Supplementary Material 8: Further details of work package 2

1 Developing a case-mix classification to describe generalist medical care workload in smaller acute hospitals in England

1.1 Introduction

In order to compare different service models, possible differences in the types of patients treated needs to be taken into account.

In order to compare different approaches to medical generalism across hospitals, we needed to be able to test whether the mix of patients treated was similar or different. This meant having to use some descriptions of case mix applied to data sets that were consistent across hospitals. In terms of the data sets, there was only one contender – namely Hospital Episode Statistics (HES) data. This data set is based on summary electronic records from individual consultant episodes – and can be aggregated across hospital spells and across patient histories (using pseudonymised identifiers). The ability to link over time means that the analysis can exploit information about prior hospital activity before an admission spell, and track subsequent events, such as readmission. The Nuffield Trust has considerable experience in using linked HES data sets and extended its current agreements with the Health and Social Care Information Centre (HSCIC) to undertake this work.

The following sections describes how we identified a case-mix classification, and how this was validated. The key criteria for validating the case-mix groupings were firstly clinical validity, and secondly, homogeneity within each group in terms of length of stay.

In developing the groups, we sought to create ones that were useful to describe case types in a manageable number, as well as grouping together similar patterns of resources use. In these data, the only information we have at episode level about resource use is the length of stay, but this can be considered a reasonable proxy for these purposes. The degree of homogeneity within groups can be assessed by looking at the total reduction in variance (RIV) when the classification is applied. Larger values indicate that there is less within-group variability and more distance between groups. With case-mix schemes, this is typically in the region of 10-30%.

1.2 Design of the case-mix classification

The case-mix classification was designed to balance simplicity and comprehensiveness in describing medical case mix, with some ability to predict resource use, such as bed days. This classification sought to create a system that recognised something about the prior and subsequent history of the patient. The classification is therefore based on episodes of care, with a focus on the admitting emergency episode in smaller hospitals.

There were four central components considered as part of the design of the case-mix classification for an admitting emergency episode: the selection of appropriate general medical specialties, prior patient history, admitting diagnostic group and subsequent treatment. An outline of the design is provided in Figure 1, followed by discussion of each of the design elements in more detail.

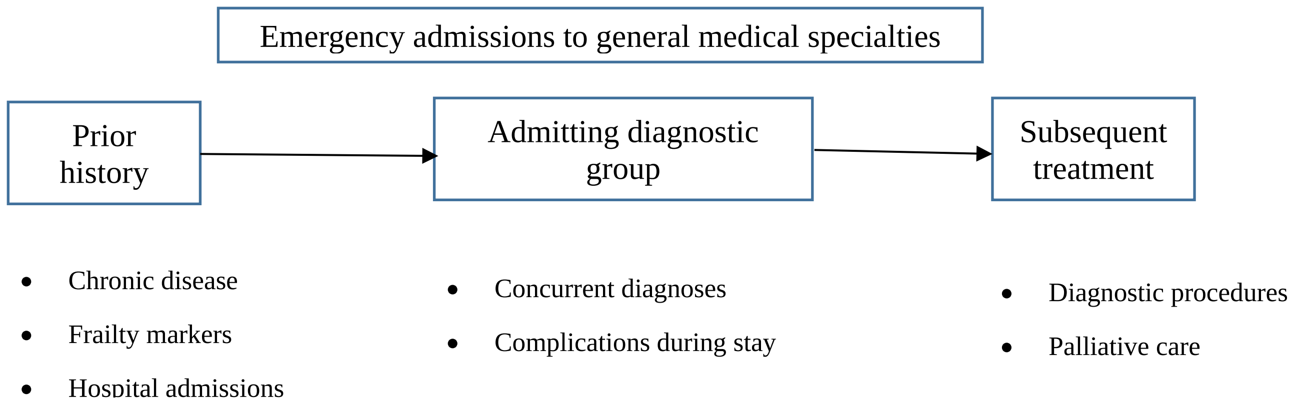

Figure 1. General design of the case-mix classification

The identification of a case-mix system progressed through a number of stages:

a. Selecting a cohort for analysis

b. Identifying the most common diagnostic categories

c. Workshops to explore clinical validity

d. Refining and regrouping

e. Analysing the homogeneity of groups (undertaken iteratively)

a. Selecting a cohort for analysis

Hospitals were categorised as ‘smaller’ using the same criteria as the 2014 Monitor report ‘Facing the Future: smaller acute providers’; namely, hospitals with an operating revenue of under £300 million in the 2012/13 financial year.[1] The final sample included 69 smaller NHS trusts providing acute medical care in England. Note that during the period of the study some of these trusts merged, such as Hinchingbrooke Health Care NHS Trust and Peterborough and Stamford Hospitals NHS Foundation Trust merging into North West Anglia Foundation Trust in April 2017. This meant that some analyses used only 68 hospitals.

In order to define the scope of generalist medical care, finished consultant episodes by main specialty of the consultant in the national data were reviewed to gain a sense of volume and how the specialty labels were used.[2] Table 1 provides details of the treatment functions selected to represent specialties where generalist clinical workload may occur. These were selected on the basis of clinical knowledge as well as volume, for example, eliminating specialisms unlikely to encounter generalist patients, such as haemophilia or allergy.

It was decided to use treatment functions rather than main specialties in the first instance when defining the cohort population, because they provide details of the service within which the patient was treated, which may not always correspond to the main consultant specialty. Acute medicine (a main specialty rather than a treatment function) was also included to take account of the recent trend in some trusts of distinguishing acute medicine from general medicine. Not all trusts follow this practice.

Table 1. Generalist medical care specialties selected

GENERAL MEDICINE	INFECTIOUS DISEASES
ACCIDENT & EMERGENCY	RHEUMATOLOGY
GASTROENTEROLOGY	GERIATRIC MEDICINE
ENDOCRINOLOGY	CLINICAL HAEMATOLOGY
CARDIOLOGY	DIABETIC MEDICINE
RESPIRATORY MEDICINE	NEUROLOGY
ACUTE MEDICINE*	

*Acute medicine is a main specialty rather than a treatment function

1.3 Establishing index episodes of care

As described above, this analysis was undertaken using HES data (year range 2007/08–2017/18; © 2018, NHS Digital; re-used with the permission of NHS Digital; all rights reserved). Episode level data were pseudonymised and all sensitive data provided to the Nuffield Trust were processed in accordance with all applicable privacy and data protection legislation. Read more at: https://www.nuffieldtrust.org.uk/about/corporate-policies#information-security-and-data.

The first step was to create a data set based on 'Index episodes of care' for emergency admissions across the selected generalist medicine specialties identified in HES inpatient data 2012/13 for the smaller hospitals cohort. 2012/13 was chosen as the index year as we wanted to look back at two years of prior patient history for the cancer patients, as well as three years of subsequent history, and HES permissions were initially for data from 2010/11 to 2017/18. We subsequently applied for, and received permission to include, data from 2007/08, so that five years on from prior cancer diagnosis could be identified. Cases with a specific diagnosis indicating specialist care or where patients had been transferred out of hospital were excluded. Episode duration was capped to remove excess lengths of stay: after discussions within the team, a six-week figure was chosen as the maximum (42 days). A data set was created covering 1.9 million episodes in the selected smaller hospitals.

b. Identifying the most common diagnostic categories

The starting point was to look at the pattern of three-digit diagnostic codes (ICD-10) to identify find the most common groupings. Our intention was to use this as a basic diagnostic episode descriptor and then explore the additional value of a range of variables, including age, prior hospital history, the presence of comorbidities and secondary diagnoses, frailty, and whether a procedure was undertaken.

The initial mapping covered 1381 ICD-10 codes; 1248 non-cancer groups and 133 cancer groups. We sought to simplify this scheme by grouping together codes that were contiguous and clinically related and had similar overall lengths of stay. MB and LV reviewed the results to create the first iteration of non-cancer case-mix groups, looking in the first instance for groups that were distinct in terms of their volume or length of stay.

As the aim was to provide comprehensive coverage of all ICD codes, smaller volume diseases within chapters were grouped together. The initial case-mix scheme comprised just over 100 groups, primarily based on diagnoses. There was then a further review process to determine whether some groups could be merged based on whether they had a similar resource use to consecutive case-mix groups. It was also considered whether some groups should be split based on whether the diagnosis groups appeared heterogeneous.

The labelling of the case-mix groups within which each diagnosis would sit was designed along the same principles as ICD-10 classification, in that each group was represented by a letter of the alphabet corresponding to the ICD-10 chapter it resided in. Using this approach would mean that the classification scheme could adapt to future changes to the ICD-10 codes, as positioning alongside other relevant codes would identify the matching classification code.

1.4 Cancer groups

Patients with a primary diagnosis of cancer were addressed separately based on prior and subsequent hospital events rather than type. Following clinical advice, we sought to group patients not on the body system or type of cancer, but rather on the nature of the presentation to acute emergency medicine. The key variables of interest that we would have some hope of capturing within HES were:

- Patient getting an initial diagnosis of cancer – so we looked at diagnoses in the two years before admission
- People with complications of cancer treatments
- People showing signs of disease progression following treatment, or patients needing palliative or end-of-life care.

In terms of the performance of the cancer groups, our first attempt identified 27 groups producing an RIV in length of stay of 4.9%, against 337 healthcare resource groups (HRGs) with an RIV of 15.8%. This performance comparison was expected given the difference in group sizes, but it was unexpected that the patient cohort would be so mixed with a large proportion of short stay episodes. A decision was made to group ‘benign’ and ‘in-situ’ groups together; with two additional, separate groups: ‘uncertain behaviour’ and ‘malignant’. The final scheme is shown in Table 2.

Table 2. Final cancer groups at highest level

	No. episodes (2015/16)
C1 Benign and in-situ neoplasms	1512
C2 Malignant neoplasms, no prior history, without palliative care	12728
C3 Malignant neoplasms, no prior history, with palliative care	6006
C4 Malignant neoplasms, prior history of same cancer, without palliative care	15224
C5 Malignant neoplasms, prior history of same cancer, with palliative care	12676
C6 Malignant neoplasms, prior history of different cancer, without palliative care	4376
C7 Malignant neoplasms, prior history of different cancer, with palliative care	3050
C8 Neoplasms of uncertain behaviour without palliative care	2436
C9 Neoplasms of uncertain behaviour with palliative care	235

c. Workshops to explore clinical validity

As part of the development of the classification we held two meetings with a panel of selected clinicians from across the country to review the emerging scheme. The panel was used to explore whether the groups made clinical sense and if they related to the patterns of service use clinicians were familiar with. In creating such schemes, there is inevitably a degree of compromise needed in order to create a manageable number of groups, therefore the face-to-face meeting was a chance to come to a group consensus.

For the first meeting, the panel members were sent information packs in advance, including general descriptors and examples of outputs to illustrate activity in their own hospitals using the classification scheme. The panel members were asked to review the materials and answer questions about the current construction of the groups and if/how they could be improved. The questions and examples of some of the answers provided are listed below:

- *Do the groups capture important aspects of workload?*

The panel explored how to get the right balance between the ‘presenting symptoms’ versus eventual diagnosis in the classification system. We recognised that the groups we used conflated these two.

- *How could the case-mix groups be improved (given constraints on data)?*

  There was a tendency to merge rather than split groups. The clinicians felt that a number of the groups could be merged without losing the value of the classification system as a whole. For instance, ‘fever of unknown origin’ could be joined with ‘other infectious diseases not elsewhere classifiable’. In terms of splitting groups, there was a detailed discussion around certain issues, e.g. how to group cerebral haemorrhage and stroke/TIA groups, and if it was possible to split these into three groups.

The comments from the clinicians were used to revise our definitions of the case-mix groups. It was not possible to address all of the changes suggested (for instance we were not able to add a satisfactory way to differentiate between different types of ambulatory care).

The workshop attendees also raised several questions that were addressed in follow-up analysis:

- Do we need to verify the principal diagnoses as the most important driver of resource use? For instance, where a patient is admitted with a pneumonia diagnosis, but they have lung cancer. Sensitivity analysis was conducted to look at the impact of swapping primary and secondary diagnoses.
- How do we best account for outpatient and ambulatory workload, in particular where information recorded about activity is inconsistent between trusts?

Following the meeting, the number of non-cancer diagnostic groups was reduced from 102 to 73.

We also noted that some of the groups that appeared in the data were attributed to our general medical specialties, but did not match clinical expertise – in particular the group ‘O1 Pregnancy, childbirth and congenital or chromosomal conditions’. This presumably reflects patients encountering acute problems before/after childbirth that appeared in A&E. We opted to include it in the data while still recognising it is an oddity.

d. Refining and regrouping

To enable greater descriptive power of the classification system, as a secondary phase of development, other variables such as frailty flags and procedures were added. The purpose of this was to enable additional analysis of factors likely to influence resource use and outcome.

We agreed that the basic diagnostic groups would be augmented by three separate variables:

a. *A frailty flag*. In our analysis of reduction in variance we had found that applying a basic flag indicating potential 'frailty' proved better than age at explaining differences in lengths of stay and was also felt to be more clinically meaningful. There are a number of approaches to measuring frailty[125–127] and two methods have been developed that are based on the type of diagnostic information found in HES records, in particular work from a team at Imperial College[128] and at Leicester/the Nuffield Trust[129]. We compared the performance of these two schemes in terms of additional reduction in variance. The RIV from the Nuffield Trust scheme was slightly better and so we opted for that – though the differences were small.

b. *A procedure flag.* This was one of the issues raised in our workshops: that the clinical perception of a patient so often revolves around whether there was some procedure, usually diagnostic, undertaken. Empirically this was seen to be a big influence on resource use and a driver of length of stay.

c. *Cancer as a secondary diagnosis.* One of the problems raised by our clinical groups was the challenge of distinguishing what was the most important diagnosis influencing care. We used the principal diagnosis to drive our schemes and in some cases that could potentially be misleading, such as a patient admitted with pneumonia but who also has lung cancer. Sometimes the principal diagnosis may not be the most important one influencing treatment and care. This was felt to be particularly problematic for people with a cancer diagnosis. We therefore added a flag to see if any of the secondary diagnostic fields include cancer, as this might be driving an atypical pattern of resource use.

1.5 Final classification system

The final classification scheme consists of 82 diagnostic groups (see Table 3 below), of which:

- 73 were defined by principal diagnosss
- The nine cancer groups were defined by a combination of diagnosss, prior episodes and treatment.

The basic groups could then be refined as needed by looking at independent flags for:

- Frailty (yes/no)
- Procedures (yes/no)
- Secondary cancers (yes/no/no cancer diagnoses).

Using all variables, there were a total of 328 permutations – which is still less than the number of HRGs. In practice, most of the time for descriptive analysis we used the diagnostic groupings at episode level and used secondary variables for sensitivity testing.

Table 3. Summary characteristics of diagnostic level case-mix groups (CMGs) 2015/16

CMG	Episodes	(% of all episodes)	Average episode length (days)	% short stay	% of all bed days	% over 74s
A1 Intestinal infections and nausea and vomiting	42185	2.2%	2.9	56.5%	1.8%	42.1%
A2 Septicaemia	38580	2.0%	4.9	36.9%	2.8%	52.1%
A3 Other infectious diseases not elsewhere classified and fever of unknown origin	21345	1.1%	3.0	59.2%	0.9%	21.4%
C1 Benign and in-situ neoplasms	1512	0.1%	4.6	46.5%	0.1%	43.6%
C2 Malignant neoplasms, no prior history, without palliative care	12728	0.7%	6.4	31.4%	1.2%	49.3%

CMG	Episodes	(% of all episodes)	Average episode length (days)	% short stay	% of all bed days	% over 74s
C3 Malignant neoplasms, no prior history, with palliative care	6006	0.3%	9.1	21.6%	0.8%	62.1%
C4 Malignant neoplasms, prior history of same cancer, without palliative care	15224	0.8%	3.8	48.8%	0.9%	40.9%
C5 Malignant neoplasms, prior history of same cancer, with palliative care	12676	0.6%	5.7	32.1%	1.1%	42.5%
C6 Malignant neoplasms, prior history of different cancer, without palliative care	4376	0.2%	4.9	39.8%	0.3%	49.4%
C7 Malignant neoplasms, prior history of different cancer, with palliative care	3050	0.2%	7.5	26.7%	0.3%	56.6%
C8 Neoplasms of uncertain behaviour without palliative care	2436	0.1%	4.2	48.8%	0.2%	55.3%
C9 Neoplasms of uncertain behaviour with palliative care	235	0.0%	9.3	21.3%	0.0%	73.2%
D1 Iron deficiency anaemia	10521	0.5%	2.2	64.9%	0.4%	55.0%
D2 Sickle cell disorders	4400	0.2%	2.0	67.0%	0.1%	0.3%
D3 Other anaemias	8958	0.5%	2.2	65.1%	0.3%	58.8%
D4 Other diseases of blood and blood-forming organs	7999	0.4%	3.2	52.7%	0.4%	38.7%
E1 Insulin-dependent diabetes mellitus	10062	0.5%	2.3	60.6%	0.3%	7.4%
E2 Non-insulin-dependent diabetes mellitus	10595	0.5%	3.9	49.6%	0.6%	38.0%

CMG	Episodes	(% of all episodes)	Average episode length (days)	% short stay	% of all bed days	% over 74s
E3 Other disorders of pancreatic internal secretion	6625	0.3%	3.0	58.8%	0.3%	54.4%
E4 Disorders of mineral metabolism	4228	0.2%	3.2	55.4%	0.2%	40.9%
E5 Volume depletion and other fluid disorders	26057	1.3%	3.1	56.0%	1.2%	58.6%
E6 Other metabolic diseases	6348	0.3%	4.8	45.8%	0.5%	34.9%
F1 Dementia and senility	11466	0.6%	8.9	35.5%	1.5%	88.5%
F2 Delirium	8824	0.5%	6.5	37.1%	0.9%	82.3%
F3 Mental and behavioural disorders due to use of alcohol	21030	1.1%	2.1	63.3%	0.7%	3.5%
F4 Other mental and behavioural disorders	13143	0.7%	2.3	75.9%	0.4%	20.4%
G1 Parkinson's disease	3574	0.2%	8.8	31.2%	0.5%	69.0%
G2 Epilepsy and convulsions, not elsewhere classified	26189	1.3%	2.3	65.1%	0.9%	25.1%
G3 Migraine and headache	31797	1.6%	1.0	81.7%	0.5%	10.4%
G4 Transient ischaemic attacks and dizziness and giddiness	52549	2.7%	1.5	75.3%	1.2%	52.8%
G5 Hemiplegia	916	0.0%	3.5	55.0%	0.0%	37.3%
G6 Other disorders of brain	3001	0.2%	5.2	44.8%	0.2%	20.9%
G7 Other neurological and somnolence, stupor and coma	15002	0.8%	4.9	50.3%	1.1%	32.9%
H1 Ear, nose and throat	9938	0.5%	1.8	71.0%	0.3%	31.7%
I1 Hypertension	6472	0.3%	1.5	77.5%	0.1%	32.6%

CMG	Episodes	(% of all episodes)	Average episode length (days)	% short stay	% of all bed days	% over 74s
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	50452	2.6%	7.8	33.3%	5.9%	62.6%
I11 Other cerebrovascular diseases	2150	0.1%	6.0	39.0%	0.2%	60.7%
I12 Phlebitis and thrombophlebitis and hypotension	24454	1.3%	2.6	65.2%	0.9%	57.3%
I13 Oesophageal varices	1137	0.1%	3.1	49.0%	0.1%	16.2%
I14 Other circulatory	16549	0.8%	5.0	44.5%	1.2%	41.6%
I2 Angina pectoris and dyspepsia	24783	1.3%	1.4	74.4%	0.5%	38.8%
I3 Acute myocardial infarction	50620	2.6%	3.5	40.5%	2.6%	48.7%
I4 Chronic ischaemic heart disease	6067	0.3%	3.1	45.8%	0.3%	34.5%
I5 Pulmonary embolism	16905	0.9%	3.4	47.5%	0.9%	38.3%
I6 Pericarditis	3240	0.2%	2.3	61.1%	0.1%	14.5%
I7 Valve disorders	3932	0.2%	5.1	36.2%	0.3%	69.1%
I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat	66612	3.4%	2.2	63.9%	2.2%	49.5%
I9 Heart failure and pulmonary oedema	53876	2.8%	5.1	37.0%	4.1%	72.6%
J1 Diseases of the pharynx and larynx	4018	0.2%	1.1	78.2%	0.1%	6.9%
J2 Acute upper respiratory infections of multiple and unspecified sites	2658	0.1%	1.0	82.5%	0.0%	18.7%

CMG	Episodes	(% of all episodes)	Average episode length (days)	% short stay	% of all bed days	% over 74s
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	233311	11.9%	4.7	41.2%	16.3%	59.3%
J4 Chronic lung disease inc. COPD	90467	4.6%	3.2	48.7%	4.3%	45.4%
J5 Asthma	21717	1.1%	2.1	59.1%	0.7%	14.3%
J6 Interstitial lung disease and pleural effusion	13559	0.7%	3.5	48.3%	0.7%	43.7%
J7 Respiratory failure, not elsewhere classified	4656	0.2%	5.1	36.7%	0.4%	42.0%
J8 Other respiratory and haemorrhage from respiratory passages and cough and abnormalities of breathing	26657	1.4%	1.9	73.0%	0.7%	37.6%
K1 Oesophagitis and ulcers of the digestive system and gastritis	29979	1.5%	2.2	67.5%	1.0%	36.9%
K2 Crohn’s and other intestinal diseases	31230	1.6%	3.5	50.8%	1.6%	42.9%
K3 Failing liver and alcoholic liver disease	17166	0.9%	5.1	37.5%	1.3%	10.5%
K4 Gallbladder and biliary tree diseases	16613	0.8%	4.2	43.0%	1.0%	52.5%
K5 Acute pancreatitis	2857	0.1%	3.7	47.0%	0.2%	19.7%
K6 Other digestive and dysphagia	40153	2.1%	2.7	60.9%	1.6%	41.9%
L1 Ulcer of lower limb, not elsewhere classified	6018	0.3%	6.3	38.6%	0.6%	58.9%
M1 Joints	56788	2.9%	2.7	69.8%	2.3%	48.4%
M2 Back pain	18445	0.9%	2.4	68.6%	0.7%	41.1%

CMG	Episodes	(% of all episodes)	Average episode length (days)	% short stay	% of all bed days	% over 74s
N1 Acute kidney disease and chronic kidney disease	40078	2.1%	4.2	42.1%	2.5%	54.6%
N2 Calculus of kidney or urinary tract	2853	0.1%	0.9	84.6%	0.0%	7.7%
N3 Other genitourinary and retention of urine	102558	5.2%	4.8	42.4%	7.4%	69.5%
O1 Pregnancy, childbirth and congenital or chromosomal conditions	3905	0.2%	1.1	80.5%	0.1%	2.1%
R1 Pain in throat and chest	94436	4.8%	0.6	90.1%	0.9%	23.6%
R2 Skin and cellulitis	50333	2.6%	3.6	55.0%	2.7%	39.5%
R3 Abnormalities of gait and mobility	42098	2.2%	4.0	52.7%	2.5%	79.4%
R4 Signs/symptoms not elsewhere classified	59427	3.0%	1.9	72.1%	1.7%	40.9%
S1 Head injury	41836	2.1%	2.0	74.5%	1.3%	62.3%
S2 Spine injury	7183	0.4%	5.8	39.8%	0.6%	82.6%
S3 Serious injury usually treated by physicians	20185	1.0%	3.7	60.8%	1.1%	68.0%
S4 Fracture of femur	6995	0.4%	10.5	23.5%	1.1%	83.5%
S5 Other injury	19577	1.0%	2.5	68.9%	0.7%	61.0%
T1 Poisoning	42955	2.2%	1.1	81.0%	0.7%	6.2%
T2 Complications of treatment	12507	0.6%	3.6	56.1%	0.7%	45.5%
T3 Other external injury	6640	0.3%	1.4	81.3%	0.1%	28.2%
Z1 Other	4251	0.2%	1.6	79.4%	0.1%	44.5%
Grand total	1954933	100%	3.7	54.7%	100.0%	42.8%

COPD, chronic obstructive pulmonary disease; LRTI, lower respiratory tract infection.

