Gateway Reference: 06662

Paediatric Critical Care and Specialised Surgery in Children Review

Paediatric critical care and ECMO: interim update

June 2017

Contents

Executive summary

NHS England is undertaking a review of paediatric critical care and specialised surgery in children. This pack focuses on critical care, as well as Extracorporeal Membrane Oxygenation (ECMO). Data on specialised surgery in children is the subject of a separate analysis.

Paediatric critical care is a highly valued specialised service that saves the lives of children, costing around £230m per year. It delivers high quality outcomes, but there is evidence to suggest that critical care services are not sustainable in their current form. Significant peaks in winter and high average occupancy creates real pressures on units during some parts of the year.

To further understand these pressures, the review has undertaken analysis of data supplied by paediatric intensive care units to the Paediatric Intensive Care Audit Network (PICANet). The analysis shows that demand for these services is changing, with relatively stable admissions but increasing average length of stay. There are significant seasonal peaks, driven largely by unplanned respiratory admissions, and a small number of technology-dependent children accounting for a large proportion of resources. Most of the increased demand seen over recent years has been for the most basic levels of intensive care.

This data suggests that some children could be moved out of paediatric intensive care units into more appropriate settings. These settings may also be closer to the child's home. To enable this shift, however, a new model of care for these services is needed.

Additional modelling has been undertaken to understand what the impact of these pressures would be if patients continued to be treated in the same place. This shows that the model of care in its current form will not be sufficient to meet future demand. Developing a new model of care that ensures that patients are treated in the right place could improve patient experience as well as make services affordable in the future.

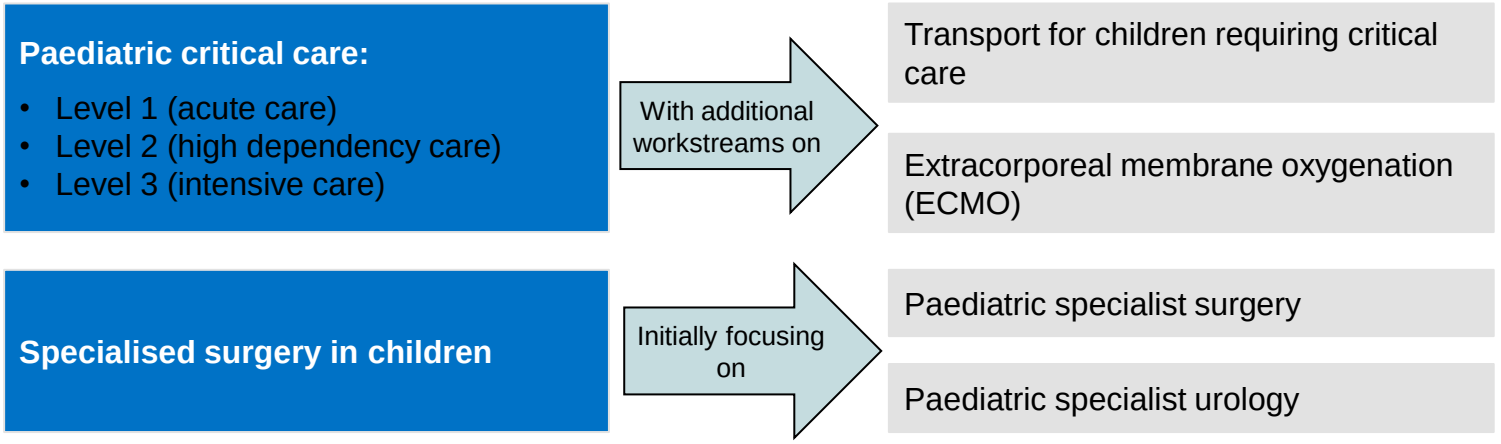
The review is now using the data presented in this pack, as well as extensive stakeholder engagement, to develop a proposed future model of care. Comments on the analysis are welcomed and can be sent to england.paedsreview@nhs.net.

1. Introduction

1.1 NHS England is conducting a review of paediatric critical care and specialised surgery in children

NHS England's review aims to develop a sustainable model of care for paediatric critical care and specialised surgery in children that enables the current high quality of services to be delivered in an affordable way into the future.

The review is focusing on the following areas:



The review aims to develop a vision and proposals for these services, including the shape of a future model of care, and consult on these proposals by the end of the year.

The review's terms of reference can be found on the NHS England webpage.

This slide pack focuses on paediatric critical care and ECMO. The review has been able to make quicker progress in assessing demand and capacity in these areas because it has analysed existing data from the Paediatric Intensive Care Audit Network (PICANet).

Data on specialised surgery in children is currently the subject of separate analysis.

1.2 So why do we need a review, and what elements of these services need to change?

Paediatric critical care is a highly valued service that saves the lives of children in England every day. It is a specialised service, meaning that it is commissioned centrally by NHS England, although some care delivered outside of Paediatric Intensive Care Units (PICUs) is commissioned by CCGs. It is high cost, with annual expenditure of around £230m for the specialised elements alone, and delivers outcomes that are globally recognised as high quality through 23 units spread across England.

There is, however, evidence to suggest that, although quality is high, the services themselves are not sustainable in their current form. Significant peaks in winter and high average occupancy creates real pressures on units during some parts of the year. Early discussions with stakeholders identified a number of challenges that the review needs to address.

Paediatric critical care	• Significant seasonal pressures every winter • Balancing emergency / elective demand • Possible variation in admissions criteria across England • Increasing morbidity in those children who survive • Variable provision of high dependency care • Staffing critical care units to the appropriate levels
ECMO	• Reported inequity of access to respiratory ECMO • A need to transfer patients a significant distance to receive care • Lack of agreement about the model of service provision, the role of mobile ECMO, and the need for minimum standards • Variable referral arrangements • Seasonal demand for ECMO services

To explore these challenges further, the review has undertaken analysis of critical care activity using data from the Paediatric Intensive Care Audit Network (PICANet), the national clinical audit which has been collecting data on paediatric intensive care since 2002. The analysis presented here therefore focuses on care delivered in PICUs. Data on high dependency care is also included in this analysis where that care has been delivered on a PICU.

1.3 Our analysis of the data draws highlights the current pressures on critical care

NHS England's analysis supports an initial hypothesis that – if the model of paediatric critical care does not change – the services will not be sustainable or affordable in the medium to long term. It demonstrates that, although admissions to paediatric critical care have remained relatively stable over the last three years, the service is facing increasing pressures:

- Some of these pressures are seasonal, with peaks in winter, driven largely by unplanned respiratory admissions, and troughs in the summer.
- The nature of the PIC population appears to be changing, with an increasing average length of stay and a small number of technology-dependent children accounting for a significant proportion of resources.
- Most of the increase in bed days seen over the last five years has been in those children who require the most basic levels of intensive care.
- Units vary in their size and case mix, which may affect their ability to absorb unplanned demand. Units also vary in their rates of ventilation, which may suggest differences in admissions criteria as well as variation in case mix.

To further determine the extent of these pressures, the review has undertaken modelling to project what the impact of these pressures would be if the model of care does not change. It shows that **the model of paediatric critical care in its current form will not be sufficient to meet future demand.**

The review has noted the following from this analysis:

- Some children could be moved out of PICUs into more appropriate settings that are enhanced in order to manage ill children outside of intensive care
- These settings are likely to be a better environment for children and closer to the child's home
- **A new model of care is required in order to facilitate this shift.**

1.4 NHS England would welcome your comments on this analysis to support the next stage of the review

The review is now using the data presented in this pack, as well as extensive engagement with stakeholders, to develop proposals for a future model of care that delivers the high quality of services that we currently see in a way that is affordable into the future.

We will be developing and testing this model over the coming months, working with the commissioners, providers and clinicians that will be involved in its delivery, as well as the patients and parents who will experience these services. We will be considering how a future model of care could enable those patients who could more appropriately be treated outside of intensive care, such as those patients on long term ventilation, to move to a more appropriate environment that may also be closer to home.

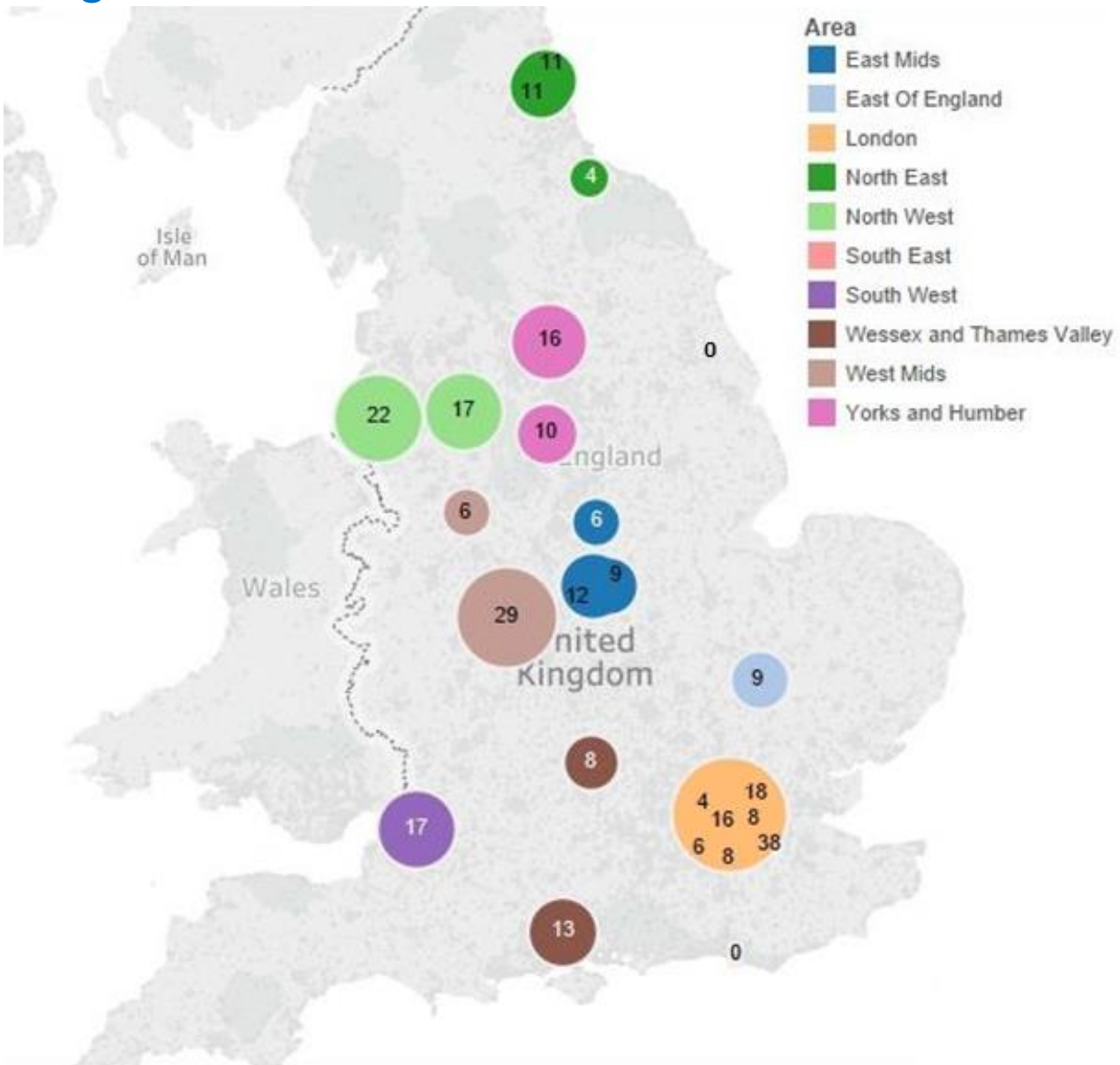
Comments on this analysis and our initial conclusions are welcomed, and can be sent to england.paedsreview@nhs.net. They will be considered as the review develops. There will be further opportunities to engage in the review over the coming months; please visit NHS England's webpage or send an email to the address above and ask to be added to our mailing list.

