

# Assessment of Oral Mucositis in Adult and Pediatric Oncology Patients: An Evidence-Based Approach

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## Abstract

Oral mucositis is a frequent side effect of cancer treatment and can lead to delayed treatment, reduced treatment dosage, altered nutrition, dehydration, infections, xerostomia, pain, and higher healthcare costs. Mucositis is defined as “inflammatory lesions of the oral and/or gastrointestinal tract caused by high-dose cancer therapies. Alimentary tract mucositis refers to the expression of mucosal injury across the continuum of oral and gastrointestinal mucosa, from the mouth to the anus” (Peterson, Bensadoun, & Roila, 2008, p. ii122). Evidence demonstrates that oral mucositis is quite distressing for patients. In addition, the majority of oncology nurses are unaware of available guidelines related to the care of oral mucositis.

A multidisciplinary Oral Mucositis Committee was formed by the University of Iowa Hospitals and Clinics to develop evidence-based prevention and treatment strategies for adult and pediatric oncology patients experiencing oral mucositis. The first step was implementing an evidence-based nursing oral assessment. The Iowa Model was used to guide this evidence-based practice initiative. The Oral Assessment Guide (OAG) is reliable and valid, feasible, and sensitive to changing conditions. The OAG was piloted on an Adult Leukemia and Bone Marrow Transplant Unit leading to modification and adaptation. The pilot evaluation found 87% of patients had an abnormal oral assessment involving all categories in the tool. Nursing questionnaires showed that staff (8/23; 35% response) felt they were able to identify at risk patients using the OAG (3.3; 1-4 scale), and the tool accurately identifies mucosal changes (2.9; 1-4 scale). A knowledge assessment found nurses correctly identified OAG components 63% of the time. Unlike results from a national survey, most University of Iowa Hospitals and Clinics nurses (63%) were aware of national guidelines for prevention and treatment of oral mucositis.

Developing an evidence-based nursing policy and updating documentation systems was done before implementation occurred. Computer-based and printed educational materials were developed for nursing staff caring for oncology patients. Team members were responsible for facilitating adoption in clinical areas. After organizational roll out, the nursing assessment was documented in all patients 87% of the time, and 99% for inpatients. The highest risk population, head and neck cancer patients receiving radiation, had documentation in 88% of audited visits. Other clinics required further work. Changing the system to the electronic medical record created an additional need for integration of the evidence-based practice with house-wide documentation of oral assessment being completed 60.9% of the time.

Use of an evidence-based assessment is the first step in a comprehensive program to reduce a common and highly distressing side effect of cancer treatment. Nursing documentation of oral assessment is well integrated on inpatient units. Opportunities for improvement remain in ambulatory care. Multidisciplinary team collaborations to expand evidence-based assessment and research questions generated from this work will be shared.

Provision of evidence-based healthcare continues to be less than desired for both pediatric and adult patients (Mangione-Smith, DeCristofaro, Setodji, Keeseey, Klein, Adams, Schuster, & McGlynn, 2007; McGlynn, Asch, Adams, Keeseey, Hicks, DeCristofaro, & Kerr, 2003). Similar to findings in other clinical areas, delivery of evidence-based cancer care is challenging although there have been some improvements (Boxer, Forstner, Kneebone, Delaney,

Koh, Fuller, & Kaadan, 2009; Cunningham, 2006; Kedikoglou, Syrigos, Skalkidis, Ploiarchopoulou, Dessypris, & Petridou, 2005). Oral mucositis is one of the most frequent side effects of cancer treatment and evidence-based guidelines for assessment and management need to be adapted and adopted into practice. Oral mucositis can be a serious and long lasting side effect of cancer treatment. Nurses have a critical role in addressing oral mucositis for all

oncology patients and are in an ideal position to lead multidisciplinary teamwork to improve care for patients. The Iowa Model of Evidence-Based Practice to Promote Quality Care (Titler, Kleiber, Steelman, Rakel, Budreau, Buckwalter, Tripp-Reimer, & Goode, 2001) provided a framework for the evidence-based practice work of a multidisciplinary Oral Mucositis Committee at the University of Iowa Hospitals and Clinics (UIHC), a large academic medical center (see Figure 1).

