UK Kidney Association
UK Renal Registry

UK Renal Registry

Acute kidney injury (AKI) in England

A report on the nationwide collection of AKI warning test scores from 2022

AKI rate and mortality by Integrated Care Board

AKI rate and mortality by clinical setting

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Foreword

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This report is the follow-up of the first England wide report of Acute Kidney Injury using 2018 cases and published in 2020. In this report we are presenting data on people who had an AKI warning test score during 2022 and are publishing this at the end of 2023.

Compared to 2020 there is now significantly better coverage of the England population - with all but 4 laboratories out of 192 in England sending some data to the UK Renal Registry. This allows us to be much more confident in the population rate of AKI with fewer assumptions and adjustments necessary to estimate the population covered.

Acute Kidney Injury continues to complicate a significant proportion of admissions to hospital and is associated with significant mortality. Unfortunately we report no change in either the overall rate of AKI, or overall mortality. There are also still significant differences in the rates of AKI (adjusted for age and sex), and in-hospital mortality (adjusted for age, sex and case-mix) associated with AKI between regions and hospitals.

The most up-to-date information on AKI rate and mortality are always available on the UK Kidney Association (UKKA) website and these are regularly refreshed. Improving the prevention, detection, treatment, and follow-up of AKI remains a national priority with resources available on the 'Think Kidneys' (thinkkidneys.nhs.uk) website.

Executive summary

AKI – impact, detection and reporting

Acute kidney injury (AKI) is a sudden deterioration of kidney function, caused by, for example, dehydration, sepsis or heart attack and is associated with about 100,000 deaths every year in hospital in the UK. In 2014, NHS England mandated all blood testing laboratories in England to incorporate AKI warning test scores (AKI alerts) into their laboratory testing systems to improve early detection and outcomes of AKI. An AKI alert is triggered if there is a change in serum creatinine level over a short time. The alert ranges from the least severe AKI stage 1 to the most severe AKI stage 3. Hospital clinicians can see the AKI warnings alongside the creatinine results, alerting them to a potential AKI that needs further clinical assessment and action. Laboratories were also mandated to submit their AKI alerts, with accompanying demographic information about each person (age, sex, postcode, etc.), to the UK Renal Registry (UKRR) to enable nationwide analyses of the data. This is the second national AKI report for England and is primarily about people who had an AKI episode in 2022.

Objectives

- To demonstrate the impact of AKI on the English population, through analysis of the AKI rate and outcomes at the level of the Integrated Care Boards (ICBs).

- To show the different demographics and outcomes of various groups of people with AKI, but in particular, people who are entirely cared for in the community versus those who are admitted to hospital with their AKI, or develop it during their stay.

Key findings

- 184/192 (98%) of laboratories submitted 2022 data that could be included in the analyses as compared to 166 (87%) in 2018.
- There were 683,136 AKI episodes from 589,985 patients in 2022.
- In 2022, 87% of patients had one AKI episode, 10% had two episodes and 3% had more than two episodes.
- Only 2% of AKI episodes occurred in children, while 66% were in adults aged over 65 years.
- The rate of AKI episodes in England in 2022 was 12,651 per million population compared to 11,660 in 2018.
- The age-sex adjusted AKI rate ranged between 9,692 to 15,483 per million population across different ICBs.
- 68.2% of people with an AKI episode had a hospital stay as compared to 71% in 2018 – 36.8% following a community acquired AKI and 31.4%% were already in hospital when the AKI occurred.
- Most people had an AKI stage 1 – almost 80% of alerts at the start of an episode and 70% at the peak of an episode, similar to 2018.
- 18.8% of people with an AKI episode died within 30 days of the first alert.
- Mortality within 30 days increased with peak AKI stage – 13% for AKI stage 1, 29% for AKI stage 2 and 35% for AKI stage 3 compared to 13%, 29% and 33 % respectively in 2018.
- Mortality in the first 30 days also increased with age, from 3% in children to 27% in adults aged 75 years and over.
- Mortality within 30 days was higher for people from deprived areas after accounting for their lower median age.

- More deaths occurred in winter – 20.9% of people with an AKI episode between January and March died within 30 days, compared to 17.1% of those with an AKI between July and September.
- Mortality within 30 days was higher in people whose AKI episode started in hospital – 26% mortality compared to 9% mortality for people with an AKI who were never hospitalised, (24% and 8% respectively in 2018).
- Median length of stay in hospital with an AKI episode was unchanged from 2018 at 12 days and was more than double in hospital acquired AKI than in community acquired, subsequently hospitalised AKI, for both elective and emergency admissions.
- HES coding of AKI was better the higher the stage of the AKI alerts and there was no clear difference between HES coding for renal and acute non-renal hospitals. Generally, HES coding for AKI was poor in paediatric hospitals.

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Introduction

Acute kidney injury – definition and burden

Acute kidney injury (AKI) is a sudden drop in kidney function over a few hours to a few days. It commonly occurs with an episode of acute illness and is more likely if the illness is severe, or if an individual is at greater risk of an AKI. Examples of risk factors include older age and pre-existing conditions, such as chronic kidney disease (CKD), diabetes and heart failure.[1]

AKI represents a significant cause of mortality and morbidity, both in and out of hospital, and incurs significant healthcare costs.[2] Care between hospitals is known to vary[3] and there is evidence that AKI is not well treated in up to one third of cases.[4] It has been shown that relatively simple care bundles can improve outcomes, at least in hospitals.[5,6]

Algorithm to standardise detection of AKI in England

To improve the recognition and treatment of AKI, NHS England (NHSE) established a partnership with the UK Kidney Association (UKKA) known as 'Think Kidneys' (thinkkidneys.nhs.uk).

Guided by Think Kidneys, NHSE issued a level 3 patient safety alert in June 2014 to standardise the early identification of AKI.[7] The alert mandated NHS trusts within England, from March 2015, to implement a standardised biochemical classification of AKI by installing an algorithm in their laboratory information management system.[8] The algorithm compares a person's serum creatinine to their historical blood tests (if there are any) to determine whether they may have an AKI and, if so, the severity of the AKI.

The AKI algorithm has five possible outputs, three of which constitute AKI warning test scores or alerts (from the least severe stage 1 through to the most severe stage 3 AKI). These outputs are in accordance with the Kidney Disease: Improving Global Outcomes (KDIGO) AKI staging system:[9]

1. Null (no evidence of AKI).
2. Stage 1 AKI.
3. Stage 2 AKI.
4. Stage 3 AKI.

   } AKI warning test scores or alerts

5. Not applicable (insufficient creatinine values, but flagged abnormal if outside reference range).

The patient safety alert also mandated laboratories to send AKI alerts and basic demographic information on all people detected by the AKI algorithm to the UK Renal Registry (UKRR), for comparison and audit. The algorithm has been externally validated with a high degree of sensitivity and specificity in different hospital settings.[10] However, the high level of sensitivity can result in false positives, whereby some patients with CKD are detected. In clinical practice, the addition of an AKI alert or abnormal flag to a creatinine result highlights the possibility of an AKI and can prompt a bundle of care. This has the potential to improve patient outcomes.[11]

AKI Master Patient Index

The UKRR collates the AKI alerts (stages 1, 2 and 3) into a single Master Patient Index (MPI), which records each adult or child in England who has had an AKI alert.

Laboratories are requested to provide separate creatinine timeline files for all patients with an AKI alert. These files should contain creatinine values for the 15 months both pre and post the AKI alert. These timelines will be used to help validate the algorithm and identify people with CKD, either before or after the AKI alert.

This report is based on analyses of the 2022 MPI dataset and analyses included both adults and children. Where Hospital Episode Statistics (HES) data were included in analyses, the 2022 MPI dataset was linked to 2022 HES data.

Importance of clinical setting

The demographics and outcomes of people who had an AKI episode are presented in different ways in this report to illustrate the impact of AKI on the whole population, or on selected groups. The three key groups of people are those with: a community acquired, never hospitalised (CA) AKI; a community acquired, subsequently hospitalised (CAH) AKI; and a hospital acquired (HA) AKI. For further information on these groups, see chapter 2.

The CA AKI group, who were never admitted to hospital, represent a significant proportion of patients in the whole population, especially those with the less severe AKI stage 1. This is discussed in more detail in chapter 2, but for readers accustomed to data only on hospitalised patients with AKI, it is important to bear this in mind when interpreting analyses that include the whole AKI population.

Definition of an AKI episode

The date of a first AKI episode is defined as the date of the first AKI alert received by the UKRR from any laboratory. It is possible that a person had an earlier episode prior to the laboratory sending files, but the significance of this decreases with time as more files are received.

Subsequent alerts are only considered to be a further episode of AKI if at least 30 days have passed since the last alert (figure A). If an episode appears to last more than 90 days, duration of the episode is truncated to day 90 to align with the KDIGO definition of chronicity after 90 days of an AKI episode.[9] There is now evidence that duration of an AKI episode influences long term outcome,[12] but this is not considered in this report.

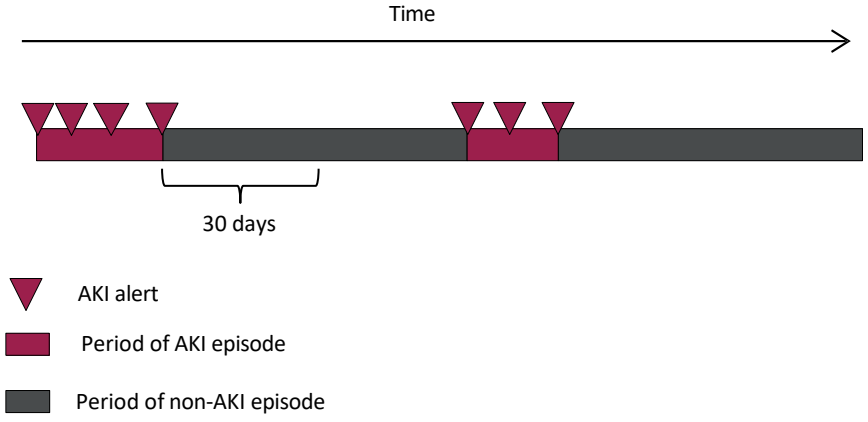

Figure A Definition of an AKI episode – an example of a person with seven AKI alerts, which equate to two episodes

The 2022 MPI included 683,136 AKI episodes from 589,985 patients (87% of patients had one AKI episode, 10% had two episodes and 3% had more than two episodes during 2022).

Data Completeness and AKI episodes by Laboratory

Currently 188 (98%) of laboratories are submitting AKI alert data to the UKRR. 8/192 (4%) did not submit any data for this report (shown as red laboratory dot in figure B). Four of these (Spire Healthcare, Colchester, Guys and St Thomas) have never submitted data to the AKI-MPI, which the UKRR is working to resolve. A further 4 laboratories (Blackpool Teaching Hospitals, Blackpool Victoria, Dorset County and Royal Sussex) have submitted AKI data to the UKRR in the past but did not submit any data in 2022. 161/192 (84%) provided a full submission in 2022 (green laboratory dot in figure B) and sent the UKRR twelve monthly reports. 23/192 (12%) submitted AKI data but did not provide a full submission (amber laboratory dot in figure B).

The distribution of laboratories in England and their red/amber/green data submission status for 2022, along with the population coverage by Integrated Care Board (ICB), can be seen in figure B. The population coverage is the estimated percentage of the ICB population covered by the submitting laboratories serving that population. Variation in number of AKI episodes and proportion of people with each AKI stage by laboratory for adults and children can also be found on our data portal.