Table 4 summarises the frequency of the secondary attributes. The average length of episode for cases with a secondary cancer diagnosis is longer than cases with no cancer diagnoses, but less than for episodes with a primary diagnosis of cancer.

Both the frailty marker and that for a procedure are associated with much longer episode lengths – and the frailty flag has proportionately more over-75s, as expected.

Table 4. Summary characteristics of secondary attributes

CMG subgroup	No. episodes	% total	Average length of episode	% over 75	Average age
No. secondary cancer diagnosis	1782625	91.19%	3.4	46.20%	67.6
Secondary cancer diagnosis	172308	8.81%	4	54.40%	73.9
Primary cancer diagnosis	58243	3.0%	6.2	52.5%	73.15
No procedure	1426244	72.96%	2.5	46.49%	39.25
With procedure	528689	27.04%	5.9	48.05%	40.36
No frailty flag	13582237	69.48%	2.5	3.61%	30.11
With frailty flag	596696	30.52%	5.6	71.53%	61.04

Table 5. Interaction of frailty and procedure markers

		Total sum of episodes	**% total**	**Average LOS**
Frailty	Procedure			
No	No	997174	51.01%	1.8
No	Yes	361063	18.47%	4.4
Yes	No	429070	21.95%	4.2
Yes	Yes	167626	8.57%	9.1

LOS, length of stay.

e. Reduction in variance for the final classification

Table 6 summarises the reduction in variance (using lengths of episodes where long stay cases are capped at 42 day) for 2015/16 data. There are a number of points to note:

- Reduction in variance will tend to increase the more groups you have – yet the classification scheme will become more difficult to use with more groups, so there is a trade-off between these two attributes.
- Adding variables such as age, procedures to the classification increases the RIV – the largest increases are for the addition of a procedure flag.
- The reduction in variance when frailty flags are added is greater than when simple age flags such as age >75 are used.
- The RIV for the combinations of diagnostic CMGs with procedure and frailty flags is slightly higher than for HRGs, despite the fact that there are far fewer groups (328 versus 969).

Classifications that incorporate variables that describe the process of care, such as operations undertaken, inevitably fare slightly better than those that try and group according to presenting features of the patient. HRGs have evolved over time to include quite a lot of information about what happens to the patient after admission. This makes them better at capturing total resource use, but less good in supporting comparisons where there is some discretionary element to a treatment.

Table 6. Reductions in variance in lengths of stay (spells) for different classifications

Description	Groups	Reduction in variance
CMGs diagnostic groups	82	12.10%
CMGs + flag for secondary diagnoses	161	13.03%
CMGs + flag for procedure yes/no	164	22.97%
CMGs + flag for age >75 split	164	15.89%
CMGs + flag for frailty (Nuffield)	164	20.18%
CMGs + flag for frailty (Imperial)	164	17.92%
CMGs + flags for procedure plus frailty (Nuffield)	328	30.75%
HRGs	969	28.55%

1.6 Discussion

A case-mix classification scheme was developed to describe generalist medical care workload in smaller acute hospitals in England, and to describe and compare workload, resource utilisation and outcomes between hospitals and models of care. The case-mix classification we have developed is a flexible one – building from a core set of diagnostic categories commonly associated with acute medical care in smaller hospitals. This can be augmented by additional variables covering frailty, presence of a procedure and whether cancer is recorded as a secondary diagnosis, as necessary. The scheme was developed using routinely available data and sought to make some clinical sense, which was gauged via workshops.

2. Summarising acute medical caseload in small hospitals

This section describes the acute emergency medical case mix of smaller hospitals based on analysis of the 2015/16 data set (1.9 million episodes).

Table 7 summarises the characteristics of the most common case groups across the sample of 69 smaller hospitals.

Note the five most common groups account for around 30% of all cases:

- J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids
- N3 Other genitourinary and retention of urine
- R1 Pain in throat and chest
- J4 Chronic lung disease inc. COPD
- I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat

The group ‘R4 Signs/symptoms not elsewhere classified’ includes cases that have not or cannot be classified. It is a common bucket category in most schemes – in this case it makes up 3% of all episodes.

The case mix can be presented in different ways.

Beds occupied on any one day – This is a figure that tries to capture how many beds in the hospital would contain patients of that type on any one day. It is calculated as the sum of bed days divided by 365.[3] Across all 69 hospitals, the average is 266 beds. The figure is a way of combining the effects of longer stay lengths and volume of cases. For example, our most common group 'J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids' makes up 12% of cases, but lengths of stay are relatively long, so it makes up 16% of all bed days.

Admissions per day – This figure tries to capture the number of cases admitted on any one day. Note that this is an average and so may mask differences between days of the week.

Table 7. Summary of the top 20 common general acute medical case mix – average across 69 small to medium NHS trusts in 2015/16

	No. episodes	% cases	Avg LOE	% bed days	Average occupied beds)	Average daily admissions
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	233311	11.9%	4.7	16.26%	43.2	9.3
N3 Other genitourinary and retention of urine	102558	5.2%	4.8	7.39%	19.6	4.1
R1 Pain in throat and chest	94436	4.8%	0.6	0.90%	2.4	3.7
J4 Chronic lung disease inc. COPD	90467	4.6%	3.2	4.34%	11.5	3.6
I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat	66612	3.4%	2.2	2.18%	5.8	2.6
R4 Signs/symptoms not elsewhere classified	59427	3.0%	1.9	1.67%	4.4	2.4
M1 Joints	56788	2.9%	2.7	2.26%	6.0	2.3
I9 Heart failure and pulmonary oedema	53876	2.8%	5.1	4.13%	11.0	2.1
G4 Transient ischaemic attacks and dizziness and giddiness	52549	2.7%	1.5	1.16%	3.1	2.1
I3 Acute myocardial infarction	50620	2.6%	3.5	2.65%	7.0	2.0
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	50452	2.6%	7.8	5.89%	15.7	2.0
R2 Skin and cellulitis	50333	2.6%	3.6	2.69%	7.1	2.0

	No. episodes	% cases	Avg LOE	% bed days	Average occupied beds)	Average daily admissions
T1 Poisoning	42955	2.2%	1.1	0.71%	1.9	1.7
A1 Intestinal infections and nausea and vomiting	42185	2.2%	2.9	1.81%	4.8	1.7
R3 Abnormalities of gait and mobility	42098	2.2%	4.0	2.53%	6.7	1.7
S1 Head injury	41836	2.1%	2.0	1.26%	3.4	1.7
K6 Other digestive and dysphagia	40153	2.1%	2.7	1.59%	4.2	1.6
N1 Acute kidney disease and chronic kidney disease	40078	2.1%	4.2	2.50%	6.6	1.6
A2 Septicaemia	38580	2.0%	4.9	2.84%	7.5	1.5
G3 Migraine and headache	31797	1.6%	1.0	0.46%	1.2	1.3
Grand total	1954933	100%	3.7	100%	266	78

LOE, length of episode.

2.1 Contrasting large and small hospitals

When the case mix of the largest and smallest five hospitals within our subset of hospitals were compared, there were only minor differences. Table 8 shows the most common CMGs. It shows that the larger hospitals had proportionally fewer cases of 'J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids' and 'N3 Other genitourinary and retention of urine', though these were still the most common groups. These groups are typically associated with older, frail patients.

Table 8. Comparing cases in groups of the five largest and five smallest providers

	Smallest five	Largest five
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	13.2%	11.6%
N3 Other genitourinary and retention of urine	5.2%	4.5%
R1 Pain in throat and chest	4.5%	4.7%
J4 Chronic lung disease inc. COPD	4.3%	4.7%
I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat	3.8%	3.6%
R4 Signs/symptoms not elsewhere classified	3.1%	3.2%
M1 Joints	2.5%	3.1%
I9 Heart failure and pulmonary oedema	3.1%	2.7%
G4 Transient ischaemic attacks and dizziness and giddiness	2.5%	2.7%
I3 Acute myocardial infarction	2.5%	2.2%
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	2.6%	2.5%
R2 Skin and cellulitis	2.5%	2.6%
T1 Poisoning	2.3%	2.2%
A1 Intestinal infections and nausea and vomiting	2.2%	2.1%
R3 Abnormalities of gait and mobility	2.4%	1.8%
S1 Head injury	2.0%	2.3%

	Smallest five	Largest five
K6 Other digestive and dysphagia	2.1%	1.8%
N1 Acute kidney disease and chronic kidney disease	2.8%	2.0%
A2 Septicaemia	2.7%	2.0%
G3 Migraine and headache	1.3%	2.0%

Table 9 looks at the case-mix groups that are most strongly correlated with overall hospital volumes, and the ones that are negatively correlated. So, for example, across all 69 hospitals for 'H1 Ear, nose and throat', there is a positive correlation (r=0.42), indicating that the volumes of cases in this group tend to be higher in larger hospitals.

Table 9. The case-mix groups with strongest positive and negative association with overall size

	Correlation	Smallest five	Largest five
H1 Ear, nose and throat	0.42	0.4%	0.7%
C1 Benign and in-situ neoplasms	0.39	0.0%	0.1%
G3 Migraine and headache	0.34	1.3%	2.0%
K1 Oesophagitis and ulcers of the digestive system and gastritis	0.31	1.1%	1.6%
F3 Mental and behavioural disorders due to use of alcohol	0.29	1.0%	1.5%
F4 Other mental and behavioural disorders	0.25	0.5%	0.9%
I13 Oesophageal varices	0.22	0.0%	0.1%
E6 Other metabolic diseases	0.22	0.3%	0.3%
D3 Other anaemias	-0.18	0.6%	0.4%
I9 Heart failure and pulmonary oedema	-0.19	3.1%	2.7%
F1 Dementia and senility	-0.20	0.9%	0.7%
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	-0.21	13.2%	11.6%

	Correlation	Smallest five	Largest five
J6 Interstitial lung disease and pleural effusion	-0.22	0.7%	0.6%
N3 Other genitourinary and retention of urine	-0.22	5.2%	4.5%
N1 Acute kidney disease and chronic kidney disease	-0.29	2.8%	2.0%

2.2 Frailty flags

There are eight groups where over half of all episodes have been flagged as high risk of frailty and these are not surprisingly mainly associated with a higher proportion of older people and longer stay length. Groups with a high proportion of cases flagged as 'frail' include:

- F2 Delirium
- F1 Dementia and senility
- G1 Parkinson's disease
- R3 Abnormalities of gait and mobility
- N3 Other genitourinary and retention of urine
- L1 Ulcer of lower limb, not elsewhere classified
- S4 Fracture of femur
- S2 Spine injury

For all groups, a frailty flag tends to be associated with a longer stay length, though this effect is less marked in those case types where frailty is less common.

Table 10. CMGs ranked according to differential stay length associated with presence of a frailty flag (just showing top 10 and bottom 10 groups)

		Not frail	Frail	Not frail	Frail
	% cases 'frail'	Average LOE	Average LOE	% >74	% >74
F2 Delirium	71.5%	5.1	7.6	66.9%	86.5%
F1 Dementia and senility	70.5%	7.1	10.1	85.0%	89.3%
G1 Parkinson's disease	64.6%	7.7	11.2	47.5%	71.8%

		Not frail	Frail	Not frail	Frail
	% cases 'frail'	Average LOE	Average LOE	% >74	% >74
R3 Abnormalities of gait and mobility	64.5%	2.8	4.8	68.4%	85.1%
N3 Other genitourinary and retention of urine	61.9%	3.0	6.0	51.9%	80.2%
L1 Ulcer of lower limb, not elsewhere classified	61.4%	4.7	8.0	36.6%	67.5%
S4 Fracture of femur	56.0%	8.9	13.1	75.8%	87.1%
S2 Spine injury	52.8%	4.8	7.3	74.0%	87.9%
E3 Other disorders of pancreatic internal secretion	47.1%	2.0	4.5	40.1%	60.8%
A2 Septicaemia	46.7%	3.8	6.3	36.5%	69.1%
S1 Head injury	46.4%	1.2	3.0	45.8%	80.5%
H1 Ear, nose and throat	7.9%	1.5	5.8	25.6%	53.8%
I1 Hypertension	7.5%	1.2	6.7	24.4%	62.1%
I4 Chronic ischaemic heart disease	6.4%	3.0	7.8	28.7%	43.8%
G3 Migraine and headache	4.4%	0.9	2.1	7.9%	30.3%
J2 Acute upper respiratory infections of multiple and unspecified sites	3.3%	0.8	10.4	5.2%	52.8%
N2 Calculus of kidney or urinary tract	1.1%	0.7	26.2	0.2%	0.0%
I6 Pericarditis	1.0%	2.3	31.3	4.7%	0.0%
O1 Pregnancy, childbirth and congenital or chromosomal conditions	0.6%	1.0	26.3	0.0%	0.0%
J1 Diseases of the pharynx and larynx	0.2%	1.0	48.3	0.9%	0.0%
C9 Neoplasms of uncertain behaviour with palliative care	0.0%	59.5		33.3%	
Grand total	30.1%	2.5	5.7	35.2%	70.6%

2.3 Procedure flags

We earlier noted the large differentials in length of episodes, according to whether or not a procedure was recorded. Table 11 ranks case-mix groups according to this difference. So, for example, for group 'J2 Acute upper respiratory infections of multiple and unspecified sites', the episode length for the 4.4% of cases when a procedure was included was on average almost six times longer than without.

There is a general pattern across groups that can be seen: where a procedure is relatively common, the differentials in stay length are less.

Table 11. CMGs ranked according to differential stay length associated with presence of a procedure (just showing highest lowest groups)

CMG	N	% with procedure	LOE with procedure	LOE without	Ratio
J2 Acute upper respiratory infections of multiple and unspecified sites	2188	4.4%	5.4	0.9	5.9
E4 Disorders of mineral metabolism	3470	10.3%	13.5	2.7	5.1
E1 Insulin-dependent diabetes mellitus	9708	6.9%	9.3	1.9	5.0
M1 Joints	56534	18.1%	7.5	1.6	4.7
O1 Pregnancy, childbirth and congenital or chromosomal conditions	3718	13.7%	3.4	0.8	4.2
F4 Other mental and behavioural disorders	12744	12.2%	6.9	1.7	4.1
E3 Other disorders of pancreatic internal secretion	6127	10.5%	9.8	2.4	4.0

CMG	N	% with procedure	LOE with procedure	LOE without	Ratio
J8 Other respiratory and haemorrhage from respiratory passages and cough and abnormalities of breathing	26385	22.4%	4.5	1.1	3.9
E2 Non-insulin-dependent diabetes mellitus	10162	13.8%	10.7	3.0	3.6
T1 Poisoning	42597	6.5%	3.4	0.9	3.6
S4 Fracture of femur	6526	37.1%	15.4	8.8	1.8
I5 Pulmonary embolism	16611	56.5%	4.3	2.5	1.7
Z1 Other	3748	15.1%	2.6	1.6	1.6
F2 Delirium	8386	34.7%	9.0	5.7	1.6
I4 Chronic ischaemic heart disease	5673	68.8%	3.7	2.4	1.6
C1 Benign and in-situ neoplasms	1130	61.0%	7.0	4.7	1.5
I13 Oesophageal varices	639	66.7%	5.6	3.8	1.5
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	50238	63.6%	8.8	6.2	1.4
S1 Head injury	41438	42.7%	2.4	1.7	1.4
I11 Other cerebrovascular diseases	1675	57.9%	8.7	6.2	1.4
Grand total	1927045	26.6%	6.1	2.5	2.4

2.4 Cancer flags

Most groups have less than 5% of cases having secondary diagnoses indicating cancer. For these groups, the length of episodes where the cancer diagnoses are present tends to be much longer.

Table 12 lists the groups with the highest proportion of cases having a secondary diagnosis flagged as cancer. In these cases, the presence of the secondary cancer diagnosis does not always link to longer average lengths of stay – and in two groups, 'A2 Septicaemia' and 'D4 Other diseases of blood and blood-forming organs', the stay length is shorter. This is may be due to neutropenic sepsis, which is a consequence of chemotherapy, and usually only lasts 3-5 days. The illness resolves when the white cell count recovers. As such, it does not behave like 'normal' sepsis.

Table 12. Groups with highest proportion of cases with cancer as secondary diagnosis

CMG	% secondary cancer diagnosis	LOE no secondary cancer	LOE with cancer
A2 Septicaemia	56.9%	5.4	4.1
D4 Other diseases of blood and blood-forming organs	53.1%	3.5	3.2
E4 Disorders of mineral metabolism	36.2%	3.5	4.7
J6 Interstitial lung disease and pleural effusion	27.7%	3.5	3.8
D3 Other anaemias	24.6%	2.3	2.4
I5 Pulmonary embolism	22.3%	3.5	3.4
T2 Complications of treatment	20.0%	3.7	3.9
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	15.6%	4.7	4.7
N1 Acute kidney disease and chronic kidney disease	14.0%	4.1	4.7
A3 Other infectious diseases not elsewhere classified and fever of unknown origin	13.8%	3.0	3.5
A1 Intestinal infections and nausea and vomiting	13.6%	2.9	3.1
K6 Other digestive and dysphagia	13.5%	2.6	3.2

CMG	% secondary cancer diagnosis	LOE no secondary cancer	LOE with cancer
N3 Other genitourinary and retention of urine	12.5%	4.8	4.9
K4 Gallbladder and biliary tree diseases	12.3%	4.1	5.3
K2 Crohn's and other intestinal diseases	11.8%	3.5	3.8

3 Differences in acute medical case mix by provider hospital

3.1 Differences in overall activity

This section considers the similarities in acute medical case mix between the 69 hospitals in the smaller hospitals cohort. Note this activity is for general medical specialties (as defined earlier) and emergency admissions, and does not all include whole hospital activity.

In terms of acute medical activity, the hospitals in our sample ranged in size from the smallest (Isle of Wight) with less than 10,000 episodes and 150 occupied beds, to Wirral University Teaching Hospital NHS Foundation Trust and St Helens and Knowsley Hospitals NHS Trust with over 50,000 episodes and 400 occupied beds.

Across all hospitals, the average length of episodes in 2015/16 was 3.5 days, with the shortest being below 2.5 days in Torbay and South Devon NHS Foundation Trust and St Helens and Knowsley Hospitals NHS Trust. The longest was over five days at Isle of Wight NHS Trust and Basildon and Thurrock University Hospitals NHS Foundation Trust. Note that these values only refer to episodes on general medical specialties and not whole hospital stays.

55% of episodes were short stay (less than two days) and there was a strong correlation between the proportion of short stays and the average across all cases. This suggests that average lengths of stay are not unduly influenced by the longer stay patients.

The proportion of people over age 75 varied from 25.7% in Homerton University Hospital NHS Foundation Trust (which was something of an outlier in this group) to over 55% in South Warwickshire NHS Foundation Trust, Wye Valley NHS Trust, and Ashford and St Peter's Hospitals NHS Foundation Trust.

