Evaluating Difficult Intravenous Access: A Program to Decrease Harm in Outpatient Oncology

Kerri A. Dalton

College of Nursing, East Carolina University

Doctor of Nursing Practice Program

Dr. Bradley Sherrod

July 18, 2022

Notes from the Author

To each faculty member at East Carolina University, thank you for your support throughout this journey. A special thank you to my faculty advisor and mentor, Dr. Bradley Sherrod, for your guidance, encouragement, and reminding me to 'trust the process' throughout this project. To my site champion, Dr. Deborah "Hutch" Allen, thank you for your guidance, mentorship, support, and wisdom provided not only throughout this project, but throughout my career. I would like to express my gratitude and appreciation for the nurses who provided months of data collection for which this project would not have been possible without.

I cannot express enough gratitude to my family for your unwavering support in all of my endeavors. To my husband, thank you for supporting this crazy notion of mine and for your continued support, love, and patience as I pursued this academic achievement. To my son, thank you for the countless hours you shared your mommy so that she could be "doing school". To my parents, thank you for being my biggest cheerleaders and instilling that I can achieve whatever I set my mind to.

Abstract

Nurse's play a critical role in the safe administration of intravenous (IV) anti-cancer therapy but are not always part of the interprofessional team in choosing the appropriate type of IV access. Venous evaluation and appropriate vascular access device selection prior to the initiation of anti-cancer therapy are recommended as a method to reduce IV failure and extravasation. The goal of this project was to reduce extravasation, IV failures, and patient harm through implementing a collaborative approach to venous evaluation, including a determination of risk factors for IV failure and to secure the appropriate IV access prior to beginning anti-cancer therapy. Three pilot cancer disease groups with the highest extravasation rates were identified and engaged for participation. The pilot groups were responsible for requesting in-clinic referrals for IV evaluation in patients when central venous access was not planned. Expert infusion nurses volunteered to be part of a venous evaluation team (VET) and were trained to use a validated venous evaluation tool when performing these assessments. The total number of venous access attempts decreased by 10% and extravasation events were reduced by 60%. One highly engaged pilot group saw a 53% reduction in the number IV access attempts. The two other pilot groups saw increases in venous access attempts, which were not statistically significant. With this project, there was a reduction in patient harm through fewer IV access attempts, extravasation events, and interprofessional collaboration.

Keywords: extravasation, infiltration, IV failure, difficult intravenous access, oncology infusion

Table of Contents

Section I. Introduction

As oncology care is shifting from inpatient hospital to ambulatory care, measuring benchmarks of quality in the outpatient setting is paramount. Establishing reliable intravenous (IV) access is an essential component to anti-cancer therapy. This project explored a program to increase quality of care by reducing IV failures and patient harm related to IV failures in the outpatient oncology infusion environment.

Background

The project site was a large National Cancer Institute (NCI) designated cancer center located in the Southeast Region of the United States. This center treats approximately 130 patients each day with IV anti-cancer and supportive therapies. The project site has a culture of zero harm, which is achieved by monitoring safety events through an online reporting system, reviewing key safety events in leadership meetings and daily unit-specific staff huddles, and through continuous quality improvement (Duke Center for Healthcare Safety and Quality, 2021). Leaders recognized a trend in IV failures and patient harms related to IV failure in the outpatient oncology infusion center through safety reporting monitoring.

Organizational Needs Statement

The definition of an IV failure is an IV that causes phlebitis, occlusion, dislodgement, or infiltration that leads to the premature removal of an IV catheter (Helm et al., 2015). Extravasation is the most serious form of an infiltration or unexpected leakage of caustic drugs capable of causing tissue damage, which are termed vesicants (Jakel & Schulmeister, 2019). Vesicant chemotherapies are capable of causing erythema, swelling, pain, and eventually tissue necrosis and long term-tissue damage (Jakel & Schulmeister, 2019). Irritant chemotherapies are

capable of causing erythema, swelling, pain, and superficial skin sloughing but are less likely to cause tissue necrosis and long-term tissue damage (Jakel & Schulmeister, 2019).

Data collected across 2018-2020 for extravasation events demonstrated the monthly vesicant and irritant chemotherapy extravasation rates were 0.41-1.72% during months where an event occurred. While the rates for extravasation were deemed to be a low percentage of all IV infusions, the potential for patient harm for even one of these events is very high. In the study published by Jackson-Rose et al. (2017), a national benchmark across 19 NCI-designated cancer centers for extravasation of vesicant and irritant chemotherapies was determined to be 0.07%-0.09%. With monthly extravasation rates reaching up to 1.72%, the project site exceeded comparative benchmarks.

The Infusion Nursing Society (INS) recommends an interprofessional collaborative approach to determining the appropriate IV access based on individual patient factors, prescribed treatment, the presence of risk factors for infiltration or extravasation, and patient preferences at the earliest opportunity prior to beginning infusion therapy (Gorski et al., 2021). After evaluating these infusion therapy guidelines for the best practices in IV placement and evaluation, it was determined that a gap exists between recommended standards and practice (Gorski et al., 2021). In addition, local leaders and frontline staff report the lack of pre-treatment venous evaluation as a contributing factor to IV failure leading to extravasation.

The Institute for Healthcare Improvement's (IHI; n.d.) Triple Aim seeks to improve patient experiences in the healthcare system as they pertain to quality of care and satisfaction, improve the health of populations, and reduce the overall cost of healthcare. Clinical Nurse Specialist (CNS) interviews with patients and families post-extravasation suggest increased distress and less satisfaction with their chemotherapy administration experience. Additionally,

with increased time spent in the infusion center, additional IV sticks, and potential use of the IV team, there is an increase in the cost of care for that encounter. Furthermore, in the event of a vesicant chemotherapy extravasation, additional costs are associated with the administration of antidotes, potential specialty consult services with wound care and dermatology, surgical debridement, reconstruction, or even hospitalization for management (Helm et al., 2015). In meeting the Triple Aim goals and the project site's goal of zero harm, it was recognized that further evaluation and intervention to reduce this problem was warranted.

Problem Statement

National benchmarks for chemotherapy extravasation rates were established in a study conducted across 19 NCI-designated cancer centers in 2017. The benchmark extravasation rates for vesicant and irritant chemotherapies of 0.07-0.09% were determined (Jackson-Rose et al., 2017). Furthermore, data collected at the project site for extravasation events exceeded the national benchmark during the months where an event occurred with vesicant and irritant chemotherapy extravasation rates to be 0.41-1.72%.

Purpose Statement

The purpose of this project was to implement a collaborative approach to venous evaluation, including a determination of risk factors for IV failure and to secure the appropriate IV access prior to beginning chemotherapy as recommended by national infusion therapy standards of practice set by the INS (Gorksi et al., 2021).

Section II. Evidence

Literature Review

A literature search was performed to evaluate chemotherapy extravasation prevention methods in cancer patients. Databases utilized included Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed. Search terms used in CINAHL included Medical Headings (MH) of intravenous, intravenous infusion, catheterization, peripheral, neoplasms or cancer patients, antineoplastic agents, extravasation of diagnostic and therapeutic materials and Titles Including (TI) the terms “intraven”, “fail or difficult”, extravasation, or “prevent or control or minimize”. Medical Subject Headings (MESH) for PubMed included “Chemotherapy” and “Extravasation” and “Prevention”.

CINAHL yielded 77 articles and PubMed yielded 245 articles. A detailed review of titles and abstracts was performed. Duplicative articles were removed, revealing 26 articles for comprehensive analysis, leading to eight pertinent articles for a comprehensive review. These articles provided various levels of evidence on the seven-point scale, with most articles rating at a level six. Due to the lack of publications on this topic, level six evidence and above were accepted.

