of this analysis.

To overcome this difficulty, but keeping the panel structure of the data, we redefined the time variable of the panel. Considering the HRGs as individuals it is not possible to have the year as time variable as each HRG would have two observations each year, one for England and one for Scotland. But if the time variable is set to be semesters, the first semester for the Scottish data and the second for the English, the country variable is no longer time-invariant because in each period (semester) the HRG has a different country (alternating between Scotland and England). This is the approach we adopt.

2.2.2.1. Variables

The previously described analysis will be applied to two dependent variables, annual total number of episodes by HRG in each country and annual total number of bed days by HRG in each country. For the reasons we set out in Section 2.1 each of these variables will have two variants, one considering only admission episodes (i.e. leaving out posterior transfers) and one considering all available episodes in the data (using imputed planned transfers in SMR). Both of these variants represent directly comparable measures across England and Scotland.

The total number of episodes is a straightforward measure of activity, but when translated into bed days there is the question about how to reflect the activity of episodes that end the same day, i.e. have zero bed days. Even though the patient did not stay overnight in hospital, there were still resources allocated to his/her care. In order to take this into account, lengths of stay of zero are replaced by 0.7 (as a robustness check, they are replaced by 0.2 and the results are unaffected by this change).

During the period of analysis, 1998 to 2011, there have been changes to the HRG classification and so it was necessary to find a common classification for all years in both countries. In HES there is no classification available for all the years, e.g. HRG3.5 is available since 2003-04. The SMR data included HRG3.5 and HRG4 (based on the 2009/10 Reference Costs). To have all the data classified consistently, all HES data were run through the 2009/10 Grouper to obtain the HRG for each episode (see Section 6.1.1.3 in the Appendix).

The explanatory variables include a time trend (calculated as the difference between the year of admission and the initial period, 1998), a dummy variable to indicate the English data, the interaction of these two variables and a set of variables to control for the application of different policy changes that were introduced during the 1998-2011 period.

The dummy variable 'England' takes value one for the HES data and value zero for the SMR data. Its interpretation, as with any other dummy variable in Equation (1), is as the marginal effect on emergency activity annual growth of that factor – in our instance the country being England – over the annual growth for the omitted category – in our instance, Scotland. Since we are considering logarithms the estimated coefficient when multiplied by 100 is the percentage additional annual growth in emergency activity in England relative to Scotland and therefore gives an immediate and quantified indication of whether emergency activity grows faster (a positive coefficient) or slower (a negative coefficient) in England than in Scotland.

A difference in growth rates of emergency activity between England and Scotland can be the result of differences in any of the demand-side, supply-side or policy interventions as discussed in Section 2.2.1 above. Whilst we cannot hope to control for all such differences, our approach to disaggregating data does control for case mix.

In term of policies, some were only applied in England (PbR) and others were applied in both countries, but at different times (4-hour A&E Targets).

Payment by Results (PbR) started in the period 2003-04 with only 15 HRGs (HRG3.5), and has since included more HRGs, in 2011-12 there were 1186 (HRG4). In each period, 2003-04 to 2011-12, a dummy variable to indicate if an episode was included in PbR was created using the HRG classification for that year. When the data was collapsed to obtain variables by HRG-country-year, the variable becomes a proportion, i.e. varies between zero and one depending on how many of the episodes of an HRG (HRG4 2009/10) in England were included in PbR in a year. This variable always takes value zero for SMR data.

PbR has undergone several changes relevant to emergency admissions, other than the inclusion of more HRGs. In 2006-07 there were two adjustments to the tariff, one for short stays (i.e. length of stay less than two days) and a differential tariff for activity above/below a threshold, the differential tariff was in force until the period 2008-09. A marginal rate to increases in the value of emergency activity was introduced in 2010-11. All these changes are represented by dummy variables that start as zero and change to one in the corresponding period in HES data and take value zero for all observations in SMR.

We regard all of the forgoing as a part of the PbR policy and whilst we include each policy shift separately we mostly discuss the combined effects.

The four-hour A&E target was to be reached by 2004 in England (Department of Health, 2000) and by the end of 2007 in Scotland (Scottish Government, 2010). These two dummy variables start as zero and change to one in 2004 for England and in 2008 for Scotland.

Changes in overall population (and any differences between Scotland and England in this regard) are already controlled for in our analysis because we use per-capita measures. There is very little population structural variation as between England and Scotland (what matters is only the change in structure in one country that is not matched in the other). The respective population structures are shown in Figures 2a and 2b.

If HRGs exhibited constant proportions of different age groups our fixed effects estimates would control for differences in population structure. We observe in practice that the age structure of patients treated within an HRG varies over time and might thus contribute to observed variation in activity between the two countries. To test whether differential changing population structure in Scotland and England might affect our findings, we constructed weighted measures of activity using HRG specific population structure. Panel fixed effects based on these measures will control for any differences in population structure between the two countries because each HRG is allowed to have a shift – fixed effect –, that reflects the proportions of different age groups that make up the treatments in that HRG. This approach was facilitated by having the age distribution of treatments within each HRG in each country. As a test of sensitivity we split the population between over and under 65 years of age. Other splits are possible but this simple approach allows for any differential population ageing. We found none of the estimates to be materially affected by this change, and so we report all regressions with the simpler to interpret 'population adjusted' activity measures.

3. Results and Findings

We present our results and findings under headings that reflect the specific questions that we investigate as set out in Section 1.

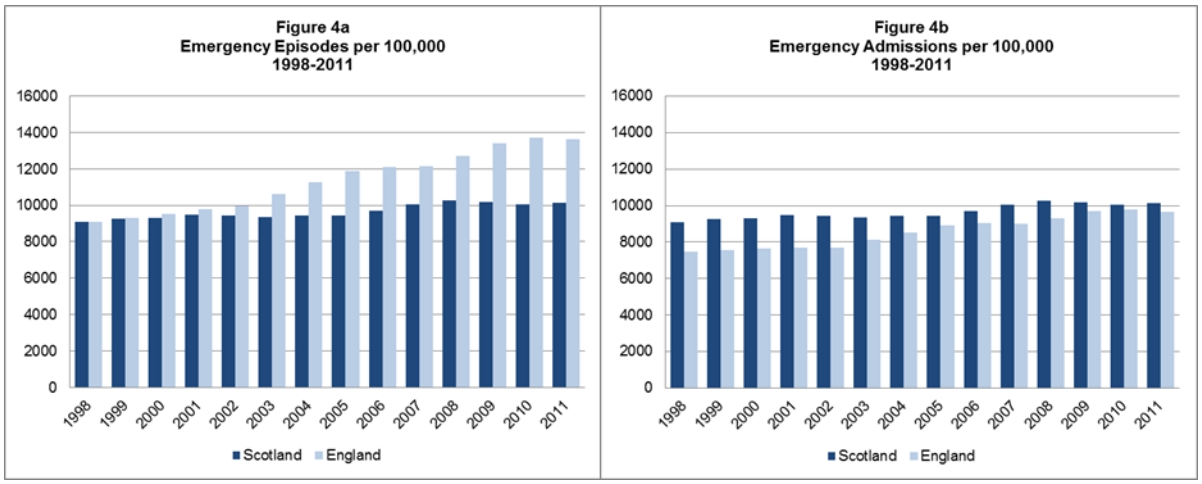
3.1. How comparable are data on emergency hospital care in Scotland and England?

3.1.1. Overview

As noted above, the key issue relevant for this analysis is in the classification of non-admission episodes. Whilst in HES episodes retain the classification, elective or emergency, of the admission episode, in SMR all posterior transfers are labelled 'planned transfers', and are considered part of the routine admissions (routine admissions being defined similarly to elective admissions in HES).

This difference in classification does not allow for direct comparison of the total number of emergency episodes between England and Scotland. However, if the focus is on admission episodes (first episodes in HES and episodes other than planned transfers in SMR) the data are comparable.

The impact of this different classification can be observed in the following figures, the left hand side figure (Figure 4a) shows the number of emergency episodes and the right hand side figure (Figure 4b) shows the number of emergency admissions (as did Figure 3). Note that in both figures Scotland has the same number of episodes, this is the consequence of labelling all posterior transfers as 'planned transfers'.



From the Figure it is clear that comparisons based on the original classification of the total number of emergency episodes and the number of emergency admissions will lead to different conclusions. In the first case it seems that both countries start from similar levels and England increases faster, and in the second, they start from different levels and England's increase brings it closer to Scotland.

Whilst a direct comparison of only emergency admissions is possible, ignoring the consequences of an admission for the subsequent and directly attributable episodes of stay in hospital risks understating the true extent of emergency care, and there may be important differences between the two countries in terms of subsequent care pathways. We thus considered ways of determining the classification of planned transfers in SMR so as to

establish which of these would be denoted emergency episodes according to the HES terminology.

