IMPACT OF AN AUTOMATED DISPENSING CABINET-REGULATED COMMUNITY INSULIN VIAL PILOT PROGRAM ON INVENTORY COSTS

by

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ABSTRACT

Purpose: To assess the impact of an automated dispensing cabinet-regulated community insulin vial pilot program on inventory costs associated with insulin regular, insulin NPH, and insulin detemir and average employee satisfaction survey scores.
Methods: An automated dispensing cabinet-regulated community insulin vial pilot program was implemented in a designated surgical unit and a medical intensive care unit (MICU) of a Level I trauma center. Insulin dispensing volumes were analyzed over a 3-month period prior to implementation and 1-month after implementation. Pharmacy and nursing employee satisfaction were measured via voluntary anonymous pre-and post-implementation surveys.
Results: Before implementation of the pilot program, inventory costs of insulin regular, insulin NPH, and insulin detemir averaged to $56.87, $30.92, and $1,699.68 in the designated surgical unit and $140.98, $23.50, and $1,720.44 in the MICU respectively. After implementation, inventory costs for insulin regular, insulin NPH, and insulin detemir were $63.07 (10.9% increase), $22.26 (28.1% decrease), $907.00 (46.6% decrease) for the designated surgical unit and $59.36 (57.9% decrease), $22.26 (28% decrease), and $0 for the MICU respectively. The reduction in MICU insulin detemir inventory costs after implementation was due to the lack of active orders. Average employee satisfaction scores decreased 57.4% (3.1 to 1.32, $P < 0.0001$) for nursing and increased 48.2% (2.51 to 3.72, $P = 0.0007$) for pharmacy after implementation.
Conclusion: The implementation of a community insulin vial pilot program resulted in a decrease in insulin NPH inventory costs in both nursing units. Additionally a decrease in nursing employee satisfaction and an increase in pharmacy employee satisfaction were observed.

Key Words: community vial, cost, insulin, inventory, pilot program

INTRODUCTION

Background Information

Subcutaneous insulin injections are a commonly used treatment for glycemic control of patients in a hospital setting. Typical insulin regimens contain a combination of basal, nutritional, and correction components.[1] Various studies have been conducted regarding the effect of switching from an insulin vial to an insulin pen in a hospital setting. One study incorporated an employee satisfaction survey in order to assess nursing satisfaction after switching from a vial and syringe method to a pen and safety needle method of administering insulin in the hospital setting. This study was able determine that overall nurses considered the pen and safety needle method an improvement over the vial and syringe method. It also identified that perceived workload was a major factor in nursing satisfaction.[2] Additionally, a review of published literature found that the benefits of insulin pens include decreased medication errors, decreased needle stick injuries, improved patient glycemic control, and increased nursing efficiency.[3]

Although there are many benefits to using insulin pens in the hospital setting, risks are associated with their use as well. In 2013, the Institute of Safe Medication Practices (ISMP) published a newsletter suggesting that hospitals consider switching away from insulin pens due to insulin pen misuse such as sharing pens among patients, user technique error, needle stick injuries, and pen design flaws. In addition to this suggestion, a recommendation to provide appropriate staff education, to separate each insulin type through pockets in automated dispensing cabinets (ADCs) and to utilize barcodes for stocking, dispensing, and administering insulin products was advised to ensure safety when switching back to the vial and syringe method.[4]

The annual change in drug expenditures in 2016 was estimated to increase by 12%.[5] Additionally, the average price per milliliter of insulin has increased over 200% in the last eight years.[6] Taking this into consideration as well as the fact that medication costs make up 80-90% of a hospital pharmacy department's total expenses, it is imperative for institutions to reduce inventory waste in order to control inventory costs.[7] One institution utilized Lean Six Sigma principles in order to improve their insulin dispensing process. This included adding insulins and insulin supplies in the ADC to eliminate inventory waste and reduce pharmacy staff rework related to insulin orders. These changes saved the institution approximately $75,000 in the first twelve months after implementation.[8] Another study assessed the economic impact of switching from a 10 mL vial short-acting insulin vial to a 3 mL vial for the preparation of intravenous products as well as switching from a pen for rapid and short acting insulins to a 3 mL vial. Overall, the institution saw a decrease in acquisition costs due to the decreased cost of the 3 mL vials compared to the insulin pens and the 10 mL vials.[9]

Even though various studies have been conducted regarding the insulin dispensing and administration processes, few studies have focused on the economic impact of utilizing automated dispensing cabinet (ADC) technology to automate the insulin dispensing process.

Study Problem and Rationale

Harris Health System is a community-owned healthcare system that serves the underinsured residents of Harris County, the nation's third largest county. It is comprised of two acute care hospitals, Ben Taub Hospital, a Level I Trauma Center with 586 licensed acute-care beds, and Lyndon Baines Johnson Hospital. Harris Health System also contains a community hospital, Quentin Mease Hospital, and numerous outpatient and specialty clinics.

At Ben Taub Hospital, 3 mL vials of insulin regular and insulin NPH are supplied to nursing via the automated dispensing cabinet (ADC). Currently, once the nurse retrieves an insulin regular or insulin

NPH vial from the ADC, the vial is labeled with a 28 day beyond use date (BUD) and the patient's information and stored in a room temperature patient-specific bin within the ADC. Although the expected storage location is the room temperature patient-specific medication bin, medications can also be stored in refrigerated patient-specific medication bins or in a locked drawer on a Workstation on Wheels (WOW). Taking into account the different work shifts, the different nurses caring for a patient, and the different medication storage habits of these nurses, medications could be in either of these locations. The current process provides the opportunity for a nurse to remove multiple vials of insulin for their patient. If a nurse cannot locate the insulin regular or insulin NPH vial, he or she may remove another one from the ADC as long as there is an active order for the patient. Since vials can only be used for the designated patient once opened, the multiple vials that are removed from the ADC and used for a patient must be wasted once a patient is transferred or discharged from the nursing unit.

Insulin detemir is the long-acting insulin of choice on the Formulary at Harris Health System. Unlike the 3 mL vials of insulin regular and insulin NPH which are supplied via the ADC, the 10 mL vials of insulin detemir are sent to the nursing unit from the central pharmacy once an order is verified by a pharmacist. Since medications are not transferred with the patients when they are moved to another unit, nursing must enter a medication message via the Electronic Health Record (EHR) to alert the central pharmacy that an insulin detemir vial is needed which may lead to a delay in administration. This delay in medication administration may clinically impact the patient and result in nursing dissatisfaction. Additionally, the current workflow prompts the central pharmacy to send an insulin detemir vial to the nursing unit for original orders as well as modified orders. This method may require a pharmacy technician to deliver an insulin detemir vial to the nursing unit when one may already be available for the patient leading to pharmacy dissatisfaction as well as inventory waste.