A note on the data

- This information pack uses data from the PICANet which has been analysed and interpreted by NHS England.
- It is important to note that the current analysis only considers English patients being treated in English units. NHS England is aware that some patients from Scotland, Wales and Northern Ireland travel to English units for treatment, but this initial analysis focuses on English demand. Further analysis may consider patient flows between administrations.
- Data submitted to PICANet, and therefore this analysis, is on the basis of funded beds reported by the units. We are aware that, at times, capacity may vary within a unit depending on staff resource and case mix but also on local commissioning arrangements.
- The methodology used by NHS England in this analysis can be found in appendix 2.

2. Context

2.1 There are 23 Paediatric Intensive Care Units (PICUs) in England



The circles on this map represent the location of funded PICUs.

The numbers, and the diameter of the circles, reflect the number of funded beds in the unit, as reported to PICANet in May/June 2015.

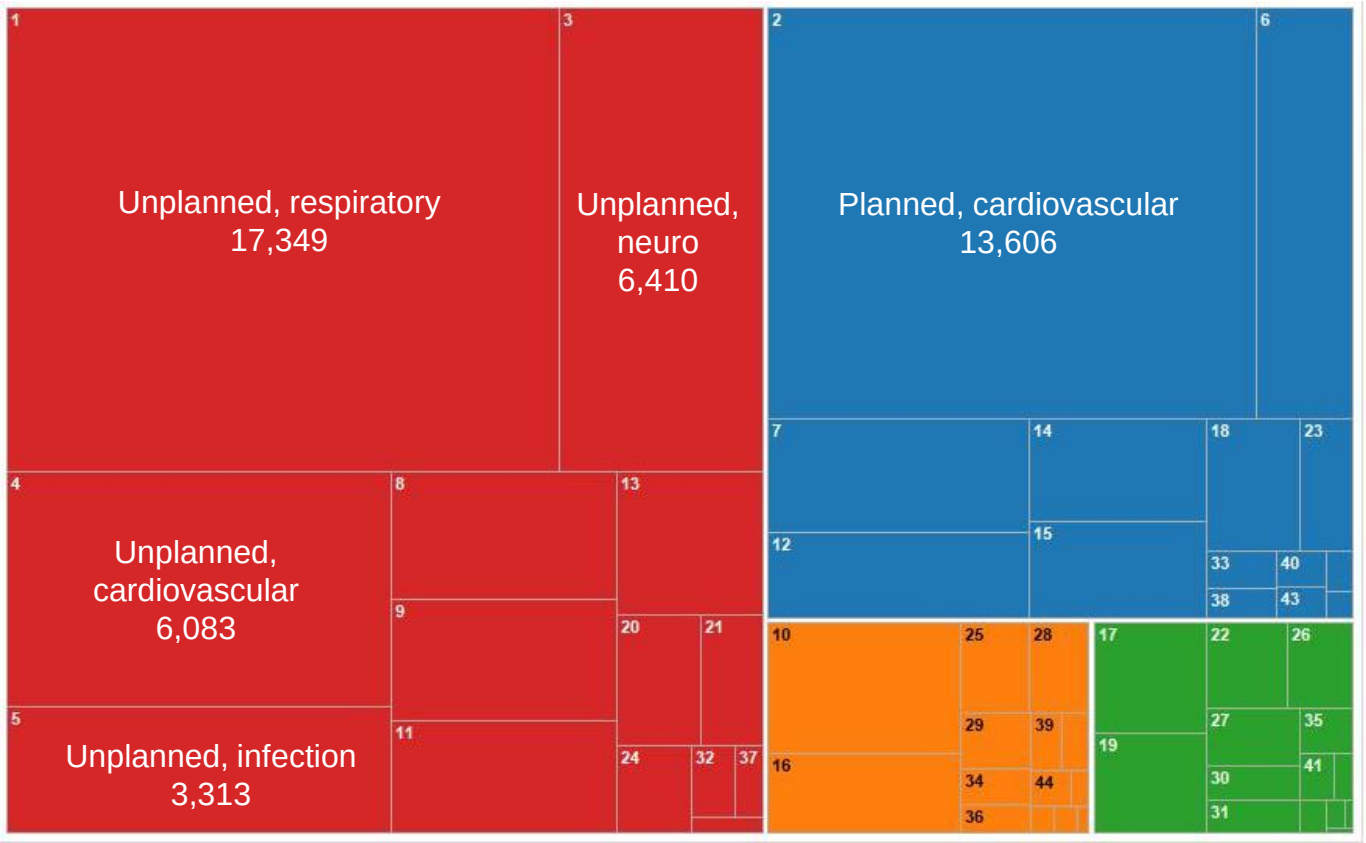
Some units have been grouped together due to their geographical proximity. It is possible that during busy periods the number of beds on units may be increased.

The units have been colour-coded according to the hub in which they sit. There are ten specialised commissioning hubs across England, which are listed next to the map. Some of the analysis in the remainder of this pack is undertaken at hub level.

2.2 Children with cardiac and respiratory conditions make up the majority of admissions to PIC services

2011 – 2015 data shows that there were both planned and unplanned admissions to PIC services. Planned admissions include those resulting from children admitted following surgery (elective procedure), and unplanned admissions can result from children being admitted in an emergency, for example from A&E, another ward or another hospital, or unexpectedly following surgery.

- For **unplanned admissions** the main users are children with respiratory conditions.
- For **planned admissions** the main users are children with cardiovascular conditions.



This infographic shows the five largest diagnostic categories. The other diagnostic categories that can not easily be shown here are listed in appendix 3 and correspond to the numbers in this infographic. They are ranked from 1 to 56 based on the number of admissions to PICUs.

3. Why are units under increasing pressure?

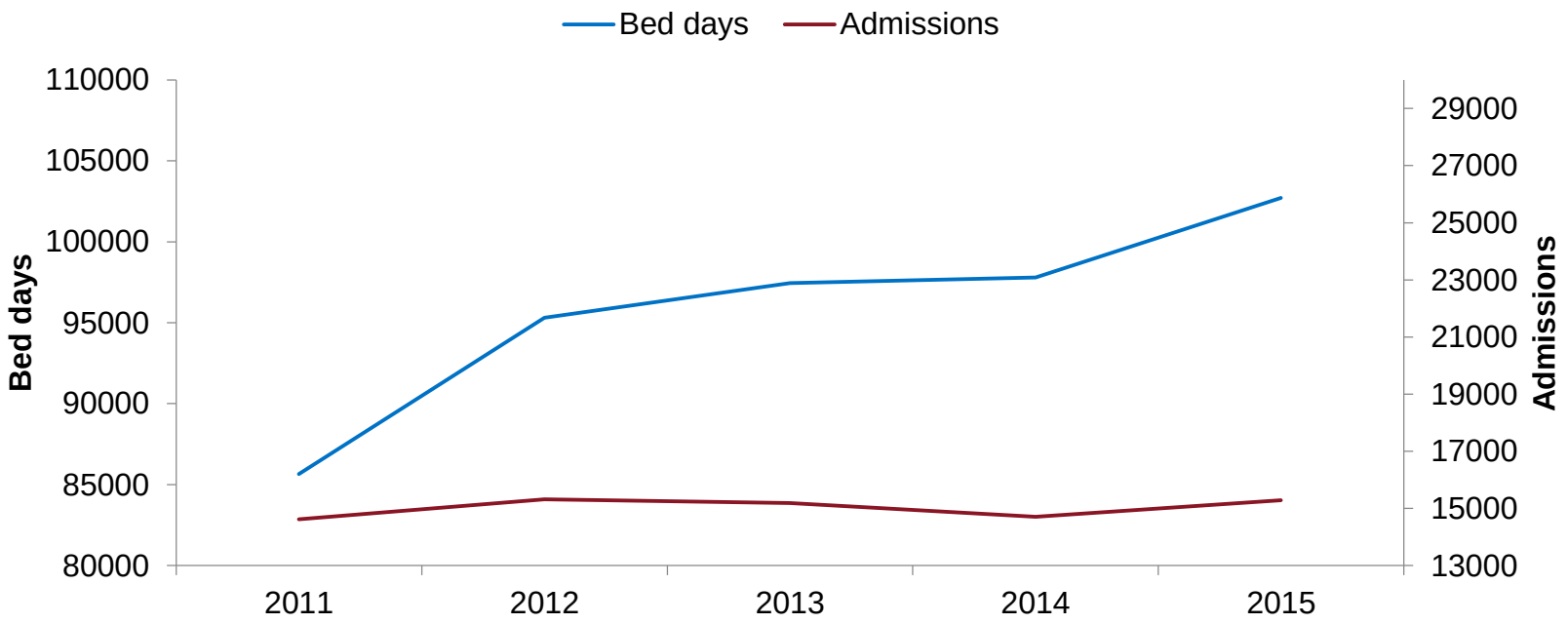
3.1 Demand for PICU is changing: admissions have remained relatively stable whilst bed days have increased

In order to understand the reasons for changing pressures on PICUs, the growth in admissions and growth in bed days were examined. The graph below demonstrates that between 2011 and 2015:

- The increase in admissions is in line with the national demographic growth rate (0.8%) and therefore represents a negligible real increase in admissions; however
- There was a 5% increase annually in bed days used.

This suggests that pressures on PICUs are caused by an increasing average length of stay as opposed to treating a greater number of children on PICUs. The review will need to explore the reasons for this, which may include the changing needs of children, particularly those who require mechanical support, and other factors such as delayed discharges.

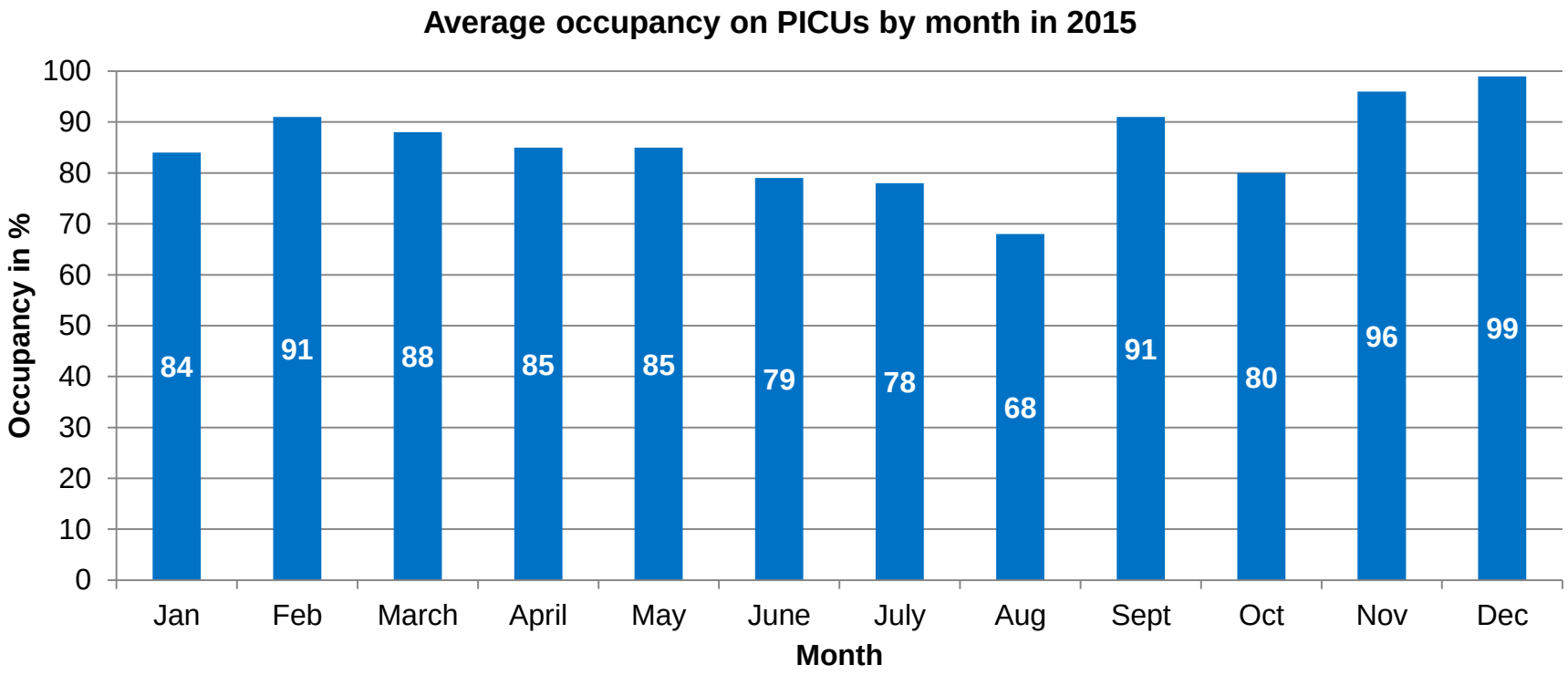
2011 to 2015 increase in bed days and admissions to PICUs



3.2 On an annual basis, PICU activity peaks in the winter months

There is seasonal variation in demand for PICU beds across the country. This graph shows that, in 2015, there was a peak in November and December. We know from PICANet data that these peaks occur annually; this graph shows data from a single year, however, because showing a longer time series would not account for the changes in bed numbers over that period.

