Spring 2023

Heparin vs. Saline: Evaluating Evidence-Based Best Practice for Maintaining Patency of Implanted Ports

Shannon D. Murdock
University of New Hampshire, Durham, sm1080@wildcats.unh.edu

Heparin vs. Saline:

Evaluating Evidence-Based Best Practice for

Maintaining Patency of Implanted Ports

Shannon D. Murdock

University of New Hampshire

Faculty Mentor: Pamela S. Kallmerten, PhD, DNP, RN, CNL

Practice Mentor: Julie Bushey, MSN, RN, OCN, CCRP

Date of Submission: June 1, 2023

Table of Contents

Abstract

Background Implanted ports are frequently used for central venous access in the adult oncology population. Maintaining patency of these ports is important for continuing uninterrupted treatment and supportive care for oncologic patients. Historically, heparin solution has been used as a locking solution for implanted ports to prevent occlusion. However, evidence shows that 0.9% sodium chloride (normal saline or NS) as a lock solution is equally effective as heparin solution at maintaining implanted port patency and poses less risk to patients.

Local Problem In an ambulatory adult oncology clinic serving Seacoast New Hampshire, a gap was identified between clinical practice where implanted ports were locked with heparinized saline, and evidence-based best practice, which recommends NS as a safer alternative locking solution.

Methods In this Gap Analysis quality improvement, project the clinical environment was assessed using the Agency for Healthcare Research and Quality (AHRQ) Gap Analysis Tool, Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis and stakeholder feedback. These tools were utilized to identify barriers to implementation of evidence-based best practice.

Interventions Guided by these assessments, a trial run of eliminating heparin saline as a locking solution is implemented in the clinical environment.

Results Both staff and patients positively receive the practice change. Several incidental findings were noted including the importance of emphasizing push-pause instillation technique of NS to optimize clearance of the catheter in nursing education and a cost-

savings benefit of this practice change due to the elimination of prefilled heparin saline syringes.

Conclusions The objectives of investigating the efficacy of NS compared with heparin as a locking solution for implanted ports and implementing this practice change in the clinical environment were both met in this Gap Analysis project. The third objective, to present findings as evidence for policy change, was not met during this project though it is outlined as a next step. Through this Gap Analysis, the lack of a clearly defined process for quality improvement at the organization is identified.

Key Words: implanted port, patency, heparin lock, saline lock, normal saline, quality improvement, gap analysis

Introduction

In the adult oncology population, it is common for patients undergoing treatment to use implanted ports for central venous access. Easy vascular access is important for these patients whose care requires frequent phlebotomy for laboratory testing and intravenous (IV) medication administration for chemotherapy, immunotherapy and supportive care, such as pain and antiemetic medication, fluids and electrolyte repletion, and blood product administration. The use of an implanted port in this population can reduce risk of pain, discomfort or bruising from multiple peripheral IV attempts as well as decrease chance of infiltration, phlebitis or extravasation from irritant or vesicant medications (Cleveland Clinic, 2021). The port is placed surgically via small incision in the subcutaneous layers of the skin, most often in the chest wall, with the tip of the port catheter leading directly into the central circulatory system, typically the superior vena cava (Cleveland Clinic, 2021). Proper maintenance of these implanted ports is extremely important to ensure continued functionality and to prevent any infection.

Problem Description

The local care center examined in this evidence-based quality improvement (QI) project is an ambulatory medical oncology infusion clinic serving the adult population of southeastern New Hampshire. The clinic is community-based with affiliation to a larger medical entity, and some patients receive care in both locations. Nurses follow the community-based clinic policy for implanted port care for the majority of patients, which is to maintain patency with routine instillation of 10 mL prefilled 0.9% sodium chloride (normal saline, or NS) syringe utilizing pulsatile technique followed by 5 mL of 100 units (U)/mL heparin lock solution upon de-access. However, nurses follow the policy of the

larger, affiliate medical entity for a select few patients, which is to maintain patency with routine instillation of NS without the use of heparinized solution. This practice discrepancy may cause confusion among nursing staff as to which policy to follow for port de-access for the various patients, as well as confusion amongst patients as to why different policies exist for the same procedure. Conducting a specific type of QI project called a gap analysis is important to identify and champion the utilization of evidence-based best practice for maintaining patency of implanted ports.

