DEVELOPMENT AND EVALUATION OF AN EVIDENCE-INFORMED PROTOCOL FOR THE NURSING CARE OF POST-CARDIAC CATHETERIZATION PATIENTS

by

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A Capstone Project submitted to the
School of Nursing
University at Buffalo
The State University of New York
in partial fulfillment of the requirements for the degree of Doctor of Nursing Practice

February 1, 2018
DNP Capstone Project Approval Form

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Development and Evaluation of an Evidence-Informed Protocol for the Nursing Care of Post-Cardiac Catheterization Patients

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Abstract

Before the cardiac catheterization laboratory opened at Niagara Falls Memorial Medical Center (NFMMC), nurses designated to care for post-catheterization patients received little training. The purpose of this capstone project was to develop and test an evidence-informed, post-catheterization protocol. Post-procedural complications are serious and costly; timely recognition and treatment can lessen their burden. A mixed-methods design with guidance provided by the IOWA model was used. The protocol was developed based on literature and expert input. Acceptability and usability testing was conducted through survey analysis and participant comments. Twenty-eight Registered Nurses at NFMMC were invited to participate. A sample of 25 participants completed two surveys, measuring their perceived confidence/preparedness, current resources, and their perceptions regarding the protocol. The results show moderate, negative relationships comparing experience with acceptability and usability (Pearson’s $r = -0.466$ and $-0.428$, respectively, $p < 0.05$), suggesting those with less experience find the protocol more useful. All participants agreed they would use the protocol. Twelve provided comments, three suggesting flowsheets for documentation. The results show the protocol is an acceptable and usable tool for nurses at NFMMC and may be especially useful for orientation and training purposes. Future projects should include protocol refinement, along with implementation and further testing.
Acknowledgements

I would like to acknowledge those who have offered me their time and support in the completion of my Capstone project.

Thank you to my Capstone advisors, Dr. Marsha Lewis and Dr. Susan Bruce. The tremendous advice, feedback and patience you have provided has been invaluable through this process.

I would like to thank my family and friends: especially my parents for always believing in me in whatever I choose to do; my closest work friend, Liza, for listening to me for the past three years and always offering helpful advice; and my NFMMC family, in particular my boss, Janet, who continuously worked around my busy schedule, not only through this DNP, but also through my BSN.

Lastly, I would like to thank my husband, John, and our daughter, Lena. John, not many people could have offered the support you did while I worked full-time, attended school and had a baby. I never would have made it through this journey without you. Lena, you are the reason I will never give up at anything in life, and I am forever grateful you are mine.
Development and evaluation of an evidence-informed protocol for the nursing care of post-cardiac catheterization patients

In the United States, over one million cardiac catheterizations are performed each year (Benjamin et al., 2017). The purpose of the procedure is to evaluate the function of the heart (American Heart Association [AHA], 2017). The most common form of the procedure, left heart catheterization, is performed diagnostically or therapeutically to determine the existence and extent of coronary artery disease (CAD), assess left ventricular function, and/or to evaluate the heart’s valves or myocardium (AHA, 2017).

There are numerous post-cardiac catheterization (PCC) complications that may occur. The most common complications are vascular access site complications (VASCs), including bleeding, hematoma, pseudoaneurysm, arteriovenous fistula, retroperitoneal hemorrhage, and arterial occlusion (Merriweather & Sulzbach-Hoke, 2012; Schueler). Vascular complications, especially when severe, can increase morbidity and mortality, as well as costs to both the patient and the facility (Schueler et al., 2013). Complications occurring from minor bleeding cost approximately $3,000 to $4,000, while complications occurring from major bleeding range from $7,000 to $14,000 (Gumersell, 2013). Other costs include laboratory and imaging tests, blood transfusions, vascular repair procedures, and if the patient works, loss of wages due to increased time off (Schueler et al., 2013). When recognized and treated in an appropriate and timely manner, severe complications can be avoided or mitigated (Huber, 2009). Recognition and appropriate treatment is dependent on the competence of the Registered Nurse (RN).

**Background and Significance**

In April 2017, NFMMC opened a cardiac catheterization laboratory (CCL) in the hospital’s heart center. At the CCL, approximately 50 cardiac catheterizations are performed each month. The CCL has the ability to do percutaneous coronary intervention (PCI); for
example, angioplasty with stenting, if deemed necessary. Stable PCC patients are brought to the step-down unit and cared for by the staff on this unit. Prior to the unit opening, RNs were given a broad, non-unit specific, two-hour lecture by the lead CCL interventionalist concerning the procedure and potential complications, as well as a brief in-service with the RN director of invasive and non-invasive cardiac services at NFMMC, regarding nursing care. Additionally, there is an over 300-page procedural outline on the step-down unit describing the basic care of the patients. This outline alludes to what the RN might document, but offers no explicit explanation. A generic, PCC physician order set is generally set in place by the time the patient arrives to the unit, displaying how often to document vital signs, “neurovascular checks,” and to discharge the patient when “stable;” yet, these orders are vague and leave room for inconsistencies.

Evidence-based practice (EBP) protocols have been shown to improve patient safety and quality; however, in the development of EBP protocols, explicit computerized documentation templates are frequently disregarded during the development process (Dols, Munoz, Martinez & Mathers, 2017). Failure to include these greatly limits the policy and its potential for successful implementation (Dols et al., 2017). Further, nursing protocols should be designed to flow with the nursing practice where they are intended to be utilized (Dols et al., 2017). Since the CCL has opened at NFMMC, numerous questions have arisen regarding the proper procedures, how they pertain to individual patients (i.e. those on blood thinners, those who have received angioplasty with stenting, etc.), what exactly needs to be documented and how often. Additionally, while a great deal of research has shown increased complication rates in patients undergoing PCI when accessed femorally versus radially (Jolly et al., 2011; Valgimigli et al., 2015), this is not addressed in NFMMC’s guidelines.
The lengthy procedural outline and lack of consistency among nurses has created questions regarding documentation, changes to generic order sets if a patient experiences a minor complication (i.e. bedrest duration change following minor bleeding), and most importantly, what to do if a complication occurs. Oftentimes, nurses are consulting other nurses with little or no experience to direct their actions. This confusion takes away from the time spent with patients, including the precious time necessary to recognize, prevent, or treat complications. Despite research supportive of clear evidence-based protocols and consistency within nursing practice, no such protocol exists at NFMMC for PCC patients.

**Gap in Practice**

The ability of the RN to recognize and adequately respond to a PCC complication is crucial; however, there are no standard guidelines for the nursing care of PCC patients or for the management of PCC complications. This gap exists despite literature declaring a need for standardized guidelines for over a decade and despite the rapidly expanding use of cardiac catheterization and the technological advancements that have accompanied the expansion (Harper, 2007; Huber, 2009; Rolley et al., 2008; Sulzbach-Hoke, Ratcliffe, Kimmel, Kolansky, & Polomano; 2010). The lack of universally accepted evidence-based guidelines may increase complication rates if nurses are unaware of how to identify and react to potential complications, or are unaware of the factors that place patients at greater risk for complications (Rolley et al., 2009).

After reviewing anonymous information submitted from healthcare facilities in Pennsylvania to the Patient Safety Authority’s reporting system from June 2004 to December 2006, Huber (2009), found that roughly half of the medical errors reported were related to complications of cardiac catheterization. The most common causes were errors in medications,
assessments, lack of proper intervention due to the inability to recognize changes in a patient’s condition, and unintentional sheath removal (Huber, 2009). This led to the conclusion that nurses caring for PCC patients require guidelines and ongoing education regarding the recognition and prevention of complications (Huber, 2009). Although this article lacks a proper study design, it supports Rolley et al.’s (2009) systematic literature review which found little data on PCC care. Sulzbach-Hoke et al. (2010) state that while there have been increases in the number of cardiac catheterizations, along with technological advances, the rates of VASCs have remained steady due to a lack of universally accepted evidence-based guidelines. They conclude that until these guidelines are developed, institutions should work to develop their own policies and procedures that align with supportive, existing evidence.

**Statement of Purpose**

The purpose of this capstone project was to create and conduct preliminary testing of an evidence-informed protocol addressing the nursing care of PCC patients at NFMMC. Appropriate nursing care of PCC patients may contribute to a reduction in complications or a decrease in the response time to complications, correlating to decreased recovery times and reduced costs to both the patient and the facility. An evidence-informed protocol that aligns with the flow of nursing care on the step-down unit at NFMMC may be a useful tool in ensuring the appropriate care of PCC patients.

The **specific aims** for this project were to:

1. Develop an evidence-informed protocol for the nursing care of PCC patients at NFMMC.
2. Identify the current confidence and preparedness of the RNs on the step-down unit in caring for PCC patients.
3. Conduct preliminary testing to determine if the protocol is an acceptable and usable tool (i.e. fit with workflow, appropriate length, content inclusion, readability, and its use of appropriate terms).

The guiding research question was as follows:

Does an evidence-informed, point-of-care nursing protocol for the care of post-cardiac catheterization patients provide an acceptable and usable tool for the RNs on the step-down unit at Niagara Falls Memorial Medical Center?

