Acute Kidney Injury demographics and outcomes: Changes following introduction of electronic AKI alerts. An analysis of a national data set.

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Abstract

Background. Electronic alerts for acute kidney injury have been widely advocated. Our aim was to describe the changes in AKI demographics and outcomes following implementation of a National electronic AKI alert program.

Methods. A prospective national cohort study was undertaken to collect data on all cases of AKI in adult patients (≥18 yrs of age) between 1st April 2015 and 31st March 2019.

Results. Over the period of data collection there were 193,838 AKI episodes in a total of 132,599 patients. **The lowest incidence of AKI was seen in the first year after implementation of electronic alerts**. 30-day mortality was highest in year 1, and significantly lower in all subsequent years. A direct comparison of mortality in year 1 and year 4 demonstrated a significantly increased relative risk of death in year 1: RR 1.08 (95%CI 1.054-1.114 p<0.001). This translates into a number needed to treat (NNT) in year 4 for one additional patient to survive of 69.5 (95% CI 51.7-106.2) when directly comparing the outcomes across the two years. The increase in number of cases and improved outcome was more pronounced in community acquired AKI, and was associated with a significant increase in patient hospitalisation.

Conclusions. The study represents the first large scale data set to clearly demonstrate that a National AKI alerting system which highlights AKI is associated a change in both AKI demographics and patient outcomes.

Key Learning points

What is already known. The use of AKI alerts is now common although little is known regarding their impact.

What this study adds. The data demonstrate a change in AKI demographic and outcomes following implementation of electronic AKI alerts.

What impact this may have on practice and policy. The data support the use of electronic AKI alerts to improve patient outcome.

Introduction

AKI is a common complication of multiple medical and surgical conditions which carries a significant morbidity and mortality and high health associated costs (1). The premise that early and appropriate clinical intervention can improve outcome for AKI (2), has driven the implementation of automated electronic AKI alerts across the NHS in England and Wales. Implementation of electronic AKI alerts across Wales was established in April 2015. The system generates an alert based on real time comparison of a serum creatinine with the patients' previous results with AKI defined by the KDIGO change in creatinine diagnostic criteria (3). Using this system of electronic AKI alerts developed a centralised system of data collection to establish a National data set encompassing all AKI alerts. Our previous data used this to characterise the epidemiology of AKI in both adults (4-9) and children (10). The majority of previously published data focused on AKI in a hospital environment, but we have also characterised in some detail the nature of Community acquired AKI (11, 12). Whilst the feasibility of implementation of AKI alerts is well documented in both hospital and community settings (13, 14), to date it is unknown whether AKI alerts alter the patterns of AKI detection or impact patient outcomes (15).

Using our National data set, and what is the largest cohort of AKI cases reported to date, we sought to examine the impact of the introduction of electronic AKI alerts, by describing changes in AKI demographics and associated patient outcomes across all hospital and community health care settings in the first four years since the introduction of a national electronic AKI alert system in Wales.

Methods

Data from all Health boards in the National Health Service in Wales, was collected from the Laboratory Information Management System (LIMS) on all patients aged 18 years or over between 1st April 2015 and 31st March 2019 that generated an AKI e-alert. The Medical Record Number, a unique reference number allocated to patients registered with the NHS in England, Wales and the Isle of Man, was used as the unique patient identifier. **The program of work has approval under the terms of Service Evaluation Project Registration.**

The AKI alert is generated by comparing in real time a current creatinine value with historic creatinine values for the same patient. It defines AKI according to KDIGO increase in creatinine parameters (6). The validation of the algorithm has previously been reported elsewhere (6, 16, 17). We have previously demonstrated that this approach ensures collection of all AKI episodes highlighted by an electronic alert across the country, regardless of the clinical location, and excludes patients with end stage renal failure, receiving renal replacement therapy. The AKI Alerts are displayed alongside the biochemical results on the pathology reporting system and consist of one of the following text statements which provide context to the change in creatinine for the receiver:

(a). *Trigger = >26μmol/l increase in creatinine within 48 hrs, Associated alert; Acute Kidney Injury alert: rising creatinine within last 48 hours.*

(b). Trigger = >50% increase in creatinine within 7 days; Associated alert; Acute Kidney Injury alert: rising creatinine within last 7 day.

