Editor's Note: In 2001, we will publish six articles for which 1 to 3 credit hours may be earned as part of a CNS's learning activities. Examination questions are provided at the end of this article for your consideration. See the answer/enrollment form after the article for additional information regarding the program.

Developing an Evidence-based Procedure: Maintenance of Central Venous Catheters

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This article describes the creation of an evidence-based guideline as part of a learning experience of a group of clinical nurse specialists. The guideline was the product of a utilization-focused integrated review of the literature conducted with the guidance of a nurse researcher. Key aspects of the evidence-based recommendations, as well as factors that facilitated or hindered this effort, are shared.

KEY WORDS: central venous line, catheterization, catheter-related infection

Evidence-based practice is a routine expectation of clinical nurse specialists (CNSs); however, it is not a simple process. It requires advanced knowledge of research utilization and, in many cases, competency in both the development and the implementation of evidence-based policies and procedures. However, even with the required knowledge and commitment, one's chosen topic, utilization decisions and clinical circumstances can create an additional challenge. This article describes the experience of one group of CNSs charged with the design of an evidence-based guideline for the care of central venous catheters across an integrated healthcare system. Key aspects of the guideline effort, as well as lessons learned from this reflective qualified success are included.

THE CHALLENGE

Two current trends in healthcare are the formation of integrated delivery systems and a focus on evidence-based practice. As a delivery network is formed, nurses among its different facilities may discover variable practices that pose a challenge to the expected standardization of care. The centralized Nursing Clinical Practice Committee (NCPC) of one such multifacility health system in New England identified this as a problem. In turn, the committee believed that evidence-based practice could provide an objective method to resolve the issue. A recently developed framework for evidence-based practice, accepted by nurse executives across the system's widespread settings, would facilitate the process.1

The NCPC first agreed upon common critical practice issues relevant to the system's 3 hospitals, home care, and infusion services. Care of central venous lines (CVL) rose to the top of the priority list and discussion indicated the following:

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The use of different dressing and flushing techniques at each facility was confusing for both nursing personnel and patients, because the latter were transferred from one facility to another.

No facility's related policies/procedures were based explicitly on scientific evidence.

That nursing would need interdisciplinary consensus before a new procedure could be approved made this a challenging choice, especially because type of dressing had been a contentious issue in one of the sites. However, an evidence-based approach was seen as strengthening nursing's ability to achieve the desired change.

An informal group of interested CNSs had been refining its research critique skills and helping to develop, with the hospital-based nurse researcher, a utilization-focused method of conducting integrative reviews. Several of these CNSs volunteered to form a CVL task force and put their newfound knowledge into practice. For this first effort, only adult patient-related practice was included.

ASSESSMENT OF THE PROBLEM

The task force embarked with 2 concurrent activities, i.e., assessment of the scope of the problem and an integrated review of the literature. For the former, each facility's policies and procedures were compared to determine how practice was currently prescribed, staff nurses were surveyed to determine variations in actual practice, and available data were explored for indications of complications.

Analysis revealed, as expected, that current policies varied across the facilities. For example, dressing types and changes ranged from gauze changed daily to transparent dressings (TD) changed on Monday, Wednesday, and Friday. Staff nurse input (N = 25) indicated that in actual practice there was variation not only across institutions but also within individual units. This inconsistent practice was true for type of dressing, frequency of dressing change, and cleansing of the site. Practice clearly did not adhere in all cases to policy.

As a basis for outcome measures, efforts were made to obtain information on current rates of complication. As in many healthcare systems, rates of central line bacteremia were not routinely collected, and no denominator data regarding the number of central lines or central line days were available. At the largest institution, catheter tip data were routinely collected and analyzed for each unit based on an estimate of routine line usage. Neither this rough estimate nor more informal methods of case monitoring suggested that either bacteremias or other negative outcomes were a concern.