Table 13. Summary of 69 smaller hospitals in data set (sorted by number of episodes) 2015/16

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
R1F Isle of Wight NHS Trust	9726	26.6	146.2	5.5	50.6%	33.6%	39.7%
RJN East Cheshire NHS Trust	11991	32.8	157.0	4.8	52.6%	45.0%	24.6%
RCD Harrogate and District NHS Foundation Trust	13425	36.8	173.6	4.7	54.4%	50.9%	26.6%
RLT George Eliot Hospital NHS Trust	13624	37.3	175.7	4.7	49.6%	38.3%	28.8%
RQQ Hinchingbrooke Health Care NHS Trust	14295	39.1	133.2	3.4	43.0%	63.0%	18.7%
RA4 Yeovil District Hospital NHS Foundation Trust	15175	41.5	186.5	4.5	49.8%	46.1%	26.4%
RAS The Hillingdon Hospitals NHS Foundation Trust	15423	42.2	182.6	4.3	38.4%	50.8%	28.5%
RA3 Weston Area Health NHS Trust	15468	42.3	154.8	3.7	53.0%	53.1%	29.7%
RNZ Salisbury NHS Foundation Trust	16611	45.5	193.7	4.3	47.3%	51.6%	28.8%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RKE Whittington Health (The Whittington Hospital NHS Trust)	16829	46.1	165.0	3.6	38.0%	55.5%	27.4%
RFR The Rotherham NHS Foundation Trust	18598	50.9	225.4	4.4	43.2%	43.8%	33.4%
RGP James Paget University Hospital NHS Foundation Trust	18726	51.3	220.4	4.3	48.4%	41.7%	31.9%
RA2 Royal Surrey County Hospital NHS Foundation Trust	18742	51.3	215.1	4.2	50.7%	49.7%	36.1%
RLQ Wye Valley NHS Trust	19378	53.1	204.8	3.9	55.2%	53.1%	28.1%
RBD Dorset County Hospital NHS Foundation Trust	19706	54.0	168.5	3.1	47.5%	55.9%	25.5%
RE9 South Tyneside NHS Foundation Trust	19805	54.2	222.4	4.1	46.9%	57.3%	25.6%
RBZ Northern Devon Healthcare NHS Trust	19915	54.5	158.3	2.9	49.8%	67.4%	18.9%
RAX Kingston Hospital NHS Foundation Trust	20013	54.8	214.6	3.9	50.7%	45.2%	29.9%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RCF Airedale NHS Foundation Trust	20970	57.4	168.9	2.9	47.4%	58.5%	19.7%
RQX Homerton University Hospital NHS Foundation Trust	21245	58.2	187.4	3.2	25.7%	59.8%	22.3%
RVY Southport and Ormskirk Hospital NHS Trust	21619	59.2	225.6	3.8	46.8%	52.3%	24.1%
RTK Ashford and St Peter's Hospitals NHS Foundation Trust	21941	60.1	251.7	4.2	57.6%	42.2%	48.5%
RRF Wrightington, Wigan and Leigh NHS Foundation Trust	22495	61.6	206.6	3.4	42.7%	52.1%	35.8%
RJC South Warwickshire NHS Foundation Trust	22851	62.6	229.0	3.7	55.0%	48.0%	23.5%
RD8 Milton Keynes University Hospital NHS Foundation Trust	22900	62.7	253.2	4.0	41.8%	49.1%	29.4%
RQW The Princess Alexandra Hospital NHS Trust	23387	64.0	288.9	4.5	43.6%	49.0%	32.2%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RNQ Kettering General Hospital NHS Foundation Trust	24499	67.1	298.0	4.4	44.7%	48.3%	35.7%
RD3 Poole Hospital NHS Foundation Trust	24527	67.2	234.5	3.5	52.2%	56.9%	22.0%
RJF Burton Hospitals NHS Foundation Trust	25083	68.7	184.5	2.7	51.4%	62.0%	23.5%
RC1 Bedford Hospital NHS Trust	25170	68.9	233.6	3.4	45.8%	56.0%	27.6%
RQ8 Mid Essex Hospital Services NHS Trust	25189	69.0	238.3	3.5	49.7%	45.8%	32.7%
RN7 Dartford and Gravesham NHS Trust	25313	69.3	273.6	3.9	45.4%	51.1%	30.0%
RNL North Cumbria University Hospitals NHS Trust	26448	72.4	289.5	4.0	44.9%	44.4%	35.7%
RJR Countess of Chester Hospital NHS Foundation Trust	26516	72.6	248.9	3.4	45.2%	56.8%	29.4%
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	26538	72.7	400.2	5.5	47.5%	34.0%	42.5%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RMP Tameside Hospital NHS Foundation Trust	26925	73.7	272.5	3.7	40.2%	54.2%	22.8%
RFF Barnsley Hospital NHS Foundation Trust	27526	75.4	237.1	3.1	44.2%	45.8%	23.3%
RAP North Middlesex University Hospital NHS Trust	27840	76.2	245.2	3.2	42.9%	54.6%	26.8%
RMC Bolton Hospital NHS Foundation Trust	28730	78.7	286.0	3.6	37.4%	48.4%	22.4%
RBK Walsall Healthcare NHS Trust	29716	81.4	302.6	3.7	43.6%	45.6%	21.9%
RGN Peterborough and Stamford Hospitals NHS Foundation Trust	30414	83.3	313.8	3.8	47.9%	51.0%	23.0%
RNS Northampton General Hospital NHS Trust	30993	84.9	355.4	4.2	39.5%	48.8%	30.5%
RFS Chesterfield Royal Hospital NHS Foundation Trust	31389	85.9	267.5	3.1	46.3%	59.1%	24.0%
RWW Warrington and Halton Hospitals NHS Foundation Trust	31705	86.8	303.3	3.5	41.2%	56.0%	29.1%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RAJ Southend University Hospital NHS Foundation Trust	31746	86.9	269.1	3.1	53.0%	55.7%	29.9%
RBA Taunton and Somerset NHS Foundation Trust	31753	86.9	266.3	3.1	46.1%	55.1%	26.6%
RR7 Gateshead Health NHS Foundation Trust	32021	87.7	261.6	3.0	46.1%	56.8%	18.1%
RGR West Suffolk NHS Foundation Trust	32027	87.7	254.5	2.9	53.2%	63.8%	22.5%
RTX University Hospitals of Morecambe Bay NHS Foundation Trust	32578	89.2	316.8	3.6	46.4%	54.2%	25.0%
RCX The Queen Elizabeth Hospital, King’s Lynn, NHS Foundation Trust	32882	90.0	241.3	2.7	50.6%	64.5%	19.0%
RBT Mid Cheshire Hospitals NHS Foundation Trust	32936	90.2	273.4	3.0	40.5%	60.8%	23.3%
RPA Medway NHS Foundation Trust	33010	90.4	347.9	3.8	41.5%	49.3%	27.9%
RA9 Torbay and South Devon NHS Foundation Trust	33879	92.8	200.8	2.2	45.8%	64.2%	20.8%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RJ6 Croydon Health Services NHS Trust	34710	95.0	280.5	3.0	43.1%	61.9%	25.1%
RDE Colchester Hospital University NHS Foundation Trust	34915	95.6	323.2	3.4	44.9%	54.1%	28.6%
RWJ Stockport NHS Foundation Trust	34925	95.6	354.3	3.7	46.8%	54.2%	31.7%
RK5 Sherwood Forest Hospitals NHS Foundation Trust	35996	98.6	398.7	4.0	48.2%	48.9%	25.6%
RN3 Great Western Hospitals NHS Foundation Trust	36484	99.9	342.4	3.4	45.5%	52.3%	32.6%
RVW North Tees and Hartlepool NHS Foundation Trust	36988	101.3	368.5	3.6	40.6%	55.9%	21.7%
RC9 Luton and Dunstable University Hospital NHS Foundation Trust	37422	102.5	337.6	3.3	43.8%	58.1%	27.9%
RD1 Royal United Hospitals Bath NHS Foundation Trust	39339	107.7	397.2	3.7	50.1%	51.2%	28.2%
RWG West Hertfordshire Hospital NHS Trust	39927	109.3	379.3	3.5	46.6%	58.1%	34.6%

HES code and trust	Sum of episodes	Admits per day	Beds per day	Avg LOE	% >74	% short stay	% with primary procedure
RGQ Ipswich Hospital NHS Trust	40727	111.5	282.9	2.5	50.5%	64.3%	19.2%
RNA The Dudley Group NHS Foundation Trust	43132	118.1	348.8	3.0	44.2%	65.9%	19.3%
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	43600	119.4	352.7	3.0	49.4%	65.3%	25.6%
RTP Surrey and Sussex Healthcare NHS Trust	43936	120.3	391.0	3.3	49.1%	56.1%	29.1%
REM Aintree University Hospital NHS Foundation Trust	49211	134.7	397.5	3.0	38.2%	57.6%	23.7%
RBL Wirral University Teaching Hospital NHS Foundation Trust	53642	146.9	415.7	2.8	43.9%	63.5%	24.9%
RBN St Helens and Knowsley Hospitals NHS Trust	59880	163.9	401.6	2.4	42.4%	70.0%	17.9%
Average*	1927045	76.5	265.2	3.5	45.9%	55.0%	26.6%

* When calculating figures, trust-level small numbers were supressed, which accounts for difference from overall sum of episode count and associated summary statistics.

3.2 Summarising case mix across hospitals

Each of our 69 hospitals has its own profile of case types, yet we can also summarise similarities and differences into single metrics:

a. Proportion of cases falling into the most common CMGs

b. Variation in excess cases (based on the differences between observed and expected cases)

c. Correlation coefficients between the proportion of cases in each group in the hospital compared with the overall average, with a larger correlation indicating greater similarity to the average

d. Measures of case-mix complexity based on demand of bed use.

In the first instance, we used these approaches looking at the episode-based analysis and using the 82 diagnostic CMG categories. As Table 15 shows, there seems to be little difference between these approaches; they all produce similar results in terms of ordering hospitals according to the similarity of case mix.

The Homerton Hospital shows a quite marked difference from the rest – a difference largely driven by the high number of cases in 'D2 Sickle cell disorders'. If these are excluded, the case mix is still atypical, but closer to the rest. Excluding Homerton, the differences in terms of the episodes in the top 10 groups ranges from around 40% to 50%, and in the top 20 groups from 60% to 70%.

Table 14. Trusts sorted according to similarity to the average case mix

HES code and trust	SD of excess	Cases top 10	Cases top 20	Correlation
RQX Homerton University Hospital NHS Foundation Trust	1.43%	34.6%	55.8%	0.66
RD3 Poole Hospital NHS Foundation Trust	0.61%	40.0%	65.4%	0.93
RKE Whittington Health (The Whittington Hospital NHS Trust)	0.56%	40.4%	62.7%	0.94
RDE Colchester Hospital University NHS Foundation Trust	0.30%	40.9%	65.2%	0.99

HES code and trust	SD of excess	Cases top 10	Cases top 20	Correlation
RAS The Hillingdon Hospitals NHS Foundation Trust	0.51%	41.3%	63.4%	0.95
RBL Wirral University Teaching Hospital NHS Foundation Trust	0.30%	41.4%	64.8%	0.98
RGN Peterborough and Stamford Hospitals NHS Foundation Trust	0.32%	41.6%	67.7%	0.98
RA2 Royal Surrey County Hospital NHS Foundation Trust	0.44%	41.6%	65.2%	0.97
RC1 Bedford Hospital NHS Trust	0.48%	41.7%	63.3%	0.97
RPA Medway NHS Foundation Trust	0.28%	42.0%	63.4%	0.99
RAP North Middlesex University Hospital NHS Trust	0.55%	42.0%	62.1%	0.95
RTX University Hospitals of Morecambe Bay NHS Foundation Trust	0.34%	42.1%	64.9%	0.98
RJN East Cheshire NHS Trust	0.55%	42.2%	64.3%	0.96
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	0.54%	42.3%	60.7%	0.95
REM Aintree University Hospital NHS Foundation Trust	0.44%	42.3%	62.2%	0.97
RD1 Royal United Hospitals Bath NHS Foundation Trust	0.35%	42.8%	64.9%	0.98
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	0.92%	42.8%	68.4%	0.86

HES code and trust	SD of excess	Cases top 10	Cases top 20	Correlation
RNS Northampton General Hospital NHS Trust	0.39%	43.2%	64.8%	0.97
RBT Mid Cheshire Hospitals NHS Foundation Trust	0.39%	43.3%	65.1%	0.97
RA9 Torbay and South Devon NHS Foundation Trust	0.40%	43.3%	66.4%	0.97
RWG West Hertfordshire Hospital NHS Trust	0.47%	43.4%	62.0%	0.96
RBZ Northern Devon Healthcare NHS Trust	0.34%	43.4%	65.8%	0.98
RRF Wrightington, Wigan and Leigh NHS Foundation Trust	0.46%	43.5%	65.9%	0.97
RBA Taunton and Somerset NHS Foundation Trust	0.43%	43.5%	66.4%	0.97
RBN St Helens and Knowsley Hospitals NHS Trust	0.39%	43.9%	66.0%	0.98
RVY Southport and Ormskirk Hospital NHS Trust	0.41%	44.0%	65.2%	0.97
RQ8 Mid Essex Hospital Services NHS Trust	0.31%	44.0%	68.4%	0.99
RLQ Wye Valley NHS Trust	0.49%	44.0%	68.2%	0.96
RGQ Ipswich Hospital NHS Trust	0.51%	44.2%	67.4%	0.95
RN3 Great Western Hospitals NHS Foundation Trust	0.36%	44.3%	66.0%	0.98
RGP James Paget University Hospital NHS Foundation Trust	0.57%	44.4%	65.9%	0.95
RJ6 Croydon Health Services NHS Trust	0.44%	44.5%	64.4%	0.97
RCD Harrogate and District NHS Foundation Trust	0.43%	44.7%	67.3%	0.97
RFF Barnsley Hospital NHS Foundation Trust	0.34%	44.8%	66.5%	0.98

HES code and trust	SD of excess	Cases top 10	Cases top 20	Correlation
RNZ Salisbury NHS Foundation Trust	0.49%	44.8%	68.4%	0.96
RJR Countess of Chester Hospital NHS Foundation Trust	0.41%	44.9%	66.9%	0.98
RCX The Queen Elizabeth Hospital, King’s Lynn, NHS Foundation Trust	0.36%	44.9%	67.9%	0.98
RK5 Sherwood Forest Hospitals NHS Foundation Trust	0.32%	44.9%	68.8%	0.99
RTP Surrey and Sussex Healthcare NHS Trust	0.31%	45.0%	67.5%	0.99
RVW North Tees and Hartlepool NHS Foundation Trust	0.42%	45.0%	64.7%	0.97
R1F Isle of Wight NHS Trust	0.68%	45.0%	69.5%	0.94
RWJ Stockport NHS Foundation Trust	0.31%	45.1%	67.3%	0.98
RLT George Eliot Hospital NHS Trust	0.46%	45.1%	67.9%	0.96
RMC Bolton Hospital NHS Foundation Trust	0.48%	45.3%	66.0%	0.97
RN7 Dartford and Gravesham NHS Trust	0.42%	45.3%	68.5%	0.97
RJC South Warwickshire NHS Foundation Trust	0.34%	45.3%	67.0%	0.98
RTK Ashford and St Peter's Hospitals NHS Foundation Trust	0.54%	45.3%	66.7%	0.96
RCF Airedale NHS Foundation Trust	0.36%	45.3%	64.3%	0.98
RFS Chesterfield Royal Hospital NHS Foundation Trust	0.35%	45.5%	66.9%	0.98

HES code and trust	SD of excess	Cases top 10	Cases top 20	Correlation
RWW Warrington and Halton Hospitals NHS Foundation Trust	0.29%	45.7%	66.0%	0.99
RGR West Suffolk NHS Foundation Trust	0.39%	45.7%	67.4%	0.98
RQQ Hinchingbrooke Health Care NHS Trust	0.35%	46.1%	68.3%	0.98
RD8 Milton Keynes University Hospital NHS Foundation Trust	0.36%	46.5%	66.4%	0.98
RA4 Yeovil District Hospital NHS Foundation Trust	0.46%	46.8%	71.8%	0.97
RBD Dorset County Hospital NHS Foundation Trust	0.45%	46.8%	68.9%	0.97
RAJ Southend University Hospital NHS Foundation Trust	0.48%	47.1%	70.0%	0.96
RBK Walsall Healthcare NHS Trust	0.53%	47.3%	66.6%	0.97
RQW The Princess Alexandra Hospital NHS Trust	0.48%	47.4%	68.7%	0.96
RMP Tameside Hospital NHS Foundation Trust	0.48%	47.5%	65.9%	0.96
RR7 Gateshead Health NHS Foundation Trust	0.47%	47.8%	69.3%	0.98
RNL North Cumbria University Hospitals NHS Trust	0.45%	47.9%	66.4%	0.97
RA3 Weston Area Health NHS Trust	0.52%	48.0%	70.4%	0.98
RC9 Luton and Dunstable University Hospital NHS Foundation Trust	0.49%	48.1%	68.8%	0.96
RAX Kingston Hospital NHS Foundation Trust	0.79%	48.5%	68.9%	0.94
RE9 South Tyneside NHS Foundation Trust	0.58%	48.7%	68.1%	0.96
RFR The Rotherham NHS Foundation Trust	0.49%	49.5%	69.4%	0.98

HES code and trust	SD of excess	Cases top 10	Cases top 20	Correlation
RNA The Dudley Group NHS Foundation Trust	0.45%	49.7%	70.0%	0.98
RNQ Kettering General Hospital NHS Foundation Trust	0.55%	50.6%	69.0%	0.97
RJF Burton Hospitals NHS Foundation Trust	0.63%	51.2%	69.7%	0.98

SD, standard deviation.

3.3 Case types with least variability

We looked at the variability between case-mix groups in terms of the share of hospital case mix. A simple metric was calculated based on the standard deviation of the percentage share across all hospitals. Larger values indicate that there is greater variability between hospitals on the percentage of cases in that groups, after standardising for the underlying prevalence of the case.

The least variable groups include some of the higher volume cases such as ‘J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids’; ‘N3 Other genitourinary and retention of urine’ and ‘R1 Pain in throat and chest’. The ratio between the highest and lowest hospitals were a 2-3-fold difference in the percentage of cases in these groups.

Table 15. Diagnostic CMGs showing least variability between hospitals

CMG	Grand total	Coefficient of variance	Min	Lowest	Max	Highest	Min/max
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	12.1%	0.14	8.8%	RQX Homerton University Hospital NHS Foundation Trust	16.7%	RJF Burton Hospitals NHS Foundation Trust	1.90

CMG	Grand total	Coefficient of variance	Min	Lowest	Max	Highest	Min/max
G2 Epilepsy and convulsions, not elsewhere classified	1.3%	0.16	0.8%	RAX Kingston Hospital NHS Foundation Trust	1.8%	RBT Mid Cheshire Hospitals NHS Foundation Trust	2.21
A1 Intestinal infections and nausea and vomiting	2.2%	0.17	1.4%	RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	3.2%	RAS The Hillingdon Hospitals NHS Foundation Trust	2.26
I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat	3.4%	0.17	1.7%	RQX Homerton University Hospital NHS Foundation Trust	4.7%	RBD Dorset County Hospital NHS Foundation Trust	2.84
I9 Heart failure and pulmonary oedema	2.8%	0.18	1.9%	RR7 Gateshead Health NHS Foundation Trust	3.9%	RLQ Wye Valley NHS Trust	2.08

CMG	Grand total	Coefficient of variance	Min	Lowest	Max	Highest	Min/max
R2 Skin and cellulitis	2.6%	0.19	1.8%	RKE Whittington Health (The Whittington Hospital NHS Trust)	4.2%	RGP James Paget University Hospital NHS Foundation Trust	2.35
N3 Other genitourinary and retention of urine	5.3%	0.21	3.8%	RMC Bolton Hospital NHS Foundation Trust	8.5%	RNQ Kettering General Hospital NHS Foundation Trust	2.24
R1 Pain in throat and chest	4.9%	0.22	2.4%	RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	7.3%	RNA The Dudley Group NHS Foundation Trust	3.03
G4 Transient ischaemic attacks and dizziness and giddiness	2.7%	0.22	1.3%	RAX Kingston Hospital NHS Foundation Trust	4.5%	RBT Mid Cheshire Hospitals NHS Foundation Trust	3.35

CMG	Grand total	Coefficient of variance	Min	Lowest	Max	Highest	Min/max
E5 Volume depletion and other fluid disorders	1.3%	0.22	0.7%	RMC Bolton Hospital NHS Foundation Trust	2.4%	RVY Southport and Ormskirk Hospital NHS Trust	3.33
J4 Chronic lung disease inc. COPD	4.7%	0.22	2.8%	RWG West Hertfordshire Hospital NHS Trust	7.0%	RFR The Rotherham NHS Foundation Trust	2.50
A3 Other infectious diseases not elsewhere classified and fever of unknown origin	1.1%	0.22	0.6%	RFF Barnsley Hospital NHS Foundation Trust	1.7%	RQX Homerton University Hospital NHS Foundation Trust	2.71

CMGs which indicated differences between hospitals may reflect differences in local admissions policies in terms of access to specialist services. For instance, the proportion of cases in ‘S1 Head injury’ ranged from 0.5% in James Paget University Hospital NHS Foundation Trust to 5% in Poole Hospital NHS Foundation Trust, representing a 10-fold difference. This may also explain the differences between hospitals in ‘S2 Spine injury’, where Poole admits more than other hospitals. There has been a long running exploration of a merger between Poole and Bournemouth, so it is likely that these two have reciprocal anomalies in case mix.

As a point of note, CMGs with the highest variability included some with low volumes of cases where the numbers become unstable.

Table 16. Examples of diagnostic CMGs showing highest levels of variability
(note some very extreme cases excluded)

CMG	Grand total	Coefficient Of variance	Min	Lowest	Max	Highest	Min/max
S1 Head injury	2.2%	0.37	0.5%	RGP James Paget University Hospital NHS Foundation Trust	5.0%	RD3 Poole Hospital NHS Foundation Trust	10.74
E3 Other disorders of pancreatic internal secretion	0.3%	0.38	0.1%	RA4 Yeovil District Hospital NHS Foundation Trust	0.7%	RKE Whittington Health (The Whittington Hospital NHS Trust)	4.75
D3 Other anaemias	0.4%	0.39	0.1%	RKE Whittington Health (The Whittington Hospital NHS Trust)	0.9%	RE9 South Tyneside NHS Foundation Trust	11.37
C5 Malignant neoplasms, prior history of same cancer, with palliative care	0.7%	0.40	0.0%	RKE Whittington Health (The Whittington Hospital NHS Trust)	1.6%	RGP James Paget University Hospital NHS Foundation Trust	

CMG	Grand total	Coefficient Of variance	Min	Lowest	Max	Highest	Min/max
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	2.6%	0.40	0.5%	RJ6 Croydon Health Services NHS Trust	5.7%	RLQ Wye Valley NHS Trust	10.46
R3 Abnormalities of gait and mobility	2.2%	0.41	0.7%	RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	4.6%	RGQ Ipswich Hospital NHS Trust	6.51
F3 Mental and behavioural disorders due to use of alcohol	1.1%	0.41	0.3%	RAJ Southend University Hospital NHS Foundation Trust	2.5%	RJN East Cheshire NHS Trust	9.77
F1 Dementia and senility	0.6%	0.44	0.2%	RC9 Luton and Dunstable University Hospital NHS Foundation Trust	1.4%	RJN East Cheshire NHS Trust	6.32
S2 Spine injury	0.4%	0.44	0.1%	RAP North Middlesex University Hospital NHS Trust	1.0%	RD3 Poole Hospital NHS Foundation Trust	7.26

CMG	Grand total	Coefficient Of variance	Min	Lowest	Max	Highest	Min/max
F4 Other mental and behavioural disorders	0.7%	0.45	0.2%	RQQ Hinchingbrooke Health Care NHS Trust	1.9%	RVY Southport and Ormskirk Hospital NHS Trust	9.49

3.4 Measures of case-mix complexity based on demand for bed use

The consequences of differences in the case-mix profile can also be expressed in terms of the impact of different case types on demand for beds. To do this, we can apply a simple case-mix-specific weighting (based on the overall average length of episode) to the number of cases in a specific hospital. This would estimate an expected number of bed days and length of stay for that hospital that can be expressed a ratio of the overall group average. Values greater than one indicate that the demand for bed days arising from the mix of cases in that hospital is higher than average, i.e. there are more cases in this group that would typically have a long length of stay. Values below one suggest the case mix would require fewer beds than average. This figure can then be compared to the overall group average (calculated from the number of spells multiplied by the average length of stay across all groups and all providers). Note that in this instance we used the simple 82 diagnostic CMGs and looked at lengths of episodes. The analysis was also conducted at spell level and with frailty included, which produced very similar results.