The linkage of episodes into continuous inpatient stays underpins Payment by Results and is therefore a natural consequence of the administrative data function of HES. It is feasible to follow the same process for SMR data only if individual patient identifiers are present. For data confidentiality reasons our download of SMR data does not include these identifiers, but we can nevertheless match episodes that are transfers to an emergency admission and we can use information on the prevalence of emergency admissions to impute the proportions of subsequent episodes that stem from an emergency admission. We use this procedure, which is further detailed under 6.1.2.4 in the Appendix, to form a measure of all emergency episodes in SMR, for comparison with the equivalent episodes in HES.

Henceforth, in our analysis there are two possible comparisons, which are both based on like-for-like data; an emergency admissions analysis and an all (imputed) emergency episodes analysis.

3.1.2. Conclusions and Recommendations

1. Care is needed in drawing conclusions based on published statistics derived from HES in England and SMR in Scotland. There are differences in the recording and naming conventions for ‘emergency’, ‘elective’ and ‘planned’ hospital care. There is further potential confusion between the measurement of activity as between admissions, episodes and hospital stays.

2. A direct comparison of admission episodes is possible and warranted. In both countries the admission route leading to the classification of emergency admission (or emergency and urgent in Scotland) is essentially the same. However emergency admission episodes only capture a part of hospital activity associated with the term emergency care. Patients are often rapidly transferred and may have protracted stays in hospital that are a direct extension of their admission.

3. The convention in SMR of denoting all transfers ‘planned’ results in a potential understatement of emergency care in Scotland relative to the convention in England. Obtaining a comprehensive measure of emergency care in Scotland that is comparable with the measure derived from examining all emergency episodes in HES necessitates an assignment of SMR planned transfers into an equivalent emergency / elective classification.

4. The most robust way of making an assignment of SMR planned transfers to either emergency or elective would be to reproduce the construction of spells that is routine in HES. That however requires personal identifying information on patients for each episode.

5. In the absence of patient identifiers it is possible to impute a classification of planned transfers and doing so facilitates a like-for-like comparison of emergency episodes rather than just emergency admissions.

6. We recommend that the feasibility and cost of obtaining a more complete download of SMR data, complete with personal identifiers, is investigated. Such a download would facilitate an assessment of the robustness of the imputation method we have used and would be of value in future work. If the robustness of results derived from non-identifiable data can be established it facilitates more speedy and less costly research in the future. If results turn out in some way to be sensitive to the absence of personal identifiers and the grouping of episodes into spells, then the benefits of more detailed information can be assessed and set against the cost, in terms of both time and money.

3.2. Reporting and interpretation of regression results

Our regression analysis is designed to understand what the possible sources of the differences in the time path of activity might be attributable to, and in particular we are concerned to examine whether, after we account for relevant differences between Scotland and England, any differences persist.

Differences between England and Scotland are best considered comprising of two components, a difference in levels or what might be termed prevalence, which is captured by the coefficient on the England dummy variable and a difference in trend rate of growth or contraction, captured by the interaction of the time trend and the England dummy. Both elements are important in thinking about whether the experience of one country in respect of emergency care gives rise to concern. A high growth in one relative to another may be offset by a lower prevalence – and policies may impact on both of these elements of difference, for example being associated with lower growth but increasing prevalence.

We make reference to regression estimates that are set out in detail in the Appendix. In all instances we report two sets of regressions: linear OLS and panel (HRG) fixed-effects. The OLS regressions are included primarily by way of a benchmark and comparator since as we have discussed above they are based on an assumption of independence that is unlikely to be satisfied. In all cases the hypothesis of joint insignificance of HRG fixed effects is rejected, and so we regard the panel fixed-effects estimates as preferable and hence we reproduce excerpts from those regression results in this section. We additionally report the results of the simplest OLS model of regressing the log of aggregate activity (the sum of all HRGs) on a time trend, country dummy and interaction (column (0)).

We consider three panel fixed-effects (FE) regression specifications in increasing complexity / completeness of controls. For the first specification (column (1)) we include only a dummy variable for England, a time trend and an interaction of the time trend with the England dummy variable. We then add controls for policies in both England and Scotland (column(2)) and then further controls interacting the effect of policies with the time trend (column (3)). These regressions estimate the following equation (i and t subindexes removed to simplify notation):

$$\log(Y) = \underbrace{\underbrace{\underbrace{\alpha + \beta_1 t + \beta_2 E + \beta_3 (t * E)}_{(1)} + \gamma Pol}_{(2)} + \delta (t * Pol) + \mu}_{(3)}$$

The key regression estimates of interest relate to the time trend, the England dummy variable and its interaction with the time trend and it is those estimates and their significance that we include in the tables in the text. Since the dependent variables are in natural logs, regression coefficients represent marginal effects in percentage terms. Hence the time trend coefficient, multiplied by 100, gives the percentage growth rate, referenced to Scotland. The coefficient on the interaction of England and time trend when multiplied by 100 gives the additional or decremental growth rate in England (the overall growth rate for England is the sum of these two coefficients). The coefficient on the England dummy variable multiplied by 100 gives the percentage difference in activity between England and Scotland.

Where reference is made to coefficients on policy variables, care should be taken in interpreting these as the 'effect' of a policy. Our modelling of policies follows a standard difference-in-differences approach and we are thus relying on the differential implementation of policies across England and Scotland and over time to identify the effect of a policy. In practice most policies are modelled as being implemented in a particular year and remaining in force until the end of the observation period. The regression coefficient will thus pick up

the effect of the policy and any other time varying factors that are country specific and coincidental in time to the policy shift. For this reason we do not place great emphasis on individual policy variables, preferring to consider the effect of their inclusion or exclusion on the regression estimates of primary interest. Nevertheless by reference to the complete regression results we draw inferences about the effect of policies in terms of increasing (or decreasing) activity in each country. Whilst regressions (3) potentially allow for policies to have an effect on growth as well as the level of activity the estimates of these effects are subject to lack of precision, we thus view these regressions as primarily a robustness check on regressions (2).

Above we have referred to the importance, both conceptually and empirically of accounting for HRG specific effects. It is possible to think of fixed effects as dummy variables for HRGs. Omitting these variables will cause bias, and the other regression coefficients will in part reflect a changing balance across HRGs. Thus one interpretation of HRG fixed effects is that they control for case mix. However, since in our regression specification we include fixed effects in a log-linear regression we are controlling for an HRG to have a time constant impact on activity. Alternative specifications are possible but beyond the remit of this report, and amongst our recommendations we include further investigation of this issue to determine whether it would impact on our conclusions.

3.3. What factors explain the observed differences between England and Scotland?

3.3.1. Emergency Episodes

A number of reports and commentaries have noted the apparent faster growth of emergency admissions in England relative to Scotland. A first task is to quantify these differences and establish the extent to which they are consistent across different definitions of emergency activity.

We first consider the case of admission episodes. As shown in Figures 3 and 4b, Scotland has a higher number of emergency admissions throughout the analysed period, ranging between 9,100 and 10,200 admissions per 100,000 inhabitants, i.e. an increase of 12%, and the number of emergency admission in England increases from 7,500 to 9,700 admissions per 100,000 inhabitants in 2011, i.e. an increase of 29%. The small decrease observed in England in 2011 with respect to 2010 is consistent with that reported in the Summary Report for the 2011-2012 HES Data (Health and Social Care Information Centre, 2012a).

In terms of percentage growth the experience of Scotland is consistent with an annual (compound) growth rate of just under 1%, whereas for England the growth in emergency episodes equates to an annual rate of approximately 2%. These growth rates are (total) population adjusted on account of activity being expressed per 100,000. So in aggregate terms it appears that emergency admission have grown just over 1% per annum faster in England than in Scotland. The compound nature of a constant growth process leads to a relatively small annual difference leading to a substantially larger growth over the whole period for England. Nevertheless it is useful to keep the relatively modest difference in annual growth rates in mind.

The OLS regression provides a way of quantifying the differential growth paths of England and Scotland allowing for each country to start at a different level of activity. The interpretation of column (0) accords well with the calculations above. The best fit linear growth equations implies that Scotland experiences 0.9% annual growth and that England experiences 1.4% higher growth than Scotland, but that England starts with initially 22% lower activity. Our FE regression analysis as reported in columns (1), (2) and (3) in Table 1

below shows this apparent difference between England and Scotland is affected by accounting for case mix and policy shifts.

Table 1
Emergency Admissions per 100,000
Dependent Variable: log(E_t)

	OLS	Panel - Fixed Effects Regressions		
	(0)	(1)	(2)	(3)
Time Trend (t)	0.009 ***	0.007 ***	0.008 ***	0.010 ***
	(0.000)	(0.002)	(0.002)	(0.002)
England (Dummy Var.)	-0.216 ***	-0.223 ***	-0.219 ***	-0.216 ***
	(0.000)	(0.022)	(0.021)	(0.022)
t * England	0.014 ***	0.018 ***	0.015 ***	0.015 ***
	(0.000)	(0.002)	(0.003)	(0.003)
Policies	NO	NO	YES	YES
t * Policies	NO	NO	NO	YES
Clustered by Country	YES			
Clustered by HRG		YES	YES	YES
N	28	32128	32128	32128
Number of Clusters	2	1251	1251	1251

Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively.
All regressions include a constant.
Full Table: 6.3.11 in Appendix.