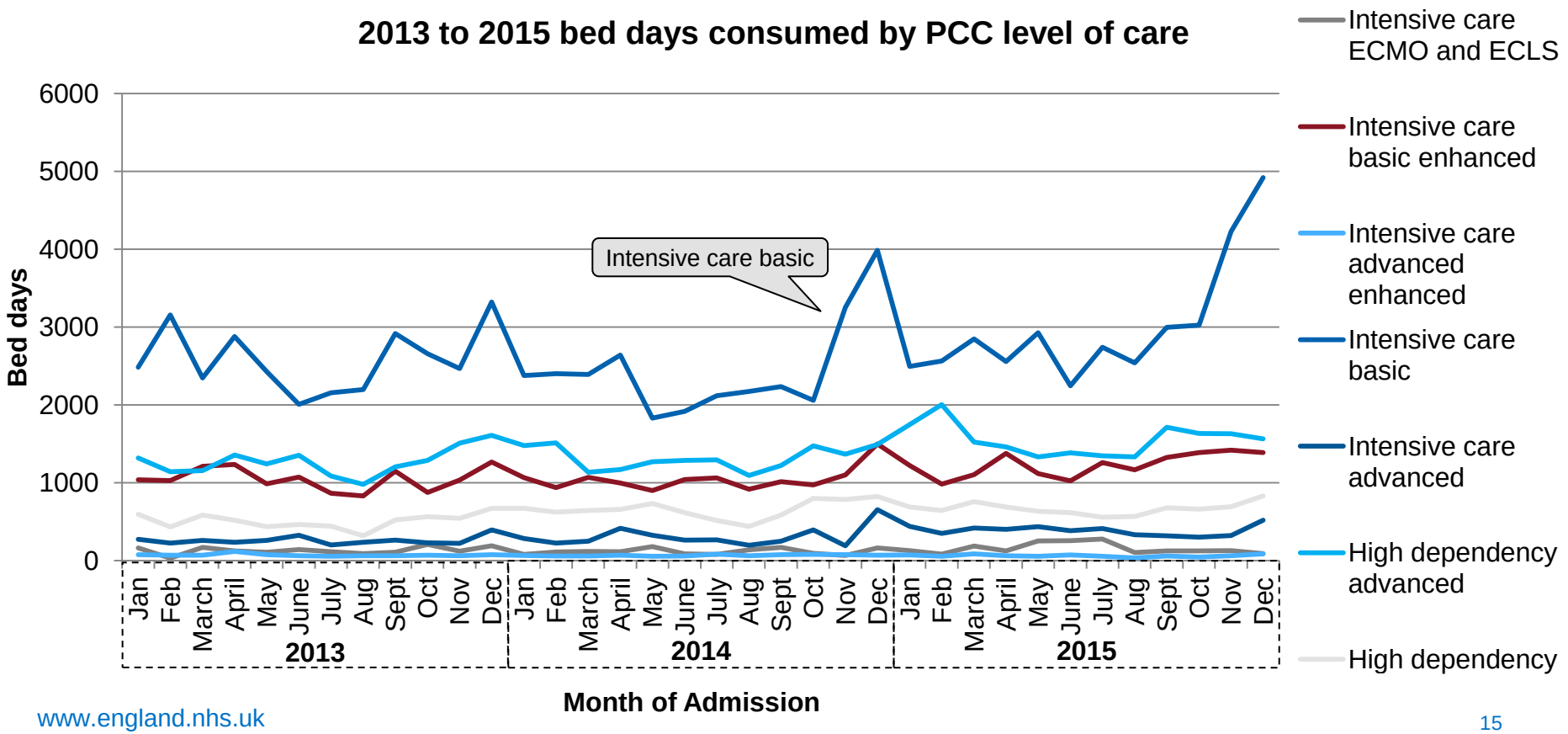
The graphs on subsequent slides show what is driving these seasonal peaks.



3.3 The winter admissions peak is driven by an increase in the number of children requiring basic intensive care…

Between 2013 and 2015, the highest proportion of bed days used on PICUs were occupied by children requiring basic intensive care. The seasonal demand was driven by an increase in the number of children requiring this level of care.

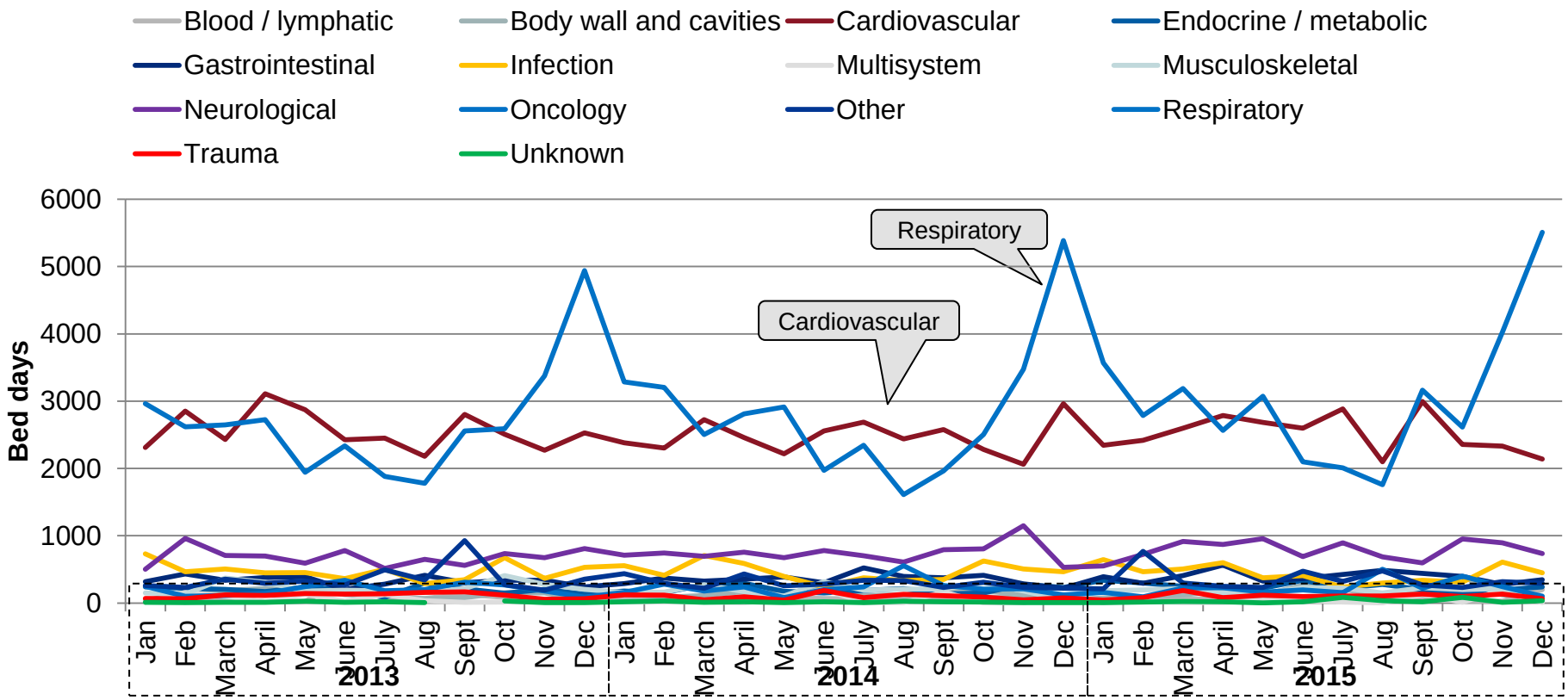
As can be seen from the graph below, children requiring the highest levels of intensive care (ECMO, advanced, and advanced enhanced) occupied the lowest volume of beds on PICUs between 2013 and 2015, and there was significantly less seasonal variation amongst these groups. As part of the development of a new model of care, the review will consider the optimal location for the provision of basic intensive care throughout the year, and how the increased demand for basic intensive care in winter can best be met.



3.4 …and is also driven by increases in respiratory illness during the winter months

The graph below shows the bed days used on PICUs for each diagnostic category between 2013 and 2015, and shows that the highest number of bed days used was due to respiratory infections such as bronchiolitis or pneumonia. An increase in these respiratory infections also drives the peak in admissions seen in November and December. Cardiovascular admissions accounted for the second highest volume of bed days used, but the data shows a small decrease in cardiovascular admissions in winter; this may be due to a reduction in the number of elective operations carried out over this period.

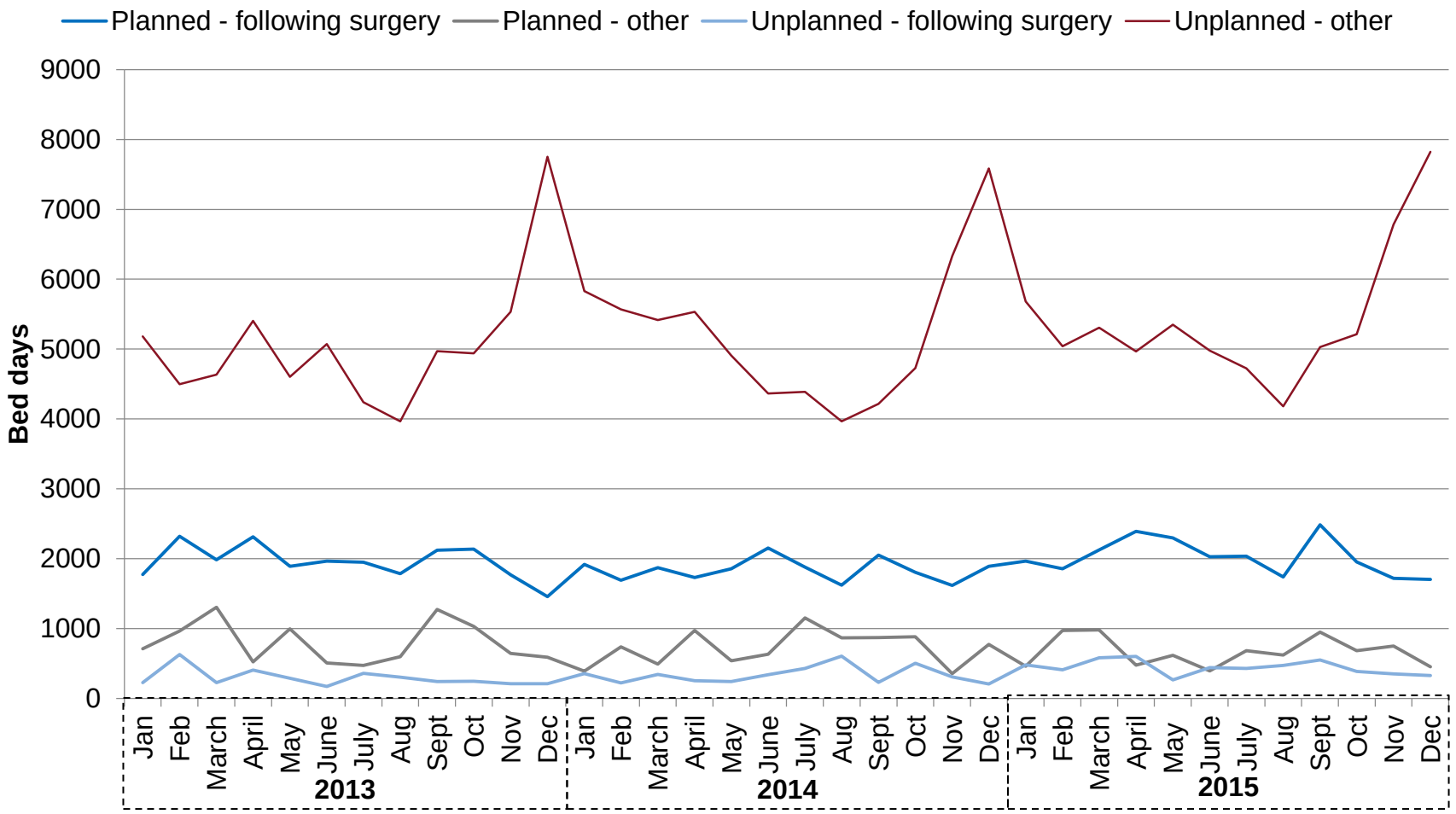
Bed days consummed by diagnostic category from 2013 to 2015, by month