The purpose of this study was to assess the impact of an automated dispensing cabinet-regulated community insulin vial pilot program on inventory costs, employee satisfaction, the number of insulin vials dispensed per patient, and the number of medication messages sent to pharmacy per order.

METHODS

An automated dispensing cabinet-regulated community insulin vial pilot program was implemented on November 1, 2016, in two nursing units of Ben Taub Hospital. This pilot program targeted insulin regular, insulin NPH, and insulin detemir in a designated surgical unit and a medical intensive care unit (MICU).

Pilot Program Development

Prior to the implementation of the community insulin vial pilot program, meetings were held with frontline members including staff nurses, pharmacists, and pharmacy technicians, the management teams of both nursing units involved in the pilot program, as well as the pharmacy department management team. Since the insulin dispensing and administration processes would be impacted by the pilot program, feedback from all stakeholders regarding changes to the processes was solicited.

Figures 1 and 2 outline the processes for the original insulin administration process and the new pilot program process respectively. The community insulin vial pilot program resulted in changes to the insulin administration workflow in the pilot program nursing units. The major changes made to the insulin administration process were: (1) the storage of insulin detemir in the ADC (2) drawing up the insulin dose at the ADC (3) requiring a second independent verification at the ADC (4) labeling the syringe at the ADC.

The new pilot program process no longer allowed nurses to remove an entire vial of insulin regular or insulin NPH from the designated location in the ADC and store it in the patient specific bin after use. Insulin regular and insulin NPH were stored in non-refrigerated medication pockets in the ADC. Additionally, insulin detemir was no longer sent from the central pharmacy; it was also stored in a non-refrigerated medication pocket in the ADC. When an order for insulin regular, insulin NPH, or insulin detemir was selected under the patient's profile in the ADC, the appropriate medication pocket in the ADC opened. The nurse drew up the appropriate amount of insulin units, documented in the ADC, and attached a barcode located in the ADC medication pocket to the syringe along with a patient label. A second nurse verified that the barcode placed on the syringe matched the vial the first nurse used and documented in the ADC. The nurse recapped the syringe using the one-hand scoop technique and used this syringe to administer the insulin at the patient's bedside. Once the nurse was ready to administer the insulin to the patient, the nurse scanned the barcode on the syringe to indicate the proper medication was administered. A second nurse verified the correct patient and the correct dose and documented in the electronic health record (EHR). After administration the syringe was discarded in a sharps disposal container.

The decision to draw up the insulin dose at the ADC was made so pharmacy could properly monitor the inventory count of the insulin products. Allowing nursing to return a vial to the ADC pocket could have potentially altered the inventory count and caused the ADC to not communicate stock outs appropriately. The determined pilot program process allowed for the inventory count to be updated at each removal.

The institution utilizes barcode medication administration (BCMA) to administer medications to patients. Since nurses were no longer removing the insulin vials from the ADC, the decision was made to label the syringes with barcodes supplied by pharmacy in order to be able to scan the products when administered at the patient's bedside. In order to avoid the mix-up of patient medications, nurses labeled the syringes with the patient's label at the ADC.

Additionally, insulin is considered a high-alert medication in the institution's medication administration policy; therefore, a second independent verification is required to verify the correct product, the correct dose, and the correct patient. In order to ensure compliance with the institution's policy, a second independent verification was added at the ADC to verify that the barcode placed on the syringe matched the indicated product. Another second independent verification was still needed at bedside to verify the correct patient and the correct dose.

Pilot Program Implementation

Education

Before the pilot program implementation, nursing and pharmacy staff received education regarding the pilot program workflows via educational live in-services as well as printed Quick Reference Guides (QRGs).

Pharmacy Information Technology (IT)

In order to implement the community insulin vial pilot program in these two nursing units, Pharmacy Information Technology (IT) built a new method for removing the insulin products. Alternate medication identifications (IDs) were developed for the pilot program products. Pharmacy IT attached a build in the ADC to these alternate medication IDs that allowed nurses to enter the amount of insulin units removed from a vial in order to appropriately track the inventory count of the pilot program products. These alternate medication IDs were designed to require a second verification upon removal from the ADC to ensure the appropriate barcode was affixed to the syringe. Additionally, the loading of

the regular insulin products in the ADC was blocked in the pilot program units to prevent the use of the original process while the pilot program was in place.

Pharmacy Department
Since the surgery unit and MICU were the only nursing units participating in the community insulin vial pilot program, pharmacy only stored the pilot program products in these pilot program nursing units. When the pharmacists verified new medication orders, they were responsible for ensuring the correct product was chosen, either the regular insulin product or the pilot program product based on the patient's location and linking the medication to an ADC. When a patient transferred in and out of the pilot program nursing units the insulin orders would not link to the ADCs because the product linked to the order was no longer available. Pharmacy was responsible for running a "Medication Order Search" in the EHR to ensure that the correct products were chosen and that other nursing units were not using the pilot program insulins.

Since alternate medication IDs were used for refilling purposes, pharmacy technicians had to utilize "refill bags" to refill the ADCs with the pilot program products. These "refill bags" had the alternate medication ID barcodes on the bags. Because all pilot program products were stored in non-refrigerated medication pockets, pharmacy was required to label each insulin vial with a 28 beyond use date (BUD). Additionally, since nurses were no longer taking the insulin vial to the patient's bedside, pharmacy had to supply barcodes with the original product NDC so that nursing could attach them to the syringes when drawing up insulin at the ADC. The insulin vials with the 28 day BUD and the barcodes were placed in the "refill bags". Pharmacists were responsible for verifying that the correct refill bag with the alternate barcode was used, the correct BUD was affixed to the vial, and the correct barcodes for nursing were in the refill bag. Pharmacy technicians were responsible for scanning the alternate barcode on the "refill bag" to refill the ADCs. The technicians adjusted the inventory count when refilling the ADCs by converting the number of insulin vials in the refill bag to insulin units using the conversion table on the bag. Lastly, they verified the correct vials and barcodes were being placed into the medication pocket in the ADC.