SYSTEMATIC INTEGRATED REVIEW

Comprehensive reviews are time-consuming and require competency in analyzing and critiquing studies for applicability. The availability of other integrated reviews, if judged credible, greatly facilitates the problem-solving process. A Center for Disease Control and Prevention (CDC) publication provided a basic set of trustworthy, systematically developed evidence-based recommendations for best practice. These guidelines addressed prevention of nosocomial intravascular device-related infections. The guidelines contained clear descriptions of the level of evidence for each recommendation, a prerequisite to effective use of systematic reviews. Nonetheless, for the following reasons, the CDC guidelines had to be supplemented:

• Operational details were not included in all relevant components.
• Recommendations were not always based on strong evidence, and some did not indicate a clear choice of practice.

To identify additional studies, computerized searches in MEDLINE, CINAHL, HealthSTAR, and Journal of Knowledge Synthesis for Nursing were used. Key words included central lines, intravenous line, dressings and bandages, catheters, catheterization, central venous device, catheter-related infection, sepsis, and research. As noted below, line flushing was an added consideration and therefore the word search included flushing and heparin/heparinization. Recommendations from the Intravenous Nurses Society were also reviewed. Unlike CDC guidelines, these standards did not have specified levels of evidence and were not based on a systematic research review.

For frequency of dressing change, the supplemental search covered 1990–1998 because the CDC's recommendation was indeterminate, stating only that dressings should be changed if damp, loosened, or soiled. Earlier dated studies were not used because of the change over time in the permeability of TDs. For types of dressings and heparinization, integrated reviews were reviewed as available. The framework for integrative reviews developed at Baystate Medical Center is described elsewhere. Of note is the expectation that each study initially be reviewed by 2 individuals and that the final agreed-upon content be detailed on utilization-focused tables. This objective and formal approach to the critique and organization of available literature provided several advantages, that is, it enhanced reliability of each critique, enabled the entire group to readily and thoroughly understand all reviewed studies from a utilization point of view, facilitated synthesis of the findings, and provided clear communication to stakeholders regarding the basis of decision making.

FINDINGS AND RELATED RECOMMENDATIONS

Central Venous Line Dressing

The CDC made no recommendation for or against a specific type of dressing but rather indicated that either a transparent or a gauze dressing was acceptable (per "1-A" level of evidence, i.e., "strongly recommended for all hospitals and strongly supported by well designed experimental or epidemiologic studies"). To further facilitate choice of a specific dressing, supplemental findings on dressing type were summarized through a table format (Table 1). This synthesis reinforced the observation that there is no advantage relative to reduced risk of infection with use of gauze versus transparent dressings. The next step, therefore, was to examine related factors, such as frequency of dressing change and satisfaction.
Specifically, 6 studies of variable quality provided data on time frames for dressing changes. Again, findings were summarized through a table format (Table 2). Overall, they suggested that transparent dressings can be changed less frequently than gauze without an apparent negative impact. The final step in making a recommendation regarding one, “best” standard dressing type was to review the CDC document, secondary findings in studies cited in Tables 1 and 2, and other general references. Per an underlying model for research utilization, “best” meant evidence-based as well as cost-effective and feasible.

Secondary findings were often incidental or of a lower level of evidence, but they did facilitate a final interpretation of the primary data. All pointed to the potential value of TDs in terms of the following:

- ease of observability for routine assessment without site disturbance, because each handling/exposure increases potential for contamination
- decrease in potential for skin excoriation, given reduction in frequency of dressing removals
- reduction in nursing time with reduced dressing changes
- potential for increased staff satisfaction and potential for increased patient satisfaction.

Given this best available evidence, a decision was made to recommend use of a transparent dressing to cover a central venous catheter site, with a change of this dressing every 3 days. These recommendations were considered credible, per promising research findings. “Credible” is the second-highest possible rating in the table for judging strength of an evidence-based recommendation. The new procedure would apply, per CDC recommendations, to all central venous, tunneled, arterial, peripherally inserted central (PICCs), midline, and implantable vascular access catheters in adult patients. Only dialysis access catheters were excluded.

