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Original Article

The economic impact of acute kidney injury in England

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ABSTRACT

Background. Acute kidney injury (AKI) is one of the most common complications affecting hospital inpatients around the world. It is associated with high mortality and adverse long-term outcomes, but there is uncertainty regarding its prevalence and cost. We estimate the prevalence of AKI in hospital inpatients in a universal health-care system, and the immediate and long-term impacts on survival, quality of life and health-care costs.

Methods. We examined prevalence of AKI in inpatients using both routine national data for the National Health Service (NHS) in England, and laboratory data from East Kent Hospitals. We used regression analyses to estimate the impact of AKI on mortality and length of hospital stay, and a Markov model to estimate the impact on quality-adjusted life years and NHS costs.

Results. AKI was recorded in 2.43% of hospital admissions in Hospital Episode Statistics (HES), but age- and gender-standardized estimates derived from laboratory data suggest the true prevalence may be more than five times as high (14.15%). We estimate that the annual number of excess inpatient deaths associated with AKI in England may be above 40 000. The annual cost of AKI-related inpatient care in England is estimated at £1.02 billion, just over 1% of the NHS budget. The lifetime cost of post-discharge care for people who had AKI during hospital admission in 2010–11 is estimated at £179 million.

Conclusions. AKI prevalence in inpatients may be considerably higher than previously thought, and up to four fifths of cases may not be captured in routine hospital data. AKI is associated with large numbers of in-hospital deaths and with high NHS costs. Comparison of HES and East Kent data suggests that most of the cases recorded in HES may be relatively severe AKI (AKIN 2–3).

Keywords: acute kidney injury, cost, economics, mortality

INTRODUCTION

Acute kidney injury (AKI) is one of the most serious and common complications affecting hospital inpatients, and incidence is believed to be rising [1–4]. It is associated with adverse outcomes and high mortality, independent of other risk factors [5–7]. Even mild cases of AKI are associated with increased in-hospital mortality risk [8], and patients who recover kidney function after AKI are at increased risk of developing chronic kidney disease (CKD) and of death [9]. There is evidence that deficiencies in clinical care may contribute to the development and progression of the condition. In the UK, a recent report by the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) [10] found that 30% of AKI cases occurring during hospital admission were avoidable, and that only 50% of patients with AKI received an overall standard of care that was considered good.

Measurement of the incidence and prevalence of AKI, and analysis of outcomes, have in the past been hampered by the lack of an agreed definition. Most studies have focused on relatively severe AKI [11, 12], on AKI in intensive care units [13–16] or on patients who require renal replacement therapy (RRT) [17, 18]. A 2002 study found that 7.2% of patients at a US centre acquired some degree of renal impairment during hospital admission [19]. Newly developed classification systems in recent years have focused on AKI as a spectrum of disease, and create the potential for more robust measurement of prevalence and outcomes [20–22].

This study examines AKI among inpatients, estimating prevalence, mortality, outcomes and the cost to the National Health Service (NHS) in England. The analysis is based, in the

first instance, on Hospital Episode Statistics (HES), which provide details of patient demographics and health-care activity, including recorded diagnoses, procedures, length of stay and in-hospital mortality for all individual hospital admissions in the English NHS. The national dataset is derived from patient records at each hospital. HES data do not, however, provide details of AKI stage, or of pre-admission or post-discharge kidney function, and it is generally accepted that AKI is under-recorded on patients' notes.

We therefore compare the national findings with data from East Kent Hospitals University NHS Foundation Trust (EKHUFT). At East Kent, laboratory records were used to identify AKI, the condition was classified using the Acute Kidney Injury Network (AKIN) system [21], prior CKD status was ascertained and patients were followed for up to 2 years after discharge.

We use age- and gender-standardized extrapolation from the study findings to provide an indication of the possible level of under-recording of AKI in patient records and routine datasets, of the distribution of AKI by AKIN stage, of prior CKD status and of post-discharge health status and care needs.