Available Knowledge

Search Methods

In the most recent edition (8th) of the Infusion Nurses Society's "Infusion Therapy Standards of Practice," the authors state that "0.9% sodium chloride alone may be as effective as heparin in maintaining patency," and that there is "insufficient evidence to recommend one lock solution over another" (Gorski et al., 2021, p. S114-S115). In order to evaluate the current evidence on best practice for maintaining patency of implanted ports, a comprehensive search was performed using credible health and medicine databases, including Medline, Cumulated Index to Nursing and Allied Health Literature (CINAHL), PubMed, and the Cochrane Database of Systematic Reviews. Inspection of research article reference lists, the 'similar articles' function of databases, and the search engines Google and Google Scholar were also utilized to augment the search for relevant research and to procure background information on the topic. The keywords used to refine searches included "totally implanted vascular access device," "implanted port," "central venous access device," "central venous catheters," "patency," "heparin lock," and "saline lock". These keywords were used alone and in combination with each other.

Searches were limited by English text and full text. Articles were excluded if they were not in English, did not allow full access, were published before 2013, did not directly compare saline and heparin locking solutions, or did not pertain to the adult population. It is also important to note the distinction between different types of catheters. Some studies used the term 'central venous catheters' (CVCs) which is a broad term that includes non-tunnelled catheters, tunnelled catheters, peripherally inserted catheters, and totally implantable ports (López-Briz et al., 2022). Only studies that included implanted ports were included in this review.

Eighteen articles were retained for review and analyzed for relevance to the research topic, nine of which met all of the inclusion criteria. Appraisal of the literature was conducted using the Joanna Briggs Institute (JBI) Levels of Evidence and Supporting Document (2014). The nine articles consisted of 3 systematic reviews and meta-analysis, 2 randomized controlled trials (RCTs), 1 prospective and 1 retrospective comparative studies and 2 QI projects. These studies will be evaluated individually and then the literature will be synthesized holistically.

Systematic Review and Meta Analysis 2017

Zhong et al. (2017) assessed ten RCTs with a total sample size of 7875 that all directly compared the efficacy of NS versus heparin saline in maintaining patency of CVCs in the adult population. The authors performed the review using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines from Moher et al. (2009) and determined catheter occlusion as the outcome of interest (Zhong et al., 2017). Through this meta-analysis, NS was identified as being equally as effective at maintaining CVC patency as heparin saline in adults for catheters in use longer than 30

days, with the risk ratio (RR) at 0.97 (n = 6589; 95% confidence interval (CI) = 0.76 to 1.23; P = 0.796) (Zhong et al., 2017). For catheters in use less than 30 days, heparin saline was found to be marginally significantly more effective at maintaining catheter patency as NS, with the RR 1.52 (n = 1286; 95% CI = 1.02 to 2.27; P = 0.041) (Zhong et al., 2017). The authors discuss that for individuals with CVCs indicated for long-term use such as cancer patients, NS is an adequate, if not more desirable locking solution due to less imposed risk and cheaper cost (Zhong et al., 2017).

As a systematic review and meta-analysis of randomized controlled studies, this study falls under JBI level 1a of evidence (2014). The authors do acknowledge that two out of the ten RCTs had high risk of bias due to lower than expected sample sizes, while another study had risk of detection bias due to lack of blinding (Zhong et al., 2017). However, this systematic review and meta-analysis indicates that NS is at least equally effective as a heparinized solution in maintaining patency..

Systematic Review and Meta Analysis 2018

The systematic review and meta-analysis of eleven RCTs conducted by López-Bruiz et al. (2018) was also limited by suggestion of bias. The authors report unclear allocation concealment as well as statistical imprecision with utilization of 95% CI, including harm and no harm and potential for publication bias (López-Bruiz et al., 2018). It is also acknowledged that some of the RCTs were not blinded, but determined that blinding was not important in the setting of the primary outcome of catheter occlusion (López-Bruiz et al., 2018). The authors evaluated ten RCTs (n = 1672 participants, 1025 catheters) that provided data on catheter occlusion with the conclusion that heparin may not significantly affect CVC patency when compared with NS; however, they did

downgrade the quality of the evidence due to the aforementioned limitations (López-Bruiz et al., 2018). The risks of repeated heparin flushing are reiterated, especially in individuals with history of liver, kidney, or cardiac problems, gastrointestinal ulcers, and those taking non-steroidal anti-inflammatory drugs or anticoagulants; NS may be a safer alternative locking solution (López-Bruiz et al., 2018). This study also falls under JBI level 1a of evidence (2014).

Systematic Review and Meta Analysis 2021

The third systematic review and meta-analysis, conducted by Wu et al. (2021), focused entirely on comparison of heparin versus NS as a locking solution in adult cancer patients with totally implantable vascular access ports (TIVAPs) with the objective of determining whether or not saline could be a replacement for heparin, making it the most relevant high quality piece of literature in this review.

The authors performed the review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-Protocols guidelines from Shamseer et al. (2015) and also determined the primary outcome to be port occlusion (Wu et al., 2021). This review included four studies total (n = 2652) with two retrospective cohort studies and two RCTs (Wu et al., 2021). As a systematic review of RCTs and other study designs, this is a JBI Level 1b of Evidence (2014).