Articles were limited to the English language only, and a limit of 10 years was set to the time of publication. Most articles were published within the past five years, with all published within the past seven years. Exclusion criteria were articles related to the management of extravasations versus prevention and articles related to the pediatric population. See Appendix A for article overview and synopsis.

Current State of Knowledge

Chemotherapy extravasation, as a topic, is widely published in the literature and is regarded as a significant issue in oncology nursing worldwide. However, this literature search revealed very few articles that focus on the prevention of extravasation or peripheral IV failure in cancer patients. Instead, the majority of literature is focused on the management of extravasation once it occurs. The articles reviewed were based in the United States, Brazil, Turkey, Italy, and Australia. Of the articles reviewed, quality improvement initiatives, methodological studies, descriptive studies, and two literature reviews were found. While methodologies varied, four key themes emerged concerning prevention of IV failure leading to extravasation: nurse experience and training, appropriate vascular access device (VAD) selection, patient education, and prompt recognition of potential extravasation.

Current Approaches to Solving Population Problem(s)

While the administration of intravenous chemotherapy is almost exclusively a nursing practice, failures during chemotherapy administration have implications across the entire care team. Melo et al. (2020b) report that chemotherapy extravasation incidence should be used as a healthcare quality indicator, indicating the broader consequences of this harm. Methods proposed in the literature to prevent IV failure leading to extravasation will be discussed further.

Nursing Experience and Training. Nursing's role in the administration of IV chemotherapy is a critical component highlighted throughout the literature. Four articles specifically highlight the importance of nursing staff's knowledge, experience, and training to prevent IV failure and chemotherapy extravasation. First, Kapucu et al. (2017) explored the knowledge level of 165 Turkish nurses through knowledge-based surveys with questions regarding chemotherapy administration through peripheral and central venous access. Knowledge rates varied across questions, with less than 60% of respondents answering questions

related to peripheral venous selection correctly, which is interesting given that most respondents reported knowledge of extravasation management but not extravasation prevention (Kapucu et al., 2017). Descriptive data were reported using percentages, and chi-square analysis was used to analyze differences in answers based upon levels of safe chemotherapy administration; however, this data was not presented for extravasation prevention.

Data related to Oliveira Gozzo et al. (2017) explored the knowledge of 16 Brazilian oncology nursing professionals from a single institution through knowledge-based surveys with questions related to extravasation prevention and management. While a small survey sample, all participants were designated to administer chemotherapy at this institution, with 50% specialized in oncology and 43.2% reporting prior training in the area of chemotherapy treatment (Oliveira Gozzo et al., 2017). With 100% of respondents reporting that nurse training is an important component in the prevention of chemotherapy extravasation, this highlights the interpersonal need nurses feel regarding chemotherapy training (Oliveira Gozzo et al., 2017). In this study, results related to extravasation prevention and management varied, but importantly 83.5% of respondents demonstrated knowledge deficits related to choosing an IV site in a limb with sensory or motor deficiencies. Nearly 40% did not choose the correct order of IV placement sites, and in the event of extravasation, early signs and symptoms were not recognized by up to 44% (Oliveira Gozzo et al., 2017).

In the review article by Kreidieh et al. (2016), chemotherapy extravasation prevention and management strategies are proposed. Education and training are vital components in preventing extravasation, specifically in recognizing patient-related risk factors such as small, fragile veins, presence of lymphedema, obesity, impaired mental status, and previous history of difficulty obtaining IV access (Kreidieh et al., 2016). Additionally, Kreidieh et al. emphasize the

use of guidelines from the American Society of Oncology (ASCO), the Oncology Nursing Society (ONS), European Society of Medical Oncology (ESMO), and the European Oncology Nursing Society (EONS) as practice resources and education for extravasation prevention and management.

Melo et al. (2020a) developed an extravasation prevention and management bundle using the Delphi technique in two rounds with a panel of 22 content judges. The authors included elements in the bundle that scored a content validation coefficient greater than 0.78 and also greater than 80% consensus (Melo et al., 2020a). Elements contained within the bundle were derived predominantly from descriptive or qualitative studies and pertain to extravasation prevention strategies and early extravasation notification and management strategies (Melo et al., 2020a). In addition, regarding nurse experience and training, it is postulated to encourage certification and training of nurses working with chemotherapy and promote education related to the prevention and management of extravasation as well as knowledge regarding the risk factors for extravasation (Melo et al., 2020a).

Vascular Access Device Selection. Intravenous chemotherapy administration by nature requires the insertion of a venous access device, and choice of vascular access is a critical component for preventing chemotherapy extravasation. Included in venous access device selection is the evaluation of extravasation risk factors, such as a history of multiple peripheral venous IV attempts, small or fragile veins, presence of lymphedema, obesity, skin alterations, patient movement, and level of consciousness (Kreidieh et al., 2016; Larsen et al., 2021; Pagnutti et al., 2016; Melo et al., 2020a, 2020b). In addition, the choice of vascular access was referenced as a chemotherapy extravasation prevention measure in six articles discussed further.

The choice of vascular access requires interprofessional collaboration amongst oncology nurses, oncologists and advanced practice care teams, and the patient in consideration of specific chemotherapy regimens, length of chemotherapy treatments, and patient-specific risk factors (Coyle et al., 2015; Pagnutti et al., 2016). Pagnutti et al. (2016) reference the Registered Nurses' Association of Ontario, INS, and the United Kingdom National Health System guidelines as a source for collaborative practice modeling in choosing vascular access for chemotherapy patients. In their pilot-validation study, Pagnutti et al. (2016) implemented the pre-chemotherapy assessment using the Difficulty of IV-line insertion in Cancer Patients (DIVA-CP) tool in 260 cancer patients. This study was conducted to evaluate for inter-rater reliability in using this tool. While the results were not favorable in this study, future revisions to the tool may improve inter-rater reliability and could serve as a validated tool for oncology nurses performing venous evaluation (Pagnutti et al., 2016).

Coyle et al. (2015), in their quality improvement (QI) initiative, also implemented nursing pre-chemotherapy venous evaluation at the time chemotherapy treatment was planned, and based on the evaluation results, a collaborative determination for appropriate intravenous access was made. Additionally, if vesicant chemotherapy was prescribed and central venous access was not prescribed, the CNS was notified to review the patient chart and the venous assessment to determine the safety of proceeding with peripheral venous access (Coyle et al., 2015). This interprofessional collaborative approach to venous access selection demonstrated a 90% reduction in the administration of vesicants through peripheral venous access and no extravasations in the six months post-implementation (Coyle et al., 2015).

Kreidieh et al. (2016), in their review article, also report the importance of appropriate venous access selection in chemotherapy extravasation prevention. It is recommended to perform

a venous assessment for patient-related risk factors for extravasation prior to selecting venous access (Kreidieh et al., 2016). Finally, an appropriate cannula size should be chosen, which is the smallest size that will allow for blood flow and patency (Kreidieh et al., 2016).

In an observational study by Larsen et al. (2021), peripheral IV failure rates were evaluated in cancer patients hospitalized in a single hospital in Australia. This study found that nearly 35% of all peripheral IVs failed. While none of these failures were associated with vesicant chemotherapy, failures were noted during non-vesicant chemotherapy administration, IV fluid, blood product, and antibiotic administration (Larsen et al., 2021). In evaluating for inherent and non-modifiable risk factors for IV failure, this study found that the most predictive risk factor for failure of peripheral IVs was multiple attempts to place a peripheral IV at $\geq$3 attempts, and in this study, two or more attempts was required 26% of the time (Larsen et al., 2021). This study highlights the importance of IV failure in cancer patients and the risk that multiple access attempts may lead to future IV failure, which could include extravasation.

