Electronic alerts for early detection of acute kidney injury: considering their implementation in Australian hospitals

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Electronic alerts for early detection of acute kidney injury: considering their implementation in Australian hospitals

International use of acute kidney injury care bundles, including e-alerts, represents a potential pathway for significant improvement in acute kidney injury management in Australia

The incidence of acute kidney injury in Australia is increasing, and its impact on morbidity, mortality, and health care costs is universally acknowledged.\textsuperscript{1,2} In a national snapshot, acute kidney injury was the principal or additional diagnosis in 1.6\% of Australian hospital admissions between 2012 and 2013.\textsuperscript{2} However, its true incidence is likely greater, with international data estimating one in five adults worldwide experience acute kidney injury during a hospital admission.\textsuperscript{3,4} In the short term, acute kidney injury increases length of stay, intensive care and rehabilitation admissions, early readmission to hospital, and death.\textsuperscript{5,7} In Australia, hospital-acquired acute kidney injury incurs additional costs of about $55,000 per patient admission.\textsuperscript{1} In the long term, it is an important risk factor for chronic kidney disease and long term morbidity.\textsuperscript{6}

With no targeted therapies for established acute kidney injury, early recognition and best supportive care remain fundamental to mitigating progression and need for kidney replacement therapy.\textsuperscript{4} Nevertheless, delayed diagnosis is common and basic supportive measures are often overlooked.\textsuperscript{7,8} Key international bodies have recognised that acute kidney injury electronic alerts (e-alerts) may increase detection, enhance the quality of acute kidney injury care, and improve patient and health care outcomes.\textsuperscript{9} This article explores the utility and role for such systems in early detection and management of acute kidney injury in the Australian hospital setting.

Electronic alerts

E-alerts are part of clinical decision support systems (CDSS), defined as tools that provide clinicians with targeted information for a specific situation. CDSS are designed
to improve the quality and efficiency of care, aiming to avoid adverse events. Common examples include electronic reminders and condition-specific medication order sets. With the rise of integrated electronic health records and prescribing, there is exponential potential for CDSS.

Automated e-alerts were first reported to improve early detection and management of acute kidney injury in 1994. However, it was not until the landmark National Confidential Enquiry into Patient Outcome and Death (NCEPOD) from acute kidney injury in the United Kingdom in 2009 that e-alerts gained momentum. NCEPOD highlighted significant deficiencies in management, including that 30% of hospital-acquired acute kidney injuries were avoidable and that 40% of patients who died with acute kidney injury as a primary diagnosis had suboptimal management. Consequently, the National Health Service mandated that automated acute kidney injury e-alerts be established across all UK laboratories in 2015. That year, the International Society of Nephrology released the “0 by 25” project, which targeted zero preventable deaths of acute kidney injury worldwide by 2025, and outlined e-alerts as an area of focus.

Despite intensification in the volume of e-alert research worldwide, there remains no published experience from Australian centres.

**Efficacy of electronic alerts**

The impact of e-alerts alone on meaningful clinical end points such as reduced acute kidney injury progression, need for kidney replacement therapy, mortality, or reduced hospital length of stay has not been proven. Two systematic reviews appraised e-alerts for acute kidney injury in the hospital setting. A 2017 review identified 16 primary publications, including two randomised controlled trials (RCTs), and concluded there was significant heterogeneity in study designs (including e-alert design), which yielded inconsistent results. An earlier review included six studies that published outcome data in response to instigating e-alerts, including only one RCT, and similarly discussed study heterogeneity and that introduction of acute kidney injury e-alerts gave no additional benefits to patient outcomes or resource utilisation.

The only two published RCTs explored the stand-alone intervention of automated acute kidney injury e-alerts, but both failed to achieve significant results. A single-centre RCT in the United States involved patients with at least stage 1 acute kidney injury, as determined by the 2012 Kidney Disease: Improving Global Outcomes (KDIGO) definition. Computer-generated randomisation assigned patients to an intervention arm, in which treating clinicians and pharmacists received a text-based e-alert notification \((n = 1201)\) or a control arm of standard care \((n = 1192)\). The e-alert also contained a website hyperlink to the KDIGO guidelines. There was no difference in the composite end point of maximum change in serum creatinine, need for kidney replacement therapy, and mortality at 7 days and no difference in treatment provided.

A single-centre RCT in China randomly allocated patients to an automated pop-up e-alert on the treating team’s computer dashboard \((n = 467)\) or control arm of standard care...
Detection rates were higher in the intervention arm and more patients were referred for nephrology consultation. Again, there was no significant difference in the incidence of kidney replacement therapy, kidney recovery, or death.