Two exceptions were built into these recommendations. The first, based on quality performance evidence, was that
dressing could be changed in the home care setting on a less frequent basis (every 7 days). However, given the goal for consistency and the nosocomial nature of acute care environments, when home care patients became inpatients, the routine would switch to the 3-day guideline. Patients would be educated accordingly.

The second exception was that a registered nurse (RN) should determine if an individual patient’s needs warrant a shift from the routine guideline. This introduced the component of RN clinical judgment to the policy but still requires a basis in evidence. For example, the nurse will replace the catheter site dressing whenever it becomes damp, loosened, or soiled, which is validated by CDC’s “strong recommendation per experts & suggestive science.”

Before presentation of these recommendations to a group of stakeholders, we calculated the direct and the indirect cost savings with use of transparent dressings. These savings, calculated only for the large medical center where gauze changed daily was current policy, were calculated at $116,212 for dressing supplies and at $600,000 for nursing time.

**Flushing**

Although not an initial component of the project, flushing-related issues surfaced. The CDC provided a suggestion to routinely flush central lines with an anticoagulant to prevent occlusion, based on a “strong recommendation per experts and suggestive science.” However, they gave no operational definition of “routine” nor did it differentiate any line except the Groshong.

A literature search provided a recent integrated review by Buswell and Beyea® regarding the effects of variation in the volume of flush, the concentration of heparin for each flush, and the frequency of flushes for tunneled catheters. Findings from CDC and Buswell/Beyea and similar suggestions from the Intraumenous Nursing Society resulted in the recommendation to use heparin in the smallest consistent volume relative to catheter size for routine intermittent flush of CVLs. This recommendation, to reduce patient exposure to heparin by reducing both the concentration and the frequency of heparinized flushes, was approved and commended by the Pharmacy and Therapeutics Committee as they too were concerned with the threat of heparin antibodies or heparin-induced thrombocytopenia.

Specifically, the task force recommended use of 50 units of heparin in 5 mL, 2 times a week. For intermittent flushing after medications, the group recommended use of normal saline. The group’s decision to reduce the frequency of line flushing was reinforced by the experience of the system’s largest intensive care unit (ICU). Specifically, this unit previously had switched to a normal saline rather than heparin central line flush and perceived this practice to be effective. Given the multiple lines of the patients, it also significantly reduced their exposure to heparin-related risks.

This recommendation did not apply to Groshongs, to dialysis catheters, or to implantable access devices. It was used, however, for all other central venous catheters based on nondifferentiation by CDC, the experiences in the ICU, and application of the findings regarding catheter volume. This was considered a “reasonable recommendation per limited but suggestive research-based evidence,” based on our table of strength of recommendations. However, one critical interpretation regarding fit to catheter type proved to be an issue and is further described in the evaluation section.

**ACTION STEPS**

The synthesized evidence and related recommendations, along with the individual tables of evidence, were presented to a group of 20 stakeholders from across the system. Stakeholders included staff nurses, physicians, homecare and infusion nurses, and representatives of infection control, the purchasing department, and Office of Clinical Practices Evaluation and Management. Overall, the stakeholders’ response was positive to both recommendations and the evidence-based process. Once final approval was received from both the local and the centralized NCPCs, a member of the task force and other needed experts wrote the procedures. Implementation involved the CNSs, staff educators, and staff from information systems. Self-learning packets were used to introduce the new information, and posters highlighting the key points of the procedure were placed on each unit for reference.

It should be noted that a pilot test was not conducted. Rather, it was decided that implementation should occur across the board because a number of nurses already were using the TDs, it was not a complicated change, and the evidence for its use was credible. The extensive time that preparation and approval had taken was another consideration, and it was believed that all changes, both dressing and flushing, should occur simultaneously to reduce confusion and the impact on staff nurses of “yet another change.”

**EVALUATION**

The objective to eliminate inconsistent standards was a priori achieved with approval of a system-wide policy/procedure. In addition, efficiency of nurses had been enhanced through less frequent dressing changes and flushes and through use of a more user-friendly policy, because multiple past policies for different catheters were now combined into one easily accessible policy for dressings and flush procedures.

