Implementing a Patient-Centered Education Intervention to Reduce Incidence of Chemotherapy-Induced Oral Mucositis (OM) Among Inpatient Chemotherapy Patients: A Quality Improvement Project

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Implementing a Patient-Centered Education Intervention to Reduce Incidence of Chemotherapy-Induced Oral Mucositis (OM) Among Inpatient Chemotherapy Patients:

A Quality Improvement Project

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Abstract

Oral mucositis (OM) is a common and costly complication of chemotherapy cancer treatment resulting in high costs and poor outcomes and experiences for chemotherapy patients. At the site of this quality improvement (QI) project, the quality and content of the oral care patient education for chemotherapy patients is inconsistent. The aim of this project was to improve oral care completion and knowledge by 20% among inpatient chemotherapy patients and in turn reduce incidence of chemotherapy-induced OM. A pre-intervention survey was distributed to eight eligible patients to assess baseline oral care completion and knowledge. Patients were provided with an oral care education session consisting of written and verbal education and their oral care completion and knowledge was reassessed in a post-intervention survey 24-30 hours later. The specific aims of the project were partially achieved. Oral care completion improved by 28% for toothbrushing and by 12% for oral rinsing. Additionally, oral care knowledge improved by 28% for OM understanding and by 12% for understanding the impact of oral care on one’s health. While these improvements did not fully achieve the specific aims, the improvement seen across all survey statements demonstrates the importance and effectiveness of the intervention. This project highlights the role of the Clinical Nurse Leader (CNL) as an educator, client advocate, and lifelong learner.

Keywords: chemotherapy-induced oral mucositis, oral care, quality improvement
Introduction

Problem Description

Oral mucositis (OM) is a common, costly, and serious complication of chemotherapy cancer treatment. Chemotherapy treatment breaks down rapidly dividing cells, including the epithelial cells of the mucosa, creating erythema, edema, atrophy, and/or ulceration of the oral mucosa (The Oral Cancer Foundation, 2022). The World Health Organization grades the severity of OM with the following 0-4 Oral Toxicity Scale:

- Grade 0: None
- Grade I: Mild OM with oral soreness and erythema
- Grade II: Moderate OM with oral erythema and ulcers, patient can swallow solid food
- Grade III: Severe OM with ulcers and extensive erythema, patient cannot swallow solid food
- Grade IV: Life-threatening OM, oral alimentation not possible

(Naidu et al., 2004, p. 425)

A multitude of factors contribute to the severity of OM including the patient’s level of immunosuppression, genetic predisposition, local tissue damage, and the local oral environment (Treister, 2017). The inflammation of the mouth can result in pain, infection, inability to eat, and weight loss. Severe OM can cause interruptions and dose reductions in chemotherapy treatment, leading to poorer patient outcomes (Brown & Gupta, 2020). For patients undergoing chemotherapy prior to bone marrow transplantation (BMT), OM has been described as the “most debilitating aspect of their treatment,” demonstrating the grave impact it can have on patients’ cancer experiences and treatment progression (Treister, 2017, p. 2).

OM affects approximately 40% of chemotherapy patients and up to 85% of patients undergoing chemotherapy prior to BMT (Pulito et al., 2020). It can contribute to longer hospital admissions and increased cost of care. The cost of care can be further exacerbated by a need for parenteral nutrition, antibiotics, pain medications, and medicated rinses and can contribute to
additional costs of $3,700 per cycle of chemotherapy treatment and upwards of $70,000 for chemotherapy with BMT (Treister, 2017; Elting & Chang, 2019). Collectively, poor patient outcomes and experiences as well as high accrued costs associated with chemotherapy-induced OM highlight the need for change. Patient education focused on the importance of good oral care throughout chemotherapy treatment is essential as evidence suggests that regular prophylactic oral care can mitigate the risk of mucositis to a degree (Brown & Gupta, 2020).

Local Problem

At the site of this QI project, the quality and content of the oral care patient education for chemotherapy patients is inconsistent. There is an oral care policy in place for BMT patients, however not for chemotherapy patients, resulting in a lack of consistent oral care completion among chemotherapy patients. The oral care policy defines regular oral care as toothbrushing twice daily and oral rinsing four times daily, after each meal and before bed (Dartmouth-Hitchcock, 2021). The project leader performed a tick and tally to assess current oral care completion (N=9), 55.6% of the surveyed patients completed regular oral care and 44.4% did not, highlighting a need for improvement. Additionally, a previous QI project conducted by the Clinical Nurse Leader (CNL) examined the actual versus projected length of hospital stay for 11 patients with chemotherapy-induced OM. The CNL found that the mean actual hospital stay was 11.4 days longer than the projected stay which contributes to higher costs (Pomeroy, 2021). The CNL also found that there was wide variation in staff oral care documentation, with oral care documentation rates ranging from 25%-63% over an eight-week period of chart audits (Pomeroy, 2021). The microsystem assumes that if oral care is not being documented, it is not being completed. Collectively, this data highlights the need for a patient education intervention to
implement oral care completion and knowledge and in turn reduce incidence of OM among chemotherapy patients.

Available Knowledge

**PICO**

The following PICO question was developed: In adult oncology patients receiving chemotherapy, how does daily oral care compared to no intervention affect incidence of chemotherapy-induced OM?