**Literature Review**

Developing an evidence-based protocol for PCC patients includes a sound knowledge of current evidence, including prevalence, risk factors, and management of complications, as well as examining what already exists at NFMMC and how to best align it with evidence-based practice (EBP). An evidence-informed protocol was created based on current evidence regarding basic PCC care, common complications, recognition and management of common complications, as well as input from the Medical Director of the cardiac catheterization laboratory at NFMMC, Dr. Neil Dashkoff. To develop the protocol, literature regarding basic PCC care and the care of PCC complications was considered, along with protocols used at other hospitals. To test the protocol, literature concerning acceptability and usability of nursing protocols was considered.

**Complications**

Complication rates for cardiac catheterization are low; however, the potential complications are serious and often life-threatening. The risk of complications is increased in patients who receive therapeutic intervention, such as PCI compared to those who undergo diagnostic angiography (Merriweather & Sulzbach-Hoke, 2012). Advancements in antiplatelet
and antithrombotic medications used in PCI have contributed to an increased risk of VASCs; however, their use is crucial, as they help decrease major complications, such as myocardial infarction (MI) and stroke (Merriweather & Sulzbach-Hoke, 2012). Additional modifiable risk factors include access site, sheath size, number of access attempts, operator experience, and arterial closure method (Lee et al., 2014). Non-modifiable risk factors include female gender, low body mass index (BMI), age greater than or equal to 70 years, low baseline platelet and hematocrit levels, and medical histories that include hypertension, peripheral vascular disease (PVD), congestive heart failure (CHF), or kidney disease (Huber, 2009; Merriweather & Sulzbach-Hoke, 2012).

Complications may be reduced when transradial access (TRA) rather than TFA is used (Jolly et al., 2011; Koifman et al., 2017; Pristipino et al., 2009; Valgimigli et al., 2015). In a randomized, multicenter, superiority study, Valgimigli et al. (2015) found significant reductions in both major cardiovascular events (8.8% versus 10.3%; \( p = 0.03 \)) and net adverse clinical events (11.7% versus 9.8%, \( p = 0.01 \)) when TRA versus TFA was used. This study aligns with Jolly et al.’s (2011) multicenter study showing lower rates of major vascular complications when using TRA versus TFA. In another large, multicenter study, Pristipino et al. (2009) found reductions in both minor and major bleeding with TRA versus TFA (4.2% versus 1.96%, \( p = 0.03 \)), with the results being most significant in acutely ill and heavily anti-coagulated patients. Reasons include the superficiality and compressibility of the radial artery, and the fact that it is not an end artery; meaning serious complications and surgery can be avoided because the hand is supplied by both the ulnar and radial arteries (Schueler et al., 2013). Factors that deter radial access include hemodynamic instability, female gender, radial artery spasm, abnormal modified
Allen test result, weak radial pulses, and age greater than 70 years (Lee et al., 2014; Schueler et al., 2013).

**Assessment and Documentation**

The Society for Cardiovascular Angiography and Interventions (SCAI) consensus statement on the 2016 best practices in the cardiac catheterization laboratory promote monitoring PCC patients on telemetry until they are discharged, and checking vital signs and access sites every 15 minutes for the first two hours the patient is on the unit (Naidu et al., 2016). During these checks, neurovascular assessments, including pulses, color, motion, pain, and sensation of the extremity distal to the access site should be completed (Huber, 2009). Patients should also be assessed for a bruit, which may indicate a vascular complication, such as a pseudoaneurysm or arteriovenous fistula (Huber, 2009).

If the patient underwent diagnostic catheterization, their length-of-stay should be approximately two-to-six hours, depending on the access site (shorter for radial, longer for femoral), how well the patient is ambulating, and the overall RN assessment (Naidu et al., 2016). In patients who underwent PCI, further considerations include comorbidities, site complications, and their future needs for testing (Naidu et al., 2016). Patients undergoing elective, non-emergent PCI, can be considered for same-day discharge after six-to-eight hours (Naidu et al., 2016). The length of bedrest with femoral access ranges in the literature from two-to six-hours (Huber, 2009), and there are no bedrest recommendations for patients accessed radially.

**TR Band.** For patients accessed transradially, an additional aspect of nursing care, assessment and documentation is necessary - the TR band. The TR band is placed in the CCL after sheath removal and provides compression to the radial artery until hemostasis is achieved. It is filled with air which is gradually removed by the RN providing PCC care. Although the
manufacturer does not provide instruction on compression time and there is sparse literature describing best practice of TR band removal, proper maintenance and removal is essential for obtaining hemostasis in the PCC patient (Dangoisse et al., 2017). In patients who underwent diagnostic intervention, hemostasis can likely be achieved by removing air 60 minutes post-procedure at a rate of 2 mLs every 10 minutes with the application of a dry, sterile dressing once all air has been removed (Deuling, Vermeulen, van den Heuvel, Schurer, & van der Harst, 2017). In patients who received PCI, hemostasis can likely be achieved by removing air 90 to 120 minutes post-procedure at a rate of 2 mLs every 10 minutes with the application of a dry, sterile dressing once all air has been removed (Dangoisse et al., 2017). A greater risk for radial artery occlusion (RAO) may exist if the band is left fully inflated for greater than 120 minutes (Dangoisse et al., 2017).

**Treatment of Common Complications**

VASCs are the most common complications following cardiac catheterization; therefore, their basic treatment was included in the protocol. The literature provides a great deal of information regarding the recognition and treatment of VASCs.

**Bleeding.**

*Transfemoral access.* If a nurse notes bleeding, manual pressure should be applied to the site, all anti-coagulants should be stopped, and the physician should be notified (BMC2 PCI-VIC, 2014). If stable, the nurse should continue to monitor for re-bleed. If instability is noted, two large bore IVs should be started, STAT packed red blood cells should be acquired, and labs including CBC with differential, PTT, and PT should be drawn. Additionally, an ultrasound and ECG should be obtained (BMC2 PCI-VIC, 2014).
**Transradial access.** If a nurse notes bleeding in a patient accessed transradially, all anticoagulants should be stopped and the TR band should be reapplied and/or re-inflated until the bleeding stops (maximum addition of air is 18mL) and remain re-inflated for 30 minutes before air is once again removed at a rate of 2mL every 10 minutes (Forbes Regional Hospital, 2012). If bleeding continues, the nurse should apply manual pressure and call the physician immediately. If instability is noted, the same procedure should be followed as listed above.

**Hematoma.** A hematoma is a collection of blood in the soft tissue which occurs as the result of arterial or venous perforation (Merriweather & Sulzbach-Hoke, 2012). A hematoma presents as swelling around the puncture site and may be palpable (Merriweather & Sulzbach-Hoke, 2012). A severe hematoma may cause hypotension, tachycardia and a decrease in hemoglobin (Merriweather & Sulzbach-Hoke, 2012). Regardless of access site, if the nurse suspects a hematoma, (s)he should apply pressure to the area, mark the area, maintain bedrest, stop any anti-coagulants, monitor blood count, and notify the physician (Merriweather & Sulzbach-Hoke, 2012). A severe hematoma may require blood products or surgery (Merriweather & Sulzbach-Hoke, 2012). A femoral hematoma should be initially managed by immediate manual compression of the hematoma and proximal femoral artery for 20 to 30 minutes (Tavakol, Ashraf, & Brener, 2012). Tavakol et al. (2012) states that in their experience, in the absence of further bleeding or a false aneurysm, this method results in complete resolution of the hematoma.

Bertrand (2010) created a forearm hematoma classification guide, grading forearm hematomas according to their size, which correlates with severity and proper management. Management of grade I (<5cm) and grade II (<10cm) forearm hematomas require the need for an additional transradial band (TR band), local ice application, and analgesia, while management of
grade III and IV forearm hematomas, which include the entire length of the forearm and extension beyond the forearm, respectively, require the need for an additional TR band, an inflated blood pressure cuff placed over the hematoma, local ice application, and analgesia (Bertrand, 2010). A grade V hematoma is classified as a hematoma that has led to compartment syndrome and requires surgical intervention (Bertrand, 2010).

**Pseudoaneurysm.** A pseudoaneurysm is an open tract between the tissues and the wall of an artery, causing blood to leak into the tissue (Merriweather & Sulzbach-Hoke, 2012). It presents as swelling at the insertion site with ecchymosis, a large, often painful hematoma, and possibly, a pulsatile mass (Merriweather & Sulzbach-Hoke, 2012). If the nurse suspects a pseudoaneurysm, (s)he should stop any anti-coagulants, maintain bedrest and notify the physician immediately. Small pseudoaneurysms may resolve spontaneously, but larger ones may require surgical intervention or ultrasound-guided thrombin injection (Merriweather & Sulzbach-Hoke, 2012).