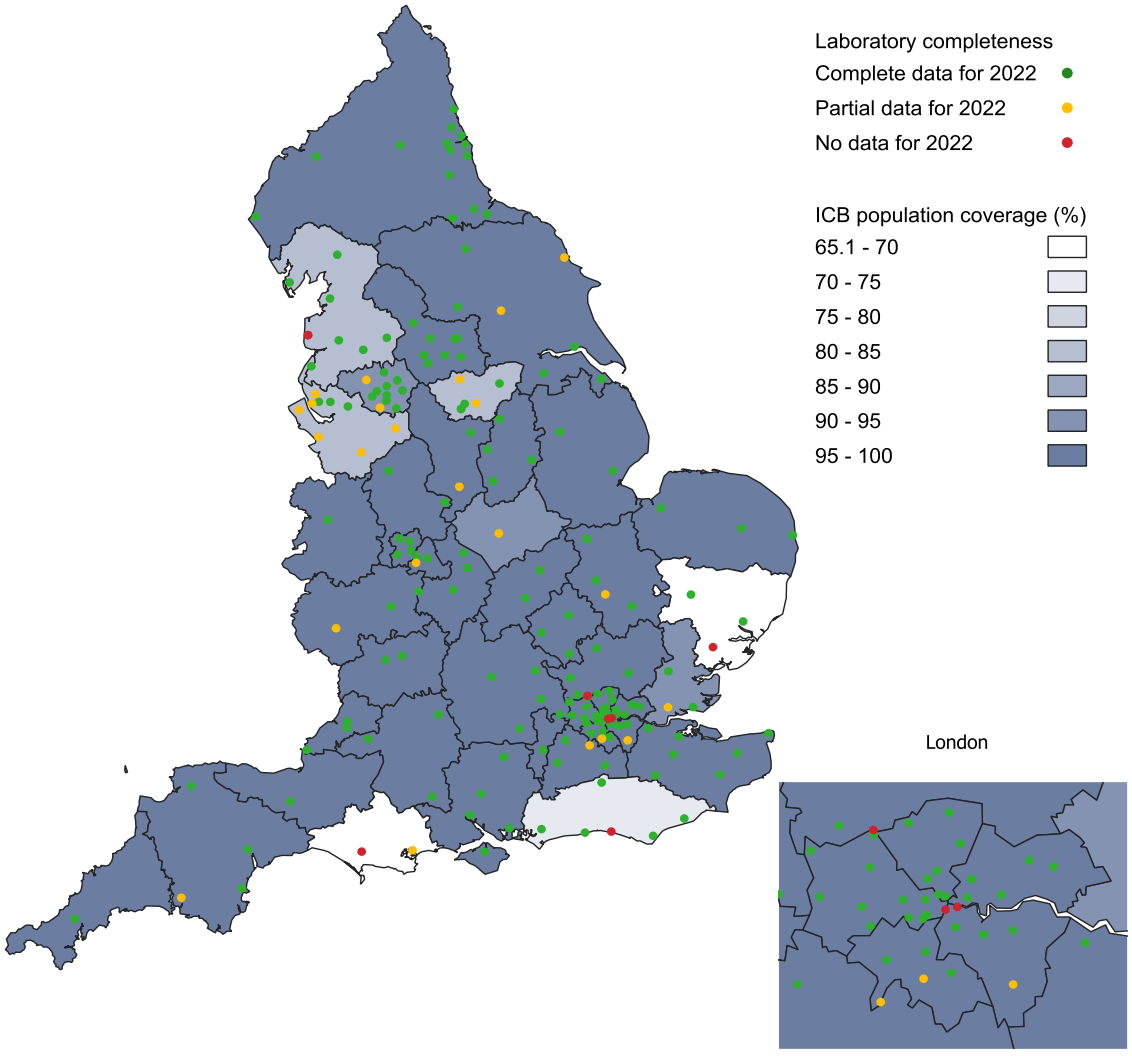

Figure B The distribution of laboratories in England, including their red/amber/green (RAG) rating and Integrated Care Board population coverage for 2022

Objectives of the report

1. To demonstrate the impact of AKI on the English population, through analysis of the AKI rate and outcomes at the level of Integrated Care Boards (ICBs).
2. To show the different demographics and outcomes of various groups of people with AKI, but in particular, people who are entirely cared for in the community versus those who are admitted to hospital with their AKI, or develop it during their stay.

Please note, this is an audit report, the primary aim of which is to describe, benchmark and compare AKI alerts and episodes in England, without interpreting the results.

Structure of the report

Chapter 1 describes the demographics of people with AKI episodes. It also presents the population rates of AKI in England by ICB and patient outcomes.

Chapter 2 describes AKI in people admitted, or not admitted to English hospitals as part of their AKI episode. These data are presented by the provider trust of that hospital care. Some of these measures were co-produced by the UKRR and the 'Getting It Right First Time' (GIRFT) initiative.

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Chapter 1

AKI rate and mortality by Integrated Care Board

Introduction

This chapter describes the demographics of the entire population of people in England who had an episode of AKI in 2022, as determined from their laboratory AKI warning test scores (alerts). As noted in the introduction to the report, it is important to remember that this includes patients with AKI in all clinical settings (community and hospital) and that if considered separately, these groups have different demographics and outcomes. Analysis by clinical setting is presented in chapter 2. Variation in mortality by hospital trust in the 30 days after the beginning of an AKI episode is also reported in chapter 2.

The chapter also includes rates of laboratory derived AKI episodes by ICB in England. Rates by ICB pose challenges. Laboratories and ICBs have very few shared boundaries. We have used historic data to assign laboratories to ICBs to determine ICB population coverage. ICB coverage can be incomplete so AKI rates for ICBs are shown alongside the population coverage on our data portal.

Demographics of people with AKI episodes

The 2022 MPI included 683,136 AKI episodes from 589,985 patients (87% of patients had one AKI episode, 10% had two episodes and 3% had more than two episodes during 2022). This includes all the data sent by laboratories regardless of patient residence. For analysis of AKI rates, and analyses by ICB, we only included the 680,398 episodes where the patient was resident in England.

Figure 1.1 illustrates the distribution of the AKI stage at the start of the AKI episode, separated by adults and children, while figure 1.2 shows the age distribution by first stage of AKI episode.

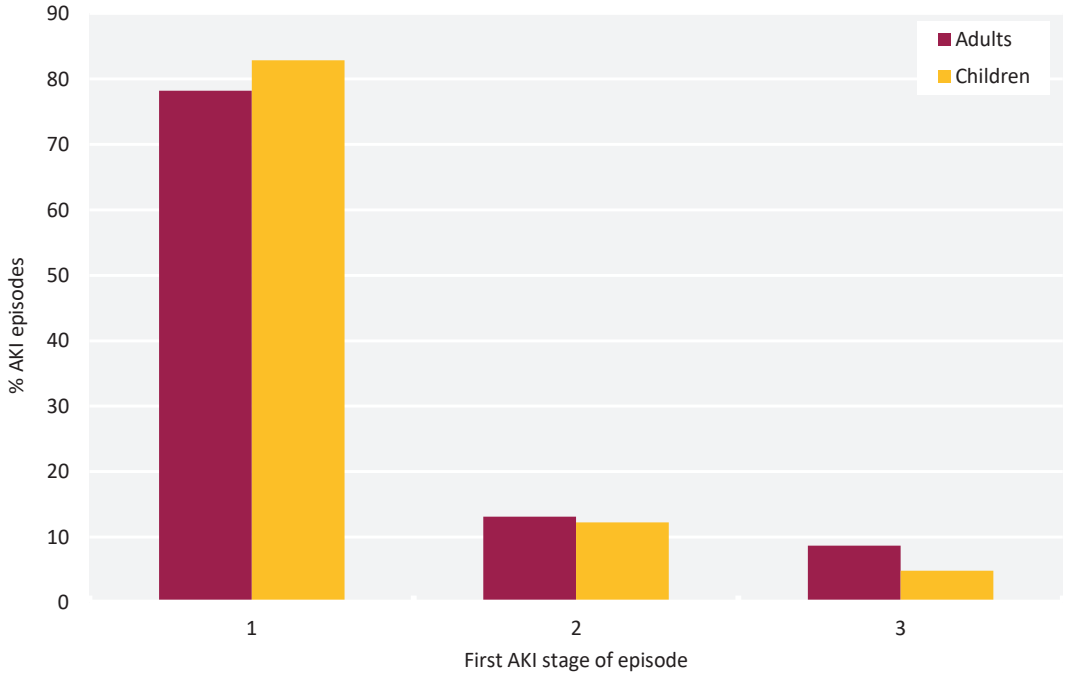

Figure 1.1 The proportion of adults (≥18 years) and children (<18 years) by first stage of AKI episode in 2022

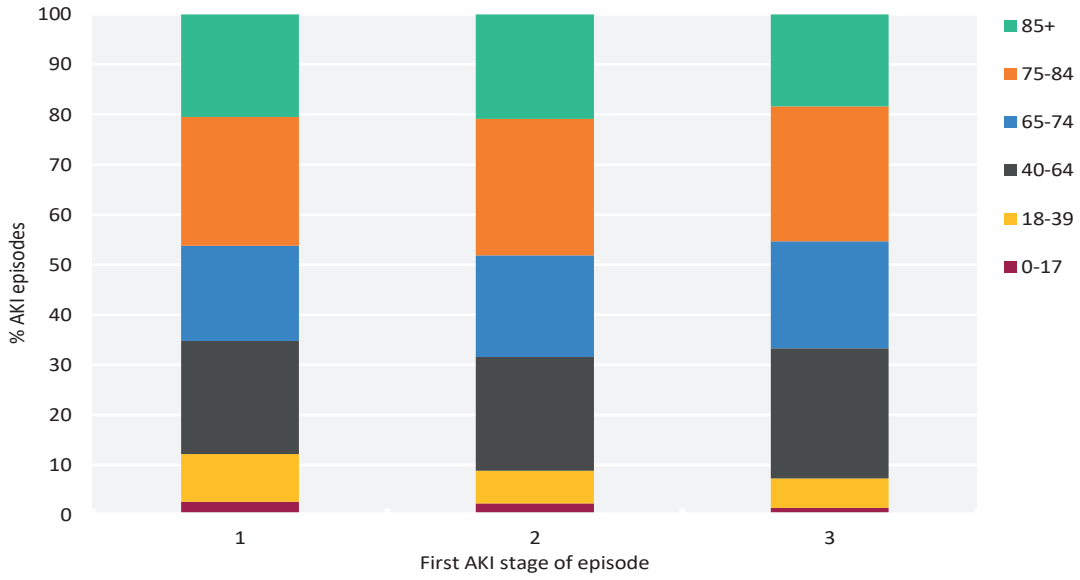

Figure 1.2 The proportion of adults (≥18 years) and children (<18 years) by first stage of AKI episode in 2022

Mortality following an AKI episode

These analyses include the outcomes of all patients with laboratory derived AKI episodes. Note that in patients not admitted to hospital, AKI stage 1 is more common and overall mortality for this group is lower (see chapter 2). Two ICBs (Dorset and Coventry & Warwickshire) were excluded from the mortality analyses because mortality data were incomplete.

Data were stratified by age, sex, quintile of Index of Multiple Deprivation (IMD), month of AKI alert and AKI stage. The IMD is a composite measure of how deprived a small geographic (neighbourhood) area is in relation to other areas and is based on income, employment, education, health, crime, housing and living environment.[13]

Table 1.1 shows 30 day unadjusted and age-sex adjusted mortality from start of episode by peak and first stage of AKI. Table 1.2 shows 30 day unadjusted mortality stratified by age, sex, deprivation and quarter of the year. Mortality from AKI in 2022 was highest with AKI stage 3, in older ages and in the quarter January–March.

Table 1.1 30 day mortality by peak and first stage of AKI for patients with an AKI episode in 2022, unadjusted and adjusted to males aged 65–74 years

AKI stage	Number of AKI episodes	Mortality (%)	
		Crude	Adjusted
Peak			
1	399,135	13.2%	12.8%
2	98,647	28.6%	26.9%
3	75,447	35.4%	33.2%
First			
1	451,695	16.1%	16.1%
2	75,600	27.7%	26.9%
3	45,934	29.9%	28.4%

Age-sex adjusted mortality from start of episode by peak and first stage of AKI

Table 1.2 30 day mortality by peak stage of AKI and demographics for patients with an AKI episode in 2022

	All AKI episodes		Peak stage of AKI					
			1		2		3	
Variable	N	Unadj. mortality (%)	N	Unadj. mortality (%)	N	Unadj. mortality (%)	N	Unadj. mortality (%)
All	573,229	18.8	399,135	13.2	98,647	28.6	75,447	35.4
Age group (years)								
<18	13,895	3.3	10,316	2.0	2,417	4.7	1,162	11.7
18-39	52,621	2.7	42,560	1.4	6,187	5.8	3,874	11.6
40-64	128,220	11.1	88,723	6.4	21,062	18.3	18,435	25.4
65-74	109,343	17.5	73,268	11.6	19,731	26.2	16,344	33.1
≥75	269,150	26.9	184,268	20.4	49,250	38.1	35,632	45.0
Sex								
Male	275,235	20.8	184,062	15.2	46,984	29.8	44,189	34.4
Female	297,994	16.9	215,073	11.4	51,663	27.5	31,258	36.9
Deprivation quintile								
1 - most deprived	133,107	17.9	91,776	12.2	23,057	27.7	18,274	34.3
2	119,672	18.2	83,132	12.7	20,569	27.9	15,971	34.4
3	113,337	18.8	79,282	13.3	19,403	28.4	14,652	35.6
4	107,240	19.3	74,634	13.7	18,530	29.1	14,076	36.2
5 - least deprived	98,555	19.4	69,573	13.9	16,756	29.8	12,226	36.6
Month of AKI alert								
Jan-Mar	137,276	20.9	94,889	14.9	24,153	30.9	18,234	38.6
Apr-Jun	138,073	18.5	96,544	12.9	23,653	28.4	17,876	35.7
Jul-Sep	143,770	17.1	100,589	11.8	24,406	26.4	18,775	33.2
Oct-Dec	154,110	18.7	107,113	13.2	26,435	28.8	20,562	34.3

Patients from more deprived areas were of lower average age – the reduction in mortality with increasing deprivation was not seen when stratified by age group (table 1.3).

