# Routine Versus Clinically Indicated Short Peripheral Catheter Replacement

## An Evidence-based Practice Project

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**ABSTRACT**

Despite current, high-quality, level 1 evidence that supports clinically indicated short peripheral catheter (SPC) replacement, the current practice in the health care system studied was to change SPCs routinely every 96 hours. A before-and-after design was used to evaluate the impact of SPC replacement when clinically indicated. Following the practice change, there were no SPC-related infections, monthly phlebitis rates ranged from 1.9% to 3.5%, and SPC use decreased by 14.2%, resulting in estimated cost savings of $2100 and 70 hours of nursing time saved. The translation of evidence on timing of SPC replacement into practice was a success.

**Key words:** cost savings, evidence-based practice, infection rates, phlebitis rates, short peripheral catheter

## INTRODUCTION

The insertion of short peripheral catheters (SPCs) is a necessary and frequently used intervention in the care of many adult hospitalized patients. The Centers for Disease Control and Prevention (CDC) guidelines recommend that SPCs be replaced at 72 to 96 hours in adults to reduce risk of infection and patient discomfort associated with phlebitis.[1] However, the *Infusion Therapy Standards of Practice* state that SPC replacement should occur when clinically indicated, based on nurses' assessments of the patient's condition, access site, skin and vein integrity, length and type of prescribed therapy, venue of care, and integrity and patency of the SPC and dressing and stabilization device.[2]

In a recent, high-quality systematic review with meta-analysis, researchers found no difference in infection or phlebitis rates for hospitalized patients whether their SPC was replaced before 96 hours or as clinically indicated.[3] An estimated 200 million SPCs are inserted every year in the United States, and if 15% are needed for more than 3 days, a change to replacement when clinically indicated could prevent as many as 6 million unnecessary insertions and could result in savings of as much as $60 million dollars in health care costs and 2 million hours of staff time.[4]

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### Problem Statement

The study hospital has approximately 9000 discharges a year. Current practice has been to change SPCs every 96 hours. Using a conservative estimate of $10 a catheter and 20 minutes for each insertion, the fact that 50% of the 9000 discharges a year need an SPC, and of those 15% need the SPC for more than 96 hours, changing the policy to when clinically indicated could translate into a savings of $6750 in health care costs and 225 hours of staff time.

This evidence-based practice (EBP) project addressed the following clinical question written in the *patient or population*, *intervention*, *comparison*, *outcome* (PICO) format. In adult hospitalized patients requiring a peripheral intravascular catheter (P), does replacing the catheter when clinically indicated only (I) compared with replacing the catheter every 72 to 96 hours (C) increase the patient's risk for phlebitis or infection (O)?

### Significance to Nursing

Decreasing the frequency of catheter replacement may have an impact on safety for both patients and nurses. There is risk for infection each time the integrity of the patient's skin is disrupted.[5] Moreover, despite significant improvement in intravenous (IV) device protective mechanisms, there is the risk of a needlestick or blood exposure each time a registered nurse (RN) inserts an SPC.

Nursing is focused on opportunities to improve the patient's experience of care. This change in practice may be very satisfactory to a patient who previously may have had to have a well-functioning catheter replaced because it was time to change it.

Reducing costs should be a consideration for nursing. Changing to clinically indicated SPC replacement may reduce costs by eliminating the cost of the catheter plus any other related supplies, such as transparent film dressing and catheter administration set connectors. Morrison and Holt[6] estimate that $24 million could be saved and 660 000 unnecessary catheter insertions avoided by changing to clinically indicated SPC replacement.

## Theoretical Framework

Kotter's change model[7,8] was used to guide the translation of evidence into practice. This theory is suitable for implementing practice changes in health care systems because it includes clear steps to help the user prepare for change thoroughly and implement the change successfully.

## Objectives

The first step in this EBP project was to search for and evaluate relevant current evidence on routine SPC replacement versus when replacement is clinically indicated in adult hospitalized patients. Part 2 was the implementation and evaluation of the EBP change of SPC replacement when clinically indicated.