Endpoints
Inventory Costs
The primary endpoint of this study was the inventory costs associated with insulin regular, insulin NPH, and insulin detemir. The inventory cost was calculated by multiplying insulin utilization before and after implementation by the institution's acquisition cost. The acquisition cost for each product was gathered from the Group Purchasing Organization (GPO) account in the wholesaler online portal. An insulin utilization report for Ben Taub Hospital was provided for August 1, 2016 to November 30, 2016 by Pharmacy IT. This report listed the number of insulin vials dispensed per each nursing unit in Ben Taub Hospital.

$$\text{Inventory Cost} = \text{Number of Insulin Vials Dispensed} \times \text{Acquisition Cost}$$

Employee Satisfaction Surveys
A secondary endpoint of this study was the average employee satisfaction score for the pharmacy insulin dispensing process and the nursing insulin administration process. Anonymous electronic surveys were distributed to the pharmacy and pilot program nursing staff before and after the implementation of the community insulin vial pilot program. The "Nursing Insulin Administration Pre-Implementation Survey" and "Pharmacy Insulin Dispensing Pre-Implementation Survey" were distributed to employees in June 2016. The "Nursing Insulin Administration Post-Implementation Survey" was distributed to nursing employees on November 15, 2016, two weeks after the pilot program implementation, and the

"Pharmacy Insulin Dispensing Post-Implementation Survey" was distributed to pharmacy employees in March 2017 approximately four months after the implementation of the pilot program. The purpose of these surveys was to evaluate employee satisfaction regarding the insulin dispensing process and insulin administration processes by utilizing a 5-point Likert scale to rate responses. These surveys also served as a method to gather feedback regarding the pilot program after the implementation. Table 1 summarizes the point value associated with each response on the 5-point Likert scale. The average employee satisfaction score was determined by adding the point values for each response and diving by the number of responses received for the respective survey item. The pre- and post-implementation average employee satisfaction scores for nursing and pharmacy were analyzed using a 2-tailed, unpaired *t* test, with alpha equal to 0.05 (95% confidence interval).

Insulin Vials Dispensed

Another secondary endpoint of this study was the average number of insulin vials dispensed per patient for each insulin product. The insulin utilization report for Ben Taub Hospital was utilized to determine the number of insulin vials dispensed per patient each month. The average number of vials dispensed per patient was calculated for each pilot program nursing unit for months August to November 2016.

Medication Messages

The final secondary endpoint of this study was the average number of medication messages sent to pharmacy from nursing per insulin order for each pilot program insulin product. A monthly report for medication messages sent through the EHR is provided to pharmacy management each month by Pharmacy IT. This report was used to determine the average number of medication messages sent for each insulin product for months August to November 2016.

RESULTS

Inventory Costs

The total number of vials dispensed and inventory costs associated with each insulin product for each month for the surgical nursing unit and MICU are summarized in Tables 2 and 3 respectively. Figures 3 and 4 provide graphical comparisons of the pre- and post-implementation inventory costs associated with insulin regular and insulin NPH and insulin detemir for both pilot program nursing units. Tables 4 and 5 display the pre- and post-implementation inventory costs and the percent change for the surgical unit and MICU respectively. The inventory cost of insulin regular decreased by 10.9% (average of $56.87 to $63.07) in the surgical unit and decreased by 57.9% (average of $140.98 to $59.36) in the MICU. The inventory cost of insulin NPH decreased by 28.1% (average of $30.92 to $22.26) in the surgical unit and decreased by 28% (average of $23.50 to $22.26) in the MICU. The inventory cost of insulin detemir decreased by 46.6% (average of $1,699.68 to $907.00) in the surgical unit and decreased from an average of $1,720.44 to $0 in the MICU. The severe reduction in the MICU insulin detemir inventory costs was due to the lack of active orders for insulin detemir during November 2016.

Employee Satisfaction Surveys

The average response scores for the "Nursing Insulin Administration Pre-Implementation Survey" are displayed in Table 6. Forty-one nurses completed the survey, seventeen from the surgical unit and twenty five from the MICU. The average pre-implementation response score to the item "I am satisfied with the current insulin storage and administration process" was a 3.1 [Neutral]. Additional comments from the open-ended question regarding the current insulin administration process included statements about delays with insulin detemir delivery, medications that are not transported when the patient changes nursing units, and a request to stock insulin detemir in the ADC. The post-implementation survey was completed by fifty one nurses, twenty-seven were from the surgical unit and twenty-four were from the MICU. The average response scores for the "Nursing Insulin Administration Post-

Implementation Survey" are displayed in Table 7. The average post-implementation response score to the item "I am satisfied with the new pilot program storage and administration process for insulin" was a 1.32 [Strongly Disagree]. This average response score represented a 57.4% ($P < 0.0001$) decrease in nursing employee satisfaction with regards to the insulin storage and administration process. Comments from the open-ended question regarding the pilot program insulin administration process included the pilot program being time consuming, nurses felt unsafe recapping needles, and ADCs not being available due to having to draw up insulin doses at the ADC.

Twenty-six pharmacy employees completed survey pre-implementation pharmacy survey, nineteen were pharmacists and eight were pharmacy technicians. Comments from the open-ended question regarding the current insulin dispensing process included requests to store all insulin products in the ADC and comments regarding having to send multiple vials for the same medication, labels printing out for order modifications, receiving requests for insulin due to a misplaced medication, and medications that are not transported when the patient changes nursing units. Twenty-three employees completed the post-implementation pharmacy survey, eleven were pharmacists and twelve were pharmacy technicians. Comments to the open-ended question regarding the pilot program insulin dispensing and storage process included employees liking the storage of insulin detemir in the ADC. The results from the "Pharmacy Insulin Dispensing Pre- and Post-Implementation Surveys" are summarized in Table 8. The average response rate for the item "I frequently receive calls/medication messages from nursing regarding a missing dose of insulin regular/insulin NPH" increased by 4.6% (3.04 to 3.18 [Neutral], $P = 0.67$). The average response rate for the item "I frequently receive calls/medication messages from nursing regarding a missing dose of insulin detemir" decreased by 4.1% (3.67 to 3.52 [Agree], $P = 0.66$). The average response rate for the item "I redispense/deliver insulin detemir each time an existing order is modified" increased by 24.8% (2.58 to 3.22 [Neutral], $P = 0.09$). The average response rate for the item "I regularly find multiple vials of the same insulin left in the patient's bin" decreased by 16.7% (4.5 to 3.5 [Strongly Agree to Agree], $P = 0.02$). The average response rate for the item "I am satisfied with the current insulin dispensing/storage process" increased by 48.2% (2.51 to 3.72 [Neutral to Agree], $P = 0.0007$).

