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Improving the Timing of Insulin Administration in Adult Acute Care Patients

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ABSTRACT

Background: The correct timing of insulin administration in diabetic patients admitted to the hospital is important for the prevention of transient and serious glycemic deviations that could lead to negative patient outcomes. In November 2021, a South Florida Hospital identified an area of opportunity for quality improvement related to the process of subcutaneous insulin administration. In addition to bar code scanning, manual verification of the insulin dose by the primary nurse and another nurse was required prior to administration. Patients were experiencing delays in the timing of their insulin dose and nurses were reporting frustration with the process.

Methods: The project followed the Plan-Do-Study-Act (PDSA) cycle for performance improvement.

Results: The change in medication administration workflow resulted in achievement of administering insulin within 30 minutes of the scheduled time. Ninety percent of the nurses surveyed reported improvement in their workflow when giving subcutaneous insulin to their patients ($n=112$).

Conclusion: Interdisciplinary collaboration, innovation in education of the nursing staff, monitoring adherence to the process, and sustaining engagement among stakeholders contributed to the success of this initiative, resulting in improved workflow in subcutaneous insulin administration.

Keywords: Bar code medication administration, insulin, safety, quality improvement

INTRODUCTION

The prevention of medication errors remains a top priority for U.S. healthcare organizations. The most common errors reported in hospital settings include those that result from prescribing, transcribing, dispensing, distributing, administering, or monitoring (Zirpe et al., 2020). The bar code medication administration (BCMA) technology carries many patient-related safety benefits, including increased accuracy rate of patient iden-

tification, reduction in the rate and severity of medication administration errors, less use of the medicine room, and reduced administration time per dose (Barakat, & Franklin, 2020). The Leapfrog Group (2018), a national non-profit organization that measures hospital performance and advocates for patient safety recommends that at least 95% of bedside medication administrations take place via scanning. Through the bar code scanning process, the nurse is able to confirm the

five rights of medication administration: right patient, right time, right medication, right dose, and right route (Mulac et al., 2021).

The literature remains mixed on the benefits of BCMA on medication administration workflows. Some studies report BCMA may contribute to disrupted workflow, increased workload, and cause medication errors when it is poorly implemented (Mulac et al., 2021). Therefore, healthcare organizations may rely on alternative and/or additional measures to support these workflows. One of these practices involves the independent double verification by providers, especially for medications that pose the greatest risk of harm if an error occurs (Institute for Safe Medication Practice [ISMP], 2018). While this practice may contribute to the reduction of administration errors, timing errors can be most prevalent and are not resolved with double-checking interventions (Modic et al., 2016).

Here we describe an organization's process to improve nursing workflow in administration of subcutaneous insulin. The change led to improvements in the timeliness of insulin administration to diabetic patients. This quality improvement project took place at a South Florida Hospital in Miami, an 866-bed, urban, non-teaching, faith-based, non-profit, adult acute care facility with an average daily census of 578 patients. The hospital has utilized BCMA and automated dispensing cabinets through its Pyxis system for many years. BCMA scanning is required on all inpatient nursing units, including medical surgical units, telemetry units, and the intensive care unit. The organizational goal for BCMA scanning compliance was set at $\geq 95\%$. The process for BCMA was required for all medications. High-alert medications such as subcutaneous insulin required an additional independent double verification from two registered nurses prior to administration.

Problem

In September 2021, nurses reported concerns about the subcutaneous insulin administration workflow during a town hall meeting. The process required the nurse to perform multiple steps, leading to delays in the timing of insulin administration. The nurse would: (1) remove the multi-dose insulin vial from the Pyxis system, (2) scan the bar code to verify the medication in the electronic record, (3) prepare the insulin dose in the syringe, and (4) contact another nurse to physically verify the insulin dose and electronically cosign the administration in the medical record.

Failure of the second nurse to cosign the entry would result in the electronic system triggering an alert, and the primary nurse would not be able to continue administering medications.

Nurses working in clinical units with five or six patients on insulin struggled with the process. Another problem was the difficulty some nurses had in locating the multi-dose insulin vials from the Pyxis system. Members who retrieved the vial for dose preparation would fail to timely return these for the next user.