In the Melo et al. (2020a; 2020b) chemotherapy extravasation prevention bundle and scoping review for the prevention of chemotherapy extravasation, the selection of appropriate venous access device is emphasized. In addition to evaluating for the aforementioned patient-related risk factors for extravasation, the site for peripheral IV access should be appropriately evaluated to avoid areas with small superficial veins, bruising, limbs of axillary lymph node dissection, limbs with vascular disease, and limbs with sensory disturbances, but should be placed in a region and dressed in a fashion to allow for continuous visibility (Melo et al., 2020a; 2020b). Melo et al. (2020a) also state to request central venous access when there are known difficulties in obtaining peripheral IV access, such as requiring up to three attempts to obtain peripheral IV access.

Patient Education. Including the patient in the decision-making process regarding venous access selection and understanding the signs and symptoms of extravasation are highlighted in three articles as a concept related to extravasation prevention. Patients are often the first to notice the signs and symptoms of an extravasation, which may include pain, burning, tingling, or itching at their peripheral IV site (Kreideh et al., 2016; Melo et al., 2020a). Patients should be educated to report any signs and symptoms of extravasation, and it is imperative that the health care team does not undervalue these reports and initiates prompt management (Kreidieh et al., 2016). Coyle et al. (2015) specifically mentioned patient involvement in venous access selection, which was closely tied to ensuring patients were educated regarding the specific chemotherapy agents in their treatment plan, comprehension of risks and benefits of the various venous access options, and the signs and symptoms of infiltration or extravasation.

Prompt Recognition of Potential Extravasation. While prompt recognition of potential extravasation is not a means to prevent extravasation, it is a means to minimize potential damage and was highlighted in the Melo et al. (2020b) scoping review and the Melo et al. (2020a) extravasation prevention bundle. Melo et al. (2020a) state that early recognition of extravasation is the next most important measure in managing potential extravasations. It is worth noting that Melo et al. (2020b) link early recognition with appropriate education and training of the individuals administering intravenous chemotherapy.

Evidence to Support the Intervention

After evaluating the literature for methods to reduce peripheral IV failure and chemotherapy extravasation in cancer patients, it became evident that no single strategy can be used in isolation to solve this problem. Moreover, the key themes identified were nursing education and training, vascular access selection, patient education, and early recognition and

management. While nursing education and training in chemotherapy administration and extravasation is the theme with the broadest body of knowledge in the literature, this was not an area the partnering organization felt was lacking in structure. Of the four themes, the one intervention where a gap was noted was in vascular access selection.

Pagnutti et al. (2016) assert that while the process for choosing appropriate vascular access should be an interprofessional collaborative process, nurses who administer chemotherapy should be at the core of the decision-making. Additionally, venous evaluation for extravasation risk factors and appropriateness for peripheral IV placement should be performed before all chemotherapy administration, especially prior to vesicant chemotherapy administration (Coyle et al., 2015; Gorski et al., 2021; Kreidieh et al., 2016; Pagnutti et al., 2016). The project site agreed that implementing a pre-chemotherapy venous evaluation was the most appropriate intervention to reduce peripheral IV failures and chemotherapy extravasation.

Evidence-based Practice Framework

The Iowa Model of Research in Practice and the Iowa Model Revised were the evidence-based practice integration frameworks used to guide this project (Buckwalter et al., 2017; Titler et al., 1994). The problem-focused triggers included incident report data related to chemotherapy infiltrations and extravasation and oncology infusion nursing reports of difficult venous access leading to extravasation (Titler et al., 1994). Additionally, knowledge-focused triggers included the need to implement INS standards related to venous evaluation prior to initiation of chemotherapy (Titler et al., 1994). As this problem was identified as a priority, the project team was formulated due to the high degree of potential patient harm and the cost to the organization for each harm (Buckwalter et al., 2017). The next phase in the Iowa Model was to appraise and synthesize the literature and determine the utility of the knowledge base in guiding an evidence-

based intervention (Buckwalter et al., 2017; Titler et al., 1994). A venous evaluation tool was designed, and a nursing process was developed to perform a venous evaluation in the oncology clinic at the time of chemotherapy prescribing to allow for interprofessional decision-making regarding appropriate venous access for chemotherapy administration could occur (Buckwalter et al., 2017; Titler et al., 1994). This process was evaluated for feasibility, and specific outcomes evaluated were the number of peripheral IV failures and extravasations during the implementation phase (Buckwalter et al., 2017; Titler et al., 1994). Site champions were selected to sustain the practice change (Buckwalter et al., 2017). Finally, these evidence-based practice intervention results were disseminated to project site stakeholders and the project team stakeholders (Buckwalter et al., 2017).

Ethical Consideration & Protection of Human Subjects

There were no ethical considerations for this evidence-based practice intervention. Due to the size of the project site and resources available, the oncology disease-based teams with the highest rates of peripheral IV failure and extravasation were included in this project. Protected health information (PHI), including name and medical record, were collected for the purposes of chart review for infiltration and extravasation events. While this PHI was used to access the medical record, only the extravasation and infiltration event information were recorded in the data collection forms. This data included the primary cancer, type of IV access, number of attempts to obtain IV access, chemotherapy regimen, chemotherapeutic agents that infiltrated, rate of infusion at time of infiltration, and symptoms reported at time of infiltration. No patient identifiers or PHI were reported, and all data were kept confidential by limiting access only to the project team. No harm was expected to any of the participants in this evidence-based practice project.

As part of project planning and preparation, the project lead completed training through the Collaborative Institutional Training Initiative (CITI) for Biomedical Research with Good Clinical Practice (GCP) and the Responsible Conduct of Research Module. Additionally, this project was submitted to the project site's Institutional Review Board (IRB) for QI Exempt Research approval as well as the East Carolina University (ECU) IRB. See Appendix B for the project sites IRB approval and Appendix C for ECU IRB approval.

Section III. Project Design

Project Site and Population

The project site was a large academic NCI-designated cancer center located in the Southeastern United States. The primary population involved in the project was the interprofessional care team, including physicians, advanced practice providers, and infusion registered nurses. The venous evaluation team consisted of two registered nurses from the infusion center, the clinical team lead, and the infusion center CNS. The site has a culture of safety that fosters evidence-based practice and research. However, a barrier to implementing the venous evaluation team was short-staffing ratios.

Description of the Setting

The outpatient oncology infusion center and cancer center were chosen as the implementation site. In 2021, the infusion center treated approximately 2500 new patients, with an average of 48 new patient treatments per week (Duke Cancer Institute, 2021). The outpatient oncology infusion center total volume for 2021 was approximately 29,000 visits with an average daily census of 114 visits (Duke Cancer Institute, n.d.). The infusion center is staffed by 33 registered nurses (RNs), six medical assistants, and has 64 infusion chairs. The venous evaluation team performed evaluations in the medical oncology clinics. However, data specific to peripheral IV attempts, extravasation, and infiltration events were collected from the outpatient oncology infusion center.

Description of the Population

The primary population consisted of the interprofessional Thoracic, Gastrointestinal, and Genitourinary medical oncology healthcare team, including medical oncologists, advanced

practice providers, and clinic and infusion RNs. In addition, the venous evaluation team was comprised of expert oncology infusion registered nurses.