Audit data, however, were needed regarding both actual implementation and patient outcomes to affirm that quality was maintained. Formal data collection occurred primarily in the large medical center. Specifically, a process audit, to determine whether nurses were actually following the approved procedures, was conducted approximately 2 months after initiation of the new policy. Based on a pragmatic decision, a goal of 60 catheter days per 3 representative units was established as the sample. The units involved were ICU, a large surgical unit, and the oncology unit. The latter was chosen because these nurses understandably would be most concerned with the potential for infection among their vulnerable population. Practice was observed over a 2-week period. A simple structured tool with yes-no options was used to record compliance for key procedural components.
Availability of the observers and presence of patients with CVLs during the 2-week period resulted in a total of 17 days of observation and 112 patient catheter days. Only the ICU achieved the desired number (N = 69 catheter days), with oncology assessing 32 and the surgical unit only 11 due to a low number of central lines. With this convenience sample, transparent dressings were present in all instances, and in cases where a small gauze was in place, 90% were considered appropriate. Observation of the site occurred in 96% of the cases, and the dressing was secure in 97%. Any lack of adherence or need for reinforcement was followed up by the observer, but overall, compliance was considered to be good. Two other observations emerged at this stage:

- Local units create local, adapted practice. For example, the ICU continued to use minimal heparin, as had been their “successful” practice in the past.
- Variations in the degree of successful implementation from unit to unit is influenced by multiple factors, including the behavior of local leadership and the related presence or absence of persistent reinforcement to facilitate full compliance.

When assessing outcomes, both pre-implementation and postimplementation audits were planned for the 3 units. A structured tool to record signs of potential CVL complications was used, including redness at exit site, drainage, pain, actual or suspected bacteremia, and actual or suspected catheter tip infection, as well as skin excoriation and line/port occlusion.

Three days of predata and 6 days of postdata were collected from the oncology unit. Postimplementation data were available for a period of 6 days in the ICU and surgical unit. Such limitations obviously presented challenges, and in such circumstances, one has to determine how to make meaning out of less-than-desirable data.

A total of 39 patients were observed, with 20 in the ICU, 10 in the surgical unit, and 9 in oncology. In total, there were 130 catheter days. Overall, only 2 patients had a catheter tip infection, one each in the ICU and surgical unit. This number could be an underestimation given the lack of a standard definition of suspected infection. Two patients had bacteremia that appeared to be CVL-related; again one on each of the above units. For other dressing-related complications, a number of patients had symptoms but the majority were mild and many short-lived. One patient with a CVL infection had persistent, progressive pain. On the oncology unit, where rigorous attention had traditionally been given to the safety of CVL dressings, there were no signs of infection and no actual infections in either the pre-period or post-period. Although the observation period was short, these data as well as ongoing, informal monitoring through the nursing practice committee, suggested that no infection-related problems existed with introduction of the new dressing policy. This observation was further reinforced because no negative feedback reached the infection control office postimplementation. This office routinely monitors reported cases of bacteremia, and, in contrast, before implementation had been exploring such reports.

Flushing and Peripherally Inserted Central Catheter Lines

During outcome audits, lines were surveyed for occlusion problems. Overall, 5 occurrences of occlusion were noted, 4 of which were in the ICU. It was undetermined how many lines this represents as “triple lumens” are their predominant type of catheter, and the use of saline vs heparin was also involved (as noted, ICU nurses continued that practice rather than the new heparin policy). Only 1 non-ICU patient experienced an occlusion, and in only 2% of line days was there an occlusion. Three of the patients had a PICC, and none of these was occluded.