3.5 The number of unplanned admissions significantly increases during winter

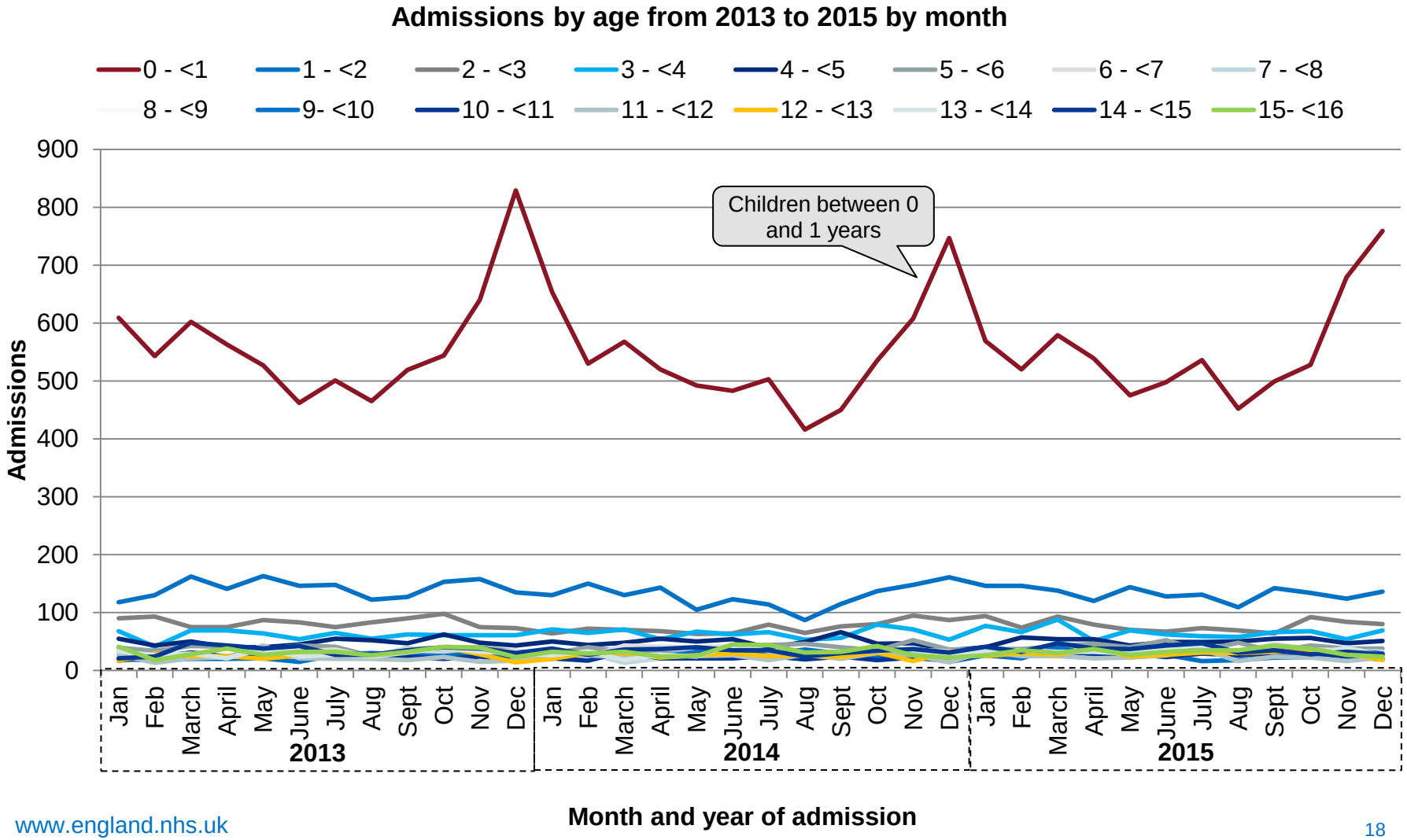
The previous slides show that peaks in demand for basic intensive care, and respiratory conditions, drive seasonal pressures. The graph below demonstrates that this activity is largely unplanned.

Bed days consumed by planned and unplanned admissions from 2013 to 2015



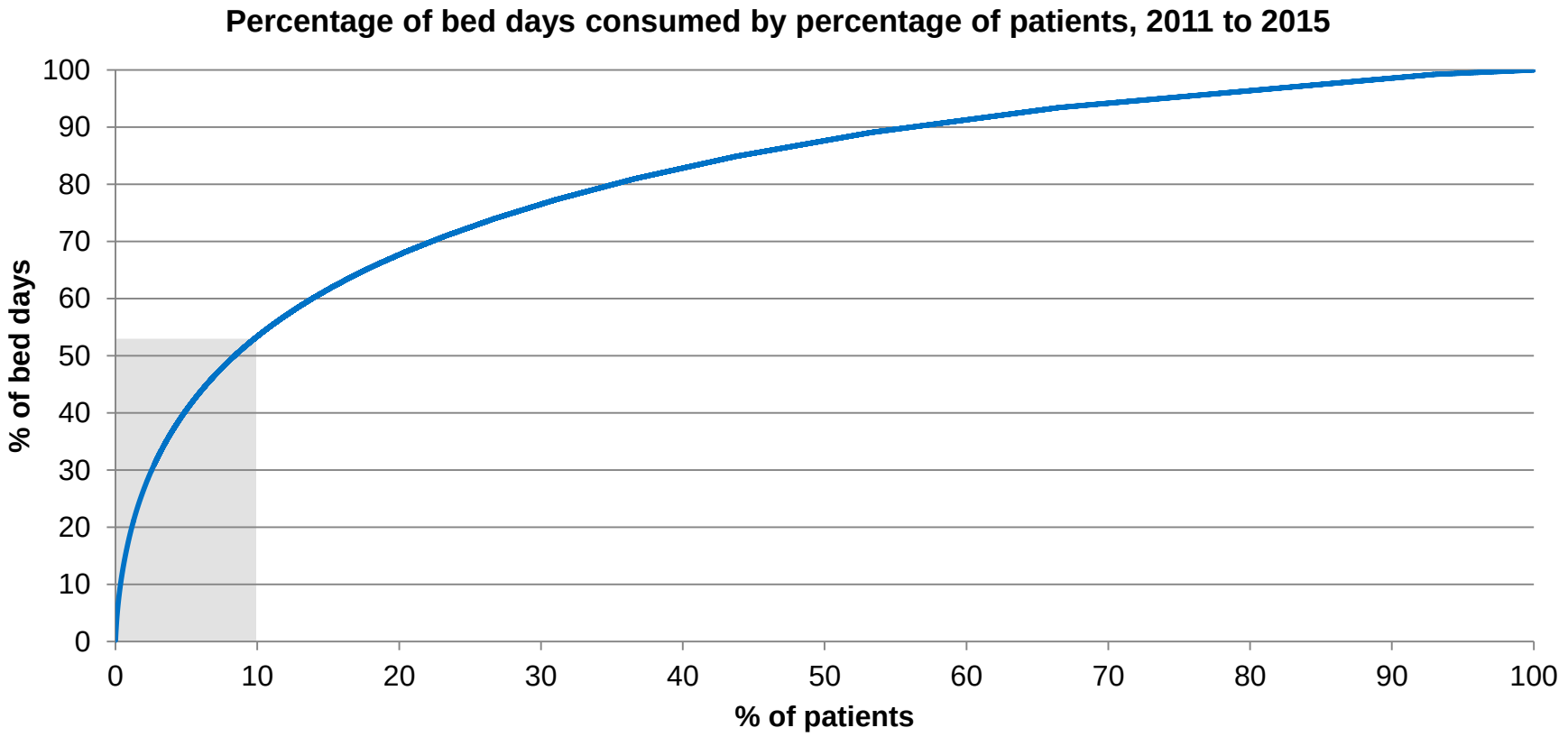
3.6 Most of this seasonal peak in activity is seen in children under the age of one

The data shows that the peaks in demand for unplanned, basic intensive care are largely driven by children who are under one year old.



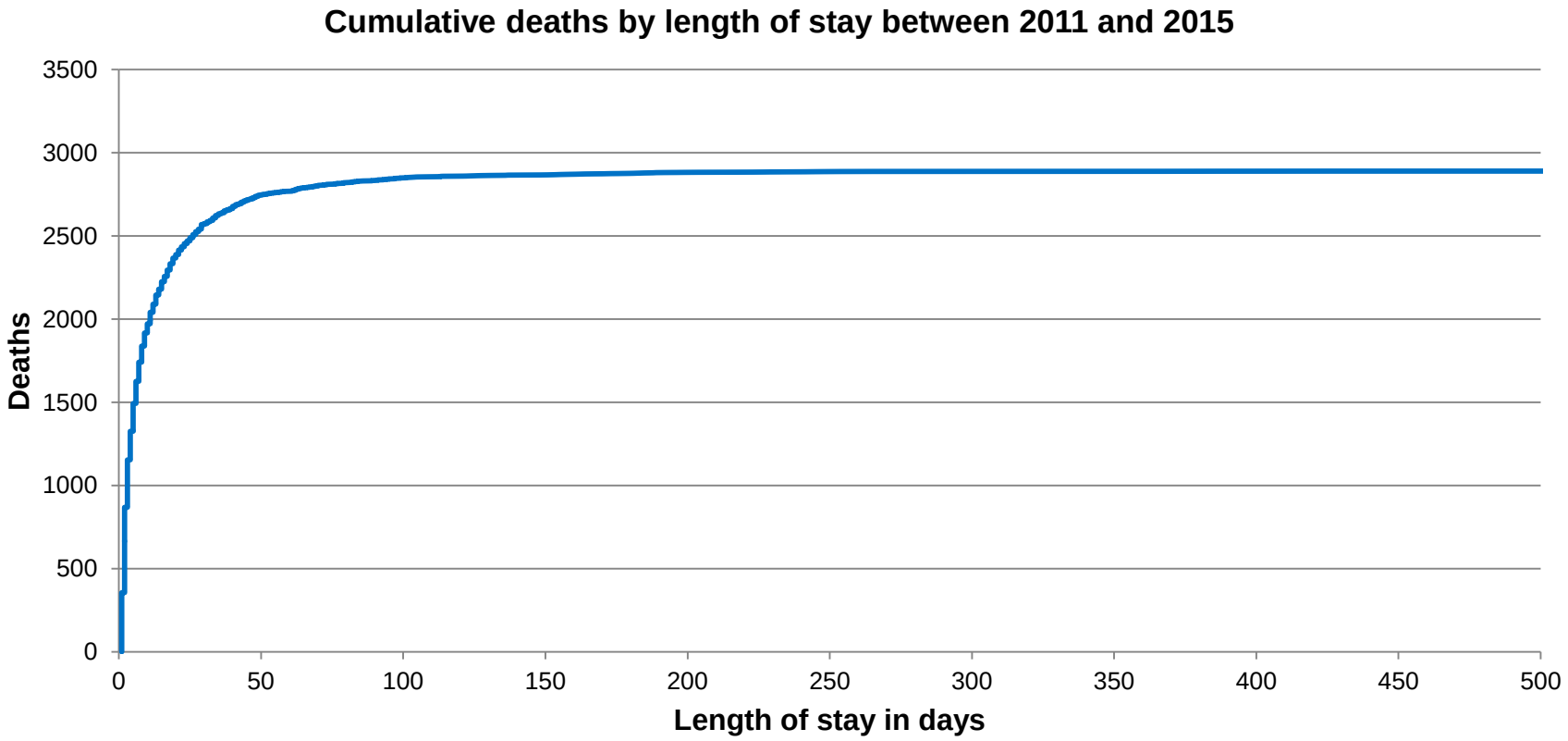
3.7 Ten per cent of children admitted to PICUs use more than half of resources

2011 to 2015 data from PICANet shows that 10% of children admitted to PICUs used over 50% of PICU resources . The review will be considering the nature of this cohort of patients, which is likely to be children with long-term, complex needs, and whether alternative care settings could benefit these children and their families as well as help to optimise the use of PICU beds. This is particularly important given the potential for further increased demand for critical care from children who have a life-limiting illness but who are surviving longer.