Insulin Vials Dispensed

Table 9 summarizes the average number of insulin vials dispensed per patient for each insulin product per month for the surgical nursing unit and MICU. Figure 5 displays a graphical comparison of the average number of insulin vials dispensed per patient for insulin regular, insulin NPH, and insulin detemir pre- and post-implementation. Tables 8 and 9 display the pre- and post-implementation comparison for the number of insulin vials dispensed as well as the percent change for the surgical unit and MICU respectively. The average number of insulin regular vials dispensed per patient increased by 78.1% (average of 0.32 to 0.57) in the surgical unit and decreased by 1.1% (average of 0.90 to 0.89) in the MICU. The average number of insulin NPH vials dispensed per patient increased by 45.6% (average of 1.03 to 1.4) in the surgical unit and by 94.2% (average of 0.86 to 1.67) in the MICU. The average number of insulin detemir vials dispensed per patient decreased by 35.1% (average of 1.71 to 1.11) in the surgical unit. The percent change for insulin detemir could not be calculated for the MICU due to the lack of active orders for insulin detemir during November 2016.

Medication Messages

The average number of medication messages sent to pharmacy by nursing per insulin order per month are summarized in Table 9. Figure 6 displays a graphical comparison of the number of medication messages sent to pharmacy by nursing per insulin order pre- and post-implementation. Tables 10 and

11 compare the average number of medication messages sent to pharmacy per order pre- and post-implementation including the percent change. The average number of medication messages sent to pharmacy for insulin regular per each order decreased by 77.5% (average of 0.8 to 0.18) in the surgical unit and increased by 400% (average of 0.02 to 0.1) in the MICU. The average number of medication messages sent to pharmacy per each insulin NPH order increased by 1350% (average of 0.02 to 0.29) in the surgical unit and increased by 361.5% (average of 0.13 to 0.6) in the MICU. The average number of medication messages sent to pharmacy per each insulin detemir order increased by 224.4% (average of 0.41 to 1.33) in the surgical unit and increased by 75.4% (average of 0.57 to 1) in the MICU.

DISCUSSION

Due to the estimated 12% increase in drug expenditures each year, institutions must make an effort to lower inventory waste. Considering the large amount of diabetic patients that are managed with subcutaneous insulin regimens at Ben Taub Hospital, targeting insulin waste is an opportunity to reduce inventory waste. The implementation of an automated dispensing cabinet-regulated community insulin vial pilot program in a designated surgical unit and MICU at Ben Taub Hospital aimed to reduce inventory waste and therefore decrease inventory costs.

Inventory Costs

The primary purpose of this study was to assess the impact of the community insulin vial pilot program on inventory costs. There was no distinct pattern identified with the inventory costs associated with insulin regular. This was more than likely due to the variable number of patients prescribed insulin during these months. Both pilot program units saw a decrease in the average inventory cost associated with insulin NPH. This could be due to the implementation of the pilot program, but may be due to the decreased number of insulin NPH orders in November 2016. A decrease in the inventory cost associated with insulin detemir was seen in November in the surgical unit; however, this was probably due to the GPO price decrease and unlikely to a decrease in the utilization of the medication as a result of the pilot program. A pattern for insulin detemir could not be observed in the MICU due to the lack of active insulin detemir orders in November 2016.

Employee Satisfaction

A secondary endpoint of the study was the average pharmacy and nursing satisfaction scores related to the insulin dispensing and administration processes. The pilot program resulted in a 48.2% increase in pharmacy employee satisfaction with regards to the insulin dispensing process which was statistically significant. This increased satisfaction could be due to the convenience of storing insulin detemir in the ADC which may have reduced workload in the central pharmacy for the pilot program nursing units. Overall, pharmacy employees seemed to be content with the pilot program. Conversely, the 57.4% decrease in nursing employee satisfaction with regards to the insulin administration process, also statistically significant, indicated that the nursing employees were very dissatisfied with the implementation of the community insulin vial pilot program. Although they were dissatisfied with the pilot program, most nurses preferred to have insulin detemir available in the ADC instead of being supplied by the central pharmacy. Even though the pilot program resulted in a decrease in the inventory costs associated with insulin NPH, the strong feedback received from nursing will affect the future of the pilot program. Some of the comments received such as the pilot program being time-consuming and the unavailability of the ADCs when patient doses are due could potentially lead to an increase in personnel costs and medication delays. Since nursing was neutral to the insulin administration process prior to the implementation of the pilot program, consideration should be made to change the pilot program process to closely match the original process.

Insulin Vials Dispensed

Another secondary endpoint of the study was the average number of insulin vials dispensed per patient. No distinguishable pattern was observed with insulin regular since the surgical unit increased the number of insulin regular vials dispensed per patient by 78.1% and the MICU decreased by 1.1%. Although the inventory cost associated with insulin NPH decreased in both pilot program units, the number of insulin vials dispensed per patient increased in both units (45.6% in the surgical unit and 94.2% in the MICU). This was likely due to the decreased number of patients prescribed insulin NPH in November 2016 which may have skewed the results. Additionally, the average number of insulin vials dispensed per patient for insulin detemir decreased in the surgical unit after the implementation of the pilot program. Although a decrease in the number of insulin detemir vials dispensed was observed in the surgical unit, a definitive pattern as a result of the pilot program could not be identified due to the lack of active insulin detemir orders prescribed in the MICU during November 2016.

Medication Messages

The final secondary endpoint of the study was the number of medication messages sent to pharmacy by nursing per insulin order. Overall there was an increase in the number of medication messages sent to pharmacy per order for insulin NPH and insulin detemir in both the surgery unit and MICU after implementation of the pilot program. Also, an increase in the number of medication messages associated with insulin regular in the MICU was observed. The increase in medication messages sent to pharmacy could have been attributed to the implementation of the pilot program since the process was new and unfamiliar. The electronic medication messages were utilized to request syringe barcodes for pilot program products in the ADC. Additionally, the overall decrease in the number of insulin orders in both pilot program units during November 2016 could have skewed the post-implementation data.

Limitations

There was a small number of patients on insulin products in the surgical unit and the MICU during November 2016 immediately following the implementation of the pilot program. Because of this, the small post-implementation population could have cause identified trends to be falsely elevated. Additionally, due to the dissatisfaction of the nursing employees, the pilot program ended after one month resulting in limited post-implementation data. The nursing post-implementation survey was administered two weeks after the implementation which could have influenced the responses to the survey. Also, the pharmacy post-implementation survey was administered four months after the pilot program implementation which could have influenced the pharmacy employee responses.

CONCLUSION

The implementation of a community insulin vial pilot program in a surgical unit and MICU led to a decrease in the inventory cost associated with insulin NPH, an increase the number of insulin NPH vials dispensed per patient, an increase in the number of medication messages sent to pharmacy per insulin order, a decrease in nursing employee satisfaction with the insulin administration process, and an increase in pharmacy employee satisfaction with regards to the insulin dispensing process. Additional research is warranted to examine the impact of an alternate community insulin vial pilot program that takes into account the feedback provided by the “Nursing Insulin Administration Post-Implementation Survey”.

