

Leveraging Partnerships to Reduce Insulin Needlestick Injuries

Nurse-Led System-Wide Quality Improvement Project

Beth Ann Friel, MSN, RN; Ray Sieradzan, PharmD; Chris Jones, MHA, RN; Rachael A. Katz, MS; Cole M. Smith, MBA, CPSM; Alyssa Trenergy, PharmD, MPH; Julie Gee, PhD, RN

ABSTRACT

Background: Percutaneous injuries from needlesticks are a major occupational hazard for nurses.

Local Problem: Reducing subcutaneous insulin-related needlestick injuries was part of a nurse-led comprehensive sharps injury-reduction program at an integrated, not-for-profit health system.

Methods: The incident rate of needlestick injuries was compared between 1 year before and 1 year after introducing this quality improvement project.

Interventions: A system-wide educational program instituting changes in subcutaneous insulin administration practices was combined with supply chain standardization using a single type of safety-engineered insulin syringe.

Results: The average monthly incidence of needlestick injuries per 10 000 subcutaneous insulin injections fell significantly from year to year (incidence rate ratio, 0.49; 95% CI, 0.30-0.80; Poisson regression $P = .004$). One-year cost savings for supplies totaled \$3500; additional annual median savings were \$24 875 (2019 US dollars) in estimated costs of needlestick injuries averted.

Conclusions: The effectiveness of this multifaceted project provides a practical template to reduce subcutaneous insulin-related needlestick injuries.

Keywords: diabetes mellitus, insulin syringe, needlestick injury, safety-engineered device, subcutaneous administration

Author Affiliations: Intermountain Healthcare, Salt Lake City, Utah (Ms Friel and Katz, Messrs Jones and Smith, and Dr Gee); and Becton, Dickinson and Company (BD), Franklin Lakes, New Jersey (Drs Sieradzan and Trenergy). Dr Gee is now with the University of Utah College of Nursing, Salt Lake City.

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Percutaneous injuries from sharps, including needlestick injuries, continue to be a major occupational hazard for nurses and other health care professionals worldwide.¹ In the United States, passage of the Needlestick Safety and Prevention Act in 2000² contributed to a decline in these injuries.³ Nonetheless, recent evidence indicates that sharps injuries remain an ongoing serious problem at US hospitals and other health care facilities.⁴⁻⁶ The most common type of needlestick injury results from use of disposable syringes, and, of those, approximately 20% are attributable to insulin syringes according to a large annual US survey.^{5,7} This survey found that, from 2012 to 2016, nurses experienced almost 95% of reported needlestick injuries that were associated with insulin syringes.⁷ Furthermore, the high prevalence of type 2 diabetes,⁸ which

Correspondence: Beth Ann Friel, MSN, RN, Intermountain Healthcare, 36 S State St, Salt Lake City, UT 84111 (BethAnn.Friel@imail.org).

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frequently requires nurse-administered subcutaneous insulin delivery, often places nurses at risk for needlestick injuries.⁹

Needlestick injuries result in numerous human costs, including exposure to blood-borne pathogens, subsequent fear of needle use, anxiety, workplace disruption, and scheduling challenges,^{4,10,11} highlighting the continued need for improvement in safety processes and plans associated with needlesticks. In addition, both direct and indirect monetary costs of these injuries are concerning. Worldwide, lost productivity accounts for most of the indirect costs, and the overall aggregate indirect and direct costs to the health care system of a needlestick injury ranged from \$650 to \$750 (2015 US dollars) according to a recent systematic review.¹²

Minimizing the risk of needlestick injuries associated with subcutaneous insulin delivery via syringe is important to protect nurses and other health care providers from harm. Recent evidence supports using a safety-engineered device and the shortest needle (ie, for insulin syringes, a 6-mm or shorter needle), which allows nurses to skip the traditional skin pinch up or skinfold method for most adult patients,¹³⁻¹⁵ thus minimizing the risk of a needlestick injury for the nurse administering the injection.¹³ Moreover, the US Centers for Disease Control and Prevention (CDC) emphasizes the use of broad-based, multicomponent approaches to reducing needlestick and other sharps injuries.^{10,15} Recommended components include education on optimal injection techniques, use of safety-engineered sharps devices, appropriate sharps disposal, and adequate staff-to-patient ratios. The CDC guidance emphasizes the importance of “safety culture” while acknowledging the need for institution-specific programs.¹⁵