Table 1.3 30 day mortality by age and deprivation quintile for patients with an AKI episode in 2022

		Age group (years)									
		<18		18-39		40-64		65-74		≥75	
Deprivation quintile*	Median age (years)	N	Unadj. mortality (%)	N	Unadj. mortality (%)	N	Unadj. mortality (%)	N	Unadj. mortality (%)	N	Unadj. mortality (%)
1	68.4	4,074	3.8	15,768	3.2	38,289	11.7	26,688	18.7	48,288	28.4
2	71.7	3,039	3.2	12,310	2.8	29,884	11.0	23,388	17.7	51,051	27.3
3	74.6	2,523	3.4	9,827	2.3	23,797	10.9	21,654	17.3	55,536	26.3
4	76.1	2,241	2.4	8,082	2.2	19,615	10.5	19,924	16.7	57,378	26.4
5	77.4	1,990	3.0	6,593	2.1	16,420	10.5	17,458	15.6	56,094	25.8

*1 – most deprived to 5 – least deprived

AKI rates by ICB

Figure 1 shows the rate of AKI episodes per million population (pmp) for the 42 ICBs, standardised to the population age-sex distribution for England in 2022. Table 1.4 shows both unadjusted and adjusted rates alongside the percentage of the ICB population covered by the laboratories submitting data. AKI rate pmp stratified by age, sex and Index of Multiple Deprivation can be found on the online data portals. The overall 2022 population rate of AKI in England was 12,651 pmp. Figure 1.4 shows the longitudinal national AKI rate by ICB.

The unadjusted AKI rates by ICB are the number of AKI episodes in patients residing in the ICB divided by the population of ICB, adjusted for the coverage of the laboratory data. The adjusted AKI rate is calculated using direct standardisation, and is the AKI rate we would expect to see in the ICB if its population had the same age-sex structure as England. The coverage is calculated based on the completeness of the data submissions of laboratories serving the ICB. Laboratory coverage is estimated using historical data, but we have no data for Guy's and St Thomas' Hospital laboratories, so the population covered by these laboratories cannot be estimated. Guy's and St Thomas' are situated in South East London ICB, but are very close to other London ICBs, therefore all London rates may be underestimated.

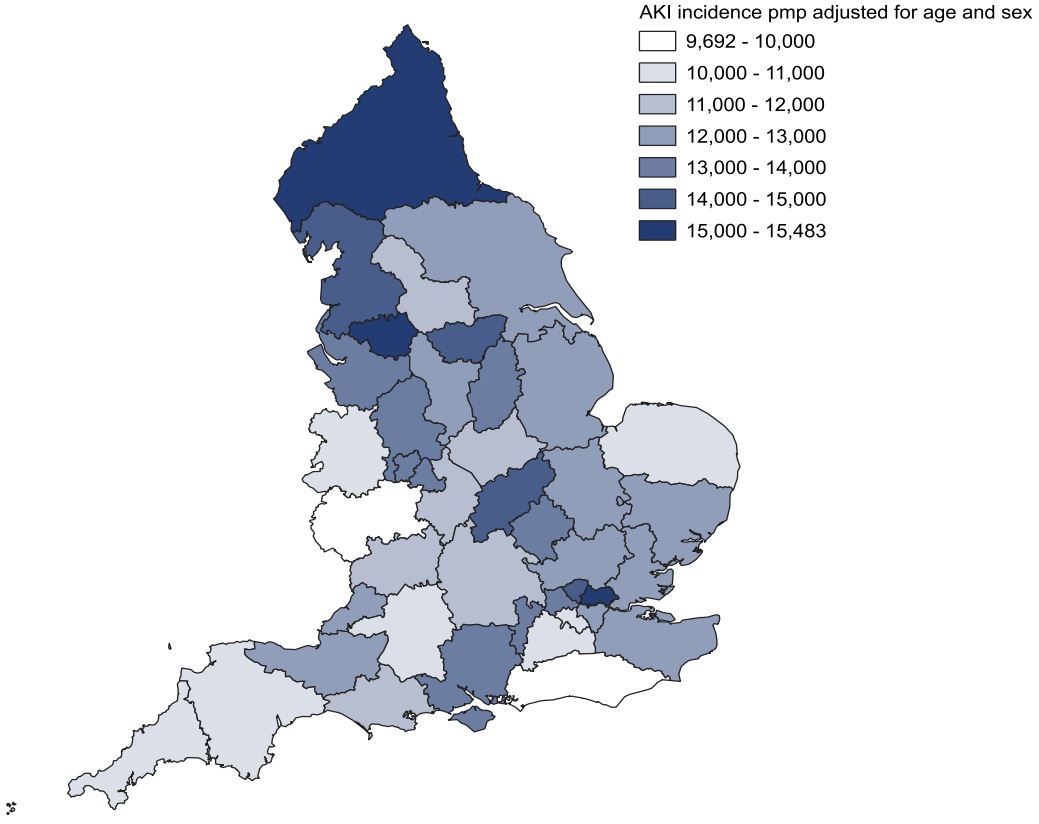

Figure1.3 Map of AKI rates by ICB in 2022

Table 1.4 Population coverage and unadjusted and adjusted (directly standardised to the population age-sex distribution) AKI rates per million population (pmp) for ICBs in 2022

ICB	Coverage (%)	Unadjusted AKI rate (pmp)	Adjusted AKI rate (pmp)
Bath and North East Somerset, Swindon and Wiltshire	100	11,602	10,986
Bedfordshire, Luton and Milton Keynes	100	11,964	13,830
Birmingham and Solihull	98	11,256	13,379
Black Country	100	12,866	13,476
Bristol, North Somerset and South Gloucestershire	100	12,353	12,922
Buckinghamshire, Oxfordshire and Berkshire West	100	11,758	11,935
Cambridgeshire and Peterborough	100	11,857	12,238
Cheshire and Merseyside	81	13,891	13,193
Cornwall and the Isles of Scilly	98	12,933	10,495
Coventry and Warwickshire	100	11,693	11,694
Derby and Derbyshire	96	13,666	12,710
Devon	98	13,224	10,885
Dorset	70	15,021	11,865
Frimley	100	12,278	13,357
Gloucestershire	100	12,454	11,086
Greater Manchester	92	13,837	15,483
Hampshire and Isle of Wight	100	14,645	13,363
Herefordshire and Worcestershire	98	11,748	9,908
Hertfordshire and West Essex	100	12,133	12,426
Humber and North Yorkshire	97	14,169	12,483
Kent and Medway	100	12,839	12,368
Lancashire and South Cumbria	82	15,791	14,818
Leicester, Leicestershire and Rutland	92	11,555	11,839
Lincolnshire	100	15,111	12,921
Mid and South Essex	94	12,574	12,159
Norfolk and Waveney	100	12,945	10,530
North Central London	100	11,380	14,610
North East London	100	10,103	15,272
North East and North Cumbria	100	16,054	15,010
North West London	100	10,637	13,637
Northamptonshire	100	13,669	14,407
Nottingham and Nottinghamshire	100	13,588	13,584
Shropshire, Telford and Wrekin	100	12,418	10,900
Somerset	100	15,692	12,912
South East London	98	9,318	12,370
South West London	99	8,224	10,361
South Yorkshire	82	14,593	14,646
Staffordshire and Stoke-on-Trent	100	14,496	13,396
Suffolk and North East Essex	65	15,071	12,998
Surrey Heartlands	98	11,316	10,777
Sussex	71	11,341	9,692
West Yorkshire	100	10,594	11,379

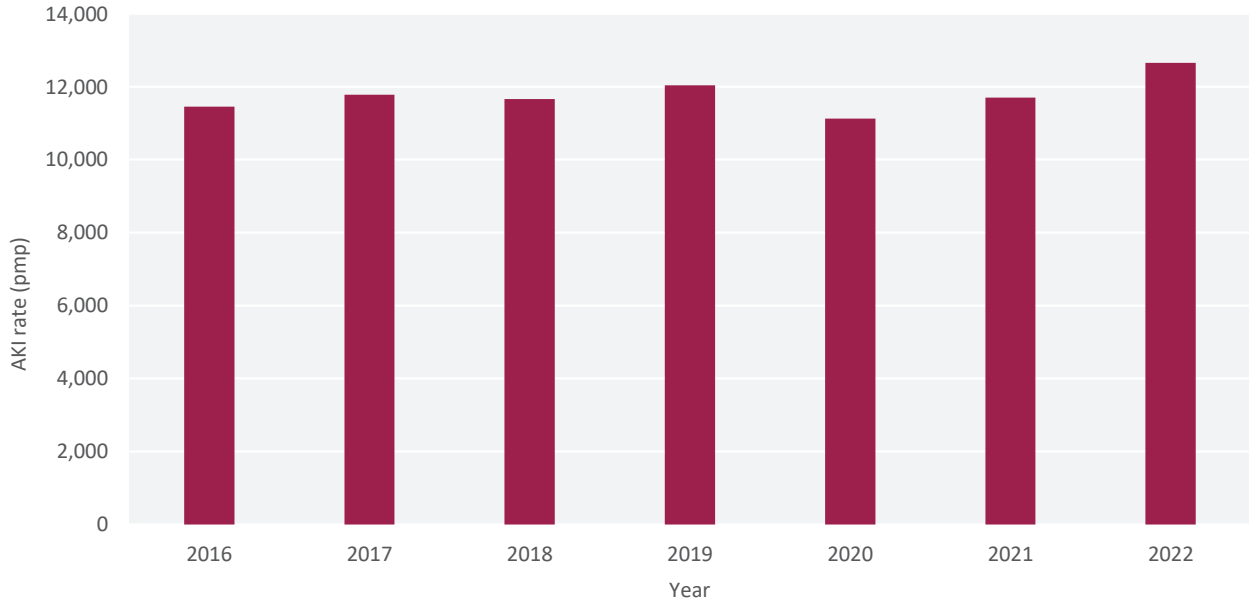

Figure 1.4 AKI rates per million population (pmp) in England by year

The unadjusted and adjusted rates of AKI for each ICB are shown in figures 1.5 and 1.6, respectively.

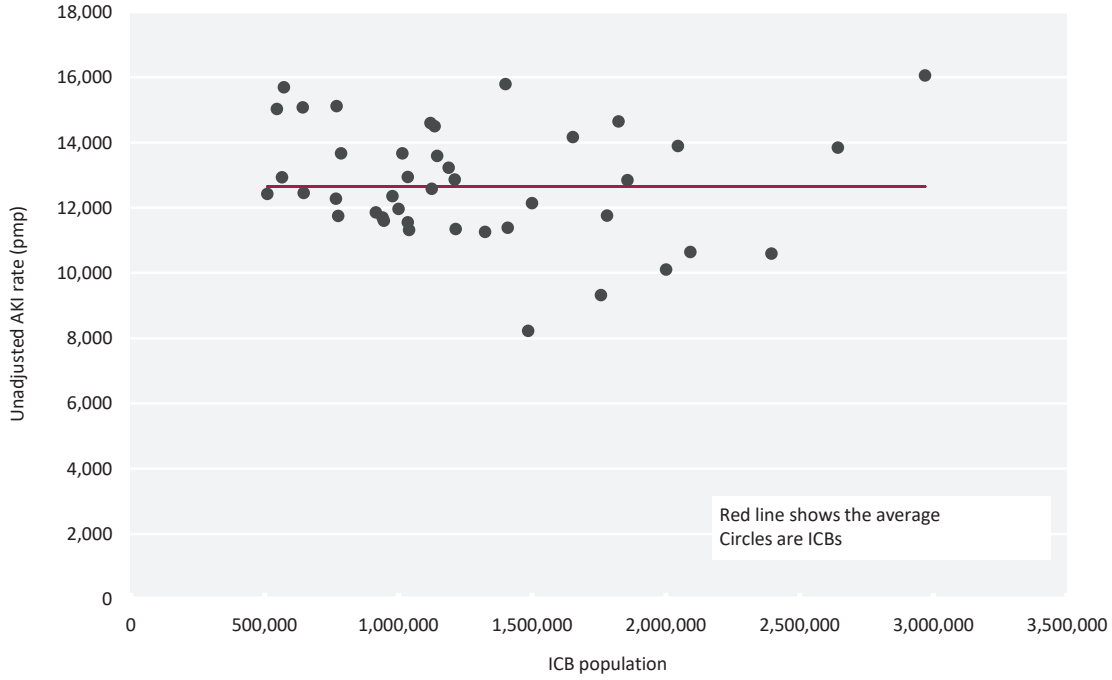

Figure 1.5 Scatterplot of unadjusted AKI rate per million population (pmp) for Integrated Care Boards (ICBs) in 2022