Subcutaneous insulin remains the preferred agent for glycemic control in non-critical care settings, with basal insulin administered once or twice daily and rapid acting insulin given before meals (Umpierrez & Pasquel, 2017). Insulin administration should take place within at least 30 minutes before meals for optimal glycemic control (Slattery et al., 2018). Hospital policy requires that medication administration occurs within one hour of the scheduled time. However, from a quality perspective, the established benchmark for insulin administration is within 30 minutes of the scheduled time. The delay in insulin administration may present issues with glycemic control in the hospital when patients need it the most (Umpierrez & Pasquel, 2017). Therefore, the purpose of this quality improvement project was to improve the safe administration of subcutaneous insulin by continuing to use the BCMA technology and safely eliminate the independent double-verification process with another nurse. The aim of the project was to improve the administration of subcutaneous insulin to within 30-minute of scheduled time (goal $\geq 80\%$) in medical-surgical, telemetry care, and the intensive care units.

METHODS

The Plan-Do-Study-Act (PDSA) cycle has been proposed as a simple but powerful tool to help accelerate the quality improvement process (Institute for Healthcare Improvement, 2022). In September 2021, an interdisciplinary group of clinical nurses, pharmacists, nurse leaders, clinical nurse educators, and clinical informatics personnel began the cycle by reviewing the literature on the process of insulin administration. Findings suggested the process of requiring nurses to perform an independent double-check of the dose prior to administration of subcutaneous insulin in the hospital to be inefficient in prevent-

ing most insulin-related errors (Westbrook et al., 2010).

Next, the interdisciplinary group met to review and determine the gaps in insulin administration workflow. The group reviewed baseline reports of insulin administration generated by the Pharmacy and Nursing departments. First, the interdisciplinary group worked on improving workflow during the removal of the multi-dose insulin vial from the Pyxis system. The nurses printed a bar code from the Pyxis medication system to scan the insulin. Once they scanned the bar code and prepared the insulin syringe, the nurses placed the vial back in the storage system. The nurse then placed the printed label from the Pyxis system on the syringe (Figure 1) followed by administering the insulin. Patients 18 years of age and older no longer required an independent double-check from another nurse for subcutaneous insulin in adult nursing units. Pediatric and neonatal patients and adult patients requiring intravenous insulin administration continued to require an independent second check prior to insulin dose administration.

In November 2021, the revised workflow was piloted in four nursing units after education was delivered to the staff. In February 2022, the interdisciplinary team regrouped to follow up on the feedback from the four nursing units that had gone through the implementation of the revised workflow. There were no reported adverse events or medication errors related to the revised process. Then the group proceeded to work on the deployment of this initiative throughout the hospital. They reviewed baseline data from January 2022 to July 2022, which indicated a total of 97,158 insulin administrations, with an insulin delivery time average of 23 minutes in the nursing units. Sixty-eight percent of the insulin administrations were under the 30-minute benchmark. The hospital benchmark was set at 80%. Only 10% ($n = 3$) of the 29 nursing units were compliant with the insulin dosing under 30 minutes of scheduled time (not shown). The BCMA scanning compliance rate was $> 95\%$ for fiscal years 2021 and 2022.

In July 2022, the interdisciplinary group launched the BCMA with subcutaneous insulin process within the remaining 29 nursing units. The nurses were educated by the clinical educators using a variety of learning methods. A step-by-step education flyer was created and posted in every medication room (Figure 1). An “Insulin

Administration Form” was created and published on the institution’s intranet for the nurses to utilize as a resource when collecting information on blood glucose and the amount of insulin to be administered. A hybrid in-person/online course was also developed and provided to all nurses. The course curriculum included the step-by-step process and a video to provide a visual and auditory example of the process. The live course provided the opportunity for hands on learning with appropriate labeling of insulin syringes.

The clinical educators also created a rolling cart to visit nursing departments to provide hands on, real-time training at the Pyxis system. Through this interactive rolling cart, the clinical educators engaged the nurses and provided them with additional opportunities to ask questions on the new insulin administration process. There were 74 sessions and approximately 1,091 nurses were educated on the new process. Nursing department leaders were given guidelines on troubleshooting printer issues, preparing medication rooms, and guidance on how to reprint any faulty labels. Each nursing unit identified super users for each shift as an additional resource to the nurses during the new implementation of this monumental change.

To ensure ongoing education, the online course was uploaded into the organization’s online education platform for all new nurse residents and new employees to complete during the onboarding process. After hospital-wide implementation of this revised process, the nurses were surveyed (Figure 2). They were asked to rate statements such as: (1) I feel that the pilot is safe, (2) I feel that the RN workflow with the pilot has improved, and (3) I feel that my colleagues are following the pilot. Their responses were classified as: strongly agree, agree, neutral, disagree, or strongly disagree.