At our institution, a system-wide, nurse-led quality improvement (QI) project was developed to improve practice standardization, reduce product and process variation, and advance clinician proficiency and compliance with the aim of reducing all types of sharps injuries. Internal and external strategic partnerships focused on reducing the risk of needlestick injuries, increasing operational efficiencies, and introducing supply chain standardization while improving health care worker safety. The aim of this article is to describe an aspect of the broader QI project, specifically the standardization of subcutaneous insulin administration practice and product, the

strategic internal and external partnerships, and the associated educational rollout to reduce subcutaneous insulin-related needlestick injuries.

METHODS

Setting

Intermountain Healthcare is an integrated, not-for-profit health system headquartered in Salt Lake City, Utah, with numerous primary care clinics and home health agencies and 24 hospitals (1 virtual), staffed by more than 10 000 nurses across the Intermountain West, primarily in Utah, Idaho, and Nevada.¹⁶

The Intermountain Healthcare Internal Review Board approved the plan for this QI project. Patient consent was not required, as the study utilized standard, cleared medical devices, and no personal identifiers for patients or caregivers were collected.

Overview of the insulin needle QI project

In June 2018, Intermountain Healthcare’s nursing team, led by the first author, and BD, a global medical technology company, initiated a sharps safety assessment program with the goal of creating a comprehensive educational plan to reduce injuries from sharps across all Intermountain Healthcare facilities. BD supported Intermountain Healthcare’s goals by performing an external evaluation of injury trends and providing a clinical safety assessment team to (1) observe variations in internal practices, processes, and products; (2) compare findings with available national evidence-based practice guidelines; and (3) provide logistical support for recommendations that we chose to implement. A review of sharps injury data by Intermountain Healthcare’s nursing and BD teams recognized a trend of increased subcutaneous insulin needlestick injuries. Direct observation of practice and products by the BD team in 4 hospitals and 3 clinics identified opportunities to improve injection administration and disposal practices.

Results of the safety assessment guided the next steps taken by Intermountain Healthcare’s nursing team in engaging our internal supply chain partners and product standardization committee to review and standardize insulin syringes and needles. After further independent review of national trends and literature by nursing leaders, we elected to standardize to a safety-engineered insulin syringe with a 6-mm needle. In addition, we collaborated with BD

on practice change education and Intermountain Healthcare created a strategy to monitor compliance with insulin injection and needle disposal practices.

Device selection and standardization

Before the start of this QI project, Intermountain Healthcare stocked and utilized 36 different insulin needles and syringes from multiple manufacturers to administer approximately 330 000 subcutaneous insulin injections across the system each year. Most of the needles were 5/16 inch (8 mm) in length. The project's goal was to standardize to a single manufacturer and a safety-engineered insulin syringe with the shortest available needle. At the time of standardization, BD was the only manufacturer of a safety-engineered insulin syringe with 6-mm needle and, furthermore, was able to provide continuity of supply assurances. The selected safety-engineered insulin syringe comes pre-assembled with an integrated 6-mm × 31-gauge (G) needle and a sliding needle cover, designed for 1-handed use to help protect health care professionals and other caregivers from accidental needlestick injuries (BD SafetyGlide Insulin Syringes with the BD Ultra-Fine needle 6 mm × 31G; BD, Franklin Lakes, New Jersey; see Supplemental Digital Content, Figure, available at: <http://links.lww.com/JNCQ/A895>).

From December 14 through December 17, 2018, a small pilot project ($n = 12$ nurses) was conducted on a Medical Endocrine Nursing unit at a quaternary Intermountain Healthcare hospital to introduce 3 sizes (0.3, 0.5, and 1.0 mL) of the selected 6-mm safety insulin syringes. Before pilot project implementation, nurses were informed by their manager about the selected safety insulin syringes and the recommended 1-handed injection technique without skin pinch up for avoiding injection-related injuries. A paper feedback sheet was created and available for those who used the new devices to provide comments regarding their experience. Nurses were encouraged to share concerns and provide their input on the safety mechanism, potential safety benefits and/or risks, and any other aspect related to the new insulin syringes. Comments were overall positive and indicated acceptance of the new devices. This nursing unit was selected because of the high number of subcutaneous insulin injections administered per shift. The pilot project also ensured adherence to Occupational

Safety and Health Administration regulations for receiving input from frontline nurses that the proposed new insulin syringes constituted an acceptable alternative to prior products.