Through meta-analysis of the four studies, the authors found no statistically significant difference between heparin and NS as a locking solution for maintaining TIVAP patency in adults with cancer, and recommend that saline be considered as a replacement for heparin (Wu et al., 2021). This systematic review and meta-analysis was limited by the number of studies that met inclusion criteria, and by the lower-quality type

of study; the authors recognize that more high-sample size RCTs need to be conducted in the future (Wu et al., 2021).

Randomized Controlled Trial 2013

For this study, the researchers randomly assigned a sample size of 765 patients to a heparin group (n = 383) where totally implantable vascular access devices (TIVADs) were locked with 10 mL NS followed by 3 ml of 100 U/mL heparin and a NS group (n = 382) where TIVADs were locked with just 10 mL NS (Goossens et al., 2013). An additional 10 mL NS flush was added to both groups if locked after a blood product or parenteral nutrition infusion (Goossens et al., 2013). Study findings indicate "non-inferiority" of NS lock compared to heparin and saline lock for "easy injection, impossible aspiration" solution could be easily flushed through the catheter but blood could not be drawn out (Goossens et al., p. 1896, 2013). Study limitations include no blinding, less than 30% recruitment of patients in care center that were eligible for study, and extensive expertise in terms of TIVAD placement from the surgical team and post-placement support from the venous access team that may not be accessible in other care centers (Goossens et al., 2013). This study is graded a JBI Level 1c of Evidence (2014).

Randomized Controlled Trial 2015

Conversely, Dal Molin et al. (2015) were unable to claim non-inferiority of NS as a lock solution for adult cancer patients with a newly implanted (less than 45 days) TIVAD when compared to heparin. Also a RCT graded a JBI Level 1c of Evidence (2014), a sample size of 415 patients recruited from 14 different cancer centers were randomly assigned to a NS group (n = 203) and a heparin group (n = 212). Ports in the NS group were flushed with 20 mL NS using push-pause technique and locked with 5

mL NS using positive pressure technique (Dal Molin et al., 2015). Ports in the heparin group were also flushed with 20 mL NS using push-pause technique but locked with 5 mL of 50 U/ml heparin solution (Dal Molin et al., 2015).

The authors identified the primary outcome as catheter occlusion, and found no significant difference between NS as a locking solution and NS with heparin; however the authors reiterate that they were unable to demonstrate non-inferiority of NS compared to heparin and articulate that larger prospective studies should be conducted (Dal Molin et al., 2015). The study is limited by less than expected sample size which reduced statistical power, as well as lack of blinding (Dal Molin et al., 2015). Patients requiring parenteral nutrition through TIVAD during course of study were excluded due to greater risk of occlusion (Dal Molin et al., 2015). This study also included a positive pressure technique during NS locking, which was not specified in other studies (Dal Molin et al., 2015).

Prospective Comparative Study 2021

Egnatios and Gloria (2021) conducted a prospective comparative study to determine if NS is as effective as heparin in maintenance of port patency on adults with implanted ports that is graded a JBI Level 3c of Evidence (2014). This study was conducted at an oncology clinical trials infusion clinic that primarily provides care for patients with implanted ports and utilizes NS followed by heparin to lock ports. The authors compared data for alteplase orders on 37 patients for two months locking ports with standard procedure (NS followed by heparin) and for two months locking ports with only NS. The confidence interval did not exceed the predetermined p value of 0.05 (actual value = 0.02), corroborating that NS may be equally as effective as saline

followed by heparin for preventing catheter occlusion (Egnatios & Gloria, 2021). Though there was enough port de-accesses (heparin = 302, saline = 261) required for power analysis, the sample size (n = 37) was smaller than desired which is a limitation of the study (Egnatios & Gloria, 2021). The authors also did not disclose the concentration or volume of heparin used to lock in the pre-intervention phase, nor did they disclose the volume of NS used to lock in the pre- or post-intervention phases (Egnatios & Gloria, 2021).

Retrospective Comparative Study 2018

Brito et al., (2018) conducted a retrospective study at a cancer center of sample size 862 comparing heparin lock and saline lock on occlusion, flow dysfunction and reflex dysfunction of implanted ports. The ports in the heparin lock group (n = 270) were locked with a NS solution with heparin (100 IU/mL) while the ports in the saline solution group (n = 592) were locked solely with NS; each locking solution was 1.5 mL (Brito et al., 2018). There were 8 cases of occlusion in each group, and the authors did not find any statistically significant difference between the two groups (Brito et al., 2018). This study is graded JBI Level 2d of Evidence due to the retrospective nature of the study design (2014).