(c). Trigger = 50% increase in serum creatinine against median result for 8-365 days, Associated alert; Acute Kidney Injury alert – creatinine increase over baseline value.

An incident AKI episode was defined as lasting 30 days, and the first AKI alert was defined as the incident alert i.e. multiple alerts within 30 days of the incident alert were not considered new episodes. For patients with multiple episodes, the first episode was described as their index episode.

Episodes were classified as hospital acquired (HA)-AKI if the alert was issued in an inpatient setting and was accompanied by a normal creatinine value generated in an inpatient setting within the preceding seven days. Episodes were classified as community acquired (CA)-AKI if the alert was issued in any non-inpatient setting, this includes primary care and all non-inpatient settings in secondary care. Hospitalization of CA-AKI was defined as a measurement of renal function in an inpatient setting within 7 days following the alert. It was not possible to classify those AKI episodes which occurred in an inpatient setting but for which there were no results recorded in the previous 7 days as HA or CA. As such these were classified as 'Undetermined in hospital alerts' and excluded from the subgroup analyses.

Data on patient mortality was collected from the Welsh Demographic Service, which electronically records the date of every registered death (18). Progression of AKI was defined as a peak AKI stage higher than the alert AKI stage, or for stage 3 alerts a further increase in creatinine of ≥50% higher than the alert creatinine. Recovery of renal function was defined as achievement of a creatinine value during the episode no

longer in keeping with the definition of AKI when compared to the baseline creatinine value associated with the episode**.** Patients were only included in the progression and recovery analysis if they survived their episode and had at least one creatinine test during the episode. To identify pre-existing CKD eGFR was calculated using CKDEpi eGFR formula and defined as an eGFR <60ml/min.

Statistical analysis was carried out using SPSS software, version 25 (IBM SPSS, Chicago, I). Student's t test was used for analysis of normally distributed data. Categorical data were compared using a Pearson chi-squared test. The relationship between survival and AKI over the four years was analysed by Binomial logistic regression, with results presented both as unadjusted and adjusted for pre-existing CKD, AKI stage of index episode, and age. Comparisons were made using year 1 as the reference. P values less than 0.05 were considered statistically significant. 95% confidence intervals for binomial data were defined as 1.96 multiplied by the standard error.

Results

All AKI episodes (Table 1): In the first four years since the introduction of the national electronic AKI alert system, there were a total of 193,838 AKI episodes in a total of 132,599 patients. HA-AKI represented 29.3% and CA-AKI 53.5% of all AKI episodes. The remainder (17.2%) represent undetermined in hospital alerts. **Data on the population at risk during the four years was generated from data published by the Welsh Government Office of National Statistics (19), and is shown in Table 1. Over the four years there was no statistical difference in the population number or age. Over the four years, the lowest incidence (and absolute number of episodes) of AKI**

was seen in the first year. The incidence of AKI was statistically greater in year 2 (2023.4 vs 1854.6/100 000 p=0.006) and year 3 (1981.7 vs 1854.6/100000, p=0.03) compared to year 1. There was however, no statistical difference in the incidence comparing year 1 and year 4. Comparison of the demographics of patients in year 4 compared to year 1 demonstrated a significantly younger age of the patients at the time of the AKI episode, a significantly smaller proportion of patients with pre-existing CKD and a higher proportion of episodes presenting as AKI stage 1.