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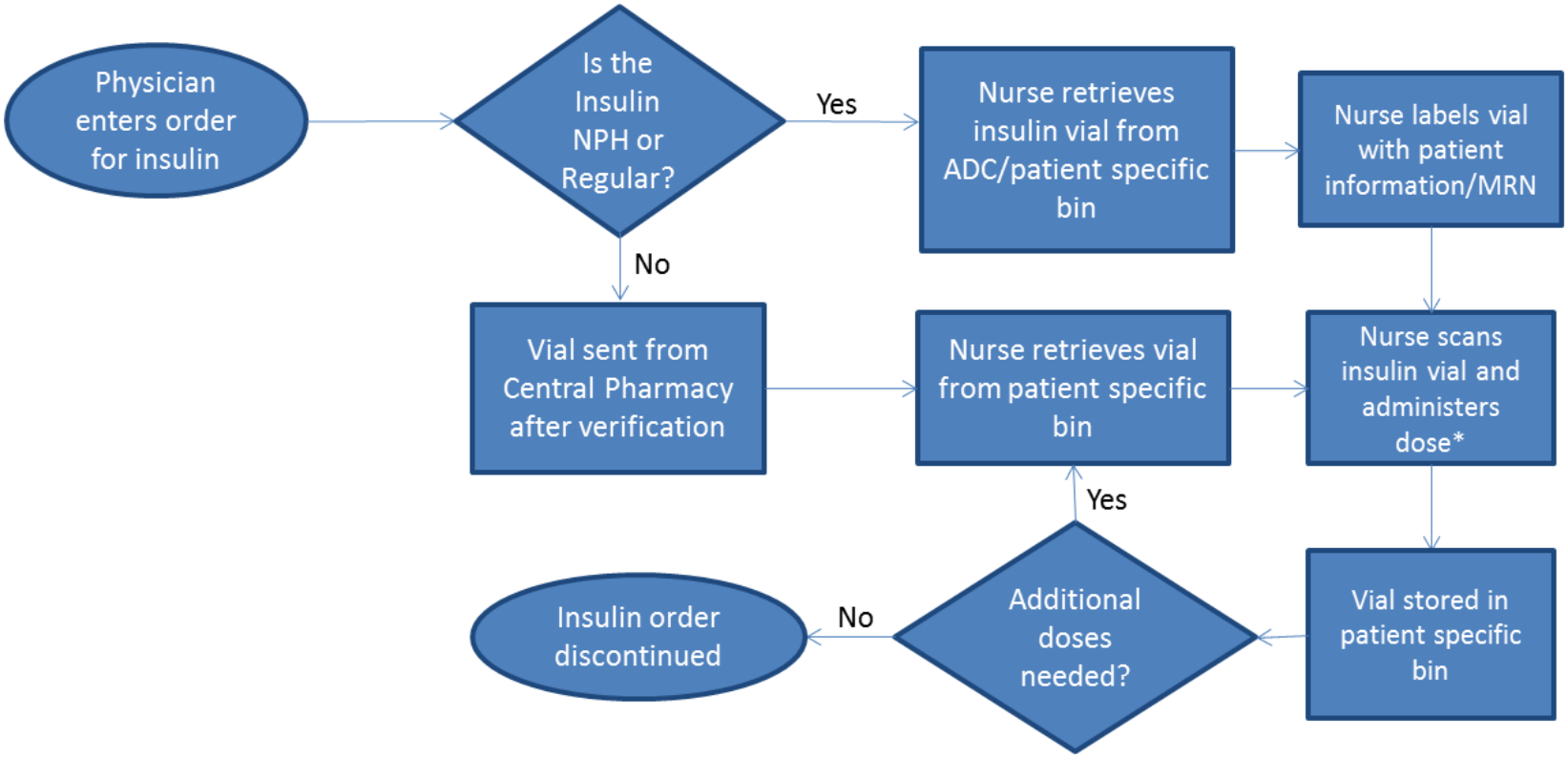
Figure 1. Original Insulin Administration Process