Informal feedback from CPC members concurred with these formal observations and indeed at each regular CPC meeting reinforced the impression of successful implementation. However, 6 weeks after the in-patient changeover, adverse information came from the home care/infusion agency, which had just begun the new regime. It reported that an increased number of PICC lines appeared to be clotting with the new heparinization procedure. A decision was made by the task force to immediately discontinue the new practice in the home setting and to discuss this unanticipated outcome with the home infusion nurses and inpatient intravenous (IV) nurses. The cause of the clotting was undetermined, but the group hypothesized that despite the theoretical “fit” of catheter volume research, the PICC’s diminutive diameter and length, in combination with the amount of heparin used in the new regime, could be responsible.

Although there was no indication of in-patient problems, the IV nurses were asked to conduct a brief audit on all PICC lines. A 2-week observation uncovered 7 instances of clotting in 32 observations of 14 PICC lines. The cause was not clear. However, based on available evidence and the possible relationship of the new policy, we immediately increased the frequency of heparin flushing for all PICC (and Midline) catheters to once a day. A follow-up measurement found that only 2 of 15 PICC catheters occluded over another 2-week observation period and that clotting was not attributed to the new regime.

The task force reviewed the results of the heparin policy on PICC lines and how they might have been avoided. Because of changes in personnel, there was inconsistent participation in procedure development from the home care and infusion sector. In-depth expertise with PICC lines thus was lost. In hindsight, we should have been more aggressive in obtaining such input, in which case our interpretation that research on other types of central lines “fits” the PICC lines might not have been made.

LESSONS LEARNED

Both time and resources must be invested in a project such as this to ensure its success. The CNS group met monthly for 2 hours for 9 months to complete the research and to review and develop subsequent recommendations. It should be noted that the group was also developing the integrated review model® and refining an evidenced-based practice model. Implementation that included the presentation to stakeholders, development of an educational plan, initiation of the change at all facilities, and evalu-
tion took 6 months. In general, 1 year for the process should be expected.

A second lesson was the need to integrate clinical judgment into the application of research utilization at 2 levels. First, research utilization requires the integration of often diverse findings that may not provide clear direction for the details needed in a policy, procedure, or program. Knowledge-based judgment is required, and CNSs, given their advanced knowledge of both research utilization and clinical practice, are in the best position to make such complex decisions. They are able to leap between the best available evidence and the realities of practice to develop sound and pragmatic guidelines for the bedside clinician.

The second type of judgment that is required is that of the bedside clinician. Although policies and procedures should provide clear, research-based direction, the nurses need to critically think about the application of such findings to individual patients. By building clinical judgment into a policy or procedure, the bedside clinician is encouraged to make changes to meet the needs of individual patient’s needs and to do so on the basis of a clear documented rationale.

Our utilization-focused integrated review framework, in combination with a structured approach to evidence-based practice and research application, facilitated creation and implementation of new CVL procedures. Creation of such an evidence-based procedure is a challenging task. It requires the resource of time, and it requires commitment. This commitment is not only to the rigsors of review and decision making, often in the light of a less-than-desirable level of evidence or specificity of that evidence, political considerations, and the pressures of deadlines, but also to self-learning about the process of creating evidence-based practice. From the viewpoint of group learning, this was a successful experience and one that hopefully can facilitate the evidence-based experiences of other CNSs.

References

School of Nursing Campaign
The NACNS Membership Committee has embarked on a new mission to recruit student nurses in graduate school CNS tracks. This new endeavor provides opportunities for the students to “see” NACNS as an organization and to read about CNS practice. These are just a few of the advantages of this mission to the student. The advantage to NACNS is increasing its strength in members and as an organization uniquely qualified to describe and support CNS practice.

This recruitment effort will be piloted with several volunteer CNS track faculty members nationwide. Each faculty member will receive a PowerPoint slide presentation and membership application. The slide presentation focuses on both the essential functions and the competencies of the CNS, as well as on NACNS the organization. Additionally, each faculty member will receive a survey designed to help us understand how the presentations were delivered and how many students were reached.

The membership committee believes that encouraging student CNSs to join us will help them as they develop their career path. Perhaps a new path for NACNS members is the mentorship of each other as well as our student colleagues. Please join with us as we reach out to faculty and student with the richness of opportunity within our organization: NACNS.