The highest 30-day mortality was seen in the first year, with significantly lower 30-day mortality in all subsequent years. A direct comparison of mortality in year 1 and year 4 demonstrated a significantly increased relative risk of death in year 1: RR 1.08 (95%CI 1.054-1.114 p<0.001). This equated to a number needed to treat (NNT) in year 4 for one additional patient to survive of 69.5 (95% CI 51.7-106.2) when directly comparing the outcomes across the two years. Similarly, binary logistic regression demonstrated survival benefit for patients in all years compared to year 1 (Y2, OR 1.11 95% CI 1.07-1.14 p<0.001, Y3 OR 1.04 95%CI 1.01-1.07 p= 0.029, Y4, OR 1.06 95% CI 1.03-1.10 p=0.001). Following adjustment for age, pre-existing CKD and AKI stage at presentation, survival benefit remained significant when comparing year 2 and 4 to year 1 (Y2, OR 1.08 95% CI 1.04-1.12 p<0.001, Y4 OR 1.04 95%CI 1.01-1.08 p= 0.03).
In contrast, while patient mortality improved over time, this was associated with a reduction in the recovery of renal function. This was significantly lower in all years compared to year 1 (83.2% in Y1 vs. 82.3% in Y2 vs. 82.6% in Y3 vs. 82.4% in Y4, p<0.05). There was no difference across the four years in the proportion of episodes which progressed to a higher AKI stage. Similarly, the time to recovery of renal

function was no different across the four years. We have previously used the proportion of patients with a repeat measurement of renal function within 30 days of the alert, and the time to said repeat measure of renal function as surrogate process measures. There were no changes in these parameters over the first four years of the national electronic AKI alert system being introduced.

Hospital acquired AKI (Table 2): Subgroup analysis of HA-AKI episodes demonstrated no significant differences in patient demographics across the four years. Progression of AKI was also no different over the four years. There was a significant improvement in patient mortality in year 4 compared to year 1 (23.9% vs. 25.5%, $p<0.05$). The relative risk of death in year 1 compared to year 4 was 1.06 (95%CI 1.02 -1.11, $p=0.003$) with an associated NNT of 64.7 (95% CI 58.8-193.8) in year 4. Improved mortality outcome was again associated with a significant reduction in the proportion of patients who recovered their renal function in year 4 compared to year 1 (82.4% vs. 83.2%, $p<0.05$).

Community Acquired AKI (Table 3): CA-AKI represented a significantly higher proportion of all AKI episodes in each of year 2, 3 and 4 compared to year 1. Similarly, the absolute number of episodes was also greater in each of year 2, 3 and 4 compared to year 1. Comparison of the demographics of CA-AKI patients in year 4 with year 1 demonstrated that patients in year 4 were significantly younger (68.3 ±17.9 vs. 68.9 ±17.7, $p<0.001$), and a higher proportion of episodes presenting as AKI stage 1 (70.8% vs. 69.1%, $p<0.05$). The proportion of AKI episodes associated with admission to hospital was significantly greater in years 2, 3 and 4 compared to year 1 (21.2% in Y1

vs. 24.3% in Y2 vs. 24.4% in Y3 vs. 25.1% in Y4). 30-day mortality was significantly lower in years 2 and 4 compared to year 1 (14.4% in Y1 vs. 13.4% in Y2 vs. 13.2% in Y4). A direct comparison of mortality in year 1 and year 4 demonstrated a significantly increased relative risk of death in year 1: RR 1.09 (95% CI 1.04 – 1.14, p<0.001), which translates into a NNT in year 4 of 88.27 (95%CI 57.3-192.3). Progression to a higher stage of AKI was no different over the four years. This was also the case for recovery of renal function, however the time to recovery was statistically significantly shorter for years 3 and 4 compared to year 1 (8.0 ±8.6days in Y1 vs. 7.7 ±8.3days in Y3 vs. 7.7 ±8.3days in Y4).