3.8 Most deaths that occur on PICUs happen after a relatively short stay

The graph below shows cumulative deaths of English patients on PICUs in England, between 2011 and 2015, arranged by length of stay. The steep slope on the left hand side of the graph suggests that most deaths occur after a relatively short stay on a PICU.

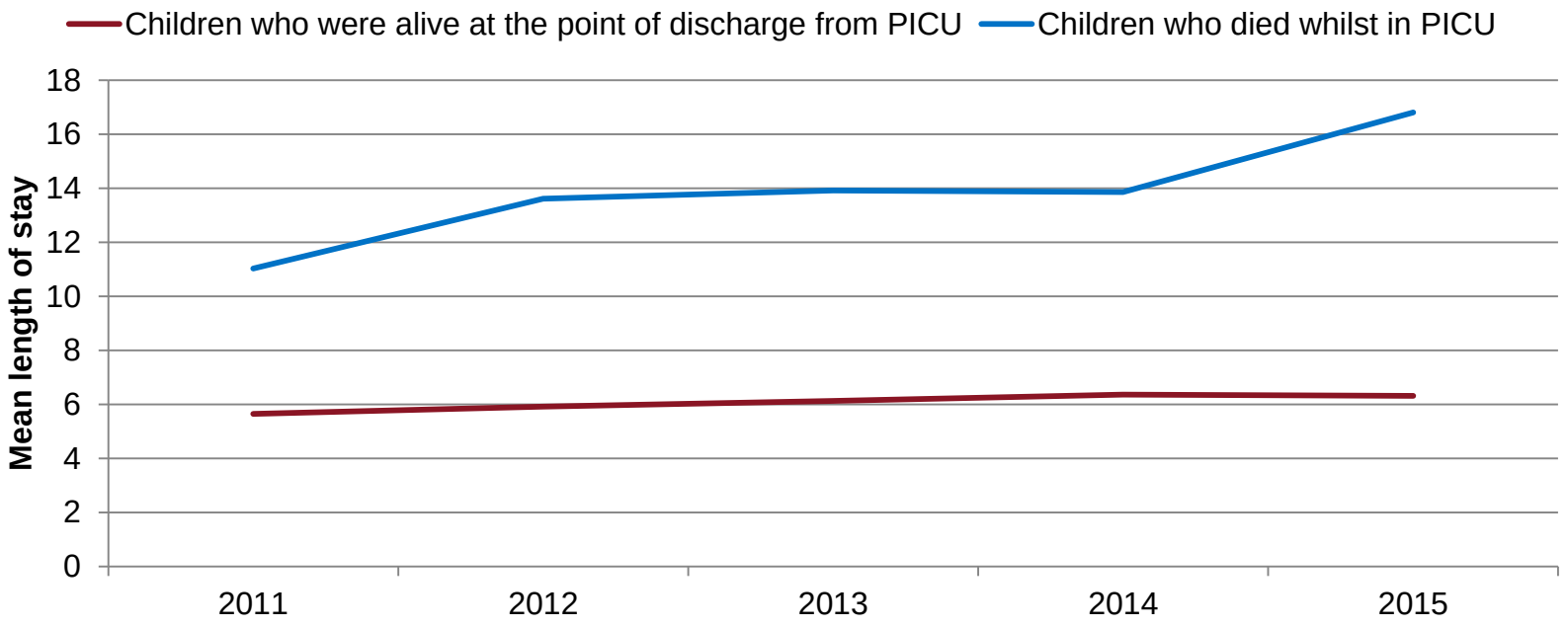


3.9 The number of bed days used to care for very poorly children who do not survive is growing

From 2011 to 2015, there was a 6% growth in the proportion of total days that were dedicated to caring for very poorly children who did not survive because of the terminal or complex nature of their condition. This could be a result of patients with more complex care needs being treated on PICUs.

Where individual units have a higher number of days spent caring for children who did not survive, this could indicate that they provide more complex care and admit children who are much sicker, compared to elsewhere.

Mean length of stay on PICU for children who survived and children who died between 2011 and 2015



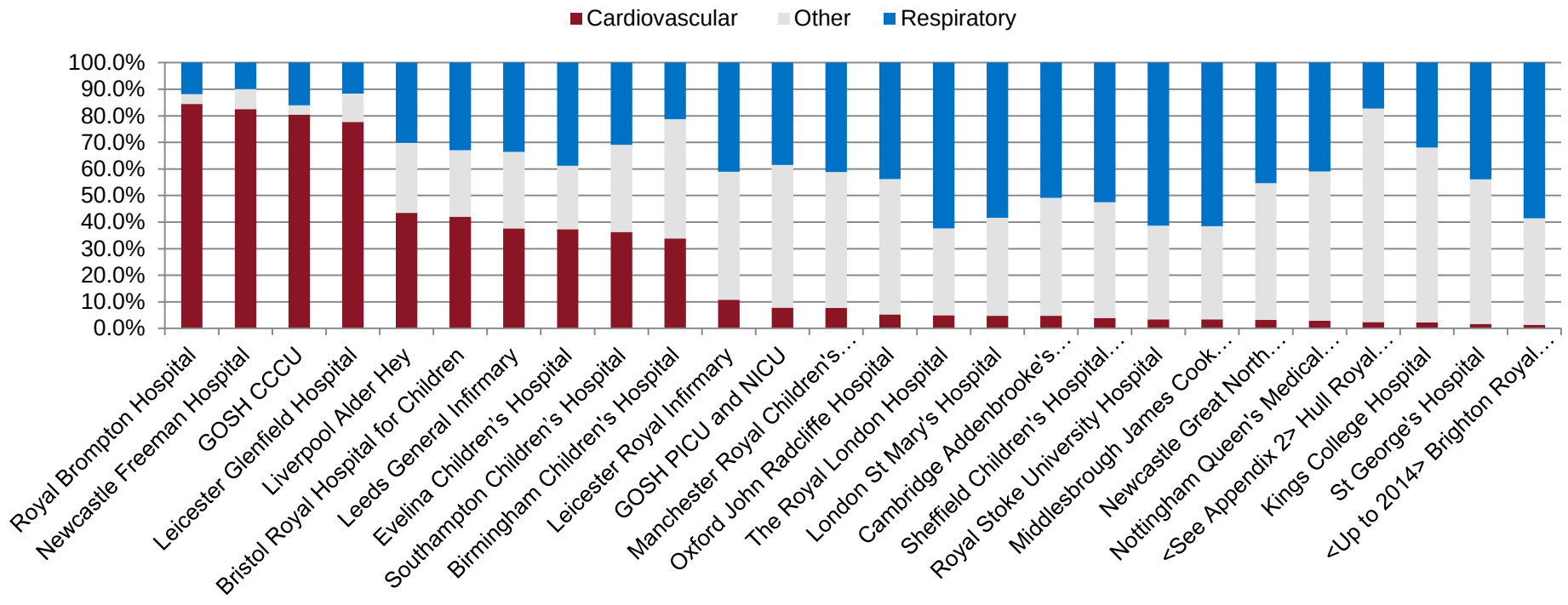
4. Variation in the provision of care

4.1 Units have a different case mix of patients, something that may affect their ability to absorb unplanned demand

The graph below shows the proportion of bed days used by the two main diagnostic categories, cardiovascular and respiratory, on PICUs. Most units are dominated by either cardiac or respiratory patients. The four PICUs to the left of the graph are primarily cardiac PICUs.

Cardiac admissions tend to be predominantly planned following surgery, whilst respiratory admissions tend to be unplanned. Different PICUs will therefore have different abilities to respond to increases in emergency admissions, for example in winter.

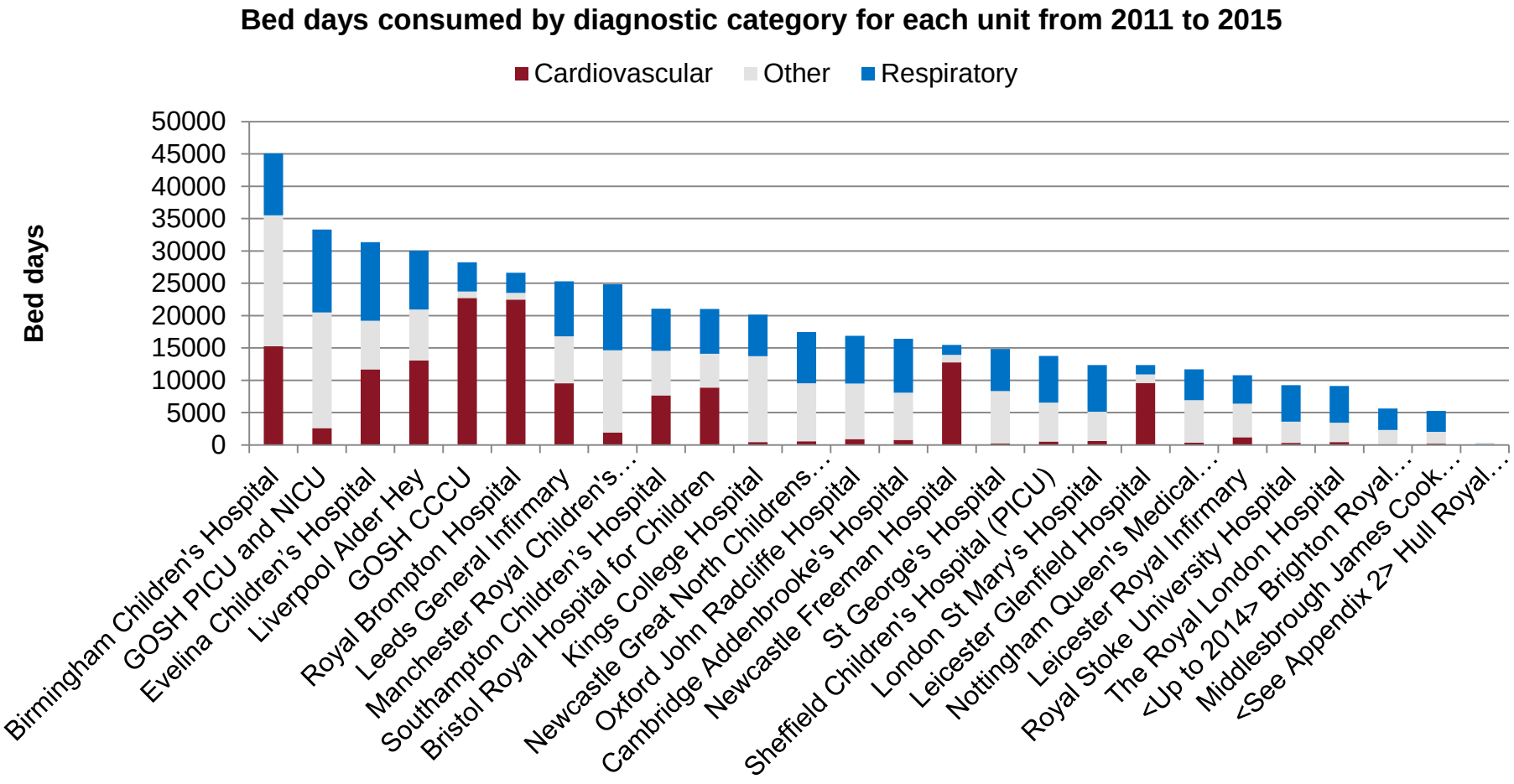
Percentage of bed days by diagnostic category for each unit from 2011 to 2015