MATERIALS AND METHODS

Our analysis used HES data to measure the recorded prevalence of AKI in hospital admissions in England, the age and gender distribution of people with AKI, survival to discharge and the impact of AKI on inpatient costs. These findings were compared with data from EKHUFT, a group of three inpatient hospitals in the South of England, which serves a defined population of ~720 000 people. In both cases, the analysis was restricted to adults (aged ≥ 18). Elective day case and maternity admissions were excluded. In addition, patients on chronic RRT were excluded from EKHUFT data, but could not be discretely identified in HES.

Data

We examined all finished hospital admissions during 2010–11 in HES, and identified those with a recorded diagnosis of AKI, using International Classification of Diseases (ICD-10) codes N17 or N280.

The EKHUFT data covered admissions from 1 February to 31 July 2009 inclusive. Patients with AKI during admission were identified and classified by the AKIN criteria using serum creatinine (SCr) data from pathology records [21]. The pathology records used covered all SCr tests commissioned in primary, community and acute sectors from 1 February 2008 to 31 July 2010. Baseline SCr was estimated using the lowest level recorded in the 12 months prior to hospital admission, after the method of LaFrance *et al.* [23], and this was compared with the highest SCr recorded during hospital admission in the study period. In cases where there were no pre-hospitalization values and the follow-up SCr (lowest in the 12 months following discharge) was lower than the peak in the study admission, the follow-up value was used as the reference SCr. In these cases the assumption was made that, if SCr fell by more than 26.4 μmol/L after discharge, the admission involved an AKI. Cases where no SCr value was available for either the 12 months preceding or the 12 months following admission were recorded as 'AKI status unknown'.

The lowest SCr recorded in the 12 months before admission was also used to estimate baseline glomerular filtration rate (eGFR). Patients with baseline eGFR <60 mL/min were identified as having prior CKD, and eGFR levels were used to classify stages 3–5 CKD [24].

For both HES and EKHUFT data, we calculated AKI prevalence for four patient age bands (18–39, 40–59, 60–79, 80+) sub-divided by gender to produce eight sub-groups. We applied the EKHUFT prevalence figure for each of the sub-groups to the admission numbers recorded in HES, to produce an England-level prevalence estimate standardized for age and gender.

Inpatient analysis

We estimated the impact of AKI on mortality and length of stay in both datasets, using regression analyses. The impact on days in critical care was examined in EKHUFT only. The impact of AKI on mortality (odds ratio) was estimated using multivariate logistic regression. The impacts on length of hospital stay and on days in critical care were estimated using multilevel negative binomial regression. Two-level models were used with individual admissions nested within patients. Covariates used in the HES analysis were AKI diagnosis, patient age, gender, index of multiple deprivation score, admission method (elective or non-elective) and specialty type (surgical or non-surgical). Covariates used in the EKHUFT regressions were age, gender, index of multiple deprivation score, admission method (elective or non-elective), admission source (home or not), admission day (weekend or week day), CKD diagnosis and stage, number of hospital admissions in the previous 12 months, number of outpatient appointments in the previous 12 months, comorbidities and primary diagnosis. A complete list of covariates is provided in the Supplementary Appendix. Analyses were carried out in Stata versions 8 and 12.1.

We report results as means with standard deviations or as ratios with 95% confidence intervals. Further detail on prevalence, mortality, CKD status and AKI status at hospital admission are provided in the Supplementary Appendix.

Inpatient costs

We estimated acute costs related to AKI for general inpatient care and critical care. For general inpatient care, separate cost estimates were derived from HES and EKHUFT activity data. Cost estimates for critical care were based on EKHUFT data only, as HES do not provide robust data in this area.

Most inpatient care in the English NHS is reimbursed through national tariffs, which are set at Healthcare Resource Group (HRG)-level. HRGs are groups of health-care activities that are clinically related and similar in cost. Each admission is grouped to a single HRG, using ICD-10 and OPCS Classification of Interventions and Procedures (OPCS-4) codes. In admissions with multiple diagnoses and/or procedures, the HRG relating to the most expensive health-care activity is generally selected.

For admissions grouped to AKI-specific HRGs, we attributed the entire cost of the admission to AKI, and used the tariff price to estimate unit cost [25]. Tariff prices vary around England, depending on local cost differences. A formula known as the Market Forces Factor (MFF) is used to make these local adjustments. Prices used here are estimated using the average MFF for the country.

