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Implementation of Lymphedema Education Toolkit for Nurse Coordinators

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Implementation of Lymphedema Education Toolkit for Nurse Coordinators

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NURS 670: Quality Improvement Internship

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Abstract

Problem Lymphedema is a chronic condition that develops secondary to cancer treatments such as chemotherapy, radiation, and surgical removal of affected lymph nodes. This swelling in patient's limbs can cause discomfort and limit mobility, however lymphedema is often not detected until later stages, delaying treatment and patient education. **Context** This quality improvement project was conducted at Hospital S Women's Cancer Center, an outpatient center specializing in advanced treatments for breast and gynecological cancers. This center has a multidisciplinary team focusing on both the medical and surgical aspects of oncology treatment. **Interventions** An evidence-based lymphedema education toolkit was created for nurse coordinators at Hospital S Women's Cancer Center to utilize and refer to when educating patients on lymphedema, standardizing the quantity and quality of education patients receive. **Measures** An identical pre- and post- survey was administered to nursing staff prior to and following implementation of our lymphedema education toolkit. This survey assessed nurse coordinators' current knowledge of lymphedema, aiming to see if there was an increase in knowledge following implementation. **Results** Implementation of the lymphedema education toolkit showed an average 12% improvement of lymphedema knowledge amongst the 40% of nurse coordinators on staff in our microsystem who participated in both the pre- and post- assessment surveys (n=6). This data indicates an enhanced understanding and ability to educate patients with lymphedema on their diagnosis, risk factors, prevention, and treatment options compared to the current practice. **Conclusion** This quality improvement project has positive implications in improving early interventions for patients with lymphedema.

Section II: Implementation of Lymphedema Education Toolkit for Nurse Coordinators

Introduction

Breast cancer is a common cancer among women and treatment often includes radiation and removal of affected breast tissue and lymph nodes. With the production and movement of lymph fluid now affected from the lack of lymph nodes, lymphedema, or swelling, commonly occurs in breast cancer patients' upper limbs (Fu, 2014). Lymphedema is much more manageable in early stages or prevention, so educating patients early on the risk factors they have, prevention measures they can take, and treatment options available should be standard education.

Hospital S is an academic medical center working with patients from all backgrounds. The Women's Cancer Center at Hospital S specializes in advanced treatments for breast cancer and gynecologic cancers. Many of their patients go on to develop lymphedema, and educating patients on their risk factors, prevention, and treatment options is not a current standard of care. The nurse manager, a nurse practitioner, and a nurse coordinator approached our group of Clinical Nurse Leader (CNL) students to perform a quality improvement (QI) project of the current state, implementing a lymphedema education toolkit and assessing the toolkit's efficacy via a pre- and post-survey analysis.

Problem Description

At Hospital S Women's Cancer Center, patients are treated for breast and gynecological cancers, and many of these patients develop lymphedema following cancer treatment. At Hospital S, there is currently no standardized education or tool to ensure recent, evidence-based information is provided to patients with breast cancer. There are numerous nurse coordinators and nurse practitioners at this practice, who may specialize more in medical or surgical

components of cancer care. With the variance in care, lymphedema education is inconsistent across staff. Some nurse coordinators have taken interest and advocated for patients by giving their own knowledge on lymphedema, however this is not formal or standardized amongst the care team. Additionally, getting seen by a provider for lymphedema treatment can be challenging due to scheduling, referrals, and insurance policies. In Hospital S's current state, patients with lymphedema are waiting upwards of two years for treatment from cardiology, allowing lymphedema to worsen and progress to later stages.

This project began with an initial microsystem assessment of the quality gap and literature review of current lymphedema practices, risk factors, prevention, and treatment methods, as well as studies standardizing education for health care professionals. CNL students culminated this information into a lymphedema education toolkit aimed at standardizing education across staff and sub-specialties at Hospital S. A lymphedema knowledge assessment was given to Hospital S staff before and after implementation of the toolkit. Through this toolkit, nurse coordinators can hopefully decrease delays in care and improve early interventions for patients with lymphedema.

PICOT Question

CNL students used the population, intervention, comparison, outcome, timeline (PICOT) format to target this quality gap. Does implementing a standardized education tool (I) for nurse coordinators (P) improve their knowledge and enhance early interventions for patients with lymphedema (O) compared to the current practice (C) in four months (T)? This PICOT question and corresponding key words guided the process of gathering evidence-based research for the literature synthesis.

Search Methodology

A literature synthesis was conducted in February 2024 to gather the most recent evidence-based research to answer our PICOT question. PubMed was used to identify peer-reviewed journals published in the last five years, from 2019 to 2024. Keywords and topics criteria included *lymphedema, standardized education, nursing, breast cancer, risk factors, prevention, and treatment*. A wide variety of available research was considered including experimental and non-experimental studies, qualitative data, quantitative data, and systematic reviews to strengthen this review, allowing for a comprehensive analysis of lymphedema education (Dang et al., 2022). Of available articles, CNL students critically appraised 10 articles using the Johns Hopkins Evidence Appraisal Tool to evaluate the literature with a five-level grading scale (Dang et al., 2022).

Of the 10 articles included in this review, two articles were randomized controlled trials (Level I), two were quantitative studies, (Level II), five articles were non-experimental studies and systematic reviews (Level III), and one article was clinical practice guidelines (Level IV). Applicability of source to our PICOT question determined inclusion and discussion for the literature synthesis (see Appendix A). Given the various levels of evidence, this literature synthesis represents a robust look of the available knowledge regarding lymphedema risk factors, screening modalities, prevention, treatment options, and education standardization.

Literature Synthesis

Risk Factors and Screening

To summarize the available knowledge, this literature synthesis discusses various peer-reviewed journal articles regarding risk factors, prevention, and treatment or lymphedema as well as standardized lymphedema education for health care professionals. Beginning with risk factors,

high body mass index (BMI) has been a known risk factor for breast cancer-related lymphedema (BCRL) (Jørgensen et al., 2021). In this cross-sectional study of 206 patients with and without cellulitis, cellulitis and increased BMI were found to be associated with more excess fat and lean mass in arms of patients with BCRL (Jørgensen et al., 2021). This was touched upon in our meeting with nurse coordinators at the Hospital S Women's Cancer Center regarding BMI not being the main indicator, but more so how fat is distributed that can increase risk of BCRL. In addition, axillary surgery, regional lymph node radiation, and low-level limb volume changes are identified risk factors for BCRL, defying previous beliefs that surgical removal of lymph nodes was the sole cause of lymphedema (McLaughlin et al., 2020). Top risk factors in another study were found to be rurality and high BMI (Koelmeyer et al., 2022). These findings indicate patients in rural settings are patients with high BMI should receive adequate education on lymphedema prevention and risk reduction to maintain quality of life. Rurality being a risk factor asks us to consider the social determinants of health, and how this may affect nurses' education and advocacy for patients by connecting them with appropriate resources such as social work.

Signs and symptoms commonly reported by patients with BCRL are lower quality of life, feelings of heaviness and swelling, discomfort, and loss of self (McLaughlin et al., 2020). By educating at-risk patients of these subjective signs and symptoms of BCRL in our QI project, they are empowered to screen themselves periodically at home for early detection. The recommended self-screening strategy consists of measuring both arms circumference every six to twelve months for two years following a patient's breast cancer diagnosis (McLaughlin et al., 2020). Bioimpedance spectroscopy, a noninvasive clinical assessment of a patient's body cell mass and distribution of bodily fluid has been used to detect BCRL (Shah et al., 2023). In a randomized controlled trial of 963 women with breast cancer, subjects were followed over three

years using either tape measurement or bioimpedance spectroscopy to measure the development of BCRL (Koelmeyer et al., 2022). The bioimpedance spectroscopy group had less progression to complex decongestive physiotherapy than the tape measurement group with statistical significance, indicating a preventative measure of BCRL (Koelmeyer et al., 2022).