Project Team

The core team for this evidence-based project included the project lead, site champion, and faculty champion. The project lead was responsible for project concept development, organizing meetings with stakeholders, implementation, and oversight. The site champion provided project development guidance, organizational feasibility development, and mentorship. The faculty champion provided overall project guidance, mentorship, and feedback throughout each project stage. Several key stakeholders were included in the project but were not part of the core project team.

Project Goals and Outcome Measures

The goal of this evidence-based project was to implement a collaborative approach to venous access evaluation, including a determination of risk factors for IV failures and to secure the appropriate IV access prior to beginning chemotherapy as recommended by the national standards set forth by INS (Gorski et al., 2021). Outcomes measures included the following:

1. Implement standard procedures to improve compliance with INS national standards for venous evaluation prior to intravenous chemotherapy.
2. Reduce the number of peripheral IV attempts by 50% in cancer patients receiving treatment in the infusion center.
3. Reduce the number of IV infiltrations and extravasations in cancer patients receiving treatment in the oncology infusion center by 25%.

Description of the Methods and Measurement

This project took place in the outpatient cancer center at the project site. Initially, nursing staff in the infusion center collected data specific to the number of peripheral IV attempts to start IVs for cancer patients using a paper collection tool called the Daily IV Access Attempt Log (see Appendix D). This data was collected for a 4-week period (December 1 to December 31, 2021) before the implementation of the project. This data established an internal benchmark for the average number of IV attempts at the project site.

The implementation phase involved training a core team of clinical nurses from the infusion center to evaluate venous access using a modified Difficult Intravenous Access (DIVA) venous evaluation tool, which is displayed in Appendix E (Ehrhardt et al., 2018). Patients consulted in the Thoracic, Genitourinary, and Gastrointestinal Medical Oncology Clinic participated in proactive venous evaluation during clinic visits. The venous evaluation team was paged while the patient was in the oncology clinic for venous evaluation. This process was designed to promote proactive interprofessional discussions regarding appropriate IV access placement for the patient's oncology treatment.

Beginning March 18, 2022, two weeks after implementation of the venous evaluation team, the infusion nurses collected data specific to the number of peripheral IV attempts to start IVs for cancer patients. In addition, extravasation and infiltration data were also measured using the safety reporting system (SRS).

Discussion of the Data Collection Process

Data from the pre and post-implementation paper surveys regarding the number of attempts to place peripheral IVs were collected. These results were entered into an Excel spreadsheet. The change in peripheral IV attempts was determined through 2-tailed t-tests, $p \leq .05$ significance. In addition, descriptive statistics were used on aggregate pre and post-

implementation data (Frequency, mean, standard deviation [SD]). Extravasation and infiltration rates were measured during and post the intervention. Evaluation for change in extravasation and infiltration rates were determined through 2-tailed t-tests, $p \leq .05$ significance.

Implementation Plan

The first phase of implementation for this project began upon IRB approval. The nursing staff in the outpatient oncology infusion center were trained to collect pre-implementation data using a paper tool to collect information daily related to how many attempts it takes to place peripheral IVs. This data was reviewed weekly by the project lead. Staff and leadership were continuously engaged to encourage the completion of this data collection tool.

Key stakeholders, including physicians, advanced practice providers, and leadership for the Thoracic, Genitourinary, and Gastrointestinal medical oncology clinics, were educated and engaged in the data for extravasation, infiltration, and the average number of attempts to place peripheral IVs in the outpatient oncology infusion center. In addition, the project plan and timeline were shared. Opportunities for questions and clarifications were afforded during the initial training as well as throughout the project. During this same time, the venous evaluation team nurses were trained to use the modified DIVA tool and the electronic medical record to document the assessment.

The final phase of implementation involved deploying the venous evaluation team to perform venous evaluations at the time of chemotherapy treatment prescribing. Two weeks after implementation of the venous evaluation team, the nurses in the outpatient oncology infusion center would reinitiate collecting data regarding the number of attempts to place peripheral IV access. The project lead monitored this data weekly as well as reviewed SRS reports for

infiltration and extravasation. In addition, the project lead offered continuous consultation and engagement with the teams involved throughout this project.

Timeline

The timeline for this project is found in Appendix F. Upon full IRB approval November 11, 2021, pre-implementation peripheral IV attempt data collection began and continued for four weeks. Starting January 10, 2022, sessions for interprofessional team training were held. The project lead trained medical oncologists, advanced practice providers, and clinic nurses on venous evaluation methods before implementation of chemotherapy. Additionally, the venous evaluation team nurses were trained to use the modified DIVA tool during that time. Project implementation began March 4, 2022 and continued through May 31, 2022. Post-intervention data collection started March 18, 2022, continued through May 31, 2022 and was reviewed weekly by the project lead. Data analysis began at the conclusion of the project.

Section IV. Results and Findings

Results

Baseline data was collected at the project site in December 2021, which included elements such as total number of IV attempts, treatment patient received, and the primary cancer disease group. This data showed that out of 467 peripheral IV starts, the average number of attempts was 1.47, meaning that approximately 50% of IV attempts were successful on the first attempt, and 50% required more than two attempts. Exploring this further by disease group indicated a significant amount of variability. The highest rate of peripheral IV attempts was 1.77 in the Gynecologic-oncology group, followed by 1.71 in the Brain tumor group. In the three groups with the highest extravasation rates, the data revealed a rate of 1.59 attempts in the Genitourinary cancer group, 1.38 attempts in the Gastrointestinal cancer group, and 1.36 in the Thoracic cancer group. Extravasation rates for December 2021 revealed five reported extravasation events, producing an extravasation rate of 1.07%.

Data collected from March 18, 2022 through May 31, 2022 showed that out of 624 peripheral IV starts, the average number of attempts at the project site was 1.42%, which represented a 10% change from pre-intervention. In analyzing the three pilot groups, the Genitourinary cancer group revealed a peripheral IV attempt rate of 1.28, which demonstrates a 53% reduction. Data were entered into SPSS and analyzed using an independent samples *t*-test with a two-tail test and alpha set at .05. There was a significant difference between the pre-intervention data (M = 1.59, SD = .90) and the post-intervention data (M = 1.28; SD = .57), $p < .001$. The Thoracic cancer group revealed a peripheral IV attempt rate of 1.48, which demonstrates a 33% increase from baseline. There was not a significant difference between the pre-intervention data (M = 1.36; SD = .76) and the post-intervention data (M = 1.48; SD = .85),

p = .09. The Gastrointestinal group revealed a peripheral IV attempt rate of 1.53, which demonstrates a 39% increase from baseline. There was not a significant different between the pre-intervention data (M = 1.38; SD = .92) and the post intervention data (M = 1.53; SD = .78), p = .43.

The venous evaluation team consulted on 27 patients throughout the implementation phase. The Genitourinary program accounted for 13 referrals, followed by the Thoracic program with 12 referrals, and two referrals from the Gastrointestinal program. The average DIVA score was two, indicating less risk for difficulty with venous access. Out of 27 referrals, central venous access was only recommended in six cases. Finally, in regard to extravasation, there were six events total during the implementation phase for an average of two events per month, demonstrating a 60% reduction in extravasation events.

Discussion of Major Findings

Venous evaluation and appropriate vascular access device selection prior to initiation of treatment are recommended from multiple literature sources as an extravasation prevention method. The organization and pilot programs were supportive of implementing this intervention. The venous evaluation team nurses were comfortable using the DIVA venous evaluation tool, and having the DIVA score facilitated conversations with the provider team regarding the intravenous access recommendations. In total, the venous evaluation team performed 26 evaluations determining that 20 patients were candidates for peripheral venous access and six were recommended for central venous access device placement. The recommendation for central venous access devices was accepted in all recommended situations.