## Evidence Search, Appraisal, and Recommendations

Searches were undertaken in CINAHL Complete, the Cochrane Database of Systematic Reviews, and MEDLINE. The search range in each database was January 2009 to December 2015.

Table 1 summarizes the search terms used and the number of articles returned for each database. Criteria for selecting articles included level 1 (systematic review of single randomized controlled trials [RCTs] with or without meta-analysis, evidence review of a single RCT) or level 2 evidence (a well-designed RCT) published within the past 5 to 7 years and focused on peripheral IV catheter replacement and adverse outcomes in the adult hospitalized patient.

Articles were selected based on the following definitions. *Adult* was defined as 18 years old or older. *SPCs* were defined as invasive devices inserted in a patient's vein for the purpose of administering fluids, medications, or nutrition, or in anticipation of a potential emergent event.[7] *Outcomes* included phlebitis, defined as an inflammation of the walls of the vein with associated symptoms of pain, redness of the skin, swelling, and palpable thrombosis of the vein with the catheter[9]; *catheter-related bloodstream infection* was defined as an infection in the bloodstream (bacteremia) during the presence of an IV catheter or up to 48 hours following its removal without another clinical explanation for the infection.[6] The Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool[10] was used to assess the quality and strength of the evidence.

## Evidence Review Results

Review of articles from the Cochrane Database of Systematic Reviews produced 3 papers. Only 1 was selected because the other 2 were earlier versions of the most current review.[3] More than 600 articles were screened from the CINAHL Complete and MEDLINE searches. Six were selected for comprehensive review. Only 1 was selected for inclusion, because others were either research recapitulations of the RCT included in Webster and colleagues' systematic review[3] or the original RCT. An evidence review by Morrison and Holt[6] provided a rigorous review of individual RCT and systematic reviews with meta-analysis on SPC replacement that warranted its inclusion in this evidence review.

**TABLE 1**

**Complete Search Terms, Boolean Operators, and Search Results by Database**

| Search Terms | CINAHL[a] | Cochrane[b] | MEDLINE |
|---|---|---|---|
| Adult hospitalized patients | 248 | 3 | 985 |
| Peripheral intravenous catheters OR peripheral intravenous device | 208 | 1 | 100 |
| Adult hospitalized patients AND peripheral intravenous catheters OR peripheral intravenous device | 403 | 0 | 179 |
| Phlebitis | 265 | 0 | 2248 |
| Catheter-related bloodstream infections | 471 | 0 | 1 |
| Adult hospitalized patients AND phlebitis AND peripheral intravenous catheters OR peripheral intravenous device | 211 | 1 | 89 |
| Adult hospitalized patients AND catheter-related bloodstream infections AND peripheral intravenous catheters OR peripheral intravenous device | 189 | 3 | 179 |

[a]Cumulative Complete Index to Nursing and Allied Health Literature.
[b]Cochrane Database of Systematic Reviews.

In Webster et al,[3] some reviewers were also the investigators on some of the included studies. To minimize potential bias, these study assessments were allocated to a reviewer who was not an investigator for those studies. If there was a difference of opinion, a third reviewer was used. In the Morrison and Holt[6] evidence review, 2 independent researchers using the Melnyk critical appraisal tools[11] reviewed articles.

High-quality evidence from Webster et al[3] and Morrison and Holt[6] supported that there was no statistical difference in clinical outcomes of infection or phlebitis when an SPC was changed routinely at 72 to 96 hours or when clinically indicated. The studies included in both reviews avoided selection bias and used allocation concealment.[3,6] Blinding was not possible. All the studies compared routine change versus clinically indicated changes. However, there were variations regarding when the catheter was changed (eg, 72-96 hours or a 48-hour change schedule). Heterogeneity was an issue across studies in the review by Webster et al[3] because of different catheter-change schedules, small sample sizes, and population differences.