However, most admissions with recorded AKI are grouped to non-AKI HRGs, reflecting the fact that AKI frequently occurs in patients who have multiple interventions and/or diagnoses. For admissions in which the patient had AKI, but the admission was grouped to a non-AKI HRG, the cost impact of AKI was estimated using regression analyses on length of stay. Costs were estimated for excess bed days associated with AKI, using the mean cost of a hospital bed day for AKI HRGs (LA07C-G) in NHS Reference Costs for acute hospitals (£311) as an estimate of unit cost [26].

The cost of excess critical care days associated with AKI was estimated, based on the critical care regression analysis outlined above. The average unit cost of a critical care bed day was estimated from NHS Reference Costs (£1213) [26].

Long-term impacts and costs

We constructed a Markov model to estimate long-term quality-of-life impacts and costs arising from excess CKD and RRT in patients who have had AKI, relative to a matched group without AKI. The model was run for a representative patient aged 72 at outset (estimated from age distributions in HES and EKHUFT). Parameters were estimated based on data from EKHUFT, UK Renal Registry, Office for National Statistics, NHS Blood and Transplant and earlier studies (Table 1). Supplementary regression analysis on mortality (Poisson with scaled standard errors to correct for over-dispersion) was conducted to estimate relative risk for use in the Markov model. Quality-adjusted life years (QALYs) were estimated using EQ-5D utilities derived from a recent meta-analysis [27]. Model structure is shown in Figure 1. Analysis was carried out in TreeAge Pro.

Sensitivity analysis

In sensitivity analysis, we applied the upper and lower bound 95% confidence interval estimates for AKI prevalence in each of the age and gender sub-groups at EKHUFT to HES

Table 1. Markov model parameters and sources

Parameters		Estimated value	Source
% of patients with CKD Stage 3 at hospital admission	AKI and comparator	34.18%	East Kent data–AKI group. Same prevalence is applied in model to comparator.
% of patients who die during hospital admission	AKI	17.44%	East Kent data
	Comparator	4.98%	East Kent data: % of patients with AKI who die/relative risk of death in AKI
% of patients on RRT 90 days after discharge	AKI	0.26% in base case, 0.11% and 0.42% in sensitivity analysis	East Kent data (excluding patients with CKD Stage 4 or 5)
	Comparator	0.00%	East Kent data
Annual transition probabilities			
Normal kidney function to CKD	AKI	2.50%	Bucaloiu *et al.* (2012) [9] Baseline risk of de novo CKD × HR with reversible AKI event
	Comparator	1.31%	Bucaloiu *et al.* (2012) [9]
CKD to RRT	AKI and comparator	0.17%	Incidence of RRT England (Renal Registry 2011) [28] minus estimated RRT 90 days after AKI (East Kent)/CKD prevalence England (HSE 2010) [29]
Dialysis to transplant	AKI and comparator	7.05%	(Transplant incidence 2010–11, England (NHSBT), [30] minus transplant within 90 days of starting RRT (Renal Registry 2011)) [28]/Prevalent dialysis England (Renal Registry 2011) [28]
Transplant graft failure	AKI and comparator	2.50%	Renal Registry 2011 [28]
Normal kidney function to death	AKI and comparator		ONS Life Tables by year of age, [31] adjusted for CKD and RRT mortality. CKD prevalence by age band from Health Survey for England 2010, [29] CKD mortality from Matsushita *et al.* (2010), [32] RRT prevalence by age Renal Registry 2011, [28] RRT mortality rate by age band Renal Registry 2011 [28]
CKD to death	AKI and comparator	RR = 1.28	Normal kidney function risk by age × RR of death by CKD stage from Matsushita *et al.* (2010) [32], Distribution of CKD by stage from de Lusignan *et al.* (2011) [33]
RRT to death	AKI and comparator		Mortality rate in RRT by age band from Renal Registry report, 2011 [28]
Annual cost			
CKD Stages 3–4		£241	Kerr *et al.* (2012) [34] updated to 2010–11 prices
Dialysis		£27 765	
Transplant year 1 (including pre-transplant care)		£34 036	
Transplant after year 1		£7520	
EQ-5D			
Normal kidney function		0.78	UK population norm, age 65–74 from Kind *et al.* (1999) [35]
CKD Stages 3–4		0.72	Wyld *et al.* [27]
Dialysis		0.63	
Transplant		0.75	