## Synthesis of the Evidence

Oral mucositis is one of the most frequent side effects of cancer treatment (Avritscher, Cooksley, & Elting, 2004; Brown & Wingard, 2004; Dodd, 2004; Epstein & Schubert, 2004; Fulton, Middleton, & McPail, 2002; Jones, Avritscher, Cooksley, Michelet, Bekele, & Elting, 2006). Over 132,000 cases of oral mucositis occur each year in the United States (2003 data) (Epstein & Schubert, 2004), with 40% of oncology patients having oral mucositis (Brown & Wingard, 2004; Cawley & Benson, 2005; Dodd, 2004; Fulton, Middleton, & McPail, 2002; Lalla, Sonis, & Peterson, 2008) resulting from both chemotherapy and radiation therapy (Avritscher, Cooksley, & Elting, 2004; Brown & Wingard, 2004). Severe oral mucositis occurs frequently in certain cancer treatment groups, but treatment of head and neck cancer creates one of the highest risks for this complication (Avritscher, Cooksley, & Elting, 2004; Brown & Wingard, 2004), with upwards of a 99% incidence for this side effect (Elting, Keefe, Sonis, Garden, Spijkervet, Barasch, Tishler, Canty, Kudrimoti, & Vera-Llonch, 2008b; Nonzee, Dandade, Markossian, Agulnik, Argiris, Patel, Kern, Munshi, Calhoun, & Bennett, 2008). Unfortunately, 67% of oncology nurses are not aware of available national guidelines (McGuire & Johnson, 2005) aimed at prevention and treatment of oral mucositis.

The need for this project was supported by available evidence reporting that patients describe oral mucositis as the most distressing side effect of their cancer treatment (Jaroneski, 2006; Quinn, Stone, Uhlenhopp, McCann, & Blijlevens, 2007). Oral mucositis is problematic and may result in any or all of the following issues: delayed treatments, reduced treatment dosages, altered nutrition, dehydration, infections, xerostomia, pain, decreased quality of life, and increased healthcare costs (Brown & Wingard, 2004; Cella, Pulliam, Fuchs, Miller, Hurd, Wingard, Sonis, Martin, & Giles, 2003; Elting et al., 2008b; Silverman, 2007; Sonis, Oster, Fuchs, Bellm, Bradford, Edelsberg, Hayden, Eilers, Epstein, LeVeque, Miller, Peterson, Schubert, Spijkervet, & Horowitz, 2001). Pain has been identified as particularly problematic for patients (Tomlinson, Gibson, Treister, Baggott, Judd, Hendershot, Maloney, Doyle, Feldman, & Sung, 2009). Pain

associated with oral mucositis peaks 11-16 days following cytotoxic treatment (Cella et al., 2003; McCann, Schwenkglenks, Bacon, Einsele, D'Addio, Maertens, Niederwieser, Rabitsch, Roosaar, Ruutu, Schouten, Stone, Vorkurka, Quinn, & Blijlevens, 2009). The need for oral assessment continues following administration of chemotherapy because the myelosuppression effect lasts 10-12 days after the therapy is complete (Andersson, Persson, Hallberg, & Renvert, 1999; Harris, Eilers, Cashavelly, Maxwell, & Harriman, 2007; Jaroneski, 2006). Oral mucositis results in oral inflammation causing an increase in oral temperature but not systemic temperature. This elevated oral temperature may lead to a 20-40% over use of antibiotics and increased healthcare costs (Ciuraru, Braunstein, Sulkes, & Stemmer, 2008). Oral mucositis also increases hospital length of stay by 2.3-14 days and costs \$1,700-\$43,000/patient (and may even be >\$200,000/patient) depending on the severity (Elting, Avritscher, Cooksley, Cardenas-Turanzas, Garden, & Chambers, 2008a; Elting, Cooksley, Chambers, & Garden, 2007; Jones, Qazilbash, Shih, Cantor, Cooksley, & Elting, 2008; McCann et al., 2009; Nonzee et al., 2008; Sonis et al., 2001; Vera-Llonch, Oster, Ford, Lu, & Sonis, 2007).