This evidence review included the most recent systematic review and evidence review (through December 2015) that included all RCTs comparing routine SPC changes with changing SPCs when clinically indicated. The outcomes of interest were infection and phlebitis, and no differences between the groups were found. The quality of evidence for phlebitis was high; however, the evidence for infection was moderate. In conclusion, 2 independent reviews[3,6] and the current evidence review determined that the evidence did not support the current practice of changing an SPC every 72 to 96 hours. As a result, the recommendation was to revise the SPC change policy to when clinically indicated.

## IMPLEMENTATION METHODS

### Kotter's 8 Steps for Change

#### *Step 1: Create a sense of urgency*

For this project, key stakeholders included frontline and clinical leadership staff (nursing and medicine), regulatory, and legal stakeholders. These stakeholders were given an opportunity to review the evidence search results and ask questions, and they were encouraged to participate in any aspect of the project. A kickoff meeting was held in January 2016, and communication occurred with biweekly conference calls and on a rolling basis. The project leader provided stakeholders with cell phone, office phone, and email information so they could contact her with questions or issues.

#### *Step 2: Form and develop a team, conduct stakeholder analysis*

For this project, the team consisted of the medical director for infection control, 2 infection prevention specialists, the director of quality and safety, the manager of regulatory preparedness, the director of nursing, a nurse manager and RNs from the pilot unit, and several RNs from other units in the health care system. The medical director for infection control was an early adopter of this EBP project.

A force field analysis designed to weigh the driving and restraining forces that impact organizational change was conducted to assess the drivers in favor and against the practice change in this setting. Initial support from the medical director for infection prevention was a positive force. Another powerful, positive force was the high level of evidence that existed in support of the change. The potential impact on both RN and patient satisfaction sides was a positive force, and cost savings was a smaller positive force. The application of the change across the entire health care system would increase cost savings and, subsequently, the strength of the force as a positive influencer.

Potential and powerful negative or restraining forces included the current CDC guidelines and the challenges that might be faced with the state's (Connecticut's) Department of Public Health (DPH). The regulatory manager initially expressed concern that the change in practice was outside CDC guidelines and that the state's DPH might challenge it during a hospital regulatory site visit. The issue was discussed, and the regulatory manager concluded that the practice change would be reflected in infection prevention council minutes as improving practice based on current best evidence. There was initial resistance from the infection prevention specialists who were responsible for overseeing strategies aimed at reduction of hospital-acquired infections, but this, too, was quickly mitigated with review of the evidence.

#### *Step 3: Create a vision for change*

Time was spent helping the team understand the current SPC policy and the compelling evidence that existed to support the change. Team members had varying degrees of knowledge of systematic reviews with or without meta-analysis and RCTs. Education was provided for team members so that there was a common understanding of the strength and quality of the evidence. This was also an important part of the education for the frontline nurses involved in the implementation.

#### *Step 4: Communicate the vision*

Individuals or teams can derail or destroy a change initiative if they have not received adequate communication, disagree with the change strategy, or do not understand the change. The team and staff were given an opportunity to learn about the practice change and voice concerns and/or recommendations. This initially occurred through communication to the staff of the pilot unit by the project leader during the unit's monthly staff meetings in advance of implementation.

#### *Step 5: Empower the action*

This was accomplished by maintaining regular communication with the nurse manager, clinical resource leaders, infection prevention specialists, and staff RNs on the implementation team by means of a weekly conference call during the preceding month and the month during implementation.

### Step 6: Planning for and creating short-term wins

Short-term wins are the proof of progress and are meant to be motivators. Each month after the practice change, outcome data were displayed for the staff in a high-traffic area with a basket of healthy snacks for the staff to eat while they reviewed the data.