Prevention and Treatment

Conventional preventative therapies for BCRL include patient education and exercises including aerobics, resistance training, and stretching of upper limbs (Nadal Castells et al., 2021). By using compression garment therapy in tandem with bioimpedance spectroscopy for BCRL diagnosis, there was a 59% reduction of chronic BCRL in breast cancer patients who underwent axillary lymph node dissection (Shah et al., 2023). Compression garment therapy can be included as an effective treatment option for post-surgical patients with follow up every three to six months (Shah et al., 2023). Patients undergoing compression garment therapy in addition to one-hour educational sessions and a 12-week exercise program has a significantly lower incidence of lymphedema compared to patients utilizing education and exercise alone, however there was no significant difference between groups with an overall incidence of BCRL of 12.3% (Nadal Castells et al., 2021). This may be due to patients' decreased adherence to treatment over the course of the two-year study (Nadal Castells et al., 2021). To further tailor this therapy option, compression garment therapy could be referred based on patient risk factors and clinical presentation and offered to both surgical and non-surgical breast cancer patients. Jørgensen et al. (2021) recommends evaluating patient's overall health and arm health when evaluating BCRL treatment efficacy.

In addition to bioimpedance spectroscopy and conventional preventative therapies, manual lymph drainage is an early intervention for BCRL prevention (Donahue et al., 2023). For

advanced stages of lymphedema, surgical approaches aim to be reconstructive by restoring the body's physiologic lymphatic drainage system or reductive by removing excess accumulated mass (Donahue et al., 2023). However, no treatment approach is curative for lymphedema.

Standardizing Education

A major barrier in progressing BCRL prevention and treatment is the lack of standardized measurements for these outcomes (Donahue et al., 2023). Patient education is key component for prevention and treatment of BCRL. Oncology nurses' knowledge on the assessment and examination of BCRL has room for improvement. In a survey study of 150 oncology nurses, 96% reported having no continuing education on lymphedema (Abu Sharour, 2019). In a systematic review, Yarmohammadi et al. (2021) found that the overall knowledge health care professionals have on lymphedema is low to average, and prior education on lymphedema is a main contributor to their knowledge at the time of their knowledge assessment. Registered nurses also had greater knowledge of BCRL than nurse practitioners and physicians on assessment (Yarmohammadi et al., 2021). These studies indicate the need for a structured education on BCRL for nurses, which can be achieved through the proposed lymphedema education toolkit. Potential topics include anatomy, pathophysiology, assessment and exam, risk factors, prevention, consultation, and follow-up for improved patient education. Standardizing education nurses provide patients regarding BCRL can help improve patients' health literacy regarding their diagnoses.

No universal guidelines for lymphedema education exist, however the topics most consistently taught to patients with breast cancer include definition, risk reduction practices, early signs and symptoms, and self-care management (Perdomo et al., 2023). The information that varied in depth across 2,230 women educated included physiology and pathophysiology, risk

reduction, and interventions (Perdomo et al., 2023). When creating the lymphedema education toolkit in our QI project, it is important to include all stages of lymphedema development and risk factors for nurses to then tailor their patient education based on the patients' own health literacy and risk factors. When educating 84 staff nurses who work with BCRL patients on lymphedema, there was a significant increase ($p < 0.001$) in average knowledge on lymphedema prevention and risk reduction following the teaching session (Natarajan et al., 2023). Natarajan et al. (2023) utilized a one-group, pre-test, and post-test design, reminiscent of what our group aims to do. This proves that a lymphedema education toolkit such as the one proposed in our project could have a significant impact on nurses' knowledge of lymphedema and confidence in educating patients at Hospital S Women's Cancer Center. All articles reviewed encouraged improved lymphedema education for health care professionals. These findings align with our most recent meeting with Hospital S Women's Cancer Center staff and show the need for improved lymphedema education.

Summary

Regarding BCRL, risk factors, screening options, prevention, and treatment options have been reviewed. Healthcare professionals' and nurses' knowledge levels on BCRL have been reviewed, as well as their overall positive benefit from educational interventions on BCRL. These studies indicate both the content the lymphedema education toolkit for Hospital S Women's Cancer Center should include as well as its potential efficacy for improving nurses' knowledge.

Rationale

Lippitt's theory of change has seven steps that fit within the four elements of the nursing process: assessment, planning, implementation, and evaluation. In the assessment element, steps

one through three occur: diagnosing the issue, assessing the motivation for change, and assessing the microsystem's resources for change (Mitchell, 2013). Within planning are steps four and five: identifying the change objective and the role of the change agent, such as CNLs (Mitchell, 2013). Implementation includes step six of maintaining the change; and evaluation is step seven, the removal of the change agent (Mitchell, 2013). Lippitt's theory gives CNLs a detailed plan to initiate and maintain change and is most applicable when implementing QI projects.

Lippitt's theory can be utilized to understand the current state of the microsystem's lack of standardized lymphedema education, planning and implementation of a lymphedema education toolkit for nurse coordinator use, and evaluation of the toolkit via an identical pre- and post-assessment on nurse coordinators' knowledge of BCRL. CNL students, the change agents, focus on the change objective of improving nurse coordinators' knowledge on lymphedema to improve patients' health literacy and early interventions for lymphedema long after the QI team finishes implementation of the toolkit.

Ethical Considerations

This project meets the guidelines for an evidence-based QI project. An Institutional Review Board review was not required, as this project did not involve research on human subjects. A statement of non-research determination form was completed to validate this initiative followed by a review and approval by clinical faculty at the University of San Francisco's School of Nursing and Health Professions (see Appendix B). This QI project received no funding, and the five CNL students involved declare no conflict of interest for our project.

The American Nurses Association (ANA) Code of Ethics was taken into consideration throughout this project, specifically Provision Seven, which encourages nurses to advance our

profession through research, professional standards development, and nursing policy (ANA, 2015). Provision 7.1 discusses developing knowledge through research and scholarly inquiry (ANA, 2015). In this project, CNL students conducted a literature synthesis of current research to create a toolkit to improve the knowledge nurse coordinators have on lymphedema. Provision 7.2 encourages nurses to make contributions to the field by “developing, maintaining, and implementing professional practice standards” (ANA, 2015). Creating a standard to educate patients at risk for lymphedema with appropriate knowledge on risk factors, prevention, and treatment options helps us achieve these provisions.

To align with the Jesuit values of the University of San Francisco, *cura personalis*, a Latin phrase meaning “care for the whole person,” was considered throughout this project. Breast and gynecological cancers are life altering diagnoses, and cancer treatments such as surgery and chemotherapy can lead to lymphedema. Lymphedema affects how a person may look, feel, and present themselves. In caring for the whole person, CNL students aim to improve education on not just lymphedema’s diagnosis and treatment, but lifestyle modifications, well-being, and self-care methods for patients within and outside of the clinical setting.

Project AIM

This QI project aims to improve early interventions for patients with lymphedema at Hospital S Women’s Cancer Center by implementing a standardized education tool for nurse coordinators. To achieve this, registered nurse coordinators will receive evidence-based training and exhibit improved knowledge in lymphedema. Nurses’ knowledge and patients’ health literacy on the topic of lymphedema will improve with the implementation of the toolkit. This project empowers nurses and patients alike to take prophylactic measures for lymphedema care. In doing so, CNL students aim to improve early interventions for patients with lymphedema.

Section III: Methods

Context

Microsystem Assessment

A microsystem assessment was conducted using the 5 P's approach, evaluating the purpose, patients, professionals, processes, and patterns of Hospital S Women's Cancer Center. This assessment helps to establish the microsystem's current state and need for change. The purpose of this QI project is to standardize the lymphedema education nurse coordinators receive, developing a lymphedema education toolkit with up-to-date evidence-based information to provide patients. The patients impacted by the microsystem are patients with breast cancer or gynecological cancers such as ovarian, uterine, and cervical cancers. The professionals in this microsystem are nurse coordinators who are registered nurses, nurse practitioners, physician assistants, and CNL students working together. The processes include being asked for history and assessment by a nurse coordinator, and a focused assessment by the advanced practice provider. Should a patient be recommended surgery, a nurse coordinator may come in and educate the patient on lymphedema risk factors, prevention, and treatment options. A pattern identified within the microsystem assessment is that the extent of comprehensive lymphedema health education needed to improve patients' health literacy could pose challenges in providing efficient care and the overall flow of the clinic.

SWOT Analysis

The CNL students met with a nurse coordinator and a nurse practitioner at the Hospital S Women's Cancer Center, and utilized the information obtained here and in the literature synthesis for the strengths, weaknesses, opportunities, and threats (SWOT) analysis (see Appendix C). Strengths of this project include being a low-cost implementation for a small

number of staff who want to integrate the toolkit. Weaknesses include the projected timeframe, short staffing, and inconsistent expectations for the project. Opportunities include being at a teaching hospital dedicated to improving quality of care and utilizing evidence-based practice. A major threat to this project was insufficient communication and collaboration with the larger mesosystem of Hospital S.