Where the ratio is greater than one, this indicates a case-mix profile that suggests it will require more beds than average and, in these terms, be more complex. Values less than one indicate that cases in that hospital are generally case types with shorter lengths of stay and so there would be less demand for beds days.

Note that this approach does not equate to a measure of complexity in clinical terms, such as acuity or risk of death, or in terms of costs. In fact, it may be that shorter stays incur greater daily costs as treatment is more intensive. Nevertheless, the resulting ratio provides an indication of the extent to which differences in case mix may lead to longer stay lengths and more bed use. These comparisons in length of stay are addressed in more detail below.

The results show that using a simple diagnostic standardisation, the complexity ratios range from 0.92 to 1.14 and most hospitals sit within a range of plus or minus 5% of the average. Overall, these results indicate that there is relatively little variation in case-mix complexity.

Table 17 shows the hospitals at the either end of the complexity range. As noted earlier, the Homerton is atypical in terms of case mix. There are only four hospitals where the complexity value falls below 0.95, indicating they would require 5% fewer bed days as a consequence of their case mix.

At the other end of the range, there are eight hospitals where the case mix implies a need for more than 5% above average bed days. As we noted earlier, the Isle of Wight is also atypical on a number of counts.

Table 17. Hospitals with the greatest and lowest case complexity with regard to bed use

Hospital	No. episodes	Average LOE	'Complexity ratio'
RQX Homerton University Hospital NHS Foundation Trust	21245	3.2	0.92
RAS The Hillingdon Hospitals NHS Foundation Trust	15423	4.3	0.92
RC9 Luton and Dunstable University Hospital NHS Foundation Trust	37422	3.3	0.94
RBT Mid Cheshire Hospitals NHS Foundation Trust	32936	3.0	0.94
RJ6 Croydon Health Services NHS Trust	34710	3.0	0.95
RNA The Dudley Group NHS Foundation Trust	43132	3.0	0.95
RMP Tameside Hospital NHS Foundation Trust	26925	3.7	0.95
RKE Whittington Health (The Whittington Hospital NHS Trust)	16829	3.6	0.96
RNZ Salisbury NHS Foundation Trust	16611	4.3	0.96

Hospital	No. episodes	Average LOE	'Complexity ratio'
RNS Northampton General Hospital NHS Trust	30993	4.2	0.96
RWW Warrington and Halton Hospitals NHS Foundation Trust	31705	3.5	0.96
RBZ Northern Devon Healthcare NHS Trust	19915	2.9	1.04
RGR West Suffolk NHS Foundation Trust	32027	2.9	1.05
RJC South Warwickshire NHS Foundation Trust	22851	3.7	1.07
RD1 Royal United Hospitals Bath NHS Foundation Trust	39339	3.7	1.07
RA3 Weston Area Health NHS Trust	15468	3.7	1.07
RTK Ashford and St Peter's Hospitals NHS Foundation Trust	21941	4.2	1.09
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	26538	5.5	1.09
RLQ Wye Valley NHS Trust	19378	3.9	1.09
RGP James Paget University Hospital NHS Foundation Trust	18726	4.3	1.11
R1F Isle of Wight NHS Trust	9726	5.5	1.14

3.5. Impact of short stay cases

Our original estimates of episode length and spell length include all cases – including a high proportion of short stay (0-1 day stay) cases. It was clear that the volumes of very short stay cases were influencing the overall picture (see Figure 2).

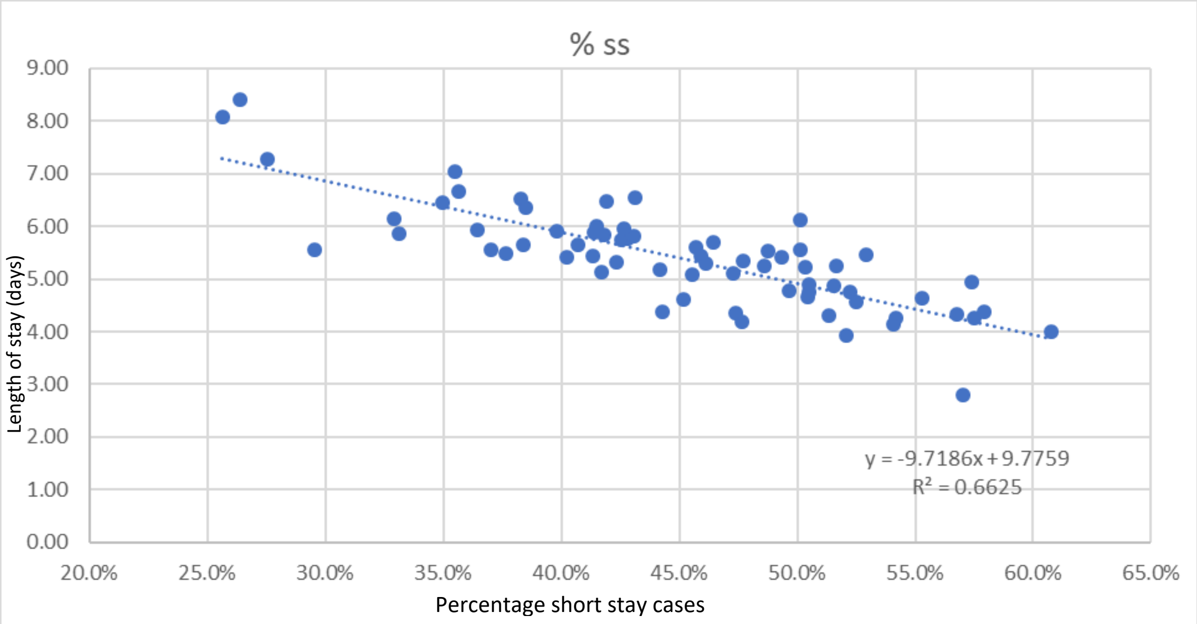

Figure 2. Influence of percentage short stay cases on overall LOS (17/18 data at spell level)

Lengths of spell were recalculated to exclude short stay cases. The length of spell excluding short stay cases is therefore based on:

- Long stay spells = total spells - short stay spells
- Long stay bed days = total bed days - numbers of spells, i.e. assuming short stay average one bed day

Across all spells (1.2 million), the average length of spell in 2017/18 was 5.2 days. However, once short stay cases were excluded, average length of spell for the remaining spells is 7.9 days. The length of spell including and excluding short stay cases are strongly correlated.

4. Population-level analysis of admissions patterns

In exploring the characteristics of the case-mix groupings, we wanted to look at the level of variability between geographic areas and the extent to which that might be explained by local demographic factors. Differences in underlying admission rates might arise for a number of reasons:

a. The underlying prevalence and severity of disease. For example, deprivation impacts on the prevalence of cardiovascular disease, which may in turn be reflected in emergency hospital admissions.

b. The impact of local clinical practice in making decisions about whether to admit cases. This may be combination of clinical decision making linked with local resource provision.

c. Supply factors in the wider environment – the extent to which alternatives to admission are available and used by the acute hospitals.

d. Artefacts of recording and information systems.

Our aims in this analysis were:

a. To assess the degree of variability between areas in the incidence with which the case-mix groups were admitted. Too unstable a distribution would suggest that our groups were overly sensitive to differences in coding and recording practice.

b. To test whether the differences in underlying admission rates matched expected patterns across populations as part of our test.

4.1. Methods

In order to do this analysis, we had to use a data set that included all hospitals and focused on hospital spell level data. The analysis used data from 2017/18 and related those to Office for National Statistics (ONS) population estimates from 2016.[4] Population-based admission rates were calculated using indirect standardisation. Observed values were derived from hospital admissions to one of 326 local authority areas. Expected admissions for each area were calculated by applying national average age/sex specific admission rates to local population estimates. When the resulting ratio of observed-to-expected cases exceeds one, more people have been admitted from that area than expected.

As a marker of deprivation, we used Index of Multiple Deprivation (IMD) scores calculated in 2015 and published by the Ministry of Housing, Communities and Local Government.[5]

The degree of variability at CMG level was based on the distribution of individual local authority level standardised admission ratios, indicated by the standard deviation and the difference between the 10th and 90th percentiles in the distribution.

4.2. Results

The total number of spells was 3,222,465. Note that this is around 2.5 times the number of spells seen in our subset of smaller hospitals for the same year (1.26 million); the majority of this activity is happening in other hospitals.

At the CMG level, CMGs with the least variability (standard deviation of less than 0.26) represent groups where the underlying incidence of the disease was more constant, and less influenced by differences in disease prevalence, the accessibility of services or the vagaries of hospital recording systems:

- I10 Cerebrovascular haemorrhages/stroke/cerebral infarction
- I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat
- G4 Transient ischaemic attacks and dizziness and giddiness
- J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids
- I3 Acute myocardial infarction
- K6 Other digestive and dysphagia
- C4 Malignant neoplasms, prior history of same cancer, without palliative care
- G2 Epilepsy and convulsions, not elsewhere classified
- I5 Pulmonary embolism
- A1 Intestinal infections and nausea and vomiting

In contrast, the groups with the greatest variability (standard deviation >0.9) were:

- I13 Oesophageal varices
- O1 Pregnancy, childbirth and congenital or chromosomal conditions
- C9 Neoplasms of uncertain behaviour with palliative care
- S4 Fracture of femur
- G5 Hemiplegia
- Z1 Other
- D2 Sickle cell disorders

While some of these, such as sickle cell disease, are clearly linked with differences in local population needs, others, such as oesophageal varices or hemiplegia, are low volume cases. Some of these conditions are ones that you would not typically expect to be treated in general medicine, but they are recorded as such in the data sets, e.g. ‘O1 Pregnancy, childbirth and congenital or chromosomal conditions’ and ‘S4 Fracture of femur’. The high level of variability between areas is therefore presumably an indication of differences in recording systems.

4.3. Correlation between variability at CMG level and IMD

One set of factors that we might expect to drive differential levels of hospital admission for some conditions is deprivation. We looked at the correlation between standardised admission ratios and IMD scores. Table 18 shows the CMGs where these correlation coefficients were over 0.5. For some CMGs, there appears to be clear links with differences in health-related behaviour and the prevalence of certain conditions (for example smoking rates and COPD). Other groups suggest more subtle influences of the wider determinants on relationships between deprivation and well-being, such as anaemia and stroke.

As a rule of thumb, with 326 observation correlations above 0.15 are statistically significant at the 1% level. Some of the groups that show relatively little variability (e.g. stroke) also have significant associations with deprivation.

Table 18. Case-mix groups with the highest correlation to deprivation

CMG	Correlation with IMD
J4 Chronic lung disease inc. COPD	0.77
K3 Failing liver and alcoholic liver disease	0.61
I3 Acute myocardial infarction	0.60
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	0.59
A1 Intestinal infections and nausea and vomiting	0.56
E5 Volume depletion and other fluid disorders	0.55
I9 Heart failure and pulmonary oedema	0.55
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	0.55
D1 Iron deficiency anaemia	0.54
G2 Epilepsy and convulsions, not elsewhere classified	0.53
E2 Non-insulin-dependent diabetes mellitus	0.53
F3 Mental and behavioural disorders due to use of alcohol	0.52
K6 Other digestive and dysphagia	0.52
E3 Other disorders of pancreatic internal secretion	0.52
N1 Acute kidney disease and chronic kidney disease	0.52
J5 Asthma	0.50

4.4. Variability between local authority areas

Standardised admission ratios at local authority level ranged from over 1.5 to ratios below 0.6. The areas with the lower rates were predominantly smaller and more rural local authorities. There are probably two effects going on here:

a. Rural areas are smaller and so more likely to be at the extremes of distribution

b. Rural areas tend not to have the lowest deprivation scores – and deprivation is associated with higher emergency admission rates

c. Access to hospital will be more challenging in rural areas – and this will influence the choices people make about going to A&E and possible admission decisions.

Table 19. Local authority (LA) areas with highest and lowest standardised admission ratios (SAR)

LAs with highest SAR	LAs with lowest SAR
Knowsley	Rushcliffe
Slough	Broxtowe
Halton	Malvern Hills
St Helens	Gedling
Northampton	Rutland
Stoke-on-Trent	South Norfolk
South Tyneside	Wyre Forest
Hounslow	Broadland
Middlesbrough	Eden
Liverpool	Forest of Dean
Manchester	Stroud

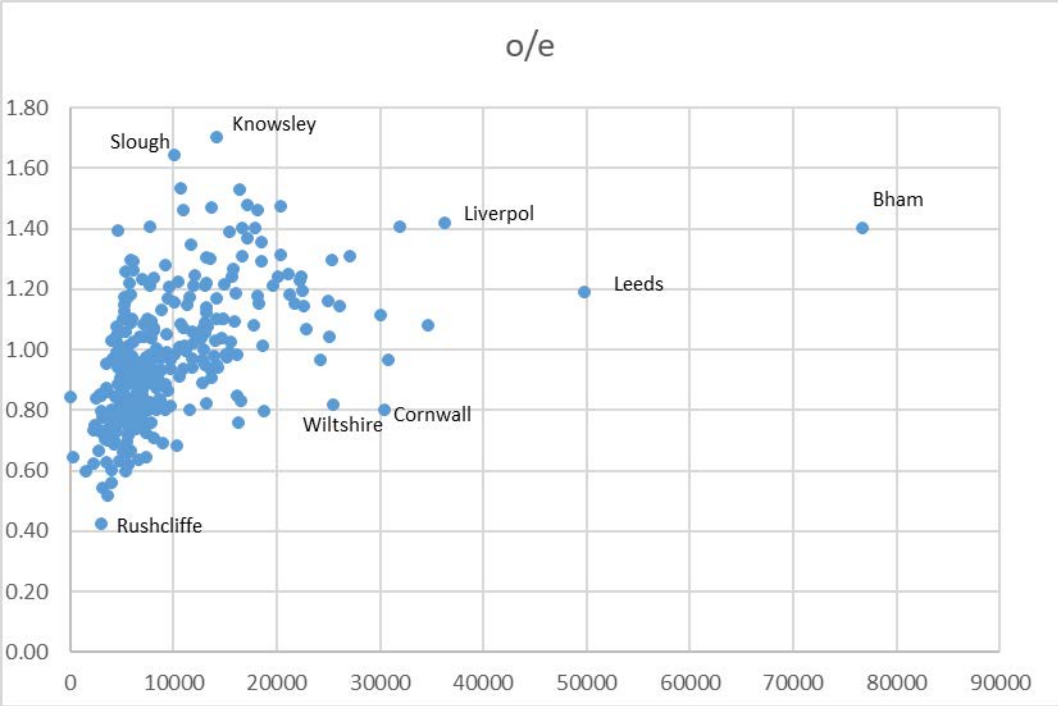

Figure 3. Differences in standardised admission ratios according to size of area

Figure 4 shows the standardised admission rate versus IMD score. There is a significant positive relationship between them, as might be expected, but there is also considerable variability between areas (r2=0.35).

Some of the areas in the East Midlands, Nottingham, North East Lincolnshire and Rushcliffe appear to have consistently lower admission rates than average, despite these areas having quite different deprivation levels. Halton and Knowsley both have high admission rates and deprivation levels.

Slough seems to be something of an outlier in terms of the admission rates being higher than expected.

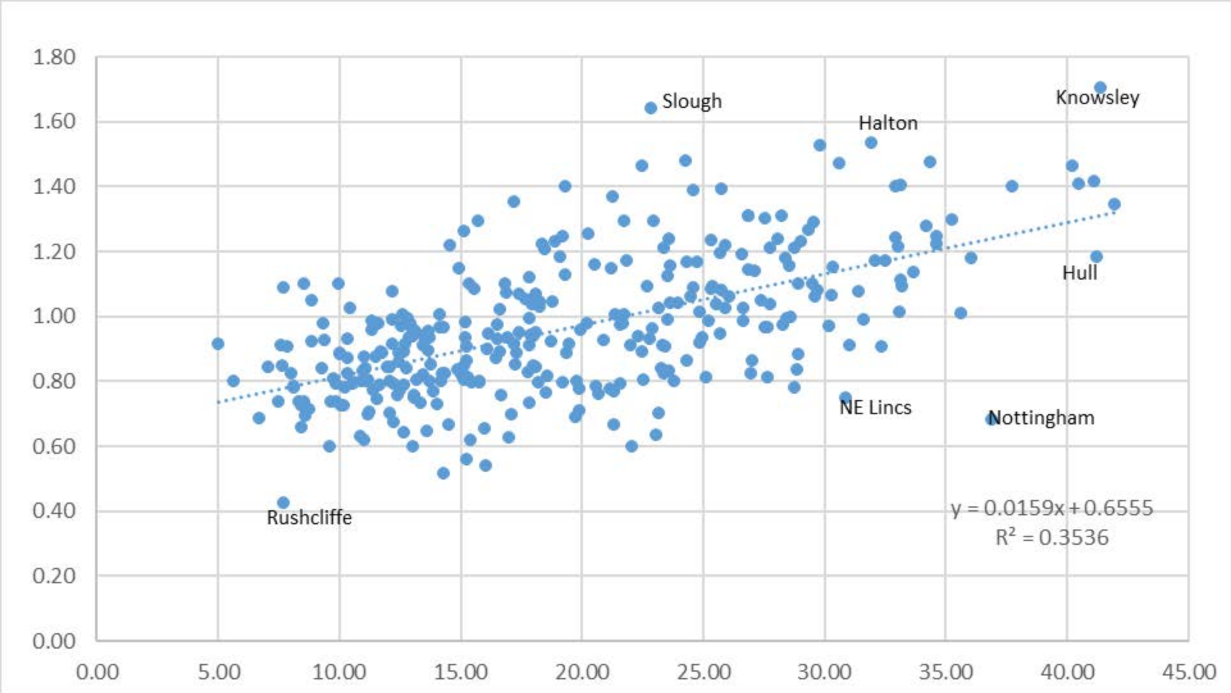

Figure 4. Standardised admission ratios for general medical acute case types for local authority areas versus IMD

Table 20. Number of admissions and standardised admission ratios for acute emergency medical case types in local authorities in England (highest and lowest local authorities)

LA	Sum of observed	Sum of expected	o/e	IMD - average score	Expected SAR	Difference
Knowsley	14296	8393.5	1.70	41.39	1.31	0.39
Slough	10110	6163.7	1.64	22.87	1.02	0.62
Halton	10750	7011.4	1.53	31.94	1.16	0.37
St Helens	16540	10830.3	1.53	29.81	1.13	0.40
Northampton	17193	11629.6	1.48	24.31	1.04	0.44
Stoke-on-Trent	20499	13920.6	1.47	34.36	1.20	0.27
South Tyneside	13720	9330.3	1.47	30.61	1.14	0.33
Hounslow	18194	12442.8	1.46	22.47	1.01	0.45

LA	Sum of observed	Sum of expected	o/e	IMD - average score	Expected SAR	Difference
Middlesbrough	11063	7573.3	1.46	40.22	1.29	0.17
Liverpool	36335	25645.7	1.42	41.13	1.31	0.11
Manchester	31958	22734.9	1.41	40.51	1.30	0.11
Stroud	4805	7639.7	0.63	10.89	0.83	-0.20
Forest of Dean	3638	5808.7	0.63	16.99	0.93	-0.30
Eden	2395	3864.8	0.62	15.41	0.90	-0.28
Broadland	5730	9255.4	0.62	11.07	0.83	-0.21
Wyre Forest	4074	6790.3	0.60	22.07	1.01	-0.41
South Norfolk	5487	9178.7	0.60	13.03	0.86	-0.26
Rutland	1611	2699.0	0.60	9.62	0.81	-0.21
Gedling	4080	7322.6	0.56	15.27	0.90	-0.34
Malvern Hills	3187	5893.7	0.54	16.07	0.91	-0.37
Broxtowe	3669	7113.3	0.52	14.31	0.88	-0.37
Rushcliffe	3135	7410.1	0.42	7.70	0.78	-0.35

4.6. Summary

The association between underlying admission rates and individual CMGs is in line with what we might expect. Some case types show more variability, which is probably linked to local needs, while others show little variability, which is likely an indication of case types where differences in the underlying prevalence of disease are fewer and where the treatment options (i.e. whether to admit or not) are more probably uniform.

The relationship between admission rates and measures such as deprivation are generally in line with what we might expect too.

We also observed that the ‘complexity of cases’ in terms of their needs for beds varied between area by around 10%. This is noticeably less than the differences in the overall level of admissions, which varied by over 50% from the national average. We did not, however, look into the questions of how the operating models and typologies within smaller hospitals might be influencing these admission patterns.

5. Changes in case mix over time

Changes in the case-mix groups between 2012/13 and 2017/18 were examined to determine how stable the groups were over time and which groups changed the most in terms of volume. The aim was to establish whether the relative proportion in each case-mix group was broadly consistent year-on-year, and to identify any significant variations and any changes in the demographics of the patient population across the same time period, which may impact on the case-mix volume or outcomes such as length of stay.

5.1. Analysis

In order to examine changes in the case-mix groups over time, frequencies and associated statistics, including percentage change year-on-year, and change for an ‘average’ smaller hospital (total scores divided by 69) were calculated on the yearly data files from 2012/13 to 2017/18. The 2017/18 data file included spells discharged 1st March 2017- 28th Feb 2018 inclusive, and therefore is excluded from certain year-on-year change calculations for consistency in data collection periods. Demographic characteristics of the patient population of each case-mix group were also examined, including average patient age, number of over 74 year olds, average length of stay, number of short stay episodes and number of patients classified as frail based on the Nuffield frailty score.[129]

5.2. Results

Overall, there was a 26% increase in the total number of episodes between 2012/13 and 2017/18, from 1,703,783 to 2,155,126. The average yearly increase in the number of episodes was 5% (range 4-6%). There was a 19% increase in the total number of spells across a comparable time period.

Length of stay declined at both episode and spell level between 2012/13 and 2017/18. Average episode level length of stay declined by 0.71 days, from 4.12 to 3.41 days. Average spell level length of stay fell by 0.73 days, from 6.52 to 5.79 days. Table 21 shows the total number of episodes, spells and length of stay, by year.