**Critical Appraisal of the Evidence**

Hong et al. (2019) conducted a systematic review to examine the effects of basic oral care on preventing and managing OM secondary to cancer therapy. The findings of the review were used to update the basic oral care recommendations in the Multinational Association of Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO) Clinical Practice Guidelines (Hong et al., 2019). Relevant papers from 2011 to 2016 were identified in PubMed and Web of Science and ultimately 17 new articles were included in the review. Two independent reviewers and a standard electronic form were used to identify and extract data. The articles examined six interventions of basic oral care including “professional oral care, multi-agent combination oral care, patient education, saline, sodium bicarbonate, and chlorhexidine” (Hong et al., 2019, p. 3951). Eight of the included studies were randomized controlled trials (RCTs) examining the following four interventions, “professional oral care, multi-agent combination oral care, patient education, and chlorhexidine” (Hong et al., 2019, p. 3951). Each intervention was given a guideline determination of “recommendation, suggestion, or no guideline possible” based on the level of evidence of the studies (Hong et al., 2019, p. 3951).
Hong et al. (2019) reviewed three RCTs and six comparative studies examining the role of professional oral care in preventing OM. Two RCTs found reduced OM severity and one RCT found decreased associated pain, however variation in patient demographics and treatment methods resulted in insufficient evidence to support this intervention and “no guideline was possible” (Hong et al., 2019, p. 3952). Five RCTs examined the effects of multi-agent combination oral care protocols on OM prevention. The panel suggested that “the implementation of multi-agent combination oral care protocols is beneficial for the prevention of OM during chemotherapy and hematopoietic stem cell transplantation” (Hong et al., 2019, p. 3955). One RCT and two comparative studies examined the effects of patient education. Due to insufficient and conflicting data, “no guideline was possible regarding the use of patient education for the prevention of OM” (Hong et al., 2019, p. 3962). However, an expert opinion stating that patient education is beneficial in improving patients’ “self-management and adherence to the recommended oral care treatment” complemented the guideline (Hong et al., 2019, p. 3962). Two RCTs examined the use of saline and two RCTs examined the use of sodium bicarbonate. No guideline was possible due to insufficient data, however the expert opinion that saline and sodium bicarbonate rinses promote oral health and improve patient comfort complemented the guideline. Five RCTs examining the impact of chlorhexidine were reviewed. The panel stated that “no guideline was possible with regard to the use of chlorhexidine in the prevention of OM” as a result of inconsistent data (Hong et al., 2019, p. 3963). Collectively, the work of Hong et al. (2019) encourages the use of multi-agent combination oral care protocols, bland rinses, and patient education for the prevention and treatment of OM. The authors acknowledge that there is “limited evidence from high-quality, rigorous studies” (Hong et al., 2019, p. 3963). Future RCTs with large sample sizes and greater consistency between cancer
treatment methods are needed. Additionally, the review includes both randomized and non-randomized studies, the use of non-randomized studies weakens the overall quality of the findings. Strengths of the review include the use of independent reviewers as well as the Somerfield and Hadorn criteria to eliminate bias and evaluate study quality. The findings of Hong et al. (2019) support the use of oral care in cancer patients.

Yu et al. (2020) conducted a network meta-analysis of RCTs examining the effects of nine oral care solutions on the prevention of OM among cancer patients. Authors searched PubMed, Embase, Scopus, the Cochrane Library, and Google Scholar to identify 28 RCTs involving 1861 patients to include in the analysis. Nine oral care solutions including chlorhexidine, benzydamine, sucralfate, povidone-iodine, granulocyte macrophage colony stimulating factor (GM-GSF), honey, allopurinol, and curcumin were investigated. The Cochrane Handbook was used to evaluate the RCT quality and the nine interventions were ranked according to the Surface Under the Cumulative Ranking curve (SUCRA). The SUCRA probabilities of various oral solutions on preventing OM showed the following rank of efficacy: curcumin (6.4), honey (23.9), benzydamine (29.2), chlorhexidine (42.3), allopurinol (48.6), sucralfate (56.4), GM-GSF (61.2), povidone-iodine (71.2), aloe (74.6), and placebo (84.8) (Yu et al., 2020). The statistical analysis of Yu et al. (2020) found that chlorhexidine (RR= 0.39; 95% CI, 0.81-0.82), benzydamine (RR= 0.30; 95% CI, 0.13-0.68), honey (RR= 0.25; 95% CI, 0.11-0.56) and curcumin (RR= 0.08; 95% CI, 0.01-0.60) were more effective than placebo in preventing OM (p< 0.05) (Yu et al., 2020). The authors also found that honey (RR= 0.32; 95% CI, 0.11-0.97) and curcumin (RR= 0.10; 95% CI, 0.02-0.60) were more effective than povidone-iodine (p< 0.05) (Yu et al., 2020). The comparisons for the other oral care interventions were not statistically significant.
These findings suggest that various oral care solutions, specifically curcumin and honey, are effective at preventing OM in cancer patients, however several limitations must be acknowledged. Many of the studies included in the analysis had small sample sizes which limits the generalizability of the findings. Additionally, two of the authors participated in extracting the chosen articles which contributes to bias and can impact the validity of the findings. Strengths include use of RCTs and the Cochrane Handbook to assess quality of each study. The findings of Yu et al. (2020) highlight the importance of oral care solutions in preventing OM among cancer patients.