The total number of venous access attempts throughout the project decreased from 1.47 to 1.42 demonstrating a 10% reduction in the number of attempts. Concerning the pilot groups,

the Genitourinary population saw the most significant reduction in venous access attempts from 1.59 to 1.28, representing a 53% reduction. The Thoracic and Gastrointestinal programs saw increases in venous access attempts, which were not statistically significant. Of the 26 referrals for venous evaluation, the Genitourinary program alone accounted for 50% of those referrals. Additionally, the Genitourinary clinical pharmacist developed criteria for specific chemotherapy regimens that should require central venous access without consideration for peripheral venous access. The Genitourinary program also engaged earlier during the implementation period, which would allow for the impact of the venous evaluations to be demonstrated in the data. Generally, venous evaluations were performed two to four weeks prior to initiation of therapy. The Thoracic program became more engaged during the last month of implementation; thus, the data collected may not reflect the impact. The Gastrointestinal program accounted for two referrals for venous evaluation, demonstrating minimal engagement, which is reflected in the data.

The goal to reduce extravasation and infiltration events by 50% was exceeded in reducing the number of events by 60%. Upon further review of the events for the pilot groups, the two events that occurred in the Genitourinary population, neither of those patients would have been eligible for a venous evaluation as they began treatment before this project was implemented. The remainder of the events would have been eligible for venous evaluation. Moreover, the extravasation and infiltration events did not occur in patients who had a venous evaluation from the venous evaluation team.

Ideally, this project would promote interprofessional collaboration through discussions of the DIVA venous evaluation recommendations with the care teams. The nurses who served on the venous evaluation team reported new relationships with clinic teams that they did not have previously. While the Thoracic program did not engage early in the implementation phase, an

unexpected occurrence was three referrals made to the venous evaluation team to assess and evaluate the venous status of patients who had previously begun their anti-cancer therapy while they were receiving treatment due to difficulty with previous venous access attempts. To conclude, this project fostered interprofessional collaboration through reducing patient harm related to venous access.

Section V. Interpretation and Implications

Costs and Resource Management

The actual costs of implementing this project were minimal, as the primary cost was labor in conducting the research, developing, implementing, and managing this project. The project site already employs several CNSs who lead and manage micro and macrosystem evidence-based projects, and this work would fall within the scope of those individuals. Currently employed infusion RNs volunteered to serve on the venous evaluation team and local management allowed flexibility in using these ten RNs to perform 26 venous evaluations. The average time per assessment was 15 minutes. This organization also has a strong culture for promoting evidence-based practice and shared governance through a robust clinical ladder program. By using the existing infrastructure to implement this project, the cost to implement or to sustain would be budget neutral.

The potential financial benefits of this project are substantial. There is a saving in supplies for every fewer IV sticks a patient receives, including the IV catheter, cleansing agents, gauze, and dressings. In the prevention of extravasation, the cost is even more substantial. In the event of extravasation, there is additional chair and nurse time associated with adding a minimum of $1000 to the patient's encounter from those costs alone (M. Krasno, personal communication, December 2, 2021). For situations where an antidote is available for the extravasated drug, the price for the antidote is over $2000 (A. McGee, personal communication, December 3, 2021). When nurse, chair, and travel time for the patient are factored in, this is a very costly event. The costs are not insignificant in the most extreme cases that warrant specialty consults with wound management or dermatology for surgical debridement, reconstructive surgery, or hospitalization for infection management (Helm et al., 2015).

Implications of the Findings

Utilization of a validated venous assessment tool to evaluate the venous status of cancer patients prior to initiation of anti-cancer therapy meets compliance with INS standards (Gorski et al., 2021). Additionally, the findings from this project support meeting the Triple Aim's goal to improve patient experiences in the healthcare system as they pertain to the quality of care and satisfaction, improve the health of populations, and reduce the overall cost of healthcare (IHI, n.d.). Furthermore, this project's findings may benefit cancer patients receiving IV therapy and the healthcare providers who care for them, including physicians, advanced practice providers, nurses, and the healthcare system.

Implications for Patients

The patient was the greatest beneficiary of the findings in the project. The reduction in extravasation and infiltration events demonstrates that fewer patients had the potential for short or long-term tissue damage from IV failure events. Additionally, by reducing the number of IV access attempts in the Genitourinary population by more than 50%, this subset of patients experienced less potential for IV failure, tissue damage, fear and anxiety related to IV placement, and satisfaction. While not directly measured through patient surveys in this project, a less studied but significant concern with IV failures is the potential psychological impact on the patient. Plohal (2021) describes the patient's experience with multiple IV attempts and failures as producing anxiety, fear, dread, and despair related to future IV attempts. Furthermore, Plohal reports participants citing hopelessness and helplessness related to their medical care.

Implications for Nursing Practice

Venous evaluation is central to oncology infusion nursing as this is part of daily practice. Nurses are central to IV failure prevention, and the findings of this project demonstrated the

benefit of performing this assessment prior to beginning cancer treatment. Despite evidence supporting this concept, prior to this project, infusion nurses were not part of the decision-making process in choosing a patient's IV access. Anecdotal reports from staff during project leader weekly rounding indicated feelings of failure when patients require multiple IV attempts, and this project has the potential benefit of improving staff satisfaction concerning IV failures.

Moreover, the 10 nurses who served on the venous evaluation team reported developing relationships with nurses and healthcare providers that they did not previously have, describing improved interprofessional collaboration. This new collaboration has the potential to improve team dynamics which would ultimately lead to more cohesive, comprehensive cancer care. With greater interprofessional collaboration, nurses can lead this process change improving patient outcomes.

Impact for Healthcare System(s)

For the healthcare system, this project could realize many benefits. First, while there are few ambulatory nursing-sensitive indicators for oncology, Jackson-Rose et al. (2017) established a national benchmark for extravasation rates, and this should be utilized as a measured oncology nursing-sensitive indicator. This project demonstrated methods for tracking this benchmark. Moreover, the potential sequelae of extravasation can negatively impact quality, cost, patient outcomes, and the patient's psychological experience with the healthcare system. Adopting and expanding this initiative across this NCI-designated cancer program could decrease costs and harm across the health system.

Sustainability

The project site planned to sustain the venous evaluation program developed through this project. To promote professional practice, the nurses who served on the venous evaluation team

have the opportunity to use participation towards clinical ladder maintenance or progression. The success of the Genitourinary program's involvement was shared across team meetings to promote referrals to the venous evaluation team. Strategies used by that team were shared with the other two pilot groups to promote engagement, and with the medical director who provided direction for methods to integrate referrals as standard practice.

In the second phase, the venous evaluation team nurses planned to train interested clinic nurses on using the DIVA venous evaluation tool. Engaging with the clinic nurses reduces the time infusion nurses spend away from the infusion center and promotes collaboration across practice areas. In addition, clinic nurses often provide the initial cancer treatment education, and that visit provides an optimal forum to perform the venous evaluation.

Furthermore, the project site supported expansion across the cancer center to incorporate all disease groups and across the health system oncology programs. The labor need increases with the expansion, thus requiring each clinic or program to determine which complement of nurses to perform these assessments. The project lead agreed to stay involved in leading this initiative across the healthcare system and mentoring clinical nurses with this evidence-based practice work in their clinical areas.