Table 21. Total number of episodes and spells, 2012/13 – 2017/18

Year	Total no. episodes	Average episode level length of stay	Total no. spells	Average spell level length of stay
2012/13	1,703,783	4.12	1,078564	6.52
2013/14	1,766,171	4.01	1,116,358	6.33
2014/15	1,868,511	3.85	1,133,038	5.93
2015/16	1,954,933	3.73	1,198,067	6.23
2016/17	2,057,845	3.64	1,273,376	5.83
2017/18	2,155,126	3.41	1,278,500	5.79

Despite an increasing volume of episodes, the proportion each individual case-mix group represented of all episodes was broadly consistent year-on-year (within +/- 0.5%). Table 22 shows the three case-mix groups which showed change greater than +/- 0.5% in any comparable year-on-year period. 2016/17 cannot be directly compared to 2017/18 due to the overlap in time periods. The only increases above the 0.5% threshold occurred in the proportion of pneumonia cases, which increased by 1.4% between 2013/14 and 2014/15, and 1.1% between 2015/16 and 2016/17.

Table 22. The three case-mix groups which showed the greatest year-on-year change in proportion of all episodes (per cent and absolute number of episodes)

CMG	2016/17 % of all episodes/n	2015/16 % of all episodes/n	2014/15 % of all episodes/n	2013/14 % of all episodes/n	2012/13 % of all episodes/n
I2 Angina pectoris and dyspepsia	1.1% 23,129	1.3% 24,783	1.3% 23,999	1.9% 33,509	2.0% 34,530
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	13% 268,377	11.9% 233,311	11.8% 220,057	10.4% 182,901	10.5% 178,144
R1 Pain in throat and chest	4.5% 92,777	4.8% 94,436	5.1% 94,571	5.7% 100,476	6.0% 102,055

Table 22 shows that for the larger volume case-mix groups such as pneumonia, even a small percentage change year-on-year can result in large changes in the absolute number of episodes. Looking at the absolute number of episodes for each case-mix group in more detail, it seems that ‘A2 Septicaemia’ represents a special case, in that in absolute terms the number of episodes increased from 21,935 in 2012/13 to 119,059 in 2017/18. ‘A2 Septicaemia’ represented 1.3% of all medical generalist cases in 2012/13, but 5.5% of cases in 2017/18.

Table 23 shows the five case-mix groups which showed the greatest absolute increase in episode numbers between 2012/13 and 2017/18, and Table 24 shows the groups which demonstrated the greater absolute decline in episode numbers across the time period.

Table 23. The five case-mix groups that showed the greatest increase in absolute number of episodes 2012/13 to 2017/18 (number of episodes and per cent of all episodes)

CMG	2012/13 episodes/ % of all episodes	2017/18 episodes/ % of all episodes	Absolute change 2012/13 – 2017/18
A2 Septicaemia	21,935 1.3%	119,059 5.5%	97,124
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	178,144 10.5%	255,515 11.9%	77,371
R4 Signs/symptoms not elsewhere classified	66,612 3.9%	92,260 4.3%	25,648
M1 Joints	42,622 2.5%	64,616 3.0%	21,994
R3 Abnormalities of gait and mobility	31,002 1.8%	51,308 2.4%	20,306

Table 24. The five case-mix groups that showed the greatest decrease in absolute number of episodes 2012/13 to 2017/18 (number of episodes and per cent of all episodes)

CMG	2012/13 episodes/ % of all episodes	2017/18 episodes/ % of all episodes	Absolute change 2012/13 – 2017/18
I2 Angina pectoris and dyspepsia	34,530 2.0%	23,117 1.1%	-11,413
R1 Pain in throat and chest	102,055 6.0%	94,821 4.4%	-7,234

G4 Transient ischaemic attacks and dizziness and giddiness	55,659 3.3%	51,002 2.4%	-4,657
I4 Chronic ischaemic heart disease	7,122 0.4%	6,085 0.3%	-1,037
I11 Other cerebrovascular diseases	2,609 0.2%	1,980 0.1%	-629

5.3. Case-mix consistency at hospital level

In order to examine whether case-mix consistency was maintained at individual trust level, Mann-Whitney U tests were conducted for each trust to test whether case-mix distribution in 2012/13 and 2017/18 was significantly different. As multiple tests were being conducted, a significance level of >.01 was selected. Table 25 shows that of the 69 hospital trusts, only three showed significant changes in their case-mix distribution.

Table 25. Hospital trusts with a significant difference in case-mix distribution between 2012/13 and 2017/18

Hospital trust	Two-sided Pr > |Z|
Northampton General Hospital NHS Trust	0.005
Royal Surrey County Hospital NHS Foundation Trust	0.005
Burton Hospitals NHS Foundation Trust	0.008

Looking at the results for the individual trusts in more detail, it appears that some of these differences can be partially explained by the large increase in the number of septicaemia episodes recorded. For all three trusts, none of the case-mix groups showed a noticeable change in the proportion each case-mix group represented of all cases, but there were some noticeable changes in terms of the absolute number of cases for some groups, which may explain the significant difference in overall distribution between the time points. For instance, at Northampton General Hospital NHS Trust, there were 165 episodes classified as ‘F4 Other mental and behavioural disorders’ in 2012/13, but this had increased to 716 by 2017/18. At Royal Surrey County Hospital NHS Foundation Trust, there were 15 episodes classified under ‘J1 Diseases of the pharynx and larynx’ in 2012/13, but this had increased to 215 episodes in 2017/18.

5.4. Patient demographics

Across all case-mix groups, the average patient age showed little change between 2012/13 (66.11 years) and 2017/18 (66.06 years), with some individual case-mix groups showing a slight decline in average age, and some a small rise. For instance, average patient age for episodes of 'C1 Benign and in-situ neoplasms' reduced from 67.43 years in 2012/13 to 66.05 years in 2017/18. Patient episodes classified under 'D4 Other diseases of blood and blood-forming organs' showed an increase in average age from 64.39 years in 2012/13 to 66.85 years in 2017/18.

Despite the fact that average age remained fairly consistent across the time period, a large number of the case-mix groups saw a rise in the number of episodes where patients were over 74 years old; 45 of the 82 case-mix groups had an additional 500 or more episodes in this age range. For instance, there were an additional 10,833 'I9 Heart failure and pulmonary episodes', and 5660 'J4 Chronic lung disease inc. COPD' episodes where patients were 74 years or above, across the time period.

Patient frailty, measured from 2015/16 to 2017/18, can also be seen to have increased. The number of episodes where patients were classified as frail increased in 74 of the 82 case-mix groups between 2015/16 and 2017/18. The three groups which showed the largest increase in the number of frail patients were 'A2 Septicaemia' (269% increase, from 18,055 in 2015/16 to 66,669 in 2017/18); 'R4 Signs/symptoms not elsewhere classified' (66% increase, from 17,283 in 2015/16 to 28,698 in 2017/18); and 'J8 Other respiratory and haemorrhage from respiratory passages and cough and abnormalities of breathing' (57% increase, from 4500 in 2015/16 to 7073 in 2017/18).

5.5. Length of stay

We have already seen that overall length of stay fell between 2012/13 and 2017/18, and this can also be seen at a case-mix group level. For 78 of the 82 case-mix groups, length of stay declined between 2012/13 and 2017/18. Groups showing the largest decline were 'G1 Parkinson's disease' (2.07 day reduction, from 9.96 days in 2012/13 to 7.89 days in 2017/18), 'E6 Other metabolic diseases' (1.67 day reduction, from 5.70 days in 2012/13 to 4.03 days in 2017/18), and 'C3 Malignant neoplasms, no prior history, with palliative care' (1.63 day reduction from 9.88 days in 2012/13 to 8.26 days in 2017/18). Length of stay also declined for patients classified as frail across 77 of the 82 case-mix groups.

The reduction in average length of stay may be reflective of the increase in the number of short stay episodes over the time period: 27 of the 82 case-mix groups showed in increase in excess of 3000 short stay episodes. The number of short stay episodes for 'N1 Acute kidney disease and chronic kidney disease' increased by 8297 across the time period, from 10,541 in 2012/13 to 18,838 in 2017/18. This is reflected in the length of stay for acute kidney disease, which declined by 1.16 days across the time period, from 4.86 days in 2012/13 to 3.69 days in 2017/18.

5.6. Discussion

The results show that the number of episodes of care falling under the generalist case-mix classification increased by approximately 5% year-on-year between 2012/13 and 2017/18. The case-mix groups are largely stable in terms of percentage each case-mix group represented of all cases within a year, but the patient case mix has grown more complex over time, with a higher number of patients over the age of 74 years old, and a higher number classified as frail. Case-mix stability can also be seen at individual trust level, with only three of the 69 trusts showing a significant difference in their case-mix distribution between 2012/13 and 2017/18.

There has been a decline in length of stay over time across nearly all case-mix groups, and accordingly the number of short stay episodes reported has increased.

Case-mix groups 'J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids' and 'A2 Septicaemia' showed the highest degree of change over time. In the case of 'A2 Septicaemia', the substantial increase in case numbers can likely be attributable to changes in coding practice and the national sepsis campaign.

6. Balance of different specialties for the same case types

By looking at the way episodes of care link together within a hospital spell we were able to explore the pattern of handovers between treatment specialties within spells of care for specific case-mix groups. The aim was to identify general patterns in the specialties which manage specific case-mix groups as they move between episodes of care within spells, as well as to understand how consistent pathways of care were between trusts.

6.1. Analysis

Initially four case-mix groups were selected to test and document pathways of care: 'A2 Septicemia', 'I9 Heart failure and pulmonary oedema', 'J4 Chronic lung disease' and 'J5

Asthma'. These conditions were chosen in consultation with LV, on the basis of sufficient case volume and the potential for variations in pathways of care.

The pathways of care were defined using spell-level data from all smaller hospitals in the cohort. Pathways of care for individual trusts were examined to consider the extent to which they were similar or different to the pattern exhibited across the set of smaller hospitals as a whole.

The pathways of care (the most common treatment specialty pathways) for each case-mix group were calculated using adjusted 2017/18 M11 data (spells discharged 1st March 2017 to 28th Feb 2018, inclusive). This was a spell-level data file, which included spells of care for each case-mix group across the 68 smaller hospitals (from 1st April 2017, North West Anglia NHS Foundation Trust was formed from Peterborough and Stamford Hospitals NHS Foundation Trust and Hinchingbrooke Health Care NHS Trust, therefore reducing the number of smaller hospitals in the sample from 69 to 68).

In accordance with NHS Digital HES guidelines, small numbers have been supressed (five or below) from reporting.

6.2. Results

What are the overall pathways of care for the selected case-mix groups?

Table 26 shows the top six pathways of care for 'A2 Septicemia' based on spell volume, including average episode length, number of spells, average length of stay and average patient age.

Table 26. Top six pathways of care for 'A2 Septicemia'

General medical treatment specialties	Episode 1 (average episode length)	Episode 2 (average episode length)	Episode 3 (average episode length)	No. spells	Average LOS	Average age (years)	% classified as frail
1. General Medicine (300)	4.27	.	.	12875	4.27	70	40%

General medical treatment specialties	Episode 1 (average episode length)	Episode 2 (average episode length)	Episode 3 (average episode length)	No. spells	Average LOS	Average age (years)	% classified as frail
2. General Medicine (300) – General Medicine (300)	2.33	5.97	.	10397	8.29	73	51%
3. General Medicine (300) – Geriatric Medicine (430)	2.16	9.32	.	4816	11.48	82	70%
4. General Medicine (300) – General Medicine (300) – General Medicine (300)	1.66	3.94	6.12	2801	11.72	73	56%
5. General Medicine (300) – Respiratory Medicine (340)	2.15	6.60	.	2240	8.75	70	43%
6. Geriatric Medicine (430)	8.22	.	.	1940	8.22	81	61%

The most common treatment pathway was General Medicine, with three out of six of the top pathways of care for ‘A2 Septicemia’ involving one or more episode of care purely under General Medicine.

Average patient age was highest in the pathway when patients moved from General Medicine to Geriatric Medicine (82 years) or a single episode spell under Geriatric Medicine (81 years).

The average age of patients treated under the other pathways was between 70 and 73 years old.

Pathway 4, involving three episodes of care under general medicine, had the longest length of stay (11.7 days). The General Medicine to Geriatric Medicine pathway had the second longest length of stay (11.5 days); length of stay was three days shorter when patients went straight to Geriatric Medicine (8.2 days).

Table 27. Top five pathways of care for 'I9 Heart failure and pulmonary oedema'

General medical treatment specialties	Episode 1 (average episode length)	Episode 2 (average episode length)	No. spells	Average LOS	Average patient age (years)	% classified as frail
1. General Medicine (300)	2.80	.	6334	2.80	78	27%
2. General Medicine (300) – General Medicine (300)	2.02	5.64	3427	7.66	80	38%
3. General Medicine (300) – Cardiology (320)	2.06	8.04	3155	10.10	76	28%
4. General Medicine (300) – Geriatric Medicine (430)	2.06	8.52	1626	10.59	86	52%
5. Cardiology (320)	7.66	.	1202	7.66	74	24%

Table 27 shows that the most common pathway of care for patients with 'I9 Heart failure and pulmonary oedema' was a single episode spell under General Medicine. The average length of stay for this treatment pathway was approximately five days shorter than any of the other top five pathways of care.

Pathway 3, General Medicine – Cardiology; and pathway 4, General Medicine – Geriatric Medicine, both had average lengths of stay in excess of 10 days.

Average patient age was highest under pathway 4, General Medicine – Geriatric Medicine (86 years), and was lowest under pathway 5, when patients received a single episode of care under Cardiology (74 years).

Table 28. Top six pathways of care for 'J4 Chronic lung disease inc. COPD'

General medical treatment specialties	Episode 1 (average episode length)	Episode 2 (average episode length)	Episode 3 (average episode length)	No. spells	Average LOS	Average patient age (years)	% classified as frail
1. General Medicine (300)	1.96	.	.	16388	1.96	71	20%
2. General Medicine (300) – General Medicine (300)	1.70	3.67	.	8648	5.38	72	29%
3. General Medicine (300) – Respiratory Medicine (340)	1.61	4.93	.	6940	6.54	71	26%
4. Respiratory Medicine (340)	5.58	.	.	2279	5.58	70	22%
5. General Medicine (300) – Geriatric Medicine (430)	1.82	5.96	.	1819	7.78	81	42%

General medical treatment specialties	Episode 1 (average episode length)	Episode 2 (average episode length)	Episode 3 (average episode length)	No. spells	Average LOS	Average patient age (years)	% classified as frail
6. General Medicine (300) – General Medicine (300) – General Medicine (300)	1.32	2.81	4.23	1726	8.36	73	33%

Table 28 shows that the most common pathway of care for patients with ‘J4 Chronic lung disease inc. COPD’ was a single episode spell under General Medicine.

Average length of stay was highest under pathway 6, with three episodes of care under General Medicine (8.36 days). Length of stay when patients receive a single episode of care under Respiratory Medicine (5.58 days) was almost a day less than when patients move to Respiratory Medicine from General Medicine (6.54 days).

Average patient age was highest under pathway 5, General Medicine – Geriatric Medicine (81 years). For all of the other top six pathways, average patient age was between 70 and 73 years old.

Table 29. Top four pathways of care for ‘J5 Asthma’

General medical treatment specialties	Episode 1 (average episode length)	Episode 2 (average episode length)	No. spells	Average LOS	Average patient age (years)	% classified as frail
1. General Medicine (300)	1.32	.	5959	1.32	48	5%

2. General Medicine (300) – General Medicine (300)	1.44	2.32	2311	3.76	51	10%
3. General Medicine (300) – Respiratory Medicine (340)	1.60	3.40	1711	5.01	50	9%
4. Accident & Emergency (180)	0.28	.	765	0.28	47	6%

Table 29 shows that the most common pathway of care for patients with ‘J5 Asthma’ was a single episode spell under General Medicine.

Length of stay was shortest under a single episode spell within Accident & Emergency (0.28 days) and was longest under pathway 3, General Medicine – Respiratory Medicine (5.01 days).

Average patient age was similar in all of the top four pathways, ranging between 47 and 51 years old.

6.3. Trust-level differences in pathways of care

Comparison of trust-level differences in pathways of care focused on two of the four tracer conditions: ‘J4 Chronic lung disease inc. COPD’ and ‘I9 Heart failure and pulmonary oedema’. In order to compare how consistent pathways of care were between trusts, the percentage of spells which fell under each pathway by trust were calculated.

6.4. Chronic lung disease inc. COPD

Table 30 shows the average percentage of all spells which fell under the key pathways at a trust level for 'J4 Chronic lung disease inc. COPD', alongside the quartiles and interquartile range to illustrate the spread of scores.

Table 30. 'J4 Chronic lung disease inc. COPD' per cent of spells falling under each pathway at individual trust level

General medical treatment specialties	Average % of all spells	Min/max % of all spells	Quartile 1	Quartile 2	Quartile 3	Interquartile range
1. General Medicine (300)	31%	5-55%	24%	31%	39%	15%
2. General Medicine (300) – General Medicine (300)	18%	1-63%	8%	13%	26%	18%
3. General Medicine (300) – Respiratory Medicine (340)	14%	1-48%	5%	13%	20%	15%
4. Respiratory Medicine (340)	6%	1-41%	1%	3%	7%	5%
5. General Medicine (300) – Geriatric Medicine (430)	4%	1-11%	1%	3%	6%	4%
6. General Medicine (300) – General Medicine (300) – General Medicine (300)	5%	1-25%	1%	3%	6%	5%
Other pathways	28%	6-91%	16%	26%	39%	23%

The largest degree of variation between trusts in terms of pathway of care for chronic lung disease and COPD is between those who adopt the ‘top six’ pathways, and those who follow alternative pathways captured under ‘Other pathways’. Spells falling under ‘Other pathways’ shows the greatest interquartile range (23%), ranging between 6% and 91% of spells. Figure 5 shows the five trusts with the highest and lowest proportion of spells categorised under ‘Other pathways’.

The greatest degree of consistency between trusts is in the proportion addressing chronic lung disease under pathway 4, Respiratory Medicine, pathway 5, General Medicine – Geriatric Medicine and pathway 6, General Medicine – General Medicine – General Medicine, which all have an interquartile range of between 4% and 5%.

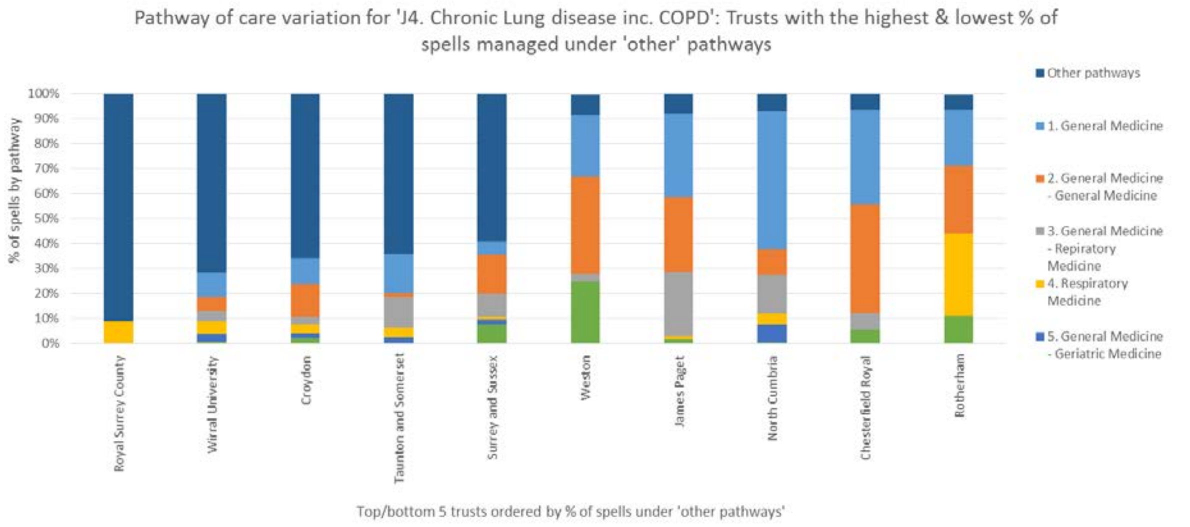

Figure 5. Pathways of care variation for ‘J4 Chronic lung disease inc. COPD’: Trusts with the highest and lowest percentage of spells managed under ‘other pathways’

6.5. Heart failure and pulmonary oedema

Table 31 shows that the lowest degree of variation between trusts in terms of pathway of care for heart failure was spells dealt with directly by cardiology – this group had the lowest interquartile range of 4%. A high proportion of spells for ‘I9 Heart failure and pulmonary oedema’ were dealt with under ‘other pathway, ranging from 15% to 95% of spells across trusts. Figure 6 shows the five trusts with the highest and lowest proportion of spells categorised under ‘Other pathways’.