Salvador et al. (2012) conducted a pilot RCT to examine the effects of an oral intervention on the incidence and severity of OM in autologous stem cell transplant (ASCT) patients with multiple myeloma. Participants were randomly assigned to the experimental group (n= 23) or the control group (n= 23). All participants received education on basic oral hygiene and participated in oral self-care skills training. They all received their own cryopreserved stem cells on Day 0 and high-dose melphalan chemotherapy on Day 1. The participants in the control group continued with their usual care which included toothbrushing, sodium bicarbonate mouthwash, lip moisturizer, and flossing (if platelets were greater than 50,000). In addition to the standard oral care, participants in the experimental group sucked on ice chips for five minutes before the melphalan infusion, during the entire infusion, and for 30 mins after the administration of the melphalan chemotherapy. The primary outcomes were incidence and severity of OM (determined by the World Health Organization Oral Toxicity Scale) and the secondary outcomes were mucositis-related pain, functional intake of food and fluids, and length of hospital stay. A visual analogue scale (ranging from 0-10) was used to assess pain as was the amount of opioid analgesics documented for pain control. Data was collected on days 1, 3, 6, 9, and 12. The
results showed that all participants were symptom free on days 1 and 3. However, signs and symptoms of OM were present on day 6 and there were significant differences in mucositis severity scores between the experimental and control groups on days 6 (0.09 vs. 0.05, F= 5.85, p< 0.02), 9 (0.43 vs. 1.14, F= 16.86, p< 0.001), and 12 (0.04 vs. 0.41, F= 4.58, p< 0.03) (Salvador et al., 2012). Additionally, the mean mucositis-related pain score was significantly less in the experimental group (0.3 ± 0.23) compared to the control group (1.64 ± 0.24) (p<0.001) as was the mean milligrams of Morphine IV equivalent pain medications (34mg in the experimental group vs. 54mg in the control group) (p<0.001) (Salvador et al., 2012). The experimental group had a shorter length of hospital stay (14.1 ± 2.8 days) compared to the control group (15.3 ± 2.8 days), however the difference was not statistically significant (p= 0.17) (Salvador et al., 2012). Similarly, there was no significant difference between study groups on functional intake of foods and fluids.

While the findings of Salvador et al. (2012) did not prevent OM, the oral cryotherapy intervention did significantly reduce OM severity and OM-associated pain among multiple myeloma ASCT patients. However, when assessing the quality of this data, it is important to note that there were significant differences in age (p = 0.02) and education (p= 0.05) between the two groups, with a higher mean age and education in the experiment group which contributes to participation bias. However, the use of randomization strengthens the quality of the findings. Overall, the findings of Salvador et al. (2012) highlight the benefit of oral care interventions in decreasing the severity and pain of OM.

Saito et al. (2014) conducted a RCT to examine the effects of prophylactic professional oral health care (POHC) on the prevention of chemotherapy-induced OM. In this study, POHC was performed by either dentists or dental hygienists. 26 breast cancer patients, undergoing
adjuvant chemotherapy, participated in the study. Patients were randomly assigned to the self-care control group or the POHC experimental group. Both groups received education on brushing, nutrition, and lifestyle, however the POHC group received weekly scaling and brushing by a dentist or dental hygienist. Examined outcomes included the oral environment measured by the Eilers’ Oral Assessment Guide (OAG) and the OM severity according to the National Cancer Institute Common Terminology Criteria for Adverse Events. In the POHC group, “the OAG score was either improved or unchanged in 11” of the 14 patients (Saito et al., 2014, p. 2938). In the self-care group, five patients had improved or unchanged scores and nine patients had deteriorated scores after their chemotherapy treatment. There was significantly less deterioration in the oral assessment in the POHC group compared to the self-care group (p=0.01) (Saito et al., 2014). Additionally, there was a significantly higher incidence of OM in the self-care group compared to the POHC group (p=0.04) (Saito et al., 2014).

The findings of Saito et al. (2014) suggest that POHC performed throughout chemotherapy treatment can prevent degradation of the oral mucosa and reduce incidence and severity of OM among breast cancer patients. The two groups were statistically similar in regards to age, body mass index, and number of teeth which strengthens causality. However, the comparability at baseline and small sample sizes in this study limit generalizability beyond this population of female breast cancer patients. Additionally, randomization contributes to the strength of the overall findings. The work of Saito et al. (2014) highlights the efficacy of POHC in chemotherapy patients.

**Evidence Synthesis**

The evidence suggests that various oral care interventions are effective at preventing and reducing severity of chemotherapy-induced OM. The aforementioned four studies all found a
reduction in incidence and severity of chemotherapy-induced OM after oral care interventions. Systematic reviews and meta-analyses of RCTs are the gold standard to summate available evidence regarding a clinical question. This investigation included a systematic review/clinical practice guideline (level 1), a meta-analysis (level 1), and two randomized-controlled trials (level 2). Despite the high-quality evidence supporting the use of oral care interventions to prevent and reduce severity of chemotherapy-induced OM, it is essential to have a strong understanding of the type of study, the level of evidence, and the resulting limitations that hinder the validity of the findings. Future research must prioritize RCTs with large sample sizes which will fuel the formation of systematic reviews and meta-analyses, further enhancing the quality of available evidence. More high-quality and extensive research would enable registered nurses and CNLs to advocate for evidence-based, patient-specific oral care interventions to prevent incidence and reduce severity of chemotherapy-induced OM.

Implications for this QI Project

With the evidence supporting the use of oral care interventions to prevent and reduce severity of chemotherapy-induced OM, a QI project aimed at improving the oral care habits of chemotherapy patients is vital to reducing incidence and severity of OM. The microsystem has low rates of oral care completion among chemotherapy patients and low rates of oral care documentation among staff. As the evidence suggests, this nonadherence to daily oral care leaves a vulnerable population at risk for OM. This QI project could improve patient outcomes and experiences and motivate nurses on the unit to participate in evidence-based interventions such as oral care.