Root Cause Analysis

A fishbone diagram was created to perform a root cause analysis on the specific needs of the microsystem. Here, the CNL students analyzed the processes/policies, providers, equipment, people, and environment contributing to the current delay in care for patients with lymphedema in our microsystem (see Appendix D). In processes/policies, there is the opportunity to enhance the staff's knowledge of lymphedema, as patient education is not standardized and up to the nurse's discretion. Providers entail of only one registered nurse trained to provide lymphedema education to patients, yielding an opportunity to standardize nurse training. The opportunity to develop and implement the lymphedema education toolkit is equipment that can target the delay in care. People involved are patients with lymphedema, or patients with breast and gynecologic cancers at risk for lymphedema due to delayed awareness of symptoms and delayed education on lymphedema management. The environment is one of a silo culture amongst providers, and external referral for surgical management of lymphedema takes upwards of one year.

Cost Benefit Analysis

The initial implementation of this intervention has an estimated cost benefit ratio of 1.44, with greater benefit over time (see Appendix G). The 200 hours of CNL's time developing the lymphedema education toolkit at a San Francisco Bay Area average pay of \$81 per hour totaled \$16,200, in addition to \$40 cost of materials, and lymphedema bundle training of 24 RNs and

APPs for one hour at a San Francisco Bay Area average pay of \$82 per hour totaled \$1,968. This creates an initial projected startup cost of \$18,208. The annual revenue costs include the \$1,968 cost for training the staff, \$40 for materials, as well as \$81 for one hour of a CNL's time for lead the staff training, totaling an annual expenditure of \$2,089. The cost avoidance of this project is \$26,269, or the average cost of hospitalization for lymphedema complications for one patient. With an initial startup cost of \$18,208 and cost savings of \$26,269, the cost benefit ratio within the first year of implementation is 1.44:1. In successive years, with the same cost savings but annual expenditure of \$2,089, the cost benefit ratio skyrockets to 12.57:1.

Timeline

A GANNT chart was created with stages for initiation, planning, implementation, and evaluation for this QI project's 13-week timeline (see Appendix E). Project initiation took two weeks, in which the project was defined, and the PICOT question and AIM statements were determined. Project planning followed spanning all of week three, where CNL students met with leadership at Hospital X Women's Cancer Center, a microsystem assessment was conducted, and the intervention was proposed to leadership. From here, project implementation was a nine-week long stage spanning from weeks four to 12. A literature synthesis was conducted across weeks four through eight, guided by the PICOT question to shape the intervention. The lymphedema education toolkit and pre- and post- assessment surveys were created following the start of the literature synthesis in weeks six through eight. The interventions were reviewed for school faculty and microsystem leadership approval during weeks nine and 10. The lymphedema education toolkit and pre- and post- assessment surveys were distributed to nurse coordinators at during weeks 11 and 12 for data collection. Project evaluation took place in week 13, where data analysis was conducted, and results and future recommendations were presented to leadership.

Intervention

An evidence-based lymphedema education toolkit was created for nurse coordinators and staff at Hospital S Women's Cancer Center to utilize and refer to when educating patients on lymphedema, standardizing the quantity and quality of education patients receive (See Appendix F). The toolkit was developed by the CNL students, focusing on specific aspects of lymphedema care including staging, risk factors, diagnostic modalities, prevention, and both conservative and surgical treatment methods. The information was retrieved from both the CNL students' literature synthesis as well as educational courses on lymphedema provided by a nurse coordinator at Hospital S Women's Cancer Center. An abridged version of information was formatted onto a two-page, tri-fold document, with a QR code on the first page linking to an extended version with additional information and references. By introducing this toolkit, the CNL students hope to bring a standardized level of education to nurse coordinators, improving their knowledge on lymphedema and thus providing patients with up to date, evidence-based information on lymphedema care.

Study of the Intervention

A Plan, Do, Study, Act (PDSA) cycle was formed to establish how we would study the lymphedema education toolkit's development and efficacy (see Appendix H). In the planning stage, CNL students collaborated with Hospital S Women's Cancer Center leadership to identify gaps in current lymphedema education and brainstormed what areas to focus on for the proposed toolkit. The PICO and AIM statements were also established in this stage. For the "do" stage, the CNL students conducted a microsystem assessment and literature search and developed the lymphedema education toolkit and a pre- and post- intervention assessment survey for nursing staff. The study of the intervention analyzed data collected from the pre- and post- assessment

survey, interpreting the scores to see if there was an overall increase in knowledge amongst nurse coordinators. Finally, to act, Hospital S leadership are to be presented with results of the intervention from the assessment surveys, future recommendations are offered, and the standardized toolkit will be implemented into the greater mesosystem.

The pre- and post- assessment survey was developed to reflect the teachings in the lymphedema education toolkit and include pertinent information regarding lymphedema care (see Appendix I). The questions test staff's knowledge of risk factors, staging, diagnostic testing modalities, standard treatments, and a plethora of true or false statements regarding lymphedema care. In total, there are 11 questions in the assessment, and the same questions are asked for both the pre- and post- assessment to gauge if there is an improvement in knowledge from the education toolkit intervention. In total it took roughly 20 to 30 minutes for a nurse coordinator to take the initial pre-assessment, become familiar with the toolkit, and take the post-assessment.

Outcome Measures

An identical pre- and post- survey was administered to nursing staff prior to and following implementation of our education toolkit. This survey assessed current knowledge of lymphedema, aiming to seek if there was an increase in knowledge with use of our toolkit. The survey utilized closed-ended questions to determine the knowledge on pre-determined topics regarding lymphedema. The survey assesses the nursing staff's education and identifies areas of improvement. To protect the identity of the Hospital S Women's Cancer Center staff, the survey responses were anonymously collected. Additional observations were made during on-site visits by the CNL students regarding current processes for lymphedema education, and plans regarding standardizing education for nurse coordinators. Stakeholders hope to improve the health literacy of patients with lymphedema following implementation of the lymphedema education toolkit.

Section IV: Results

The pre- and post-assessment survey was a tool used to analyze the efficacy of the lymphedema education toolkit amongst nurse coordinators at Hospital S Women's Cancer Center (see Appendix J). The microsystem has 15 nurse coordinators, seven participated in our pre-assessment survey to assess their baseline knowledge of lymphedema. Six of those nurses also participated in the post-assessment survey following the review of the education toolkit. Omitting the response from the nurse who completed the pre-assessment survey but did not complete the post-assessment survey, we have (n=6). This is a cumulative 40% survey response rate amongst the 15 nurse coordinators. From the pre-assessment survey, scores had a range of 63% to 93%, with an average score of 81%. The post-assessment survey had a range of scores from 81% to 100%, with an average score of 93%. There was an average 12% increase in lymphedema knowledge after the implementation of a standardized toolkit for nurse coordinators, with the greatest improvement being a 30% increase from 63% to 93% after implementation of the lymphedema education toolkit. The smallest improvement of 3% came from a nurse whose score on the pre and post surveys were 93% and 96%, respectively. There was no decrease in scores between the pre- and post-assessment surveys following implementation of the lymphedema education toolkit.

Section V: Discussion

Summary

This QI project aims to improve early interventions for patients with lymphedema at Hospital S Women's Cancer Center by implementing a standardized education tool for nurse coordinators. The outcome measure of improving nurse coordinators' knowledge on lymphedema was met, as exemplified by the 12% average increase in score from the pre- and post-assessment surveys following the toolkit's implementation. All nurse coordinators who participated showed improved knowledge based on their assessment survey responses, which aligns with previous research showing a significant increase ($p < 0.001$) in average knowledge on lymphedema prevention and risk reduction following the teaching session (Natarajan et al., 2023). This outcome measure reflects that utilized by Natarajan et al. (2023) with a one-group, pre-test, and post-test design, indicating that the lymphedema education toolkit in our project has a significant impact on nurses' knowledge of lymphedema and confidence in educating patients at Hospital S Women's Cancer Center.