*Second Independent Verification Required

Figure 2. Pilot Program Insulin Administration Process

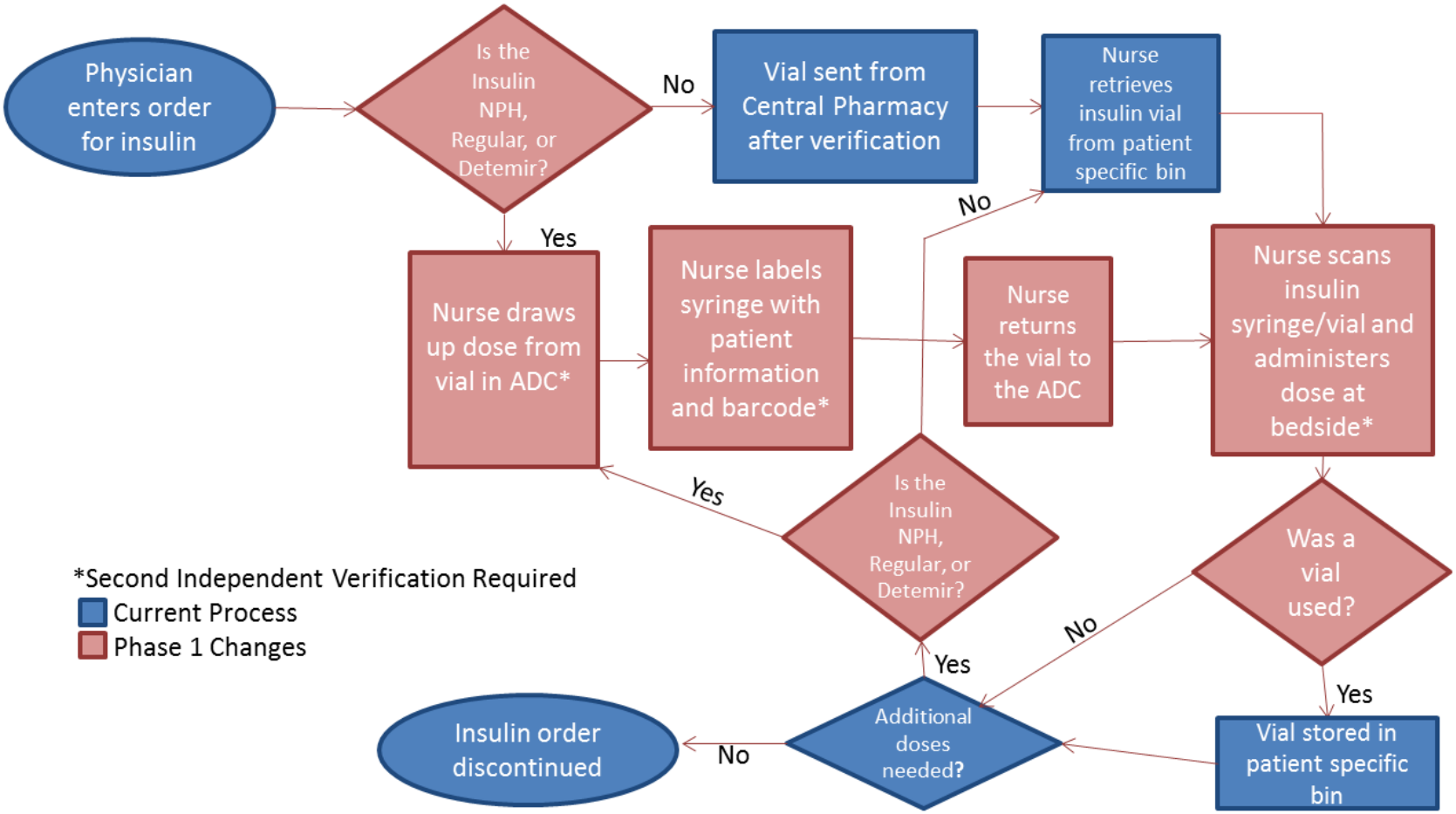


Figure 3. Inventory Cost Comparison Insulin Regular and Insulin NPH Pre- and Post- Implementation

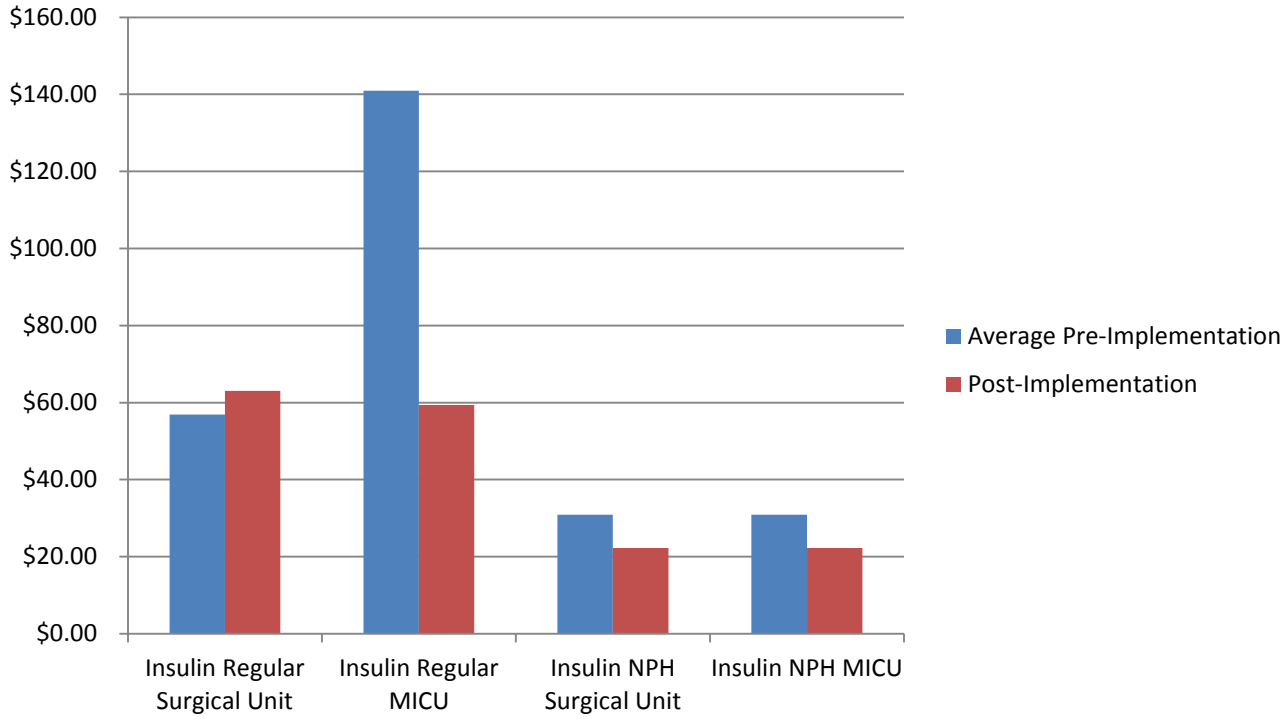


Figure 4. Inventory Cost Comparison Insulin Detemir Pre- and Post-Implementation

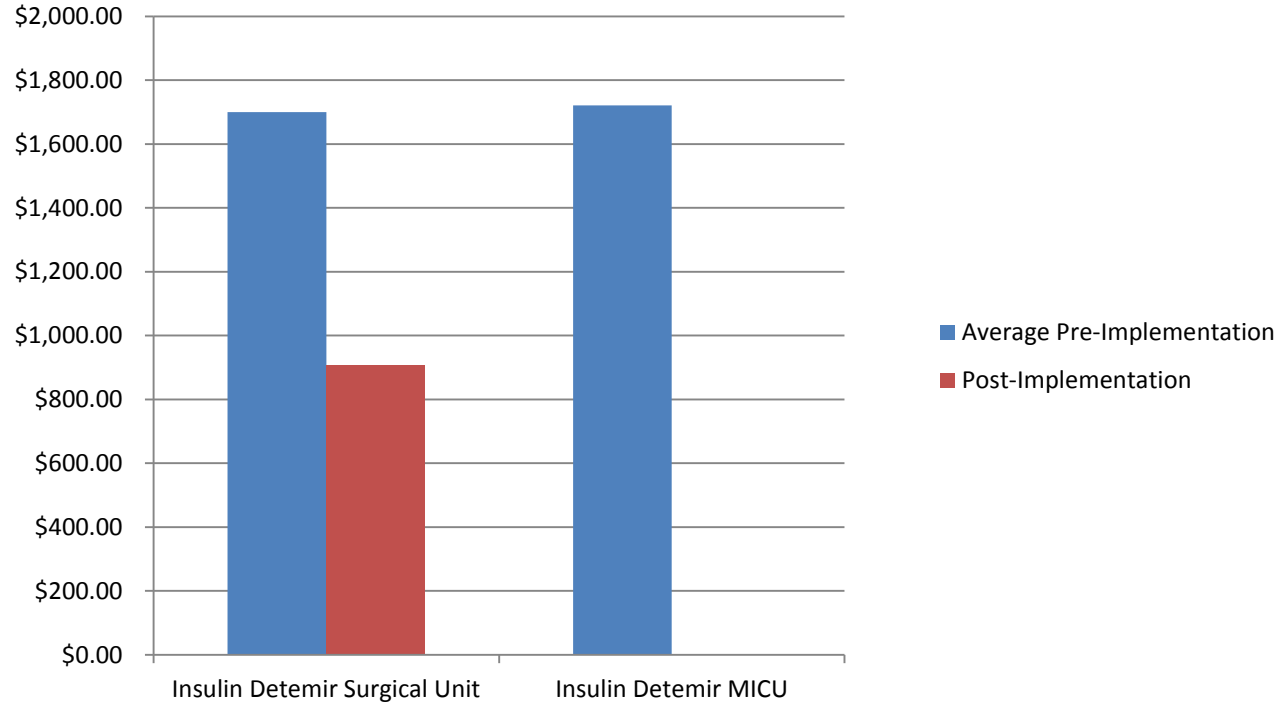


Figure 5. Insulin Vials Dispensed Per Patient Pre- and Post-Implementation Comparison