Evidence-Based Practice Quality Improvement Project 2022

Two evidence-based projects are included in this literature review, graded a Level 2d using JBI Levels of Evidence (2014). While their lower quality of evidence is acknowledged, they are included for direct relevancy and for contribution to nursing research and discussion on this topic, as well as for meeting inclusion criteria.

In the first QI project, the project leads in a cancer center serving the adult population implemented a procedure change from locking implanted ports with 10 mL of NS, followed by 500 units of heparin to locking implanted ports with only 10 mL NS using a push-pause (pulsatile) technique (Hoffman & Fischer-Cartlidge, 2022). Catheter occlusion rates were measured by tracking alteplase orders before (13 months) and after (12 months) implementation of new policy (Hoffman & Fischer-Cartlidge, 2022). At 6 months post-implementation of practice change, alteplase order rate was not statistically significant from baseline, however the alteplase order rate did become statistically significant from baseline at 12 months (Hoffman & Fischer-Cartlidge, 2022). This change is attributed to a large amount of new-hire nurses and a suspected drift in practice from pulsatile flushing (Hoffman & Fischer-Cartlidge, 2022).

The authors do emphasize the importance of nursing staff as a critical stakeholder in this clinical practice change, and illustrated a "shared governance" approach through dissemination of information in councils and nursing grand rounds about the practice change before launch, as well as through continued support during implementation from clinical nurse specialists (Hoffman & Fischer-Cartlidge, p. 259, 2022). Limitations of this QI project include systemic organizational changes during the COVID-19 pandemic, difficulty obtaining data from the electronic health record, and not having an established numerator/denominator for capturing data in the literature (Hoffman & Fischer-Cartlidge, 2022).

Evidence-Based Practice Quality Improvement Project 2022

Similarly, Jabaley et al. (2022) also sought to evaluate the effect of switching from heparin to NS as a locking solution for CVADs on intraluminal occlusion in the

setting of an adult ambulatory oncology clinic, and did so by measuring alteplase usage before and after clinical practice change. Policy before practice change was to flush with 1,000 U/mL of "catheter volume" heparin, and policy after practice change was to flush with 10 mL NS using push-pause technique and a positive pressure clamp after flushing (Jabaley et al., p. 286, 2022). Accumulated alteplase rates between the two groups were compared using proportion z-tests ($p = 0.003$) (Jabaley et al., 2022). As with previously published studies and QI projects, the authors found that NS was as effective as heparin in maintaining patency of CVADs (Jabaley et al., 2022).

The second part of this QI project involved a peer nurse mentoring initiative to facilitate the policy change. Five nurses were trained as mentors to implement the interventions which included: a two-minute instructional video demonstration of flushing and locking CVADs according to the updated policy, individualized mentor support including practice and discussion and a nurse information card with background information with supporting references (Jabaley et al., 2022). Nurse perspectives on the policy change were obtained via surveys ($n = 79$) that were administered at baseline ($n = 34$), at three months ($n = 23$) and at six months ($n = 22$). Patient information cards that described the policy change were also distributed, and patient surveys ($n = 358$) were likewise administered at baseline ($n = 120$), at three months ($n = 113$) and at six months ($n = 125$) (Jabaley et al., 2022). Of all nurse survey points, "awareness of current evidence" increased the most by the last data collection (Jabaley et al., p. 291, 2022). Similarly, patient survey data collection showed an increase in patient support for the policy change over time, highlighting the importance of the nurse-patient relationship (Jabaley et al., 2022). The authors acknowledge that the design as an evidence based

project as a limitation of the project, as well as not performing a full-depth cost-savings analysis (Jabaley et al., 2014).

Synthesis of Evidence

Heparin solution, in varying concentrations, has historically been used as a 'locking' solution for central venous catheters, including implanted ports, with the intention of preventing intraluminal occlusion from fibrin sheath or blood clots (López-Briz et al., 2018). However, as noted from a robust review of the research, NS has been found to be "non-inferior" as a locking solution when compared with heparin (Wu et al., 2021).

Furthermore, utilization of heparin presents opportunity for increased risks. Though rare in occurrence, frequent administration of heparin can cause heparin-induced thrombocytopenia (HIT), an immune-mediated adverse drug reaction in which antibodies activate platelets that clot in the presence of heparin and put the patient at risk for thrombosis (Kuter et al., 2017). Some studies show that heparin may increase *Staphylococcus aureus* biofilm growth (Mishra & Horswill, 2017). As with all drug administration, there is a risk for hypersensitivity reaction to heparin. The patient may also have religious or cultural beliefs that do not align with use of porcine-derived heparin (which is used at the local MO clinic examined in this project) but may not know that heparin is porcine-derived (Gorski et al., 2021). The use of NS eliminates the opportunity for unknown imposition upon patient religious or cultural beliefs or practices.