The data following implementation of the lymphedema education toolkit indicates an enhanced understanding and ability to educate patients with lymphedema on their diagnosis, risk factors, prevention, and treatment options compared to the current practice of having no standardized, evidence-based educational material. The results from this PDSA cycle show the potential positive implications in improving early interventions for patients with lymphedema at Hospital S Women's Cancer Center. Moving forward, this PDSA cycle could be repeated within the greater mesosystem of Hospital S Women's Cancer Center expanding to their additional clinics around the San Francisco Bay Area and include more health care personnel to be educated in lymphedema care.

Limitations

This QI project had limitations including time constraints, miscommunication, and stakeholder buy in. With the limited timeline, only one PDSA cycle was able to be performed, and the outcome measures were only accounting for 40% of nurse coordinators. This could be due to nurse coordinators having different schedules, not being in the clinic when the assessment surveys were being conducted, working remotely, or being on leave during the project's timeline. Because of the fast-paced environment and busy schedules of nurse coordinators, there were delays in receiving approval on the assessment surveys and lymphedema education toolkit, as well as finding a time to implement the toolkit. These delays also led to miscommunication between the CNL students and the nurse coordinators, limiting participation and broader implementation of this project.

Conclusion

The implementation of the lymphedema education toolkit greatly benefits nurse coordinators at Hospital S Women's Cancer Center. From the CNL students' PDSA cycle, there was an increase in lymphedema knowledge amongst nurse coordinators, which can directly impact patient care. By improving and standardizing the education nurse coordinators receive, they can educate patients with lymphedema utilizing the toolkit as a resource to provide up to date, evidence-based information regarding their patients' lymphedema care. Moving forward with improved stakeholder communication and extended timeframes, this lymphedema education toolkit has potential to positively impact early interventions for patients with lymphedema in this microsystem.

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Section VII: Appendices

Appendix A

Johns Hopkins Evidence Appraisal Table

Journal #	Citation	Evidence Type	Sample, Sample Size, Setting	How Does Article Address Problem?	Quality of Evidence	Other Highlights from Article (consider including limitations & outcomes)
1	Abu Sharour L. (2019). Oncology nurses' knowledge about lymphedema assessment, prevention, and management among women with breast cancer. <i>Breast Disease</i> , 38(3-4), 103-108. https://doi.org/10.3233/BD-190381	cross-sectional descriptive design	N= 150 oncology nurses across 3 institutions completing survey; affiliated with AAL-Zaytoonah University of Jordan	Nurses showed lack of knowledge on assessment and examination of breast cancer related lymphedema (BCRL), and 96% did not receive any continuing education on lymphedema. Knowledge that could be improved in our QI project includes anatomy, pathophysiology, assessment and exam, risk factors, prevention, consultation, and follow-up for improved patient education.	Level III B, non-experimental study with transparency	Outcomes: indicated need for a structured education on breast cancer related lymphedema for oncology nurses
2	Donahue, P. M. C., MacKenzie, A., Filpovic, A., & Koelmeyer, L. (2023). Advances in the prevention and treatment of breast cancer-related lymphedema. <i>Breast Cancer</i>	systematic review	N= 141 journal articles reviewed, authors affiliated with Vanderbilt University Medical Center	early interventions: bioimpedence spectroscopy, compression garment therapy, and manual lymphatic drainage. Surgical interventions are reconstructive reinstating physiologic capability to drain lymph or reductive in removing excess mass from BCRL. Emphasizes importance of patient education in prevention	Level III A, review with recommendations from thorough review of qualitative and quantitative evidence	Recommendations: improve education and monitoring for BCRL prophylaxis

	cancer-related lymphedema: An observational study of tissue composition. <i>Cancers</i> , 13(14), Article 3584. https://doi.org/10.3390/cancers13143584			This indicates potential risk factors of BCRL such as BMI, fat distribution, and excess fat. Recommends evaluating patient's overall health and arm health when evaluating BCRL treatment efficiency. This was touched upon in our meeting with nurse coordinators at our QI site regarding BMI not being the main indicator, but more so how fat is distributed that can increase risk of BCRL.		
3	Koelmeyer, L. A., Gaitatzis, K., Dietrich, M. S., Shah, C. S., Boyages, J., McLaughlin, S. A., Taback, B., Stollendorf, D. P., Elder, E., Hughes, T. M., French, J. R., Ngui, N., Hsu, J. M., Moore, A., & Ridner, S. H. (2022). Risk factors for breast cancer-related lymphedema in patients undergoing 3 years of prospective surveillance with intervention.	randomized clinical trial prospective, multisite, international, RCT	N= 963 women newly diagnosed with breast cancer, divided into tape measurement (n=481) or bioimpedance spectroscopy (n=482) followed over 3 years	Comprehensive, prospective examination of risk factors of BCRL. The bioimpedance spectroscopy group had less progression to complex decongestive physiotherapy than the tape measurement group with statistical significance, indicating a preventative measure of BCRL. Risk factors found to include: rurality and high BMI. These findings indicate these groups should receive adequate education on lymphedema prevention and risk reduction to maintain quality of life. Rurality as a risk factor brings up the idea of social determinants of health, and how this may affect how nurses educate patients in our QI	Level I A, clinical RCT, international sample, generalizable results	Limitations: small number of patients in sample progressed to complex decongestive physiotherapy, limiting study's ability to conduct multivariate analysis
	<i>American Cancer Society</i> , 128(18), 3408-3415. https://doi.org/10.1002/cncr.34377			project, i.e. connecting them with appropriate resources such as social work.		
4	McLaughlin, S. A., Brunelle, C. L., & Taghian, A. (2020). Breast cancer-related lymphedema: Risk factors, screening, management, and the impact of locoregional treatment. <i>Journal of Clinical Oncology</i> , 38(20), 2341-2350. https://doi.org/10.1200/JCO.19.02896	systematic review	Axillary surgery: N = 7,617 patients for 60 months who have undergone sentinel lymph node biopsy	Defines major risk factors of breast-cancer related lymphedema (BCRL), contrary to long-standing belief that surgical removal of lymph nodes was the only cause of lymphedema <ul style="list-style-type: none"> - axillary surgery - RNL- regional lymph node radiation - BMI and fat distribution - cellulitis - low-level limb volume changes These risk factors as well as ones outlined by our QI site can be included in our educational toolkit.	Level III A, review with recommendations from thorough review of qualitative and quantitative evidence	This article focused heavily on prevention and conservative management, including sleeves and lifestyle changes such as exercise. Encourages screening strategy of measuring both arms and continued every 6 to 12 months for at least 2 years following diagnosis of breast cancer
5	McNeely, M. L., Harris, S. R., Dalgoy, N. D., Al Onazi, M. M., Parkinson, J. F., Radke, L., Kostaras, X., Dennett, L., Ryan, J. A., Dalzell, M. A.,	clinical practice guidelines	N = 20 stakeholders in Canada, includes patients with BCRL, palliative care physician, breast cancer oncologist, physical medicine and rehabilitation	Patient oriented approach, focusing on self-management of lymphedema and the positive health model first introduced in the Netherlands, focuses on patient's resilience and coping of BCRL to improve quality of care for patients with BCRL.	Level IV B, utilizes evidence from systematic reviews, meta-analyses, and clinical studies	Limitations: limited availability of high-quality research on BCRL may be a barrier to developing comprehensive recommendations on some categories. Recommendations may be influenced by clinician's opinions, availability, or own