### Steps 7 and 8: Consolidating improvements, producing still more change, and institutionalizing new approaches

These steps relate to continuous change until the desired state is reached and changes to the organizational culture stick. They included extending the SPC policy to the other hospital units and the larger health care system. Nurses on the first pilot unit were encouraged to share how the change has decreased their workload and unnecessary SPC insertions.

### Setting and Sample

The combined intensive care/step-down unit of a 144-bed community hospital was the pilot unit for this intervention. This 29-bed unit was selected because it had the highest SPC use in the 3 months before the practice change.

### Intervention and Implementation Plan

The Institutional Review Board of the hospital in which the study was undertaken gave the EBP project an exempt status. The intervention was to replace SPCs when clinically indicated versus every 96 hours. Staff RNs on the pilot unit received an online education module on the practice change and the rationale for the change. Education included information on the expected frequency of SPC site evaluation (every shift) and signs of phlebitis at the insertion site. Education included information on the project timeline and RNs' responsibilities during the preimplementation and implementation phases of the project. The project leader reinforced the education by attending unit staff meetings during January 2016.

### Methods of Evaluation

Infection prevention specialists carried out surveillance for SPC-related infections for 3 months before and after the practice change. *Infection* was defined as a microbial pathogen in a blood culture as the result of infection, not specimen contamination. Determination was made by either a quantitative culture of the catheter tip, or a positive SPC culture and a negative peripheral blood culture.

Definitions of phlebitis vary in the literature, with no universally accepted scale or evaluation tool.[12] For the purposes of this project, a very conservative definition of phlebitis was used. Phlebitis was considered if even 1 symptom (redness, swelling, pain, or palpable cord) was present. A data collection tool was developed for RNs to document the reason for SPC replacement (Table 2).

Data on SPC use were collected for 3 months before and after the practice change. Monitoring the number of catheters used per 1000 patient days allowed comparison between both periods, regardless of the impact of patient census. SPC use before the practice change was obtained as raw data from the hospital supply chain. After the practice change, SPC days were documented by staff RNs.

Wallis et al[13] estimated that spending reduction approximated $10 per SPC and that nursing time saved approximated 20 minutes per SPC insertion. These broad estimates were used to determine savings in both hospital spending and nursing time.

## RESULTS

Figure 1 displays SPC use before and after the practice change. The bar graph denotes the actual number of catheters used based on hospital supply chain data. The catheter use rate after the practice change (denoted by the line graph) decreased by 14.2%. Despite an increase in patient days during the 3 months after the practice change, the raw number of SPCs used decreased by 210, or 141 fewer SPCs per 1000 patient days. This resulted in an estimated $2100 SPC-related savings during the 3-month period. It also resulted in an estimated nursing time savings of 70 hours over the 3-month pilot.

Figure 2 shows the SPC days reported by RNs, with a daily average of 19.3 days (SD = 4.1) for the 3 months after the practice change. The graph represents the distribution of the observed SPC days over the implementation period. There was a decrease in reporting of SPC days by RNs on weekends. Therefore, the CDC surveillance modeling rule of using the average value for the known days of data for periods of time with more than 3 days of missing data was used.[14] SPC catheter days were needed for calculation of infection and phlebitis rates, which were not collected routinely before the practice change.

**TABLE 2**

**Data Collection Tool for SPC Change Rationale**

| Date and Time of SPC Catheter Change | Rationale for Catheter Change |
|---|---|
| MM/DD/YY | Select all that apply: |
| 00:00 | ☐ Redness |
| | ☐ Palpable cord or thrombus |
| | ☐ Pain |
| | ☐ Swelling |
| | ☐ Routine 96-hour catheter change |
| | ☐ Other (please explain): |

Abbreviation: SPC, short peripheral catheter.