Our previous studies demonstrated that the majority of CA-AKI patients alert either at the time of presentation to hospital, in the Emergency Department or as a result of a blood test taken in primary care (11, 12). Table 4 compares the patient outcomes of these two cohorts over the first four years since the introduction of the national electronic AKI alert system in Wales. Analysis showed a significant reduction in 30-day mortality in year 4 compared to year 1 (20.9% vs. 22.5% in the Emergency Department and 6.5% vs. 7.6% in Primary Care, p<0.05 for both). In the primary care cohort, improved mortality was associated with a significantly higher proportion of patients being admitted to hospital (17.1% in Y4 vs. 14.9% in Y1, p<0.001), and a higher proportion of patients with a repeat measurement of renal function within 30 days of the alert (72.5% in Y4 vs. 71.0% in Y1, p<0.001).

Discussion

Despite many improvements in clinical medicine, there is clear evidence that the incidence of AKI is increasing both in the UK (20, 21) and USA (22, 23). Currently there are no specific novel therapeutic interventions available for the treatment of AKI. **This reflects the nature of AKI which is predominantly not caused by intrinsic renal disease.** Deficiencies in the delivery of basic care in AKI are well reported. In the UK the National Confidential Enquiry report in 2009, reported sub-optimal care in up to 50% of patients with AKI (24). Given the lack of specific therapy for established AKI, other than supportive measures, the combination of prompt diagnosis; early clinical assessment of acute illness and volume status and urgent review of medications with appropriate temporary cessation of nephrotoxic ones, still offers the best opportunity to improve patient outcomes(2). Facilitation for early AKI detection and timely intervention is the rationale for introduction of electronic AKI alerts.

Despite this evidence to support the use of AKI alerts, there is little published data on the impact of alerts on detection of AKI, nor is there evidence to show that they change patient outcomes, even though their introduction is associated with improvement in care processes and earlier identification of AKI(14, 25-27). A single centre hospital based randomised trial of e-alerts involving isolated use of a text message e-alert did not affect clinician behaviour or patient outcomes (28). Similarly, the recent results of a randomised trial in the UK across five hospitals involving AKI alerts showed no benefit on patient mortality, although this study did demonstrate reductions in hospital lengths of stay (29). This lack of effect on patient related outcome has also been highlighted in a recent systematic review of currently available data (30). In response to this, statements following the Acute Dialysis Quality Initiative

(ADQI) consensus conference, which brought together experts in nephrology, critical care, epidemiology, informatics, and biostatistics, highlighted the evidence care gap in the evaluation of electronic AKI alerts, and concluded that implementation should not be done without further evaluation of effectiveness (31, 32).

Our study represents the use of the largest AKI patient cohort reported to date to examine changes in AKI demographics and trends in outcome following implementation of a national AKI alert system. In addition, it provides data for the longest duration of time since the implementation of an electronic alert system. Our data suggests that the demographic of the patients in which AKI is being detected has changed over time. **Introduction of AKI alerts led to an initial increase in AKI incidence, which was not apparent by the forth year. This may represent an increase awareness of AKI leading to an increase in the number of blood tests requested although this is speculation as we do not have information on the absolute number of biochemistry requests.** In addition, the data suggests that over the four years AKI was detected in a relatively younger cohort with less pre-existing CKD detected in year 4 compared to previous years. This may in part reflect more widespread "AKI testing" related to an increased awareness of its significance in addition to the previously reported increased incidence of AKI (33). The data also supports the notion that electronic AKI alerts facilitate earlier detection as a higher proportion of patients presented with AKI stage 1 in years two, three and four compared to the first year the alert system was in place. The data also demonstrate a temporal association of improvement in mortality over the four years since the introduction of the national electronic alert system. It is likely that this benefit reflects the larger patient sample

compared to previous relatively smaller reported data sets. We also report that the improvement in mortality results in a trade off against a higher degree of residual renal impairment in the surviving cohort. Whilst these factors are likely to influence patient related outcome measures, even after correction for these, there was significant survival benefit in the years following introduction of AKI alerts.