**Pitfalls of acute kidney injury e-alerts**

It is unsurprising that evidence supporting acute kidney injury e-alerts has been inconsistent. This may reflect technological or human factors. Early e-alerts were automated, untargeted, and stand-alone interventions. These basic alerts ignored crucial factors such as patient population (whole hospital or intensive care unit), target recipient (treating team, outreach team or allied health staff), mode of transmission (pop-up box, email or SMS), hierarchy of disruption (“hard-stop” that must be actioned or a pop-up box), timing (real-time or in-hours only), and content (diagnostic notification alone or combined recommendations for further management and follow-up). Alert fatigue and clinician desensitisation are additional barriers to e-alert effectiveness. Alert fatigue is frequently discussed in literature exploring medication alerts systems, but is likely to be relevant to all automated e-alerts. Desensitisation may occur when e-alerts lack sensitivity and specificity, resulting in high override rates and poor clinician acceptability.

**Acute kidney injury care bundles**

Incorporation of e-alerts into acute kidney injury care bundles has shown more compelling results. Defined as sets of evidence-based practices, treatments or interventions that collectively improve outcomes, care bundles have been effectively used to reduce central line-associated bloodstream infections in the intensive care unit and to improve the management of patients with sepsis in the emergency department. In the UK, numerous publications have reported research combining e-alerts with additional hospital-wide strategies. Central design elements include hospital-wide education and awareness campaigns on acute kidney injury incidence and impact, e-alerts for early detection, and a care bundle or checklist for interventions that are priorities in acute kidney injury management. A trial in a UK hospital employed two renal nurse specialists to ensure consistency in implementing recommendations and a dedicated pharmacist for medication review, in addition to e-alerts and an education program. This multifaceted approach increased acute kidney injury early detection (< 24 hours) from 53% to 100%, reduced incidence from 9% to 6.5%, and reduced the time to recovery by 36% and the length of stay for patients with acute kidney injury by 23%.

An acute kidney injury quality improvement project at a large UK hospital combined e-alerts, an education program, a management priority checklist, and an outreach support team including a critical care nurse who screened at-risk patients using a live database that flagged abnormal pathology. The outreach support team facilitated early review, initiated management, prompted treating teams to use the acute kidney injury care bundle,
and referred patients to nephrology and intensive care unit teams as required. Results showed a 14% reduction in length of stay of patients with acute kidney injury (2.6 days) and a 23% reduction of in-hospital mortality.

A quality project was undertaken at a large UK hospital where interventions included e-alerts, an educational program, an acute kidney injury smartphone application, and a pharmacy team for medication reconciliation for patients flagged with acute kidney injury. Patients flagged were also discussed at the changeover of nursing shifts during “safety huddles”. This project did not include additional staff or a dedicated outreach support team, possibly reducing overall cost, but reported a 22% reduction in acute kidney injury and a 48.5% reduction in acute kidney injury progression.

Another UK multicentre study, employing a stepped wedge cluster RCT design, investigated grouped interventions including e-alerts, a health care worker educational program, and a management care bundle. Interventions were stepped out sequentially to the five participating hospitals. During the study, 24 059 acute kidney injury episodes occurred, approximating an incidence of 7.6% of all admissions, and although interventions did not alter the 30-day mortality, there were statistically significant differences in important secondary end points, including improved acute kidney injury detection, shorter duration, and median reduction in hospital length of stay (0.7 days).

**Next steps**

The American Society of Nephrology released its AKI!Now initiative in 2020. Similar to strategies in the UK, it promotes acute kidney injury e-alerts and highlights increased awareness and education as essential in reducing acute kidney injury-related morbidity and mortality. Moreover, they recognise an acute kidney injury toolkit or care bundle is beneficial for clinicians as a simple and rapid measure to provide consistent care.

Significant international experience demonstrates e-alerts alone do not improve outcomes. However, as part of a multifaceted approach, there may be benefits for both hospitals and patients. Although the efficacy of acute kidney injury care bundles including e-alerts is likely to relate to the e-alert design, multidisciplinary collaborative processes supporting clinicians to provide best practice management and a robust institution-wide acute kidney injury education campaign also appear paramount. Despite a lack of evidence supporting improved patient survival with a care bundle approach, reductions in hospital-acquired acute kidney injury incidence and length of stay are likely to translate into significant economic benefit for countries, including Australia.

To better appreciate the role for e-alerts and care bundles within Australian hospitals, further studies are required to understand the current landscape and impact of acute kidney injury. Firstly, the true incidence of acute kidney injury in Australian hospitals must be quantified to establish the breadth of the problem faced. Secondly, current management must be assessed, focusing on alignment of care provided with best practice recommendations. Finally, areas for improved efficiency require investigation to enhance patient outcomes and minimise costs to the community. Such studies would likely confirm the high acute kidney injury incidence, identify its delayed diagnosis,
demonstrate inconsistent implementation of recommendations, and outline important opportunities for Australian hospitals to improve health care provision and patient outcomes in acute kidney injury.

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