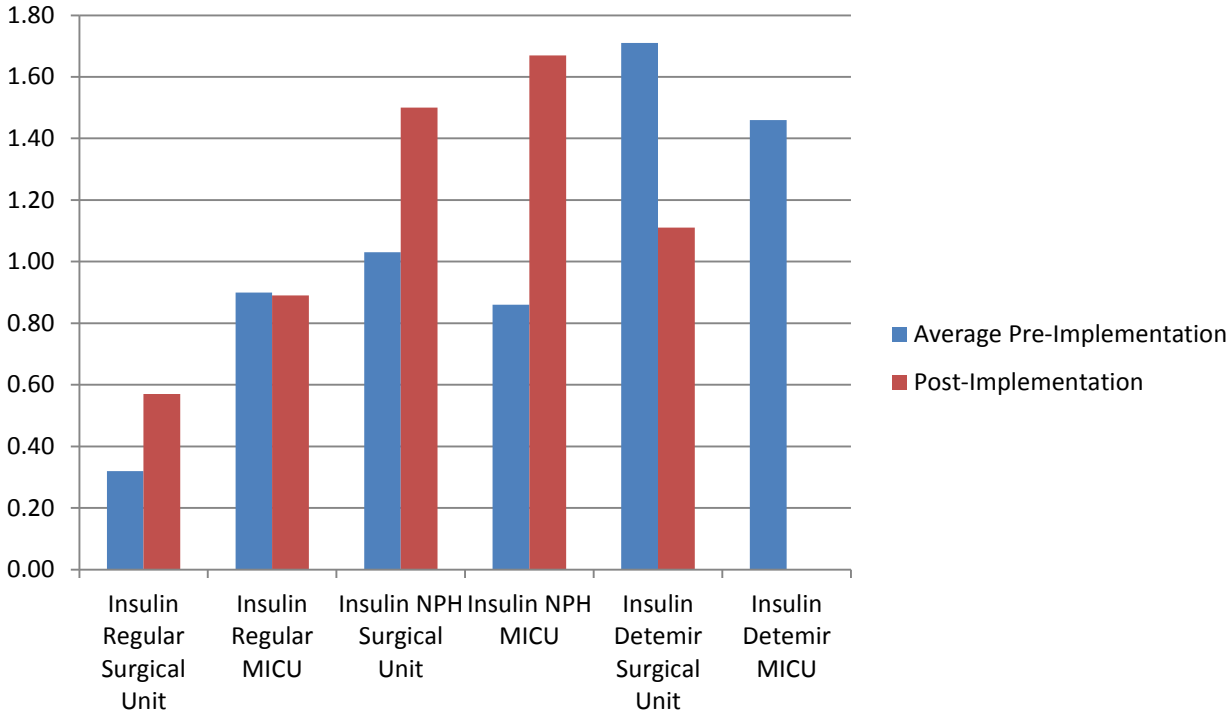


Figure 6. Medication Messages Sent to Pharmacy Per Order Pre- and Post-Implementation Comparison

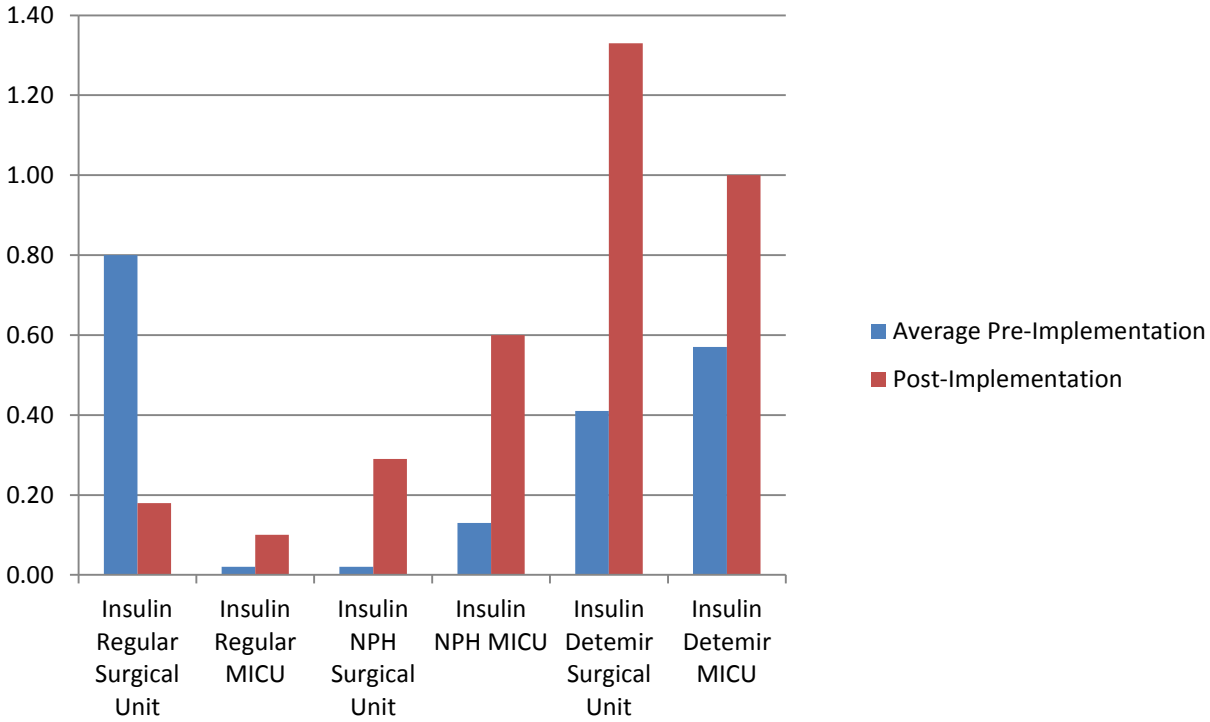


Table 1. Point Value for 5-Point Likert Scale

Response	Point Value
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

Table 2. Surgical Unit Inventory Costs Per Month

	August		September		October		November	
	Vials Dsp.	Inv. Cost	Vials Dsp.	Inv. Cost	Vials Dsp.	Inv. Cost	Vials Dsp	Inv. Cost
Insulin Regular	16	$59.36	17	$63.07	13	$48.23	17	$63.07
Insulin NPH	9	$33.39	14	$51.94	2	$7.42	6	$22.26
Insulin Detemir	10	$955.80	31	$2,962.98	12	$1,146.96	10	$907.00