With reference to column (1), the most straightforward FE regression indicates that the apparent growth rates referenced above are distorted by varying case mix. We estimate a trend growth in emergency admissions in Scotland of 0.7% per year and a differential for England of 1.8% per year. Hence the estimated rate of growth for England is 2.5% as opposed to the apparent 2% and differs from Scotland by approximately 1.5% per year, which is higher than the 1% obtained before.

Including further controls increases the estimate of the rate of growth for Scotland and reduces the differential for England slightly. In our most general specification (column (3)) the estimated annual growth rate for Scotland is 1.0% whilst the differential for England is 1.5%.

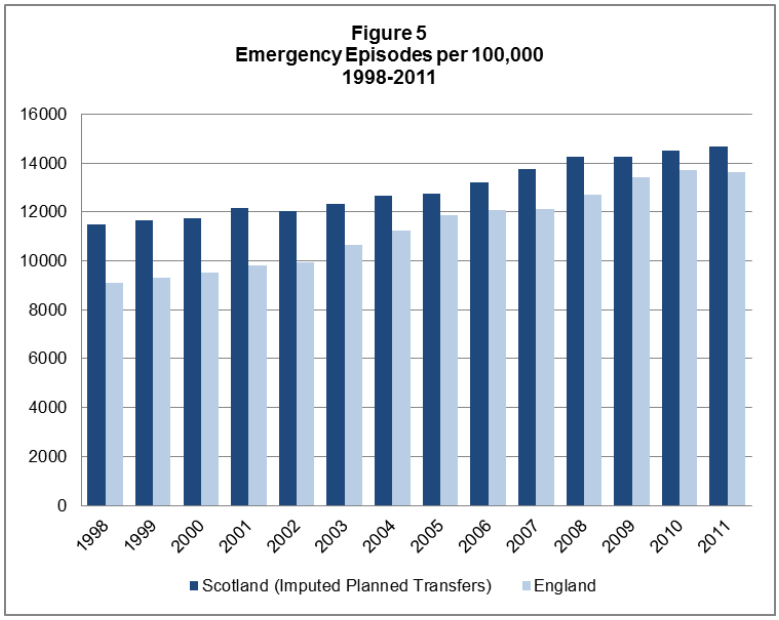
Taken together these imply that growth in emergency admissions has in fact been higher in England than in Scotland, but by a higher magnitude than the uncorrected figures suggest.

Against the modest incremental growth in emergency episodes in England is a substantially lower prevalence of emergency care as measured by emergency admissions. Over all specifications, England starts with 22% lower emergency admissions per capita than Scotland. To put this in context, if England's emergency admissions grow faster than Scotland's by 1.5%, it would take 18 years to erode England's lower propensity.

The impact of policy variables is set out in Table 6.3.1.1 (column (2)) in the Appendix. Summing the impact of PbR policy variables suggests that they have had a combined impact of reducing admissions by 8% in England. The initial impact of the introduction of PbR is a positive 0.8% and this is added to by 5.8% by the Short-Stay adjustment, but subsequent adjustments (the differential tariff and marginal rate rules) are associated with large reductions in emergency admissions. For Scotland the 4-hour target is associated with a small (2%) but not significant reduction in admissions, whilst the equivalent policy for England has a smaller and not significant effect, around 1%.

If we move to consider the more comprehensive measure of emergency care, where we include all emergency episodes in HES, and impute emergency planned transfers in SMR the resulting magnitudes of activity are shown in Figure 5. Scotland shows a higher number

of episodes during the analysed period, going from 11,500 to 14,700 per 100,000 inhabitants, an increase of 28%, while England shows an increase from 9,000 to 13,600 episodes per 100,000 inhabitants in 2011, an increase of 50%. In terms of constant growth processes these figures correspond to an annual rate of approximately 3.2% in England and 1.9% in Scotland. So whereas growth in this more broadly defined measure of emergency activity is greater than for emergency admissions, the apparent differential between England and Scotland is very similar and suggest that England has experienced 1.3% per year faster growth. This conclusion is supported by the OLS regression (column (0) in Table 2 below) which estimates growth of 2.1% per annum in Scotland and differential growth of 1.4% per annum in England.



The FE regression results set out in Table 2, show that a very similar picture to that for emergency admissions emerges once we control for case mix, policy shifts and interactions. There is, consistent with the graphs, a faster overall growth in this measure of emergency activity in both countries amounting to 1.6% per year in Scotland and 3.3% per year in England. The differential growth in England across specifications is 1.7-1.9% per year, but offsetting this higher figure than that observed for emergency admissions alone is a larger discrepancy in prevalence. The estimated coefficient on the England dummy variable suggests that there are on average 28% fewer emergency episodes per capita than in Scotland. The differential growth would again need to persist for 20 years to close this gap. And again, the impact of policies in England has been to reduce admissions relative to Scotland, so that England's faster growth rate is offset by downward shifts in episodes over time.

Table 2
Emergency Episodes (Imputed Planned Transfers) per 100,000
Dependent Variable: log(E_t)

	OLS	Panel - Fixed Effects Regressions		
	(0)	(1)	(2)	(3)
Time Trend (t)	0.021 ***	0.014 ***	0.016 ***	0.018 ***
	(0.000)	(0.002)	(0.002)	(0.002)
England (Dummy Var.)	-0.229 ***	-0.280 ***	-0.280 ***	-0.279 ***
	(0.000)	(0.022)	(0.022)	(0.022)
t * England	0.014 ***	0.019 ***	0.017 ***	0.019 ***
	(0.000)	(0.002)	(0.003)	(0.003)
Policies	NO	NO	YES	YES
t * Policies	NO	NO	NO	YES
Clustered by Country	YES			
Clustered by HRG		YES	YES	YES
N	28	32350	32350	32350
Number of Clusters	2	1251	1251	1251

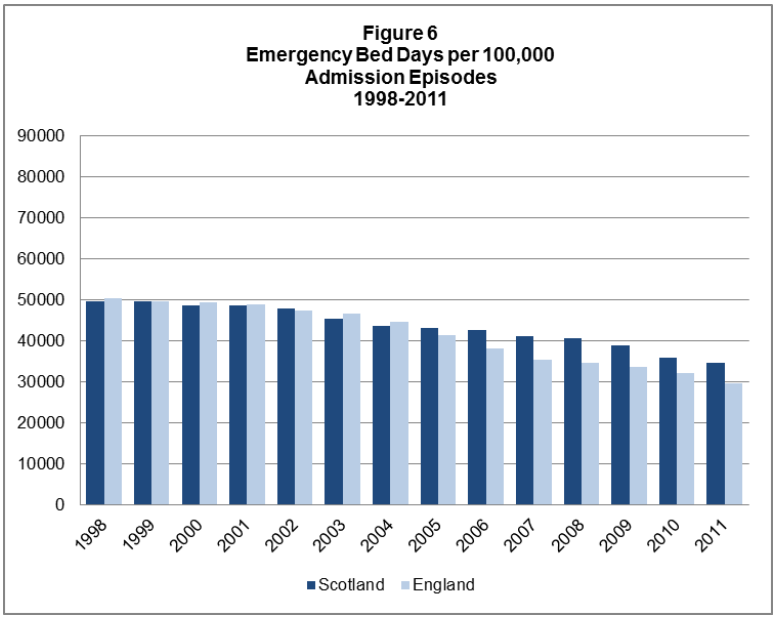
Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively.
All regressions include a constant.
Full Table: 6.3.12 in Appendix.

3.3.2. Emergency Bed Days

Emergency admissions and episodes measure emergency care without regard to the resources that are devoted to it. Assessing the resource implications of emergency activity is a potentially complex task, but as a first step assessing the number of bed days associated with emergency care would seem appropriate.

As for the episodes, the results regarding bed days will be presented first for emergency admissions and then for all emergency episodes, with imputed planned transfers.

Figure 6 shows the number of emergency bed days for emergency admissions in England and Scotland in the period 1998-2011. Unlike admissions, where England and Scotland start from different levels and become more similar over time, the number of bed days starts almost identical for both countries, close to 50,000 bed days per 100,000 inhabitants, and then it differs, with England's number of bed days for emergency admissions decreasing faster than Scotland's, reaching 29,600 and 34,600, respectively, in 2011; these decreases correspond to 41% and 30% respectively.



It is thus immediately obvious that measuring bed days presents a very different impression of emergency hospital care. Rather than an inexorable rise, bed days exhibit a more complicated pattern, but the overall tendency is decline – this is spite of the fact that admissions and episodes are growing at between 2% and 3% as the analysis of Section 3.3.1 has established. Both in emergency and elective care an important and notable aspect of hospital care has been the reduction in lengths of stay.

Figure 6 does not indicate a simple explanation of the time path of bed days in terms of growth or decline, or a simple comparison of England and Scotland. If growth of emergency care is considered a problem, the picture Figure 6 gives is more benign than that of Figure 3; the paths of the two countries appear to have diverged rather than converged, and England has experienced the greater overall decline in this measure of emergency hospital care.