Rationale
The framework for this quality improvement project was the Institute for Healthcare Improvement’s Plan-Do-Study-Act (PDSA) model. The PDSA model is a four-step scientific method for testing and carrying out change (Institute for Healthcare Improvement, 2022). With this model, a change is initially tested on a small scale and modified and refined through repeated PDSA cycles before being implemented on a larger scale with an entire unit or patient population (Institute for Healthcare Improvement, 2022).

**Plan**

In the *Plan* phase of this QI project, a 5P Assessment was initially conducted to examine the functionality of the microsystem. The purpose, patients, and processes portions of the assessment provided insight into the problem of OM and lack of oral care completion among chemotherapy patients in the microsystem. Insight was gathered from nursing staff and leaders and the CNL shared previous QI work investigating the role of staff education on oral care documentation and OM. A fishbone diagram was created to perform a root cause analysis and oral care completion was identified as a potential focus. A tick and tally (N=9) was performed to assess the current state of oral care completion among chemotherapy patients in the microsystem. A literature review was completed and the evidence supported the promotion of regular oral care to prevent and/or reduce severity of chemotherapy-induced OM. The project leader collaborated with key stakeholders to construct a patient education intervention. Pre and post-intervention surveys as well as an educational pamphlet were created by the project leader and approved by the unit manager and CNL.

**Do**

During the *Do* phase, the patient education intervention was carried out. 10 eligible participants completed a pre-intervention survey assessing their current oral care completion and
knowledge. The survey was immediately followed by a written and verbal education session with the project leader. Participants completed a post-intervention survey at least 24 hours after the education intervention.

**Study**

In the *Study* phase, the mean Likert survey scores were compared to assess the efficacy of the education intervention. A paired t-test was performed to determine if the pre and post-intervention scores for oral care completion and knowledge were significantly different.

**Act**

In the *Act* phase, the results of this QI project were presented verbally to the staff and leaders of the microsystem as well as with a poster hung on the unit. The patient education resources (verbal content and written pamphlets) were provided to the unit and kept in an accessible location with other staff resources. The staff were encouraged to provide all chemotherapy patients with oral care education.

**Specific Aims**

The global aim of this project was to reduce incidence of chemotherapy-induced OM among chemotherapy patients. The specific aims of the project include the following:

1. Increase oral care completion in chemotherapy patients by 20% by July 1, 2022
2. Improve oral care knowledge in chemotherapy patients by 20% by July 1, 2022

**Methods**

**Context**

The microsystem for this QI project was a 33-bed Hematology/Oncology/BMT unit within a 400-bed academic medical center and level 1 trauma center in New England (DHMC, 2022). The unit primarily provides care to patients with solid tumors, blood malignancies and
disorders. The microsystem is a part of a comprehensive cancer center which collaborates with inpatient units like this microsystem to provide cancer care (Dartmouth Cancer Center, 2022). A 5P Microsystem Assessment was conducted to provide a framework for the QI project and the purpose, patients, and processes portions of the assessment provided relevant information.

**Purpose**

The microsystem aims to provide “advanced, comprehensive cancer care to patients within a compassionate environment” (Dartmouth Cancer Center, 2022, para. 1). The mission statement of the mesosystem, the cancer center, is to “prevent and cure cancer through pioneering interdisciplinary research, to translate new knowledge into better prevention and treatment, and to provide effective and compassionate clinical care that improves the lives of patients with cancer and their families” (Dartmouth Cancer Center, 2022, para 1). Similarly, the macrosystem strives to “advance health through research, education, clinical practice, and community partnerships, providing each person the best care, in the right place, at the right time, every time” (DHMC, 2022, para. 7). Collectively, these statements reflect a commitment to quality improvement as all levels of care strive to provide high-quality care and improve patient outcomes and experiences.

**Patients**

Patients included in this QI project were adult (≥18 years old) oncology/chemotherapy patients admitted to the microsystem. Common medical conditions for this patient population include acute myeloid leukemia, acute lymphocytic leukemia, multiple myeloma, and diffuse large B-cell lymphoma. Chemotherapy breaks down rapidly dividing cells including the mucosal epithelial cells lining the gastrointestinal tract leaving chemotherapy patients at an increased risk for developing OM (Treister, 2022).
IMPLEMENTING A PATIENT-CENTERED EDUCATION INTERVENTION TO REDUCE INCIDENCE OF OM AMONG INPATIENT CHEMOTHERAPY PATIENTS

Processes

While there is a preventative oral care protocol in place for BMT patients, there are no oral care policies or oral care education guidelines for patients admitted for chemotherapy treatment aside from BMT. Patients are informed of the risk of OM during the chemotherapy informed consent with the provider but are not provided comprehensive education about the importance of regular oral care. Currently, the quality and content of the oral care patient education is inconsistent.

Cost-Benefit Analysis

A cost-benefit analysis was conducted to examine the financial implications of the project. OM can lead to longer hospital admissions and increased cost of care. Previous QI work by the unit CNL found that the mean actual hospital stay on the unit was 11.4 days longer than the projected stay for patients that developed chemotherapy-induced OM (Pomeroy, 2021). Additionally, research shows that OM can contribute to additional costs of $3,700 per chemotherapy cycle and upwards of $70,000 for patients undergoing chemotherapy and BMT (Elting & Chang, 2019). Implementing an intervention to improve oral care completion and knowledge among chemotherapy patients can reduce incidence of OM and reduce hospital costs. This intervention did not result in any additional costs for the hospital at this time as the project leader supplied the printed and laminated educational pamphlet. The project leader spent approximately $30 on pamphlet creation and distribution (paper, ink, lamination) per 10 pamphlets. If the microsystem decides to continue the intervention beyond July 1, the hospital will adopt the cost of the pamphlet distribution.