 

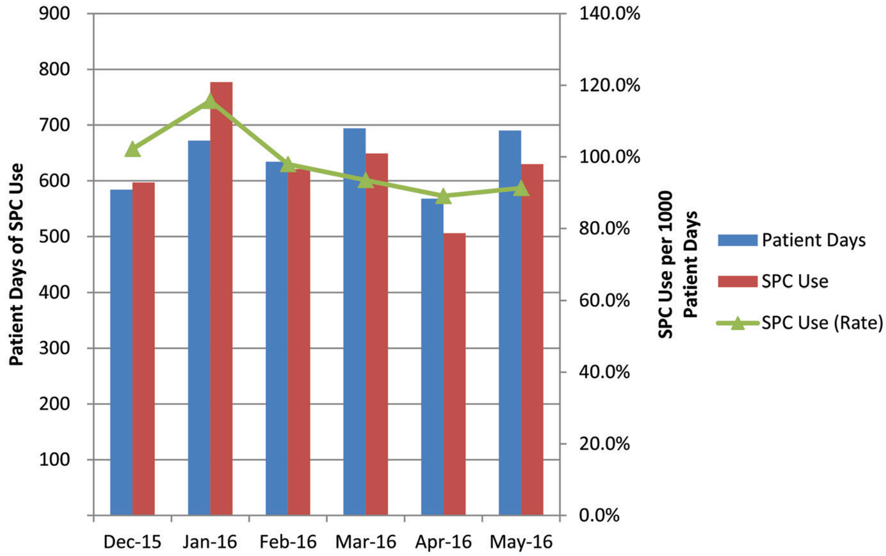


**Figure 1** SPC use 3 months before and after practice change. *Abbreviation: SPC, short peripheral catheter.*

The overall mean phlebitis rate was 2.4% (SD = 0.9%). Rates by month were 2.0% (March), 1.9% (April), and 3.5% (May). As seen in Figure 3, only 2% of the SPC replacements were related to "true phlebitis," defined as swelling, pain, redness, and presence of palpable cord. Reasons for SPC replacement unrelated to phlebitis symptoms (49%) included *malfunctioning SPC* (44%), *hospital policy* (37%, SPC replacement for patient transfers to other facilities), *patient pulled SPC* (16%), and *patient requested replacement* (3%).

## DISCUSSION

The purpose of this EBP project was to translate best, current evidence for SPC replacement in hospitalized adults into practice and to track infection and phlebitis rates for 3 months. There were no SPC infections during the 3 months following the practice change. This finding is consistent with a review of infection rates associated with SPCs, in which Hadaway[15] found low rates of infection reported in the published literature from 2000 to 2011.

In this project, monthly phlebitis rates ranged from 1.9% to 3.5%, which was well below the nationally accepted benchmark of 5%.[12] Although this rate was higher than the phlebitis rate (1.4%) reported in a 2015 systematic review,[3] other more recent studies have found phlebitis rates for SPCs between 4.6% and 37%.[12,15-18] It is likely that differences in phlebitis definitions and study populations explain the substantial variation.

Documented reasons for SPC replacement before 96 hours during the practice change included *signs and symptoms of phlebitis*, *malfunctioning SPC*, *patient pulled SPC*, *patient preference for change*, and *hospital policy for SPC replacement for outbound transfers*. In a longitudinal study by Palese and colleagues[19] in 7 Italian hospitals, researchers observed similar reasons for SPC replacement before 96 hours (eg, phlebitis, occlusion, extravasation, patients no longer needed infusions). Helm and colleagues[20]