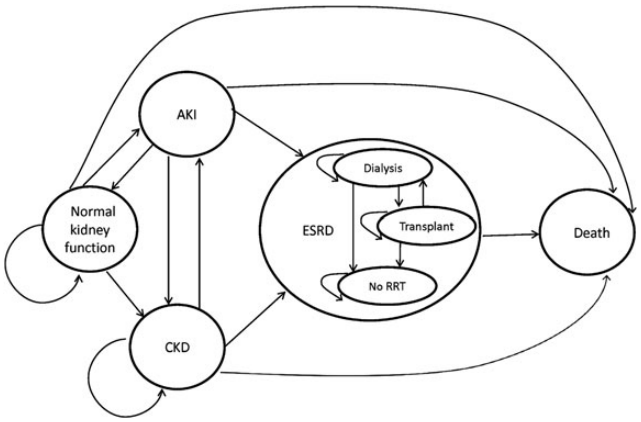

FIGURE 1: Structure of Markov model.

admission figures. We summed the lower and upper bound estimates, respectively, and used the resulting prevalence estimates to derive cost and QALY estimates.

We also re-ran the Markov model using the 95% confidence interval bounds for the proportion of patients requiring RRT at 90 days post-discharge from the EKHUFT data.

RESULTS

Prevalence

HES data record 5 881 635 inpatient admissions for 3 792 951 patients in 2010–11. AKI was recorded in 142 705 of these admissions (2.43%) and 122 928 patients (3.24%) had at least one admission with recorded AKI during the year. Prevalence ranged from 0.32% in patients aged 18–39 to 5.74% in those aged ≥80 (Figure 2).

During the 6-month study period at EKHUFT, there were 36 015 admissions (27 436 patients). Laboratory data indicate that AKI was present in 5521 admissions and that 4462 patients had at least one admission with AKI, a prevalence of 15.33% of admissions and 16.26% of patients. The EKHUFT inpatient population is older than that in HES (Figure 3). The age- and gender-standardized prevalence for England is estimated at 14.15% of admissions and 14.65% of patients.

At EKHUFT, 38.10% of patients who had AKI during the study period had pre-existing CKD stage 3–5. In 73.37% of admissions with AKI, the patient had AKI when admitted to hospital. Further detail is provided in the Supplementary Appendix.

Mortality

In 40 109 (28.11%) admissions with recorded AKI in HES, the patient died before discharge. Mortality rates increased with age. The odds ratio for death in hospital for patients with AKI relative to those without AKI was 10.52 (95% confidence interval 9.93–11.16). The relative risk of death in hospital for patients with AKI was 4.69 (4.59–4.80) (Table 2).

In 13.93% of admissions with AKI at EKHUFT, the patient died before discharge. Of all inpatient deaths, 55.77% occurred in patients with AKI. The odds ratio and relative risk for in-hospital mortality at EKHUFT increased by AKIN stage (Table 3).

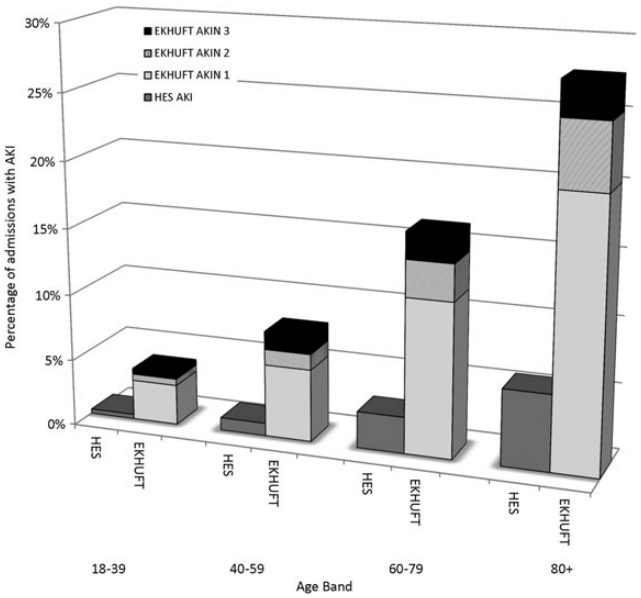

FIGURE 2: Percentage of admissions with AKI, HES and EKHUFT.