*Note that this data has been normalised and does not show volume per provider

4.2 Different units also have varying capacity, which may in turn impact on their ability to absorb unplanned demand

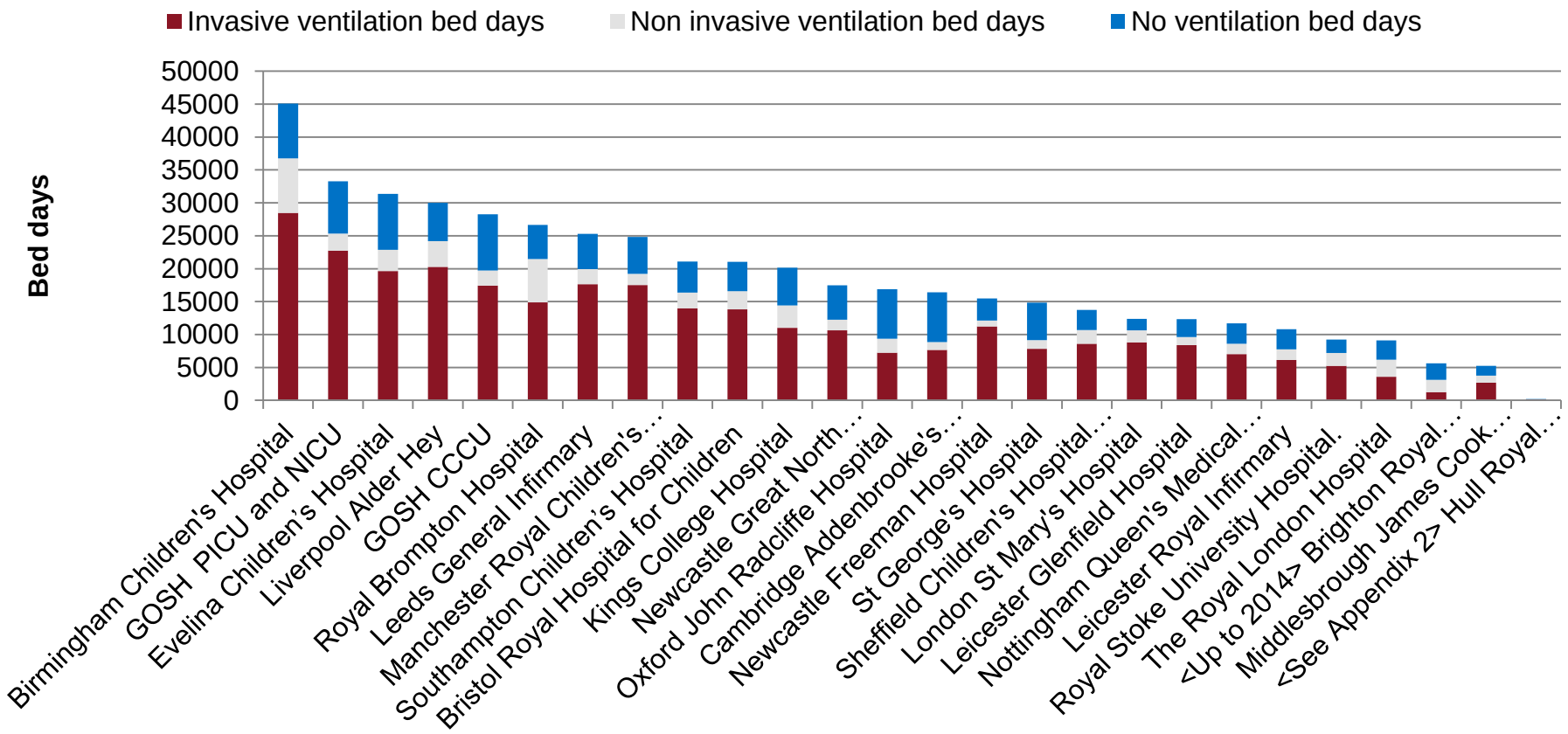
The graph below shows the number of bed days consumed on each unit, subdivided by diagnostic category. The number of bed days may correlate with the unit's ability to absorb unplanned demand, with larger units possibly more able to do so. There can be significant differences in case mix and complexity of surgery carried out in the largest centres, which may increase the average length of stay for some patients.



4.3 The number of bed days used by patients undergoing invasive ventilation varies by unit

In 2011 to 2015, the number of bed days that included invasive or non-invasive ventilation varied across the country as shown in the graph below. This variation may reflect differing case-mix of patients, or different admissions criteria across the country.

Bed days for patients on invasive ventilation, non-invasive ventilation and no ventilation on PICUs from 2011 to 2015



5. Extracorporeal Membrane Oxygenation (ECMO)

5.1 There is variation in the number of patients from each hub who receive ECMO

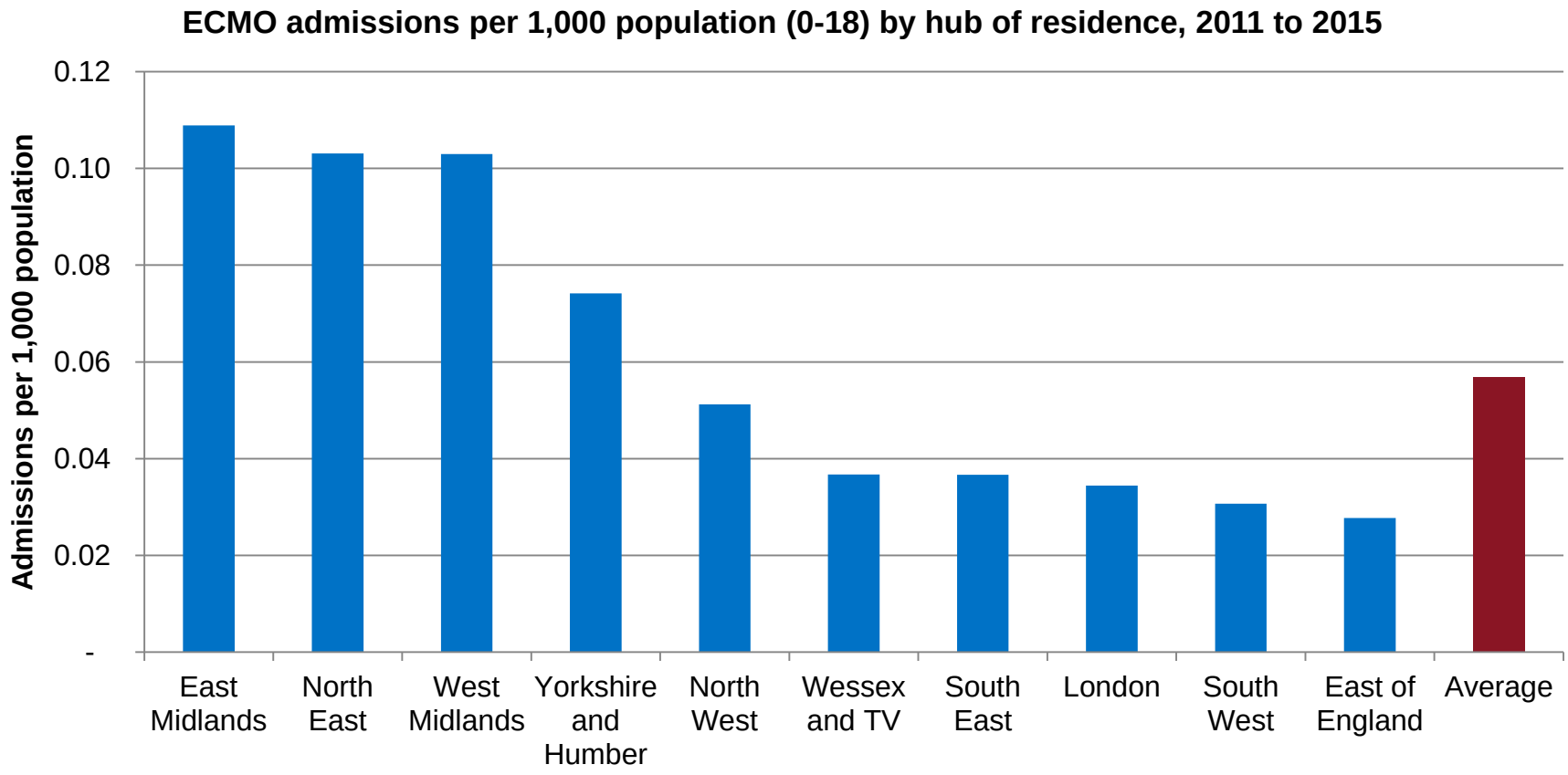
This matrix shows the volume of paediatric admissions from each hub who received ECMO (respiratory and cardiac) between 2011 - 2015, and where they were treated. For example, two children from the North East were treated in the East Midlands, and 62 within the North East. There is variation in the number of patients from each hub receiving ECMO. Note, however, that these are absolute numbers of admissions and are not normalised by population. See the next slide for the number of ECMO admissions by population.

Volume of ECMO admissions by hub of origin and hub of placement, 2011 - 2015

	Hub of placement								
Hub of Patient	East Midlands	London	North East	North West	South West	Wessex and Thames Valley	West Midlands	Yorkshire and Humber	Total
East Midlands	94	7	2	.	.	4	4	1	112
East of England	12	59	3	.	.	1	1	.	76
London	14	124	4	.	.	.	1	.	143
North East	2	.	62	.	.	.	.	.	64
North West	30	3	19	52	.	.	1	.	105
South East	5	42	2	.	.	1	.	.	50
South West	9	8	3	.	22	4	.	.	46
Wessex and Thames Valley	5	11	3	.	.	26	1	.	46
West Midlands	63	7	11	1	.	.	56	.	138
Yorkshire and Humber	45	1	14	3	.	.	2	23	88

5.2 Variation in the amount of ECMO activity still exists when hub population is taken into account

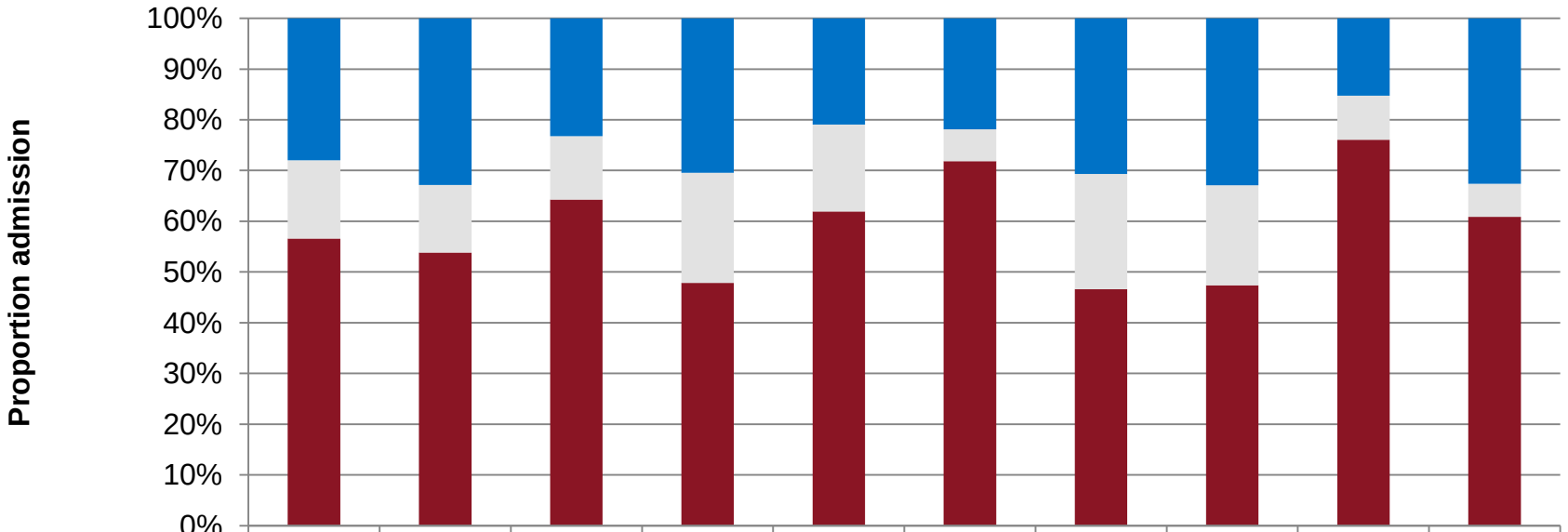
The analysis on the previous page shows ECMO admissions by hub of residence and hub of treatment. However, it is difficult to determine the extent of any variation without also looking at the population of that hub. The graph below therefore shows the level of ECMO admissions per 1,000 population between 2011 and 2015, by the patient's hub of residence. It shows that variation still exists, even when admissions are normalised by population. The review will need to consider whether there is clinical justification for these variations.