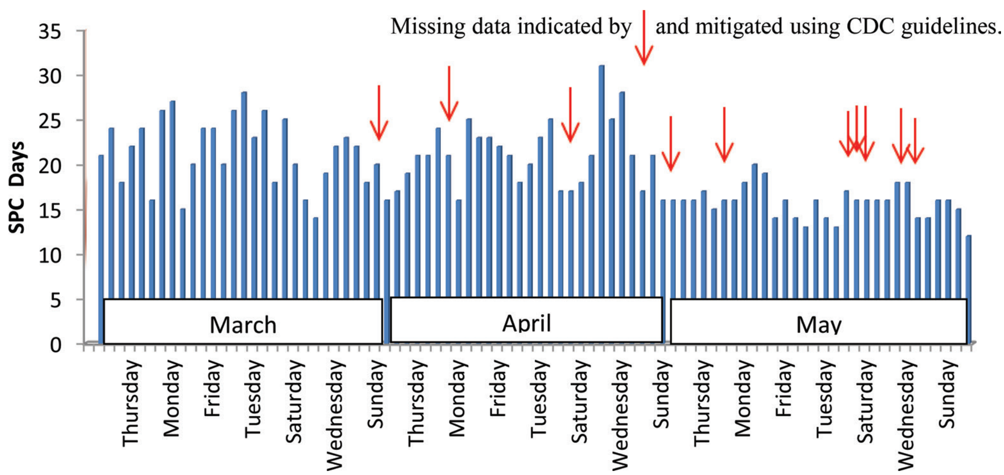


**Figure 2** SPC days reported by RNs for 3 months before the practice change. *Abbreviations: CDC, Centers for Disease Control and Prevention; RN, registered nurse; SPC, short peripheral catheter.*

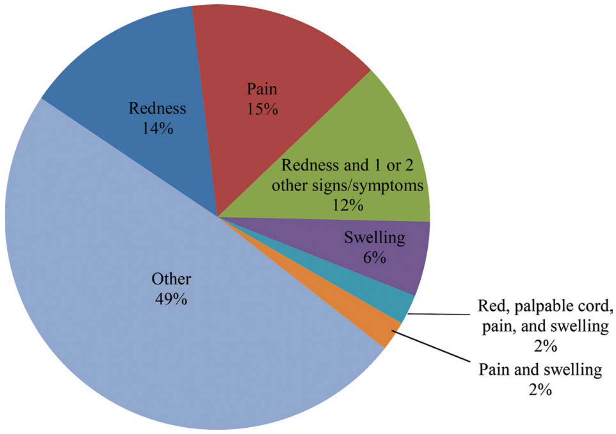


**Figure 3** Documented reasons for short peripheral catheter replacement.

reported an SPC malfunction rate of 35% to 50%, similar to the rate found in the current project.

The cost savings realized in this project were consistent with decreased costs reported in Webster and colleagues' systematic review.[3] Annualizing the current project savings and adjusting for additional patient volume on other patient care units would result in an estimated hospital savings of $33,600, which far exceeds the initial projected savings of $6750.

Nursing time saved in the current project was consistent with findings from a recent descriptive study on timing of SPC replacement.[21] Annualizing the nursing time savings and adjusting for additional patient volume on other patient care units would result in an estimated savings of 1120 hours of nursing care compared with the 225 hours of nursing care that was projected for this project.

## Limitations

Factors that may have had an impact on the observed phlebitis rates were the hospital transfer policy, missing data, and variation in catheter use. The intensive care/step-down unit was selected because it had the highest SPC use. However, patients who transferred from this unit to a lower level of care, according to hospital policy, required SPC replacement at 96 hours. In addition, there were missing reports from RNs of catheter days and SPC assessments, particularly during the third month. Missing data were most likely related to the implementation of an electronic health record and the lack of clinical leadership oversight on weekends. The use of more catheters between December and February was likely due to the fact that those are months when influenza is prevalent and the need for fluids delivered through SPCs increases. However, the investigators were reassured that the results were not driven by the lower burden of influenza between March and May because the sample number of patient days increased during that time.

Finally, the time saved by RNs may be an overestimate because the 210 fewer catheters recorded from the hospital supply chain may not have been for 210 isolated patient interactions but, rather, several catheters used during 1 patient interaction because of an inability to insert the SPC on the first attempt.

## Implications and Next Steps

Project data support the maintenance of the practice change on the intensive care/step-down unit and the expansion of the change to other units in the organization. Additional steps are to implement the practice change systemwide and, ultimately, statewide to promote RN and patient well-being, and to produce significant cost savings.

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