Rationale

Through the review of the literature, it is found that current evidence demonstrates non-inferiority of NS compared with heparin as a locking solution for

implanted ports, and that it is in fact a safe and effective alternative in maintenance of port patency. The Agency for Healthcare Research and Quality (AHRQ) Gap Analysis Tool was utilized to assess barriers in the clinical environment that would need to be addressed before implementing a practice change based on evidence found through the literature review.

Methods

Context

It is important to acknowledge here that eliminating heparin as a lock solution in the ambulatory Medical Oncology clinic requires a lot less resources than if this change were to be made hospital-wide. A hospital-wide policy change is not made during this QI project, however it is outlined in the discussion as part of next steps. It is also important to note that these resources would primarily comprise of time, energy, and expertise of management and administrative staff as well as educative materials for clinical staff. With the elimination of prefilled heparin saline syringes, there is no additional material cost for the actual de-access procedure, in fact there is instead a cost-savings.

Gap Analysis

Information in the AHRQ Gap Analysis Tool is organized into several sections including *Best Practice* based on evidence found through the literature review, *Strategies for Best Practice*, *Local Practice*, *Barriers to Implementation* of the practice change and *Decisions* regarding whether or not implement the change with rationale. The Gap Analysis (Table 1) of the chosen clinical environment's *Management of Implanted Port* policy, in which implanted ports are locked with 5 U/mL of heparin, highlights a gap between evidence-based best practice and current clinical practice.

Table 1

Gap Analysis

Best Practice (References)	Best Practice Strategies	How Your Practices Differ from Best Practices	Barriers to Best Practice Implementation	Will Implement Best Practice (Y/N; why not?)
Use 10 mL NS as lock solution for implanted ports (López-Bruiz et al., 2018; Zhong et al., 2017; Wu et al., 2021).	- Edit current policy to reflect best practice based on recommendation and literature	EH policy is to flush with 10 mL prefilled NS syringe utilizing push-pause technique followed by 5 mL of 100 U/mL heparin lock	- Requires policy change throughout the whole organization (stakeholders must buy in) - Requires nursing education	Yes MGH has asked EH to make this policy change already. This would also produce cost savings and streamline care for nurses.
Utilize pulsatile (push-pause) flushing technique (Goossens et al., 2013, Hoffman & Cartlidge, 2022).	- Emphasize importance of this in yearly online learning modules		- Lack of reinforcement of pulsatile flush technique - Practice drift	Yes While the pulsatile flush is part of policy, literature supports this technique as crucial to maintaining catheter patency.
Provide peer mentor support for practice change (Jabaley et al., 2022).	- Use RNs as 'Champions' of practice change, provide education and peer support re why/how	Charge nurse or superior (Clinical Practice Leader) will facilitate disseminating information re changes in practice.	- Finding nurses that are willing to take on being a champion	Yes. Champions of practice change are a way for nursing to take ownership of implementing best practice in clinical setting.

Specific Aims

The purpose of this Gap Analysis project was to investigate the efficacy of NS compared with heparin as a locking solution for maintaining patency of implanted ports, to implement this practice change in a way that provides both nursing and patient support, and to ultimately present findings as evidence for policy change.

SWOT Analysis

A review and analysis of the strengths, weaknesses, opportunities, and threats (SWOT Analysis) of the clinical environment was a helpful tool for planning the execution of this QI project. This tool (Table 2) was utilized to identify internal and external factors of Medical Oncology department and the organization as a whole that would both positively and negatively affect the outcome of the implementation of the elimination of the heparin lock from the implanted port de-access procedure.

Through the process of this analysis, the prominent theme of organizational commitment to evidence-based best practice was identified as a major strength. This theme is emphasized by the Magnet Recognized status of the clinical environment, and was reinforced by the Magnet site visit that occurred during the planning stage of the QI project. One of the components of the Magnet Model is New Knowledge, Innovation and Improvements, including application of new and existing evidence into practice (American Nurses Credentialing Center, 2017). The background research and outline of this QI project was discussed with Magnet evaluators as an example of this Magnet component.

Table 2

SWOT Analysis

	What is helpful in achieving the objective?	What is harmful in achieving the objective?
Internal Origins: Organizational Attributes	**STRENGTHS**	**WEAKNESSES**
	- Staff commitment to evidence based practice (EBP). - Improve clinical adherence with pulsatile flushing technique (leading to improved outcomes regarding port patency). - Department Management commitment to cost savings. - Potential to change organizational policy to be in line with current evidence.	- Change in practice may be stress inducing or confusing for clinical staff (aim to avoid this feeling with thorough education and peer support through 'Champions' if policy change is made). - Time. Attempting policy change may be time-consuming and actual implementation of education for practice change purpose may be slow to occur. - Education will not be regularly reinforced in clinical practice in areas of hospital that do not utilize implanted ports frequently.
External Origins: Environmental Attributes	**OPPORTUNITIES**	**THREATS**
	- Opportunity to bring implanted port management policy in line with affiliate care center (MGH). - Opportunity to improve patient health outcomes by decreasing risks, lowering costs, using EBP. - EH is a Magnet Recognized hospital (since 2013) and awaiting our Magnet site visit for 2023. One of the components of the Magnet Model is New Knowledge, Innovation and Improvements, including application of new and existing evidence into practice (ANCC, 2017).	- Patients may be confused regarding practice change or be thrown off by change in procedure (which highlights need for patient education as well!).