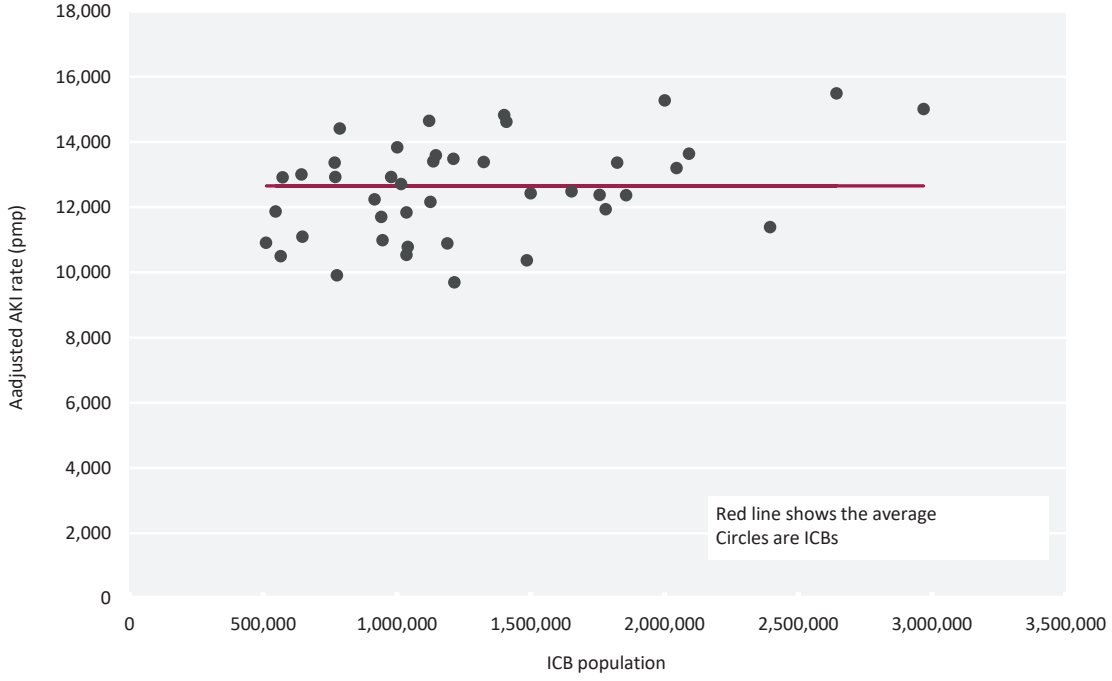

Figure 1.6 Scatterplot of adjusted (directly standardised to the population age-sex distribution) AKI rate per million population (pmp) for Integrated Care Boards (ICBs) in 2022

Figures 1.7 and 1.8 show AKI for each ICB by age and index of multiple deprivation respectively.

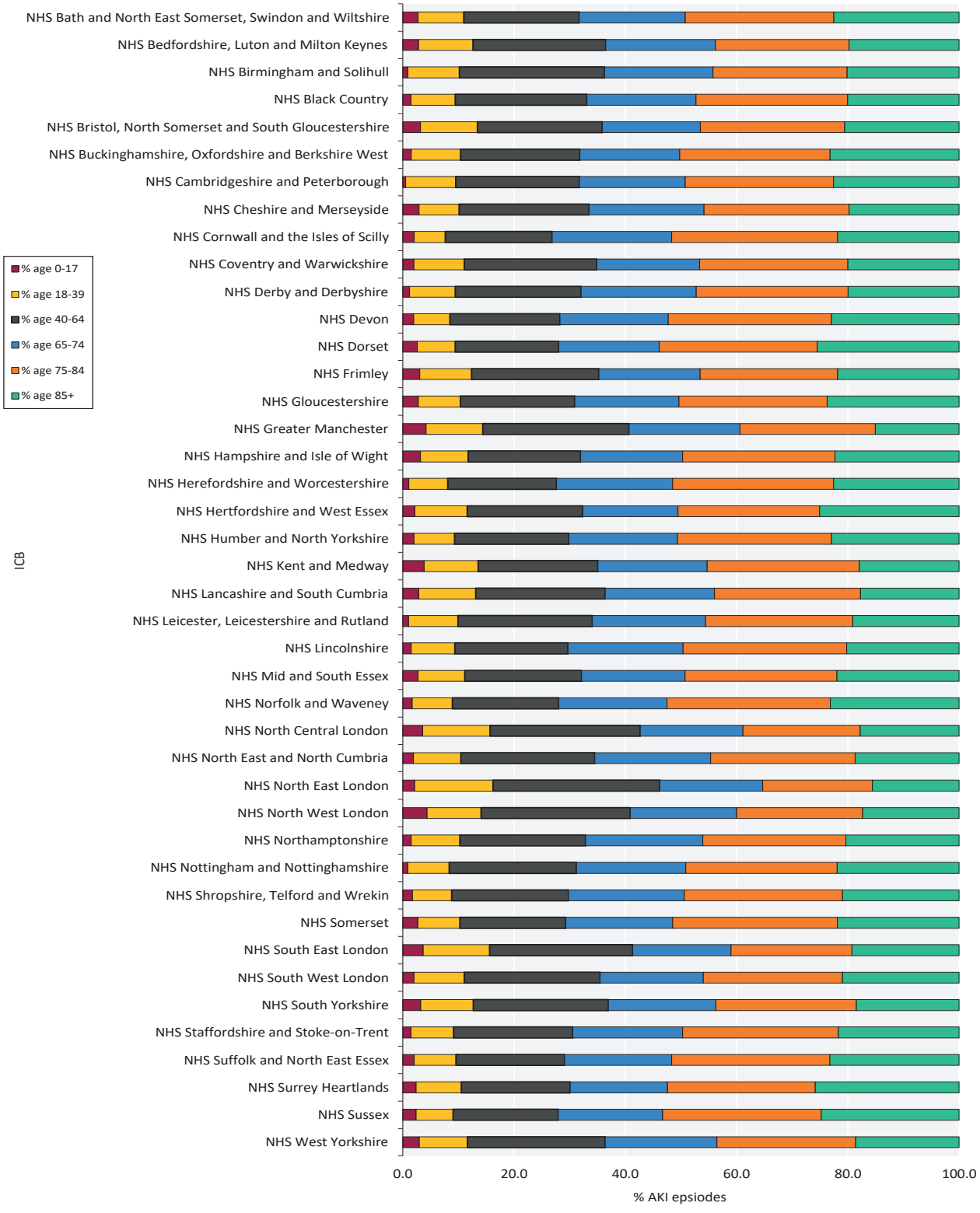

Figure 1.7 AKI for each ICB by age group

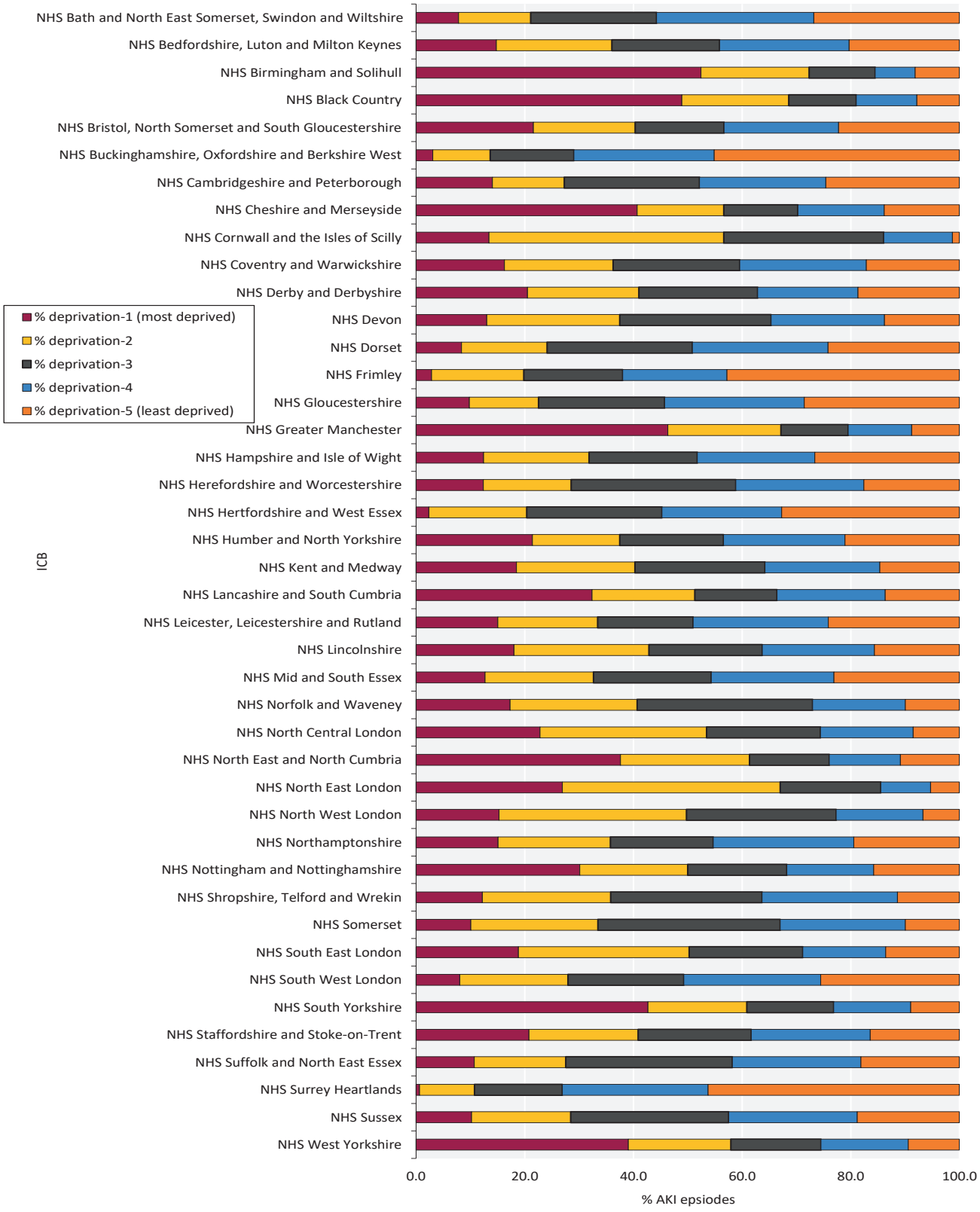

Figure 1.8 AKI for each ICB by index of multiple deprivation quintile

Mortality following an AKI episode by ICB

Figures 1.9 and 1.10 show unadjusted and adjusted (age-sex) 30 day AKI survival, respectively, for ICBs. Two ICBs (Dorset and Coventry & Warwickshire) were excluded from the mortality analyses because mortality data were incomplete.