RESULTS

Prior to the implementation of the revised workflow, about one-third of the scheduled insulin administrations between January 2022 to July 2022 were administered over their 30-minute scheduled time. A noticeable improvement was achieved in August 2022, immediately after implementation of the revised workflow hospital wide. Nursing and Pharmacy department leaders performed random visual audits in the various nursing units of the hospital from August to

September 2022. The compliance rate with the revised insulin process increased from 76% to 100% over a period of three weeks (Table 1). By September 2022, the nursing units that had been audited ($n=17$) had greater than 90% compliance with the revised process (Table 1). The insulin delivery time ranged from 12 minutes to 30 minutes (not shown). No medication errors associated with the change in workflow were reported during the hospital wide implementation. Follow-up data from July 2022 to November 2022 indicated a total of 52,973 insulin administrations, with insulin delivery time averaging 25 minutes in the nursing units. While there were no drastic changes in the overall administration of insulin within the 30-minute benchmark (65%), there was a 2.5-fold increase in the number of nursing units that were compliant with the insulin dosing under 30 minutes of scheduled time ($n=7$).

Results from the nurses' survey after implementation of this revised process indicated that 90% of the nurses agreed or strongly agreed that the subcutaneous insulin administration pilot was safe. Ninety percent of the nurses agreed or strongly agreed that the subcutaneous insulin administration pilot improved the nurses' workflow. Approximately 88% of the nurses agreed or strongly agreed that their colleagues were following the revised subcutaneous insulin administration process (Figure 2).

DISCUSSION

For nurses caring for patients requiring insulin administration, the medication preparation process required revision. The delay in timing of medication administration presented significant concerns for the nurses, from the point of having to direct efforts to find the multi-dose insulin vial and the primary nurse having to wait for a second nurse to physically verify and cosign the insulin dose prior to patient administration. Nurses who had more than one patient scheduled for insulin administration became overwhelmed by the existing process. There was a need for interdisciplinary collaboration, engaging all stakeholders, to improve timely care and glycemic control for patients requiring this regimen.

The results of this quality improvement project demonstrated the importance of streamlining the workflow for insulin administration using the PDSA model. The interdisciplinary approach in combining the Nursing and Pharmacy efforts to

improve the process led to the successful implementation of the revised workflow for subcutaneous insulin administration. The nurses were able to transition to the new process, maintaining the bar code scanning process, but removing the independent physical verification by the second staff nurse. The gradual improvement in the nursing units during the visual audits after hospital wide implementation highlights the impact of the change in workflow and education processes.

Our findings align with previous studies reporting the benefits of BCMA in addressing the five rights of medication administration, the prevention of administration errors with the use of bar code technology, and nursing education as effective tools to minimize these errors (Ho & Burger, 2020). Efforts have been intensified to continue maintaining the momentum. The group will continue working on improving the workflow for subcutaneous insulin administration. Efforts will be particularly directed toward sustainability of the revised practices to support patient safety through timely delivery of subcutaneous insulin. Future goals include increasing bar code compliance to reach 98% across all nursing units. Additionally, efforts are underway to monitor weekly Pharmacy reports highlighting top ten medications not scanned, a detailed breakdown for insulin, and a scanning compliance report by nursing unit and user. The results of this project have implications for future research and practice at large healthcare organizations with high influx of insulin-dependent diabetic patients.

CONCLUSION

The timing of insulin administration in diabetic patients admitted to the hospital is important. While the addition of technology may be designed to improve safety in the delivery of care to patients, it is important to highlight the need to periodically reevaluate workflow processes to support optimal care for patients. By restructuring the workflow, the timing in the delivery of subcutaneous insulin improved. Nurses advocated for their patients and reported satisfaction with the change in workflow. The success of the revised workflow was the outcome of the interdisciplinary work designed and implemented by key stakeholders of the process. It is vital for organizations to evaluate workflows and come up with alternatives that may lead to optimal patient outcomes. Without innovation, healthcare organizations run the risk of becoming stagnant in old

practices, ultimately affecting patient outcomes.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Table 1*Insulin Compliance Rates (%) with Revised Workflow in Nursing Units (n=17)*