**Retroperitoneal hemorrhage (RPH).** RPH is specific to femoral access. It is defined as bleeding between the serous membrane and the abdominal or pelvic walls (Merriweather & Sulzbach-Hoke, 2012). Symptoms include vague to severe back, flank, or abdominal pain, hypotension, tachycardia, and abdominal distention (Merriweather & Sulzbach-Hoke, 2012). Late signs are ecchymosis and decreased blood counts, and late recognition may be fatal (Merriweather & Sulzbach-Hoke, 2012). If RPH is suspected, the nurse should provide hydration, monitor blood counts, prolong bedrest, stop anti-coagulants, be ready to provide a blood transfusion, and notify the physician immediately; a severe bleed may require prompt surgical intervention (Merriweather & Sulzbach-Hoke, 2012). Diagnosis is confirmed by computed tomography (Merriweather & Sulzbach-Hoke, 2012).
**Radial artery occlusion (RAO).** Due to the small size of the radial artery and the dual vascular supply of the hand, RAO is a common, and often quiescent complication of TRA (Rashid et al., 2016). Risk factors may include female gender, older age, and larger sheath size (Rashid et al., 2016). The risk is reduced by higher doses of heparin (Rashid et al., 2016). RAO often presents as an absent radial pulse in an asymptomatic individual; however, possible symptoms may include hand pain or index finger and thumb paresthesia in the hand where TRA was performed (Patwardhan, Mehra, Movahed, & Daggubati, 2016). If dual supply from the palmar arch is inadequate, hand ischemia is possible (Patwardhan et al., 2016). However, in most cases RAO is asymptomatic and its long-term effects include loss of a future access site for PCI, a conduit for coronary artery bypass grafting (CABG), or a fistula site in hemodialysis (Rashid et al., 2016). RAO is confirmed by ultrasound and often treated successfully with enoxaparin or fondaparinux (Patwardhan et al., 2016).

**Guidelines for practice**

The development and application of evidence-based protocols have shown to improve care, outcomes, nurses’ skills, and be an acceptable and usable tool to the RNs for whom they are intended (Kenny & Goodman, 2010; Stacey et al., 2012). Stacey et al. (2012) developed and evaluated a needs-based, evidence-informed protocol for support of cancer-induced symptoms for nurses providing telephone assessment. Testing the new protocol prior to implementation showed a high level of acceptability and usability, including fit with workflow, length, content inclusion, readability, and use of appropriate terms (Stacey et al., 2012).

A nationwide program for military nurses was implemented to incorporate evidence into practice for patients receiving enteral feedings. Pre-test data were gathered regarding nursing knowledge prior to developing the protocol, then an evidence-based protocol was implemented
(Kenny & Goodman, 2010). Results of the study, including pre/post-test comparisons, chart reviews, and environment of care data showed statistically significant increases in staff knowledge and improved documentation (Kenny & Goodman, 2010).

Habich & Letizia (2015) implemented an evidence-based pain assessment protocol at a pediatric community hospital with the goal of improving nurses’ knowledge and standardizing care. The methods included a pre-test, an educational program, protocol exposure, then a post-test. The results of the study showed significant differences in the mean pre- and post-test scores, and a review of records showed consistent protocol use (Habich & Letizia, 2015).

**Theoretical Framework**

The seven-step IOWA model was chosen as the theoretical framework for this Capstone project. The IOWA model was developed by Marita G. Titler in 1994 at the University of Iowa Hospitals and Clinics to direct nurses and other healthcare professionals (HCPs) in using research to better care for their patients (Titler et al., 2001). The model has been used by HCPs all over the world, as well as in many influential studies (Titler et al., 2001). The model was updated in 2001 and 2015 to incorporate feedback from end-users and to evolve with the ever-changing world of healthcare (Steelman, 2015). The steps involved in the IOWA model are: (1) identify the issue/opportunity, (2) state the question, (3) form a team, (4) assemble, appraise, and synthesis evidence, (5) design and pilot the practice change, (6) integrate and sustain practice change, and (7) disseminate results (Steelman, 2015).

The Iowa model is a good fit for this project because it provides a step-by-step framework for healthcare professionals looking to incorporate evidence into practice. While each step was not fully addressed, given the restricted time-frame, the majority were covered and an opportunity to pilot and implement the protocol will be considered in future implications.
The first two steps in the IOWA model, identify the issue/opportunity and state the question, have previously been addressed in this paper. This brings us to step three, forming a team. The team for this project includes the primary investigator, the Medical Director of the cardiac catheterization laboratory at NFMMC, as well as the end-users whose input will eventually be used to update and refine the protocol.

Step four, assemble, appraise, and synthesize evidence - a synthesized literature review assisted in the formation of the research question. There is strong evidence supporting the need to standardize the care of PCC patients, as well as a great deal of information regarding how to care for the most common complications. The literature was appraised and synthesized by the primary investigator and the best evidence was incorporated into the protocol. Evidence-based guidelines regarding best PCC care, especially systematic reviews and clinical studies, were given priority, as well as those pertaining to developing and testing nursing protocols.

Step five is designing and piloting the change. This step involves protocol development and refinement. Baseline data, including acceptability and usability is also covered in this step. This data was collected and analyzed, and for the purposes of this project, its analysis served as an end-point; however, integrating the protocol into practice, sustaining the practice change, and post-implementation testing will be considered as a future project. Aligning with the IOWA model, the process is continuous and ever-evolving.

**Methods**

A mixed methods, embedded design was used. This type of design includes a small portion of qualitative or quantitative data embedded within a larger qualitative or quantitative study (Creswell & Clark, 2007). It is considered useful when open-ended questions are asked for the purposes of collecting qualitative data in a survey or questionnaire (Creswell & Clark, 2007).
Further, due to the study’s limited time frame, practicality was taken into account (Creswell & Clark, 2007).

A point-of-care protocol for the nursing care of PCC patients was developed from a combination of current evidence-based literature regarding PCC care, PCC protocols used at other hospitals, NFMMC’s generic PCC order-set, and a PowerPoint presentation developed by Dr. Neil Dashkoff, the Medical Director of the CCL at NFMMC (see Appendix D). The Medical Director also reviewed and made minor edits to the protocol before it was shown to potential study participants. Consideration was given to the fast-paced environment of the step-down unit at NFMMC in terms of length, font size, and inclusion material.

The protocol along with a demographic (paper and pencil) survey (see Appendix B) asking years of RN experience, age range, education level, gender, and prior experience with post-catheterization care, as well as two Likert-type surveys were offered to potential participants. Survey 1 (see Appendix C) served the purpose of determining their current attitudes and behaviors pertaining to PCC care. It was broken into two domains, (1) views on the current resources available at NFMMC (questions 2, 4 and 9) and (2) their perceived confidence and preparedness in caring for PCC patients (questions 3, 5, 6, 7 and 8). Question 10 on Survey 1 did not fit into either domain and was analyzed separately. Survey 2 (see Appendix E) concerned their perceptions of the protocol. It was also broken into two domains, (1) acceptability (questions 1 through 4) and (2) usability (questions 5 through 10). Potential participants were prompted to first complete the demographic survey and Survey 1, then to review the protocol independently and to complete Survey 2, which questioned participants about the protocol’s fit with workflow, length, content inclusion, readability, and its use of appropriate terms (Stacey at al., 2013). Directions were clearly listed under “procedures” on the “Information Sheet” (see Appendix A); however if participants
completed the surveys out of order, it is unlikely the results were affected. Nevertheless, because there was no way to monitor if participants waited a period of time before completing them, it is possible they sought out unit resources prior to answering questions about resources on the unit. Further, there was no way to monitor whether participants completed Survey 2 immediately after reading the protocol or waited; however, given the homogeneity of the results of this survey, it is unlikely the lack of monitoring affected the perceptions of the participants.

Participants were asked to rate survey questions on a scale of one to five (where one = strongly disagree; two = disagree; three = neither agree nor disagree; five = strongly agree). A comments section was included at the end of Survey 2, asking for suggestions and comments for the purposes of refining the protocol to better fit their needs. The demographic survey served to identify relationships among survey questions and participant characteristics.

All Registered Nurses working on NFMMC’s step-down unit were invited to participate. This includes day and night-shift RNs, three float pool RNs, and an RN who has been designated to care for post-catheterization patients. A total of 28 nurses met the inclusion criteria and were invited to participate. Nurses were recruited via a flyer located on the bulletin board in the conference room of the step-down unit (where other informational items are located). The flyer informed potential participants of the survey and protocol and invited them to participate. In addition, the primary investigator explained the study to potential participants at bi-weekly staff meetings. The protocol and all surveys were located in this room for three weeks and potential participants had access to these at any time during the three weeks. An information and consent sheet was included with the surveys and protocol. Individual packets, including the information and consent form, a demographic survey, both Surveys 1 and 2, and the protocol were made in advance to ensure each participant viewed the consent form and had access to each study
A locked drop-box was located in this room for participants to place their anonymous surveys.

Likert-type surveys were used because their intention is to measure attitudes and opinions of a sample of individuals, a crucial part in developing an instrument designed to fit the needs of that sample (Losby & Wetmore, 2012). Additionally, it was proposed that the simplicity of the surveys would promote a high response rate. The surveys were evaluated quantitatively, but Survey 2 included a comments section that was analyzed qualitatively.

The surveys did not ask any personally identifiable information and finished surveys were not accessible to anyone except the primary investigator. The study was approved by the ethics committee at NFMMC and by the Institutional Review Board (IRB) of the University at Buffalo, IRB approval #FWA00008824.