5.3 There is a greater proportion of patients receiving cardiac than respiratory ECMO

The analysis below demonstrates that a greater proportion of patients receiving ECMO have a cardiovascular presentation. Further work is being undertaken to determine the respiratory cases that may be counted in the 'other' categories in this data and the reason for any differences between datasets. These differences will be considered during discussions about a future model of ECMO care.

Proportion of ECMO admissions by type, by hub of treatment, 2011 to 2015

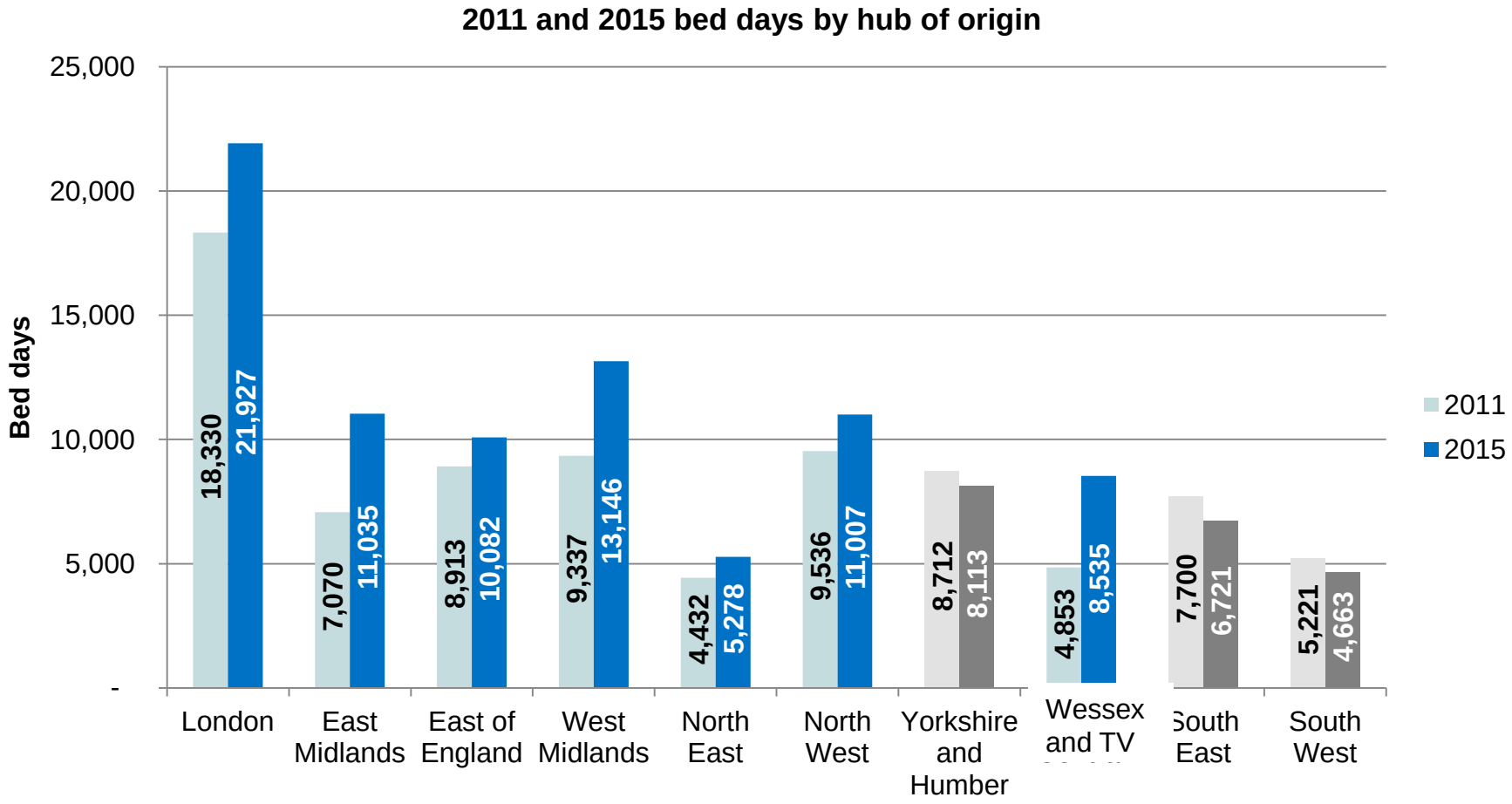


	Grand Total	London	East Midlands	West Midlands	North West	North East	Yorkshire and Humber	East of England	South West	Wessex and TV
Respiratory	243	47	26	42	22	14	27	25	7	15
Other	134	19	14	30	18	4	20	15	4	3
Cardiovascular	491	77	72	66	65	46	41	36	35	28

6. Future demand

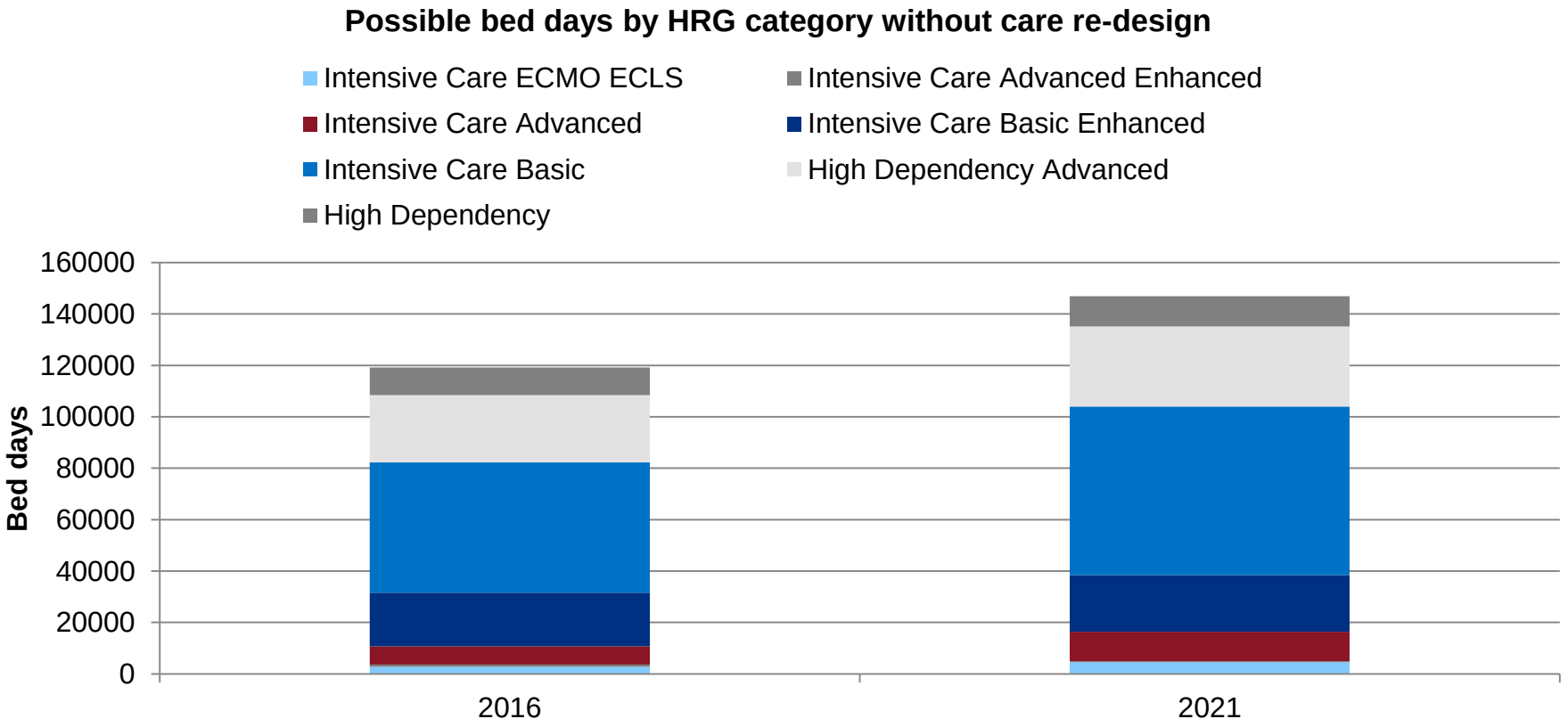
6.1 In most hubs, the number of bed days has increased between 2011 and 2015

This graph shows that the number of bed days consumed nationally increased between 2011 and 2015. Although there is variation by hub, with seven hubs increasing the number of bed days used (in blue) and three decreasing in the same time period (in grey), the overall increase is beyond the population growth rate for that period.



6.2 Our analysis suggests that a new model of care is required to enable us to meet future demand

A new model of care could enable some patients to be treated outside PICUs in an environment that is more appropriate to their needs and that may be closer to their home, which could help make services affordable as well as improve patient experience. This is supported by the modelling shown below, which suggests that most of the increased need would be for high dependency and intensive care basic and intermediate days, rather than for the highest levels of critical care.



(Note that the modelling has apportioned the number of uncoded bed days proportionately across each HRG)

7. Next steps for the review

7.1 This analysis will help to inform the next stage of the review

The data and analysis in this pack will now be used by the review as it develops its proposals for a future model of care.

The review will be developing and testing this model over the coming months, working with a wide range of stakeholders including commissioners, providers, clinicians and patients and their parents and carers. It will be considering how a future model of care could enable those patients who could more appropriately be treated outside of intensive care, such as those patients on long term ventilation, to move to a more appropriate environment that may also be closer to home. It will also be thinking about the best way to deliver ECMO in future, taking into consideration the current distribution of activity.

This work will also take into account the review of Congenital Heart Disease (CHD) services in England, which is currently out to consultation. The CHD review has identified that, should its proposals be implemented, there would be an impact on both paediatric intensive care and ECMO. The review will therefore need to consider the best way of managing this impact, should the proposals be implemented. More details of the CHD review consultation can be found on the webpage.

The paediatric critical care and specialised surgery in children review welcomes comments on this analysis, and its initial conclusions. They can be sent to england.paedsreview@nhs.net and will be considered as the review develops. You can also use this email address to request to be kept informed of the review's developments, or alternatively please visit NHS England's webpage to find out about further opportunities to engage in the review.

This slide pack focuses on paediatric critical care and ECMO. The review has been able to make quicker progress in assessing demand and capacity in these areas because it has analysed existing data from the Paediatric Intensive care Audit Network (PICANet). Data on specialised surgery in children is currently the subject of separate analysis.

Appendices

Appendix 1 – Terminology

Some of the terms commonly used in this document are defined below. Please note that cardiac centres order the levels care in the opposite order with Level 1 being highest level of acuity.

Terminology	Definition
Paediatric critical care (PCC)	• Provides care for children with a wide range of conditions who may need a high level of observation or more intensive therapies. There are three levels of critical care unit, as defined below.
Level 1 Paediatric Critical Care Units (PCCUs)	• Located in all hospitals providing inpatient care to children • Level 1 incorporates high dependency care provided in all acute hospitals which have inpatient facilities • Clinical Commissioning Groups (CCGs) are responsible for commissioning Level 1 services
Level 2 PCC units (High Dependency Units – HDUs)	• May be specialist or non-specialist • Level 2 services incorporate high dependency and high dependency advanced critical care. They are commissioned by NHS England when they are in specialist children's hospitals or designated district general hospitals, or if the unit is associated with a PICU.
Level 3 PCC units (Paediatric Intensive Care Units – PICUs)	• Level 3 units provide care for children requiring intensive care and monitoring, including medically unstable patients requiring intubation or ventilation, single or multi-organ support, and continuous or intensive medical or nursing supervision • Level 3 units also provide routine planned post-operative care for surgical procedures, or during some planned medical admissions • They are usually located in tertiary centres or specialist hospitals and can provide all levels of care. • Level 3 units are commissioned by NHS England
Extracorporeal Membrane Oxygenation (ECMO)	• A potentially life-saving intervention for babies and children with reversible lung (respiratory) or heart (cardiac) failure, involving the use of an artificial lung (membrane) located outside the body (extra corporeal) that puts oxygen into the blood (oxygenation) and continuously pumps this blood into and around the body.
Bed Days	• As defined by the Quarterly Bed Availability and Occupancy Data Set: an occupied bed day is a hospital bed which has been used for at least one day case admission during the day
Regions	• NHS England has four regions from which services are commissioned. These regions are: North, South, Midlands and East, and London. Regional teams work closely with organisations such as clinical commissioning groups, local authorities, NHS trusts, GP practices etc.
Specialised Commissioning Hubs	• NHS England Specialised Commissioning has ten 'hubs' responsible for commissioning its ~140 services. These hubs sit within the four NHS England regions.