This study also suggests that the largest impact of electronic AKI alerts can be found in CA-AKI and is most prominent in primary care. Over the period of data collection, CA-AKI represents a higher proportion of all AKI episodes, suggesting more cases are being detected, and being detected at an earlier AKI stage. There is also a significant increase over time in the number and proportion of CA-AKI cases which are hospitalised. Our previous data on AKI in the community suggest that poor outcome is in part related to a lack of recognition and appropriate intervention, and that hospitalisation whilst associated with the most severe AKI cases was associated with improved outcomes (11).

Data on the effect of electronic AKI alerts in the community setting are very sparse. Consistent with our data, a study confined to AKI stages 2 and 3 with only 391 events, demonstrated improved response to AKI and reduced all-cause mortality(34). The higher rates of hospital admission from the community is also consistent with a study which involved 9781 patients with AKI in primary care, and reported higher rates of creatinine monitoring and hospitalisation from primary care following implementation of electronic reporting(35). This study however did not report change

in patient mortality, which in part is likely to reflect the relatively smaller number of AKI episodes in comparison to our data.

As the e-alert system is IT driven it lacks "intelligence" and therefore there is no clinical context applied. For this reason, the variation in serum creatinine seen in dialysis patients, unless specifically flagged by location, may lead to a number of false positives. We have previously reported our methodology to minimise the impact of inclusion of patients receiving renal replacement therapy (6). Using these criteria results in a false negative rate of 0.27% (exclusion of AKI patients) and a false positive rate of 0.83% (inclusion of known dialysis patients). The study is also limited in that any patient presenting with AKI but without a measurement of renal function in the previous 365 days will not be included. **Using an IT based approach and a lack of linkage to primary care data sets, also precludes inclusion of clinical information, such as the cause of AKI, renal replacement therapy or cause of death**. Furthermore, the data is unable to shed light on the detail of any local AKI initiatives and clinical interventions which may be responsible for the apparent improvement in outcome. Whilst we acknowledge interventions and the models of their delivery might be varied, it can be assumed that all interventions to improve AKI outcomes involve simple clinical care solutions and are based on early assessment of the patient, adequate volume replacement, early treatment of sepsis and avoidance of nephrotoxic agents. During the period of data collection there were no centralised/national care pathways or care bundles. Rather, the national launch of electronic alerts provided impetus for locally delivered quality improvement projects. The best mechanism for delivery of these clinical interventions is however beyond the

scope of our data set, but likely to be best tailored to local needs to improve awareness and develop care pathways. In addition, our data reports the incidence of AKI in which the diagnosis is a creatinine based definition in which the baseline creatinine may be generated based on blood samples taken in the preceding 365 days. As such, this does not meet the strict agreed AKI definition of "abrupt deterioration", does not take into account a "urine output" based AKI diagnosis, and will not include patients with AKI but with no previous measurement of renal function for comparisons.

In conclusion the study represents the first large scale data set to describe the change in AKI demographics associated with introduction of a National AKI alerting system. The data also suggests that even accepting the changes in the AKI population, introduction of alerts is also associated with improved patient outcomes**.**

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JH designed the study, collected and analysed the data and produced the figures. JDW, KD and JG interpreted the data and wrote the report. AOP set up the program of work, designed the study, interpreted the data and wrote the report.
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Disclosures; There are no competing interests