**Statistical Analysis**

Survey data were uploaded into IBM SPSS Statistics for Windows, Version 24.0. Demographic data were summarized using descriptive statistics, including frequencies and percentages. To promote analysis, two study variables were re-grouped into two ranges (presented in Table 2); experience (0-5 years and > 5 years) and age (20-45 years and > 45 years). Experience was re-grouped this way on the basis of Patricia Benner’s Model of Clinical Competence, describing novice nurses as having less than five years’ experience and experienced nurses having greater than five years’ experience; a model which has been widely utilized in nursing literature (Benner, 2011). This model states experienced nurses use their past experiences to guide their actions, while novice nurses have a greater reliance on abstract principles (Benner, 2011). Re-grouping of age was based primarily on having and an equal distribution of groups.
A domain score was calculated for each of the two domains in *Survey 1* and in *Survey 2* by summing all item responses (with response codes 0 to 5) and dividing these by the total number of domain items. Additionally, a total domain score was calculated for each participant for each of the four domains, or study variables (resources, knowledge/preparedness, acceptability and usability). Once the participant domain scores were calculated and entered into SPSS, correlation analyses were conducted to determine relationships and relationship significance between demographic variables and study variables.

Correlation analyses generated Pearson’s $r$ coefficient values, which by definition, range from -1 to +1 (Mukaka, 2012). A coefficient of -1 indicates a perfect negative linear relationship while a coefficient of +1 indicates a perfect positive linear relationship, and a coefficient of zero indicates no relationship between variables (Mukaka, 2012). The stronger the correlation, the closer the coefficient is to ±1 (Mukaka, 2012). For the purposes of this study, an alpha value of 0.05 was used, meaning $p$ values less than 0.05 are considered statistically significant.

**Results**

**Quantitative Analysis**

A total of 28 RNs on the step-down unit at NFMMC were asked to participate in the study. Twenty-five of these RNs returned completed surveys (89.3%). Demographic data are presented in Table 1. The majority of the participants were female (80%), which is representative of the overall sample. Thirty-six percent of the sample had zero to five years of experience, while 24% had greater than 25 years of experience. The age group of participants was varied, with 72% aged between 26 to 55 years. The highest level of education in nursing showed mixed results, with the greatest number of respondents holding an Associate’s degree in nursing (56%) or a
Bachelor’s of Science degree in nursing (40%). Only one respondent (4%) held a Master’s degree in nursing. Interestingly, 96% (24/25) of participants had no prior PCC experience.

Domain scores were calculated for each of the four domains in Survey’s 1 and 2. The calculated domain score for availability of resources was 2.52, indicating low to neutral perceptions about the current available resources on the unit. The calculated domain score for confidence/preparedness was three, indicating overall neutral perceptions of the RNs ability to care for PCC patients. Domain scores for acceptability and usability were 4.48 and 4.61, respectively, indicating the RNs agree to strongly agree that the protocol is both acceptable and usable. One-hundred percent of participants agreed or strongly agreed that a point-of-care protocol would be helpful in clinical practice (Question 10, Survey 1), and after reading the protocol 100% of the participants agreed or strongly agreed they would use it in clinical practice (Question 10, Survey 2).

Table 3 shows the correlation analysis of participant demographic variables with study variables. A correlation analysis revealed a moderate positive relationship between years of experience and perceived availability of resources on the unit (Pearson’s r = 0.481, p < 0.05), suggesting those with more experience (six or more years) believe the currently available resources are more adequate to assist with PCC care compared to those with less experience (zero to five years). Moderate negative relationships were found comparing experience with both acceptability and usability (Pearson’s r = -0.466 and -0.428, respectively, p < 0.05), suggesting those with less experience find the protocol more acceptable and useful than those with more experience. There was no significant correlation between years of experience and confidence/preparedness.
When comparing age with resource availability, confidence/preparedness, and protocol acceptability and usability, the only statistically significant relationship occurred between age and perceived resource availability (Pearson’s \( r = 0.494 \), \( p < 0.05 \)), suggesting older nurses (46+ years old) believe the currently available resources are more adequate to assist with PCC care compared to their younger counterparts (20 to 45 years old). Gender was not associated with any statistically significant relationships amongst study variables.

There was a weak to moderate negative relationship between education level (Associate’s degree versus Bachelor’s degree or higher) and perceived resource availability (Pearson’s \( r = -0.419 \), \( p < 0.05 \)), meaning those with less education found the resources to be more adequate. It is possible this relationship can be accounted for by the fact that many of the younger nurses on the unit tend to have their Bachelor’s degrees. A correlation was run between education level and age and a negative relationship was found; however, it was not significant at the \( p < 0.05 \) level (Pearson’s \( r = -0.299, p = 0.147 \)). Education level was not significantly associated with perceived confidence/preparedness, protocol acceptability or protocol usability.

**Qualitative Analysis**

The last question on Survey 2 asked participants for feedback or suggestions for protocol improvement (positive or negative). Twelve participants (48%) provided comments. The majority (58%) of those who commented provided brief, positive feedback, stating the protocol was “helpful,” “clear,” and “easy to follow.” Three participants suggested inclusion of a “documentation sheet” or “flowsheet,” in order to quickly write down vital signs and assessments and later enter these data into the computer. One participant suggested separating femoral and radial protocols to assist with ease of use. Additionally, one participant stated the “protocol is comprehensive, but may be difficult to conform with given the current nurse-to-
patient ratio.” Each of these comments and suggestions will be useful when the protocol is refined to better fit the needs of the end-users.

**Discussion**

Results of this single-center study demonstrate the usefulness of a point-of-care protocol addressing the nursing care of PCC patients. Currently, there is no standardized protocol or method of training nurses who care for post-catheterization patients; however, studies conducted on the topic demonstrate a knowledge deficit among nurses. The costly and serious mistakes that may occur due to lack of nursing competency are profound. At NFMMC, the nurses who care for PCC patients generally have a full assignment of acutely ill patients with vastly different needs than PCC patients. Given the brevity of RN training at NFMMC, along with the identified lack of experience in caring for PCC patients, the likelihood of serious complications may be increased.

The study was completed for the purposes of developing a post-catheterization protocol that assists RNs in the basic assessment, as well as the recognition and proper reaction to potential complications. Analysis of the characteristics of the nurses’ caring for PCC patients at NFMMC and preliminary analysis of the acceptability and usability of the protocol will assist in future refinement of the protocol to better fit their needs.

Results of the study demonstrate a need for additional resources on the unit for nurses caring for PCC patients. Low to neutral aggregate domain scores for perceived available resources and confidence/preparedness reveals the need for further training and/or resources to provide the nurses with the ability and preparation to confidently care for PCC patients. The results show older nurses with more experience perceive the current available resources as more acceptable than their younger, less experienced counterparts. This may be attributed to the fact
that more experienced nurses on the step-down unit at NFMMC tend to be older and their experience may have led them to a greater knowledge or use of available resources. Additionally, they may be more aware of who to ask when they have questions about a particular area of nursing. Given this information, it not surprising that nurses with less experience rated the protocol higher in terms of acceptability and usability. This result aligns well with Benner’s Stages of Clinical Competence described previously.

Along with additional training and resources concerning PCC care, the protocol may be especially useful for orienting and training new RNs on the step-down unit. A way to incorporate the protocol into orientation and training would be to develop more elaborate resources, such as computerized or paper documents covering each aspect of PCC care, including assessment, documentation, potential complications, and appropriate discharge. The protocol could serve as a supplement to these more elaborate documents, as it is designed for quick reference. Elements of the documents and the protocol should be discussed at length with new and current employees to ensure they are confident in the care they provide to PCC patients.

**Ethics**

Based on the design of the study, there were no safety issues jeopardizing the participants. The information and consent form explained any potential risks and benefits, as well as an explanation of the confidentiality and anonymity of participation. No compensation was offered. Management and administration were not given information regarding who did and did not participate. IRB approval was obtained from both the University at Buffalo and NFMMC. The identity of participants was protected by keeping survey information anonymous and not asking any identifying questions. Completed surveys will be kept in in a locked filing cabinet at the University at Buffalo for at least three years, then will be disposed of per the
University’s protocol. Survey information was entered into SPSS by the Primary Investigator and all results were reported collectively.

**Strengths**

There were several strengths to this study. First, the development of a needs-based, evidence-informed protocol, may ultimately promote consistency of care, prevention of common complications, and the ability to recognize and appropriately treat complications. Ideally, lesser rates of morbidity and mortality, and cost-savings to both the patient and the facility, will be achieved. A second advantage to the development of the protocol is its ability to be tailored to any environment where RNs provide care for PCC patients. Feedback from the end-users at NFMMC may assist future researchers in developing a PCC protocol for their particular workplace.

A third strength is the fact that the primary investigator and protocol developer is also an end-user. An in-depth understanding of the unit’s pace and culture ultimately facilitated the development of a protocol that was rated highly amongst its end-users.

Another strength of this study was the high response rate. Almost 90% of the subjects meeting inclusion criteria participated and answered every survey question; therefore, the results are highly representative of the population of RNs on the step-down unit at NFMMC. The high response rate can likely be attributed to the simple design and the high level of interest in the topic by the participants, as it pertains directly to their jobs. Furthermore, the anonymity of the surveys allowed participants to share their opinions without being identified.

**Limitations**

A major limitation to this one-center, one-unit study is its lack of generalizability. However, although the results cannot be generalized to other units and facilities, the protocol
includes current best evidence, as well as expert opinion, and therefore, can be tailored and tested in almost any environment where RNs care for post-catheterization patients.

A second major limitation is the lack of implementation. As stated previously, due to the limited timeframe, the protocol has not yet been refined and implemented. Nevertheless, based on the preliminary acceptability and usability results, the protocol can be updated and implemented at any time.