	Kennedy, A., Capozzi, L., Towers, A., Campbell, K. L., Binkley, J., King, K., & Keast, D. (2022). Update to the Canadian clinical practice guideline for best-practice management of breast cancer-related lymphedema: study protocol. <i>Canadian Medical Association Journal</i> , 10(2), 338–347. https://doi.org/10.9778/cmajo.20210038		physician, nurse specialist, breast cancer researcher, patient advisors, and representatives from the Oncology Division of the Canadian Physiotherapy Association and the Canadian Lymphedema Framework	Paper aims to develop a guideline for patients at risk of BCRL and their physicians in Canada, which may be able to be interpreted for patients at risk of BCRL and nurses in the United States, as we aim to in our project. These guidelines can aid in our educational toolkit development for our QI project as we aim to standardize education of lymphedema focusing heavily on risk factors, prevention, and treatment. Working with an outpatient center means patients will need to learn how to self-manage their lymphedema in between visits, which is outlined in this paper.		experience in practice creating potential bias.
6	Nadal Castells, M. J., Ramirez Mirabal, E., Cuartero Archs, J., Perrot Gonzalez, J. C., Beranuy Rodriguez, M., Pintor Ojeda, A., & Bascuñana Ambros, H. (2021). Effectiveness of lymphedema	randomized controlled clinical trial	N = 70 patients with breast cancer who have had axillary lymph node dissection, split into a control (n=35) with conventional preventative therapy and an experimental (n=35) using compression garments	Overall incidence of lymphedema was 12.3% for both groups (N=70). Incidence of lymphedema was significantly lower in experimental group who continues using compression garments daily for 2 years compared to control (p=0.02) This indicates that compression garments for arms along with exercise can be a useful prevention method for BCRL, and can be recommended for patients at risk. These prevention and treatment methods can be outlined in our QI project's lymphedema educational toolkit.	Level I A, experimental study, RCT, generalizable results	Limitations: smaller sample size, difficulty monitoring compression garment usage while participants were in their own home. Follow-up time of 2 years; a longer follow up time could indicate long-term impact of compression garments better
	prevention programs with compression garment after lymphatic node dissection in breast cancer: A randomized controlled clinical trial. <i>Frontiers in Rehabilitation Sciences</i> , 2, Article 727256. https://doi.org/10.3389/fresc.2021.727256					
7	Natarajan, M. K., S J, N., Mohanraj, J., & Vishwanath, U. (2023). The effect of education on knowledge regarding breast cancer related lymphedema risk reduction and prevention among nursing personnel. <i>Cureus</i> , 15(9). https://doi.org/10.7759/cureus.45331	Pre-experimental, one-group pre-test post-test design	N= 84 staff nurses working with breast-cancer related lymphedema patients at a teaching hospital in Bangalore, Karnataka.	There was a significant increase in average knowledge score after the teaching session on lymphedema prevention and risk-reduction (p < 0.001). This shows that an educational toolkit such as the one proposed in our QI project could have a significant impact on nurses' knowledge of lymphedema and confidence in educating patients.	Level II B quasi-experimental, collecting data before and after a teaching session on lymphedema	Outcomes: increased knowledge of risk reduction, encouraged nurses educating patients on risk, offer instruction on risk reduction, and promote self-care such as exercise. Regular education required to continue providing the most up-to-date information regarding lymphedema.
8	Perdomo, M., Davies, C., Levenhagen, K.,	systematic review	N = 2,230 women diagnosed with breast cancer with	Noted that the topics most consistently taught to patients regarding lymphedema include	Level III B	Limitations: Differences in methodology across different articles reviewed,

	<p>Ryans, K., & Gilchrist, L. (2023). Patient education for breast cancer-related lymphedema: a systematic review. <i>Journal of Cancer Survivorship: Research and Practice</i>, 17(2), 384–398. https://doi.org/10.1007/s11764-022-01262-4</p>		<p>or without lymphedema whom received education on lymphedema (combined N of 15 studies published between January 2011 and December 2021)</p>	<ul style="list-style-type: none"> - definition - risk reduction practices - early signs and symptoms - self-care management. <p>The information that varied in depth across organizations included</p> <ul style="list-style-type: none"> - physiology and pathophysiology - risk reduction - interventions <p>No universal guidelines for lymphedema education exist, and education should be individualized based on the patient's needs and learning style.</p> <p>When creating the educational toolkit in our QI project, it is important to include all stages of lymphedema development and risk factors for nurses to then tailor their patient education based on the patients' own health literacy and risk factors.</p>	<p>Good quality with awareness of limitations</p>	<p>as lymphedema education may have been provided during early diagnosis of breast cancer, pre-, or post-operatively. The articles reviewed are limited to those published in the English language and the 10-year timespan only.</p>
9	<p>Shah, C., Whitworth, P., Valente, S., Schwarz, G. S., Kruse, M., Kohli, M., Brownson, K., Lawson, L., Dupree, B., &</p>	<p>clinical practice guidelines</p>	<p>N = 879 patients age 18+ diagnosed with breast cancer, screened every 3 months for 33 months for lymphedema, RCT</p>	<p>Establishes clinical practice guidelines for bioimpedance spectroscopy (BIS) to detect BCRL, showing a 59% reduction in chronic BCRL with utilization of compression garment therapy.</p>	<p>Level IV A, uses evidence from RCT and real-world data</p>	<p>Limitation: compression for all patients who underwent axillary lymph node dissection reduced BCRL but required all patients to undergo therapy which could be inaccessible compared to tailoring</p>
	<p>Vicini, F. A. (2023). Bioimpedance spectroscopy for breast cancer-related lymphedema assessment: clinical practice guidelines. <i>Breast Cancer Research and Treatment</i>, 198(1), 1–9. https://doi.org/10.1007/s10549-022-06850-7</p>			<p>This is a treatment option we can utilize in our lymphedema tool kit in our QI project.</p> <p>Recommended follow-up times are every 3 months for 3 years then every 6 six months for the 4th and 5th years from the time of initial breast cancer diagnosis.</p>		<p>therapy referrals based on patient need</p>
10	<p>Yarmohammadi, H., Rooddehghan, A., Soltanipur, M., Sarafraz, A., & Mahdavi Anari, S. F. (2021). Healthcare practitioners' knowledge of lymphedema. <i>International Journal of Vascular Medicine</i>, 2021, Article 3806150. https://doi.org/10.1155/2021/3806150</p>	<p>systematic review</p>	<p>N= 18 to 867 across 16 articles, nurses, oncologists, radiologists, surgeons (plastics, oncology), primary care providers, occupational therapists, etc.</p>	<p>Overall knowledge of health care professionals on lymphedema is low to average, and prior education on lymphedema was a main factor to their knowledge at time of knowledge assessment. Knowledge of practitioners (such as NPs, MD,) was less than professionals (RN).</p> <p>Standard management of lymphedema consists of manual lymphatic drainage, compression, skin care, and exercise to improve drainage of lymph.</p> <p>All articles encouraged improved lymphedema education for health care</p>	<p>Level III B Good quality with awareness of limitations</p>	<p>Limitations: Only articles in English, and lack of lymphedema research in literature, excluding articles that mentioned adjacent topics such as cancer survivorship</p>

			professionals. These findings align with our most recent meeting with Stanford staff and show the need for improved lymphedema education.		
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Abbreviations: BCRL = breast cancer related lymphedema

Appendix B

Statement of Non-Research Determination



Project: Statement of Determination and Non-Research Determination Form

Student Name: Heather Gee

Standardizing Lymphedema Education for Nurse Coordinators

Approximately one in five women treated for breast cancer are affected by breast cancer-related lymphedema (BCRL), a potentially debilitating condition amongst breast cancer survivors (Ren et al., 2022). Unfortunately, no universal guidelines are available to healthcare professionals to effectively educate patients about BCRL (Perdomo et al., 2022). This quality improvement project aims to improve early interventions for patients with lymphedema at Hospital S Women's Cancer Center by implementing a standardized, evidence-based lymphedema education toolkit. The implementation of this project evaluates the efficacy of a lymphedema education toolkit to enhance the knowledge of providers and patients. Providing a lymphedema education toolkit will increase the nurse coordinator's knowledge of lymphedema and promote a standard of care for patient education. A standardized delivery of lymphedema patient education aids in prevention, early detection, and management. Oncology nurses are instrumental in managing lymphedema through their systematic assessment of patient risk, and an education toolkit will enable nurses to assist patients in making informed decisions to prevent long-term complications. Implementing a standardized education toolkit improves early interventions for patients with lymphedema at Hospital S Women's Cancer Center.

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used:

(<http://answers.hhs.gov/ohrp/categories/1569>)

This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Students may proceed with implementation.

This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments:



EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

Project Title: Standardizing Lymphedema Education for Nurse Coordinators	YES	NO
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.	X	
The specific aim is to improve performance on a specific service or program and is a part of usual care. ALL participants will receive standard of care.	X	
The project is NOT designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does NOT follow a protocol that overrides clinical decision-making.	X	
The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does NOT develop paradigms or untested methods or new untested standards.	X	
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does NOT seek to test an intervention that is beyond current science and experience.	X	
The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	X	
The project has NO funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.	X	
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., not a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	X	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: <i>"This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board."</i>	X	

ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research.