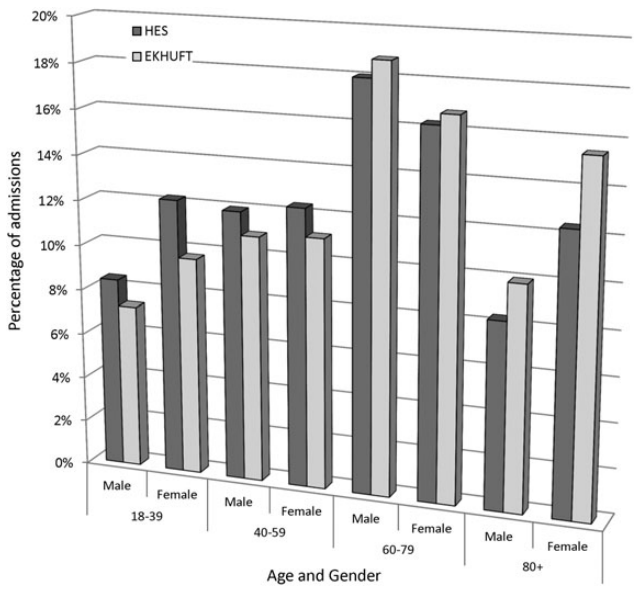

FIGURE 3: Age and gender distribution of admissions, HES and EKHUFT.

Table 2. Length of stay and mortality, by AKI status, HES data

	No AKI	AKI	P value
Length of stay			
Mean (SD)	5.14 (11.56)	16.47 (19.71)	
Ratio (95% CI)	1	2.57 (2.54, 2.60)	<0.001
In-hospital mortality			
% Mortality	1.99%	28.11%	
Odds ratio (95% CI)	1	10.52 (9.93, 11.16)	<0.001
Relative risk (95% CI)	1	4.69 (4.59, 4.80)	<0.001

Table 3. Length of stay, critical care days and in-hospital mortality in admissions, by AKI status, EKHUFT

	No AKI	All AKI	AKIN 1	AKIN 2	AKIN 3	AKI status unknown	P value
Length of stay							
Mean (SD)	4.5 (10.5)	10.72 (15.44)	9.7 (14.6)	12.3 (16.0)	14.9 (18.5)	2.3 (9.8)	
Ratio (95% CI)	1	1.62 (1.57, 1.68)	1.52 (1.46, 1.58)	1.88 (1.77, 2.00)	2.16 (2.00, 3.32)	0.45 (0.43, 0.47)	<0.001
Critical care							
Mean (SD)	0.05 (1.02)	0.35 (2.35)	0.17 (1.74)	0.31 (1.80)	1.57 (4.78)	0.02 (0.51)	
Ratio (95% CI)	1	4.32 (3.63, 5.14)	2.60 (2.10, 3.21)	5.61 (4.15, 7.58)	18.2 (14.4, 23.1)	0.02 (0.01, 0.05)	<0.001
In-hospital mortality							
% Mortality	2.00%	13.93%	8.10%	25.60%	33.30%	1.97%	
Odds ratio (95% CI)	1	5.11 (4.23, 6.17)	2.51 (2.06, 3.05)	13.3 (9.67, 18.3)	30.8 (20.7, 46.0)	1.49 (1.12, 1.99)	<0.001
Relative risk (95% CI)	1	3.50 (3.30, 3.70)	2.11 (1.98, 2.26)	5.79 (5.38, 6.22)	8.94 (8.28, 9.64)	1.31 (1.18, 1.44)	<0.001

ORIGINAL ARTICLE

Length of stay

Mean length of stay in HES was 16.47 (SD 19.71) days for admissions with AKI, and 5.14 (SD 11.56) days for admissions without recorded AKI. Multivariate regression analysis indicated that AKI diagnosis was associated with a length of stay 2.57 (95% CI 2.54–2.60) times as high as that for admissions without AKI (Table 2).

At EKHUFT, AKI was associated with hospital stays 1.62 (1.57–1.68) times as long as those for patients without AKI. The impact on length of stay associated with AKI increased with AKIN stage (Table 3).