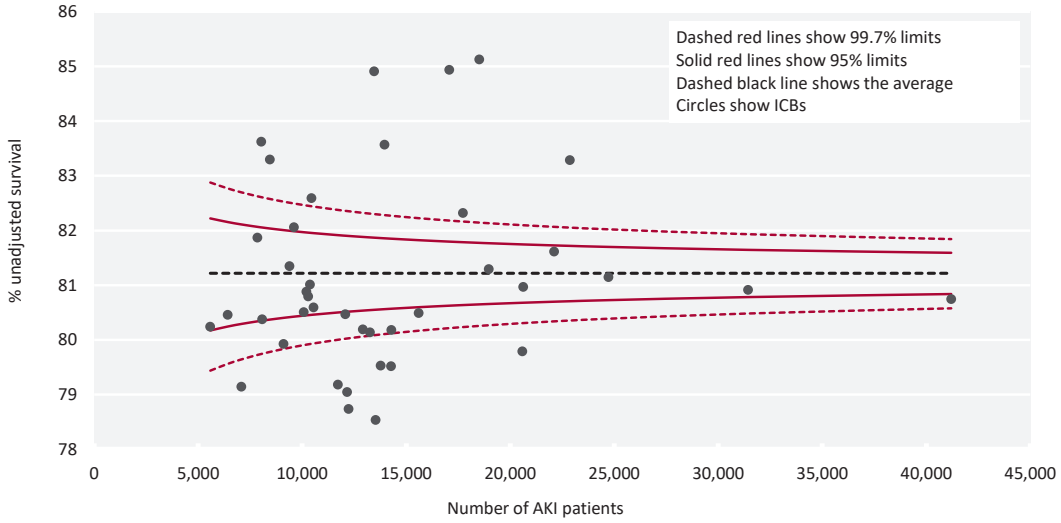

Figure 1.9 Unadjusted 30 day survival of patients with an AKI episode for ICBs in 2022

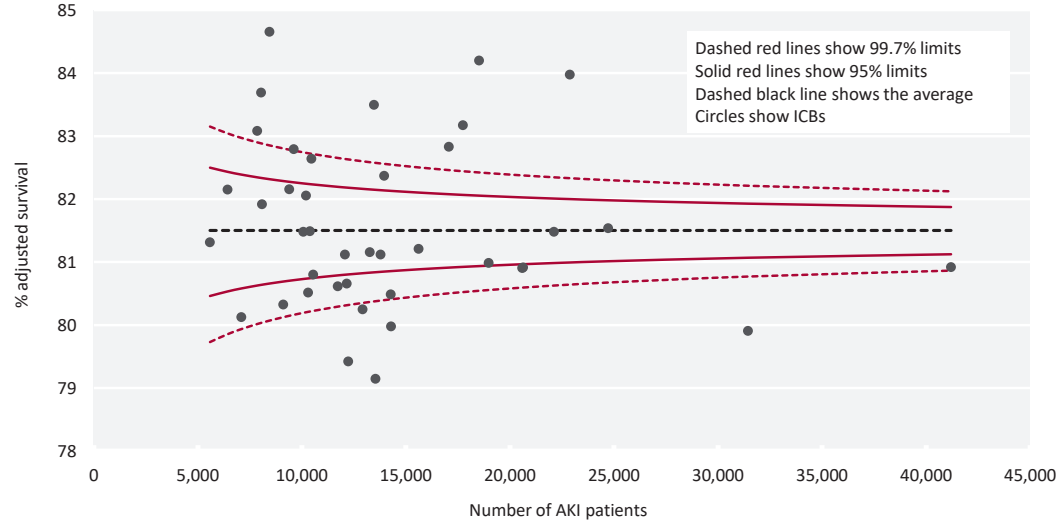

Figure 1.10 Adjusted (males aged 65–74 years) 30 day survival of patients with an AKI episode for ICBs in 2022

UK Kidney Association
UK Renal Registry

Chapter 2

AKI rate and mortality by clinical setting

Introduction

This chapter differentiates the clinical setting in which a patient's AKI episode(s) was identified, and was made possible by linking the UKRR MPI with HES. Where possible the chapter presents conformance to the UK Kidney Association's AKI guideline audit measures.[14]

Some of the measures of AKI outcomes in hospital have been developed with the assistance of the GIRFT team of NHS Improvement. In 2019 the GIRFT team visited all renal centres in England and discussed with them, individually, their conformance to a wide range of measures, including some of admitted AKI patient care.

Of the original cohort of 683,136 AKI episodes available for 2022 from 184 laboratories, 547,302 episodes (80.1%) from 177 laboratories were included in the analyses. Laboratories that had not submitted data in a timely fashion to allow matching with HES data were excluded. In addition to this, people that did not appear to have any matched data to HES between 1997-2022, probably due to opt-out or mismatching, were also excluded. For people with multiple AKI episodes, a single episode was randomly chosen for inclusion in the analysis cohort. Data on hospitalised AKI were excluded from private or community hospitals, if hospitals were deemed to be too small (annual general admission number <10 thousand), or if the hospital AKI rate appeared to be too low (<5 AKI episodes per thousand admissions), indicating specialty hospitals with inherent low AKI or indicating that laboratories serving that hospital were not submitting data for the study period (Birmingham Women's and Children, Blackpool Teaching Hospitals, Dorset County Hospital, Liverpool Heart and Chest Hospital, Liverpool Women's, Moorfields Eye Hospital, Queen Victoria Hospital, Royal Orthopaedic Hospital, Walton Centre, Univeristy Hospitals Dorset), or if the hospital is known not to be covered by their main laboratory despite a rate over 5 per thousand (Guy's & Thomas'). The demographics of the cohort remained very similar after deletions and were consistent with the 2022 cohort analysed in the previous chapter.

When determining if a person was hospitalised during their AKI episode, only ordinary in-patient admissions were considered. Admissions were divided in three groups based on method of admission; elective, emergency and other (which includes maternity and birth admissions), based on the HES categorization.

Definition of clinical settings

Patients with laboratory derived AKI episodes in 2022 were divided into three groups:

- Community acquired, never hospitalised (CA) AKI – there was no inpatient (IP) admission during the AKI episode
- Community acquired, subsequently hospitalised (CAH) AKI – if the AKI episode had started before an IP admission or in the first two days of an IP admission
- Hospital acquired (HA) AKI – if the AKI episode had started from the third day of an IP admission onwards.

Note that while most of the AKI episodes were associated only with one IP hospitalisation, in 6.2% of AKI episodes with an IP stay, multiple hospitalisations occurred during the episode. In those cases, the type of AKI (CAH or HA) was defined by the timing of the first IP hospitalisation associated with the AKI episode. The third day of hospitalisation was used to define the AKI as HA because, while date and time were available for the start of an AKI episode, only a date was recorded for an IP admission. Therefore, the conservative definition of third day rather than 48 hours was preferred.

The UK Kidney Association AKI guideline audit measures

The UKKA's Clinical Practice Guideline – Acute Kidney Injury (AKI)[14] contains a range of audit measures. The analyses here cover the incidence of AKI by setting and AKI outcomes.

Demographics of patients by clinical setting

The characteristics of patients in the three clinical setting groups are shown in table 2.1. The CA group in 2022 was younger, with lower peak AKI and included more females than expected. The CAH group was associated with higher AKI stage, both at start and at the peak.

Table 2.1 Demographics of patients with community acquired, never hospitalised (CA), community acquired, subsequently hospitalised (CAH) and hospital acquired (HA) AKI in 2022

		Clinical setting of AKI episode		
Variable	All AKI episodes	CA	CAH	HA
Number	547,302	173,629	201,639	172,034
%		31.7	36.8	31.4
Age group (years)				
Median	73.9	69.3	74.2	76.9
% <18	2.4	2.5	2.3	2.4
% 18 - 39	8.9	13.7	7.7	5.5
% 40 - 64	22.2	26.4	22.1	18.1
% 65 - 74	19.1	18.6	20.1	18.4
% 75 - 84	26.2	22.7	27.0	28.8
% ≥85	21.2	16.1	20.9	26.8
Sex (%)				
Male	48.1	42.3	51.7	49.7
First AKI stage (%)				
1	78.7	84.9	67.9	85.1
2	13.2	9.8	18.3	10.8
3	8.1	5.4	13.8	4.1
Peak AKI stage (%)				
1	69.5	83.3	55.7	71.8
2	17.2	10.7	23.0	17.2
3	13.3	6.1	21.3	11.0
Deprivation quintile (%)				
1 - most deprived	23.0	23.4	23.8	21.7
2	21.0	21.4	20.9	20.7
3	20.0	19.8	19.9	20.3
4	18.9	18.4	18.6	19.5
5 - least deprived	17.1	17.0	16.7	17.8

Length of hospital stay associated with an AKI episode

For each AKI episode with associated hospitalisations (CAH and HA), a length of stay (LOS) in hospital was calculated. If a person had more than one hospital stay during a single AKI episode, the sum of the time spent in hospital during the multiple spells was used, rather than using the time for each hospital stay separately. In these cases, LOS was attributed to the first hospital to which the patient was admitted. Also, the LOS was determined to be elective, emergency or other type based on the first hospital admission during the AKI episode being elective, emergency or other type respectively.

Note that most patients had only one hospital stay during a single AKI episode, with only 23,401 (6.2%) of AKI episodes associated with more than one hospital stay. Of these, the repeated hospitalisations were in different hospitals in 27.0% of cases (corresponding to only 1.7% of the total AKI episodes being associated to multiple hospitalisations in different hospitals).

Median LOS across all 125 hospitals by elective, emergency and other type admissions is presented in table 2.2. This includes a sub-analysis that excluded patients who died during the admission, to investigate whether those with an early poor outcome of AKI artificially improved the overall LOS. The data suggest that this was not the case.

Table 2.3 shows the LOS for each admission type by hospital. The UKRR does not have access to any data on patients who had a hospital admission without an AKI and hence it was not possible to include a comparator group. Figure 2.1 shows the overall median and range LOS by admission type.

Table 2.2 Length of stay in hospital associated with AKI by elective, emergency and other type admissions and community acquired, subsequently hospitalised (CAH) versus hospital acquired (HA) AKI for hospitals in 2022

	Time in hospital (days)		
Type of admission	Total	Median	IQR
ALL ADMISSIONS			
All	373,673	12	6-24
Elective	26,961	10	5-21
Elective CAH	10,996	6	3-11
Elective HA	15,965	14	8-27
Emergency	333,107	13	6-25
Emergency CAH	184,863	8	4-17
Emergency HA	148,244	19	11-34
Other	13,605	7	5-19
Other CAH	5,780	5	3-8
Other HA	7,825	11	6-32
ADMISSIONS ALIVE AT DISCHARGE			
All	291,276	12	6-25
Elective	25,074	10	5-20
Elective CAH	10,441	6	3-10
Elective HA	14,633	14	8-26
Emergency	253,476	13	6-25
Emergency CAH	145,319	9	4-18
Emergency HA	108,157	20	11-35
Other	12,726	7	4-17
Other CAH	5,581	5	3-8
Other HA	7,145	10	6-30

IQR – interquartile range

Table 2.3 Length of stay by hospital for elective, emergency and other type admissions associated with hospitalised AKI (community acquired, subsequently hospitalised and hospital acquired) in 2022

	Length of hospital stay (days)					
	Elective		Emergency		Other	
Hospital	Number	Median	Number	Median	Number	Median
Airedale	60	8	1,399	10	41	6
Alder Hey Children's	137	13	316	11	10	49
Ashford and St Peter's Hospitals	115	7	2,084	10	170	6
Barking, Havering and Redbridge University Hospitals	151	9	3,323	13	151	7
Barnsley Hospital	23	12	983	10	30	10
Barts Health	626	14	5,145	15	463	7
Bedfordshire Hospitals	218	6	4,580	12	111	7
Bolton	123	8	1,922	13	168	8
Bradford Teaching Hospitals	137	9	2,085	11	126	7
Buckinghamshire Healthcare	162	8	2,408	12	167	6
Calderdale and Huddersfield	70	6	1,947	11	31	7
Cambridge University Hospitals	453	11	3,176	15	98	11
Chelsea and Westminster Hospital	99	7	2,783	12	173	8
Chesterfield Royal Hospital	52	8	2,002	11	24	5
Countess of Chester Hospital	70	8	2,272	13	62	6
County Durham and Darlington	87	10	4,171	11	96	5
Croydon Health Services	42	9	1,590	16	96	8
Dartford and Gravesham	135	13	2,178	14	83	5
Doncaster and Bassetlaw Teaching Hospitals	208	6	3,086	11	69	6
East and North Hertfordshire	166	7	2,269	13	242	5
East Cheshire	13	11	322	17	0	
East Kent Hospitals University	293	8	4,375	12	108	6
East Lancashire Hospitals	359	10	3,743	13	268	5
East Suffolk and North Essex	111	7	2,711	12	90	9
East Sussex Healthcare	156	7	3,019	13	62	5
Epsom and St Helier University Hospitals	82	7	1,813	14	40	8
Frimley Health	133	7	2,162	14	87	5
Gateshead Health	98	11	1,953	12	61	10
George Eliot Hospital	35	8	918	14	15	7
Gloucestershire Hospitals	290	9	3,676	13	154	6
Great Ormond Street Hospital for Children	271	14	205	21	20	23
Great Western Hospitals	205	10	2,361	12	109	7
Hampshire Hospitals	144	12	3,413	13	119	6
Harrogate and District	60	9	1,173	12	14	7
Homerton Healthcare	38	12	998	13	94	4
Hull University Teaching Hospitals	407	10	3,355	13	60	5
Imperial College Healthcare	518	11	3,158	13	193	12
Isle of Wight	33	7	1,258	11	29	8
James Paget University Hospitals	108	10	1,520	14	36	6
Kettering General Hospital	144	8	2,611	12	86	11
King's College Hospital	666	12	3,782	15	354	9
Kingston Hospital	72	9	1,821	16	124	6
Lancashire Teaching Hospitals	325	12	3,096	14	118	13
Leeds Teaching Hospitals	511	14	3,200	14	197	16
Lewisham and Greenwich	101	9	3,980	13	490	7
Liverpool University Hospitals	379	11	3,910	16	50	39
London North West University Healthcare	207	15	3,118	14	86	8
Maidstone and Tunbridge Wells	131	8	2,777	11	102	7
Manchester University	705	13	4,749	14	252	22
Medway	150	5	2,597	12	122	7