Table 31. 'I9 Heart failure and pulmonary oedema' per cent of spells falling under each pathway at individual trust level

General medical treatment specialties	Average % of all spells	Min/max % of all spells	Quartile 1	Quartile 2	Quartile 3	Interquartile range
1. General Medicine (300)	23%	0-43%	16%	25%	30%	14%
2. General Medicine (300) – General Medicine (300)	15%	0-48%	6%	11%	21%	15%
3. General Medicine (300) - Cardiology (320)	14%	0-44%	5%	12%	21%	16%
4. General Medicine (300) – Geriatric Medicine (430)	6%	0-22%	2%	5%	10%	8%
5. Cardiology (320)	6%	0-33%	2%	4%	6%	4%
Other pathways	41%	15-98%	27%	38%	48%	21%

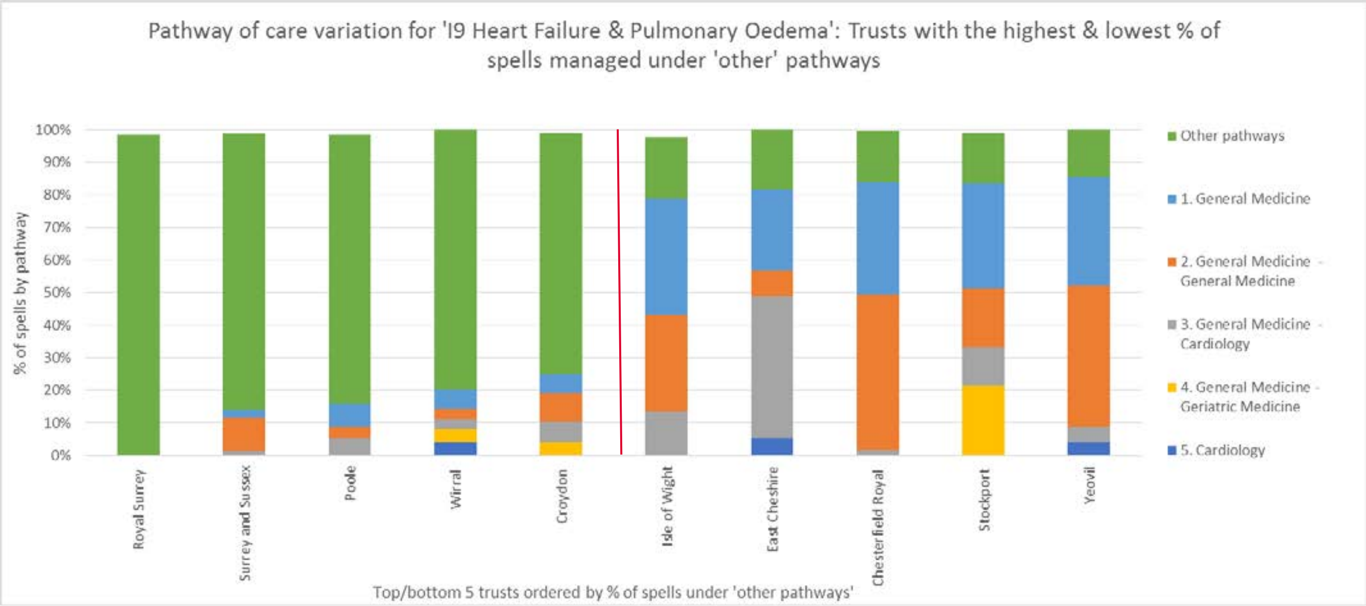

Figure 6. Pathway of care variation for I9 Heart failure and pulmonary oedema: Trusts with the highest and lowest percentage of spells managed under ‘other pathways’

6.6. Discussion

Analysis of pathways of care at an overall level showed that for all of the tracer conditions selected, the most common pathway of care was a single episode spell under General Medicine. The results also show that where patients are treated under Geriatric Medicine, average lengths of stay tend to be longer. This is most likely due to more complex case presentation and/or increased levels of frailty as individuals age.

When looking at the consistency of pathways of care between trusts, it can be seen that some pathways show a greater degree of variation than others. For instance, the proportion of ‘J4 Chronic lung disease inc. COPD’ spells treated under either Respiratory Medicine or moving from General Medicine to Geriatric Medicine was fairly similar between trusts, but the proportion following a purely General Medical pathway was much more variable. It may be that this reflects that for some trusts, pathways of care primarily fall under ‘Other pathways’ as they do not have sufficient consistency of approach to create the spell volume to be a common pathway.

It is also clear that for some case-mix groups such as ‘J5 Asthma’, the pathway of care is fairly standardised across hospital trusts due to the nature of the clinical condition.

7. Exploring case mix and lengths of stay differences in generalist medical care in smaller hospitals

7.1. Introduction and methods

When looking at acute general medical services, we were interested in seeing how the organisation of medical care can impact on bed use, as manifested in average lengths of stay. In general, case mix can be an important determinant of average length of stay in a hospital: if hospitals admit cases that are more complex and require a longer stay, this will, not surprisingly, increase the hospital-wide average length of stay. So if we want to see how the organisation or medical services may be related to lengths of stay, we need to find a way to estimate the impacts of differences of case mix.

One approach advocated by Fetter *et al.* in their original paper on the creation of diagnosis-related groups (DRGs)[6] was based on a technique described by Kitagawa.[7] This is not often used, but it can help to unpick aggregate effects and explore what is causing them.[8] It uses a simple approach to splitting differences on average aggregate lengths of stay into three components:

a. Effects of cases mix – i.e. whether the pattern of cases treated had a different profile in terms of expected lengths of stay (where expected derived from overall group average)

b. Effects of length of stay itself – i.e. whether across case-mix groups the stay length was longer

c. Interaction between the two – where both the case mix and length of stay was different. This is a kind of uncertainty around the other two elements.

The arithmetic neatly splits differences between average length of stay (a) in a single hospital from an overall group mean (A), such as a national average. The proportion of cases in case-mix group (p) in each hospital is contrasted with the overall average (P) across hospitals. So, when summing across all case-mix groups, the formula can estimate the effects for each hospital (and for individual cases mix groups):

Overall LOS difference	=	Case-mix effect	+	LOS effect	+	Interaction
a-A	=	Σ A(p-P)	+	Σ P (a-A)	+	Σ (p-P)(a-A)

One advantage of this approach is that these elements can be disaggregated at hospital and case-mix group, and so give an idea of which case-mix groups within a hospital are most responsible for a given variance.

7.2. Application to acute medicine in smaller hospitals

In order to explore the utility of the approach, we looked at the higher diagnostic level of case-mix groups (n=82) across a subset of smaller hospitals. We had the option to look at lengths of individual episodes or hospital spells. For this analysis we wanted to compare the overall differences in stay lengths across the whole spell and so classified cases to the first case-mix group on admission

This analysis is based on a data set from our (68) selected hospitals and selected specialties for 2016/17. Long stay cases over 42 days (six weeks) were given a stay length of 42 – to avoid having too strong an effect from extreme outliers (winsorisation).

Table 32. Summary of data sets used

Total spells (total episodes)	1,260,821
Number of hospitals	68*
Average spell length (range)	5.2 (2.8-8.4)

**Note 511 spells from Hinchinbrooke were excluded.*

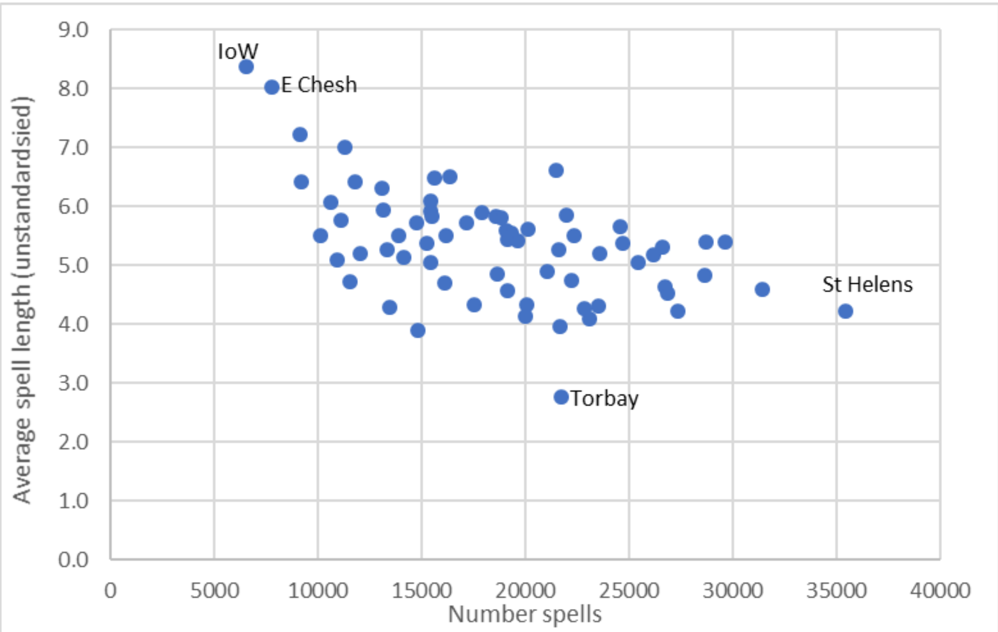

Figure 7. Average length of stay versus volume of cases seen

The unstandardised average lengths of stay across all hospitals was 5.2 days and ranged from 8.4 days (Isle of Wight) and 8.1 days (East Cheshire), to 2.8 days (Torbay), 3.9 days (Burton) and 2.6 days (Bournemouth). As Figure 7 shows, there was a weak inverse relationship with the volume of cases (r-squared=.238): smaller hospitals tended to have longer unstandardised stay lengths. As we have noted elsewhere, there is also a relationship between the volume of short stay cases and overall stay lengths. Even taking this into account, there was still variability in average stay lengths between hospitals.

We used the Kitagawa method to study differences between hospital average lengths of stay and the overall small hospitals' group average of 3.7 days. Our earlier analysis had indicated that length of stay would be sensitive to differences in both frailty and whether a procedure was undertaken, so we used these as moderators of the basic diagnostic groups. However, there are differences between these characteristics. Frailty could be considered to be an attribute of the presenting patient and beyond the control of the hospital and, in general, independent of the clinical treatment choices that are made. Whether or not a procedure is undertaken, however, will to a certain extent be determined by local clinical practice and the availability of resources or organisation of services. We therefore looked at these effects separately.

7.3. Hospitals with shortest lengths of stay

Table 33 shows the results for the hospitals with shortest average lengths of stay. The hospital with the shortest stay length is Torbay at 2.8 days – which is 2.43 days below the group average. Part of this difference (-.44 days) seems to be explained by the case mix of the hospital being 'less demanding' in terms of expected bed days. A much larger share of the difference (-1.76 days) seems to be that the hospital shows shorter lengths of stay across case types.

Looking at Table 33, it appears that in most of the hospitals, the length of stay is having more of an effect than the case mix itself. Hospitals are tending to exhibit lower than average stay length across all or most case types. For most of these hospitals, the case mix element is also negative in effect – indicating that these hospitals have slightly fewer than expected case-mix groups where you might expect a longer length of stay, i.e. a less demanding (in bed terms) case mix. The exceptions are Southend (where the case mix is more demanding) and Bournemouth where there is little effect due to length of stay.

Table 33. Hospitals with shortest and longest lengths of stay: case mix and lengths of stay effects based on CMG+frailty

			A (p-P)	P (a-A)	(a-A) (p-P)
HES code and trust	LOS	Variance group mean	Due to case mix	Due to LOS	Interaction
RAJ Southend University Hospital NHS Foundation Trust	4.36	-0.88	0.47	-0.98	-0.45
RQX Homerton University Hospital NHS Foundation Trust	4.33	-0.91	-0.32	-0.25	-0.29
RFS Chesterfield Royal Hospital NHS Foundation Trust	4.30	-0.94	0.08	-0.88	-0.15
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	4.26	-0.97	-0.83	-0.02	0.07
RBN St Helens and Knowsley Hospitals NHS Trust	4.26	-0.98	-0.17	-0.64	-0.14
RRF Wrightington, Wigan and Leigh NHS Foundation Trust	4.19	-1.05	0.04	-0.98	-0.07
RCX The Queen Elizabeth Hospital, King’s Lynn, NHS Foundation Trust	4.14	-1.10	-0.38	-0.54	0.03
RBT Mid Cheshire Hospitals NHS Foundation Trust	4.01	-1.23	-0.22	-0.97	0.01

			A (p-P)	P (a-A)	(a-A) (p-P)
HES code and trust	LOS	Variance group mean	Due to case mix	Due to LOS	Interaction
RJF Burton Hospitals NHS Foundation Trust	3.93	-1.30	-0.34	-0.94	0.17
RA9 Torbay and South Devon NHS Foundation Trust	2.80	-2.43	-0.44	-1.76	0.15

We can break down these figures to individual case types. Table 34 shows a selection of case-mix groups within one trust (Torbay) that have the strongest influence on reducing overall average stay lengths. The most extreme is ‘J3 Pneumonia’ with frailty: the hospital LOS is 6.4 days shorter than the average, and there is also a case-mix effect, indicating that there were slightly fewer of these cases (which are long stay) than elsewhere. For many of the groups, the observed lengths of stay is lower in Torbay than the overall average for all the hospitals. The length of stay effect is more widely scattered across case-mix groups and tends to be negative.

Table 34. Individual length of stay elements for one hospital by selected case types (diagnosis plus frailty)

Case type (F1 indicates frailty; F0 no frailty)	Group avg LOS	Hospital LOS	Case mix	LOS	Interaction	Sum CMG effect
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids+F1	12.4	6.4	-0.11	-0.14	0.05	-0.21
A2 Septicaemia+F1	13.4	7.3	-0.08	-0.10	0.03	-0.15
R4 Signs/symptoms not elsewhere classified+F1	23.7	1.3	0.13	-0.15	-0.12	-0.14

N3 Other genitourinary and retention of urine+F1	9.2	4.9	-0.09	-0.09	0.05	-0.14
R3 Abnormalities of gait and mobility+F1	10.3	3.8	-0.06	-0.08	0.04	-0.10
C4 Malignant neoplasms, prior history of same cancer, without palliative care+F1	10.6	4.9	-0.06	-0.06	0.03	-0.10
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction+F1	14.2	6.1	-0.03	-0.06	0.02	-0.07
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction+F0	8.5	3.6	-0.01	-0.07	0.01	-0.07
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids+F0	5.5	4.2	-0.02	-0.05	0.00	-0.07
C4 Malignant neoplasms, prior history of same cancer, without palliative care+F0	4.8	2.9	-0.01	-0.04	0.00	-0.05
N1 Acute kidney disease and chronic kidney disease+F1	12.2	5.6	-0.04	-0.03	0.02	-0.05
J4 Chronic lung disease inc. COPD+F1	8.6	4.3	-0.03	-0.03	0.01	-0.05
C5 Malignant neoplasms, prior history of same cancer, with palliative care+F0	10.8	6.4	-0.03	-0.02	0.01	-0.04

The effects of frailty can be shown in the same way for this one hospital (see Table 35). In this case, the hospital still shows the differential in stay length for both frail and not frail patients.

Table 35. Effect of frailty on average stay length in one hospital

Case type (F1 indicates frailty; F0 no frailty)	Small hospital LOS	Hospital LOS	Case mix group	LOS	Interaction	Sum effect
Not frail	3.9	2.3	0.28	-0.83	-0.09	-0.64
Frail	11.2	5.0	-0.81	-1.39	0.41	-1.79

Across all hospitals there seems to be some case-mix groups that tend to be more influential (*as measured by the absolute sum of differences across hospitals*):

- Cerebrovascular haemorrhages/stroke/cerebral infarction
- Other genitourinary and retention of urine
- Fracture of femur
- Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids
- Chronic lung disease inc. COPD

7.4. Hospitals with longest average lengths of stay

Looking at the hospitals where average length of episode is longer than elsewhere (see Table 36), it seems that the case-mix element is more marked in these hospitals – with effects on average stay lengths of an additional 1.2 days in the Isle of Wight and 0.99 days at George Eliot hospitals. However, the length of stay effect is also generally large and positive, and in most cases greater in magnitude than the case-mix effect. The implication is that even though these hospitals may have a case mix which would suggest longer lengths of stay, the stay lengths within individual case-mix groups are still longer than average.

Table 36. Hospitals with longest lengths of stay: case mix and lengths of stay effects based on CMG+frailty

			A(p-P)	P(a-A)	(a-A)(p-P)
HES code and trust	LOS	Variance group mean	Due to case mix	Due to LOS	Interaction
R1F Isle of Wight NHS Trust	8.41	3.17	1.23	2.34	-0.39
RJN East Cheshire NHS Trust	8.07	2.83	0.77	1.94	0.17
RLT George Eliot Hospital NHS Trust	7.27	2.04	0.99	1.13	-0.08
RLQ Wye Valley NHS Trust	7.04	1.80	0.36	1.47	-0.02

RTP Surrey and Sussex Healthcare NHS Trust	6.65	1.42	0.69	0.77	0.03
RJR Countess of Chester Hospital NHS Foundation Trust	6.55	1.32	0.10	1.21	0.00
RD8 Milton Keynes University Hospital NHS Foundation Trust	6.52	1.28	0.64	0.71	-0.03
RNZ Salisbury NHS Foundation Trust	6.46	1.23	-0.03	1.36	-0.09
RA3 Weston Area Health NHS Trust	6.46	1.23	0.65	0.81	-0.14

Figure 8 shows the impacts of the two elements, plotting the size of each element for each hospital moving from shortest to longest length of stay. This graph shows that as you move from shortest to longest stay length, the case-mix elements generally stay in a band of plus or minus 0.5 days. But the length of stay element swings more dramatically and is clearly far more important in 'explaining' differences in the aggregate stay lengths. Aside from the extremes, there are some trusts that appear atypical, in that they have a positive case-mix effect and negative lengths of stay – these are Ashford, Mid Essex and Southend.

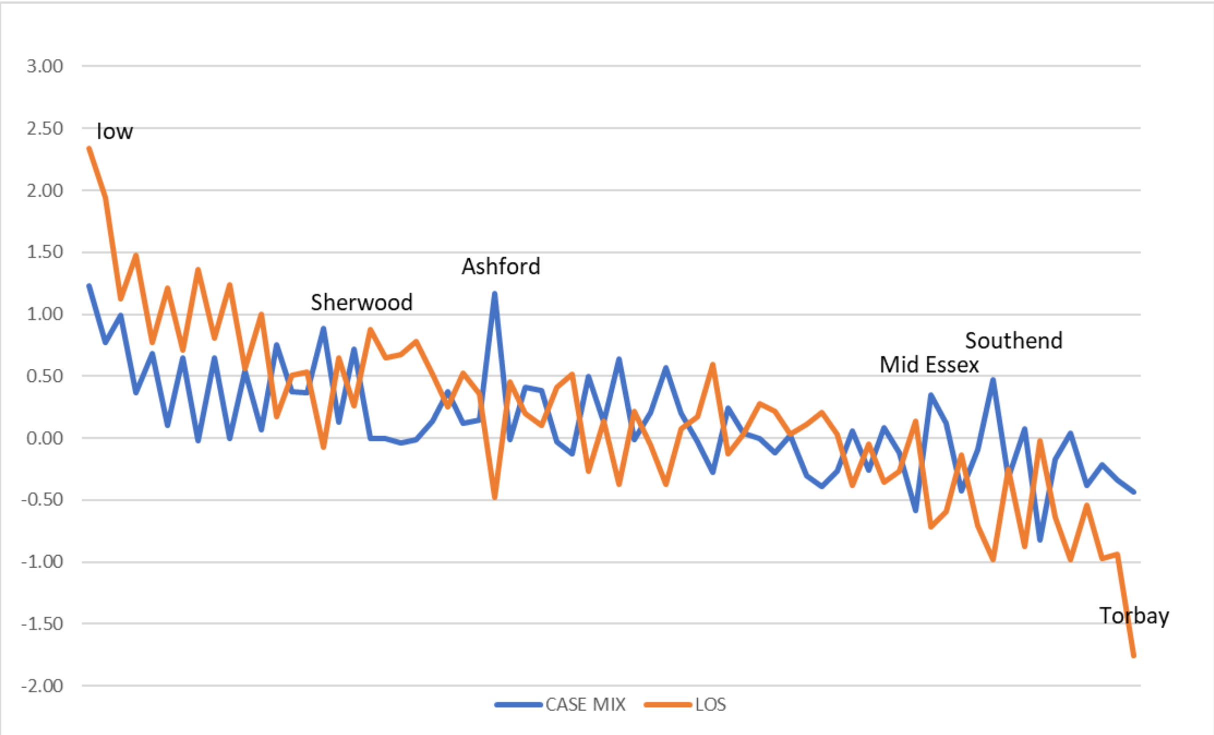

Figure 8. Length of stay and case-mix components for individual hospitals, standardised using CMG+frailty (sorted by aggregate average length on stay; longest on the right)

7.5. Additional impacts of including procedure in case-mix classification

We also undertook analysis including the procedure flag as a refinement to our case-mix groups. As we noted earlier, patients that had a procedure typically had longer spell lengths. Table 37 summarises the length of stay effects and case-mix effects when three different variants of the case-mix classification are used: (a) Diagnostic groups alone; (b) Diagnosis plus frailty; or (c) Diagnosis plus frailty plus procedure. The table is based on analysis of 2017/8 data and hospitals are sorted according to the overall average length of stay.

Overall, the addition of the procedure to the classification increases the case-mix component, as we would expect. However, it is important to note that:

a. The effects of adding the procedure to the classification are not the same in all hospitals. For example, including procedure changes the case-mix impacts for the Isle of Wight from 1.23 to 2.28 days. Yet in East Cheshire there is much less of a change from 0.77 to 0.92 days. In some hospitals, e.g. South Warwickshire NHS Foundation Trust or Tameside Hospital NHS Foundation Trust, adding the procedure actually reduces the size of the case-mix effect.

b. The relative contribution of the case mix element for many trusts is still smaller in scale than the impact of the length of stay within case-mix group.

c. For some hospitals, the case-mix effect may be to increase average stay lengths, yet the within case type effects work in the opposite direction, e.g. Sherwood Forest Hospitals NHS Foundation Trust, Ashford and St Peter's Hospitals NHS Foundation Trust.

The addition of the procedure flag adds some additional insight to the differences between hospitals. In particular, it helps unpick where differences in stay length, and by implication bed use and care processes within the organisation, may be linked with the use of procedure. Perhaps the most important message though is that the balance between these elements differ between hospitals.

However, using procedure coding can also be problematic – as the use of procedures may vary between hospitals and we have no indication of what the ‘right’ level of procedures is for a given health problem. Untangling this issue on the appropriateness of a treatment path would require more sophisticated information about patients that we can extract from HES.

