

Identifying Acute Kidney Injury in children: comparing clinical indicator alerts with electronic health record data

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Background: Acute Kidney Injury (AKI), defined as a sudden decline in renal function, is associated with significant morbidity in children including hospitalisation, admission to intensive care and risk of death. Early detection and intervention are key to preventing disease progression: often serum creatinine and/or urine output serve as indicators for evolving AKI. In 2014, NHS England issued a patient safety alert, requiring hospitals to issue real-time electronic warnings for AKI using a rising serum creatinine as a clinical indicator. NHS laboratories are now required to report all AKI warning data to the UK Renal Registry (UKRR). The aim of this project was to determine whether identification of AKI in children and young people (CYP) using a rising serum creatinine could be validated using linked electronic health record (EHR) data.

Methods: AKI warning alert data received by the UKRR between 01/01/2017 and 31/12/2017 was examined for CYP aged <18 years. AKI severity (stages 1-3) was defined by 1.5-2, 2-3 and >3-fold increases from the age-specific upper limit of the creatinine reference interval respectively. Where possible, linkage to Hospital Episode Statistics (HES) data was performed to determine whether AKI warning alerts could be validated against AKI codes within the EHR. Funnel plots were constructed to explore differences in the proportion of cases with HES-validated AKI by centre and AKI alert stage. Comparisons were also made with adult data.

Results: Over a period of 12-months, 5407 patients received an AKI warning alert and had a related hospitalisation documented in HES. The median age was 5.1 years (IQR 1.6-12.3), 52.5% were male, 78.9% white ethnicity and 27.8% were under 2 years of age at initial alert. Of these, 1008 (18.6%) were diagnosed at paediatric-specific hospitals; 2927 (54.1%) cases were seen at hospitals offering nephrology services (adult and/or paediatric).

Overall, few paediatric patients with an AKI warning result were validated through HES-linkage (20.8%). This finding correlated with AKI severity: a lower proportion of CYP with an AKI stage one alert were validated in HES compared with stage three (mean 15.6% versus 40.1%, $p < 0.001$). Considerable differences in the proportion of HES-validated AKI cases were also noted comparing paediatric with adult patients: 3.2%, 12.3% and 24.3% of children with AKI stage 1, 2 and 3 alerts were coded in HES compared with 18.1%, 28.3% and 44.8% in adults respectively ($p < 0.001$). No differences were seen in the proportion of validated AKI alerts by age-group or gender.

Conclusion: AKI alerts using a rise in creatinine from baseline are poorly validated in CYP using linked HES data. This is particularly true for CYP with stage 1 AKI alerts, highlighting that cases are not being recognised and documented within the EHR. Use of HES to identify CYP with AKI may under-estimate the incidence of AKI, particularly of lower stages. It is unclear how accurate serum creatinine AKI alerts are, particularly for young children experiencing rapid growth changes. Further work is required to determine the diagnostic utilities of AKI warning alerts using population-level data.