Limitations of survey data include truthfulness of the respondents and potential response bias. The survey was conducted by employees and is questioning their ability to carry out job requirements; therefore, it is possible participants did want to appear as if they cannot carry out these requirements. Also, since there is no previously validated survey measuring knowledge and confidence in caring for PCC patients, the survey may contain error. The surveys were tailored by the primary investigator to answer the research question at hand. In order to mitigate error, the surveys asked clear and concise questions, leaving little room for confusion.

Lastly, as mentioned previously, there was no way to monitor when the participants completed the surveys or they followed the directions listed on the information sheet regarding the order of survey completion. It is possible participants sought out unit resources prior to completing the questions about resource availability; thus, skewing the results of this section either positively or negatively.

**Implications for Practice**

This project served as a reference point for future development and use of PCC nursing protocols. As stated previously, no nationwide guidelines for PCC nursing care or training exist. By developing and sharing evidence-based guidelines at single centers, nurse educators and researchers can work to standardize and optimize the care of PCC patients everywhere.
Future implications for this particular project include refining the protocol based on the quantitative and qualitative data the survey participants provided, then implementing it into practice. A pilot study would be helpful to determine if the protocol is feasible for use in clinical practice. Given the results of Survey 1, displaying an overall lack of confidence and preparedness perceived by the RNs at NFMMC in terms of PCC care, it is clear additional training and materials are necessary, especially for younger, inexperienced nurses. This may include mandatory education sessions provided by the education department at the hospital or unit specific methods of training. Evaluating and updating the protocol and other training methods should occur regularly and should be a team effort.

Once the protocol has been implemented, a future project that may provide more objective data includes checking the consistency of computer documentation before and after implementation of the protocol. It would also be helpful to question the nurses’ knowledge and confidence post-implementation, either through the use of surveys and/or knowledge-based testing. Lastly, the protocol should be tailored to additional sites, such as the intensive-care-unit (ICU) at NFMMC, or more diverse environments, such as local hospitals with cardiac catheterization laboratories.

**Conclusion**

The aim of this study was to create an evidence-informed protocol for the nursing care of PCC patients at NFMMC and determine if it is an acceptable and usable tool for its end-users. The CCL at NFMMC is relatively new and the current training for nurses caring for PCC patients is minimal; therefore, baseline testing was used to assess their perceptions of the unit’s current resources and determine how confident and prepared nurses felt prior to viewing the protocol. The findings of this study indicate the RNs at NFMMC do not perceive the current
resources as adequate and do not rate themselves highly in terms of confidence and preparedness overall. Both of these findings were especially apparent in younger, less experienced nurses.

NFMMC is a small, privately owned institution which prides itself highly on being the first hospital in Niagara County with a CCL (Niagara Falls Memorial Medical Center, 2017). Increased complications rates due to lack of consistency and competency among nurses has the potential to negatively impact the hospital’s reputation, create a financial burden and place cardiac catheterization patients at risk for higher rates or morbidity and mortality. Conversely, improvement upon the education and training for nurses caring for PCC patients may have the opposite effect. The development of an evidence-informed protocol which addresses the basic care, as well as potential PCC complications, was rated highly among participants of this study. In fact, every nurse who participated agreed they would use the protocol in clinical practice.

The results of this study not only show that an evidence-informed protocol is an acceptable and usable tool for the RNs caring for PCC patients at NFMMC, but opens the door for additional opportunities. To generate a properly trained and empowered nursing staff, future projects within the organization should include broad, unit-specific, training sessions for nurses caring for PCC patients at NFMMC, along with the development and use of resources such as the evidence-informed protocol created for the purposes of this project. The ability to tailor the protocol to fit any environment where nurses care for PCC patients may eventually contribute to the development of regional or national standards.
References


Table 1

*Characteristics of Survey Participants (N=25)*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>(%)</th>
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<tr>
<td><strong>Years of RN Experience</strong></td>
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<td></td>
</tr>
<tr>
<td>0-5</td>
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<td>6-10</td>
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<tr>
<td>16-20</td>
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<td>(16)</td>
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<tr>
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<td>(0 )</td>
</tr>
<tr>
<td>&gt;25</td>
<td>6</td>
<td>(24)</td>
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<tr>
<td><strong>Age</strong></td>
<td></td>
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</tr>
<tr>
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<td>1</td>
<td>(4 )</td>
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<td>26-35</td>
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<td>46-55</td>
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<tr>
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<td>(20)</td>
</tr>
<tr>
<td>Female</td>
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<td>(80)</td>
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<tr>
<td>Bachelor’s</td>
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<tr>
<td>Master’s</td>
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<td>(4 )</td>
</tr>
<tr>
<td><strong>Previous Post-Catheterization Experience</strong></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
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<td>(4 )</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>(96)</td>
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Table 2

*Experience and Age of Survey Participants (N=25)*

<table>
<thead>
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<th>Characteristic</th>
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<tr>
<td><strong>Years of RN Experience</strong></td>
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</tr>
<tr>
<td>0-5</td>
<td>9 (36)</td>
</tr>
<tr>
<td>6+</td>
<td>16 (64)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>20-45</td>
<td>14 (56)</td>
</tr>
<tr>
<td>46+</td>
<td>11 (44)</td>
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</table>
Table 3

**Correlation Analysis of Participant Demographic Variables with Resources, Confidence/Preparedness, Acceptability and Usability**

<table>
<thead>
<tr>
<th>Experience (0-5 years/6-10 years)</th>
<th>Age Range (20-45 years/46+ years)</th>
<th>Gender (Male/Female)</th>
<th>Education Level (ADN/BSN or higher)</th>
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</thead>
<tbody>
<tr>
<td><strong>Resources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s correlation</td>
<td>0.481*</td>
<td>0.494*</td>
<td>0.095</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.015</td>
<td>0.012</td>
<td>0.650</td>
</tr>
<tr>
<td>N</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td><strong>Confidence/Preparedness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s correlation</td>
<td>0.175</td>
<td>0.212</td>
<td>0.105</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.402</td>
<td>0.310</td>
<td>0.617</td>
</tr>
<tr>
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<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td><strong>Acceptability</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Pearson’s correlation</td>
<td>-0.466*</td>
<td>0.072</td>
<td>0.029</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>0.892</td>
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<td>25</td>
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<td>25</td>
</tr>
<tr>
<td><strong>Usability</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s correlation</td>
<td>-0.428*</td>
<td>-0.033</td>
<td>-0.070</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.033</td>
<td>0.877</td>
<td>0.740</td>
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<tr>
<td>N</td>
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</table>

*Correlation is significant at the 0.05 level (2-tailed).
Appendix A

Information Sheet
Invitation to Participate in a Research Study

Introduction
You are being invited to participate in a research study titled, “Development and Evaluation of an Evidence-Informed Protocol for the Nursing Care of Post-Cardiac Catheterization Patients.” This study is being conducted by Megan Granchelli through the University at Buffalo, The State University of New York School of Nursing. This research is intended for Registered Nurses who work on the step-down unit at Niagara Falls Memorial Medical Center and care for post-catheterization patients. If you are not an RN or do not care for post-catheterization patients on the step-down unit, please do not participate.

Volunteer Status
Your participation in this study is completely voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You have the right to refuse to answer any question(s) within the enclosed surveys. You may elect to withdraw from this study at any time by not submitting the questionnaire.

Purpose
The purpose of this study is to determine your current attitudes and behaviors regarding post-catheterization care and to conduct preliminary testing of an evidence-informed protocol addressing the after-care of cardiac catheterization patients. The data you provide will be used to refine the protocol to better fit your needs.

Procedure
Three survey documents and a protocol are attached. The first page is a demographic survey. The second page (labeled “Survey #1”) is a Likert-type survey, which will be used to identify your current attitudes and behaviors pertaining to the after-care of post-catheterization patients. After you have completed the demographic survey and Survey #1, please review the “evidence-informed protocol,” then complete “Survey #2. When finished, place the completed surveys in the locked-drop box. The protocol is yours to keep or discard.

Risk
There are no risks involved in your participation in the study.

Benefits
Benefits from having a needs-based, evidence-informed, post-catheterization protocol include increased ability and confidence in carrying out required clinical duties.

Confidentiality
By returning the surveys you are giving implied consent to the investigators to use your survey data for this study. All of your responses will be reported as aggregate or grouped data. No individual responses will be reported. If results are published or presented in a public forum, your identity will not be disclosed, as it is not recorded in any way that associates a name. Data will be kept in a locked file and investigators will be the only ones with access to this file.

For Further Information
Any questions, concerns, or complaints that you may have about this study can be answered by Megan Granchelli at (716) 531-6445 (mechals@buffalo.edu).