The absence of constant growth in emergency bed days, means that the results of our regression models need to be interpreted with care. Although we can estimate growth rates for England and Scotland, the effects of any constant growth are likely to be offset by shifts over time in the levels of activity which in our regression models are captured largely by policy dummy variables. The caveat set out in Section 3.2 applies – although these policy shifts are associated with changes in activity they are not necessarily caused by them.

Nevertheless regression analysis is important in beginning to understand the patterns exhibited for bed days in Scotland and England in Figure 6.

The results are summarised in Table 3. Starting with the OLS estimates, these indicate a downward trend of 2.8% for Scotland and a differential of minus 1.6% for England. Thus England, ignoring case mix or other time varying factors, is estimated to experience a 4.4% annual percentage reduction in bed days of the period. This is a dramatic rate of decline and the differential decline in England relative to Scotland would suggest a dramatic divergence between the two countries starting at a 5% differential (the estimate on the England dummy variable). The FE regressions strongly suggest that this initial picture is flawed by failing to account for differences across different HRGs. In the simplest panel model (column (1)) the time trend indicates that the best fit growth line, accounting for changing case mix over this period, predicts a 2.1% decline in bed days per annum in Scotland and a slightly smaller 1.3% decline per year in England, this differential is countered by an average 13% lower propensity of bed days in England. Now it is Scotland that is 'catching up' with England's

Table 3
Emergency Bed Days per 100,000 Admission Episodes
Dependent Variable: log(BD_t)

	OLS	**Panel - Fixed Effects Regressions**		
	(0)	(1)	(2)	(3)
Time Trend (t)	-0.028 ***	-0.021 ***	-0.019 ***	-0.017 ***
	(0.000)	(0.002)	(0.003)	(0.003)
England (Dummy Var.)	0.047 ***	-0.132 ***	-0.181 ***	-0.178 ***
	(0.000)	(0.024)	(0.023)	(0.024)
t * England	-0.016 ***	0.008 ***	0.027 ***	0.028 ***
	(0.000)	(0.002)	(0.004)	(0.003)
Policies	NO	NO	YES	YES
t * Policies	NO	NO	NO	YES
Clustered by Country	YES			
Clustered by HRG		YES	YES	YES
N	28	32128	32128	32128
Number of Clusters	2	1251	1251	1251

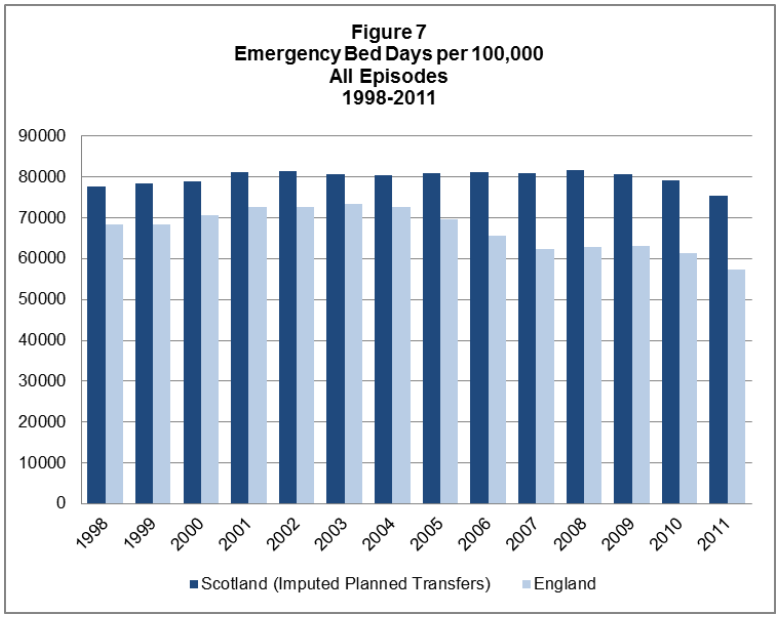
Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively.
All regressions include a constant.
Full Table: 6.3.2.1in Appendix.

lower propensity and it would take approximately 18 years of continued faster decline in bed days in Scotland to eliminate the gap.

As we add more controls the (negative) growth in Scotland remains constant whilst the gap with England's (now positive) growth widens. This however is an artefact of attempting to fit a constant growth line to what is more easily reconciled series of piecewise linear trends. The apparent faster growth in England is coupled with a shift towards a lower propensity, from 13% lower than Scotland to 18% lower.

Understanding these twin changes is aided by considering the impact of the policy dummy variables which are set out in the detailed regression results in the Appendix. The series of policies that are introduced in England over this period successively reduce the number of bed days. Thus for example, using regression (2), Table 6.3.2.1 in the Appendix, the introduction of Payment by Results is associated with a 5.1% reduction in bed days – a result that is consistent with previous evaluations of this policy (Farrar et al., 2009) and each subsequent policy based on PbR further reduces bed days in total by approximately 27%. Thus our regression estimates indicate that the widening differential between England and Scotland in regard to bed days is best understood in terms of successive reductions in bed days due to policy interventions rather than differential trend. We urge caution is using the implied magnitudes reported in Table 6.3.2.1 because a number of the point estimates are imprecise and we cannot reject the hypothesis that some are in fact zero. Nevertheless there would appear to be an important issue of interpretation that it is hard to totally discount: the implementation of PbR and refinements of the tariff in England is associated with reductions in emergency bed days, relative to Scotland.

Again, a more general measure of emergency activity in respect of bed days can be formulated by considering all emergency episodes. Figure 7 shows the number of emergency bed days for emergency episodes in England and Scotland (with imputed planned transfers in SMR) in the period 1998-2011. In this case there is always a difference between the two countries, with Scotland showing a higher number of emergency bed days, which averages 8,700 bed days per year in the first half of the analysed period and then increases to 16,800 bed days per year in the second half. Hence on this broader measure there is always lower activity in England, notwithstanding the fact that as we have seen in Section 3.3.1, episodes are increasing faster in England.



The regression results suggest a very similar picture to that determined for the case of emergency admissions. The only notable difference being that the decline in emergency bed days in Scotland is smaller for this broader measure, being almost zero. The interpretation of the effect of policy interventions is unaffected. PbR and its subsequent revisions are associated with reductions in emergency bed days.

Table 4
Emergency Bed Days per 100,000
All Episodes (Imputed Planned Transfers in SMR)
Dependent Variable: log(BD_t)

	OLS	Panel - Fixed Effects Regressions		
	(0)	(1)	(2)	(3)
Time Trend (t)	0.000 ***	-0.006 **	-0.004	-0.001
	(0.000)	(0.002)	(0.003)	(0.003)
England (Dummy Var.)	-0.083 ***	-0.195 ***	-0.243 ***	-0.245 ***
	(0.000)	(0.024)	(0.024)	(0.025)
t * England	-0.014 ***	0.009 ***	0.026 ***	0.029 ***
	(0.000)	(0.002)	(0.004)	(0.003)
Policies	NO	NO	YES	YES
t * Policies	NO	NO	NO	YES
Clustered by Country	YES			
Clustered by HRG		YES	YES	YES
N	28	32350	32350	32350
Number of Clusters	2	1251	1251	1251

Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively.
All regressions include a constant.
Full Table: 6.3.2.2 in Appendix.

3.3.3. Conclusions and Recommendations

1. Inspection of graphs can be misleading. Whereas it appears that emergency episodes have grown a lot more in England than Scotland over the period 1998-2011 the per annum growth differential is small (of the order of 1.5%) and should be viewed in the context of the lower propensity for emergency admissions in England.

2. The overall growth rate in emergency admissions and the difference in growth rates between England and Scotland are both exaggerated by the failure to control for case mix changes and policy instruments.

3. Overall it is reasonable to suppose that emergency admissions have grown by around 1.5% per annum more in England than in Scotland but from a base that is approximately 22% lower. It would require a very protracted period of constant differential growth to cause England to have a higher rate of emergency admissions per capita than Scotland.

4. In addition the policies related to PbR that have applied in England but not in Scotland are associated overall with reductions in admissions

5. The conclusions drawn in respect of emergency admissions are valid when considering the broader measure of emergency episodes with only small changes in the relevant percentages.

6. The time pattern of emergency bed days gives a first indication of the changing resource implications of emergency care. Consideration of graphs in this case gives a more benign but complex picture. Bed days per capita have fallen but have followed different paths in England and Scotland. Bed days have fallen more in England, in spite of the faster growth in emergency admissions and episodes.

7. Caution is needed in converting this complex pattern into growth rates. The regression analysis reveals that the differences between England and Scotland can only be understood in terms of differential growth rates (Scotland being negative and England less so, or positive after controlling for policy effects) and shifts, with England having experienced several downward step changes in emergency bed days coincident with policy initiatives, specifically PbR and changes in the tariff.

