Electronic Alerts in Acute Kidney Injury—More Questions Than Answers

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The move toward widespread adoption of electronic medical records in the last several decades has held the promise of a more cohesive and analytics-based approach to patient care. This technological advancement has also paved the way for the introduction of electronic notifications or alerts, an area of growing interest and study across numerous medical specialties, including nephrology. The appeal of medical alerts in the management of acute kidney injury (AKI) stems from the sizeable body of available literature suggesting that its timely identification and treatment can improve patient outcomes. These interventions include, but are not limited to, the adjustment of fluid and electrolyte imbalances, careful management of medication dosages (especially nephrotoxic drugs), and the timing of kidney replacement therapies. Other studies emphasize the critical nature of early intervention in the progression of AKI, especially in the intensive care unit (ICU) setting, where patients are particularly vulnerable to rapid clinical deterioration.

In this landscape, electronic alerts have been proposed as a tool to enhance the prompt identification and management of AKI. These alerts operate on the premise that real-time surveillance of declining kidney function paired with a prompt notification to the relevant health care practitioner have the potential to trigger timely interventions. Although the majority of literature in this area has attested to the ability of alerts to change physician behaviors in a way that favors earlier intervention as anticipated, most come up short in demonstrating any meaningful effect on patient outcomes. The latest of several randomized clinical trials (RCTs) scrutinizing the impact of an electronic alert system for AKI is a study by Li and colleagues. Their study was a single-center, double-blinded RCT that enrolled 2208 patients. It focused on the primary outcome of the maximum change in estimated glomerular filtration rate (eGFR) within 7 days after randomization, with secondary patient-centric outcomes including mortality, need for dialysis, progression of AKI, and recovery. In addition, care-centric outcomes were evaluated, considering the diagnostic and therapeutic interventions following an AKI diagnosis. Despite a rigorous study method, the results of the trial were ultimately negative with regard to major outcomes, which is consistent with results from other trials.

The inability of these trials to demonstrate meaningful clinical impact raises some important clinical considerations. First, the choice of eGFR as a monitoring tool in this study, although consistent with other similar trials, brings to light certain methodological concerns inherent in the monitoring of AKI. The premise of eGFR calculations rests on stable serum creatinine levels, an assumption that is rarely met during the acute changes seen in AKI. This misalignment between the theoretical model of kidney function assessment and the clinical reality of its fluctuations in AKI poses a major challenge. Such a discrepancy has the potential to delay the recognition of AKI by electronic alert systems and may serve as one explanation for the neutral or even negative results that have been reported by multiple studies in the field. The focus on eGFR as a primary outcome measure underscores a common thread in AKI research that relies on serum creatinine as a surrogate marker of kidney function. However, in the setting of AKI, the kinetics of creatinine can lag its true clearance, misrepresenting the real-time state of kidney function and potentially affecting the timing and appropriateness of clinical interventions. This limitation calls into question the reliability of eGFR-based outcomes in any study, including those suggesting that earlier intervention is associated with improved kidney outcomes, the leading rationale for many of the studies of alerts in the AKI context to date.

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A second, and perhaps more important, consideration lies in the nature and management of AKI itself. The heterogeneous nature of AKI lends itself to multiple possible management strategies that depend entirely on its cause. For example, in a patient with hypovolemia with prerenal AKI, the most common initial step would be to consider the administration of intravenous fluids. On the other hand, a patient with urinary retention would be unlikely to benefit from this approach and possibly may experience harm until the cause of the retention is relieved. In this regard, there is no clear standard of care in AKI management that can be easily applied in a one-size-fits-all model in response to an alert. This underscores the importance of clinical expertise in the management of AKI.

The design and implementation of electronic alerts are further complicated by the heterogeneity of alert systems and the context in which they are used. In the RCTs conducted to date on this topic, patients in both ICU and non-ICU care settings were included, acknowledging that the same treatment in an ICU patient with many morbidities is less likely to produce anticipated positive kidney and or survival outcomes compared with a stable ward patient. In the study by Li et al, the alert system used was delivered via text message to targeted health care practitioners. In another negative RCT of AKI alerts in varied clinical settings similar to that studied by Li and colleagues, Wilson and colleagues deployed a general, untargeted pop-up alert system that could potentially contribute to alert fatigue, a condition where the frequent interruption by alerts leads to desensitization among health care practitioners and may diminish the response to alerts.

Addressing this variability in alert efficacy, Kwan and colleagues conducted a meta-analysis of 108 studies that examined the impact of clinical decision support systems, including electronic alerts. Their findings suggest that such systems lead to only modest improvements in care processes and have a minimal effect on clinical end points. This aligns with the results from Li et al and other recent AKI alert studies, indicating that the anticipated benefits of electronic alerts in improving patient outcomes are not consistently realized in practice.

The collective insights from these studies underscore the complexities involved in the development and application of electronic alerts for AKI. The mere integration of electronic alerts into clinical practice has proven insufficient for substantial improvements in patient outcomes. Indeed, the current evidence suggests a gap between the theoretical advantages of such alerts and their actual performance in clinical practice settings. Whether these alerts have the potential to be useful in the management of AKI in the future will depend on how the landscape of AKI care changes. This includes growing research that continues to explore the biological markers and algorithms that can provide earlier and more accurate indicators of AKI, as well as research that enhances the design and usability of electronic medical record systems.

Moving forward, it is crucial that future use of electronic alert systems in the context of AKI come with a clear recognition of their limitations in a condition with complex pathophysiology and inherently nuanced management. Their ongoing use should be coupled with educating health care practitioners on how to optimally react to AKI alerts, integrating alert systems into comprehensive care plans where possible, and promoting a work culture that values prompt and effective action in response to digital clinical decision support tools, with the objective of minimizing interference with clinical workflow.

In conclusion, the latest of several rigorous scientific studies confirms that at least in the world of AKI, electronic alerts miss the mark on meaningful clinical impact. Additionally, they pose the risk of a negative impact on practitioner workflow and fatigue. Although the study by Li et al and other similar previous studies fail to make a case for the use of electronic alerts, they have shed light on an important opportunity to reexamine the evidence for these studies, specifically, whether the current evidence supporting early intervention in AKI is as robust as once thought, or whether the time has come for another look.
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REFERENCES