If you have any questions about your rights as a subject in a research project, or questions, concerns or complaints about the research and wish to speak with someone unaffiliated with the project, you should contact (anonymously, if you wish), the Office of Research Subject Protection at the Social and Behavioral Science Institutional Review Board at the University at Buffalo at 716-645-6774 or by email at SBSIRB@research.buffalo.edu.
By answering questions in the enclosed surveys and submitting them in the drop-box, you are consenting to participate in this project.
Appendix B

Demographic Survey:

1. Years of experience as a Registered Nurse (RN):
   a. 0-5 years
   b. 6-10 years
   c. 11-15 years
   d. 15-20 years
   e. 21-25 years
   f. More than 25 years

2. Age:
   a. 20-25 years
   b. 26-35 years
   c. 36-45 years
   d. 46-55 years
   e. 56-65 years
   f. Older than 65 years

3. Gender:
   a. Male
   b. Female

4. Highest level of nursing education:
   a. Associates or diploma
   b. Bachelor’s degree
   c. Master’s degree
   d. Doctorate
   e. Other (please specify)

5. Prior to the catheterization laboratory opening at Niagara Falls Memorial Medical Center, did you have experience caring for post-catheterization patients?
   a. Yes
   b. No
Appendix C

Survey #1

Instructions: Please use the scale below to answer each question. If you do not feel comfortable answering a question, please leave it blank. All information will be presented collectively and again, surveys are ANONYMOUS and CONFIDENTIAL.

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

1. I was well-prepared to care for post-catheterization patients prior to the catheterization laboratory opening:
   1  2  3  4  5

2. The resources available on the unit provide adequate guidance for the basic care of post-catheterization patients:
   1  2  3  4  5

3. I was well-prepared to care for post-catheterization complications prior to the catheterization laboratory opening:
   1  2  3  4  5

4. The resources available on the unit provide adequate guidance for recognizing and managing post-catheterization complications:
   1  2  3  4  5

5. I feel confident in my ability to recognize post-catheterization complications:
   1  2  3  4  5

6. I feel confident in my ability to respond to post-catheterization complications:
   1  2  3  4  5

7. I understand what I should be assessing to prevent or mitigate post-catheterization complications:
   1  2  3  4  5

8. I understand what I should be documenting when I assume the care of a post-catheterization patient:
   1  2  3  4  5

9. I know where to go for help in managing post-catheterization complications:
   1  2  3  4  5

10. I believe a point-of-care protocol that addresses basic care, documentation, and how to recognize and manage post-catheterization complications would be helpful:
    1  2  3  4  5
Appendix D

Post-Cardiac Catheterization Nursing Protocol

1. Radial Access Site Management

*Activity:* Bed-rest for 2 hours. Limit movement of affected arm for 3 hours. Do not bend wrist.

*Diet:* Patient may eat after procedure per diet orders.

*Fluids:* Encourage oral fluid intake unless otherwise indicated. IV fluids will generally be ordered for a specified duration (see order set).

*Cardiac monitoring:* until discharge

- **Assess and document** the following q 15 min. x 4; q 30 min. x 2; q 1 hr. x 2; q 4 hrs until discharge:
  - Blood pressure, heart rate, respiratory rate, pulse oximetry, cardiac rhythm
    - No blood pressure readings, lab draws or IV access in affected arm
  - Site (swelling, bleeding, oozing, bruising, firmness, pain, intact dressing)
    - Hand of accessed arm (compare to non-accessed arm): warmth, color, sensation (pain, numbness, tingling), presence of a radial pulse, capillary refill

- **VascuBand Removal**
  - Initial volume of air _____mL at _____ hours
    - **Diagnostic Procedure** (i.e. patient received no stents or systemic anticoagulation)
      - 1 hour after the VascuBand application, deflate 2mL of air from cuff. If no bleeding occurs from site, deflate 2mL of air q 10 min. until all air has been removed.
      - If bleeding occurs when 2mL of air is removed, re-inflate with 2mL of air. Wait 30 mins., then if no bleeding, continue deflating 2mL of air q 10 min. until all air is removed. **If bleeding occurs despite addition of air, refer to pages 3 & 4.**
      - Once all air has been removed, apply sterile gauze dressing to access site and wrap wrist with Elastoplast.
      - Discharge 1 hour after dressing applied if stable (i.e. no bleeding; vital signs stable; neuro status unchanged).
    - **Interventional Procedure** (i.e. patient received stent[s]; may or may not be receiving systemic anticoagulation, such as Angiomax [Bivalirudin] or Aggrastat [Tirofibin HCl])
      - 1.5 hours after the VascuBand applied, deflate 2mL of air from cuff. If no bleeding occurs from site, deflate 2mL of air q 10 min. until all air has been removed.
      - If bleeding occurs when 2mL of air is removed, re-inflate with 2mL of air. Wait 30 mins., then if no bleeding, continue deflating 2mL of air q 10 min. until all air is removed. **If bleeding occurs despite addition of air, refer to page 2.**
Once all air has been removed, remove VascuBand, apply sterile gauze dressing to access site, and wrap wrist with Elastoplast.

Most patients who received intervention will stay overnight.

☆ For patients who qualify for discharge ADD EDUCATION in Cerner (Depart →Patient Education→Search and add “radial access site care” and “post-coronary angiogram”→Sign→save/print)

2. **Radial Vascular Access Site Complications (VASCs) and Treatment**
   **Notify Hospitalist and Interventional Cardiologist ASAP**

**i. Bleeding**
   i. Elevate arm
   ii. For minor bleeding, re-apply VascuBand and inflate until bleeding stops (Do not inflate >18 mL)
   iii. If bleeding does not stop, apply manual compression to access site
   iv. Maintain bed rest
   v. Stop any infusing anti-coagulants
   vi. Assess for intravascular volume depletion (tachycardia, widening pulse pressure, hypotension, decreased peripheral perfusion)
   vii. Be prepared for blood transfusion

**ii. Forearm Hematoma** (early presentation may simply be difference in “softness” in between forearm accessed versus non-accessed forearms. Later presentation may be swelling around the puncture site and may be palpable) **See page 5 for photo example**
   i. Small forearm hematomas may only require conservative treatment
   ii. Apply manual compression over the artery, both proximal and distal to the access site
      1. May be done with an additional VascuBand above/below initial band
      2. For larger hematomas (Grade III or IV) inflate BP cuff to <20mmHg of SBP and deflate gradually q 15 mins.
   iii. Maintain bed rest
   iv. Stop any infusing anti-coagulants
   v. Assess for intravascular volume depletion (tachycardia, widening pulse pressure, hypotension, decreased peripheral perfusion)
   vi. Be prepared for blood transfusion
   vii. Confirmation may be done via ultrasound

**iii. Radial Artery Occlusion** (often quiescent due to dual blood supply of hand via palmar arch)
   i. If loss of palpable radial pulse, hand pain, or index finger/thumb paresthesia of accessed arm, notify physician
   ii. If confirmed via ultrasound, treatment is often low molecular weight heparin
iii. Although limb ischemia is rare due to dual blood supply, long-term effects include loss of a future access site for PCI, a conduit for coronary artery bypass grafting (CABG), or a fistula site in hemodialysis

**Risk of VASCs are higher in patients with femoral access and in those who received intervention**

3. Femoral Access Site Management

*Activity*: Bed rest x 2 hrs. after closure device applied, then OOB per MD orders OR bed rest x number of hrs. specified by MD. Duration of bed rest will likely be shorter in *diagnostic* versus *interventional* procedures.

*Diet*: Patient may eat after procedure per diet orders.

*Fluids*: Encourage oral fluid intake unless otherwise indicated. IV fluids will generally be ordered for a specified duration (see order set).

*Cardiac monitoring*: until discharge

- **Assess and document** the following q 15 min. x 4; q 30 min. x 2; q 1 hr. x 2; q 4 hrs until discharge:
  - Blood pressure, heart rate, respiratory rate, pulse oximetry, cardiac rhythm
  - Site (swelling, bleeding, oozing, bruising, firmness, pain, intact dressing)
  - Extremity distal to access site – pulses (dorsalis pedis, posterior tibial), color, temperature, sensation, and capillary refill

- Keep head-of-bed $\leq 30^\circ$ for duration of bed rest.
- Keep affected extremity extended for duration of bed rest.
- If the patient did not receive intervention, it is likely they will be discharged (if outpatient procedure). If they received intervention, such as stenting, they will likely stay overnight.

- For patients who qualify for discharge *ADD EDUCATION*. in Cerner (Depart → Patient Education → Search and add “femoral access site care” and “post-coronary angiogram” → Sign → save/print)

4. Femoral Vascular Access Site Complications (VASCs) and treatment

**Notify Hospitalist and Interventional Cardiologist ASAP**

A. Bleeding

- i. Apply manual compression with fingertips of both hands 2cm above access site until bleeding stops (typically 20 to 30 mins); continue to assess
- ii. Maintain bed rest
- iii. Stop any infusing anti-coagulants
- iv. Assess for intravascular volume depletion (tachycardia, widening pulse pressure, hypotension, decreased peripheral perfusion)
- v. Be prepared for blood transfusion
vi. If bleeding does not stop after 30 mins., follow MD orders

B. **Hematoma** (presents as swelling around the puncture site and may be palpable. See page 5 for pictures)
   i. Apply manual compression over the hematoma to prevent further bleeding
   ii. Stop any infusing anti-coagulants
   iii. Maintain bed rest
   iv. Apply pressure above insertion site to achieve hemostasis. Usually achieved in 5 to 10 mins.
   v. Mark area to monitor for increase/decrease in size
   vi. Assess for intravascular volume depletion: tachycardia, widening pulse pressure, hypotension, decreased peripheral perfusion
   vii. Auscultate hematoma for presences of pulse and a systolic bruit (bruit may indicate pseudoaneurysm).