After successful completion of the pilot project, insulin syringe options were reduced to the 3 sizes of the selected 6-mm safety insulin syringe. The phaseout of the 36 different insulin syringes and needles began 1 week after site-specific educational training sessions were conducted and continued on a rolling basis across all Intermountain Healthcare sites from May 27 through June 17, 2019.

Safe practice education and new device implementation

Together with product standardization, an educational plan was developed to address the injection technique change and highlight safe disposal practices needing improvement as identified in the safety assessment, such as 1-handed safety activation and immediate disposal. The Intermountain Healthcare nursing and BD teams collaborated on introducing educational materials describing safe injection and disposal practices and specific details regarding the new device and injection technique. Intermountain Healthcare's education team and supply chain coordinated with the BD team to schedule in-service and train-the-trainer sessions to demonstrate the new device, provide training aids for practice, answer device-related questions, and escalate any concerns to Intermountain Healthcare's nurse leads. These sessions were typically scheduled to occur 1 week before the "Go Live" schedule when supply chain replaced old products with the new standard insulin syringes. Sessions were held to accommodate varying shifts and were held in open time blocks so that nurses could attend when convenient.

Call to action: Monitoring and compliance

In June 2019 after the implementation was complete across all sites, the Chief Nursing Executive and the Chief People Officer jointly delivered a "Call to Action" for the entire QI project, asking leaders to monitor trends, evaluate sharps container placement, remediate sharps container risk factors, conduct "Safety SWARMS" (mini-root cause analysis for employee injuries), and perform and observe 5 to 10 subcutaneous insulin injections per hospital unit per month for 4 months. The product standardization

committee also solicited feedback from various sites and discussed feedback in their meetings.

Charge nurses across the system documented more than 1000 observations of subcutaneous insulin injections over 4 months. The charge nurses entered the collected information each month into a secure web application designed for managing electronic databases to support research studies (REDCap, version 10.1.2, Vanderbilt University¹⁷). Nursing leaders accessed the electronic dashboard to monitor their unit's progress in adopting safe injection practices, including the change in insulin administration procedures. After the 4-month period, additional feedback was provided to each site nurse administrator through direct verbal and written communications. Formal plans to continue or sustain practice adoption were documented for each site. The Chief Nursing Executive and the Chief People Officer provided system-wide recognition for overall sharps injury reduction, and consultation and resources were provided to sites to continue progress.

Measures

We collected data from the Intermountain Healthcare pharmacy on the total number of subcutaneous insulin injections administered each month from June 2018 through May 2020 across all Intermountain Healthcare sites. In addition, we compiled data on all reported needlestick injuries experienced by nurses and other health care professionals related to subcutaneous insulin administration during this time period. The insulin needlestick injury reports were collected and managed through the existing Employee Health process.

Analyses

The numbers of insulin-related needlestick injuries and all subcutaneous insulin injections were analyzed by month to determine the incident rate of injuries per 10 000 subcutaneous insulin injections. Outcomes were grouped into 1 year prestandardization (baseline period, June 2018–May 2019) and 1 year poststandardization (study period, June 2019–May 2020) and compared using the incidence rate ratio with testing for statistical significance using Poisson regression with robust standard error.

Estimated mean and median direct and indirect costs attributable to each needlestick injury

were drawn from the combined data- and model-driven approaches in the studies included in the 2016 systematic review of Mannocci et al¹² and converted to 2019 US dollars using the medical care component of the Consumer Price Index.¹⁸ This review defined direct costs as including the costs of testing both the source and the exposed health care provider in addition to the costs of treatment and medical visits after needlestick injuries. Indirect costs were defined as the costs of lost productivity (absenteeism and presenteeism), overhead, compensation, and litigation.¹² Statistical analysis was conducted using SAS software package version 9.4 (SAS Institute, Cary, North Carolina).