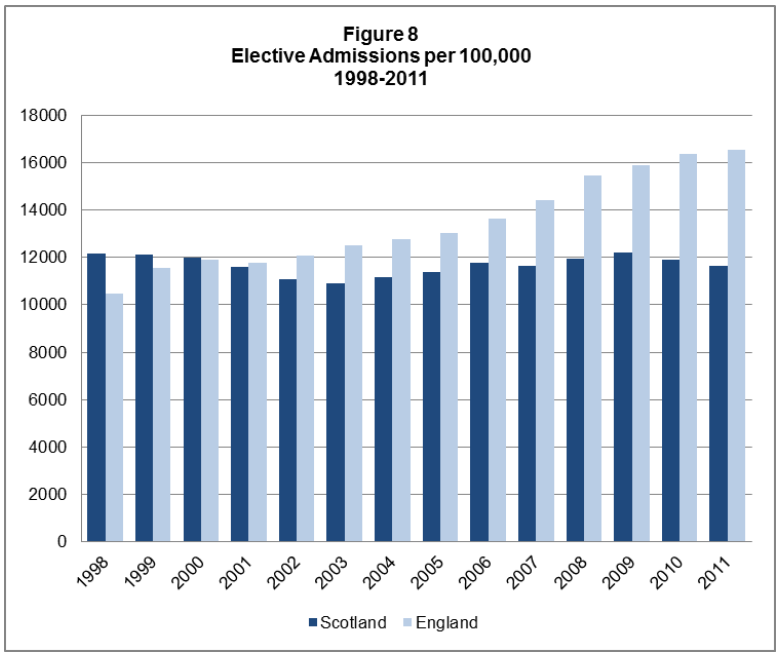
8. Overall our regression estimates indicate that PbR has been associated with substantial reductions in emergency bed days, and that having controlled for these shifts there is relatively little residual trend.

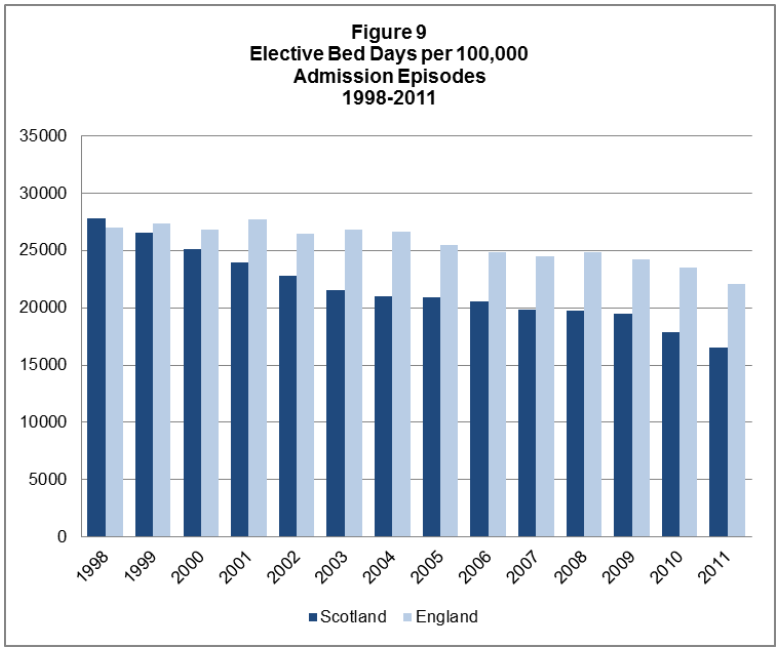
9. In regard to both admissions (or episodes) and bed days England has displayed lower levels of emergency activity over the period studied. After accounting for changing case mix, population growth, and policy interventions there is no evidence that the gap in emergency activity has changed substantially. Whereas the growth in admissions has been higher in England, the decline in bed days has been greater.

10. The decline in emergency bed days (against a pattern of increasing admissions) is a notable and important development but one that does not receive as much comment as the increase in admissions. We recommend that due attention is given to understanding the link between admissions and bed days and that the resources being applied to emergency care, not just the head count figure of admission, are explained and set in context.

3.4. Are differences in emergency care offset or mirrored by differences in elective care?

Our data comprises both emergency and elective episodes and bed days. An analysis of elective activity is beyond the scope of this report and thus we simply summarise the time paths of elective admission episodes and bed days in Scotland and England. These are depicted in Figures 8 and 9 below.





Based on these measures there is more (population adjusted) elective activity in England than Scotland over the majority of the sample period. There is thus no prima facie evidence of a deficiency of elective activity contributing to the greater emergency activity in England. Overall the two countries exhibit similar levels of all hospital activity per capita with a greater propensity of emergency care in Scotland and a corresponding greater propensity of elective care in England.

3.5. Comparing England and Scotland and possible future patterns of emergency admissions and bed days

3.5.1. Interpreting regression models

Our regression analysis is not designed to be a forecasting tool. It would therefore not be appropriate to extrapolate from the comparative trends in emergency care that we have identified. At the aggregate level we have identified relatively stable relationships in emergency care in both countries over the study period. There has been constant growth in episodes, and a decline in bed days.

The growth in episodes persists after we control for changing population, case mix and policy interventions. By reference to our broad classification of the drivers of hospital care this leaves capacity (both physical and financial) and technology as the most obvious causes of the continuing growth in episodes. Our data and analysis do not allow us to discriminate between these causes, but there are other analyses that would permit this, if appropriate variation in either capacity or technology can be identified.

The decline in bed days is driven by reductions in length of hospital stays. As noted above the decline in bed days is better rationalised in England as a series of downward shifts which correlate with policy interventions rather than a constant (negative) trend. If these reductions however caused are interpreted as efficiency savings, there is a natural limit as hospital stays become shorter, as to how much further reduction can be expected in the future.

For the purposes of addressing our key questions we have not needed to exploit the estimated variation in actual versus predicted time paths of episodes and bed days on an HRG by HRG basis. Comparisons on the basis of individual HRGs are however a potentially

powerful tool, highlighting areas of activity that have grown faster (or slower) than average and areas of activity where the pattern of variation between Scotland and England is atypical. Although our regression models have been referenced to an aggregate measure the FE framework naturally lends itself to providing a breakdown across HRGs.

To illustrate this we have included in the Appendix (Section 6.4) graphs showing the paths of both actual and regression predicted episodes and bed day for England and Scotland, selecting 4 HRGs that are associated with high levels of activity. These graphs suggest that there are some HRGs where growth in activity is representative of the aggregate and some which are substantially different.

3.5.2. Conclusions and recommendations

1. It is unwise to extrapolate from existing trends to forecast the likely path of emergency care in the future; the trend growth in episodes could have a number of causes and any of those underlying causes might change; the declines in lengths of stay that lead to reductions in bed days have a natural limit once stays become very short, and so it cannot be assumed that this process will continue.

2. The FE regression framework that we have developed is capable of providing an analysis down to HRG level and some important differences exist in the paths of emergency care for different HRGs. We recommend that further analysis is undertaken in regard to this as it may prove a valuable tool for policy makers and commissioners in understanding the pattern of emergency care. With all such exercises comparing outcomes in England with those in Scotland provides valuable additional insight.

4. Discussion and Conclusions

The purpose of the investigations reported here was to place the documented growth in emergency inpatient hospital care in England in context, by considering how it compares with the experience in Scotland. Scotland is an interesting and important comparator because whilst it has experienced a very similar pattern of expenditure growth on its NHS, it has adopted a different policy framework. We have presented detailed conclusions for each element of our analysis above; here we highlight some key points.

Care is needed in comparing emergency hospital activity in Scotland and England.

Whilst there is potential value in comparing Scotland and England the realisation of that potential depends on the existence of comparable data. A first step of our investigation was to examine the comparability of hospital inpatient activity measures in Scotland and England derived from SMR and HES respectively. We have presented our detailed findings in Section 3.1 but in summary we conclude that care is needed due to terminological differences in the two countries. Some existing studies have avoided this issue by comparing a narrow definition of emergency care – admission episodes. We devised a strategy for broadening the measure to include all episodes of care that follow from an emergency admission. In the case of Scotland our approach entails a degree of approximation and in the future we hope to test the sensitivity of our findings to this issue. For the purposes of our comparative study we find that the results from the narrow definition of emergency care are very similar to those for the wider definition.

It is important how 'activity' is measured – episodes of care do not give the same picture as bed days.

Existing studies have focused on the number of episodes but this does not account for the intensity of resource use that is entailed. We have therefore considered both episodes and total bed days throughout. This distinction is both conceptually and practically important. Whereas episodes have displayed almost incessant growth in per capita terms, bed days have fallen and thus the extent to which there is perceived to be a problem of increasing emergency care depends on the measure chosen. Whereas episodes have grown faster in England than in Scotland, bed days have fallen more substantially in England.

It is important to account for the differences between the two countries in terms of case-mix, population and policy choices.