IRB review is not required. Keep a copy of this checklist in your files. If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME (Please print): Heather Gee

Signature of Student:



DATE: 03/21/2024

SUPERVISING FACULTY MEMBER NAME (Please print): Dr. Nneka Chukwu

Signature of Supervising Faculty Member



DATE 03/21/2024

Appendix C

Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis

SWOT ANALYSIS

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STRENGTHS

- Small unit (staff)
- Financial resources (low cost)
- Easy implementation
- Staff desire to increase level and depth of knowledge
- Staff desire to integrate EBP

WEAKNESSES

- Time (staff)
- Staff shortage
- Unable to gather data due to staff on leave
- Lack of in person engagement with staff
- Inconsistent/ unclear expectations for QI project

W**O**

OPPORTUNITIES

- Magnet status
- Resourced / highly equipped
- Teaching institute
- Innovative/ advanced medical practice
- Society/ Lymphedema network partnership

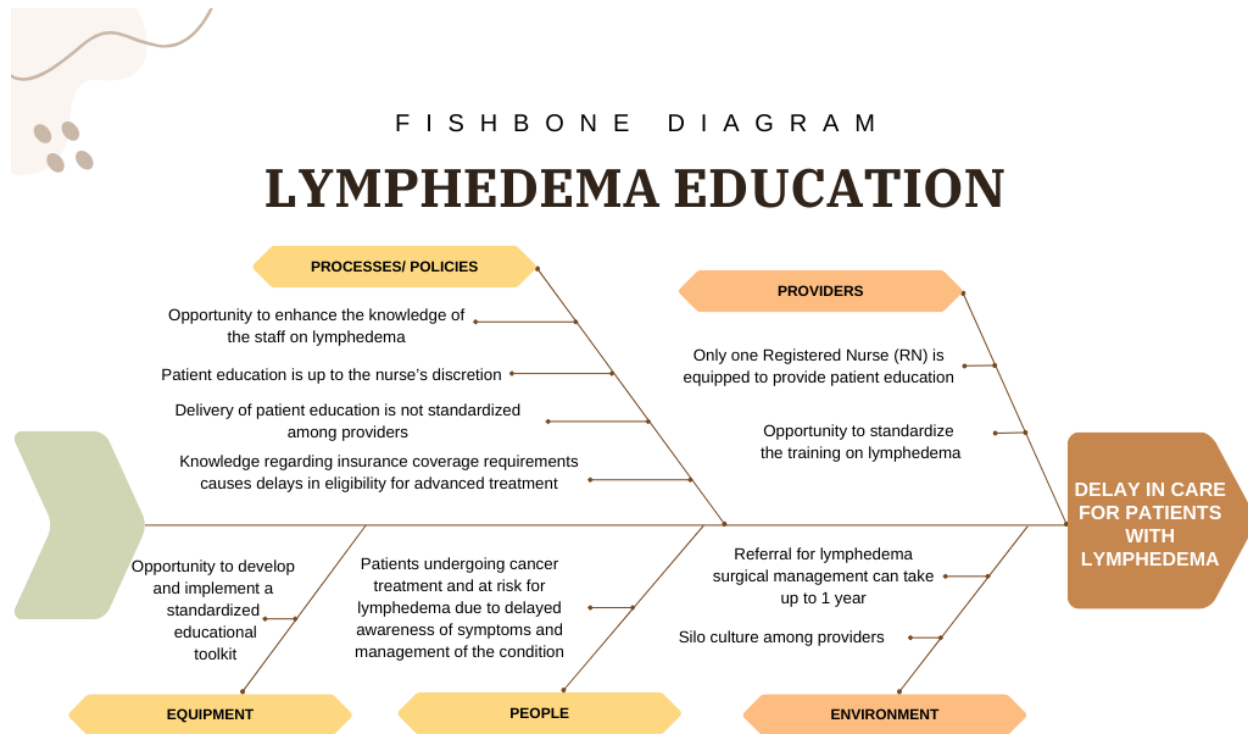
THREATS

- Contradicting educational guidelines from other organizations
- Lack of communication and collaboration with mesosystem

T

Appendix D

Root Cause Analysis



Appendix E

GANNT Chart

Quality Improvement Project Spring 2024													
PROJECT TASK	JANUARY	FEBRUARY				MARCH				APRIL			
	WEEK	WEEK				WEEK				WEEK			
	1	2	3	4	5	6	7	8	9	10	11	12	13
Project Initiation													
Define Project													
Generate PICOT Question													
Develop AIM Statement													
Project Planning													
On Site Meeting with Leadership													
Microsystem Assessment													
Propose Intervention													
Project Implementation													
Conduct Literature Review													
Develop Education Toolkit													
Create Pre/Post Survey													
Implementation Approval													
Distribute Education Toolkit													
Administer Pre/Post Survey													
Project Evaluation													
Data Analysis													
Present Results and Offer Future Recommendations to Leadership													

Appendix F

Lymphedema Education Toolkit

LYMPHEDEMA

WHAT IS LYMPHEDEMA?

Lymphedema is a chronic and progressive disorder that results from impaired lymphatic system function due to the accumulation of protein-rich fluid (lymph) in a particular area of the body.

STAGES OF LYMPHEDEMA

Stage 0: Normal extremity presentation with abnormal lymph transport.

Stage 1: Mild enlarged limb to the affected side. Reversible edema upon limb elevation and compression garments.

Stage 2: Moderate limb swelling with pitting edema that does not resolve with elevation. The affected limb has a spongy appearance and inflammatory quality leading to the creation of scar tissues, inhibiting lymphatic flow.

Stage 3: Persistent edema does not resolve with elevation. Skin integrity leads to thickening and scarring.

Stage 4: (Lymphostatic Elephantiasis) Patient presentation will experience decreased mobility and blistered skin to the affected limb.



RISK FACTORS

Many risk factors may impact a patient's likelihood of developing lymphedema. Some of the most notable are having a **high BMI (> 30)**, but more specifically, having **excess fat distribution** occur in the posterior upper arms. **Cellulitis** can exacerbate lymphedema creating a cellulitis-lymphedema flare cycle. Patients with a history of **axillary lymph node dissection (ALND)** are at increased risk of lymphedema, as lymphatic disruption occurs with the removal of lymph nodes.

Lizet Campos, RN,
Heather Gee, RN,
Julian Miranda, RN,
Fawnda Nguyen, RN,
& Tiffany Silva, RN

For more information
and references,
please scan here:



Risk-Reducing Practices

- Non-Surgical
 - Skin care
 - Proper nutrition
 - Physical exercise
 - Weight control
 - Pharmacological therapy
 - Intermittent external pneumatic compression
 - Complete decongestive therapy
 - Compression garments

Referral to a Certified Lymphedema Therapist

- Review of fit and use of compression garments
- Supervised progressive resistance training
- Self-manual lymphatic drainage

Referral to Physical Therapist for Range of Motion Exercises

Medical Check-Ups

TREATMENT

Conservative (Non-surgical)

Compression Garments

Compression garments can help decrease fluid buildup in the tissues, stopping the backward flow of lymphatic fluid and assisting the muscles in pushing the fluid through the lymphatic system.

Inelastic compression garments allow the lymphatic system to push lymph fluid more effectively through the body. These garments also apply consistent pressure to the affected area, which may help to firm and soften the edema. Inelastic garments can help the reduction and maintenance phase of stages II and III lymphedemas. **Elastic compression garments** are recommended for stage I lymphedema and lymphedema that have progressed to stage II after complete decongestive therapy (CDT). Proper compression garments (sleeves or stockings) that fit based on individual measurements and are prescribed by a provider or physical therapist are most effective.

Intermittent Pneumatic Compression (IPC)

The IPC device consists of inflatable sleeves connected to an external air-powered pump. These sleeves alternate between inflating and deflating, creating a gentle squeezing effect on the affected limb. This motion mimics the muscle's natural pumping action, helping to redirect any fluid buildup back to the center of the body, which allows the body to remove the fluid. It's important to note that the IPC should only be used with compression garments and only when compression garments alone are not effective in treating lymphedema. IPC treatment should be individualized, and pressures greater than 60 mm Hg and long-term use may cause injury to lymphatic vessels.