RESULTS

Subcutaneous insulin-related needlestick injuries

A total of 320 544 subcutaneous insulin injections were administered during the baseline year (prestandardization, June 2018–May 2019) and 308 946 during the study year (poststandardization, June 2019–May 2020). The total numbers of reported subcutaneous insulin-related needlestick injuries were 57 versus 27 during baseline and study years, respectively.

The mean monthly numbers of subcutaneous insulin injections were 26 712 during baseline and 25 746 during the study year, with average monthly rates of insulin-related needlestick injuries of 1.78 versus 0.88 per 10 000 injections, respectively. The rates by month are depicted in Figure 1. The average monthly incidence of needlestick injuries per 10 000 subcutaneous insulin injections was significantly lower during the study year, approximately half of that during the baseline year (incidence rate ratio, 0.49; 95% CI, 0.30–0.80; $P = .004$).

Costs

Validated 12-month cost savings for supplies totaled \$3500, accounting for multiple factors including supply chain optimization, inventory control, and manufacturer pricing. Moreover, the project resulted in a substantial decrease (53%) in both median and mean estimated costs (savings of \$24 875 and \$28 671, respectively) attributable to insulin needlestick injuries during the study year as compared with the baseline year (Figure 2).

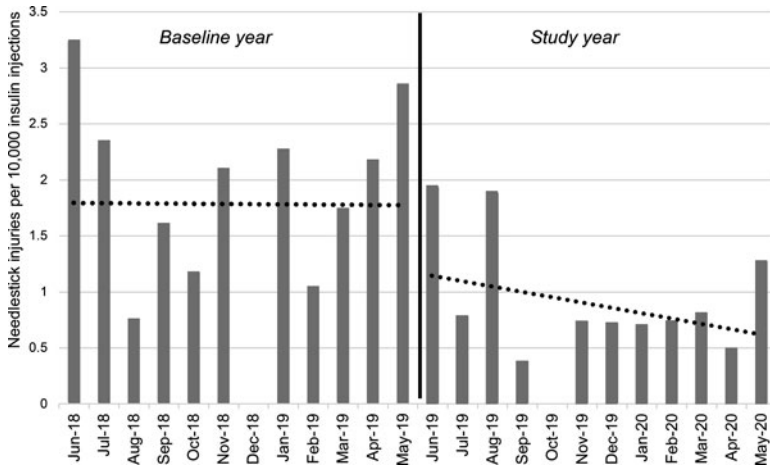


Figure 1. Monthly rate of insulin needlestick injuries, normalized per 10 000 subcutaneous insulin injections, during 1 year before and 1 year after device standardization to a single type of safety-engineered insulin syringe.

DISCUSSION

The first phase of this QI project to reduce sharps injuries at a large health care system resulted in a significant reduction in the incidence rate of needlestick injuries associated with subcutaneous insulin administration. This improvement in caregiver safety was accompanied by \$3500 in 1-year savings for supplies and an estimated median annual savings of \$25 000 for averted injuries. The broad-based educational and training plan put in place via the collaboration between BD and the Intermountain Healthcare education team contributed to a quick implementation strategy. Moreover, the shared strategy and roll-out allowed for documentation of key lessons

learned, enabling scalability for future phases of a comprehensive injury-reduction strategy. Essential for success was collaboration among nurse leaders, internal supply chain staff, and the product standardization committee.

The effectiveness of this multicomponent intervention in decreasing caregiver injuries had several other associated benefits. Indirect costs mitigated by reducing needlestick injuries included the costs associated with lost productivity, with disruption in workflow and patient care, and with the time involved in filling out reports, processing orders, drawing blood, and following patient and caregiver health status. Intangible benefits of this program should