Table 37. Effects of case mix, frailty and procedures on overall average (10 trusts with the highest and lowest difference in LOS reported)

		Due to case mix				Due to LOS		
	Difference LOS	Basic diagnosis group	+Frailty	+Frailty +Procedure		Basic diagnosis group	+Frailty	+Frailty +Procedure
R1F Isle of Wight NHS Trust	3.2	0.81	1.23	2.28		2.79	2.34	1.07
RJN East Cheshire NHS Trust	2.8	0.54	0.77	0.92	X	2.17	1.94	1.61
RLT George Eliot Hospital NHS Trust	2.0	0.42	0.99	1.30		1.40	1.13	0.74
RLQ Wye Valley NHS Trust	1.8	0.50	0.36	0.46	X	1.28	1.47	1.39
RTP Surrey and Sussex Healthcare NHS Trust	1.4	0.19	0.69	1.45		1.30	0.77	0.19
RJR Countess of Chester Hospital NHS Foundation Trust	1.3	0.11	0.10	0.62	X	1.06	1.21	0.70
RD8 Milton Keynes University Hospital NHS Foundation Trust	1.3	0.32	0.64	0.98		0.89	0.71	0.41
RNZ Salisbury NHS Foundation Trust	1.2	-0.15	-0.03	0.19	X	1.47	1.36	1.15
RA3 Weston Area Health NHS Trust	1.2	0.47	0.65	1.24		0.99	0.81	0.22
RVY Southport and Ormskirk Hospital NHS Trust	1.1	0.13	0.00	-0.05	X	1.12	1.24	1.34
RAJ Southend University Hospital NHS Foundation Trust	-0.9	0.09	0.47	0.63		-0.92	-0.98	-1.06
RQX Homerton University Hospital NHS Foundation Trust	-0.9	-0.56	-0.32	-0.24		-0.11	-0.25	-0.25
RFS Chesterfield Royal Hospital NHS Foundation Trust	-0.9	-0.08	0.08	-0.22		-0.84	-0.88	-0.62
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	-1.0	-0.26	-0.83	-0.55		-0.66	-0.02	-0.11

		Due to case mix				Due to LOS		
	Difference LOS	Basic diagnosis group	+Frailty	+Frailty +Proced ure		Basic diagnosis group	+Frailty	+Frailty +Proced ure
RBN St Helens and Knowsley Hospitals NHS Trust	-1.0	-0.24	-0.17	-0.44		-0.67	-0.64	-0.21
RRF Wrightington, Wigan and Leigh NHS Foundation Trust	-1.0	-0.06	0.04	0.31		-0.94	-0.98	-1.17
RCX The Queen Elizabeth Hospital, King's Lynn, NHS Foundation Trust	-1.1	-0.32	-0.38	-0.70		-0.91	-0.54	-0.08
RBT Mid Cheshire Hospitals NHS Foundation Trust	-1.2	-0.36	-0.22	-0.34		-0.93	-0.97	-0.77
RJF Burton Hospitals NHS Foundation Trust	-1.3	-0.34	-0.34	-0.31		-1.19	-0.94	-0.84
RA9 Torbay and South Devon NHS Foundation Trust	-2.4	0.02	-0.44	-0.85		-1.93	-1.76	-1.40

8. Case mix and skill mix

In this analysis we looked at the link between specialist consultant roles and case mix within smaller hospital acute medical workload.

The following analyses bring together data from the inpatient hospital activity data for 2017/18 from 67 smaller hospitals (Peterborough and Hinchingbrooke were excluded as they were undergoing a merger). This was linked with information on the medical workforce from NHS Digital described in the main report. As noted in earlier sections, there are wide differences between hospitals in the mix of medical workforce.

In this section we look at whether there is an observable relationship between the numbers of 'specialist consultants' within a hospital and the mix of cases seen in the acute medical workload. We have used a number of specific probes to look at this:

a. Does the proportion of 'generalists' in the medical workforce vary in line with how typical or atypical the case mix is (based on per cent of cases in most common CMGs)?

b. Is there a relationship between the proportion of cases flagged as frail and the portion of generalists?

c. Are there specific links between cases types and particular specialties?

In this analysis we separate the volumes of cases with very short stays, which would in most cases be associated with acute medical unit care only, from the longer stay patients. Our rationale is that the specialist time would be more often linked with the longer staying patients admitted to the wards.

The analysis was undertaken for:

- Respiratory medicine
- Cardiology
- Gastroenterology
- Elderly care medicine (versus the number of 'frail cases')

For each of these specialties we identified a subset of case types that would be linked with the specialist area, for example, through the organ systems or the presence of the frailty flag for care of the elderly. It is important to note that there are still many cases within these broad diagnostics groups that will also be treated by generalists.

8.1. Respiratory consultants

We used a subset of respiratory conditions (see Table 38) and compared the proportion of episodes in these groups to the overall numbers of respiratory consultants. For this analysis we looked at total episodes of care as well as the 'longer stay episodes', i.e. excluding 0-1 days which are probably linked to care in just the acute medical unit.

Table 38. CMGs linked with respiratory disease

J2 Acute upper respiratory infections of multiple and unspecified sites
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids
J4 Chronic lung disease inc. COPD
J5 Asthma
J6 Interstitial lung disease and pleural effusion
J7 Respiratory failure, not elsewhere classified
J8 Other respiratory and haemorrhage from respiratory passages and cough and abnormalities of breathing

As Table 39 shows, the number of consultants in 'Respiratory Medicine' ranged from zero to almost 16, and the proportion of cases in respiratory CMGs ranged from 20% to 30%. Yet there was no apparent relationship between the number of respiratory cases and the number of respiratory consultants, whether expressed as an absolute value or as a percentage of all consultants. This applied to total cases and the longer staying episodes only.

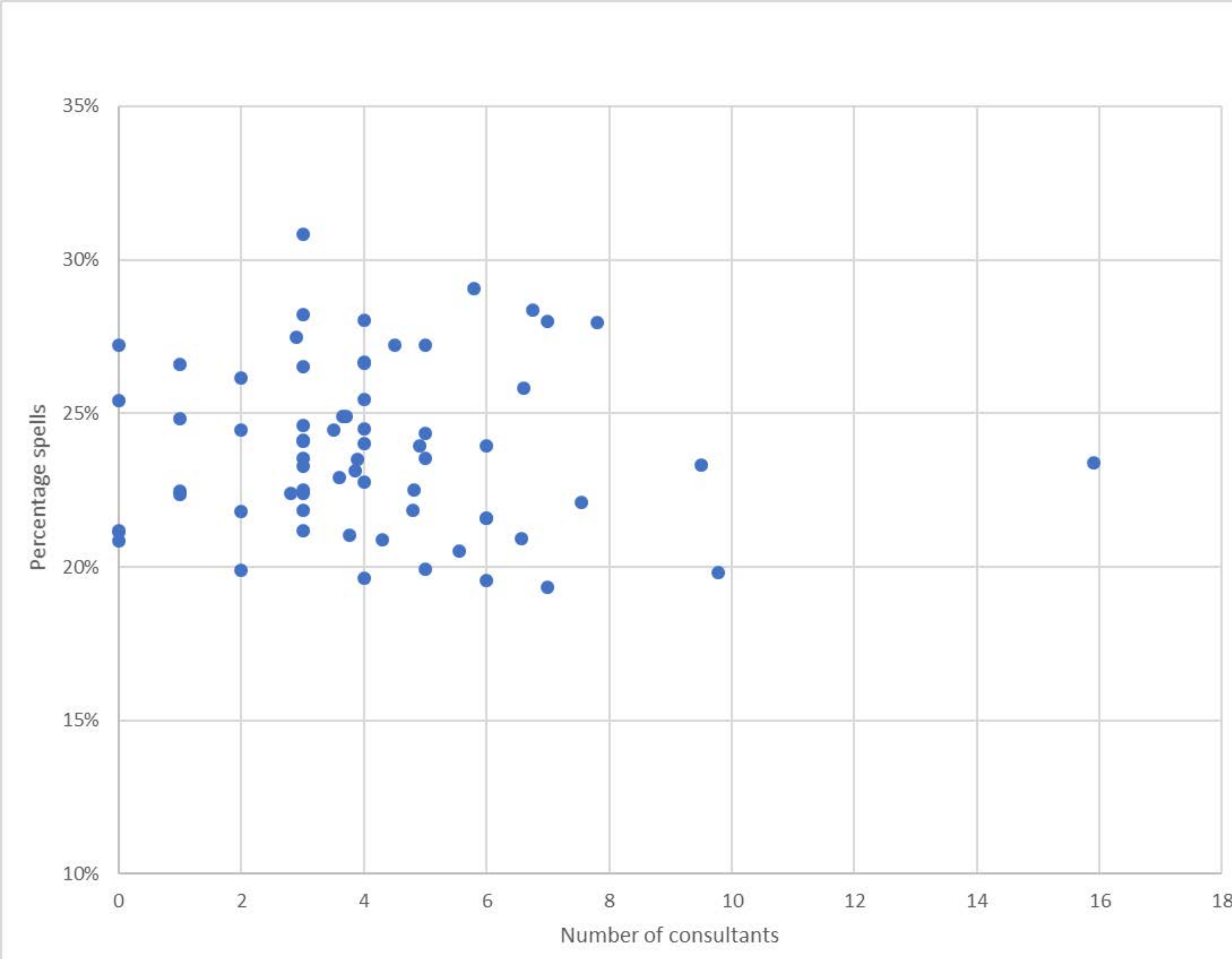

Figure 9. The percentage of spells in respiratory CMGs (excluding short stay) versus the number of consultants in respiratory medicine

Table 39. Respiratory consultants and activity by trust (showing trusts with the highest/lowest numbers of respiratory consultant)

HES code and trust	Respiratory medicine	% cases resp CMGs (J2-j8)	% resp long stay as % all long stay	Total cases resp CMGs (J2-j8)	Resp cases per consultant	Resp consultants as % all medical staff
REM Aintree University Hospital NHS Foundation Trust	15.9	19.4%	23.4%	10291	647.2	9.6%
RWG West Hertfordshire Hospital NHS Trust	9.8	15.5%	19.8%	6416	656.7	5.0%
RK5 Sherwood Forest Hospitals NHS Foundation Trust	9.5	20.7%	23.3%	7551	794.8	7.0%
RMC Bolton Hospital NHS Foundation Trust	7.8	25.5%	28.0%	6458	827.9	5.9%
RCX The Queen Elizabeth Hospital, King's Lynn, NHS Foundation Trust	7.5	18.3%	22.1%	7390	979.6	4.8%
RBK Walsall Healthcare NHS Trust	7.0	24.7%	28.0%	8207	1172.4	3.9%
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	7.0	16.5%	19.3%	6836	976.6	4.4%
RNQ Kettering General Hospital NHS Foundation Trust	6.8	23.8%	28.4%	7512	1112.9	6.8%
RNA The Dudley Group NHS Foundation Trust	6.6	23.2%	25.8%	9162	1388.2	5.0%
RN3 Great Western Hospitals NHS Foundation Trust	6.6	17.5%	20.9%	7449	1135.2	4.2%
RBA Taunton and Somerset NHS Foundation Trust	6.0	17.9%	21.6%	6874	1145.7	4.9%

HES code and trust	Respiratory medicine	% cases resp CMGs (J2-j8)	% resp long stay as % all long stay	Total cases resp CMGs (J2-j8)	Resp cases per consultant	Resp consultants as % all medical staff
RBL Wirral University Teaching Hospital NHS Foundation Trust	6.0	19.0%	19.6%	12575	2095.8	3.6%
RC1 Bedford Hospital NHS Trust	6.0	17.6%	21.6%	5598	933.0	4.8%
RTK Ashford and St Peter's Hospitals NHS Foundation Trust	6.0	21.2%	24.0%	5162	860.3	4.8%
RAX Kingston Hospital NHS Foundation Trust	5.8	21.7%	29.1%	5384	928.3	5.0%
RCD Harrogate and District NHS Foundation Trust	5.6	18.7%	20.5%	2556	460.5	7.5%
RD3 Poole Hospital NHS Foundation Trust	5.0	19.1%	24.3%	4877	975.4	4.9%
RJR Countess of Chester Hospital NHS Foundation Trust	5.0	23.4%	27.2%	6920	1384.0	4.5%
RQ8 Mid Essex Hospital Services NHS Trust	5.0	17.9%	19.9%	5613	1122.6	4.2%
RQW The Princess Alexandra Hospital NHS Trust	5.0	18.5%	23.5%	4265	853.0	5.1%
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	4.9	18.6%	24.0%	8835	1803.1	3.0%
RJC South Warwickshire NHS Foundation Trust	4.8	19.8%	22.5%	5834	1212.3	6.3%
RKE Whittington Health (The Whittington Hospital NHS Trust)	4.8	16.8%	21.8%	2455	511.5	4.0%

HES code and trust	Respiratory medicine	% cases resp CMGs (J2-j8)	% resp long stay as % all long stay	Total cases resp CMGs (J2-j8)	Resp cases per consultant	Resp consultants as % all medical staff
RFF Barnsley Hospital NHS Foundation Trust	4.5	22.8%	27.2%	7132	1584.9	4.0%
RAP North Middlesex University Hospital NHS Trust	4.3	18.0%	20.9%	4581	1065.3	3.3%
RA9 Torbay and South Devon NHS Foundation Trust	4.0	19.4%	24.0%	8041	2010.3	3.2%
RE9 South Tyneside NHS Foundation Trust	4.0	22.7%	26.6%	4205	1051.3	5.3%
RN7 Dartford and Gravesham NHS Trust	4.0	19.3%	25.4%	5748	1437.0	4.0%
RPA Medway NHS Foundation Trust	4.0	20.4%	22.7%	8247	2061.8	3.1%
RQX Homerton University Hospital NHS Foundation Trust	4.0	14.6%	19.6%	3093	773.3	3.0%
RR7 Gateshead Health NHS Foundation Trust	4.0	25.9%	28.0%	8221	2055.3	3.4%
RRF Wrightington, Wigan and Leigh NHS Foundation Trust	4.0	22.1%	24.5%	6383	1595.8	3.4%
RVW North Tees and Hartlepool NHS Foundation Trust	4.0	23.1%	26.7%	10853	2713.3	2.7%
RA2 Royal Surrey County Hospital NHS Foundation Trust	3.9	17.1%	23.5%	4246	1088.7	3.8%
RWJ Stockport NHS Foundation Trust	3.9	19.9%	23.1%	7034	1827.0	2.5%
RGR West Suffolk NHS Foundation Trust	3.8	18.8%	21.0%	6766	1794.7	3.5%

HES code and trust	Respiratory medicine	% cases resp CMGs (J2-j8)	% resp long stay as % all long stay	Total cases resp CMGs (J2-j8)	Resp cases per consultant	Resp consultants as % all medical staff
RNS Northampton General Hospital NHS Trust	3.7	19.8%	24.9%	6906	1866.5	2.9%
RJN East Cheshire NHS Trust	3.7	23.6%	24.9%	3104	850.4	5.7%
RD8 Milton Keynes University Hospital NHS Foundation Trust	3.6	20.2%	22.9%	4800	1333.3	4.1%
RTX University Hospitals of Morecambe Bay NHS Foundation Trust	3.5	20.6%	24.5%	6561	1874.6	3.1%
RBD Dorset County Hospital NHS Foundation Trust	3.0	18.2%	22.4%	3355	1118.3	3.6%
RBZ Northern Devon Healthcare NHS Trust	3.0	20.4%	24.6%	3585	1195.0	3.8%
RFR The Rotherham NHS Foundation Trust	3.0	25.2%	28.2%	6387	2129.0	4.7%
RGQ Ipswich Hospital NHS Trust	3.0	20.1%	23.5%	8205	2735.0	2.6%
RJ6 Croydon Health Services NHS Trust	3.0	20.8%	24.1%	7177	2392.3	2.1%
RJF Burton Hospitals NHS Foundation Trust	3.0	25.5%	30.8%	8904	2968.0	4.3%
RLQ Wye Valley NHS Trust	3.0	22.2%	23.3%	5023	1674.3	5.5%
RLT George Eliot Hospital NHS Trust	3.0	22.9%	26.5%	3269	1089.7	5.2%
RNZ Salisbury NHS Foundation Trust	3.0	17.4%	21.2%	3263	1087.7	3.3%
RTP Surrey and Sussex Healthcare NHS Trust	3.0	20.5%	21.9%	11875	3958.3	2.2%

HES code and trust	Respiratory medicine	% cases resp CMGs (J2-j8)	% resp long stay as % all long stay	Total cases resp CMGs (J2-j8)	Resp cases per consultant	Resp consultants as % all medical staff
RVY Southport and Ormskirk Hospital NHS Trust	3.0	20.3%	24.1%	4071	1357.0	4.6%
RWW Warrington and Halton Hospitals NHS Foundation Trust	3.0	16.5%	22.5%	5379	1793.0	2.6%
RMP Tameside Hospital NHS Foundation Trust	2.9	24.2%	27.5%	6468	2230.3	3.7%
RAS The Hillingdon Hospitals NHS Foundation Trust	2.8	17.5%	22.4%	3040	1085.7	2.8%
RC9 Luton and Dunstable University Hospital NHS Foundation Trust	2.0	18.5%	21.8%	8083	4041.5	2.6%
RCF Airedale NHS Foundation Trust	2.0	20.7%	24.5%	4138	2069.0	2.8%
RD1 Royal United Hospitals Bath NHS Foundation Trust	2.0	19.2%	19.9%	8884	4442.0	1.8%
RNL North Cumbria University Hospitals NHS Trust	2.0	23.0%	26.1%	6291	3145.5	2.1%
R1F Isle of Wight NHS Trust	1.0	21.8%	22.3%	2552	2552.0	1.6%
RA3 Weston Area Health NHS Trust	1.0	24.9%	26.6%	4409	4409.0	1.9%
RBN St Helens and Knowsley Hospitals NHS Trust	1.0	19.4%	22.5%	12802	12802.0	1.2%
RGP James Paget University Hospital NHS Fundation Trust	1.0	22.1%	24.8%	5262	5262.0	1.2%

HES code and trust	Respiratory medicine	% cases resp CMGs (J2-j8)	% resp long stay as % all long stay	Total cases resp CMGs (J2-j8)	Resp cases per consultant	Resp consultants as % all medical staff
RA4 Yeovil District Hospital NHS Foundation Trust	0.0	17.2%	20.8%	3103		0.0%
RAJ Southend University Hospital NHS Foundation Trust	0.0	22.2%	27.2%	8044		0.0%
RBT Mid Cheshire Hospitals NHS Foundation Trust	0.0	15.8%	21.1%	4907		0.0%
RDE Colchester Hospital University NHS Foundation Trust	0.0	18.4%	21.2%	6417		0.0%
RFS Chesterfield Royal Hospital NHS Foundation Trust	0.0	20.9%	25.4%	7449		0.0%

8.2. Cardiologists

The case-mix groups linked with cardiology are shown in Table 40. On average, these make up 10.5% of all medical cases (and 11.8% of longer stay cases). The proportion at trust level varied from under 8% of all cases (The Hillingdon Hospitals NHS Foundation Trust, St Helens and Knowsley Hospitals NHS Trust and The Dudley Group NHS Foundation Trust) to over 14% of cases in Dorset County Hospital NHS Foundation Trust, Basildon and Thurrock University Hospitals NHS Foundation Trust and North Cumbria University Hospitals NHS Trust.

Table 40. Case-mix groups linked with cardiology

I14	Other circulatory
I2	Angina pectoris and dyspepsia
I3	Acute myocardial infarction
I4	Chronic ischaemic heart disease

I6	Pericarditis
I7	Valve disorders
I8	Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat
I9	Heart failure and pulmonary oedema

The number of cardiologists recorded at these trusts varied from none at Chesterfield Royal Hospital NHS Foundation Trust, James Paget University Hospital NHS Foundation Trust and Northern Devon Healthcare NHS Trust, to over 10 in The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust and Taunton and Somerset NHS Foundation Trust.

Figure 10 plots the percentage of longer staying cardiology case types against cardiology as a % of all medical consultants. Though there is a wide variation in the numbers of cardiologist recorded at these hospitals, the proportion of cases shows less variation (whether looking at all cases or just the longer stay spells).

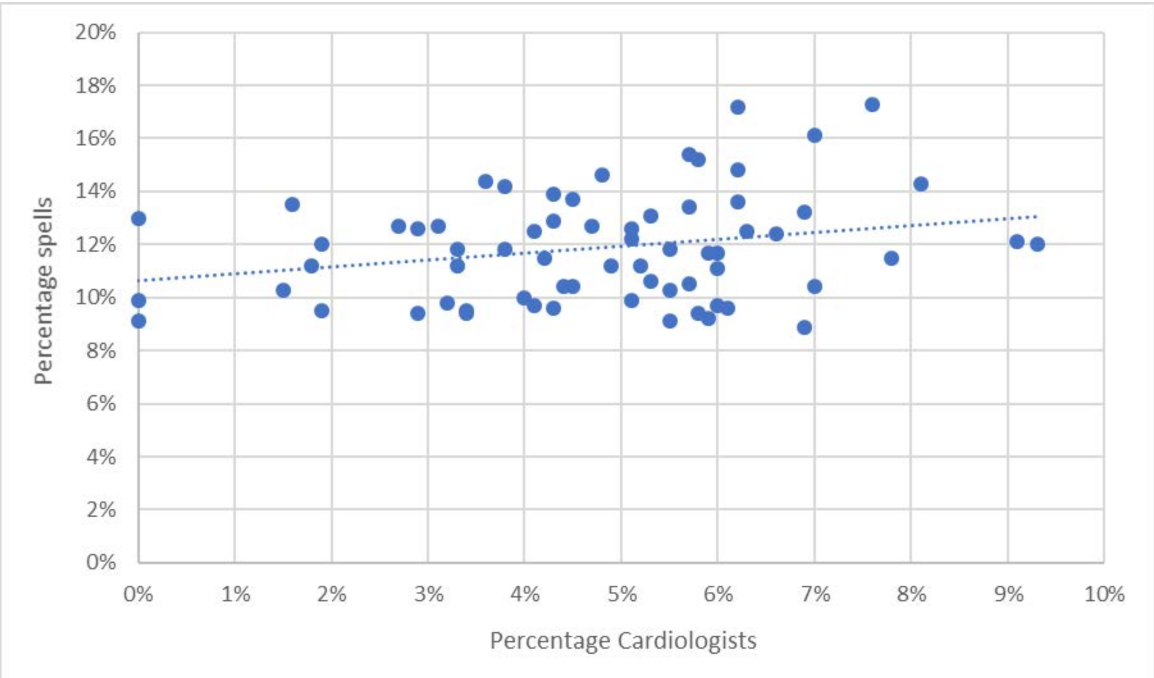

Figure 10. Percentage of spells with cardiac CMGs versus the percentage of consultant cardiologists in the overall medical consultant workforce

Table 41. Proportion of cases in selected cardiology CMGs versus number of cardiologists (top 10 trusts and bottom 10 trusts)

HES code and trust	No. cardiology consultants	Cardiology % all medical staff	% all cases in cardiology CMGs	% all long stay cases in cardiology CMGs	LOS cardiology CMGs excluding short stay
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	11.4	7.0%	13.0%	16.1%	4.9
RBA Taunton and Somerset NHS Foundation Trust	10.0	8.1%	12.8%	14.3%	4.7
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	9.9	6.2%	14.6%	17.2%	5.2
RAJ Southend University Hospital NHS Foundation Trust	9.8	6.9%	11.6%	13.2%	4.3
RD1 Royal United Hospitals Bath NHS Foundation Trust	9.8	6.2%	11.8%	14.8%	5.7
RWG West Hertfordshire Hospital NHS Trust	9.7	4.9%	11.5%	11.2%	5.7
RNQ Kettering General Hospital NHS Foundation Trust	9.0	9.1%	9.3%	12.1%	6.5

HES code and trust	No. cardiology consultants	Cardiology % all medical staff	% all cases in cardiology CMGs	% all long stay cases in cardiology CMGs	LOS cardiology CMGs excluding short stay
REM Aintree University Hospital NHS Foundation Trust	8.4	5.1%	9.4%	9.9%	4.2
RDE Colchester Hospital University NHS Foundation Trust	8.0	9.3%	11.4%	12.0%	5.5
RJ6 Croydon Health Services NHS Trust	8.0	5.7%	10.8%	10.5%	5.7
RQX Homerton University Hospital NHS Foundation Trust	2.6	1.9%	8.0%	12.0%	6.5
RN3 Great Western Hospitals NHS Foundation Trust	2.4	1.6%	13.0%	13.5%	4.7
RKE Whittington Health (The Whittington Hospital NHS Trust)	2.2	1.8%	8.7%	11.2%	7.5
R1F Isle of Wight NHS Trust	2.0	3.3%	12.3%	11.2%	5.9
RFR The Rotherham NHS Foundation Trust	2.0	3.2%	8.8%	9.8%	6.1
RA3 Weston Area Health NHS Trust	1.0	1.9%	10.3%	9.5%	4.9

HES code and trust	No. cardiology consultants	Cardiology % all medical staff	% all cases in cardiology CMGs	% all long stay cases in cardiology CMGs	LOS cardiology CMGs excluding short stay
RVY Southport and Ormskirk Hospital NHS Trust	1.0	1.5%	9.9%	10.3%	5.4
RBZ Northern Devon Healthcare NHS Trust	0.0	0.0%	11.4%	13.0%	5.9
RFS Chesterfield Royal Hospital NHS Foundation Trust	0.0	0.0%	9.0%	9.9%	6.5
RGP James Paget University Hospital NHS Foundation Trust	0.0	0.0%	10.0%	9.1%	5.0

8.3. Frailty and elderly care medicine consultants

We used the prevalence of the frailty flag to compare the numbers of consultants in elderly care medicine. At trust level, the portion of cases flagged as frail ranged from 14.4% to 39% of spells, and these equated to between 30% and 66% of acute medical bed days.