Stakeholder Feedback

Involvement of stakeholders is crucial for implanting new practice changes in a clinical environment in order to include a multitude of perspectives, and to obtain buy-in for approval of practice changes. The following stakeholders were evaluated through open discussion to assess attitudes toward eliminating heparin from the de-access

procedure of implanted ports: pharmacy, infusion nurses, nursing management, Clinical Practice Leader (CPL) of Vascular Access Team (VAT), Intensive Care Unite (ICU) and Progressive Care Unit (PCU). In order to condense stakeholder feedback (Table 3) common themes were extricated from the conversations.

Identified Themes

Not a New Concept. Most stakeholders had either heard about other local care centers making a switch to saline only as a lock solution for implanted ports or had read about this topic in the literature.

Generally Positive Response. The majority of stakeholders expressed positive attitude towards potential practice change and felt it would be a change for the better.

Education. All stakeholders felt strongly that there would be a need for education with this practice change, both for nurses and for patients.

Potential Cost Savings. Stakeholders identified that if heparin were to be eliminated, it would be very financially beneficial both for Medical Oncology department and the organization as a whole.

Table 3

Stakeholder Feedback

STAKEHOLDER FEEDBACK (MO = Medical Oncology)	**This is a new concept?**	**Benefits of practice change?**	**Disadvantages of practice change?**	**Barriers to making practice change?**
MO Infusion Nurses	No	- streamlined workflow for nursing - decreased risk to patients	No true disadvantages of practice change identified if saline is non-inferior to heparin in maintaining implanted port patency.	- nursing and patient education
MO Pharmacy	No	- streamlined workflow for pharmacy staff - decreased risk to patients - cost savings		- time to change hospital-wide policy
MO Director of Nursing and Clinical Practice Leader	No: MGH listed policy as one to review	- decreased risk to patients - organizational cost savings		- nursing and patient education
Clinical Practice Leader of ICU/PCU/VAT	Yes: but interested in learning more	- organizational cost savings - streamline workflow for inpatient staff		- time to change hospital-wide policy - implementing education throughout

Results

Though the trial run of eliminating the heparin lock from the de-access procedure of implanted ports has only been in place for approximately 2 weeks, the transition has gone smoothly. Infusion nurses and pharmacy staff have reported improved workflow as pharmacy no longer has to dispense the heparinized saline prefilled syringes and nursing no longer has to wait for pharmacy to do so. Patient response to the practice change, which was a preemptive concern of the infusion nurses, has been very positive. There has not been any resistance from patients about no longer having their ports locked with heparin, and many have verbalized being happy about needing one less drug. The trial run will continue past the end of the project timeline, with the ultimate goal of revising the hospital-wide policy.

Discussion

Summary

There was more hesitancy and concern from staff in anticipation of this practice change than there was after implementation. Stakeholder feedback emphasized a great need for patient and nurse education, and highlighted concerns for patient resistance to the elimination of locking implanted ports with heparinized saline prefilled syringes. After just a short period of this practice change being implemented in the Medical Oncology department, both staff and patients have adjusted very quickly. In fact, some patients verbalized feeling relieved to be able to eliminate one of the many medications that are injected into their bodies during their treatment for cancer. Staff also made the transition to this practice change very quickly and did not require reinforcement after

initial training and education. In summary, this practice change was made smoothly and was positively accepted by staff and patients

Interpretation

In contrast with studies and evidence-based projects analyzed in the review of literature, this gap analysis did not track rate of implanted port occlusions post-intervention compared with pre-intervention. Instead, results focused on reception of this practice change by staff and by patients; the positive response in transition to evidence-based best practice by staff and patients was expected, though there was less resistance to change by patients than expected. Separately from this project, nursing management of the Medical Oncology department reported that they would like to retrospectively compare rate of implanted port occlusions pre- and post-intervention moving forward.

Key Findings

During the process of this Gap Analysis, the following incidental findings were made, and it is valuable to acknowledge them here.