Table 1: Comparison of patient demographics and outcomes for electronic AKI alerts					
	All episodes	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of episodes	193 838	45 830	50 286	49 480	48 242
Population at risk		2 471 198	2 485 244	2 496 876	2 508 846
Median age of at risk population		42.3	42.4	42.5	42.5
AKI incidence rate (number of episodes per 100 000 population at risk)		1854.6	2023.4	1981.7	1922.9
Number of patients	132 599	37 242	40 657	40 340	39 371
AKI incidence rate (number of patients per 100 000 population at risk)		1507.0	**1635.9***	**1615.6***	1569.3
Mean patient age ±SD (yrs)	70.37 ±17.19	70.57 ±17.13	70.53 ±17.18	70.46 ±17.12	**69.93 ±17.33†**
% Male	48.14	48.03	47.70	48.30	48.52
% with pre-existing CKD	36.18	37.02	36.12	36.49	**35.12†**
% AKI Stage 1 Stage 2 Stage 3	75.1 13.6 11.3	74.9 13.6 11.4	74.9 13.8 11.3	**76.1†** 13.5 11.6	**75.5*** 13.4 11.1
% with a repeat test in 30 days	84.07	83.93	83.70	84.54	84.13
Time to repeat test ±SD (days)	3.4 ±5.4	3.32 ±5.35	3.45 ±5.45	3.34 ±5.37	3.40 ±5.43
Progression of AKI to higher stage (%)	10.19	10.45	9.98	10.30	10.07
30 day recovery of renal function (%)	82.71	83.23	**82.58***	**82.63***	**82.42***
Time to recovery of renal function ±SD (days)	6.87 ±7.99	6.89 ±8.04	6.94 ±8.01	6.85 ±8.02	6.80 ±7.93
30 day mortality (%)	17.84	18.59	**17.6†**	**17.97***	**17.15†**
*Recovery of renal function included only surviving patients with available tests of follow up renal function: 133092 episodes (31144 episodes, Y1; 34647 episodes, Y2; 34447 episodes, Y3; 32854 episodes, Y4) were included in the 30day recovery of renal function analysis. Mortality data was available for 188508 episodes (44611, Y1; 48814, Y2; 48124, Y3; 46958, Y4). *p<0.05 vs. Y1, †p<0.001 vs. Y1.*					

Table 2: Comparison of patient demographics and outcomes for electronic HA-AKI alerts					
	All episodes	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of episodes	56 857	13 955	14 642	14 415	13 845
Number of patients	-	12700	13311	13121	12623
Mean patient age ±SD (yrs)	72.50 ±15.91	72.77 ±15.85	72.73 ±15.91	**72.37 ±15.92***	**72.14 ±15.98***
% Male	49.94	49.92	48.98	50.58	50.32
% with pre-existing CKD	31.44	31.44	31.70	31.37	31.23
% AKI Stage 1 Stage 2 Stage 3	84.7 10.8 4.5	85.1 10.7 4.2	84.2 11.4 4.4	87.9 10.3 4.8	84.8 10.5 4.7
% with a repeat test in 30 days	89.89	89.46	89.83	90.07	90.19
Time to repeat test ±SD (days)	1.91 ±3.03	1.94 ±3.11	1.92 +3.02	1.87 ±2.98	1.90 ±3.01
Progression of AKI to higher stage (%)	16.21	16.45	16.23	16.42	15.72
30 day recovery of renal function (%)	84.04	84.71	84.05	83.83	**83.36***
Time to recovery of renal function ±SD (days)	5.98 ±7.53	5.93 ±7.39	5.94 ±7.51	6.01 ±7.66	6.02 ±7.57
30 day mortality (%)	24.88	25.46	24.99	25.14	**23.92***
*Recovery of renal function included only surviving patients with available tests of follow up renal function: 39024 episodes (9489 episodes, Y1; 10067 episodes, Y2; 9963 episodes, Y3; 9505 episodes, Y4) were included in the 30 day recovery of renal function analysis. Mortality data was available for 55096 HA-AKI episodes (13566, Y1; 14164, Y2; 13944, Y3; 13422, Y4). *p<0.05 vs. Y1.*					