Regional lymph node radiation (RLNR) destroys cancerous cells in lymph nodes, and damages lymph nodes in the process. RLNR contributes to lymphedema, to a lesser degree than ALND. Lower risk factors include **sentinel lymph node biopsies**, as this also does not disrupt the lymphatic system as much as ALND does.

Following surgery, **low level limb volume changes** increase the progression to lymphedema. Arm volume increases indicate swelling, and measuring for changes in arm circumference is recommended follow up for patients post-operatively.

The patient's **social determinants**, specifically **rurality**, also impact their ability to seek and carry out treatment plans which further increases their risk of developing lymphedema.

Damage to or removal of lymph nodes due to cancer treatment is the most common cause of lymphedema. It is important to remember that while lymphedema is common in cancer patients, **lymphedema does NOT affect ALL cancer patients!**

DIAGNOSTIC MODALITIES

Diagnosis of lymphedema is conducted clinically with numerous tools available for disease staging. Healthcare professionals use a combination of comprehensive history, physical examination with subject and objective symptoms, and physiologic measures.

- **Client's medical history:** risk evaluation, previous medical conditions, and medications that potentially cause edema.
- **Subjective clinical symptoms:** The patient experiences swelling, numbness, heaviness to the affected limb, stiffness, tightness, decreased mobility, and limb fatigue.
- **Physical examination:** Measuring the size of the affected area, presence of scarring and thickening, comparing to healthy limb, skin condition, and skin sensation

Lymphoscintigraphy: Injecting small amounts of radioactive glucose to trace the flow of lymph fluid and identify blockage. A specialized imaging device to detect lymph node uptake, the presence of linear or absent lymphatic ducts, and determine the location of dermal backflow. This dynamic test is used to stage the severity of the disease and visualize the lymphatic vessels. Magnetic resonance imaging (MRI) and Magnetic Resonance Lymphangiography (MRL) are similar procedures to identify potential blockage of lymphatic vessels.

Ultrasound: A high-energy sound wave examining blood and lymph moving throughout the body evaluating superficial and deep veins for the presence of blood clots as a potential cause of swelling and ensuring blood flow is going in one direction.

Complete Decongestive Therapy (CDT)

A gold standard of care for stage II lymphedema. CDT combines various techniques and is typically completed in two phases to help manage symptoms, improve mobility, and reduce the risk of infections.

• **Manual Lymph Drainage (MLD)** is a specialized massage technique that improves the lymphatic system's ability to absorb and move lymphatic fluid to the functioning lymph nodes. The technique involves gently stretching the skin to promote the removal of excess fluid from tissues back into the lymphatic vessels. MLD helps to reduce swelling in affected areas and is performed by a trained specialist. The number of weeks depends on the swelling, tissue firmness, and how long it takes for skin symptoms to improve.

• **Compression Therapy:** After undergoing manual lymphatic drainage (MLD), a multi-layered low-stretch bandage is applied to the affected limb. This pressure helps absorb and transport lymphatic fluid from the limb to the circulation system. The compression bandages provide support and comfort to the limb during rest and promote gentle pumping pressures during movement. It is recommended that gentle exercises be performed while wearing the compression bandages. Compression garments are recommended to be worn up to 23 hours a day, and it is essential to receive proper instruction from a therapist or provider on how to apply the bandages correctly.

• **Skincare:** Maintaining meticulous skin care and nail hygiene is critical to reducing the risk of developing infections, including cellulitis. Daily skin cleansing with mild soap and moisturizing are recommended to avoid dryness and cracking, especially under compression garments. To prevent infection, inspect the skin daily and seek medical attention immediately if there are any signs of redness, tenderness, or warmth. Avoiding injuries and treating cuts, burns, bites, or scrapes immediately is necessary. Some precautions include wearing long oven mitts when cooking, gloves when gardening or doing yard work, and wearing sunscreen or long-sleeved clothing to avoid sunburn. It is recommended to use insect repellent spray when outside, an electric razor for hair removal, and avoid carrying heavy objects with affected limbs.

• **Exercise:** Regular exercise improves circulation and lymph flow, helping to maintain a healthy weight and improve swelling. Exercise can keep the joints flexible, improve range of motion, and reduce stress and anxiety. When starting an exercise program, it's essential to begin slowly and gradually increase the intensity to prevent muscle strain and risk of injuries. It is recommended to keep the exercise low-intensity and pain-free and to follow guidelines based on an individual's treatment and surgeries. Forms of exercise can include walking, hiking, yoga, Tai chi, Pilates, cycling, swimming, aqua aerobics, or muscle strengthening exercises, including lifting weights or stretching the upper limbs. Deep breathing exercises can also help with lymphatic flow by changing the pressure in the chest and abdomen, encouraging lymph to return to the bloodstream.

Bioimpedance Spectroscopy (BIS): A noninvasive method to measure the amount of fluid in the body by calculating the rate of electrical current transmission through tissues by comparing impedance and resistance to the extracellular fluid of affected and unaffected limbs. BIS applies the Lymphedema Index (L-Dex) to calculate the amount of extracellular volume present and measures the volume differences of the limbs. An L-Dex outside of the normal range (-10 to +10) reveals early signs of lymphedema.

Lymphatic Mapping: The application of fluorescent dye injected under the skin between a patient's finger or toes to provide a visualization of the lymphatic system.

CT Imaging: A detailed imaging procedure to evaluate and assess skin thickening, subcutaneous swelling, and calculate limb volume measurement. Provides representation to differentiate conditions among lymphedema, cellulitis, and generalized edema.

PREVENTION

Patient Lymphedema Education

- Self-Care Management
 - Signs and symptoms of lymphedema and infection
 - rash, redness, pain, or increased skin temperature can be a sign of infection
 - Importance of immediate reporting
 - Self-manual lymphatic drainage
 - Common triggers that cause swelling
 - Trauma or injury to the limb - Inflammation can be caused by any injury to the limb, which can further overload the already compromised lymphatic system.
 - Use an electric razor instead of a razor blade for hair removal.
 - Be cautious with sharp and pointed objects, including kitchen knives, garden tools, and manicures.
 - Limb Constriction - Wearing tight clothing or anything that constricts the body can impede the regular flow of blood and lymphatic fluid, leading to a possible overloading of the lymphatic system. In some cases, patients wear a bracelet on the affected arm or leg, which signals medical staff to avoid performing venipuncture or blood pressure tests in these areas.
 - Extreme Temperatures - Inflammation and swelling can result from prolonged exposure to heat. Burns increase the risk of inflammation and swelling.
 - Wear sunscreen to protect the skin and avoid/limit sun exposure between 10 a.m. and 4 p.m., when ultraviolet (UV) light is the strongest.
 - Prolonged Inactivity - Gravity can impede the natural flow of lymphatic fluid from the limbs. Physical activity can stimulate muscle contraction and promote more efficient lymphatic function.
 - Wear compression garments daily, including when up and moving, traveling by air, and as a health provider advises.

Non-conservative treatment (Surgical)

• **What is lymphaticovenous anastomosis (LVA)?** Lymphaticovenous anastomosis is a surgical procedure that redirects the lymph vessels to connect with nearby veins in the affected area of the body. This helps to relieve swelling caused by the accumulation of lymph in the tissues. This new pathway allows lymph to re-enter the bloodstream and circulate throughout the body. The procedure is also referred to as LVA, LVB, and lymphovenous bypass.

• **Who is eligible for LVA?** LVA is used to treat early-stage (stage I) lymphedema when lymphatic vessels are difficult to locate.

• **What is Vasculature lymph node transfer/transplantation (VLNT)?** Minimally invasive outpatient procedure involves first injecting green dye into the patient to locate functioning lymph nodes such as the neck, abdomen, or groin, and transplanting it to an area with damaged lymph nodes, usually in the arm or leg. The transplantation of healthy tissue can stimulate the growth of lymph nodes and vessels, which can improve lymphatic fluid flow and reduce swelling.

• **Who may benefit from VLNT?** Patients with advanced-stage lymphedema (stages 2 and 3) may see sufficient improvement with VLNT alone.

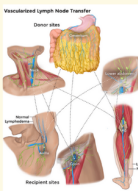
• **Why is liposuction treatment done for lymphedema?** Non-pitting chronic lymphedema is a condition that can be caused by the growth of fat cells. It occurs when the lymphatic fluid leaks into the surrounding tissues, causing inflammation and triggering the growth of fat stem cells. Surgery is usually performed to remove the excess fat caused by lymphedema.