Pulsatile Flushing Technique

Push-pause or pulsatile flushing is emphasized in the literature as an important factor preventing catheter occlusion of implanted ports, which is a key takeaway for clinical practice. Hoffman and Cartlidge (2022) identify that a practice drift from proper flushing technique may have had statistically significant effect on port patency in their study. Proper flushing technique is outlined in the "Infusion Therapy Standards of Practice" as brief, hard pushes with a short pause at each mL of the 10 mL NS flush in order to create turbulence in the catheter that clears out residual drug, bacteria or blood product (Gorski et al., 2021). While the pulsatile flushing technique is already part of the

practice at the clinical environment in this project, this step was revisited and highlighted as part of nursing education.

Cost Savings

Egnatios and Gloria (2021) explored potential cost savings in switching from heparin and saline to just saline as a locking solution for implanted ports and found that the difference in cost was statistically significantly lower when using saline alone. Hoffman and Fischer-Cartlidge (2022) also performed a cost-savings analysis that estimated $67,000 in savings annually. At the clinical environment in this project, 5 mL 100 U/mL heparin flushes cost $0.52. Though this is a relatively low expense, the elimination of stocking these heparin flushes provides an opportunity for cost savings. This has potentially significant financial implications for larger care centers and should be considered a positive incidental finding.

Limitations

This Gap Analysis project was limited by the lack of a clearly defined process for quality improvement at the organization. The majority of the project timeline was spent trying to find the right person to approve the trial run of the practice change in the Medical Oncology department; with no clearly defined process, a lot of the individuals in management roles were hesitant to sign off on a practice change, causing the baton to be passed from person to person. Consequently, this Gap Analysis project was limited by the short amount of time that the trial run of eliminating heparin from the procedure of de-accessing implanted ports was in place, about two weeks.

Another limitation of this project was the constraint from the Director of Oncology Pharmacy that the administration of 10 mL NS lock be documented in the

medication administration record (MAR). The rationale for this added step is that it makes it easier for the department to track the intervention moving forward. While this documentation is similar to the previous documentation of the 5mL heparin lock, it does prevent a further streamlined workflow for nursing and necessitated additional training for all infusion nurses on how to document this step correctly. This documentation in the MAR is temporary until the hospital-wide policy is revised to meet the implemented practice change.

Conclusions

The first two objectives for the Gap Analysis project, to investigate the efficacy of NS compared with heparin as a locking solution for maintaining patency of implanted ports and to implement this practice change in a way that provides both nursing and patient support were both met during the project timeline. A review of the literature revealed a non-inferiority of NS compared with heparin as a locking solution for maintaining patency of implanted ports, indicating that one solution cannot be recommended over another (Gorski et al., 2021). With this supporting evidence, a trial run of locking implanted ports with NS instead of heparin was implemented in the chosen clinical environment, with both nursing and patient support provided through education. The third objective, to ultimately present findings as evidence for policy change, was not achieved during the project timeline but is outlined as a next step.

Next Steps

The next step is to present the findings of this Gap Analysis project to the Policy Committee at the organization. The goal of this presentation is to present current literature and results of the trial run in the Medical Oncology as evidence for policy

revision. In the case that the hospital-wide policy is revised to meet current evidence, clinical staff, primarily nurses, in all departments will need education regarding the policy change and how that translates into clinical practice. The following are instances where education will need to be updated or implemented to reflect the policy change:

Green Notebook Activity. Green notebooks are used in each unit/department when a practice change is made. Clinical staff read information/instruction about the new practice and sign off that they have completed the reading.

VAT Tip of the Month. Each month VAT puts out an educative 'tip' that is posted in flyer format in break rooms and in bathrooms; the VAT CPL suggested that the policy revision should be a tip of the month to increase awareness of the practice change throughout all departments.

Class Curriculum. Education for practice change would have to be added to the VAD competency class (access and de-access procedures) as well as the Central Line Care and Maintenance class.

Provider Education. Providers would have to be educated re: not ordering heparin for implanted ports and why the standard of care has changed.

Opportunity for Improvement

As identified in the limitations section, through the process of this project it was discovered that there is no clearly defined process for quality improvement at the organization, a discovery that was echoed by the Acting Chair of the Research and Innovation Council. Moving forward, there is room for improvement in this area to more easily allow individuals to introduce and implement evidence-based best practices, with the goal of bringing clinical practice up to date with current evidence.