C. **Pseudoaneurysm** (presents as tender, pulsatile groin mass and an audible bruit)
   i. Stop any infusing anti-coagulants
   ii. Maintain bed rest
   iii. If <2 cm, observe; often close spontaneously
   iv. If >2cm, may need ultrasound-guided thrombin injection or surgical intervention

D. **Retroperitoneal Hemorrhage** (Vague to severe pain that is located in back, flank, or abdomen. Hypotension, tachycardia, diaphoresis and/or abdominal distention will be present. Late signs are Grey Turner’s sign [bruising along flank] and Cullen’s sign [bruising around umbilicus]. Late recognition may be fatal.)
   i. Stop and reverse any infusing anti-coagulants
   ii. Maintain bed rest
   iii. Type and cross 4 units
   iv. Start IV fluids
   v. Non-contrast CT, if and when patient is stable
   vi. May require surgery

E. **Arteriovenous fistula** (asymptomatic, or swollen/tender extremity. May have bruit or thrill at access site)
   i. Maintain bed rest
   ii. Follow physicians orders
   iii. Many resolve spontaneously without treatment
5. **CONDITIONS REQUIRING NOTIFICATION OF HOSPITALIST AND INTERVENTIONAL CARDIOLOGIST** (regardless of access site)

- Chest pain (obtain stat EKG, apply oxygen, then notify physicians)
- Shortness of breath
- Site pain, pain in extremity
- Diminished or loss of pulse(s) in distal extremity
- Abdominal or back pain (femoral access)
- Hypotension (SBP <90)/Hypertension (SBP >160)
- Respiratory distress, signs/symptoms of stroke or over-sedation
- Changes in neuro and/or circulatory status
- Arrhythmias/ST segment changes
- Bradycardia (HR < 50 bpm) or tachycardia (HR > 100 bpm)
- Bleeding/hematoma
- Puncture site lump > small pea size

6. Photo examples of common complications

*Figure 1: Forearm hematoma grading and treatment*

Figure 2: Large femoral (left) and right forearm (right) hematoma

Retrieved from

Figure 3: Cullen’s sign and Grey Turner’s sign are late signs of retroperitoneal hemorrhage

Retrieved from http://www.60secondem.com/visual-diagnosis-16-answers/
References


Appendix E

Survey #2

Instructions: Please use the scale below to answer each question. If you do not feel comfortable answering a question, please leave it blank. Lastly, an optional comments section is listed at the end of the survey; if you choose to leave comments, know these will be presented collectively and are ANONYMOUS and CONFIDENTIAL.

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

1. The protocol fits with the flow of nursing care on the step-down unit at Niagara Falls Memorial Medical Center (NFMMC):
   1          2          3          4          5

2. The protocol is an appropriate length:
   1          2          3          4          5

3. The protocol uses a good font size to promote readability:
   1          2          3          4          5

4. The protocol uses appropriate terms:
   1          2          3          4          5

5. The protocol could provide guidance for the basic care of post-catheterization patients:
   1          2          3          4          5

6. The protocol could provide guidance for the assessment of post-catheterization patients:
   1          2          3          4          5

7. The protocol could provide guidance for recognizing complications of post-catheterization patients:
   1          2          3          4          5

8. The protocol could provide guidance for managing complications of post-catheterization patients:
   1          2          3          4          5

9. The protocol could provide guidance for post-catheterization documentation:
   1          2          3          4          5

10. I would use this protocol in clinical practice:
    1          2          3          4          5

11. Please provide any feedback or suggestions for protocol improvement (positive or negative). This may include comments pertaining to the above questions or general comments or questions about the protocol itself:
September 14, 2017

Dear Megan Granchelli,

On 9/14/2017, the University at Buffalo IRB reviewed the following submission:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study</th>
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<tr>
<td>Title of Study:</td>
<td>Development and Evaluation of an Evidence-Informed Protocol for the Nursing Care of Post-Cardiac Catheterization Patients</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Megan Granchelli</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00001790</td>
</tr>
<tr>
<td>Funding:</td>
<td>None</td>
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<td>Grant ID:</td>
<td>None</td>
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<tr>
<td>IND, IDE, or HDE:</td>
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  - Ethics committee approval from Niagara Falls Memorial Medical Center, Category: Site Permission Letter;  
  - GranchelliM_flyer.pdf, Category: Recruitment Materials;  
  - Granchelli_cardiac_cath_protocol.docx, Category: Other; Category: Surveys/Questionnaires;  
  - GranchelliInformation_Sheet_and_Surveys.docx, |

The University at Buffalo Institutional Review Board has considered the submission for the project referenced above on 9/14/2017 and determined it to be Exempt.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the Click system.

UBIRB exemption is given with the understanding that the most recently approved procedures will be followed and the most recently approved consenting documents will be used. If modifications are needed that may change the exemption determination, please contact the UB IRB Office. Also, see the Worksheet: Exempt Determination (HRP-312) for information on exemption criteria and categories.

As principal investigator for this study involving human participants, you have responsibilities to the SUNY University at Buffalo IRB (UBIRB) as follows:
1. Ensuring that no subjects are enrolled prior to the IRB approval date.

2. Ensuring that the UBIRB is notified of:
   - All Reportable Information in accordance with the Reportable New Information Smart Form.
   - Project closure/completion by submitting a Continuing Review/Modification/Study Closure Smart Form in Click.

3. Ensuring that the protocol is followed as approved by UBIRB unless minor changes that do not impact the exempt determination are made.

4. Ensuring that the study is conducted in compliance with all UBIRB decisions, conditions, and requirements.

5. Bearing responsibility for all actions of the staff and sub-investigators with regard to the protocol.

6. Bearing responsibility for securing any other required approvals before research begins.

If you have any questions, please contact the UBIRB at 716-888-4888 or ub-irb@buffalo.edu.
Purpose

The development of an evidence-informed, point-of-care (POC) nursing protocol that meets the needs of the Registered Nurses (RNs) caring for post-cardiac catheterization (PCC) patients on the step-down unit at Niagara Falls Memorial Medical Center (NFMMC)

- Basic care – assessment & documentation
- Common complications

Specific Aims

1. Develop an evidence-informed protocol
2. Identify current confidence/preparedness of RNs
3. Determine if the new protocol is an acceptable and usable tool to the RNs on the step-down unit

Study Question

Does the development of a needs-based, evidence-informed, POC nursing protocol for the care of PCC patients provide an acceptable and usable tool for the RNs on the step-down unit at NFMMC?
Cardiac Catheterization

- Purpose: to evaluate the function of the heart
  - Diagnostic or therapeutic
  - Existence and extent of coronary artery disease (CAD)
  - Assess left-ventricular function
  - Evaluate heart valves or muscle (myocardium)

(American Heart Association, 2017)
- Over 1 million are performed in the U.S. each year
  (Benjamin et al., 2017)

Complications

- Rare, but often life-threatening
- Vascular access site complications (VASCs) most common
  - Diagnostic or therapeutic
  - Bleeding
  - Hematoma
  - Pseudoaneurysm
  - Arteriovenous (AV) fistula
  - Arterial occlusion

(Merriweather & Sulzbach-Hoke, 2012; Schueler et al., 2013)

Consequences of Complications

- Increased morbidity & mortality
- Increased costs
  - Imaging
  - Laboratory tests
  - Blood transfusions
  - Surgical interventions
  - Loss of wages

(Merriweather & Sulzbach-Hoke, 2012)
- Minor bleeding: $3,000 to $4,000
- Major bleeding: $7,000 to $14,000

(Gummersall, 2013)

Modifiable Risk Factors

- Access site (femoral>radial)
- PCI versus diagnostic catheterization
- Larger sheath size
- Increased sheath time
- Multiple puncture attempts
- Anticoagulation

(Lee et al., 2014; Merriweather & Sulzbach-Hoke, 2012; Schueler et al., 2013)
Non-Modifiable Risk Factors

- Female gender
- Low BMI
- Age ≥ 70 years
- Diabetes
- Hypertension
- Peripheral vascular disease (PVD)
- Kidney disease

(Merriweather & Sulzbach-Hoke, 2012)

Background & Significance

- In April, 2017 a cardiac catheterization laboratory (CCL) opened at NFMMC
- Diagnostic and therapeutic intervention performed
- Staff present at the hospital from 8am to 5pm on weekdays and on-call 24/7
- Stable, PCC patients cared for on step-down unit until discharge

Background & Significance

- Little education prior to the CCL opening
- Lack of clear guidelines
- No follow-up training
- Vague order sets
- No guidelines specifying differences in care in patients who received diagnostic versus therapeutic intervention (i.e. when to take off Vasculband)

Assessments

- Inability to recognize changes in patients' condition
- Lack of proper intervention

(Huber, 2009)

Background & Significance

- Information to PAs Patient Safety Authority (2004-2006) – half of the errors were related to complications of cardiac catheterization
  - Medication errors
  - Assessments
  - Inability to recognize changes in patients' condition
  - Lack of proper intervention
- Increased numbers of catheterizations have not decreased VASCs
  - Lack of universally accepted evidence-based guidelines
  - Hospitals should develop their own policies

(Sulzbach-Hoke et al., 2010)
Significance of Protocols

- Translation of evidence into usable clinical guidelines  
  (Stacey, Macartney, Conley & Harrison, 2012)
  - Assessments  
  - Increases in staff knowledge  
  - Consistency of skills  
  - Improved documentation  
  - Consistent protocol use  
  (Habich & Letizia, Kenny & Goodman, 2010)