Hospital	Length of hospital stay (days)					
	Elective		Emergency		Other	
	Number	Median	Number	Median	Number	Median
Mid and South Essex	525	9	6,705	13	269	8
Mid Cheshire Hospitals	14	16	707	13	12	7
Mid Yorkshire Hospitals	118	11	3,723	12	109	8
Milton Keynes University Hospital	58	8	1,814	12	59	6
Norfolk and Norwich University Hospitals	345	8	3,789	12	133	5
North Bristol	284	7	3,155	13	135	5
North Cumbria Integrated Care	64	9	2,344	12	49	5
North Middlesex University Hospital	34	9	1,833	16	89	9
North Tees and Hartlepool	112	8	2,365	10	72	5
North West Anglia	83	12	3,377	14	117	6
Northampton General Hospital	128	13	2,125	14	61	6
Northern Care Alliance	389	11	5,375	12	150	20
Northern Lincolnshire and Goole	121	7	3,040	11	96	6
Northumbria Healthcare	87	7	3,508	10	75	7
Nottingham University Hospitals	619	10	5,378	13	263	8
Oxford University Hospitals	465	9	4,155	10	120	15
Portsmouth Hospitals University	338	7	3,969	13	163	10
Royal Berkshire	147	6	2,855	10	183	6
Royal Cornwall Hospitals	241	8	2,406	11	30	7
Royal Devon University Healthcare	280	9	4,276	12	136	8
Royal Free London	414	7	3,988	13	396	7
Royal National Orthopaedic Hospital	98	8	16	30	3	-
Royal Papworth Hospital	360	13	208	10	183	16
Royal Surrey County Hospital	136	10	1,729	13	79	8
Royal United Hospitals Bath	104	8	2,567	12	108	7
Salisbury	110	11	1,609	14	78	6
Sandwell and West Birmingham Hospitals	100	10	2,641	11	32	8
Sheffield Children's	65	13	166	9	22	15
Sheffield Teaching Hospitals	754	13	4,688	15	188	7
Sherwood Forest Hospitals	88	10	2,798	12	34	5
Somerset	180	8	2,727	13	127	8
South Tees Hospitals	366	9	3,423	11	105	5
South Tyneside and Sunderland	304	9	4,301	11	89	5
South Warwickshire	39	10	984	11	35	8
Southport and Ormskirk Hospital	33	10	1,473	13	43	6
St George's University Hospitals	341	11	2,414	16	206	8
St Helens and Knowsley Teaching Hospitals	124	9	2,704	13	49	7
Stockport	130	7	2,111	13	93	7
Surrey and Sussex Healthcare	126	8	2,608	14	86	6
Tameside and Glossop Integrated Care	34	9	1,600	12	35	8
The Christie	322	13	574	11	15	48
The Dudley Group	211	8	3,047	12	87	6
The Hillingdon Hospitals	41	7	1,410	12	63	10
The Newcastle Upon Tyne Hospitals	913	11	3,856	13	380	17
The Princess Alexandra Hospital	41	9	1,233	12	45	6
The Queen Elizabeth Hospital, King's Lynn,	58	7	1,434	14	27	7
The Robert Jones and Agnes Hunt Orthopaedic Hospital	78	7	12	24	35	107
The Rotherham	63	7	946	12	26	9
The Royal Marsden	354	14	252	17	29	31
The Royal Wolverhampton	401	8	3,542	12	104	11
The Shrewsbury and Telford Hospital	125	8	3,261	12	90	6
Torbay and South Devon	105	8	1,908	11	9	-

Hospital	Length of hospital stay (days)					
	Elective		Emergency		Other	
	Number	Median	Number	Median	Number	Median
United Lincolnshire Hospitals	247	8	4,402	13	117	5
University College London Hospitals	677	15	1,472	17	113	8
University Hospital Southampton	743	14	4,709	13	318	10
University Hospitals Birmingham	763	11	8,447	13	174	14
University Hospitals Bristol and Weston	500	14	3,240	14	304	11
University Hospitals Coventry and Warwickshire	240	10	2,367	13	121	8
University Hospitals of Derby and Burton	298	10	5,690	12	146	6
University Hospitals of Leicester	570	11	5,291	13	178	8
University Hospitals of Morecambe Bay	87	9	2,383	12	58	6
University Hospitals of North Midlands	432	11	5,526	12	217	8
University Hospitals Plymouth	307	10	2,340	16	98	21
University Hospitals Sussex	161	6	3,274	13	87	5
Walsall Healthcare	63	10	1,705	13	12	5
Warrington and Halton Teaching Hospitals	69	8	1,750	15	41	5
West Hertfordshire Teaching Hospitals	91	7	2,965	14	85	7
West Suffolk	71	8	2,233	12	82	6
Whittington Health	25	14	969	15	55	5
Wirral University Teaching Hospital	131	9	2,425	13	33	6
Worcestershire Acute Hospitals	160	8	2,701	11	49	6
Wrightington, Wigan and Leigh	78	12	2,034	10	24	7
Wye Valley	56	8	1,176	12	22	4
Yeovil District Hospital	37	9	1,625	13	22	6
York and Scarborough Teaching Hospitals	206	7	3,761	12	76	7

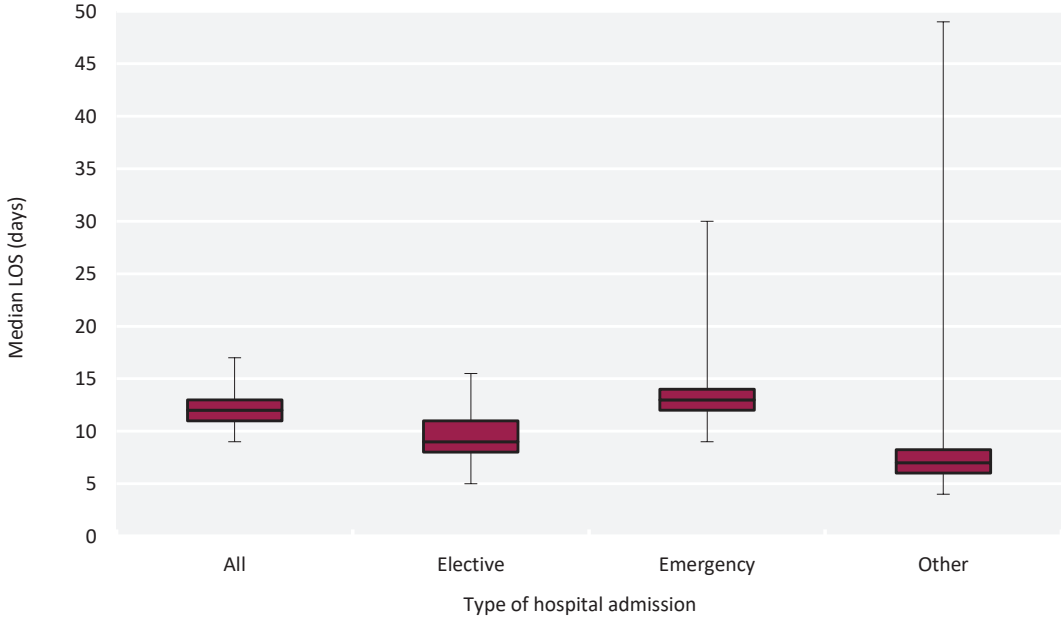

Figure 2.1 Boxplot of the median hospital length of stay (LOS) for elective, emergency and 'other' admissions associated with hospitalised AKI (community acquired, subsequently hospitalised and hospital acquired) in 2022

The box shows the median and interquartile range (IQR) and the whiskers are the minimum and maximum values. A single outlier (with median LOS=107days) was excluded from the boxplot in the group 'other'

Mortality following an AKI episode by clinical setting

Table 2.4 shows the mortality by 30 days from AKI episode start, adjusted for age and sex, by clinical setting (CA/CAH/HA). All stages of AKI were included.

Table 2.4 Adjusted (males aged 65–74 years) 30 day mortality for patients with an AKI episode by clinical setting in 2022

	All AKI episodes	Setting of AKI episode		
		CA	CAH	HA
Number	547,302	173,629	201,639	172,034
%		31.7	36.8	31.4
% died by 30 days from AKI start	19.1	9.4	21.4	26.1
ADJUSTED MORTALITY (%) BY PEAK AKI STAGE				
1	13.0	6.6	14.7	18.2
2	27.1	22.5	24.7	34.5
3	33.3	31.5	30.2	42.7

CA – community acquired; CAH – community acquired, subsequently hospitalised; HA – hospital acquired

Mortality following an HA-AKI episode in adult patients, by trust

Adjusted analysis of 30 day mortality following an episode of hospital acquired AKI was performed to estimate variability between trusts. For this analysis, paediatric patients and 'other' types of admissions were excluded (mainly maternities). Analysis was performed by using a recalibration of the logistic model previously developed.[15] Figure 2.2 shows a funnel plot for the standardised mortality ratio (SMR) spread by trust, with values over 1 indicating higher mortality than expected. Table 2.5 shows the adjusted analysis of 30 days mortality by hospital following an episode of hospital acquired AKI.

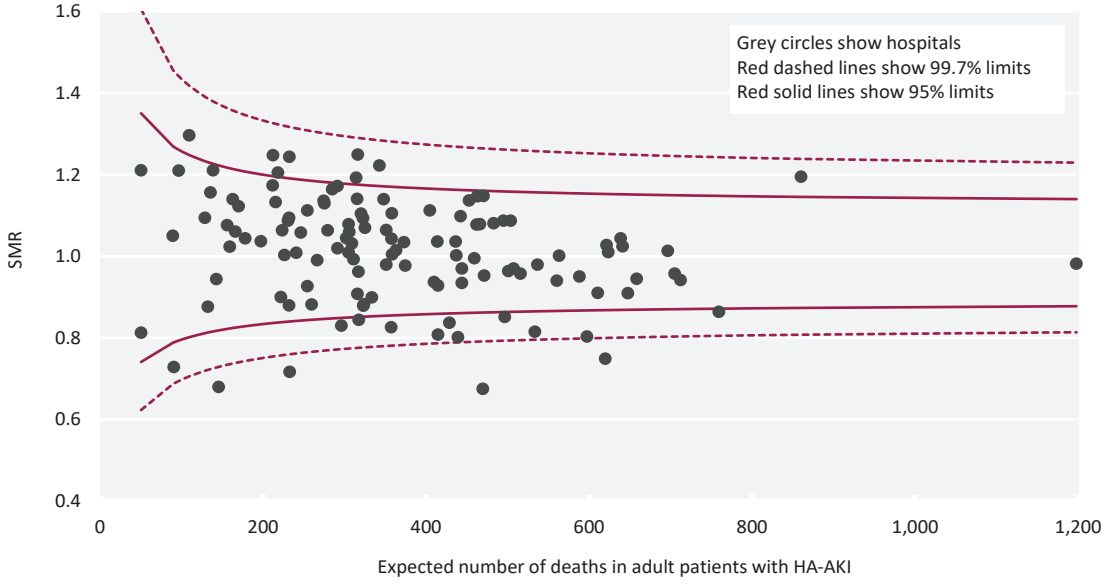

Figure 2.2 Funnel plot for the standardised mortality ratio (SMR) spread by trust

Hospitals with number of patients with HA-AKI of <100 are excluded from the figure
Funnel plot is adjusted for over dispersion
SMR - standardised mortality ratio

Table 2.5 Adjusted analysis of 30 day mortality following an episode of hospital acquired AKI, by hospital in 2022