Description of the Intervention
To improve oral care completion and knowledge among chemotherapy patients, an oral care patient education session was implemented. The education session consisted of both verbal and written education. The education material was based on evidence-based information from the following sources: 1) The unit’s BMT oral care policy and 2) The MASCC/ISOO Clinical Practice Guidelines and the associated oral care education pamphlet. Interventions aimed at improving health literacy were utilized to promote optimal comprehension. First, the verbal education was provided at a moderate pace, in nonmedical language. Second, the pamphlet was written at a sixth-grade reading level with short, simple sentences. Research shows that use of both verbal and written information increases patient knowledge and satisfaction (Johnson et al., 2003). Third, the teach-back method was used to gauge comprehension. Lastly, all participants were asked *What questions do you have?* to promote self-management and empowerment (Hersh et al., 2015).

Starting on May 23, 2022, the project leader attended morning huddle and identified chemotherapy patients on the unit. Eligible patients were provided with an informed consent and interested participants first completed a pre-intervention survey, created by the project leader, assessing their current oral care habits with the questions *I brush my teeth twice a day while in the hospital* and *I use an oral rinse after each meal and before bed while in the hospital.* Patients assigned themselves a score for each question based on the following Likert 5 Point Scale: Never, Rarely, Sometimes, Often, Always. The survey also assessed patient baseline knowledge with the questions *I understand what OM is* and *I understand how oral care can impact my health.* Participants assigned themselves a score for each question based on the following Likert 5 Point Scale: Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree. After completing the pre-intervention survey, the project leader provided participants with an *Oral Care for*
Chemo Patients educational pamphlet which was created by the project leader and previously approved by the unit manager. The project leader verbally explained the information on the pamphlet and used the teach-back method to confirm patient comprehension. The education session was divided into five sections: 1) Patients were educated on OM and why chemotherapy patients are at increased risk for developing OM, 2) Patients were educated on how oral care can help prevent OM, 3) Patients were educated on the importance of toothbrushing, they were coached to brush for 90 seconds each time with a soft-bristled toothbrush, 4) Patients were educated on the importance of utilizing oral rinses (bland saline or medicated as prescribed by their provider) after each meal and before bed, and 5) Patients were encouraged to use the oral checklist on the pamphlet to physically check off when they complete each oral care intervention throughout the day (Dartmouth-Hitchcock, 2022; International Society of Oral Oncology, 2016). The pamphlet was left in a visible and easily accessible location on the patient’s bedside table.

The project leader carried out the intervention, however stakeholder involvement with the unit manager, CNL, charge nurse, and staff nurses were vital to the success of the project. The unit manager and the CNL were involved in the planning and approved the pre and post-intervention survey as well as the patient education materials and content. The project leader collaborated with the charge nurse at the start of the shift to identify the chemotherapy patients on the unit. The project leader then communicated with the staff nurses to ensure the intervention was not disrupting the nurse or patient.

Study of the Intervention

The participants were surveyed before and after the intervention to assess the impact of the patient education session on oral care completion and knowledge. The post-intervention
survey was completed at least 24 hours after the education session to examine the efficacy of the intervention.

**Measures**

A survey was created to assess oral care completion and knowledge. This survey was developed to measure the outcomes of the intervention because there was no current tool specifically assessing oral care completion and knowledge. The final survey was approved by the unit manager and CNL. No psychometric testing was performed on the tool, however the CNL and unit manager, subject matter experts, validated the content of the survey. A Likert 5 Point Scale was used to quantify responses with *Never* representing 1 point, *Rarely* representing 2 points, *Sometimes* representing 3 points, *Often* representing 4 points, and *Always* representing 5 points for the oral care completion data. Similarly, a Likert 5 Point Scale was also used to quantify oral care knowledge data with *Strongly Disagree* representing 1 point, *Disagree* representing 2 points, *Undecided* representing 3 points, *Agree* representing 4 points, and *Strongly Agree* representing 5 points. The mean Likert scores and a paired t-test were used to compare the pre and post-intervention scores. The mean score of the following two questions were used to assess oral care completion: *I brush my teeth twice daily while in the hospital* and *I use an oral rinse after each meal and before bed while in the hospital*. The mean score of the following two questions assessed oral care knowledge: *I understand what oral mucositis is* and *I understand the impact oral care can have on my health*. Demographic data such as age, gender, and type of cancer was also collected as these factors contribute to incidence and severity of OM.

The specific outcome measures were to improve both oral care completion and oral care knowledge by 20% after the implementation of the patient education intervention, by July 1, 2022. The global outcome measure was to decrease the incidence of chemotherapy-induced OM.
Analysis

Oral care completion and knowledge were quantitatively evaluated by comparing pre and post-intervention mean Likert scale scores. A paired t-test was used to determine if the mean differences were significantly different. Standard deviation, frequency, and percentage were also examined in the descriptive analysis. The scores of 10 adult chemotherapy patients were assessed and provided insight into whether the oral care patient education session was effective. This quantitative comparison assessed if the patient education intervention improved daily oral care completion and knowledge.

Ethical Considerations

This proposal was submitted to the University of New Hampshire Department of Nursing Quality Review Committee and received determination as a QI project exempt from Institutional Review Board (IRB) approval. The intervention has been approved by the unit manager and CNL. There was an element of convenience bias as not all chemotherapy patients in the microsystem were involved in the project which limits the generalizability of the findings. Each participant received an informed consent stating that there was be no direct benefit to them for their participation and that they could decline to participate at any time. No personal patient information was collected. No additional risk was introduced to the participants. No conflicts of interest were identified as the project leader completed this as a part of the University of New Hampshire Direct Entry Master of Nursing capstone project and was not employed by the facility.