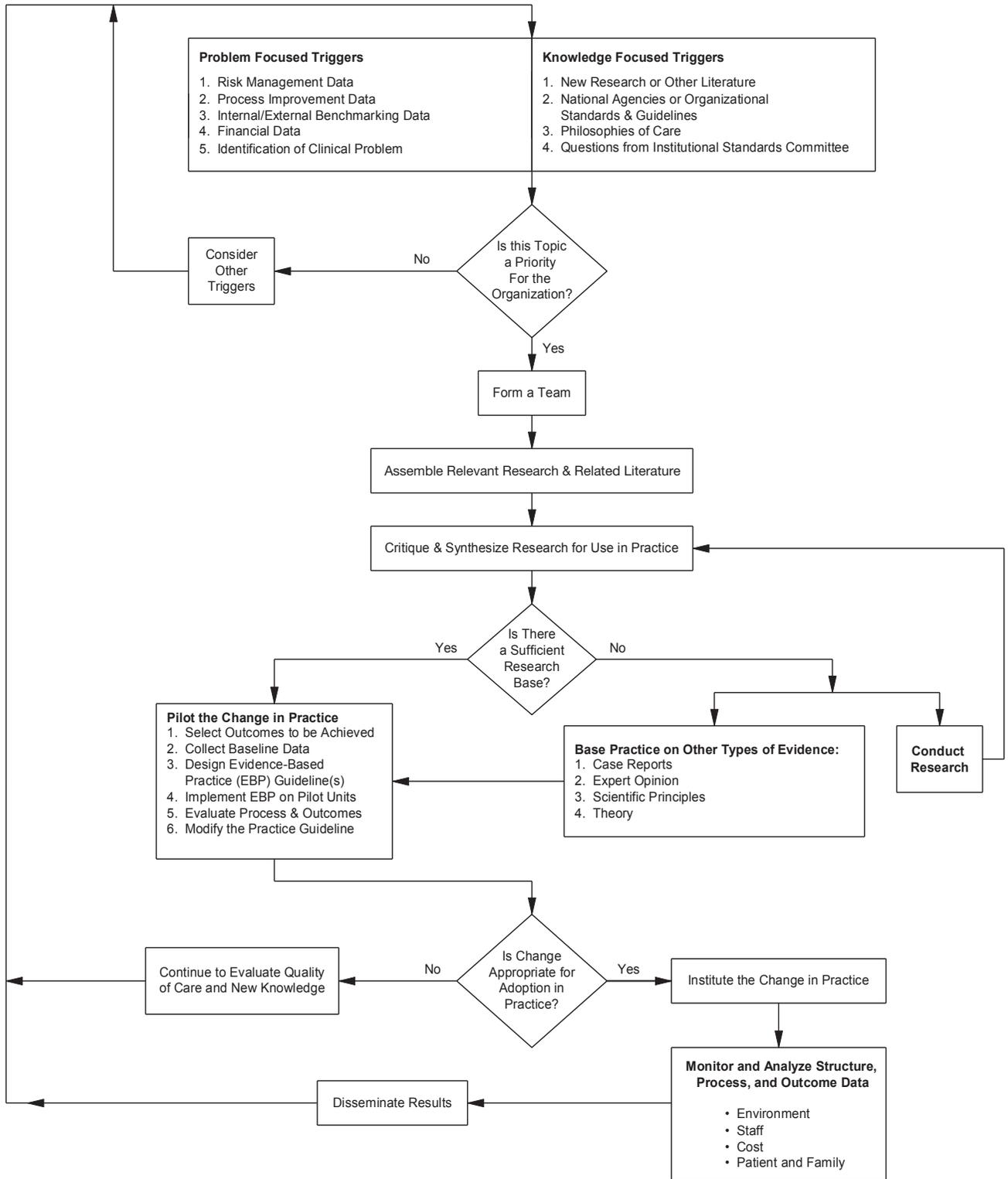
## Purpose and Process

The purpose of this project was to implement a standardized, evidence-based oral assessment scale to address oral mucositis for both ambulatory and inpatient adult and pediatric oncology patients. The Iowa Model of Evidence-Based Practice to Promote Quality Care successfully promotes the integration of evidence into practice. The model (see Figure 1) outlines the process for developing an evidence-based practice project. Identifying a practice problem or new knowledge triggers the evidence-based practice process. Leaders in the health care facility or on the nursing unit prioritize issues to be addressed and assemble a team. The team selects, reviews, critiques, and synthesizes evidence in the literature. If the research evidence is sufficient, the team initiates change. If the evidence is insufficient, the team reviews other evidence or suggests more research.

The team pilots and evaluates the practice change to determine if the change worked or whether revisions are needed before integrating and applying the change in other clinical areas. Additional evaluation and dissemination of results is essential to fully integrate the change into practice. Following roll-out and dissemination of results, the process leads to a feedback loop creating the next phase of the project.