Unit	Audit 1	Audit 2	Audit 3
	8/6/22- 8/12/22	8/20/22 - 8/26/22	9/7/22 - 9/13/22
1	82	100	100
2	92	92	99
3	95	89	99
4	98	98	99
5	99	96	98
6	98	96	97
7	99	94	97
8	87	95	97
9	87	96	97
10	89	93	95
11	60	82	94
12	60	85	94
13	66	64	93
14	94	94	91
15	91	96	91
16	91	86	91
17	75	84	88

Figure 1

Guide to the Process of Insulin Removal and Administration

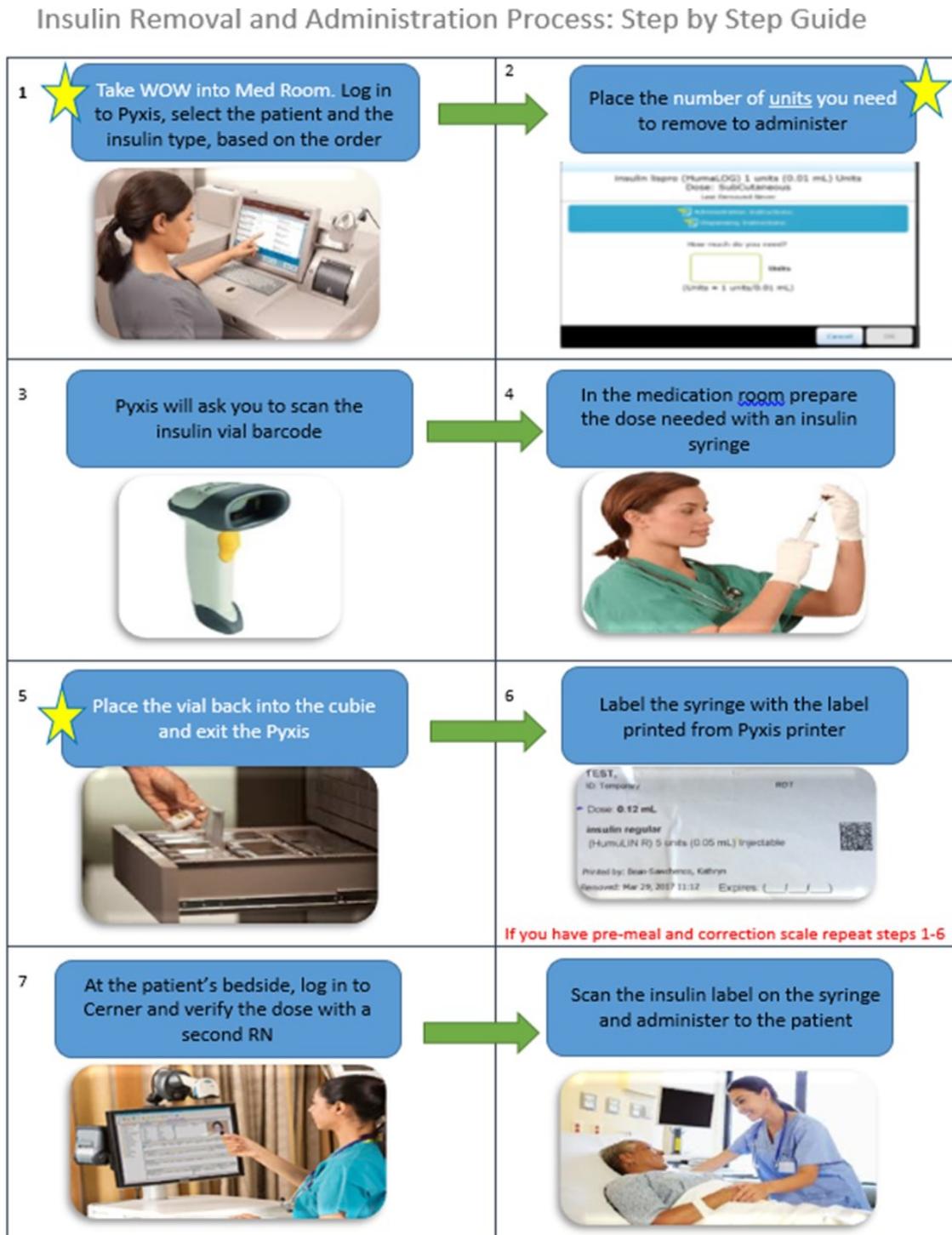


Figure 2

Post Implementation Results of Nurse Survey – September 2022 (n=112)