Results

Initial Steps of Intervention
Between April 21, 2022 and May 7, 2022, the project leader created an informed consent and an initial survey to assess pre-intervention and post-intervention data regarding oral care completion and knowledge among chemotherapy patients. Oral care completion was assessed by the following two statements: *I brush my teeth at least twice daily while in the hospital* and *I use an oral rinse after each meal and before bed while in the hospital*. Oral care knowledge was assessed by the following two statements: *I understand what OM is* and *I understand how oral care can impact my health*. The survey questions utilized a Likert 5 Point Scale for scoring.

Adjustments were made to the survey to include demographic data including participant age, gender, and type of cancer as those factors impact incidence and severity of OM (Treister, 2017). Additionally, the pre-intervention survey was expanded to include the statement, *I have received previous education from my healthcare team about the importance of oral care*, to further assess the current state of oral care education within the microsystem. The post-intervention survey was expanded to include the statements, *I will continue to use the oral care educational pamphlet & checklist provided to me* and *What did you find most helpful about this education session?* The project leader also created an oral care/OM educational pamphlet to distribute to patients during the education session of the intervention. The informed consent, the pre and post-intervention surveys, and the educational pamphlet were approved by key stakeholders in the microsystem as well as the University of New Hampshire Nursing Department Quality Review Committee as IRB exempt indicative of QI. The project leader printed the aforementioned materials, had the educational pamphlets laminated prior to the intervention, and communicated with the microsystem leadership to schedule the implementation of the intervention.

On June 22, 2022, the project leader attended morning huddle and collaborated with the staff nurses to identify eligible chemotherapy patients in the microsystem. The project leader
introduced herself to each eligible patient and reviewed the informed consent. Patients were provided with the pre-intervention survey and the project leader left the room while the patients completed the survey. The project leader collected the completed surveys and stored them in a sealed envelope, identified only by room number so the correct post-intervention survey could be distributed the following day. The project leader distributed the oral care educational pamphlet and discussed the following five points: 1) What OM is and why chemotherapy patients are at increased risk for developing it, 2) How oral care can help prevent OM, 3) The importance of toothbrushing and proper technique including brushing for 90 seconds with a soft-bristled toothbrush, 4) The importance of utilizing oral rinses (bland saline or medicated) after each meal and before bed, and 5) The benefits of using the checklist on the pamphlet to physically check off when each oral care activity was completed throughout the day. All participants were asked What questions do you have? before concluding the session.

On June 23, 2022, the project leader followed up with the six participants at least 24 hours after the initial intervention. Each patient was provided with the post-intervention survey and again the project leader left the room as the participants completed the survey. The envelopes labeled with participant room numbers were shredded to preserve anonymity. Completed post-intervention surveys were collected and patients were thanked for their time.

**Details of the Process Measures and Outcomes**

The number of participants involved in the QI project was N=6. 66.7% of participants identified as female and 33.3% identified as male. The mean age of the participants was 65.7 years old (SD = 6.8, range = 54-74). 100% of participants had a hematological malignancy, 16.7% with multiple myeloma, 33.3% with a form of lymphoma (primary central nervous system
lymphoma and B-cell lymphoma), and 50% with various forms of leukemia (acute myeloid leukemia, acute lymphocytic leukemia, and plasma cell leukemia).

**Table 1**

*Demographic Data*

<table>
<thead>
<tr>
<th>Demographic Data</th>
<th>Total Sample (N=6) n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4 (66.7)</td>
</tr>
<tr>
<td>Male</td>
<td>2 (33.3)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>64</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>65</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>67</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>70</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>74</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td><strong>Cancer Diagnosis</strong></td>
<td></td>
</tr>
<tr>
<td>Multiple Myeloma</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>Acute Lymphocytic Leukemia</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>Acute Myeloid Leukemia</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>Plasma Cell Leukemia</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>Primary CNS Lymphoma</td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>B- Cell Lymphoma</td>
<td>1 (16.7)</td>
</tr>
</tbody>
</table>

**Figure 1**

*Gender Distribution Among Participants*
IMPLEMENTING A PATIENT-CENTERED EDUCATION INTERVENTION TO REDUCE INCIDENCE OF OM AMONG INPATIENT CHEMOTHERAPY PATIENTS

Figure 2

Cancer Diagnoses Among Participants

Table 2

Descriptive Statistics for Key Study Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Intervention M</th>
<th>Pre-Intervention SD</th>
<th>Post-Intervention M</th>
<th>Post-Intervention SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>I brush my teeth at least twice daily while in the hospital</td>
<td>3.3</td>
<td>1.6</td>
<td>4.7</td>
<td>0.5</td>
<td>1-5</td>
</tr>
<tr>
<td>I use an oral rinse after each meal and before bed while in the hospital</td>
<td>3.2</td>
<td>1.6</td>
<td>3.8</td>
<td>1.2</td>
<td>1-5</td>
</tr>
<tr>
<td>I understand what oral mucositis (OM)</td>
<td>3.3</td>
<td>1.4</td>
<td>4.7</td>
<td>0.5</td>
<td>1-5</td>
</tr>
<tr>
<td>I understand how oral care can impact my health</td>
<td>4.2</td>
<td>1.6</td>
<td>4.8</td>
<td>0.4</td>
<td>1-5</td>
</tr>
</tbody>
</table>
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The means and standard deviations (SD) were calculated for the pre and post-intervention scores for each survey question. Paired t-tests were conducted to calculate p values to determine if there was a statistically significant difference between the pre and post-intervention scores. All statistical analysis was conducted with Google Sheets™. Participants could indicate Never, Rarely, Sometimes, Often, Always for their oral care completion habits, which were respectively assigned scores of 1 through 5. The mean pre-intervention score in response to the statement, *I brush my teeth at least twice daily while in the hospital*, was 3.3 (SD = 1.6, range 1-5), the mean post-intervention score was 4.7 (SD = 0.5, range 1-5) (p = 0.043). The mean pre-intervention score in response to the statement, *I use an oral rinse after each meal and before bed while in the hospital*, was 3.2 (SD = 1.6, range 1-5), the mean post-intervention score was 3.8 (SD = 1.2, range 1-5) (p = 0.102).