As Figure 11 shows, although the number of consultants described as elderly care medicine varied from zero to over 14, there was no relation between this number and the proportion of admitting spells where the patient has been flagged as frail (or potentially frail).

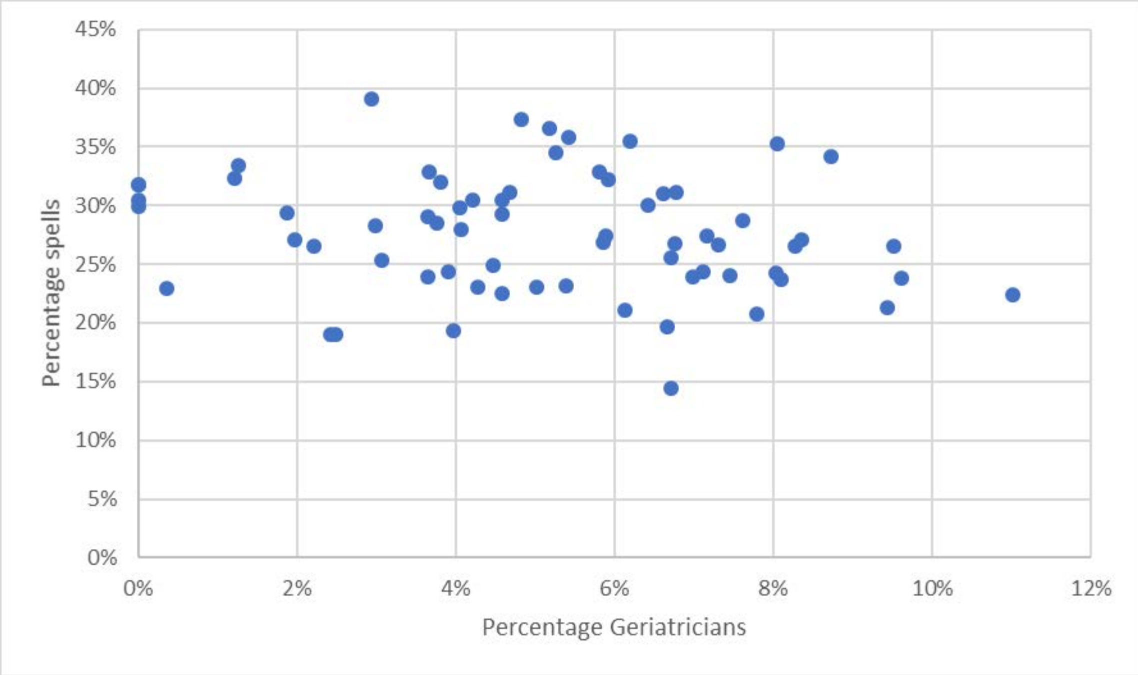

Figure 11. Percentage of spells flagged as 'frail' versus the percentage of consultant geriatricians in overall medical consultant workforce

Table 42. Number of consultants in elderly care medicine and the proportion of cases flagged as frail (top 10 trusts and bottom 10 trusts)

HES code and trust	No. consultants in elderly care medicine	% elderly care medicine consultants	% generalists	% frail spells	% frail bed days
RBL Wirral University Teaching Hospital NHS Foundation Trust	14.5	8.1%	52.3%	35.3%	64.3%
RD1 Royal United Hospitals Bath NHS Foundation Trust	13.0	8.3%	30.9%	26.6%	52.7%
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	13.0	8.1%	31.8%	23.7%	51.2%
RWG West Hertfordshire Hospital NHS Trust	13.0	6.6%	35.6%	31.0%	61.2%
RJ6 Croydon Health Services NHS Trust	12.3	8.7%	48.3%	34.2%	55.8%
RBN St Helens and Knowsley Hospitals NHS Trust	12.1	7.3%	41.6%	26.6%	55.3%
REM Aintree University Hospital NHS Foundation Trust	11.0	6.7%	38.6%	19.7%	44.7%
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	11.0	6.7%	0.0%	14.4%	30.2%
RD3 Poole Hospital NHS Foundation Trust	10.7	9.6%	40.0%	23.8%	43.1%

HES code and trust	No. consultants in elderly care medicine	% elderly care medicine consultants	% generalists	% frail spells	% frail bed days
RBA Taunton and Somerset NHS Foundation Trust	10.3	8.4%	39.9%	27.0%	53.6%
RGP James Paget University Hospital NHS Foundation Trust	2.0	2.4%	83.3%	19.0%	38.2%
RLQ Wye Valley NHS Trust	2.0	3.6%	34.0%	24.0%	43.3%
RAJ Southend University Hospital NHS Foundation Trust	1.8	1.3%	35.5%	33.4%	52.4%
RMC Bolton Hospital NHS Foundation Trust	1.6	1.2%	30.5%	32.3%	52.1%
RA3 Weston Area Health NHS Trust	1.0	1.9%	67.2%	29.4%	56.5%
RBZ Northern Devon Healthcare NHS Trust	0.3	0.4%	80.9%	22.9%	44.4%
R1F Isle of Wight NHS Trust	0.0	0.0%	53.4%	31.7%	56.0%
RD8 Milton Keynes University Hospital NHS Foundation Trust	0.0	0.0%	40.6%	31.8%	57.2%
RFS Chesterfield Royal Hospital NHS Foundation Trust	0.0	0.0%	76.7%	29.9%	52.0%
RJN East Cheshire NHS Trust	0.0	0.0%	37.8%	30.5%	52.3%

8.4. Gastroenterologists

The specific gastroenterology CMGs make up a smaller part of the overall acute medical case mix – 5-10% of all acute medical cases.

Table 43. Case-mix groups linked with gastroenterology

K1 Oesophagitis and ulcers of the digestive system and gastritis
K2 Crohn's and other intestinal diseases
K3 Failing liver and alcoholic liver disease
K4 Gallbladder and biliary tree diseases
K5 Acute pancreatitis
K6 Other digestive and dysphagia

The number of consultant gastenterologists ranges from 0 to 13. Although there is wide variation in the per cent of gastroenterology consultants, there is less variation in case mix.

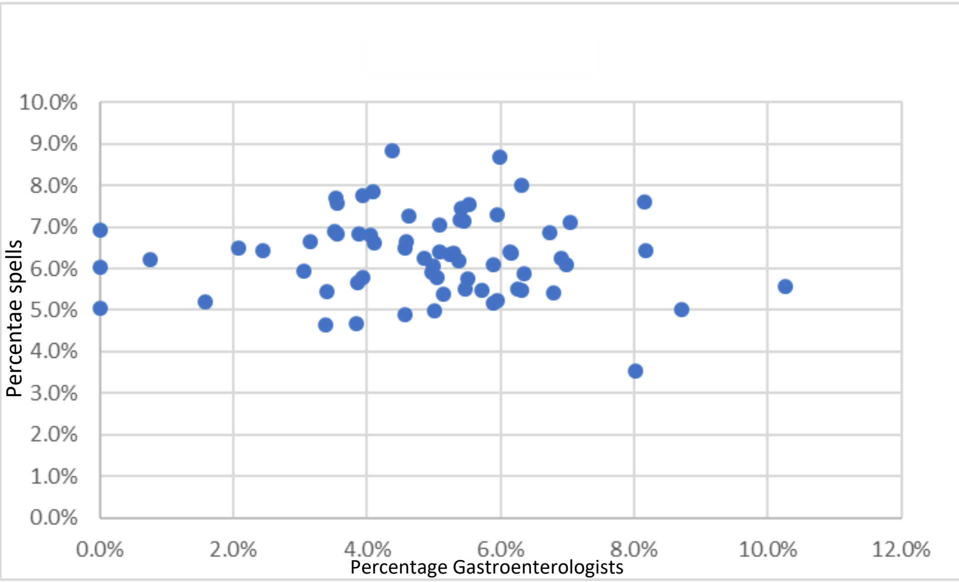

Figure 12. Percentage of spells in gastroenterology CMGs versus percentage of gastroenterology consultants in the overall medical consultant workforce

Table 44. Number of gastroenterology consultants in smaller hospitals and percentage of spells in gastroenterology case types (top 10 trusts and bottom 10 trusts)

HES code and trust	No. consultant gastroenterologists	% consultant gastroenterology	% all cases in gastroenterology CMGs	% all long stay cases in Gastroenterology CMGs
RNS Northampton General Hospital NHS Trust	13.1	10.3%	5.5%	5.6%
RBL Wirral University Teaching Hospital NHS Foundation Trust	11.0	6.1%	5.8%	6.4%
REM Aintree University Hospital NHS Foundation Trust	10.4	6.3%	7.9%	8.0%
RD1 Royal United Hospitals Bath NHS Foundation Trust	10.0	6.4%	5.0%	5.9%
RR7 Gateshead Health NHS Foundation Trust	9.5	8.1%	6.3%	7.6%
RAX Kingston Hospital NHS Foundation Trust	9.5	8.2%	5.5%	6.4%
RBN St Helens and Knowsley Hospitals NHS Trust	9.0	5.5%	7.4%	7.2%

HES code and trust	No. consultant gastroenterologists	% consultant gastroenterology	% all cases in gastroenterology CMGs	% all long stay cases in Gastroenterology CMGs
RDZ The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	9.0	5.5%	6.4%	7.6%
RNQ Kettering General Hospital NHS Foundation Trust	8.6	8.7%	6.0%	5.0%
RDD Basildon and Thurrock University Hospitals NHS Foundation Trust	8.0	5.0%	5.2%	6.1%
R1F Isle of Wight NHS Trust	2.4	3.9%	7.3%	5.8%
RJN East Cheshire NHS Trust	2.0	3.1%	7.8%	6.6%
RNL North Cumbria University Hospitals NHS Trust	2.0	2.1%	6.8%	6.5%
RVY Southport and Ormskirk Hospital NHS Trust	2.0	3.1%	5.4%	5.9%
RA3 Weston Area Health NHS Trust	1.8	3.4%	4.6%	4.7%
RFR The Rotherham NHS Foundation Trust	1.0	1.6%	4.4%	5.2%

HES code and trust	No. consultant gastroenterologists	% consultant gastroenterology	% all cases in gastroenterology CMGs	% all long stay cases in Gastroenterology CMGs
RPA Medway NHS Foundation Trust	1.0	0.8%	5.8%	6.2%
RBZ Northern Devon Healthcare NHS Trust	0.0	0.0%	4.8%	5.0%
RFS Chesterfield Royal Hospital NHS Foundation Trust	0.0	0.0%	5.0%	6.0%
RGP James Paget University Hospital NHS Foundation Trust	0.0	0.0%	6.2%	6.9%

8.5. Summary

These results indicate that for selected specialties the balance between general and specialist roles varies quite widely between hospitals. However, there was much less difference between the acute emergency case mix seen in these hospitals. It is important to note that we do not describe all hospital activity and the complete workload of these clinical teams.

9. Differences in case mix associated with acute medical typology

9.1. Background and methods

In this section we explore whether there were any major differences in case mix associated with the hospital typologies identified in the main report. In this instance we looked for any strong simple relationships between the case mix and the individual elements in the typology.

The number of hospitals in each element is quite small, making it difficult to undertake conclusive analysis using the typology as a variable.

The following analysis is based on matching the typology to hospitals in the HES data sets. Note that typologies were only available for a subset of hospitals. In the following analysis we have considered the variables in two pairs: the acute medical unit types (AMU1 and AMU2) and the ward types (Ward1 and Ward2). We considered basic descriptors including:

a. The number of episodes per year, to test for differences in average size of the unit/activity
b. The average length of episodes (including and excluding short stay cases)
c. The proportion of cases in the top 10 CMGs – as a marker of whether the overall case mix was typical of the groups as a whole (larger values indicate they are more like the group average)
d. The proportion of cases classified as frail
e. The ‘case-mix complexity’ value – an estimate of overall bed needs associated with that mix of cases.

Additional analysis of the frequency of case types by subtype is not reported here.

9.2. Findings

Table 45 summarises the results across the elements of the typology. The type of AMU was described in terms of two variables: AMU1 (Open/Closed/Partial) and AMU2 (APD/Mix/SpD). There were only eight hospitals where AMU1 was ‘Open’ and only five where AMU2 was SpD (specialty dominant).

Considering AMU1, there were no differences between Open/Closed or Partial AMUs in terms of the overall level of activity and the proportion flagged as ‘frail’. There was generally little difference between the largest subsets of hospitals with Closed or Partially Open AMU. There were no differences in the secondary characteristics of percentage of cases having procedures, percentage of patients aged over 74, percentage with secondary cancer diagnoses or percentage with short stays (table not shown).

The smaller groups of hospitals where AMU1 was Open did have slightly fewer pneumonia cases, but slightly more in ‘N3 Other genitourinary and retention of urine’ and ‘R1 Pain in throat and chest’.

Overall, there were very few consistent differences in the mix of cases according to the sub types of AMU or Ward. Although the smaller number of hospitals where the AMU was Open (n=8) made the numbers a bit more volatile, these differences were still not significant.

Table 45. Summary characteristics of hospitals classified using acute medical typology

		No. trusts	% short stay	All cases length of episode	Length of episode (excluding short stay)	% >74	average episodes per day	Case-mix 'complexity'
AMU1	Closed	18	56.8%	3.2	5.0	47.7%	86.5	1.02
	Open	8	54.9%	3.5	5.5	50.2%	78.1	1.02
	Partial	20	56.2%	3.3	5.3	46.7%	80.7	1.01
AMU2	APD	17	57.6%	3.2	5.2	49.7%	75.8	1.03
	Mix	24	55.0%	3.4	5.3	47.8%	84.3	1.01
	SpD	5	57.7%	3.1	4.9	41.8%	96.6	0.96
Ward1	Closed	23	57.0%	3.3	5.3	47.2%	84.4	1.02
	Open	3	58.9%	3.3	5.6	41.3%	60.8	0.96
	Partial	19	55.1%	3.3	5.1	48.8%	84.4	1.01

		No. trusts	% short stay	All cases length of episode	Length of episode (excluding short stay)	% >74	average episodes per day	Case-mix 'complexity'
Ward2	GMW	20	56.9%	3.3	5.4	48.3%	81.7	1.01
	SpW	26	55.7%	3.3	5.1	47.2%	83.1	1.01
	Grand total	46	56.2%	3.3	5.2		82.5	

The two variables associated with ward type were Ward1 (Closed/Open/Partial) and Ward2 (predominantly specialist (SpW) or General Medical Ward (GMW)). Table 46 summarises some basic characteristics according to both of these variables. Note that one hospital was excluded from this table as it had no classifications for Ward2. There were only three hospitals where Ward1 was Open – and so summary values for this must be considered with extreme caution.

In terms of the Ward1 variable, there was very little difference between hospitals classified as either Closed or Partially Open in terms of the total episodes per year, or the percentage of cases classified as frail, or the percentage of cases in the top 10 most common CMGs.

There was also very little difference between the two patterns of downstream wards. Overall annual activity was about the same, as was the average episode length, and the percentage of cases in the top 10 CMGs. The proportion of cases labelled as frail was very slightly lower in SpD hospitals (29.7% versus 31.75%).

Tables 47 and 48 compare the proportion of cases in high volume case types for the subsets of AMU1 and Ward1 typologies. There are small differences between these, but overall the similarity in the mix of cases is striking. Table 48 shows the proportion of cases in the most common CMGs according to Ward1 type – and shows little difference between hospitals classified as either Closed or Partial. The few hospitals that were 'Open' do show some differences, but this a small sample so it is difficult to be sure of the significance of these.

Table 46. Percentage of cases in CMGs according to AMU1 type (top 15 CMGs only shown)

CMG	% of cases			
	Closed	Open	Partial	Grand total
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	12.4%	11.7%	12.4%	12.1%
N3 Other genitourinary and retention of urine	5.2%	5.8%	5.3%	5.3%
R1 Pain in throat and chest	4.7%	5.6%	4.9%	4.9%
J4 Chronic lung disease inc. COPD	4.6%	4.6%	4.5%	4.7%
I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat	3.4%	3.3%	3.5%	3.4%
R4 Signs/symptoms not elsewhere classified	3.0%	3.5%	3.2%	3.1%
M1 Joints	2.7%	3.6%	3.0%	2.9%
I9 Heart failure and pulmonary oedema	2.9%	2.5%	2.7%	2.8%
G4 Transient ischaemic attacks and dizziness and giddiness	2.8%	2.8%	2.7%	2.7%
I3 Acute myocardial infarction	2.6%	2.5%	2.6%	2.6%
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	2.9%	2.6%	2.6%	2.6%
R2 Skin and cellulitis	2.6%	2.6%	2.6%	2.6%
T1 Poisoning	2.4%	1.9%	2.2%	2.2%

CMG	% of cases			
	Closed	Open	Partial	Grand total
A1 Intestinal infections and nausea and vomiting	2.2%	2.2%	2.2%	2.2%
R3 Abnormalities of gait and mobility	2.2%	2.5%	2.0%	2.2%

Table 47. Comparing case mix of hospitals grouped according to Ward1 (top 15 trusts)

CMG	% of cases			
	Closed	Open	Partial	Grand total
J3 Pneumonia (aspiration) and LRTI and pneumonitis due to solids and liquids	12.6%	11.8%	11.8%	12.1%
N3 Other genitourinary and retention of urine	5.2%	5.0%	5.5%	5.3%
R1 Pain in throat and chest	4.9%	4.4%	5.1%	4.9%
J4 Chronic lung disease inc. COPD	4.6%	3.3%	4.6%	4.7%
I8 Conduction disorder, tachycardia arrhythmias atrial fibrillation and abnormalities of heart beat	3.4%	3.0%	3.5%	3.4%
R4 Signs/symptoms not elsewhere classified	3.3%	2.9%	3.0%	3.1%
M1 Joints	3.0%	2.7%	2.8%	2.9%
I9 Heart failure and pulmonary oedema	2.7%	3.0%	2.8%	2.8%
G4 Transient ischaemic attacks and dizziness and giddiness	2.8%	1.9%	2.9%	2.7%
I3 Acute myocardial infarction	2.5%	1.8%	2.7%	2.6%

CMG	% of cases			
	Closed	Open	Partial	Grand total
I10 Cerebrovascular haemorrhages/stroke/cerebral infarction	2.7%	2.6%	2.9%	2.6%
R2 Skin and cellulitis	2.6%	2.6%	2.5%	2.6%
T1 Poisoning	2.2%	2.0%	2.3%	2.2%
A1 Intestinal infections and nausea and vomiting	2.1%	2.5%	2.2%	2.2%
R3 Abnormalities of gait and mobility	1.9%	2.5%	2.5%	2.2%

9.3. Summary

In this short analysis we looked for major differences associated with the typology used to describe acute medical care. Overall we did not find any significant differences in some basic case-mix descriptors that were indicative of a relationship between the organisational typology and the case mix of admitted patients. The overall impression was that although hospitals had developed lots of different ways of organising medical services, the underlying mix of acute medical cases that were being treated was pretty much the same across smaller hospitals.

References

1. Monitor. *Facing the future: smaller acute providers*. London: Monitor; 2014.

2. NHS Digital. *Hospital Admitted Patient Care Activity, 2016-17.* 2018. URL: https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity/2016-17.

3. Royal College of Physicians. *Acute care toolkit 10: Ambulatory emergency care.* London: Royal College of Physicians; 2015.

4. Office for National Statistics. *Population estimates for the UK, England and Wales, Scotland and Northern Ireland - Office for National Statistics*. 2017. URL: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2016 (Accessed 9 November 2018).

5. Ministry of Housing, Communities and Local Government. English indices of deprivation. London: Department for Communities and Local Government; 2015. URL: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/465791/English_Indices_of_Deprivation_2015_-_Statistical_Release.pdf.

6. Fetter RB, Shin Y, Freeman JL, Averill RF, Thompson JD. Case mix definition by diagnosis-related groups. *Med Care* 1980;**18**:iii, 1–53.

7. Kitagawa EM. Components of a Difference Between Two Rates. *Journal of the American Statistical Association* 1955;**50**:1168–94. https://doi.org/10.2307/2281213.

8. Jenkins LM, Bardsley MJ. Using DRGs to Separate Case Mix in the UK From Trends in Length of Stay. In: Roger FH, Grönroos P, Tervo-Pellikka R, O'Moore R. (eds) Medical Informatics Europe 85. Lecture Notes in Medical Informatics, vol 25. Berlin: Springer; 1985.