New automated insulin infusion system could reduce medical errors, improve care

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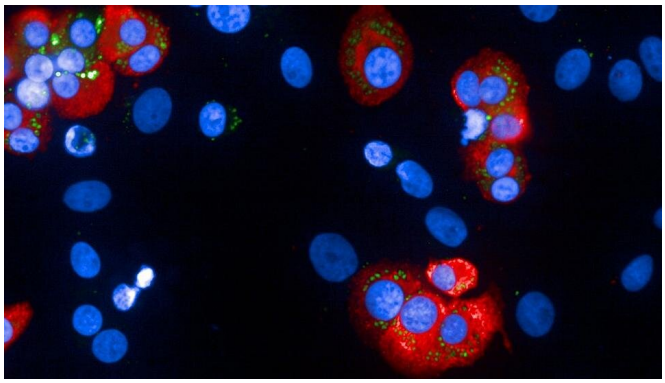

Photomicrograph showing insulin granules (blue) and the pancreatic beta cells (red) that produced them. Johns Hopkins Medicine researchers successfully tested a “smart agent” system that integrates electronic health records and infusion pumps to help nurses manage the automatic delivery of insulin to critically ill patients, reducing errors and saving time. Credit: Public domain image

Nurses traditionally manage insulin intake for critically ill patients by following precise steps to manually calculate the correct dose for each person. Looking for ways to improve this process, researchers at the Johns Hopkins Armstrong Institute for Patient Safety and Quality recently tested a "smart agent" system that integrates electronic health records and infusion pumps to automate insulin dose selection.

The study showed that Smart Agent—developed as a joint effort between the Johns Hopkins University Applied Physics Laboratory and the Johns Hopkins University School of Medicine—may reduce errors and provide faster insulin delivery when compared with manual dosing calculation. In turn, the researchers say, this could free up nurses and clinicians to focus their attention on other patient care priorities.

The findings, published online March 10, 2021, in the journal *BMJ Quality & Safety*, suggest that a smart agent system could potentially optimize safety and efficiency of insulin infusion practices in intensive care unit settings.

"Glucose management improves outcomes for critically ill patients; however, current insulin infusion protocols are work-intensive for nurses and may be error prone," says study lead author Michael Rosen, Ph.D., M.A., associate professor of anesthesiology and critical care medicine at the Johns Hopkins University School of Medicine.

The current infusion process requires a nurse to manage insulin doses hourly, based on the patient's condition. Because neither the patient's medical record nor the infusion pump's operating data communicate electronically, a nurse is required to first retrieve the patient's blood glucose level from the health record. Then, he or she must manually calculate the medication rate change using an algorithm to determine the new insulin dosage. A second nurse double checks this process before it's documented in the medical record, and finally, the new dose is manually programed into the infusion pump to administer insulin to the patient.

For the study, 20 critical care nurses at The Johns Hopkins Hospital in Baltimore, Maryland, tried a specific smart agent system in a simulation-based setting between May and July 2018. Participants completed 12 mock situations, in four blocks of three scenarios each. Each block was performed with either the manual protocol or Smart Agent.

Nurses were surveyed after each session to get their impressions of safety levels (rates of errors), efficiency (time to complete each task), perceived workload, trust in the system and usability.

The researchers say their findings show that the automated system was significantly better in dosing

accuracy calculation compared with manual calculation. In 120 scenarios, nurses never made a calculation error when using the smart agent system compared with 20 errors (16.6%) made using the manual system.

Smart Agent enabled the nurses to complete the process an average of 29 seconds faster than the manual system, along with reducing their overall workload. The tasks that consumed the most time using the manual system were retrieving information from the electronic health record and performing manual calculations—neither of which is required in a smart agent system. The nurses also found that after using Smart Agent at least twice, they trusted it more than doing the manual calculations.

In general, Smart Agent received positive remarks from all 20 nurses. Most found it to be helpful and more efficient than the manual system, and 18 (90%) found it easier to use. Fifteen (75%) nurses believed that the automated system was safer than the manual process, while five (25%) were unsure or believed both systems were about as safe.

"This approach can be applied to improve a fragmented and inefficient health care IT infrastructure through design, testing and system integration," says senior study author Adam Sapirstein, M.D., associate professor of anesthesiology and critical care medicine at the Johns Hopkins University School of Medicine.

The researchers believe that Smart Agent can serve as a template for similar systems that use algorithms built directly into electronic medical records so that they can be integrated with devices for automatically delivering medication to patients.

More information: Michael A Rosen et al. Smart agent system for insulin infusion protocol management: a simulation-based human factors evaluation study, *BMJ Quality & Safety* (2021). DOI: 10.1136/bmjqs-2020-011420

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