Dissemination Plan

The results from this project were formally shared with various stakeholder groups across the health system. The findings were shared with the Genitourinary, Thoracic, and Gastrointestinal disease groups at their monthly disease group meetings in July 2022. Results were disseminated to the Chief Nurse in Oncology, project site Clinical Operations Director, and Nurse Manager at a standing monthly nursing leadership forum in July 2022. As this work focused on an oncology nursing-sensitive indicator, the greater oncology community is an

influential group in disseminating this information. This work was submitted as an abstract for poster presentation to the Oncology Nursing Society for consideration at the Oncology Nursing Society Congress scheduled for April 26-30, 2023. Finally, this work was presented to the East Carolina University School of Nursing Doctoral Committee on July 12, 2022, and submitted to The ScholarShip repository.

Section VI. Conclusion

Limitations and Facilitators

Several limitations impacted the implementation of this evidence-based practice project. The COVID-19 Omicron surge had the most significant impact on initial team training and engagement. The health system implemented a freeze on all meetings during January 2022 in response to staff deployments and absences due to illness and reprioritization of work. Those events caused a one-month delay in staff training, provider engagement, and project implementation. Additionally, this shortened the window between deployment of the venous evaluation team and the start of and post-implementation data collection.

Another barrier in this project was hardwiring the referral process to the venous evaluation team in existing workflows. While most provider teams expressed support for this project, referrals were lacking in two of the three pilot groups throughout the project. The project lead partnered with medical leadership to determine barriers and employed strategies to overcome those barriers, including bi-weekly updates to the participating groups, daily communication with the clinic staff to remind them how to refer patients, and weekly rounding by the project lead. The pilot group with the most success throughout this project had a very engaged clinical pharmacist who facilitated the initial referrals and engaged clinic nurses and providers.

The most significant barrier to data collection from the infusion nurses was staffing. This manual data collection process was onerous during some staffing periods. The project lead met weekly with leadership and the venous evaluation team to discuss strategies to encourage the most robust data collection. Weekly rounding with all infusion staff by the project lead occurred,

as well as the project lead limited the required elements for staff to complete and shifted some elements for the project lead to complete during chart review.

The greatest facilitator was the support from stakeholders across the health system. Senior leadership continued to support this initiative despite the challenges COVID-19 had on the health system. Providers continued to support the work, and if a referral was missed prior to initiating therapy, some providers made referrals after treatment had begun. The nurses involved were engaged and provided a sense of ownership in this project. The project lead was a member of the teams involved in this project, and this helped to facilitate credibility and foster relationship development.

Recommendations for Others

Incorporating venous evaluation prior to initiating therapy is a recommendation from the INS (Gorski et al., 2021). If replicating this work in a large healthcare system, an organizational needs assessment should be conducted to assess for existing workflows and structures to support this work, infrastructure to support quality improvement and data collection, and resources to lead and oversee this work. Additionally, it would be optimal to leverage electronic medical record reporting versus manual data collection.

If replicating this work within a comprehensive oncology healthcare system, it would be recommended to start with pilot groups to demonstrate proof of concept and then expand to all groups. While the pilot groups for this project were selected based on the highest rates of extravasation, it may be recommended to focus on the groups with the highest rates of IV access attempts as this is the most significant predictor of extravasation (Larsen et al., 2021). In addition, the baseline number of IV attempts was collected immediately prior to launching the

venous evaluation team. Therefore, it would be recommended to collect that data earlier and use that information to guide implementation phases.

From the health system perspective, incorporating extravasation into oncology nursing-sensitive indicators would support the foundation for the continued expansion of this work. Frequent reporting of outcomes in multidisciplinary settings will elevate the importance of implementing strategies to reduce extravasation. Additionally, creating standard workflows across the health system for pre-treatment venous evaluation would help build cohesion, create consistency, and set the standards for this work.

Recommendations Further Study

There is an abundance of literature related to extravasation management. However, the literature is lacking regarding extravasation prevention, specifically with choosing appropriate IV access selection. There is an opportunity to further research using validated venous assessment tools, such as the DIVA, to determine the high risk for IV failure patients. Pagnutti et al. (2016) piloted the use of a chemotherapy-specific venous evaluation tool, DIVA-CP. While this tool did not show inter-rater reliability, there is an opportunity for future research using chemotherapy-specific tools.

Additionally, a significant gap in the literature is related to understanding the patient and nurse experience with IV placement. While Plohal (2021) explored the patient experience related to IV placement and failures and found these patients experienced significant distress, more research is warranted, specifically in the oncology population where there is a high need for IV placement. Nurses at the project site verbalized distress and feelings of failure when multiple IV attempts were required or extravasation occurred; however, this is an unexplored area of research.

There are opportunities to demonstrate fiscal savings with fewer IV failures and IV attempts that should be explored. Obvious areas of savings with fewer extravasations are attributed to the cost of antidotes, hospital admissions, consultation services, and surgical wound debridement. Areas of more nuanced savings that could be explored include measuring nurse time and infusion chair time. Increasing efficiency in chair time could create opportunities for enhanced workflows, patient throughout, and potentially less nursing overtime pay.

Final Thoughts

In conclusion, chemotherapy extravasation can cause significant physical and psychological harm to the impacted patient and impact the healthcare system. The extravasation rates at this NCI-designated cancer center exceed national benchmarks demonstrating the need for an action plan. Extravasation incidence should be monitored as a critical oncology-specific safety metric in various forums, including key stakeholders from senior leadership and frontline nurses, to enhance awareness of this type of event. Solving this problem will require interprofessional collaboration. Nurses are in the position of placing and using the various methods of venous access and are the first to manage extravasation when it occurs. However, historically, physicians and advanced practice providers have determined which type of venous access a patient will be prescribed. Instituting a program for venous evaluation prior to the initiation of anti-cancer therapy demonstrated compliance with INS national standards, trends towards a reduction in venous access attempts, and a significant reduction in extravasation and infiltration events. Furthermore, shared goals in meeting the organization's goal of zero harm, frequent communication regarding metrics, and instituting interprofessional collaborative venues will be essential to reduce this harm.

References

Buckwalter, K. C., Cullen, L., Hanrahan, K., Kleiber, C., McCarthy, A. M., Rakel, B., Steelman, V., Tripp-Reimer, T., Tucker, S., Iowa Model Collaborative, & Authored on behalf of the Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14*(3), 175-182. https://doi.org/10.1111/wvn.12223

Coyle, C. E., Griffie, J., & Czaplewski, L. M. (2015). Eliminating extravasation events: A multidisciplinary approach. *Journal of Infusion Nursing, 38 Suppl 6S* (Supplement 6S), S43-S50. https://doi.org/10.1097/NAN.0000000000000144

Duke Cancer Institute (n.d.) *Active treatment patients.* https://bit.ly/3r1vUAb

Duke Center for Health Safety and Quality. (n.d.) *Safety & quality.* https://www.hsq.dukehealth.org/duke-quality-system/safety-and-quality/

Ehrhardt, B. S., Givens, K. E. A., & Lee, R. C. (2018). Making it stick: Developing and testing the difficult intravenous access (DIVA) tool. *The American Journal of Nursing, 118*(7), 56-62. https://doi.org/10.1097/01.NAJ.0000541440.91369.00

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 Suppl 1), S1-S224. https://doi.org/10.1097/NAN.0000000000000396

Helm, R. E., Klausner, J. D., Klemperer, J. D., Flint, L. M., & Huang, E. (2015). Accepted but unacceptable: Peripheral IV catheter failure. *Journal of Infusion Nursing, 38*(3), 189-203. https://doi.org/10.1097/NAN.0000000000000100

Institute for Healthcare Improvement (IHI). (n.d.). *Triple aim - The best care for the whole*

population at the lowest cost. http://www.ihi.org/Engage/Initiatives/TripleAim/Pages/default.aspx

Jackson-Rose, J., Del Monte, J., Groman, A., Dial, L. S., Atwell, L., Graham, J., O'Neil Semler, R., O'Sullivan, M., Truini-Pittman, L., Cunningham, T. A., Roman-Fischetti, L., Costantinou, E., Rimkus, C., Banavage, A. J., Dietz, B., Colussi, C. J., Catania, K., Wasko, M., Schreffler, K. A., . . . Rice, R. D. (2017). Chemotherapy extravasation: Establishing a national benchmark for incidence among cancer centers. *Clinical Journal of Oncology Nursing, 21*(4), 438-445. https://doi.org/10.1188/17.CJON.438-445

Jakel. P., & Schulmeister, L. (2019). Infusion-related complications. In Olsen, M., LeFebvre, K., & Brassil, K. (Eds.), *Chemotherapy and immunotherapy guidelines and recommendations for practice* (pp. 251-270). Oncology Nursing Society.

