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CORRESPONDENCE

Improving the appropriateness of serum magnesium testing in an intensive care unit

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To the Editor,

Serum total magnesium (Mg) concentration is measured frequently and routinely in patients who are admitted to intensive care units (ICUs). Ninety-nine percent of Mg is intracellular and there is a poor correlation between serum total Mg concentration and both intracellular and serum ionized Mg concentration.[1,2] Suspected hypo- and hypermagnesemia can both be managed empirically,[3] except perhaps in cases of renal failure. We report the results of a quality improvement project whose objective was to reduce routine-priority Mg testing in our ICU.

The University of British Columbia Providence Health Care Research Ethics Board waived formal review (16 June 2016). Our ICU is a 15-bed "closed" medical-surgical unit within a 400-bed teaching hospital. Indications for Mg testing accepted by our attending physicians were: 1) suspected hypomagnesemia in the setting of renal failure and 2) optional testing per clinician in suspected hypermagnesemia. We used the following change strategies:[4] 1) monthly education sessions about Mg testing, 2) a prompt in the computer order-entry system to encourage only accepted indications, and 3) reminder posters. A before-and-after observational cohort design was used.

The pre-intervention period was 18 December 2015 to 18 December 2016, and the post-intervention period was 19 December 2016 to 31 October 2017. We recorded age, sex, Acute Physiology and Chronic Health Evaluation (APACHE)-II score, ICU occupancy, and number of serum total Mg tests ordered for all patients admitted. We report tests per patient-day during before and after periods and their ratio with 95% confidence intervals (95% CI). Differences in numbers of tests were significant if the confidence interval for the ratios excluded 1. Direct costs (in CAD) for the tests were obtained from our hospital cost dictionary. Costs for routine and non-routine tests were similar.

There were no differences in patient age, sex, APACHE-II score, ICU mortality, hospital mortality, ICU length of stay, or ICU occupancy between periods. The number of serum total Mg tests decreased from 0.71 tests/patient-day^{-1} during the pre-intervention period to 0.54 tests/patient-day^{-1} in the post-intervention period. Routine testing decreased from 0.57 tests/patient-day^{-1} to 0.41 tests/patient-day^{-1}; non-routine testing remained unchanged at 0.14 tests/patient-day^{-1}. A plot describing the weekly summary of routine and non-routine Mg tests ordered is shown in the Figure. Ratios comparing after and

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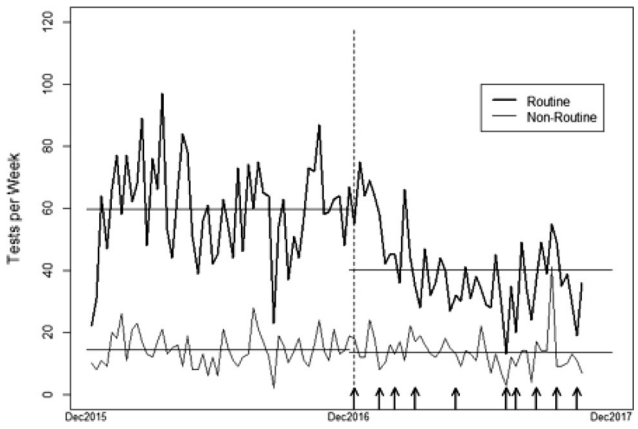

Figure Weekly routine and non-routine tests of serum total magnesium. The vertical line indicates introduction of the automated prompt in the computer ordering system and placement of educational material at the workstation. Arrows indicate small-group teaching sessions for residents. Horizontal lines are mean values before and after onset of interventions.

before intervention testing were: 0.77 (95% CI, 0.73 to 0.81) for all tests, 0.71 (95% CI, 0.67 to 0.75) for routine tests, and 1 (95% CI, 0.90 to 1.11) for non-routine tests. At a cost of 5.00 CAD per test, these changes translate to 900 fewer tests and an annual saving of 4,500.00 CAD.

After 46 weeks of education initiatives and changes to computerized order-entry systems, we reduced routine serum total Mg testing. Our multi-pronged quality improvement initiative was medical student-led, inter-professional, and did not rely on financial incentives. Our analysis is limited by our lack of treatment and outcome data related to hypo- or hypermagnesemia, and an inability to assess the individual effect of the three simultaneous interventions. Results from our single 15-bed medical-surgical ICU may not be representative of other ICUs. We hope that our findings encourage physicians to make thoughtful decisions when ordering tests and promote better stewardship of the healthcare system.

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Conflicts of interest None.

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