• **Who may benefit from liposuction?** This procedure may be considered for patients with late-stage II and stage III lymphedema who are not eligible for physiologic procedures such as LVA and VLNT.

• **What is Lymphatic debulking surgery?** It is a specialized intervention that is similar to liposuction and is used to remove the fat cells and fluid. It is important to note that this intervention is not a cure for lymphedema.

• **Who may benefit from lymphatic debulking surgery?** This procedure may be considered for patients with late-stage II and stage III lymphedema who are not eligible for physiologic procedures such as LVA and VLNT.

• **Occupational and physical therapy** can effectively manage lymphedema through skin care, manual lymphatic drainage, bandaging, stretching, exercise, self-management techniques, sequential pump use, and healthy living habits.



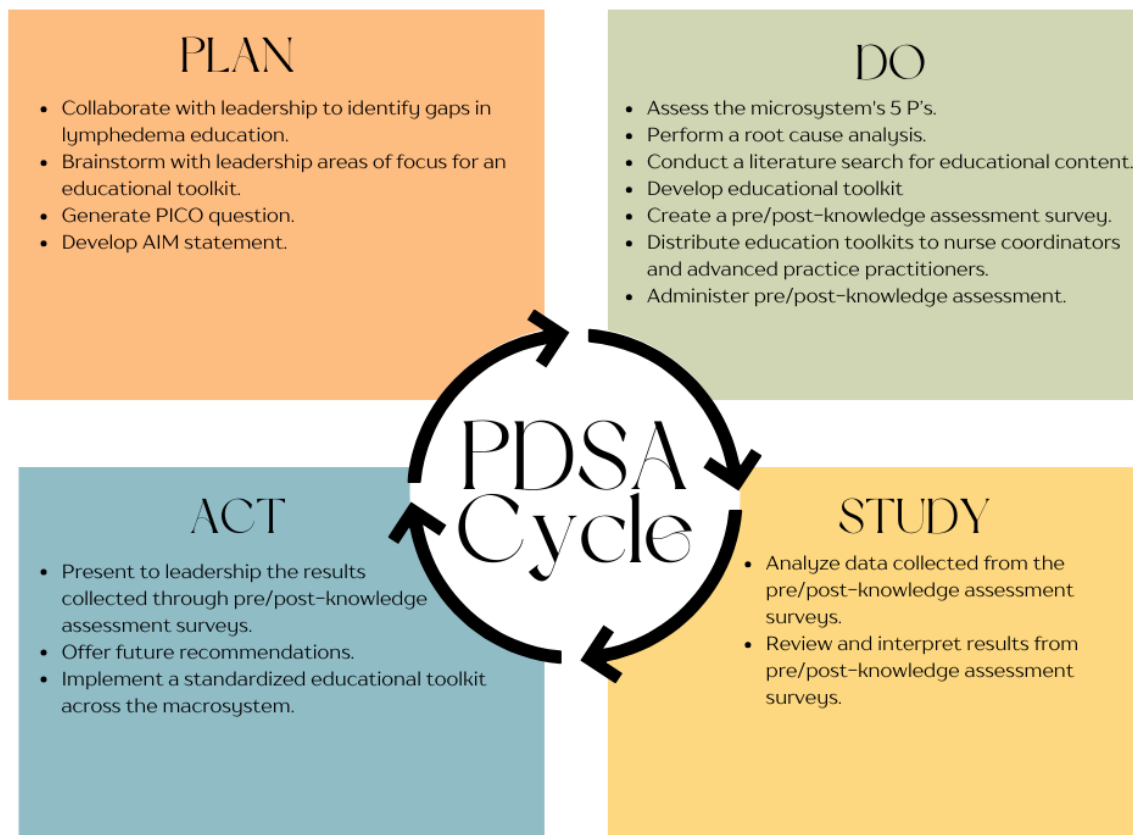
Appendix G

Cost Benefit Analysis

Cost Benefit Analysis			
Cost	Capital Costs (one time large purchase)	Annual Revenue Costs (reoccurring expenses)	Annual Benefit Savings (per patient per year)
Development of Educational Toolkit (\$81/hr x 1 CNL x 200 hours updating EBP and lymphedema education)	\$16,200	\$0	
Materials	\$40	\$40	
Lymphedema Bundle Training (\$82/h x 24 RNs and APPs x 1 training)	\$1,968	\$1,968	
Ongoing Clinical Nurse Leader Training on Lymphedema (\$81/hr x 1 CNL x 1 training)	\$0	\$81	
Total Costs	\$18,208	\$2,089	
Benefits			
Decreased Lymphedema Related Complication			\$26,269
Total Savings			\$26,269
Total Cost Ratio for Initial Implementation		\$26,269 / \$18,208	Starting Cost Benefit Ratio 1.44:1
Total Cost Ratio for Annual Implementation		\$26,269 / \$2,089	Annual Cost Benefit Ratio 12.57:1

Appendix H

Plan, Do, Study, Act (PDSA) Cycle



Appendix I

Pre- and Post- Assessment Survey



Lymphedema Education Toolkit Pre/Post Survey

- 1. True or False: All patients undergoing cancer treatment will develop lymphedema.**
 - True
 - False

- 2. Which of the following are common risk factors for lymphedema (select all that apply)?**
 - A. Increased fat distribution in upper limbs
 - B. High BMI
 - C. Patient history of axillary lymph node dissection (ALND)
 - D. Rurality

- 3. The following best describes what stage of lymphedema.
The patient is experiencing pitting edema. The swelling is soft and may reduce when the affected area is elevated.**
 - A. Stage 0
 - B. Stage I
 - C. Stage II
 - D. Stage III

- 4. What is the stage of lymphedema when scarring is visible and swelling cannot be reduced by elevating the limb?**
 - A. Stage 0
 - B. Stage I
 - C. Stage II
 - D. Stage III

- 5. Which of the following diagnostic tests provides specialized imaging to detect lymph fluid and identify blockages?**
 - A. Bioimpedance spectroscopy
 - B. Lymphoscintigraphy
 - C. Ultrasound
 - D. CT scan

- 6. True or False: Patients with lymphedema are more susceptible to cellulitis.**
 - True
 - False

- 7. True or False: Patients should be instructed to avoid exercise with the affected limb.**
 - True
 - False



8. Which of the following is not included in Complete Decongestive Therapy (CDT)?

1. Manual lymph draining (MLD)
2. Compression bandages
3. Skincare
4. Pharmacology
5. Exercise

9. The gold standard for lymphedema management is:

- A. Intermittent Pneumatic Compression (IPC)
- B. Complete Decongestive Therapy (CDT)
- C. Manual Lymph Drainage (MLD)
- D. Microsurgical reconstructive procedures

10. Lymphaticovenous anastomosis (LVA) is a surgical procedure that

- A. Involves first injecting green dye into the patient to locate functioning lymph nodes such as the neck, abdomen, or groin, and transplanting it to an area with damaged lymph nodes, usually in the arm or leg
- B. May be considered for patients with late-stage II and stage III lymphedema
- C. Is a specialized intervention similar to liposuction used to remove fat cells and fluid
- D. Redirects the lymph vessels to connect with nearby veins in the affected area of the body

11. For the following statements, please state true or false.

Statement	True	False
A. Repetitive movements will increase circulation to help reduce swelling		
B. Deep breathing helps promote lymph flow		
C. Use a cold compress to help with swelling		
D. Use the sauna at the gym to promote circulation		
E. Avoid underwire bras		
F. Avoid going outside in the sun between the hours of 10 am – 4 pm		
G. Wear compression garments during air travel		



Answer Key:

- 1) False
- 2) All the Above
- 3) B. Stage I
- 4) C. Stage II
- 5) B. Lymphoscintigraphy
- 6) True
- 7) False
- 8) 4. Pharmacology
- 9) B. Complete decongestive Therapy (CDT)
- 10) D. Redirects the lymph vessels to connect with nearby veins in the affected area of the body
- 11a.) False
- 11b.) True
- 11c.) False
- 11d.) False
- 11e.) True
- 11f.) True
- 11g.) True

Appendix J

Data Analysis

Lymphedema Toolkit Efficacy