Simple aggregate measures of activity reflect many factors. To understand whether there are as yet unexplained differences requires a comparison of 'like-for-like'. Comparing Scotland and England over the two measures of activity on a like-for-like basis requires account to be taken of their different populations, differences in the changing structure of those populations, the different mixture of treatments that are provided in each country, and differences in the policies that have been adopted. A considerable part of this report is concerned with detailing how and why we have accounted for these issues. In summary we adopt a FE regression framework that controls for case mix and we have deflated activity by population specific measures in order to control for population structure and changes. In regard to this second issue we find little evidence of important differences in the two countries so that more sophisticated controls for population have no material effect on the results.

After accounting for case-mix, population and policy differences, England has shown faster growth in emergency episodes but has a persistently lower rate of those episodes.

Taking account of the various differences between the countries turns out to be important because whereas the uncorrected data for episodes appear to show much more rapid expansion in England than Scotland, some of this is explained by case mix. Furthermore, the like-for-like comparison reveals that England has a lower propensity of emergency episodes throughout the period investigated. One interpretation is that England's faster growth is a 'catching-up' effect and that this process is slow, so that England can be expected to have a lower propensity of emergency episodes for a considerable period of time.

Using bed days as a measure of activity, England has had persistently lower emergency hospital activity than Scotland.

The time path of emergency bed days cannot easily be interpreted as a trend. After accounting for case mix variation, the picture that emerges is of a downward trend in Scotland, but a series of downward shifts in England. Overall however England exhibits substantially lower emergency activity than Scotland on this measure over the entire period, and has experienced reductions both absolutely and relative to Scotland.

Payment by Results is associated with reductions in emergency hospital activity in England.

We urge caution in interpreting our regression findings as evidence of a causal effect of any one policy on emergency activity. Nevertheless, the introduction of PbR and subsequent revisions to emergency tariffs is coincident in timing with reductions in emergency activity in England relative to Scotland which is consistent with these policy shifts having resulted in reductions in emergency activity.

5. References

Blunt, I., Bardsley, I., Dixon, J., 2010. Trends in emergency admissions in England 2004 - 2009. Nuffield Trust.

Department of Health, 2000. The NHS Plan: a plan for investment, a plan for reform. http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/publicationsandstatistics/publications/publicationspolicyandguidance/dh_4002960 (accessed 3.24.14).

Department of Health Payment by Results Team, 2012. A simple guide to Payment by Results (No. 18135). Department of Health.

Farrar, S., Yi, D., Sutton, M., Chalkley, M., Sussex, J., Scott, A., 2009. Has payment by results affected the way that English hospitals provide care? Difference-in-differences analysis. Br. Med. J. 339, b3047. doi:10.1136/bmj.b3047

Gillam, S., 2010. Rising hospital admissions. BMJ 340, c636–c636. doi:10.1136/bmj.c636

Health and Social Care Information Centre, 2012a. Hospital Episode Statistics, Admitted Patient Care - England, 2011-12 (Summary Report).

Health and Social Care Information Centre, 2012b. HRG4 2009/10 Reference Costs Grouper Documentation. http://www.hscic.gov.uk/article/2319/HRG4-200910-Reference-Costs-Grouper-Documentation (accessed 3.24.14).

Health and Social Care Information Centre, 2012c. HRG4 2009/10 Reference Costs Grouper. http://www.hscic.gov.uk/article/2318/HRG4-200910-Reference-Costs-Grouper (accessed 3.24.14).

Hurst, J., Sharpin, L., Wittenberg, R., 2013. Understanding Emergency Hospital Admissions of Older People.

Maybin, J., Thorlby, R., 2010. A High Performing NHS? The King's Fund.

National Audit Office (NAO), 2012. Healthcare across the UK: A comparison of the NHS in England, Scotland, Wales and Northern Ireland (No. HC 192).

National Audit Office (NAO), 2013. Emergency admissions to hospital: managing the demand (No. HC 739).

National Casemix Office, 2012. Introduction to Healthcare Resource Groups. http://www.hscic.gov.uk/hrg (accessed 4.7.14).

Scottish Government, S.A.H., 2010. HEAT targets due for delivery in 2007/08 and 2008/09. http://www.scotland.gov.uk/About/Performance/scotPerforms/partnerstories/NHSScotlandperformance/pastHEATtargets (accessed 3.24.14).

6. Appendices

6.1. Data

6.1.1. HES Data

6.1.1.1. Definitions

- Emergency: Method of Admission = 21, 22, 23, 24, 28.
- Admission Episode: Episode Order = 1.

6.1.1.2. Cleaning of Data

- Drop episodes that are missing the record identifier, the HES generated patient identifier or the date the episode started.
- Drop episodes with not valid episode start date check flag or episode end date check flag.
- Drop episodes that have missing or negative length of stay.
- Drop duplicates.
- Drop episodes that start before its date of admission (after grouping).

6.1.1.3. Grouping

- Once the data was cleaned, it was prepared for the Grouper according to the file preparation guide provided in the hscic website (Health and Social Care Information Centre, 2012b), keeping additionally the record identifier (epikey) to be able to match the grouped data to other variables in HES.
- The prepared files were processed using the HRG4 2009/10 Reference Costs Grouper (Health and Social Care Information Centre, 2012c).

6.1.1.4. Planned Transfers Imputation

- N/A.

6.1.2. SMR Data

6.1.2.1. Definitions

- Emergency: Admission Type = 20, 21, 22, 30, 31, 32, 33, 34, 35, 36, 38, 39.
- Admission Episode: Admission Type ≠ 18 (all emergency episodes fulfil this condition, as Admission Type 18 corresponds to ‘planned transfers’).

6.1.2.2. Cleaning of Data

- N/A.

6.1.2.3. Grouping

- N/A.

6.1.2.4. Planned Transfers Imputation

- Calculate date the episode ended using admission date and length of stay.
- Define groups of episodes where a match could be found, with same year of admission, NHS Board, provider, HRG, age, gender and SIMD deprivation decile.
- Two episodes are in the same spell if all the following conditions are met: they are in the same group (defined as in the previous bullet), the ‘first’ episode does not start as a planned transfer and ends with a transfer to the same provider, the ‘second’ episode starts as a planned transfer that comes from the same provider, and the end of the ‘first’ episode coincides with the start of the ‘second’.

- This matching mechanism uses all the information available, but it does lack an individual identifier. In addition to not having an individual identifier, which could lead to match two episodes from 'identical' (given the data available) individuals, it wouldn't be able to match episodes from spells that include the individual's birthday or December 31st, nor episodes from spells that include different providers.
- With this procedure, 30% of planned transfers are matched with an admission episode. More than 95% of them are matched to an emergency admission.
- The unmatched planned transfers are randomly assigned an admission type, 15% to elective and 85% to emergency.
- After the matching and the random assignment, the planned transfers are 89% emergency, which is slightly lower than the emergency proportion observed among non-admission episodes in HES (93%).

6.1.3. Other Differences in Data Coding

- HES includes a variable with the number of an episode within a spell (epiorder). No equivalent variable is available in SMR.
- For each episode, HES records four dates: date of admission, date the episode started, date the episode ended and date of discharge. In SMR there are only admission and discharge date for each episode.

6.2. Figures' Sources of Data

Figure 1.
Hospital Episode Statistics (HES), Inpatients, 1997-98 to 2011-12.

Figure 2.
Office for National Statistics (ONS).

- Population Estimates Total Persons for England and Wales and Regions - Mid-1971 to Mid-2011, Table B. [http://www.ons.gov.uk/ons/datasets-and-tables/index.html]
- Population Estimates Quinary Age Groups for UK Constituent Countries - Mid 1971 to Mid-2010 [http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk—england-and-wales--scotland-and-northern-ireland/population-estimates-timeseries-1971-to-current-year/index.html]
- 2011 Census: Age structure, local authorities in the United Kingdom [http://www.ons.gov.uk/ons/datasets-and-tables/index.html, Table KS102UK]

Figures 3 to 9.
Hospital Episode Statistics (HES), Inpatients, 1997-98 to 2011-12.
Scottish Morbidity Records (SMR), SMR01 - General / Acute Inpatient and Day Case.

