Use of Reference Change Value in generating e-alerts for the early identification of Acute Kidney Injury

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INTRODUCTION

Acute Kidney Injury (AKI) is common in hospitalised patients and has a poor prognosis with the mortality ranging from 10 – 80% dependent upon the population studied. One of the important aspects in the care of AKI as highlighted by the NCEPOD report is the early recognition of patients at risk, appropriate monitoring of blood chemistry, rapid remedial action and referral of patients to specialist services. Classification of AKI (RIFLE, AKIN) specify magnitude of change and rate of change. The latter can prove difficult to programme into laboratory systems.

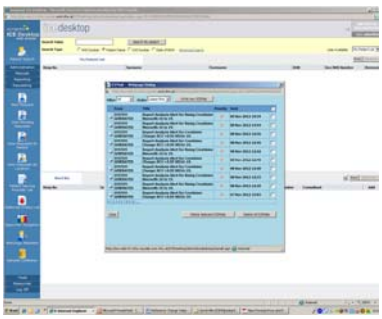
We observed increasing rates of AKI within the orthopaedic wards of Ninewells and so as part of a number of interventions aimed at reducing these rates, we introduced a pilot of e-alerts to identify these patients early by assessing reference change values (RCV) for serum creatinine.

METHODS

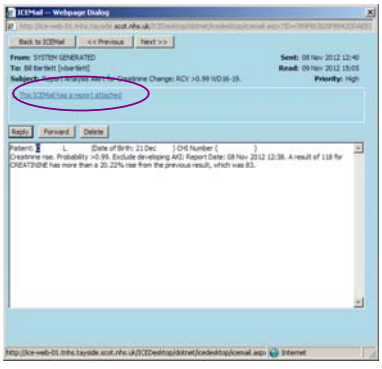
Report analysis rules were built into the ICE system, automatically alerting the renal team of patients (elective and emergency) admitted in four orthopaedic wards over a 4 week period between July 2012 and August 2012. The e-alert was made available to the clinician in the form of an "ICE-mail" highlighted at the time the clinician logs onto the electronic ordering or reporting systems. The e-mail carries a link to the entire report with links to cumulative data. They are also informed by NHS mail that an ICE-mail e-alert is available for review. Once an e-alert was generated, the renal team provided further input; either by phone or by a formal patient review. Patient's baseline Creatinine, baseline eGFR, rise in Creatinine, renal intervention and outcome were recorded.

RCV enables an objective assessment of significance of change in serum creatinine based on knowledge of the inherent within subject biological variation in serum creatinine (CV_I = 6.3%) and the analytical variability (CV_A Circa 2%). At a probability of 0.95 and 0.99 the one tailed RCVs for a rise in creatinine are 14.3% and 20.2% respectively.

Logon indication of e-alert



List of e-alerts available



Actual alert, with link to full report.

RESULTS

•68 alerts were generated during the 4 week period

•17 (25%) required renal intervention

•Of these, only 4 required review, the remainder were advised by telephone.

•No patients required renal replacement therapy

•None of the patients had been referred by the orthopaedic team

Patient Characteristics (n=68)	
Sex	M:16 F:52
Age (years)	74 ± 14
Baseline Creatinine (µmol/l)	63 (52-88)*
Change in Creatinine (µmol/l)	19 (11-40) *

* Median & IQR

CONCLUSION

RCV is a potentially useful means of early identification of AKI using electronic laboratory alerts. Embedding this approach into electronic ordering and resulting systems provides one model for enabling early identification of AKI in high risk environments. While not ideal it may provide an interim opportunity for early identification of patients to health care teams that are able to apply internationally recognised criteria. RCV can also be used initiate flags on more conventional printed reports in the absence of electronic capability. These can alert users to the fact that there has been a biologically significant change in results. This would provide an opportunity for better monitoring of CKD patients also. Most laboratories currently do not use RCV despite the fact that it is an internationally recognised concept embedded in HL7 pathology messaging.

The workload involved with managing e-alerts and who should receive these alerts pose challenging questions**.**

Reference change values (RCV) *enable clinical laboratories to communicate the significance of change between sequential results. They are based on knowledge of the inherent within subject biological variability (CVI%) of a measured parameter (for example serum creatinine) and the analytical variability (CVA%) of the method used to measure it. It is calculated from the formula: -*

$$RCV\% = 2^{1/2} * Z * (CV_I^2 + CV_A^2)^{1/2}$$

where the Z score identifies a probability level, usually 95% or 99% (these can be chosen to give a one tailed or two tailed probability (that is to say significant change in one direction or just changed). The resultant value will indicate to the user the % by which a measured parameter must change on the next occasion it is measured to be clinically significant. This percentage of course can also be converted to an absolute value (e.g. creatinine should change by 11% or 11 umol/L if the original concentration was 100 umol/L). Laboratories can therefore objectively identify clinically significant change by employing relatively simple processes within their IT systems. The concept is internationally recognised (International Federation of Clinical Chemistry) and provides a powerful tool for communicating important information to clinicians and has many applications (see Plebani Clinica Chimica Acta 2004:346:25-35). The concept has already been incorporated into HL7 V3 and enables the communication of percentage change or absolute value