Hospital	N of adults with HA-AKI	% crude 30 day mortality	N of expected deaths	Adjusted SMR
Airedale	519	32.4	139	1.21
Ashford and St Peter's Hospitals	795	28.6	226	1.00
Barking, Havering and Redbridge University Hospitals	1,589	27.6	437	1.00
Barnsley Hospital	347	33.7	97	1.21
Barts Health	3,069	21.4	759	0.86
Bedfordshire Hospitals	2,218	28.4	624	1.01
Bolton	857	30.5	247	1.06
Bradford Teaching Hospitals	863	30.5	218	1.21
Buckinghamshire Healthcare	1,133	25.2	324	0.88
Calderdale and Huddersfield	785	32.4	232	1.09
Cambridge University Hospitals	1,952	16.2	470	0.67
Chelsea and Westminster Hospital	1,122	27.5	311	0.99
Chesterfield Royal Hospital	760	32.1	215	1.13
Countess of Chester Hospital	899	25.5	260	0.88
County Durham and Darlington	1,598	30.4	443	1.10
Croydon Health Services	1,283	28.5	375	0.98
Dartford and Gravesham	1,037	30.8	309	1.03
Doncaster and Bassetlaw Teaching Hospitals	1,225	32.4	348	1.14
East and North Hertfordshire	1,208	24.8	334	0.90
East Cheshire	162	37.7	50	1.21
East Kent Hospitals University	1,790	27.5	507	0.97
East Lancashire Hospitals	1,742	26.2	459	0.99
East Suffolk and North Essex	1,248	28.8	359	1.00
East Sussex Healthcare	1,220	30.6	358	1.04
Epsom and St Helier University Hospitals	825	34.3	255	1.11
Frimley Health	1,142	24.9	323	0.88
Gateshead Health	906	29.1	267	0.99
George Eliot Hospital	441	35.6	136	1.16
Gloucestershire Hospitals	1,725	30.8	463	1.15
Great Western Hospitals	1,135	28.5	306	1.06
Hampshire Hospitals	1,679	25.2	497	0.85
Harrogate And District	542	31.0	156	1.08
Homerton Healthcare	554	24.4	143	0.94
Hull University Teaching Hospitals	1,698	30.3	453	1.14
Imperial College Healthcare	1,625	21.7	439	0.80
Isle of Wight	549	29.7	159	1.02
James Paget University Hospitals	897	27.1	241	1.01
Kettering General Hospital	1,161	30.5	321	1.10
King's College Hospital	2,521	22.1	611	0.91
Kingston Hospital	1,187	24.9	357	0.83
Lancashire Teaching Hospitals	1,614	25.7	444	0.93
Leeds Teaching Hospitals	1,660	27.2	436	1.04
Lewisham and Greenwich	1,955	26.9	537	0.98
Liverpool University Hospitals	2,514	24.7	659	0.94
London North West University Healthcare	1,716	26.2	471	0.95
Maidstone and Tunbridge Wells	1,095	28.1	305	1.01
Manchester University	2,469	22.6	588	0.95
Medway	1,080	36.6	316	1.25
Mid And South Essex	3,184	32.3	860	1.20
Mid Cheshire Hospitals	269	34.9	90	1.05
Mid Yorkshire Hospitals	1,646	30.6	466	1.08
Milton Keynes University Hospital	762	34.8	212	1.25
Norfolk and Norwich University Hospitals	1,792	30.0	495	1.09

Hospital	N of adults with HA-AKI	% crude 30 day mortality	N of expected deaths	Adjusted SMR
North Bristol	1,599	21.0	415	0.81
North Cumbria Integrated Care	993	33.4	285	1.16
North Middlesex University Hospital	988	32.0	303	1.04
North Tees and Hartlepool	933	33.4	275	1.14
North West Anglia	1,574	34.3	471	1.15
Northampton General Hospital	1,058	35.4	314	1.19
Northern Care Alliance	2,421	27.6	639	1.04
Northern Lincolnshire and Goole	1,203	34.8	343	1.22
Northumbria Healthcare	1,249	29.5	364	1.01
Nottingham University Hospitals	2,647	25.5	705	0.96
Oxford University Hospitals	2,325	25.3	648	0.91
Portsmouth Hospitals University	1,906	27.6	561	0.94
Royal Berkshire	1,145	30.4	325	1.07
Royal Cornwall Hospitals	1,091	27.2	291	1.02
Royal Devon University Healthcare	1,952	25.3	516	0.96
Royal Free London	2,185	22.0	598	0.80
Royal Papworth Hospital	439	9.3	50	0.81
Royal Surrey County Hospital	820	28.8	255	0.93
Royal United Hospitals Bath	1,111	25.8	316	0.91
Salisbury	845	24.1	232	0.88
Sandwell and West Birmingham Hospitals	1,076	31.8	292	1.17
Sheffield Teaching Hospitals	2,565	25.6	642	1.02
Sherwood Forest Hospitals	1,200	33.0	358	1.11
Somerset	1,236	27.8	351	0.98
South Tees Hospitals	1,510	25.6	373	1.03
South Tyneside and Sunderland	1,771	30.9	504	1.09
South Warwickshire	456	30.9	129	1.09
Southport and Ormskirk Hospital	623	29.9	178	1.04
St George's University Hospitals	1,783	20.1	429	0.84
St Helens and Knowsley Teaching Hospitals	1,211	30.9	351	1.06
Stockport	983	30.2	279	1.06
Surrey and Sussex Healthcare	1,470	26.2	415	0.93
Tameside and Glossop Integrated Care	679	30.2	198	1.04
The Christie	469	21.1	146	0.68
The Dudley Group	1,460	30.8	405	1.11
The Hillingdon Hospitals	563	31.3	166	1.06
The Newcastle Upon Tyne Hospitals	2,191	19.9	534	0.81
The Princess Alexandra Hospital	566	33.7	170	1.12
The Queen Elizabeth Hospital, King's Lynn,	726	34.3	212	1.17
The Rotherham	383	37.1	110	1.30
The Royal Marsden	326	20.2	91	0.73
The Royal Wolverhampton	1,966	24.6	501	0.96
The Shrewsbury and Telford Hospital	1,429	30.0	414	1.04
Torbay and South Devon	808	29.5	224	1.06
United Lincolnshire Hospitals	2,007	28.1	563	1.00
University College London Hospitals	1,263	19.5	296	0.83
University Hospital Southampton	2,436	19.0	620	0.75
University Hospitals Birmingham	4,373	26.9	1,198	0.98
University Hospitals Bristol and Weston	1,667	23.0	410	0.94
University Hospitals Coventry and Warwickshire	1,184	27.8	305	1.08
University Hospitals of Derby and Burton	2,521	26.6	712	0.94
University Hospitals of Leicester	2,518	25.4	622	1.03
University Hospitals of Morecambe Bay	930	33.4	275	1.13
University Hospitals of North Midlands	2,663	26.5	697	1.01
University Hospitals Plymouth	1,239	28.5	323	1.09

Hospital	N of adults with HA-AKI	% crude 30 day mortality	N of expected deaths	Adjusted SMR
University Hospitals Sussex	1,597	27.0	444	0.97
Walsall Healthcare	757	33.2	231	1.09
Warrington and Halton Teaching Hospitals	826	20.2	233	0.72
West Hertfordshire Teaching Hospitals	1,509	33.0	462	1.08
West Suffolk	1,133	23.7	318	0.84
Whittington Health	476	24.4	132	0.88
Wirral University Teaching Hospital	1,143	26.7	317	0.96
Worcestershire Acute Hospitals	1,140	31.6	316	1.14
Wrightington, Wigan and Leigh	777	37.2	232	1.24
Wye Valley	583	31.9	163	1.14
Yeovil District Hospital	749	26.7	222	0.90
York and Scarborough Teaching Hospitals	1,632	32.0	483	1.08

Hospitals with number of patients with HA-AKI of <100 are excluded from table.

SMR = standardised mortality ratio

Accuracy of coding of hospital AKI episodes

For all 2022 AKI episodes in the MPI that were associated with hospitalisations (both CAH and HA, in emergency, elective or other admissions), the percentage of those that were coded in HES using the International Classification of Diseases diagnostic code for AKI (N17) was calculated for each hospital. Coding of peak AKI stages 1, 2 and 3 are presented in figures 2.3, 2.4 and 2.5, respectively.

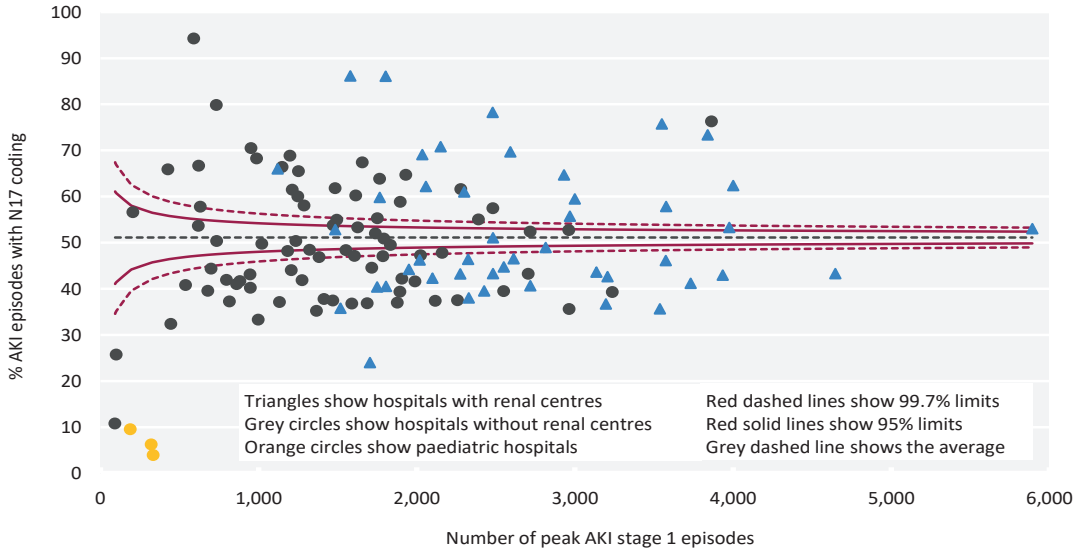

Figure 2.3 Percentage of peak AKI stage 1 episodes in the Master Patient Index that were coded in Hospital Episode Statistics using N17 by hospital in 2022

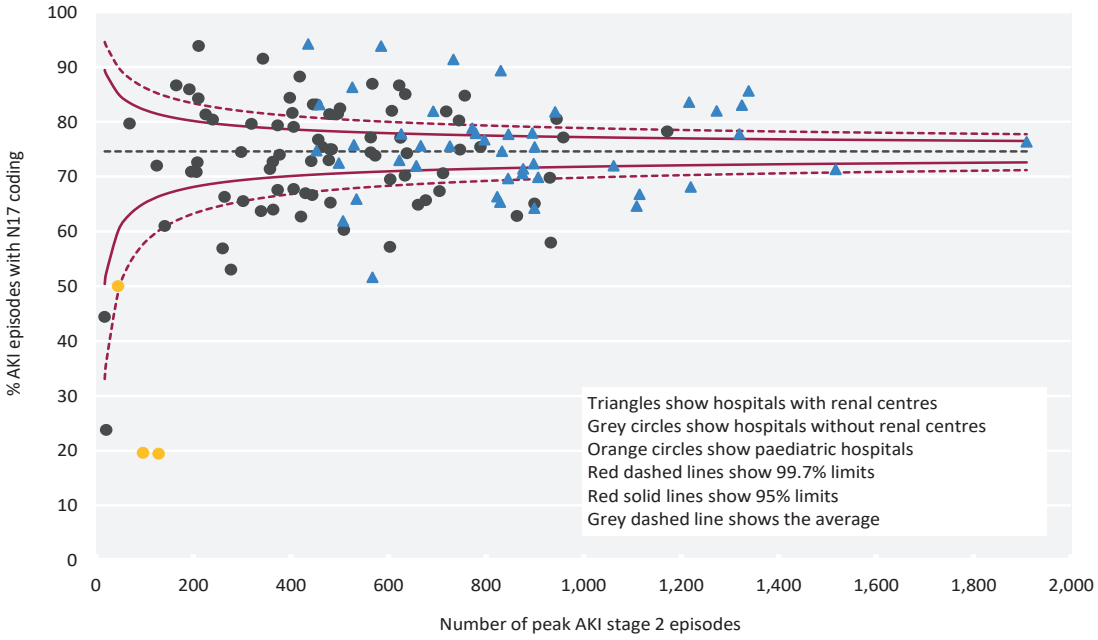

Figure 2.4 Percentage of peak AKI stage 2 episodes in the Master Patient Index that were coded in Hospital Episode Statistics using N17 by hospital in 2022

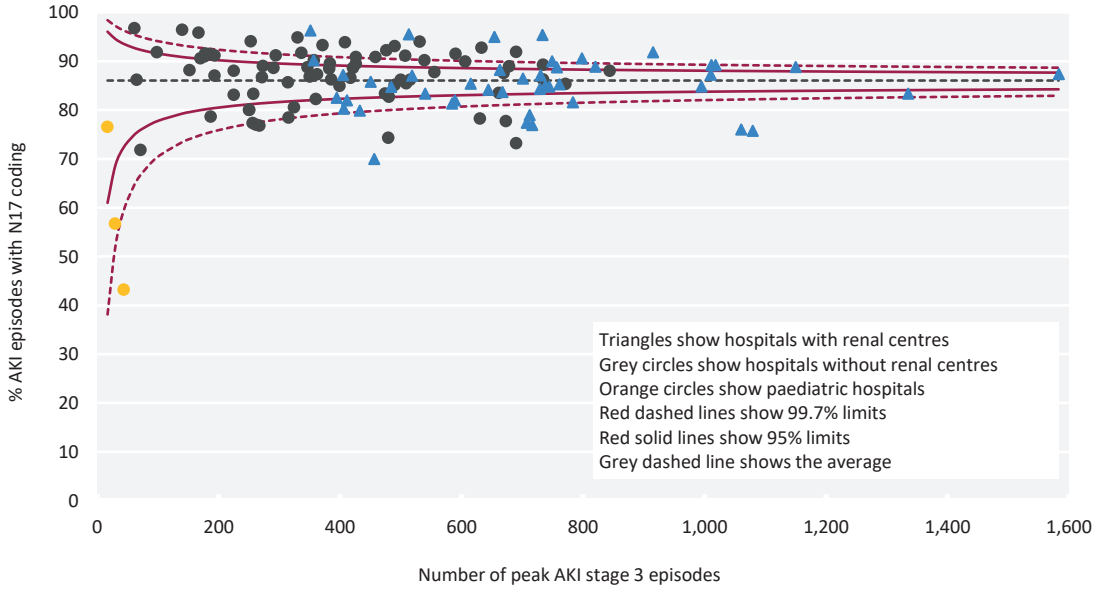

Figure 2.5 Percentage of peak AKI stage 3 episodes in the Master Patient Index that were coded in Hospital Episode Statistics using N17 by hospital in 2022

HES coding was better the higher the stage of AKI and there was no clear difference between HES coding for renal and acute non-renal hospitals. Generally, HES coding for AKI was poor in paediatric hospitals. More information about coding accuracy by hospital is presented in table 2.6.