Table 3. MICU Inventory Costs Per Month

	August		September		October		November	
	Vials Dsp.	Inv. Cost	Vials Dsp.	Inv. Cost	Vials Dsp.	Inv. Cost	Vials Dsp	Inv. Cost
Insulin Regular	32	$118.72	36	$133.56	46	$170.66	16	$59.36
Insulin NPH	12	$44.52	5	$18.55	2	$7.42	5	$18.55
Insulin Detemir	10	$955.80	16	$1,529.28	28	$2,676.24	0	$0

Table 4. Inventory Cost Comparison Pre- and Post- Implementation for Designated Surgical Unit

	Pre-Implementation Average	Post-Implementation	Percent Difference
Insulin Regular	$56.87	$63.07	+10.9%
Insulin NPH	$30.92	$22.26	-28.1%
Insulin Detemir	$1,699.68	$907.00	-46.6%

Table 5. Inventory Cost Comparison Pre- and Post- Implementation for MICU

	Pre-Implementation Average	Post-Implementation	Percent Difference
Insulin Regular	$140.98	$59.36	-57.9%
Insulin NPH	$23.50	$22.26	-28%
Insulin Detemir	$1,720.44	$0	N/A

Table 6. Nursing Insulin Administration Pre-Implementation Survey Results

Statement	Average Response Score
Insulin regular/insulin NPH is always available when I need to administer a dose.	4
Insulin detemir is always available when I need to administer a dose.	2.4
I frequently have to call/send a medication message the central pharmacy for a missing dose of insulin detemir.	3.9
I know where to find the patient's insulin vial when I need to administer a dose.	4.3
I regularly find multiple vials of the same insulin left in the patient's bin.	2.9
I am satisfied with the current insulin storage/administration process.	3.1

Table 7. Nursing Insulin Administration Post-Implementation Survey Results

Statement	Average Response Score
The new pilot program process for insulin regular/insulin NPH administration meets my expectations.	1.24
I think insulin regular should remain part of the pilot program.	1.12
I think insulin NPH should remain part of the pilot program.	1.47
The new pilot program process for insulin detemir administration meets my expectations.	1.57
I think insulin detemir should remain part of the pilot program.	1.63
I prefer to have insulin detemir available in the ADC instead of Pharmacy supplying it.	3.75
I am satisfied with the new pilot program storage/administration process for insulin.	1.32

Table 8. Pharmacy Insulin Dispensing Pre- and Post-Implementation Survey Results

Statement	Average Pre-Implementation Response Score	Average Post-Implementation Response Score	Percent Change	P-value
The pilot program process for insulin regular/insulin NPH dispensing/storage met my expectations.	-	3.81	-	-
I think insulin regular/insulin NPH should remain part of the pilot program.	-	3.95	-	-
The new pilot program process for insulin detemir dispensing/storage met my expectations.	-	3.72	-	-
I think insulin detemir should remain part of the pilot program.	-	3.91	-	-
I prefer to have insulin detemir stored in the ADC instead of Pharmacy supplying it.	-	3.73	-	-
I frequently receive calls/medication messages from Nursing regarding a missing dose of insulin regular/insulin NPH.	3.04	3.18	+4.6%	0.69
I frequently receive calls/medication messages from Nursing regarding a missing dose of insulin detemir.	3.67	3.52	-4.1%	0.66
I redispense/deliver insulin detemir each time an existing order is modified.	2.58	3.22	+24.8%	0.09
I regularly find multiple vials of the same insulin left in the patient's bin.	4.2	3.5	-16.7%	0.02
I am satisfied with the current insulin dispensing/storage process.	2.51	3.72	+48.2%	0.0007

Table 9. Average Insulin Vials Dispensed Per Patient Per Month

	August		September		October		November	
	Surgery	**MICU**	**Surgery**	**MICU**	**Surgery**	**MICU**	**Surgery**	**MICU**
Insulin Regular	0.32	0.89	0.35	0.92	0.28	0.88	0.57	0.89
Insulin NPH	1.29	1.09	1.56	0.83	0.25	0.67	1.5	1.67
Insulin Detemir	1.43	0.91	2.38	1.6	1.33	1.87	1.11	0

Table 10. Insulin Vials Dispensed Per Patient Pre- and Post-Implementation Comparison for Designated Surgical Unit

	Pre-Implementation Average	Post-Implementation	Percent Difference
Insulin Regular	0.32	0.57	+78.1%
Insulin NPH	1.03	1.5	+45.6%
Insulin Detemir	1.71	1.11	-35.1%

Table 11. Insulin Vials Dispensed Per Patient Pre- and Post-Implementation Comparison for MICU

	Pre-Implementation Average	Post-Implementation	Percent Difference
Insulin Regular	0.90	0.89	-1.1%
Insulin NPH	0.86	1.67	+94.2%
Insulin Detemir	1.46	0	N/A

Table 10. Average Number of Medication Messages Sent to Pharmacy Per Order Per Month

	August		September		October		November	
	Surgery	**MICU**	**Surgery**	**MICU**	**Surgery**	**MICU**	**Surgery**	**MICU**
Insulin Regular	0.14	0	0.05	0.03	0.04	0.04	0.18	0.1
Insulin NPH	0.06	0	0	0	0	0.4	0.29	0.6
Insulin Detemir	0.82	0.42	0.18	0.56	0.23	0.72	1.33	1

Table 11. Average Number of Medication Messages Sent to Pharmacy Per Order Per Month Pre- and Post-Implementation Comparison for Designated Surgical Unit

	Pre-Implementation Average	Post-Implementation	Percent Difference
Insulin Regular	0.8	0.18	-77.5%
Insulin NPH	0.02	0.29	+1350%
Insulin Detemir	0.41	1.33	+224.4%

Table 12. Average Number of Medication Messages Sent to Pharmacy Per Order Per Month Pre- and Post-Implementation Comparison for MICU

	Pre-Implementation Average	Post-Implementation	Percent Difference
Insulin Regular	0.02	0.1	+400%
Insulin NPH	0.13	0.6	+361.5%
Insulin Detemir	0.57	1	+75.4%