Appendix 1 – Terminology (2)

The following table identifies how the HRG definitions used in this document correspond with new HRG definitions and their description.

2016/17 HRG definitions (used in this analysis)	HRG	Current HRG definition	Description
PCC High dependency	XB07Z	Basic critical care	Monitoring and interventions
PCC High dependency advanced	XB06Z	Intermediate critical care	Monitoring and interventions
PCC Intensive care basic	XB05Z	Advanced critical care 1	Invasive ventilatory support and/or support for 2 or more organs systems
PCC Intensive care basic advanced	XB04Z	Advanced critical care 2	Invasive ventilatory support and/or support for 2 or more organs systems
PCC Intensive care advanced	XB03Z	Advanced critical care 3	Complex interventions / organ support
PCC Intensive care advanced enhanced	XB02Z	Advanced critical care 4	Complex interventions / organ support
PCC Intensive care ECMO ECLS	XB01Z	Advanced critical care 5	ECMO

Appendix 2 – Methodology (1)

General Notes

- All activity data sourced from PICANet, population data sourced from ONS, travel times calculated using the Google Maps API
- Unit bed capacities are as stated by each trust in their submissions to PICANet
- Where noted, analysis included admissions to PICU from 2011 to 2015, or just during 2015
- Admissions were attributed to regions/hubs on two different bases:
    - Hub of admission based upon the location of the unit to which the patient was admitted
    - Hub of origin, based upon mapping the LSOA of the patient's usual residence to the CCG within which the LSOA resides and from the CCG to the NHS England Specialised Commissioning Hub responsible for commissioning PICUs for those CCGs.
- Counts of admissions are based upon PICANet Event ID and, as such, individual patients may count as multiple admissions during any time period
- Diagnostic categories, admission types are as per PICANet definitions
- **Activity relating to patients whose usual residence is not within England are excluded from the analyses.**

Appendix 2 – Methodology (2)

Section-specific notes:

2.1

- Brighton and Hull are represented by zero on the infographic for the following reasons:
  - Brighton submitted data to PICANet up to 2014, but is only commissioned to provide 'step up' PIC for retrieval to other PICUs.
  - Hull is currently commissioned as a paediatric high dependency unit only and further analysis of the small number of higher care days delivered in the unit is currently under review by the regional team. It is likely that in future Hull will be excluded from reporting to PICANet.
- The bed numbers used in the infographic relate to May/June 2015 to try to best reflect the period included in the subsequent analysis. They may not represent current commissioned bed numbers which are subject to change.

2.2

- Source = PICANet
- Counts based on number of admissions to PICUs from Jan 2011 to December 2015
- Diagnostic types as defined by PICANet
- Admission types as defined by PICANet

3.1

- Source = PICANet
- Total bed days calculated by the sum of each patient's length of stay
- Year based on the date of the admission to PICU
- Years 2011 through to 2015 included
- Trend used to demonstrate growth

3.2

- Source = PICANet
- Year based on the date of the admission to PICU
- Month based on the date of admission to PICU
- 2015 admissions only used as occupancy is calculated against the bed capacities reported in 2015
- Occupancy is calculated as [total occupied days in 2015] / ([bed capacity] x 365)

Appendix 2 – Methodology (3)

3.2 continued:

- Bed days are assigned to month based upon the month of admission (i.e. all bed days incurred by patients admitted in January are counted against January)

3.3

- Source = PICANet
- Year based on the date of the admission to PICU
- Month based on the date of admission to PICU
- Bed days are assigned to month based upon the month of admission
- Level of care are as per PCCMDS as reported to PICANet
- No data included from Great Ormond Street Hospital or Alder Hey until 2015 as no PCCMDS submitted to PICANet
- Sum of bed days from 2011 to 2015 presented to demonstrate annual trend

3.4

- Source = PICANet
- Year based on the date of the admission to PICU
- Month based on the date of admission to PICU
- Bed days are assigned to month based upon the month of admission
- Diagnostic categories are as per PICANet definitions
- Three-year graph produced to illustrate cyclical nature of annual trend

3.5

- Source = PICANet
- Year based on the date of the admission to PICU
- Month based on the date of admission to PICU
- Bed days are assigned to month based upon the month of admission
- Admission types are as per PICANet definitions
- Three-year graph produced to illustrate cyclical nature of annual trend

Appendix 2 – Methodology (4)

3.6

- Source = PICANet
- Year based on the date of the admission to PICU
- Month based on the date of admission to PICU
- PICANet supplied age in admission to PICU as number of weeks, age in years derived by dividing by 52
- Three-year graph produced to illustrate cyclical nature of annual trend

3.7

- Source = PICANet
- Period 2011 to 2015 used to maximise sample size
- Resources are defined as bed days in this context
- Calculation = for each additional patient the sum of total bed days is calculated after sorting the patient records by length of stay (shortest first)

3.8

- Source = PICANet
- Period 2011 to 2015 used to maximise sample size
- Only those children who died in PICU included
- Calculation = for each additional patient who died the sum of total bed days is calculated after sorting the patient records by length of stay (shortest first)

Appendix 2 – Methodology (5)

3.9

- Source = PICANet
- Five-year graph produced to illustrate growth trend
- Average length of stay calculated as simple arithmetic mean (total bed days/total patients)

4.1

- Source = PICANet
- Period 2011 to 2015 used to maximise sample size
- Diagnostic categories are as per PICANet definitions
- Records with no diagnostic category recorded were excluded
- **Note:** Brighton submitted data to PICANet up to 2014, but is only commissioned to provide 'step up' PIC for retrieval to other PICUs.
- **Note:** Hull is currently commissioned as a paediatric high dependency unit only and further analysis of the small number of higher care days delivered in the unit is currently under review by the regional team. It is likely that in future Hull will be excluded from reporting to PICANet.

4.2

- Source = PICANet
- Period 2011 to 2015 used to maximise sample size
- Diagnostic categories are as per PICANet definitions
- Records with no diagnostic category recorded were excluded
- **Note:** Brighton submitted data to PICANet up to 2014, but is only commissioned to provide 'step up' PIC for retrieval to other PICUs.
- **Note**: Hull is currently commissioned as a paediatric high dependency unit only and further analysis of the small number of higher care days delivered in the unit is currently under review by the regional team. It is likely that in future Hull will be excluded from reporting to PICANet.

Appendix 2 – Methodology (6)

4.3

- Source = PICANet
- Period 2011 to 2015 used to maximise sample size
- PICANet data includes total length of stay, number of days with invasive ventilation and number of days with non-invasive ventilation for each patient. Non-ventilated days calculated as [Total LoS] - ([Invasive days]+[non-invasive days])
- The data that underpins this chart is captured as daily interventions, and as such a given patient may spend a part of a day ventilated and a part of a day unventilated and thus be counted twice in the data. As a result the most meaningful way to display this is as the total number of full or part days in each category, rather than as a proportion of total bed days.
- **Note:** Brighton submitted data to PICANet up to 2014, but is only commissioned to provide 'step up' PIC for retrieval to other PICUs.
- **Note**: Hull is currently commissioned as a paediatric high dependency unit only and further analysis of the small number of higher care days delivered in the unit is currently under review by the regional team. It is likely that in future Hull will be excluded from reporting to PICANet.

5.1

- Source = PICANet
- Hub of origin assigned by LSOA supplied by PICANet (see general notes)
- Count = number of admissions where the child received ECMO at any point during their stay on PICU
- Period 2011 to 2015 used to maximise sample size

5.2

- Source = PICANet
- Hub of origin assigned by LSOA supplied by PICANet (see general notes)
- Rate per population calculated as: number of admissions where the child received ECMO at any point during their stay on PICU for each Hub of origin, divided by the population for the CCGs within that Hub based upon the 2015 population projections from the 2014 ONS Census
- Period 2011 to 2015 used to maximise sample size

Appendix 2 – Methodology (7)

5.3

- Source = PICANet,
- Hub of origin assigned by LSOA supplied by PICANet (see general notes)
- Count = number of admissions where the child received ECMO at any point during their stay on PICU
- Period 2011 to 2015 used to maximise sample size
- Diagnostic categories are as per PICANet definitions
- Records with no diagnostic category recorded were excluded

6.1

- Source = PICANet
- Hub of origin assigned by LSOA supplied by PICANet (see general notes)
- Total bed days calculated by sum of length of stay for all patients from each hub of origin
- Bed equivalents calculated by [bed days]/365 rounded up to nearest whole bed

6.2

- Source = PICANet
- Level of care are as per PCCMDS as reported to PICANet
- Growth projections calculated by using MS Excel's line of best fit function to determine growth from 2011 to 2015, (total days per care level for each year 2011 through to 2015). This % growth factor was then applied to 2015 activity with an annual iteration to estimate future activity.
- Note – Alderhey and GOSH were excluded from the growth calculations as their PCCMDS submissions to PICAnet were only complete in 2015. Their quantum of bed days was included in the 2015 baseline to which the growth was applied.

Appendix 3 – Key for admissions by diagnostic category

This list follows on from the infographic in section 2.2

Admissions	Rank	Category	Admissions	Rank	Category
2704	6	Planned - following surgery - Musculoskeletal	176	33	Planned - following surgery - Infection
2006	7	Planned - following surgery - Respiratory	173	34	Planned - other - Body wall and cavities
1924	8	Unplanned - other - Gastrointestinal	170	35	Unplanned - following surgery - Trauma
1860	9	Unplanned - other - Other	143	36	Planned - other - Infection
1754	10	Planned - other - Cardiovascular	138	37	Unplanned - other - Unknown
1715	11	Unplanned - other - Endocrine / metabolic	135	38	Planned - following surgery - Trauma
1508	12	Planned - following surgery - Gastrointestinal	127	39	Planned - other - Oncology
1407	13	Unplanned - other - Trauma	123	40	Planned - following surgery – Endocrine/ metabolic
1254	14	Planned - following surgery - Oncology			
1156	15	Planned - following surgery - Other	115	41	Unplanned - following surgery - Body wall and cavities
1068	16	Planned - other - Respiratory			
866	17	Unplanned - following surgery - Respiratory	110	42	Planned - other - Endocrine / metabolic
842	18	Planned - following surgery - Neurological	102	43	Planned - following surgery - Multisystem
787	19	Unplanned - following surgery - Gastrointestinal	98	44	Planned - other - Musculoskeletal
			79	45	Unplanned - other - Multisystem
730	20	Unplanned - other - Oncology	71	46	Planned - following surgery - Blood / lymphatic
550	21	Unplanned - other - Blood / lymphatic			
483	22	Unplanned - following surgery - Cardiovascular	62	47	Unplanned - following surgery - Musculoskeletal
480	23	Planned - following surgery - Body wall and cavities	61	48	Unplanned - following surgery - Endocrine / metabolic
446	24	Unplanned - other - Body wall and cavities	47	49	Planned - following surgery - Unknown
430	25	Planned - other - Neurological	46	50	Planned - other - Blood / lymphatic
391	26	Unplanned - following surgery - Neurological	44	51	Planned - other - Trauma
375	27	Unplanned - following surgery - Other	42	52	Planned - other - Multisystem
369	28	Planned - other - Other	36	53	Unplanned - following surgery - Blood / lymphatic
272	29	Planned - other - Gastrointestinal			
223	30	Unplanned - following surgery - Oncology	21	54	Planned - other - Unknown
214	31	Unplanned - following surgery - Infection	18	55	Unplanned - following surgery - Unknown
206	32	Unplanned - other - Musculoskeletal	10	56	Unplanned - following surgery - Multisystem