References

American Nurses Credentialing Center. (2017). Magnet Model. American Nurses Credentialing Center. Retrieved March 9, 2023, from https://www.nursingworld.org/organizational-programs/magnet/magnet-model/

Bertoglio, S., Solari, N., Meszaros, P., Vassallo, F., Bonvento, M., Pastorino, S., & Bruzzi, P. (2012). Efficacy of normal saline versus heparinized saline solution for locking catheters of totally implantable long-term central vascular access devices in adult cancer patients. Cancer Nursing, 35(4). https://doi.org/10.1097/ncc.0b013e31823312b1

Brito, A. R., Nishinari, K., Saad, P. F., Saad, K. R., Pereira, M. A., Emídio, S. C., Yazbek, G., Bomfim, G. A., Cavalcante, R. N., Krutman, M., Teivelis, M. P., Pignataro, B. S., Fonseca, I. Y., Centofanti, G., & Soares, B. L. (2018). Comparison between saline solution containing heparin versus saline solution in the lock of totally implantable catheters. *Annals of Vascular Surgery*, *47*, 85–89. https://doi.org/10.1016/j.avsg.2017.09.015

Cleveland Clinic. (2021). *Implanted port: What is it, Procedure & Management*. Cleveland Clinic. Retrieved February 17, 2023, from https://my.clevelandclinic.org/health/treatments/21701-implanted-port

Dal Molin, A., Clerico, M., Baccini, M., Guerretta, L., Sartorello, B., & Rasero, L. (2015). Normal saline versus heparin solution to lock totally implanted venous access devices: Results from a multicenter randomized trial. *European Journal of Oncology Nursing*, *19*(6), 638–643. https://doi.org/10.1016/j.ejon.2015.04.001

Egnatios, D., & Gloria, C. (2021). Implanted port patency: Comparing heparin and normal saline. *Clinical Journal of Oncology Nursing*, *25*(2), 169–173.https://doi.org/10.1188/21.cjon.169-173

Goossens, G. A., Jérôme, M., Janssens, C., Peetermans, W. E., Fieuws, S., Moons, P., Verschakelen, J., Peerlinck, K., Jacquemin, M., & Stas, M. (2013). Comparing normal saline versus diluted heparin to lock non-valved totally implantable venous access devices in cancer patients: A randomised, non-inferiority, Open trial. *Annals of Oncology*, *24*(7), 1892–1899.

Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice, 8th edition. *Journal of Infusion Nursing*, *44*(1S), S113–S118. https://doi.org/10.1097/nan.0000000000000396

Hoffman, M., & Fischer-Cartlidge, E. (2022). Implementation of an evidence-based practice change removing heparin from implanted vascular access devices. *Journal of Infusion Nursing*, *45*(5), 258–263. https://doi.org/10.1097/nan.0000000000000482

Jabaley, T., Xiong, N., Conley, S., Mazeika, T., Johnson, D., Biggins, B., Hilton, N., & Hong, F. (2022). Transitioning from heparin to saline locks for central venous access devices in oncology: An evidence-based practice approach. *Canadian Oncology Nursing Journal*, *32*(2), 286–293. https://doi.org/10.5737/23688076322286293

Jardine, S. (Host). (2022, July 29). Central Venous Catheters: Heparin Harms and Recommendations for Flushing (No. 218) [Audio podcast episode]. The Oncology Nursing Podcast.

Kuter, D. J., Konkle, B. A., Hamza, T. H., Uhl, L., Assmann, S. F., Kiss, J. E., Kaufman, R. M., Key, N. S., Sachais, B. S., Hess, J. R., Ness, P., McCrae, K. R., Leissinger, C., Strauss, R. G., McFarland, J. G., Neufeld, E., Bussel, J. B., & Ortel, T. L. (2017). Clinical outcomes in a cohort of patients with heparin-induced thrombocytopenia. *American Journal of Hematology*, *92*(8), 730–738. https://doi.org/10.1002/ajh.24759

López-Briz, E., Ruiz Garcia, V., Cabello, J. B., Bort-Martí, S., & Carbonell Sanchis, R. (2022). Heparin versus 0.9% sodium chloride locking for prevention of occlusion in central venous catheters in adults. *Cochrane Database of Systematic Reviews*, *2022*(7). https://doi.org/10.1002/14651858.cd008462.pub4

Mishra, S., & Horswill, A. R. (2017). Heparin mimics extracellular DNA in binding to cell surface-localized proteins and promoting Staphylococcus aureus biofilm formation. *MSphere*, *2*(3). https://doi.org/10.1128/msphere.00135-17

Wu, X. H., Chen, L. C., Liu, G. L., Zhang, T. T., & Chen, X. S. (2021). Heparin versus 0.9% saline solution to maintain patency of totally implanted venous access ports in cancer patients: A systematic review and meta-analysis. *International Journal of Nursing Practice*, *27*(2). https://doi.org/10.1111/ijn.12913

Zhong, L., Wang, H.-L., Xu, B., Yuan, Y., Wang, X., Zhang, Y.-ying, Ji, L., Pan, Z.-mu, & Hu, Z.-S. (2017). Normal saline versus heparin for patency of central venous

catheters in adult patients - A systematic review and meta-analysis. *Critical Care*, *21*(1). https://doi.org/10.1186/s13054-016-1585-x