CORRESPONDENCE

Electronic reminders for intraoperative antibiotic re-dosing

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To the Editor,

Administration of antibiotics within one hour of surgical incision for qualifying surgeries has become the standard of care for reducing the incidence of surgical-site infections, as described by the United States' Joint Commission Surgical Care Improvement Project.^A Interestingly, although re-dosing antibiotics during prolonged surgical cases is also recommended, the dosing interval is often determined by a hospital's Antimicrobial Stewardship and Evaluation Team (ASET) and may vary by antibiotic and by hospital.¹ Although anesthesia providers at our institution are aware of these recommendations, and compliance with pre-incisional antibiotic *dosing* is > 99.9%, a recent convenience sample revealed that our compliance with antibiotic *re-dosing* during long cases was sub-optimal [68/88 (77.3%)]. Furthermore, a preliminary review of the 20 cases that failed to re-dose in a timely manner revealed a multitude of reasons. Most commonly, failure to re-dose could be attributed to (1) concurrent intraoperative activities during the anticipated time of re-dosing and (2) failure to recognize the recommended dosing interval for second-line antibiotics in cases where first-line antibiotics were contraindicated, often because of allergy.

At least two previous studies have demonstrated the utility of real-time intraoperative electronic reminder

systems for increasing compliance of timely prophylactic antibiotic re-dosing during prolonged surgical cases.^{2,3} As a quality improvement endeavor, our hospital implemented such a system in our Anesthesia Information Management System (AIMS) (Epic, Verona, WI, USA) with the intent to achieve a similar increase in compliance with timely re-dosing of intraoperative prophylactic antibiotics. In this era of frequent messages, reminders, alerts, and advisories from our AIMS, however, it was unclear whether implementation of such a system would result in improved compliance.⁴ This preliminary retrospective observational study (deemed exempt for review by our Institutional Review Board, August 2016) aimed to determine whether such a system could improve intraoperative antibiotic re-dosing compliance to > 90%.

A real-time intraoperative electronic reminder system was designed to provide a pop-up message when an antibiotic was recommended to be re-dosed as per intervals set by our ASET guideline. To determine baseline compliance, a convenience sample of all cases in neurosurgical operating suites that required re-dosing of prophylactic antibiotics were examined over a three-month period prior to intervention. In the following nine months, we analyzed the pre-intervention data, formulated a quality improvement plan for automated reminders in our AIMS, presented the plan to an internal Patient Safety and Quality Council, and worked with Epic builders to implement the automated tool. Post-intervention data were collected one month following launch of the tool, which allowed us to mitigate a potential Hawthorne effect. Furthermore, pre-intervention and post-intervention data were collected during the same academic interval to control for trainee

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^A *The Joint Commission*. Available from URL; <https://www.jointcommission.org/> (accessed December 2016).

Figure A run chart demonstrates a significant post-intervention process shift. The blue line represents a post-intervention run of compliance rates above the pre-intervention median (green line)

experience levels. We looked at re-dosing compliance for 213 patients who required re-dosing in six neurosurgical operating rooms over the course of 17 weeks ($n = 9$ weeks, pre-intervention; $n = 8$ weeks, post-intervention). At our institution, antibiotic re-dosing was defined as compliant if it occurred within 30 min before or after the recommended time.

Analysis of our preliminary data suggests that implementation of a real-time electronic reminder system in our AIMS was associated with increased mean (standard deviation) compliance of timely re-dosing of antibiotics from 79.3 (9.8)% pre-intervention to 91.6 (5.5)% post-intervention [absolute risk reduction, 12.3%; 95% confidence interval, 4.1 to 20.5; $P = 0.007$, Student's two-group t test (SAS, Cary, NC, USA)]. A run chart (Figure) demonstrates a significant post-intervention process shift, with the blue line representing a post-intervention run of compliance rates above the pre-intervention median, which is depicted by the green line.⁵

Overall, these results suggest that electronic reminders may help the provider comply with the timely re-dosing of antibiotics during prolonged surgical cases, even in the era of frequent, unrelated electronic messages and advisories. Importantly, future investigations will focus on the system-wide impact, potential association with adverse outcomes including surgical-site infections, and sustainability, which was not directly addressed in this study. Finally, we aim to identify and further characterize the causes of residual non-compliance observed despite implementation of this real-time electronic reminder system.

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