Critical care

At EKHUFT, 59.89% of critical care bed days were for people with AKI. In multivariate regression analysis, AKI was associated with critical care bed day usage 4.32 (3.63–5.14) times the level of patients without AKI (Table 3).

Long-term outcomes

HES data do not provide details of post-discharge outcomes. Data from EKHUFT indicate that, 90 days after discharge, 0.56% of patients with AKI were on RRT. However, more than half this group had pre-existing CKD Stages 4–5, so it is possible that their progression to RRT might have occurred without AKI and, indeed, that their AKI may have been due to rapidly progressing CKD. Of patients with AKI and CKD Stages 1–3, or no CKD, 0.26% were on RRT 90 days after discharge. If this pattern were repeated at national level, and if the prevalence of CKD, by stage, in inpatients with AKI were the same as at East Kent, it is estimated that 1369 (95% CI 561–2178) people a year who had AKI during an inpatient admission, and who did not have pre-existing CKD Stage 4 or 5, would require RRT 90 days after discharge.

Costs

In HES, 23 145 admissions in 2010–11 were grouped for payment to HRGs specific to AKI (LA07A-C), 16.22% of all admissions with a recorded AKI diagnosis. The total tariff cost of these LA07 admissions was £75 million (Table 4).

Based on the HES regression analysis findings, it is estimated that, in 2010–11, there were 977 116 excess bed days associated with AKI in 119 560 admissions grouped to HRGs other than LA07. The cost of these excess bed days is estimated at £304 million.

Table 4. Activity and expenditure, admissions grouped to Healthcare Resource Groups for Acute Renal Failure, HES 2010–11

HRG	Elective		Non-elective	
	Activity	Cost	Activity	Cost
LA07A				
Acute renal failure with major CC[a]	165	£636 524	10 216	£42 082 937
LA07B				
Acute renal failure with intermediate CC[a]	228	£359 100	11 581	£30 446 234
LA07C				
Acute renal failure without CC[a]	45	£33 752	910	£1 627 841
Total	438	£1 029 376	22 707	£74 157 012

[a]CC, complications or comorbidities.

If the prevalence of AKI identified in laboratory data at East Kent is representative, the number of annual admissions with AKI in England is estimated at 832 235. Based on the EKHUFT regression analysis, the number of excess bed days associated with AKI in admissions grouped to HRGs other than LA07 in England is estimated at 2 565 514. Of these, 163 423 days are estimated to have been in critical care units.

Total inpatient expenditure associated with AKI admissions recorded in HES (excluding critical care use) is estimated at £380 million. Extrapolations from EKHUFT produce an estimate of £1.02 billion for inpatient expenditure related to AKI in England (Table 5).

The Markov model estimates the lifetime cost of post-discharge care for people who have had AKI as inpatients in 2010–11 at £179 million. These costs arise through higher incidence of CKD and RRT, relative to a matched population without AKI. The lifetime QALY loss is estimated at 1.4 per inpatient with AKI.

Sensitivity analysis

Using the lower bounds of the 95% confidence interval for each sub-group at EKHUFT, and standardizing for the age and gender of the HES population, we estimate the number of admissions with AKI in England at 740 964 (494 288 patients) in 2010–11. Using the upper bounds, we estimate

Table 5. Estimated expenditure related to AKI, England 2010–11, based on HES data and extrapolations from EKHUFT

	HES	Extrapolation from EKHUFT
Admissions to LA07 HRGs[a]	£75 186 389	£75 186 389
Excess length of stay in other HRGs	£304 364 710	£750 463 603
Critical care	No data available	£198 232 502
Total inpatient care	£379 551 099	£1 023 882 494
Post-discharge care	No data available	£179 345 543
Total care	£379 551 099	£1 203 228 037

[a]LA07: Healthcare Resource Groups (HRGs) for Acute Renal Failure.