Table 3: Comparison of patient demographics and outcomes for electronic CA-AKI alerts					
	All episodes	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of episodes	103766	23816	27156	26715	26079
Number of patients	-	21323	24248	24073	23637
% of CA-AKI episodes (n=)	53.53	51.97 (23816)	**54.00† (27156)**	**54.00† (26715)**	**54.06† (26079)**
Mean patient age ±SD (yrs)	68.89 ±17.70	68.89 ±17.67	68.98 ±17.66	69.02 ±17.63	**68.27 ±17.90***
% Male	47.2	47.05	46.80	47.36	47.57
% with pre-existing CKD	38.31	39.77	38.40	38.87	36.32
% AKI Stage 1 Stage 2 Stage 3	70.0 14.7 15.3	69.1 14.9 16.0	**70.0*** **14.8** **15.2**	**70.0*** **14.5** **15.5**	**70.8†** **14.6** **16.6**
% admitted to hospital	24.40	21.18	**24.29***	**24.93†**	**25.07†**
% with a repeat test in 30 days	79.79	79.55	79.37	80.52	79.71
Time to repeat test (days)	4.63 ±6.51	4.56 ±6.49	4.71 ±6.54	4.56 ±6.46	4.68 ±6.55
Progression of AKI to higher stage (%)	7.37	7.48	7.19	7.53	7.28
30 day recovery of renal function (%)	80.88	81.33	80.57	81.01	80.67
Time to recovery of renal function ±SD (days)	7.85 ±8.38	7.96 ±8.56	7.98 ±8.41	**7.73 ±8.32***	**7.73 ±8.25***
30 day mortality (%)	13.74	14.35	**13.39***	14.05	**13.22†**

*Recovery of renal function included only surviving patients with available tests of follow up renal function: 704784 episodes (16003 episodes, Y1; 18557 episodes, Y2; 18473 episodes, Y3; 17445 episodes, Y4) were included in the 30 day recovery of renal function analysis. Mortality data was available for 101106 CA-AKI episodes (23202, Y1; 26419, Y2; 26060, Y3; 25425, Y4). *p<0.05 vs. Y1. †=p<0.001 vs. Y1.*

Table 4: Comparison of patient outcomes for CA-AKI in primary care and the Emergency department				
	Year 1	**Year 2**	**Year 3**	**Year 4**
Emergency Department				
Number of episodes	10943	12530	12856	12267
% admitted	38.00	39.22	38.33	38.78
% with a repeat test in 30 days	84.57	85.05	85.14	85.27
Progression of AKI to higher stage (%)	7.87	7.35	7.32	7.75
30 day recovery of renal function (%)	89.07	89.10	89.58	88.87
Time to recovery of renal function ±SD (days)	4.98 ±6.77	5.07 ±6.83	4.99 ±6.76	5.06 ±6.89
30 day mortality (%)	22.47	21.62	22.14	**20.90***
Primary Care				
Number of episodes	6525	7955	7596	7702
% admitted	14.91	15.78	**17.14†**	**17.10†**
% with a repeat test in 30 days	71.00	71.13	**73.84†â**	**72.51***
Progression of AKI to higher stage (%)	6.44	6.53	7.29	6.25
30 day recovery of renal function (%)	75.36	74.84	75.22	74.61
Time to recovery of renal function ±SD (days)	10.65 ±8.07	10.29 ±7.89	10.27 ±8.04	10.12 ±7.86
30 day mortality (%)	7.61	**6.85***	6.94	**6.53***

*Recovery of renal function included only surviving patients with available tests of follow up renal function. For Emergency Department AKI, 7348 episodes (Y1), 8591 episodes (Y2), 8820 episodes (Y3) and 8277 episodes (Y4) were included in the 30 day recovery of renal function analysis. For Primary Care AKI, 4123 episodes (Y1), 5183 episodes (Y2), 5125 episodes (Y3) and 5014 episodes (Y4) were included in the 30 day recovery of renal function analysis. Mortality data was available for 47452 Emergency Department AKI episodes (10678, Y1; 12199, Y2; 12568, Y3; 12007, Y4), and 29120 Primary Care AKI episodes (6376, Y1; 7778, Y2; 7419, Y3; 7547, Y4). *p<0.05 vs. Y1. †p<0.001 vs. Y1.*

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