Kapucu, S., Özkaraman, A., Uysal, N., Bagcivan, G., Şeref, F., & Elöz, A. (2017). Knowledge level on administration of chemotherapy through peripheral and central venous catheter among oncology nurses. *Asia-Pacific Journal of Oncology Nursing, 4*(1), 61-68. https://doi.org/10.4103/2347-5625.199081

Kreidieh, F. Y., Moukadem, H. A., & El Saghir, N. S. (2016). Overview, prevention and management of chemotherapy extravasation. *World Journal of Clinical Oncology, 7*(1), 87-97. https://doi.org/10.5306/wjco.v7.i1.87

Larsen, E. N., Marsh, N., O'Brien, C., Monteagle, E., Friese, C., & Rickard, C. M. (2021). Inherent and modifiable risk factors for peripheral venous catheter failure during cancer treatment: A prospective cohort study. *Supportive Care in Cancer, 29*(3), 1487-1496. https://doi.org/10.1007/s00520-020-05643-2

Melo, J. M. A., Oliveira, P. P. d., Rodrigues, A. B., Souza, R. S., Fonseca, D. F. d., Gontijo, T.

F., & Silveira, E. A. (2020a). Bundle construction and assessment before antineoplastic extravasation: A methodological study. *Acta Paulista De Enfermagem, 33*(2), 1-12. https://doi.org/10.37689/acta-ape/2020AO0075

Melo, J. M. A., Oliveira, P. P. d., Souza, R. S., Fonseca, D. F. d., Gontijo, T. F., & Rodrigues, A. B. (2020b). Prevention and conduct against the extravasation of antineoplastic chemotherapy: A scoping review. *Revista Brasileira De Enfermagem, 73*(4), e20190008. https://doi.org/10.1590/0034-7167-2019-0008

Oliveira Gozzo, T.d., Costa Santos, L. A., & Prado da Cruz, L. A. (2017). Knowledge of the nursing team on the prevention and management of extravasation of chemotherapy drugs. *Journal of Nursing UFPE / Revista de Enfermagem UFPE, 11*(12), 4789–4797. https://doi-org.proxy.lib.duke.edu/10.5205/1981-8963-v11i12a15191p4789-4797-2017

Pagnutti, L., Bin, A., Donato, R., Di Lena, G., Fabbro, C., Fornasiero, L., Gerratana, A., Rigon, L., Gonella, S., & Palese, A. (2016). Difficult intravenous access tool in patients receiving peripheral chemotherapy: A pilot-validation study. *European Journal of Oncology Nursing: The Official Journal of European Oncology Nursing Society, 20*, 58-63. https://doi.org/10.1016/j.ejon.2015.06.008

Plohal, A. (2021). A qualitative study of adult hospitalized patients with difficult venous access experiencing short peripheral catheter insertion in a hospital setting. *Journal of Infusion Nursing, 44*(1), 26-33. https://doi.org/10.1097/NAN.0000000000000408

Titler, M. G., Kleiber, C., Steelman, V., Goode, C., Rakel, B., Barry-Walker, J., Small, S., & Buckwalter, K. (1994). Infusing research into practice to promote quality care. *Nursing Research (New York), 43*(5), 307-313. https://doi.org/10.1097/00006199-199409000-00009

Appendix A

Literature Matrix

Authors	Year Pub	Article Title	Journal	Purpose and take home message	Design/ Analysis/ Level of Evidence	IV DV or Themes concepts and categories	Sample Size	Subject Charac.	Comments/critique of the article/methods GAPS
Coyle, C., Griffie, J., & Czaplewski, L.	2015	Eliminating extravasation events: A multidisciplinary approach	*Journal of Infusion Nursing*	To determine if implementing a practice change based upon national standards would eliminate vesicant chemotherapy extravasations.	Quality Improvement/ Level VI	Variables measured: Vesicant chemotherapy administered through peripheral IV, Extravasation incidence Themes: Nursing and staff education Venous access assessment Patient education	N/A	Cancer patients	This article described issues for cancer patients with difficult intravenous access, such as delay in treatment, extended treatment appointments, wait times, increased communication to physicians, and risk for extravasation. Key practice changes implemented included: pre-treatment venous evaluation,

									referral for central line placement for appropriate patients, clinical nurse specialist review of all infusion patients receiving vesicants to ensure appropriate venous access be secured, standardized patient education, and establishing guidelines for when central venous access is required. Strengths of this article were using established evidence to guide interventions, inclusion of nurses from bedside to advanced

									practice, and multi-disciplinary collaboration with physicians. Gaps noted were reporting a 90% reduction in the administration of vesicant chemotherapies periphally without extravasation in the six months post the implementation, but no pre-data related to extravasatoin was reported.
Kapucu, S., Ozkaraman, A., Uysal, N., Bagcivan, G., Seref, F., & Eloz, A.	2017	Knowledge level on administration of chemotherapy through peripheral and central venous catheter among	*Asia-Pacific Nournal of Oncology Nursing*	To evaluate the knowledge of oncology nurses regarding chemotherapy administration through peripheral and central	Descriptive Study/ Level VI	Themes: Nursing knowledge	165	Oncology nurses registered with the Turkish Oncology Nursing Society	Descriptive data provided insight into the knowledge of nurses administering chemotherapy. Some data suggests that having a bachelor's degree led to

		oncology nurses		venous catheters					more correct answers related to extravasation. Most nurses responded with knowledge for extravasation management, but did not have knowledge for extravasation prevention. Nurses who had prior training reported more correct answers. One gap noted was that lack of reporting if educational preparation had an impact on all answers to the questions, as only specific questions were highlighted.