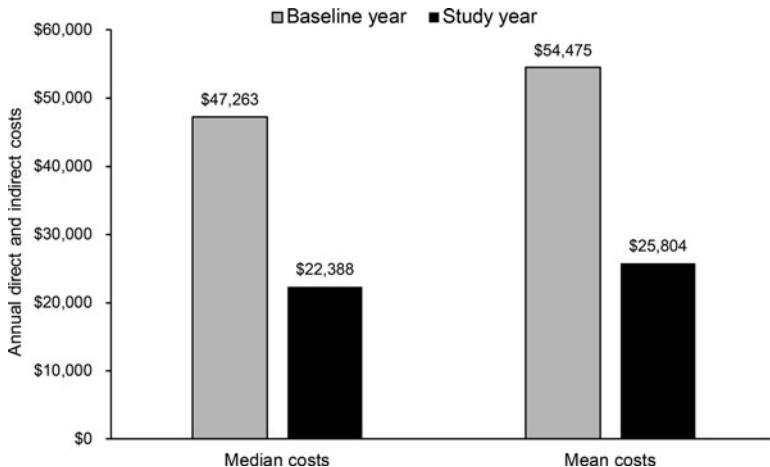


Figure 2. Estimated total annual costs (direct and indirect) attributable to insulin needlestick injuries in baseline and study years, using a mean of \$929.88 and median of \$806.76, in estimated costs per needlestick injury. Costs were estimated using data from Mannocci et al¹² and adjusted to 2019 US dollars.

be considered as well: with each injury avoided, caregiver concern about their health after a needlestick injury was avoided.

A recent report describes another successful initiative to reduce needlestick injuries at a US health network.¹⁹ Upon documentation of an increase in nurse needlestick injuries in 2016, an interdisciplinary network-wide sharps safety committee investigated and directly addressed the reasons behind this increase. Injury data tracking by nurse leaders to identify at-risk groups provided important information. Key factors in reducing needlestick injuries included revising educational strategies, including interactive learning opportunities and skills validation for newly hired nurses, standardizing supplies to include safety-engineered devices, and promoting awareness of best practices in sharps handling and disposal for all nurses.¹⁹

In our study, standardizing supplies to just 3 items, the 3 sizes of one type of 6-mm safety insulin syringe, allowed Intermountain Healthcare to realize cost savings and improve safe medication delivery, while facilitating numerous efficiencies across our materials management and clinical inventory processes. Other value levers included assurance of supply commitments from BD, elimination of all nonsafety insulin administration devices across the system, and lower carrying costs thanks to the reduced number of items being stocked in our storerooms. Other authors report similar benefits resulting from partnerships between clinical and supply chain teams to develop clinically integrated supply chain strategies, including cost savings and standardization as well as optimization of supplies.^{20,21} An effective health care supply chain impacts care delivery in many ways, including frontline nurses' satisfaction within the work environment, patient outcomes, and organizational medical supply costs.²²

It is important to note, however, that a recent Cochrane review found only low-quality and inconsistent evidence that the use of safety-engineered devices alone reduced needlestick injury rates.²³ Evidence from our work, together that of others, suggests that multifaceted, comprehensive initiatives are important components of efforts to reduce sharps injuries.^{19,23,24} Ideally, these initiatives should incorporate education, staff training, sharps supply standardization, use of safety-engineered devices, and close follow-up.

Limitations

A limitation of this study is the short timeline (2 years). Further follow-up is needed to ensure that the changes in subcutaneous insulin administration practices become routine and remain consistent. Moreover, we acknowledge that the study was conducted within one type of health care system and may not be applicable to other facilities where similar strategic partnerships are not feasible. In addition, the annual needlestick injury-related cost savings were not specific to Intermountain Healthcare but instead were estimated using data from a systematic review of studies from Europe, America, Asia, and Australia published from 1997 to 2015, both data-driven and modeling studies, and including all kinds needlestick injuries, hence not limited to those related to subcutaneous insulin injections.¹²

CONCLUSIONS

This multifaceted QI project was effective in reducing insulin-related needlestick injuries over a 1-year period at a large health care system as part of a comprehensive injury-reduction strategy. The findings from this study will be applied to future efforts at Intermountain Healthcare to standardize the supply chain via partnerships between clinical and supply chain staff. The conversion to a single type of safety-engineered insulin syringe is only the first step in a comprehensive safety needle project at Intermountain Healthcare. Moreover, the success of combining the educational and monitoring program together with standardizing insulin syringes provides a platform that we can continue to leverage as work moves forward with conversions for other hypodermic products. The need for strategies to reduce needlestick injuries is long recognized, and the results of this QI project provide other health systems with a practical template for improving health care worker safety.

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