**Figure 3**

*Mean Oral Care Completion Likert Scale Scores*
Participants could indicate Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree for their oral care knowledge, which were respectively assigned scores of 1 through 5. The mean pre-intervention score in response to the statement, I understand what OM is, was 3.3 (SD = 1.4, range 1-5), the mean post-intervention score was 4.7 (SD = 0.5, range 1-5) (p = 0.025). The mean pre-intervention score in response to the statement, I understand how oral care can impact my health, was 4.2 (SD = 1.6, range 1-5), the mean post-intervention score was 4.8 (SD = 0.4, range 1-5) (p = 0.235).

Figure 4

Mean Oral Care Knowledge Likert Scale Scores

The mean score in response to the statement, I have received previous education from my healthcare team about the importance of oral care, was 3.3 (SD = 1.6, range 1-5). The mean score in response to the statement, I will continue to use the oral care educational pamphlet & checklist provided to me, was 4.2 (SD = 0.8, range 1-5).
In response to the question, *What did you find most helpful about this education session?*, 66.7% of participants wrote that the education session was a useful reminder about the importance of oral care. Specific answers included, *Reminders about oral health are always welcome, reminders about brushing and rinsing, the importance of cleaning, and the checklist to remind me every day*. 33.3% of participants did not answer this question.

**Contextual Elements that Interacted with the Intervention**

This author is grateful for the support of the microsystem leadership (unit manager and CNL); the resources they provided to the project leader and their timely feedback on project ideas and materials were instrumental to the success of this project. The project leader required microsystem specific data and resources to complete this QI work and there were at times competing priorities such as COVID-19 and staffing shortages. Despite these challenges, the unit manager and CNL prioritized communicating with and assisting the project leader with the development of this project. As previously discussed, the mission statements of the macro, meso, and microsystems reflect a commitment to quality improvement as all levels of care strive to provide high-quality care and improve patient outcomes and experiences. The unit manager and CNL’s behavior reflects this and their commitment to QI is admirable.

**Observed Associations Between Outcomes, Interventions, and Relevant Elements**

All post-intervention survey responses were higher than the pre-intervention survey responses. However, only the statement *I brush my teeth at least twice daily while in the hospital* had a statistically significant improvement for oral care completion (*p = 0.043*) and the statement *I understand what oral mucositis is* had a statistically significant improvement for oral care knowledge (*p = 0.025*). Additionally, all participants completed both the pre and post-
intervention surveys, however 33.3% of participants declined to answer the question, *What did you find most helpful about this education session?* on the post-intervention survey.

**Unintended Consequences**

The project leader was the only individual carrying out this intervention, however staff nurses on the floor expressed interest in using the educational pamphlets for their future chemotherapy patients. One staff nurse stated that *The pamphlets are a great reminder for patients*, another stated, *I’d love to put the pamphlets in with our other patient resources for future use*. These statements reflect an intention to continue using the pamphlets and to have oral care patient education become a standard of care for chemotherapy patients.

The project leader estimated spending $20 per 10 surveys/educational pamphlets, however actually spent $34.50 on required resources for this project. The project leader utilized the public library for printing where the pamphlets cost $1 per colored page (total of $10) and $0.15 per black/white page for the informed consent/surveys (total of $4.50). The project leader had the pamphlets laminated at Staples for $1.99 per page (total of $19.90). While the cost of $34.50 is nominal when compared with the $70,000 that OM complications and care can accrue, it is important for nurse leaders to have a strong understanding of the costs of their work.

**Details about Missing Data**

The project leader initially planned to include 10 participants in the QI project so the number of participants, N=6, was smaller than anticipated. On June 22, 2022, eight chemotherapy patients were admitted to the microsystem and eligible for participation, however one patient declined to participate and one patient was off the unit for the day resulting in six patients participating in the intervention. Furthermore, 33.3% of participants declined to answer
the question, *What did you find most helpful about this education session?*, where patients were encouraged to free type their answers.

**Discussion**

**Summary**

**Key Findings**

The global aim of this project was to reduce incidence of chemotherapy-induced OM among chemotherapy patients. The specific aims of this project were to improve both oral care completion and knowledge by 20% by July 1, 2022. Oral care completion was measured by the survey statements *I brush my teeth at least twice daily while in the hospital* and *I use an oral rinse after each meal and before bed while in the hospital*. Oral care knowledge was measured by the survey statements *I understand what OM is* and *I understand how oral care can impact my health*. The specific aims were only partially achieved. For example, oral care completion improved by 28% for toothbrushing but only by 12% for oral rinsing. Additionally, oral care knowledge improved by 28% for OM understanding but only by 12% for understanding the impact of oral care on one’s health. While these improvements did not fully achieve the specific aims, the improvement seen across all survey statements demonstrated the importance and effectiveness of the intervention.