Theoretical Framework

- IOWA Model  
  - Seven step model  
  - Developed in 1994 by Marita G. Titter at University of Iowa's Hospitals and Clinics  
  - Direct healthcare professionals in using research to guide care  
  - Updated in 2001 and 2015  
    - Incorporates feedback from end-users  
    (Steelman, 2015; Titter et al., 2001)

IOWA Model

1. Identify the issue/opportunity  
2. State the question  
3. Form a team  
4. Assemble, appraise, and synthesize evidence  
5. Design and pilot the practice change  
6. Integrate and sustain practice change  
7. Disseminate results  
    (Steelman, 2015)
Sample & Design

- Sample: The study sample included all RNs on the step-down unit at NFMMC
  - A total of 28 RNs were asked to participate
  - Recruited via flyer & bi-weekly meetings

- Design: Embedded, mixed-methods study
  - Small portion of qualitative data within a larger, quantitative study
  -(Creswell & Clark, 2007)

Protocol Development

- Point-of-care protocol
  - Current literature
  - Protocols at other hospitals
  - NFMMC’s generic PCC order-set
  - CCL Medical Director – Dr. Neil Dashkoff
  - Fast-paced environment of step-down unit considered

Study Variables

Demographic survey
  - Survey 1 – current attitudes and behaviors relating to PCC Care
    - Domain 1: Resources
    - Domain 2: Confidence/preparedness
  - Survey 2 – Perceptions of protocol
    - Domain 1: Acceptability
    - Domain 2: Usability
  - Likert-type paper & pencil surveys
  (1 = strongly disagree; 2 = disagree; 3 = neither agree no disagree; 4 = agree 5 = strongly agree)

Data Collection & Subject Protection

- Packets for participants
- Surveys anonymous
  - Information & consent sheet
  - Demographic survey
  - Survey 1
  - Protocol
  - Survey 2
  - Remained in conference room for 3 weeks

**Approval by NFMMC ethics committee and UB’s IRB**
RESULTS

Table 1: Characteristics of Survey Participants (N=25)

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<th>n (%)</th>
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<td>6-10</td>
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Table 2: Experience and age of Survey Participants (N=25)

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<td>14 (56)</td>
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<tr>
<td>46+</td>
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Domain Scores

- Perceptions of resource availability = 2.52
- Confidence/preparedness = 3
- Acceptability of protocol = 4.48
- Usability of protocol = 4.61
- Survey 2, question 10: “I would use this protocol in clinical practice” - 100% answered either 4 (agree) or 5 (strongly agree)
## Table 3: Correlation Analysis of Participant Demographic Variables with Resources, Confidence/Preparedness, Acceptability and Usability

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<th>Experience (0-5 years/6-10 years)</th>
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<th>Gender (Male/Female)</th>
<th>Education Level (ADN/BSN or higher)</th>
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*Correlation is significant at the 0.05 level (2-tailed).

## Qualitative Analysis

### Survey 2, Question 11:
- Please provide any feedback or suggestions for protocol improvement (positive or negative). This may include comments pertaining to the above questions or general comments or questions about the protocol itself.
- 12 participants provided feedback
  - “helpful” “clear” “easy to follow”
  - “Separate femoral and radial protocols”
  - “Protocol is comprehensive, but may be difficult to conform with given the current nurse-to-patient ratio”

## Discussion

- Brevity of PCC training at NFMMC combined with lack of experience may increase complication rates
- Low to Neutral aggregate domain scores for resources & confidence/preparedness
  - Need for further training and resources
- Older & more experienced nurses rated resources higher
  - Experience led to greater knowledge or use of resources
- Less experienced nurses rated the protocol higher for acceptability & usability
  - Aligns with Benner’s Model of Clinical Competence
  - May be especially useful for orienting and training new RNs

## Strengths

- Needs based, evidence-informed protocol may:
  - Promote consistency of care
  - Prevent common complications
  - Foster ability to recognize and appropriately treat complications
- Can be tailored to any environment where RNs care for PCC patients
- Protocol created by end-user
- High response rate
Limitations

• Lack of generalizability
• Lack of implementation
• Limitations of survey data
  - Truthfulness
  - Response bias
• Surveys are not validated

Future Implications

• Collaborate to standardize and optimize the care of PCC patients
• Refine & pilot the protocol
• Additional material and training on unit
  - Mandatory education sessions
  - Unit specific training
• Post-Implementation
  - Consistency of computer documentation before/after implementation
  - Knowledge and confidence post-implementation
  - Tailor to additional sites
• Evaluate and update the protocol regularly

Conclusion

• RNs at NFMMC do not perceive PCC resources as adequate
• RNs at NFMMC do not have overall positive feelings of confidence and preparedness
• PCC protocol was rated highly among all study participants
• Improvement upon education & training may:
  - Foster a positive reputation NFMMC’s CCL
  - Prevent financial burden related to complications
  - Promote safety for cardiac catheterization patients
• Reference point for the development of regional or national PCC nursing care standards

Questions?

Comments?
THANK YOU!!!

References


Small forearm hematomas may only require conservative treatment but be prepared for blood transfusion:

- Stop any infusing anti-coagulants.
- Elevate arm with Elastoplast.
- Once all air has been removed, remove VascuBand, apply sterile gauze dressing to access site, and wrap wrist with a VascuBand.
- If bleeding does not stop, apply manual compression to access site.
- Confirm and document the following per site (swelling, bleeding, oozing, bruising, firmness, pain, intact dressing).

**Critical Care Nursing Clinics of North America, 13(2), 393-407.**

**Iowa Patient Education Model of Evidence-based Practice.**
If the patient did not receive intervention, it is likely they will be discharged (if outpatient procedure). If they received intervention, such as stenting, they will likely stay overnight.

For patients who qualify for discharge, PROVIDE EDUCATION in Cerner (Depart Patient Education Search and add “femoral access site care” and “post-coronary angiogram” – Sign and save/print).

1. Femoral Vascular Access Site Complications (VASCs) and treatment
   **Notify Hospitalist and Interventional Cardiologist ASAP**
   A. Bleeding
      i. Apply manual compression with fingers of both hands 2 cm above access site until bleeding stops (typically 20 to 30 mins); continue to assess
      ii. Maintain bed rest
      iii. Stop any infusing anticoagulants
      iv. Assess for intravascular volume depletion (tachycardia, widening pulse pressure, hypotension, decreased peripheral perfusion)
      v. Be prepared for blood transfusion
      vi. If bleeding does not stop after 30 mins., follow MD orders
   B. Hematoma
      i. Apply manual compression over the hematoma to prevent further bleeding
      ii. Stop any infusing anticoagulants
      iii. Maintain bed rest
      iv. Apply pressure above insertion site to achieve hemostasis. Usually achieved in 5 to 10 mins.
      v. Mark area to monitor for increase/decrease in size
      vi. Assess for intravascular volume depletion: tachycardia, widening pulse pressure, hypotension, decreased peripheral perfusion
      vii. Auscultate hematoma for presence of pulse and a systolic bruit (bruit may indicate pseudoaneurysm).
   C. Pseudoaneurysm
      i. Stop any infusing anticoagulants
      ii. Maintain bed rest
      iii. If <2 cm, observe; often close spontaneously
      iv. If >2 cm, may need ultrasound-guided thrombin injection or surgical intervention

2. Retroperitoneal Hemorrhage
   (Vague to severe pain that is located in back, flank, or abdomen. Hypotension, tachycardia, diaphoresis and/or abdominal distention will be present. Late signs are Grey Turner’s sign [bruising along flank] and Cullen’s sign [bruising around umbilicus]. Late recognition may be fatal.)
   i. Stop and reverse any infusing anticoagulants
   ii. Maintain bed rest
   iii. Type and cross 4 units
   iv. Start IV fluids
   v. Non-contrast CT, if and when patient is stable
   vi. May require surgery

3. Arteriovenous Fistula
   (asymptomatic, or swollen/tender extremity. May have bruit or thrill at access site)
   i. Maintain bed rest
   ii. Follow physicians orders
   iii. Many resolve spontaneously without treatment

4. CONDITIONS REQUIRING NOTIFICATION OF HOSPITALIST AND INTERVENTIONAL CARDIOLOGIST (regardless of access site)
   o Chest pain (obtain stat EKG, apply oxygen, then notify physicians)
   o Shortness of breath
   o Site pain, pain in extremity
   o Diminished or loss of pulse(s) in distal extremity
   o Abdominal or back pain (femoral access)
   o Hypotension (SBP <90)/Hypertension (SBP >160)
   o Respiratory distress, signs/symptoms of stroke or oversedation
   o Changes in neuro and/or circulatory status
   o Arrhythmias/ST segment changes
   o Bradycardia (HR < 50 bpm) or tachycardia (HR > 100 bpm)
   o Bleeding/hematoma
   o Puncture site lump > small pea size

Photo examples of common complications

Figure 1: Forearm hematoma grading and treatment

Figure 2: Large femoral (left) and right forearm (right) hematoma

Figure 3: Cullen’s sign and Grey Turner’s sign are late signs of retroperitoneal hemorrhage
References