6.3. Tables

6.3.1. Episodes

Table 6.3.1.1
Emergency Admissions per 100,000
Dependent Variable: log(E_t)

	Linear Regressions				Panel - Fixed Effects Regressions		
	(0)	(OLS1)	(OLS2)	(OLS3)	(1)	(2)	(3)
Time Trend (t)	0.009 ***	-0.005 *	0.000	0.000	0.007 ***	0.008 ***	0.010 ***
	(0.000)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
England (Dummy Var.)	-0.216 ***	-0.381 ***	-0.338 ***	-0.44 ***	-0.223 ***	-0.219 ***	-0.216 ***
	(0.000)	(0.085)	(0.086)	(0.084)	(0.022)	(0.021)	(0.022)
t * England	0.014 ***	0.006	-0.012	0.036 ***	0.018 ***	0.015 ***	0.015 ***
	(0.000)	(0.005)	(0.010)	(0.006)	(0.002)	(0.003)	(0.003)
PbR			0.181	-21.773 ***		0.008	-2.793 ***
			(0.130)	(1.832)		(0.027)	(0.665)
Short Stay Adjustment (2006-)			0.054	0.498		0.058 **	6.793 *
			(0.072)	(16.054)		(0.029)	(3.422)
Differential Tariff (2006-2008)			-0.069	12.159		-0.040 **	-5.134
			(0.046)	(15.886)		(0.016)	(3.363)
Marginal Rate (2010-)			-0.098 **	11.118		-0.106 ***	-1.910
			(0.048)	(10.354)		(0.013)	(2.170)
4-Hour Target England (2004-)			-0.040	5.404 ***		0.011	0.393 **
			(0.049)	(0.682)		(0.013)	(0.179)
4-Hour Target Scotland (2008-)			-0.053 **	0.028		-0.020	0.242 ***
			(0.021)	(0.104)		(0.015)	(0.056)
t * Policies	NO	NO	NO	YES	NO	NO	YES
Clustered by Country	YES						
Clustered by HRG-Country		YES	YES	YES			
Clustered by HRG					YES	YES	YES
N	28	32128	32128	32128	32128	32128	32128
Number of Clusters	2	2444	2444	2444	1251	1251	1251

Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively. All regressions include a constant.

Table 6.3.1.2
Emergency Episodes (Imputed Planned Transfers) per 100,000
Dependent Variable: log(E_t)

	Linear Regressions				Panel - Fixed Effects Regressions		
	(0)	(OLS1)	(OLS2)	(OLS3)	(1)	(2)	(3)
Time Trend (t)	0.021 ***	0.002	0.009 **	0.010 ***	0.014 ***	0.016 ***	0.018 ***
	(0.000)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
England (Dummy Var.)	-0.229 ***	-0.407 ***	-0.360 ***	-0.470 ***	-0.280 ***	-0.280 ***	-0.279 ***
	(0.000)	(0.085)	(0.085)	(0.084)	(0.022)	(0.022)	(0.022)
t * England	0.014 ***	0.008 *	-0.012	0.04 ***	0.019 ***	0.017 ***	0.019 ***
	(0.000)	(0.005)	(0.010)	(0.006)	(0.002)	(0.003)	(0.003)
PbR			0.195	-22.133 ***		0.024	-2.838 ***
			(0.136)	(1.942)		(0.030)	(0.747)
Short Stay Adjustment (2006-)			0.030	8.818		0.025	11.917 ***
			(0.075)	(16.738)		(0.030)	(3.362)
Differential Tariff (2006-2008)			-0.056	3.873		-0.025	-10.251 ***
			(0.047)	(16.450)		(0.017)	(3.283)
Marginal Rate (2010-)			-0.085 *	5.661		-0.099 ***	-5.377 **
			(0.048)	(10.849)		(0.013)	(2.134)
4-Hour Target England (2004-)			-0.036	5.841 ***		0.009	0.510 ***
			(0.050)	(0.700)		(0.013)	(0.172)
4-Hour Target Scotland (2008-)			-0.072 ***	0.135		-0.022 *	0.347 ***
			(0.020)	(0.106)		(0.013)	(0.052)
t * Policies	NO	NO	NO	YES	NO	NO	YES
Clustered by Country	YES						
Clustered by HRG-Country		YES	YES	YES			
Clustered by HRG					YES	YES	YES
N	28	32350	32350	32350	32350	32350	32350
Number of Clusters	2	2452	2452	2452	1251	1251	1251

Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively. All regressions include a constant.

6.3.2. Bed Days

Table 6.3.2.1
Emergency Bed Days per 100,000
Admission Episodes
Dependent Variable: log(BD_t)

	Linear Regressions				Panel - Fixed Effects Regressions		
	(0)	(OLS1)	(OLS2)	(OLS3)	(1)	(2)	(3)
Time Trend (t)	-0.028 ***	-0.034 ***	-0.029 ***	-0.029 ***	-0.021 ***	-0.019 ***	-0.017 ***
	(0.000)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)
England (Dummy Var.)	0.047 ***	-0.295 ***	-0.342 ***	-0.408 ***	-0.132 ***	-0.181 ***	-0.178 ***
	(0.000)	(0.090)	(0.090)	(0.088)	(0.024)	(0.023)	(0.024)
t * England	-0.016 ***	-0.004	0.015	0.047 ***	0.008 ***	0.027 ***	0.028 ***
	(0.000)	(0.005)	(0.009)	(0.006)	(0.002)	(0.004)	(0.003)
PbR			-0.003	-15.514 ***		-0.051	-1.060
			(0.116)	(1.889)		(0.033)	(0.687)
Short Stay Adjustment (2006-)			-0.115	22.519		-0.046	12.845 ***
			(0.076)	(15.110)		(0.030)	(4.392)
Differential Tariff (2006-2008)			-0.056	-12.606		-0.011	-12.065 **
			(0.050)	(14.928)		(0.018)	(4.338)
Marginal Rate (2010-)			-0.153 ***	-5.908		-0.162 ***	-6.689 **
			(0.052)	(9.613)		(0.015)	(2.770)
4-Hour Target England (2004-)			-0.022	3.072 ***		-0.024	-0.039
			(0.045)	(0.697)		(0.016)	(0.272)
4-Hour Target Scotland (2008-)			-0.054 **	0.076		-0.023	0.308 ***
			(0.025)	(0.125)		(0.018)	(0.078)
t * Policies	NO	NO	NO	YES	NO	NO	YES
Clustered by Country	YES						
Clustered by HRG-Country		YES	YES	YES			
Clustered by HRG					YES	YES	YES
N	28	32128	32128	32128	32128	32128	32128
Number of Clusters	2	2444	2444	2444	1251	1251	1251

Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively. All regressions include a constant.

Table 6.3.2.2
Emergency Bed Days per 100,000
All Episodes (Imputed Planned Transfers in SMR)
Dependent Variable: log(BD_t)

	Linear Regressions				Panel - Fixed Effects Regressions		
	(0)	(OLS1)	(OLS2)	(OLS3)	(1)	(2)	(3)
Time Trend (t)	0.000 ***	-0.020 ***	-0.012 ***	-0.011 **	-0.006 **	-0.004	-0.001
	(0.000)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)
England (Dummy Var.)	-0.083 ***	-0.334 ***	-0.366 ***	-0.448 ***	-0.195 ***	-0.243 ***	-0.245 ***
	(0.000)	(0.091)	(0.091)	(0.089)	(0.024)	(0.024)	(0.025)
t * England	-0.014 ***	-0.003	0.009	0.049 ***	0.009 ***	0.026 ***	0.029 ***
	(0.000)	(0.005)	(0.010)	(0.006)	(0.002)	(0.004)	(0.003)
PbR			0.055	-16.047 ***		-0.008	-0.933
			(0.123)	(2.078)		(0.034)	(0.804)
Short Stay Adjustment (2006-)			-0.153 *	38.347 **		-0.099 ***	20.567 ***
			(0.079)	(15.204)		(0.031)	(3.994)
Differential Tariff (2006-2008)			-0.045	-28.409 *		0.009	-19.959 ***
			(0.053)	(14.860)		(0.019)	(3.877)
Marginal Rate (2010-)			-0.135 **	-16.437 *		-0.151 ***	-11.938 ***
			(0.053)	(9.655)		(0.016)	(2.502)
4-Hour Target England (2004-)			-0.015	3.733 ***		-0.021	0.150
			(0.048)	(0.721)		(0.016)	(0.258)
4-Hour Target Scotland (2008-)			-0.087 ***	0.183		-0.031 *	0.426 ***
			(0.024)	(0.129)		(0.016)	(0.072)
t * Policies	NO	NO	NO	YES	NO	NO	YES
Clustered by Country	YES						
Clustered by HRG-Country		YES	YES	YES			
Clustered by HRG					YES	YES	YES
N	28	32350	32350	32350	32350	32350	32350
Number of Clusters	2	2452	2452	2452	1251	1251	1251

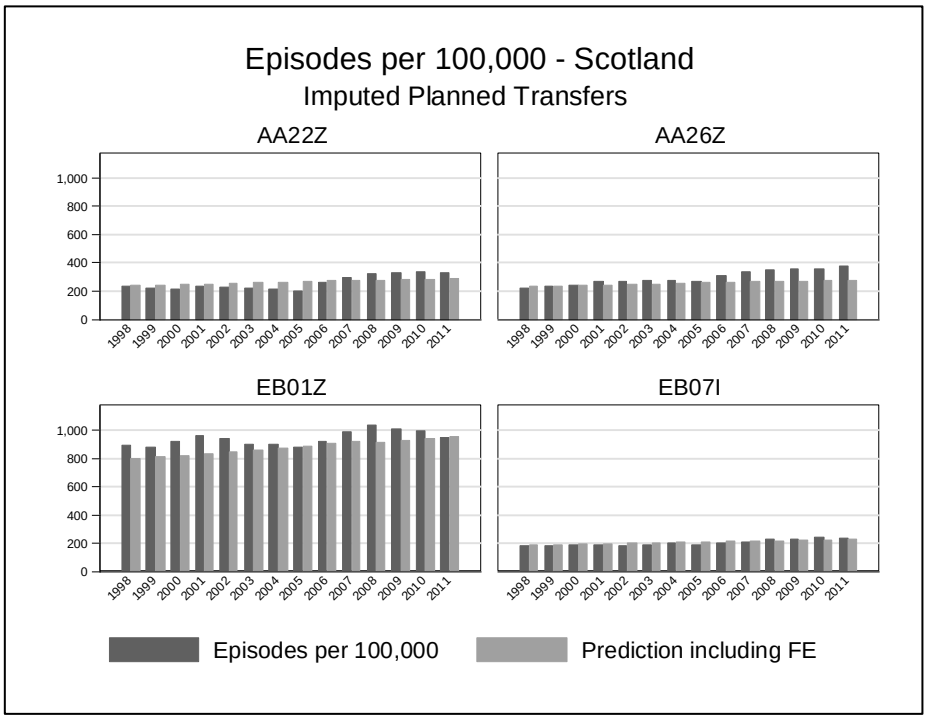
Notes: ***, ** and * indicate 1%, 5% and 10% significance, respectively. All regressions include a constant.