**Strengths of the Project**

One strength of this QI project was the high participation rate of chemotherapy patients. 75% of eight eligible patients participated, one patient declined and one patient was off the unit for a procedure. Despite the small number of participants, the high participation improves the generalizability of the findings. Another strength, as previously discussed in the results section, was the support of the unit manager and CNL. Their willingness to provide support allowed the
project leader to carry out the QI project with minimal disruptions and will contribute to the longevity of the intervention after the project has concluded.

**Interpretation**

**Association Between Intervention and Outcome**

When interpreting the outcomes of the oral care educational intervention, the quantitative and qualitative data support the association between the intervention and improved oral care completion and knowledge. There was a 28% increase in toothbrushing ($p = 0.043$), a 12% increase in oral rinsing ($p = 0.102$), a 28% increase in understanding of OM ($p = 0.025$), and a 12% increase in the understanding of the impact of oral care on one’s health ($p = 0.235$). The statistically significant improvements seen in the toothbrushing ($p = 0.043$) and understanding of OM ($p = 0.025$) highlight the impact the intervention had on improving oral care habits of chemotherapy patients within the microsystem. While oral rinsing ($p = 0.102$) and understanding of the impact of oral care on one’s health ($p = 0.235$) were not statistically significant, the 12% increase in post-intervention scores still represents improved oral care habits. Collectively, these improvements reflect the effectiveness of the intervention and address the specific aims of improving oral care completion and knowledge.

**Comparison of Results**

The literature supports these findings, with the most recent MASOO/ISOO Clinical Practice Guidelines stating that oral care patient education improves self-management and adherence to oral care protocols (Hong et al., 2019). Similarly, the work of Rapone et al. (2016) suggests that patient education is central to changing oral care habits. They found that patient education improves patient motivation to complete oral care, and in turn reduces incidence and severity of OM (Rapone et al., 2016). Research shows that use of both verbal and written
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information increases patient knowledge and satisfaction (Johnson et al., 2003). This intervention coupled a written educational pamphlet with verbal education to optimize patient comprehension, resulting in post-intervention improvements across all survey statements.

**Influence of Context**

While the intervention was associated with improved oral care and knowledge, the specific aims were not fully met. Participants’ lack of access to oral rinse supplies may have contributed to the less than 20% improvement in oral completion. Additionally, high pre-intervention scores for the statement *I understand how oral care can impact my health* contributed to the less than 20% improvement in post-intervention scores. With a pre-intervention mean score of 4.2 ($SD = 1.6$, range 1-5), an optimal mean post-intervention score of 5 would still be less than the anticipated 20% increase.

**Project Impact**

Despite the variance from anticipated outcomes, the overall response to the project from patients and staff was positive. Participants expressed that the intervention was informative and was a great reminder to complete regular oral care in the hospital. Staff expressed interest in the intervention and verbalized wanting to sustain the intervention after the conclusion of the project. Overall, this project improved patients oral care completion and knowledge which can result in positive patient experiences and outcomes.

**Cost Benefit Analysis**

The total cost of this QI project was $34.50. The project leader covered the expenses for this project, however the hospital would incur these costs going forward. OM complications and care can contribute to costs upward of $70,000 in chemotherapy and BMT patients so this intervention proved to be cost efficient (Elting & Chang, 2019).
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Limitations

One limitation to this project was the comparability at baseline of the participants’ ages and cancer diagnoses. All participating patients were between 54 and 74 years old and had a hematological malignancy (multiple myeloma, leukemia, and lymphoma), this limits the generalizability of the findings to patients in this age range and with a hematological oncological diagnosis. The results cannot be inferred to patients of different ages and with non-hematological cancer diagnoses. Additionally, the small number of participants, N=6, limits the generalizability as the results can only be applied to this small, specific population.

Internal validity of the project was further limited by imprecision in the project design where the post-intervention follow up was only conducted 24-30 hours after the initial intervention. The proximity of the intervention and post-intervention data collection hinders conclusions that can be drawn about true behavior change.

In order to limit convenience bias, all patients eligible for this project, those with an oncology diagnosis, undergoing chemotherapy, were asked to participate. One patient was off the unit and one patient declined, however attempting to include all eligible participants allows the results to be generalizable to the oncology/chemotherapy patient population within the microsystem at this time.

Conclusions

While this project was specific to the oncology/chemotherapy patient population, an oral care education intervention can be applied to other contexts. Oral health and overall health are closely connected and research shows that oral health can be linked to numerous conditions including endocarditis, cardiovascular disease, and pneumonia, highlighting a need for oral care interventions across all critical care and medical-surgical units in acute care settings (Mayo
Foundation, 2022). The positive impact that oral care can have on the health outcomes of chemotherapy patients as well as other vulnerable patient populations highlights the usefulness and the importance of the intervention.

The sustainability of the project was limited by the project leader being the only one to carry out the intervention. Key stakeholders were involved in the planning and approval of the project, however staff participation in the implementation of the project likely would contribute to greater longevity of the intervention within the microsystem. The ultimate goal of a QI project is to create true behavior change and staff buy-in is central to creating a new, evidence-based status quo.

In this project, the post-intervention survey was conducted 24 to 30 hours after the initial intervention. Future projects may want to consider weekly follow ups with the participants which may result in a more thorough understanding of the oral care completion habits and knowledge of the chemotherapy patients and would better evaluate the efficacy of the intervention. Additionally, the microsystem may want to update their oral care policy to reflect all chemotherapy patients on the unit, rather than just BMT patients. In conclusion, this QI project highlighted numerous CNL roles and competencies including the role of the CNL as an educator, client advocate, and lifelong learner. Quality improvement and the role of the CNL as a nurse leader and innovator is central to improving health outcomes and providing person-centered and evidence-based care to patients.
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