Kreidieh, F., Moukadem, H., & Saghir, N.	2016	Overview, prevention and management of chemotherapy extravasation	*World Journal of Clinical Oncology*	To answer the question "what should a healthcare practitioner know about chemotherapy extravasation, its prevention, and its management based on the current literature?"	Review of the literature/ Level I	Themes: Staff education and training, Appropriate venous access selection, Patient education, National guidelines, Extravasation management	N/A	N/A	Search within PubMed, Med-Line, and Google Scholar searched for guidelines, case reports, clinical trials, retrospective studies and conferences for chemotherapy extravasation and prevention and management literature.
Larsen, E., Marsh, N., O'Brien, C., Monteagle, E., Friese, C., & Rickard, C.	2020	Inherent and modifiable risk factors for peripheral venous catheter failure during cancer treatment: a prospective cohort study	*Supportive Care in Cancer*	To identify the risk factors for peripheral IV failure among cancer patients admitted to an inpatient oncology unit	Prospective, Cohort study /Level V	Themes: Venous access selection, Risk factors for peripheral IV failure	200	Cancer patients admitted to oncology unit	All causes for peripheral IV failure in 200 patients admitted to an inpatient oncology unit in Australia were evaluated. There was a 34.9% failiure rate for all peripheral IV. Univariable and multivariable modeling was used. More than

									3 attempts to place the perpipheral IV had the highest risk for occlusion or infiltration.
Melo, J., Oliviera, P., Rodrigues, A., Souza, R., Fonseca, D., Gontijo, T. & Silveira, E.	2020	Bundle construction and assessment before antineoplastic extravasation: a methodological study	*Acta Paulista Enfermagem*	To develop and assess the components of an extravasation of antineoplastic agents prevention and management bundlefor adult cancer patients	Bundle Construction / Level VI	Themes: Nursing education and training, Appropriate venous access selection, Risk factors evaluation, Patient education, Extravasation management	N/A	N/A	Utilizing the results from the literature review, elements of the bundle were chosen. The Delphi technique was used in two phases. For phase I, 13 judges reviewed and provided feedback to the components of the bundle. For round II, 9 judges participated, who were part of the original phase. Items with mroe than

									80% agreement and a content validity coefficient of > 0.78 were considered valid and were included in the final bundle.
Melo, J., Oliviera, P., Souza, R., Fonseca, D., Gontjo, T., & Rodrigues, A.	2020	Prevention and conduct against the Extravasation of antineoplastic chemotherapy: a scoping review	*Revista Brasileira de Enfermagem*	To conduct a systematic review of the literature and analyze and synthesize the literature on chemotherapy extravasation prevention and management	Systematic review of the literature/ Level I	Themes: Nursing education, Vascular access selection	N/A	N/A	This was a scoping review of the evidence found in PubMed and CINAHL evaluating combinations of terms for chemotherapy extravasation and bundles. Additional searches were conducted through Web of Science, SCOPUS, LILACS, and Cochrane Libarary databases.

									Theses and Dissertation catalogues were reviewed. 3110 articles were found, which yielded 18 articles for final analysis.
Oliveira Gozzo, T.d., Santos, L. A. C., & Cruz, L. A. P. d.	2017	Knowledge of the nursing team on the prevention and management of extravasation of chemothrapy drugs	*Journal of Nursing UFPE*	To evaluate the knowledge of professional oncology nurses administering chemotherapy related to extravasation prevention and management	Quantitative, descriptive, cross-sectional study/ Level IV	Theme: Nursing knowledge	16	Female RNs, experience range from 1 year to 40 years, and experience in oncology 1 year to 40 years	Small sample size of 16 participants, however, was representative of the staff on the infusion unit. Results of the survey show that staff on the unit do not have the knowledge and expertise to identify extravasation risk factors.

Pagnutti, L., Bin, A., Donato, R., Lena, G., Fabbro, C., Fornasiero, L., Gerratana, A., Rigon, L., Gonella, S., & Palese, A.	2016	Difficult intravenous access tool in patients receiving peripheral chemotherapy: A pilot-validation study	*European Journal of Oncology Nursing*	To develop a tool to measure the level of risk for difficult intravenous access for cancer patients receiving peripheral chemotherapy	Pilot-validation of tool / tool validity/ Level VI	Theme: Vascular access selection	260	Cancer patients scheduled to receive single chemotherapy cycles	The pilot-evaluation DIVA-CP demonstrated good inter-rater reliability. Internal consistency was not found. The authors suggest that the internal consistency issues are related to the multidimensionality of the factors and the binary; ordinal level rating of each item. Authors recommend future reiterations of the tool and to develop a homogenous structure of the tool with turning all evaluation items into ordinal items.

Appendix B

Health System IRB Approval

[redacted]

[redacted] INSTITUTIONAL REVIEW BOARD DECLARATION OF ACTIVITY NOT MEETING THE DEFINITION OF RESEARCH

T[redacted] IRB has determined that the following activity does not meet the definition of research as described in 45 CFR 46.102(d), 21 CFR 50.3(c) and 21 CFR 56.10(c) and satisfies the Privacy Rule as described in 45 CFR 164.514.

Protocol ID: Pro00109821
Reference ID: Pro00109821-INIT-1.0
Protocol Title: Evaluating Difficult Intravenous Access: A Program to Decrease Harm in Outpatient Oncology
Principal Investigator: Deborah Allen

This IRB declaration is in effect from November 11, 2021 and does not expire. However, please be advised that any change to the proposed research will require re-review by the IRB.

[redacted]

Appendix C

East Carolina University IRB Approval

Based on your responses, the project appears to constitute QI and/or Program Evaluation and IRB review is not required because, in accordance with federal regulations, your project does not constitute research as defined under 45 CFR 46.102(d). If the project results are disseminated, they should be characterized as QI and/or Program Evaluation findings. Finally, if the project changes in any way that might affect the intent or design, please complete this self-certification again to ensure that IRB review is still not required. Click the button below to view a printable version of this form to save with your files, as it serves as documentation that IRB review is not required for this project. 11/29/2021

Appendix D

Daily IV Access Attempt Log

Date: ____/____/2021 Nurse Initials: ____ ____

Daily IV Access Attempt Log

Instructions: Document the number of peripheral IV attempts for each patient. Please include any details that may be helpful to explain.

Categorize FAILED attempts (use as many as they apply, if appropriate):

Vein Size = VS
Vein Depth = VD
Fragile Skin = FS
Inadequate Lighting = IL
Need for UltraSound Guidance = USG
Cold Temperatures = CT
Limited Venous Options (i.e. lymph node removal, amputation) = LV

Patient Anxiety = PA
Tough Skin = TS
Dehydration = D
Inability to Position extremity properly = IP
Multiple Prior Attempts limiting suitable vasculature = MPA
Patient Refusal=PR

ID	Time Pt. arrived to chair (00:00)	Time successful IV placed (00:00)	# Attempts	Reason for IV failure	Who successfully placed PIV (OTC, VAT)	Chemotherapy/ Immunotherapy Regimen (list drugs)	Additional Comments

Appendix E

Modified DIVA Tool

Patient Characteristic	No	Yes
Altered fluid status	0	1
Scars/Tattoos/Tough Skin	0	1
Frail/Elderly	0	1
Vein palpable with tourniquet	2	0
Vein visible with tourniquet	2	0
Prescribed Chemotherapy		
Vesicant	0	1
Irritant	0	1
Disease History		
Previous chemotherapy	0	1
IV drug use (if known)	0	2
Only one arm available	0	1
Chronic renal failure	0	2
Diabetes	0	1
Sickle cell disease	0	1
Add both No and Yes columns. Subtract the "no" scores from the "yes" column score. A score of 4 or more indicates the patient may be considered a difficulty IV access and may benefit from special interventions. (i.e. ultrasound guided IV, central venous access device placement).		

Source: Ehrhardt, Givens & Lee, 2018

Appendix F

DNP Project Timeline

DATE	ACTIVITY	COMMENTS
NOVEMBER 2021	IRB Submission	
DECEMBER 1, 2021	Pre-Intervention IV Attempts Data Collection Start	
DECEMBER 31, 2021	Pre-Intervention IV Attempts Data Collection Complete	
JANUARY 2022	Interprofessional Team Education Venous Evaluation Team Training	
MARCH 4, 2022	Intervention Start Date	
MARCH 18, 2022	IV Attempts Data Collection Begins	
MAY 31, 2022	Data Collection Concludes	
JUNE 1, 2022	Post-Intervention Data Analysis	