Table 2.6 Correlation of AKI coding between UKRR and Hospital Episode Statistics (HES) – the percentage of peak AKI stage 1, 2 and 3 episodes in the Master Patient Index that were coded in HES using N17 by hospital in 2022

	% peak coded		
Hospital	AKI 1	AKI 2	AKI 3
Airedale	40.2	65.6	80.0
Alder Hey Children's	3.9	19.6	56.7
Ashford and St Peter's Hospitals	61.8	82.4	89.6
Barking, Havering and Redbridge University Hospitals	37.5	67.4	83.5
Barnsley Hospital	53.6	80.4	91.0
Barts Health	43.0	68.1	75.7
Bedfordshire Hospitals	39.3	65.1	85.3
Bolton	48.5	75.4	89.4
Bradford Teaching Hospitals	52.9	74.8	82.0
Buckinghamshire Healthcare	39.3	65.3	87.3
Calderdale and Huddersfield	58.1	81.6	90.2
Cambridge University Hospitals	43.3	75.6	87.1
Chelsea and Westminster Hospital	42.2	70.2	86.2
Chesterfield Royal Hospital	41.8	72.9	82.2
Countess of Chester Hospital	67.4	88.3	94.8
County Durham and Darlington	52.4	80.5	91.9
Croydon Health Services	37.1	63.7	83.3
Dartford and Gravesham	54.9	75.0	86.6
Doncaster and Bassetlaw Teaching Hospitals	44.2	76.8	85.4
East and North Hertfordshire	40.4	65.9	82.5
East Cheshire	56.6	79.7	96.7
East Kent Hospitals University	40.7	72.0	84.8
East Lancashire Hospitals	43.2	69.8	89.2
East Suffolk and North Essex	40.5	73.0	84.7
East Sussex Healthcare	47.3	70.6	86.2
Epsom and St Helier University Hospitals	66.0	83.2	90.2
Frimley Health	48.4	73.0	86.9
Gateshead Health	35.2	67.0	78.4
George Eliot Hospital	94.2	93.8	95.8
Gloucestershire Hospitals	51.0	75.4	85.0
Great Ormond Street Hospital for Children	6.2	19.4	43.2
Great Western Hospitals	36.9	60.3	74.3
Hampshire Hospitals	55.0	80.3	90.2
Harrogate and District	50.3	79.6	87.0
Homerton Healthcare	79.8	84.3	91.4
Hull University Teaching Hospitals	43.2	69.7	86.4
Imperial College Healthcare	38.0	65.4	78.9
Isle of Wight	41.9	74.5	88.0
James Paget University Hospitals	44.0	66.3	91.2
Kettering General Hospital	50.9	73.8	83.3
King's College Hospital	36.7	64.3	77.4
Kingston Hospital	46.9	72.7	86.7
Lancashire Teaching Hospitals	70.8	91.4	95.0
Leeds Teaching Hospitals	61.0	77.8	85.3
Lewisham and Greenwich	35.6	58.0	77.7
Liverpool University Hospitals	49.0	77.9	84.8
London North West University Healthcare	37.4	57.2	73.2
Maidstone and Tunbridge Wells	58.9	82.0	91.1
Manchester University	35.7	64.7	76.0
Medway	47.0	77.1	90.8
Mid and South Essex	43.3	71.3	83.4
Mid Cheshire Hospitals	65.9	86.7	96.4

Hospital	% peak coded		
	AKI 1	AKI 2	AKI 3
Mid Yorkshire Hospitals	57.5	75.4	88.9
Milton Keynes University Hospital	66.4	83.2	91.7
Norfolk and Norwich University Hospitals	46.5	72.4	88.8
North Bristol	46.4	75.7	81.3
North Cumbria Integrated Care	35.8	61.9	79.9
North Middlesex University Hospital	50.3	67.7	85.7
North Tees and Hartlepool	53.3	81.5	90.8
North West Anglia	47.8	75.0	87.6
Northampton General Hospital	37.5	66.7	85.0
Northern Care Alliance	57.8	77.8	89.2
Northern Lincolnshire and Goole	64.7	81.9	89.9
Northumbria Healthcare	61.6	84.8	92.7
Nottingham University Hospitals	53.3	82.0	89.2
Oxford University Hospitals	43.7	70.6	84.4
Portsmouth Hospitals University National Health Service Trust	55.7	78.9	87.1
Royal Berkshire	46.3	77.8	83.3
Royal Cornwall Hospitals	86.1	93.8	95.5
Royal Devon University Healthcare + Northern Devon	59.5	78.0	90.6
Royal Free London	42.7	71.5	77.0
Royal National Orthopaedic Hospital	10.8	23.8	
Royal Papworth Hospital	40.8	61.0	71.8
Royal Surrey County Hospital	65.5	84.4	91.2
Royal United Hospitals Bath	52.0	77.1	92.2
Salisbury	48.1	71.4	77.3
Sandwell and West Birmingham Hospitals	60.2	86.9	91.5
Sheffield Children's	9.5	50.0	76.5
Sheffield Teaching Hospitals	41.2	66.8	81.6
Sherwood Forest Hospitals	63.8	86.7	94.0
Somerset	37.0	65.7	82.7
South Tees Hospitals	39.6	66.3	84.2
South Tyneside and Sunderland	64.7	81.8	88.9
South Warwickshire	39.6	72.6	90.6
Southport and Ormskirk Hospital	70.5	91.5	94.1
St George's University Hospitals	62.2	72.5	80.3
St Helens and Knowsley Teaching Hospitals	55.3	85.0	93.1
Stockport	53.7	75.0	88.5
Surrey and Sussex Healthcare	49.5	74.5	88.6
Tameside and Glossop Integrated Care	43.1	74.0	88.7
The Christie	66.7	85.9	91.8
The Dudley Group	42.3	72.0	82.0
The Hillingdon Hospitals	41.7	64.0	76.8
The Newcastle Upon Tyne Hospitals	46.1	69.9	83.7
The Princess Alexandra Hospital	37.2	53.1	83.1
The Queen Elizabeth Hospital, King's Lynn,	33.3	56.9	77.0
The Robert Jones and Agnes Hunt Orthopaedic Hospital	25.7	44.4	
The Rotherham	57.8	81.3	91.6
The Royal Marsden	32.4	72.0	86.2
The Royal Wolverhampton	44.8	74.7	88.2
The Shrewsbury and Telford Hospital	69.1	81.9	90.0
Torbay And South Devon	68.8	83.2	93.3
United Lincolnshire Hospitals	52.7	77.2	88.0
University College London Hospitals	36.8	62.7	80.0
University Hospital Southampton	76.3	78.2	86.2

Hospital	% peak coded		
	AKI 1	AKI 2	AKI 3
University Hospitals Birmingham	53.0	76.4	87.4
University Hospitals Bristol and Weston	39.5	62.8	78.3
University Hospitals Coventry and Warwickshire	24.0	51.7	70.0
University Hospitals of Derby and Burton	62.4	83.6	91.8
University Hospitals of Leicester	75.7	85.7	88.8
University Hospitals of Morecambe Bay	37.7	69.5	85.5
University Hospitals of North Midlands	73.4	83.1	87.2
University Hospitals Plymouth	59.8	75.8	85.8
University Hospitals Sussex	69.7	86.3	87.2
Walsall Healthcare	68.3	79.1	86.2
Warrington and Halton Teaching Hospitals	61.4	79.4	89.0
West Hertfordshire Teaching Hospitals	41.6	64.9	85.1
West Suffolk	47.1	76.8	80.6
Whittington Health	44.4	70.9	88.2
Wirral University Teaching Hospital	86.1	94.3	96.3
Worcestershire Acute Hospitals	44.6	74.3	87.7
Wrightington, Wigan and Leigh	60.0	81.4	93.9
Wye Valley	41.0	70.9	78.6
Yeovil District Hospital	49.8	67.6	88.6
York and Scarborough Teaching Hospitals	78.3	89.4	95.4

References

1. National Institute of Health and Clinical Excellence (2013). Acute kidney injury: prevention, detection and management. Available from: nice.org.uk/guidance/cg169.
2. Kerr M, Bedford M, Matthews B, O'Donoghue D (2014). The economic impact of acute kidney injury in England. Nephrol. Dial. Transplant. 29: 1362–1368.
3. Medcalf JF, Davies C, Hollinshead J, Matthews B, O'Donoghue D (2016). Incidence, care quality and outcomes of patients with acute kidney injury in admitted hospital care. QJM 109: 777–783.
4. NCEPOD (2009). Acute Kidney Injury: Adding Insult to Injury (2009). Available from: ncepod.org.uk/2009akitoolkit.html.
5. Ebah L et al. (2017). A multifaceted quality improvement programme to improve acute kidney injury care and outcomes in a large teaching hospital. BMJ Open Qual. 6, u219176.w7476.
6. Chandrasekar T, Sharma A, Tennent L, Wong C, Chamberlain P, Abraham KA (2017). A whole system approach to improving mortality associated with acute kidney injury. QJM 110: 657–666.
7. NHS England (2014) Patient safety alert on standardising the early identification of acute kidney injury. Available from: england.nhs.uk/2014/06/psa-aki.
8. NHS England (2015) Acute kidney injury (AKI) algorithm. Available from: england.nhs.uk/akiprogramme/aki-algorithm.
9. Kidney Disease: Improving Global Outcomes (KDIGO) (2012) KDIGO clinical practice guideline for acute kidney injury. Kidney Int. 2 (suppl. 1): 1–138.
10. Sawhney S et al. (2015). Maximising Acute Kidney Injury Alerts – a cross-sectional comparison with the clinical diagnosis. PLOS ONE 10: e0131909.
11. Selby NM et al. (2019). An organizational-level program of intervention for AKI: a pragmatic stepped wedge cluster randomized trial. J. Am. Soc. Nephrol. 30: 505–515.
12. Brown JR, Kramer RS, Coca SG, Parikh CR (2010). Duration of acute kidney injury impacts long-term survival after cardiac surgery. Ann. Thorac. Surg. 90: 1142–1148.
13. GOV.UK (2015). English indices of deprivation 2015. Available from: gov.uk/government/statistics/english-indices-of-deprivation-2015.
14. The Renal Association (2019). Clinical Practice Guideline – Acute Kidney Injury (AKI). Available from: https://ukkidney.org/sites/renal.org/files/FINAL-AKI-Guideline.pdf
15. Peracha J et al. (2022). Centre variation in mortality following post-hospitalization acute kidney injury: analysis of a large national cohort. Nephrol Dial Transplant. 37(11):2201-2013.

Abbreviations

AKI	acute kidney injury
CA	community acquired, never hospitalised
CAH	community acquired, subsequently hospitalised
CKD	chronic kidney disease
GIRFT	Getting It Right First Time
HA	hospital acquired
HES	Hospital Episode Statistics
ICB	Integrated Care Board
IMD	Index of Multiple Deprivation
IQR	interquartile range
KDIGO	Kidney Disease: Improving Global Outcomes
LOS	length of stay
MPI	Master Patient Index
NHSE	NHS England
pmp	per million population
RAG	red/amber/green
SMR	Standardised Mortality Ratio
UKKA	UK Kidney Association
UKRR	UK Renal Registry

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