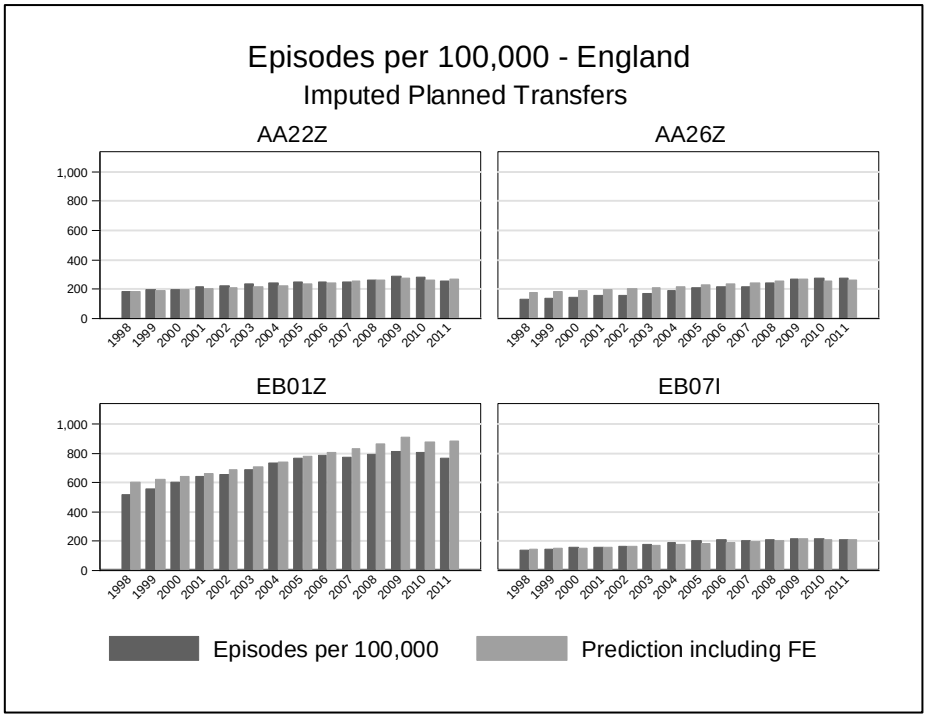
6.4. Fitted Values by HRG

Next we present plots of the actual data and the prediction based on the coefficients obtained with regression (2) using all episodes (with imputed planned transfers in SMR) for four HRGs that are consistently among those with higher activity in both countries throughout the analysed period, they are:

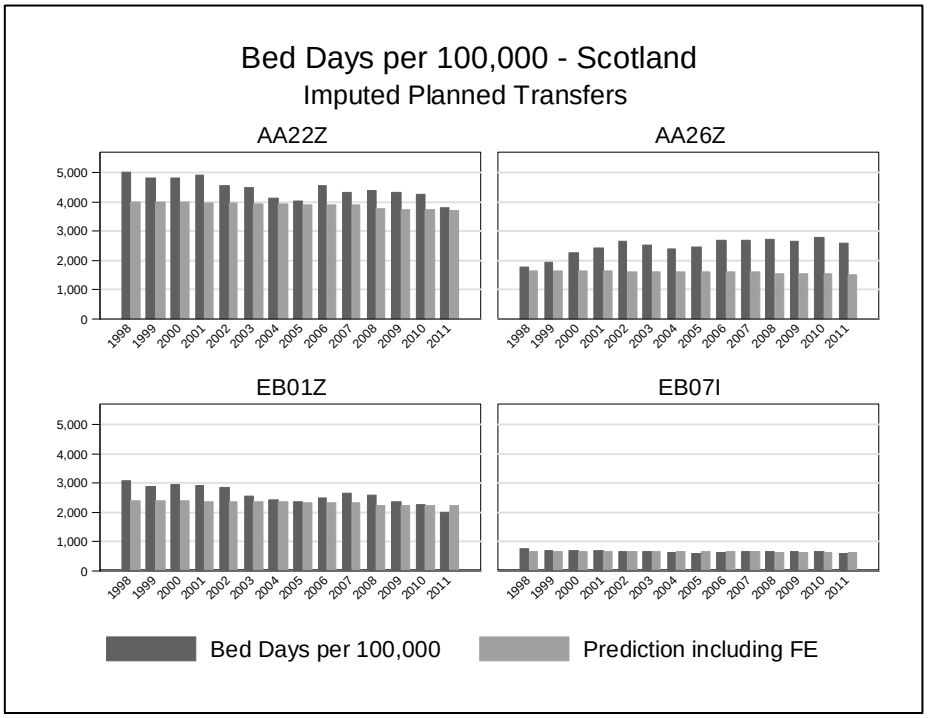
- AA22Z Non-Transient Stroke or Cerebrovascular Accident, Nervous system infections or Encephalopathy
- AA26Z Muscular, Balance, Cranial or Peripheral Nerve disorders; Epilepsy; Head Injury
- EB01Z Non interventional acquired cardiac conditions.
- EB07I Arrhythmia or Conduction Disorders without CC.

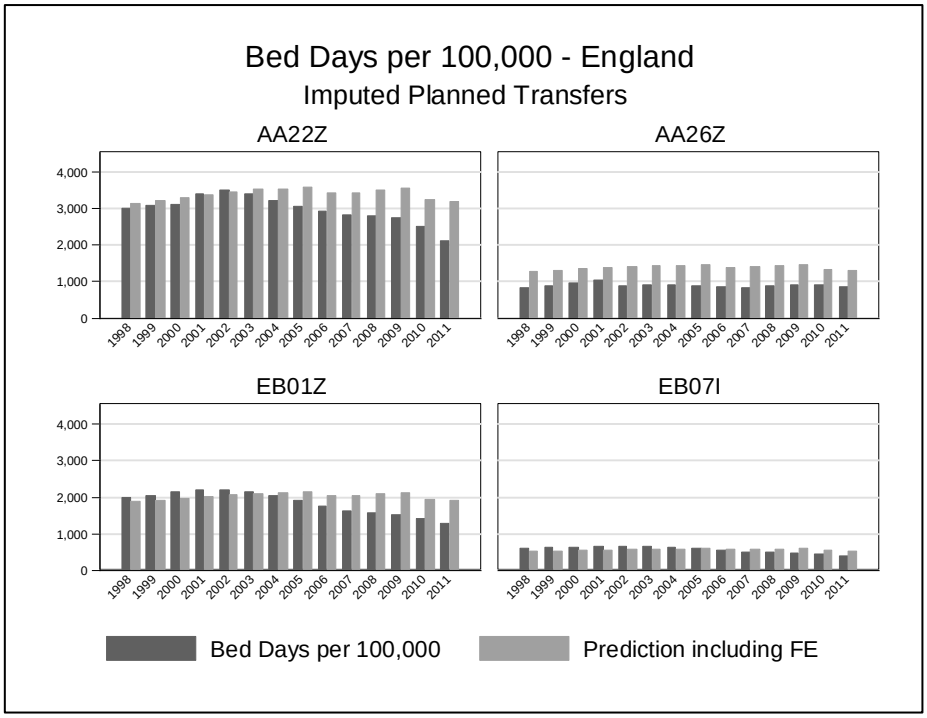
6.4.1. Episodes




Episodes per 100,000 - England
Imputed Planned Transfers
AA22Z
AA26Z
EB01Z
EB07I
1,000
800
600
400
200
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Episodes per 100,000
Prediction including FE

6.4.2. Bed Days


Bed Days per 100,000 - Scotland
Imputed Planned Transfers
AA22Z
AA26Z
EB01Z
EB07I
5,000
4,000
3,000
2,000
1,000
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Bed Days per 100,000
Prediction including FE


Bed Days per 100,000 - England
Imputed Planned Transfers
AA22Z
AA26Z
EB01Z
EB07I
4,000
3,000
2,000
1,000
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Bed Days per 100,000
Prediction including FE