Table 6. Estimated expenditure related to AKI, England 2010–11, sensitivity analyses, based on extrapolations from EKHUFT

	Lower estimate	Upper estimate
Sensitivity analysis 1		
Excess length of stay in non-LA07 HRGs[a]	£653 360 453	£847 728 441
Critical care	£165 647 101	£230 817 902
Total inpatient care[b]	£894 193 943	£1 153 732 733
Post-discharge care	£159 531 140	£204 601 432
Sensitivity analysis 2		
Post-discharge care	£116 552 207	£246 325 103

[a]LA07: Healthcare Resource Groups (HRGs) for Acute Renal Failure.
[b]Including expenditure on admissions to LA07 HRGs.

admissions at 923 505 and patients at 633 932. In sensitivity analysis 1, we estimated costs based on these prevalence estimates (Table 6).

Another key area of uncertainty is the proportion of patients who require RRT 90 days after discharge. In sensitivity analysis 2, the Markov model was re-run using the upper and lower confidence intervals for post-discharge RRT in patients who have had AKI, from EKHUFT data. Using these values, the lifetime cost of post-discharge care for people who have had AKI during hospital admission is 2010–11 in England is estimated at £117–£246 million (Table 6).

DISCUSSION

The data presented here provide the most comprehensive estimate to date of AKI prevalence in inpatients in England. The figure based on laboratory data and AKIN classification is considerably higher than earlier estimates based on sub-sets of the AKI population. The comparison with HES data suggests that there may be substantial under-recording and possibly under-recognition of AKI in English hospitals.

Our study finds that AKI is associated with high mortality; the relative-risk estimates from the HES regression analysis suggest that AKI was associated with ~15 000 excess deaths among inpatients in England in 2010–11, while extrapolations from EKHUFT data suggest the annual number of excess deaths associated with AKI in England may be above 40 000. We also find that AKI is associated with large QALY losses.

The EKHUFT data suggest that mortality and length of hospital stay increase with AKIN stage. Mortality in admissions with recorded AKI in HES was higher than that for AKIN 1 and AKIN 2 at EKHUFT, and lower than that for AKIN 3. The mean length of stay for admissions with recorded AKI in HES was higher than that for all AKIN stages at EKHUFT. While there are multiple factors that impact on mortality and length of stay, these findings may suggest that relatively severe AKI (AKIN 2 or 3) is more frequently recorded in HES than AKIN 1. More than 70% of AKI cases at East Kent were AKIN 1.

The financial burden of AKI, as estimated here, is substantial, equivalent to just over 1% of the NHS budget for England in 2010–11.

The EKHUFT population is older and less ethnically diverse than that of England. While the extrapolated prevalence estimates presented here have been standardized for age and gender, it was not possible to adjust for ethnicity. Further study is needed to examine AKI prevalence in an ethnically diverse population in England.

It is also important to note differences between the two datasets and analyses. Patients on RRT were excluded from the East Kent dataset but not from HES. The East Kent regression analyses used a wider range of covariates than those available in HES.

There is uncertainty regarding the incidence of long-term RRT after AKI. The sample size for 90-day post-discharge RRT at EKHUFT was small, and the confidence intervals around the point estimate are correspondingly large. Further studies are needed to examine the impact of AKI on long-term RRT need.

This study focuses only on AKI in adult hospital inpatients. Further research is needed on the incidence and impact of AKI in primary and community care settings.

The recent NCEPOD report in the UK found that 20% of fatal post-admission AKI cases were both predictable and avoidable. Many of the failings identified in that report related to basic medical care, such as checking of electrolytes, performance of physiological observations and adequate senior review. However, at EKHUFT, AKI was present at the point of admission in nearly three quarters of admissions in which AKI occurred. It is likely therefore that efforts to prevent AKI will need to focus on primary and community care as well as on inpatient care.

If 20% of AKI cases were prevented, the figures presented in this report suggest that the gross savings to the NHS could be in the region of £200 million a year, equivalent to 0.2% of the NHS budget in England. It is hoped that the estimates presented here will provide a foundation for future economic evaluation of prevention and early management interventions for AKI, and of strategies for the prevention of complications in AKI survivors.

SUPPLEMENTARY DATA

Supplementary data are available online at http://ndt.oxfordjournals.org.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest. The contents of this paper have not been published previously in whole or part, except in abstract format.

(See related article by Lewington and Hall. The cost of ignoring acute kidney injury. *Nephrol Dial Transplant* 2014; 29: 1270–1272.)

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