This project began after the research committee received three separate requests in June 2005 (See Figure 2 for Project Timeline) for project support related to oral health. A staff nurse on the adult

**Figure 1:**  
**The Iowa Model of Evidence-Based Practice to Promote Quality Care**



◊ = a decision point

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**Reference**

Titler, M.G., Kleiber, C., Steelman, V.J., Rakel, B.A., Budreau, G., Everett, L.Q., Buckwalter, K.C., Tripp-Reimer, T., & Goode C. (2001). The Iowa Model of Evidence-Based Practice to Promote Quality Care. *Critical Care Nursing Clinics of North America*, 13(4), 497-509.

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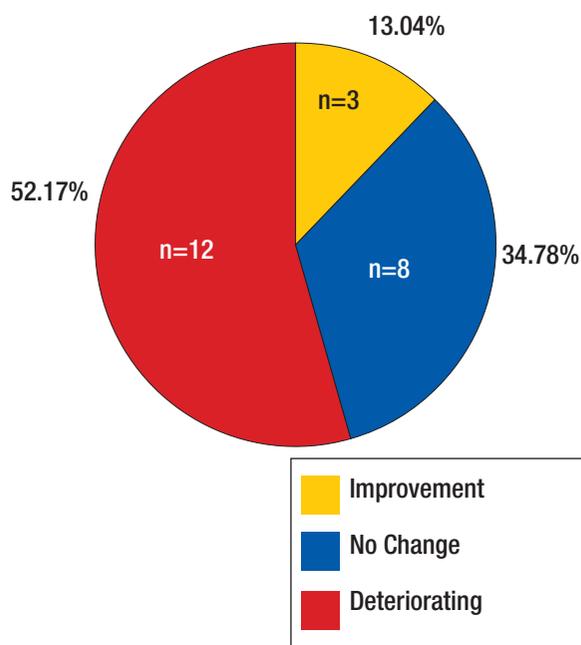
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(Redrawn from Titler M et al: The Iowa Model of Evidence-Based Practice to Promote Quality Care. *Critical Care Nursing Clinics of North America*, 13(4):497-509, 2001.)

**Figure 2: Project Timeline**

June 2005	Multidisciplinary team formed to review the evidence
March 2006	Oral Assessment Guide (OAG) chosen
August/September 2006	OAG Pilot on Adult Leukemia and BMT (ALBMT) unit
May 2007	Nursing Knowledge Assessment on ALBMT unit
September 2007	Oral Mucositis Assessment Policy approved
October 2007	Hospital-wide roll-out and site visit by June Eilers (OAG creator)
July/August 2008	Chart audit of nursing documentation of oral mucositis assessment
May 2009	Hospital-wide change in documentation system
July/August 2009	Chart audit of nursing documentation of oral mucositis assessment with new documentation system

**Figure 3: Changes in Oral Health – Pilot Data N=23 patients**



leukemia and bone marrow transplant (ALBMT) unit identified a problem with assessment of oral mucositis; a nurse manager and staff nurse on an inpatient adult oncology unit identified a problem with oral care for head and neck cancer patients; and the third request for which no specifics are available. These three clinically important requests were combined into one project and submitted to the Clinical Administrative Council (a council of nurse leaders in the organization) for approval.

### Oral Mucositis Assessment

After reviewing the evidence and comparing tools, an evidence-based oral mucositis assessment tool was chosen for clinical use for adult, pediatric, inpatient, and ambulatory care areas. Use of a standardized and evidence-based oral mucositis assessment tool is the first step in a comprehensive program with prevention and treatment (Jaroneski, 2006; Peterson, Keefe, Hutchins, & Schubert, 2006). Parameters for assessing oral mucositis include: subjective, objective, and functional (Jaroneski, 2006; Potting, Blijlevens, Donnelly, Feuth, & Van Achterberg, 2008; Tomlinson et al., 2009). The team reviewed four tools: World Health Organization (WHO) Tool (Putwatana, Sanmanowong, Oonprasertpong, Junda, Pitiporn, & Narkwong, 2009; Quinn, Stone, Uhlenhopp, McCann, & Blijlevens, 2007; Stokman, Spijkervet, Boezen, Schouten, Roodenburg, & de Vries, 2006), Beck's Oral Assessment Scale (Beck, Agutter, Dudley, Peterson, & McGuire, 2007), Oral Assessment Guide (OAG) (Eilers, 2004; Eilers, Berger, & Petersen, 1988; Luke, 2006), and National Cancer Institute (NCI) (Cella et al., 2003; Luke, 2006; National Cancer Institute, 2003) for use in practice. Evaluation criteria used for selecting the oral

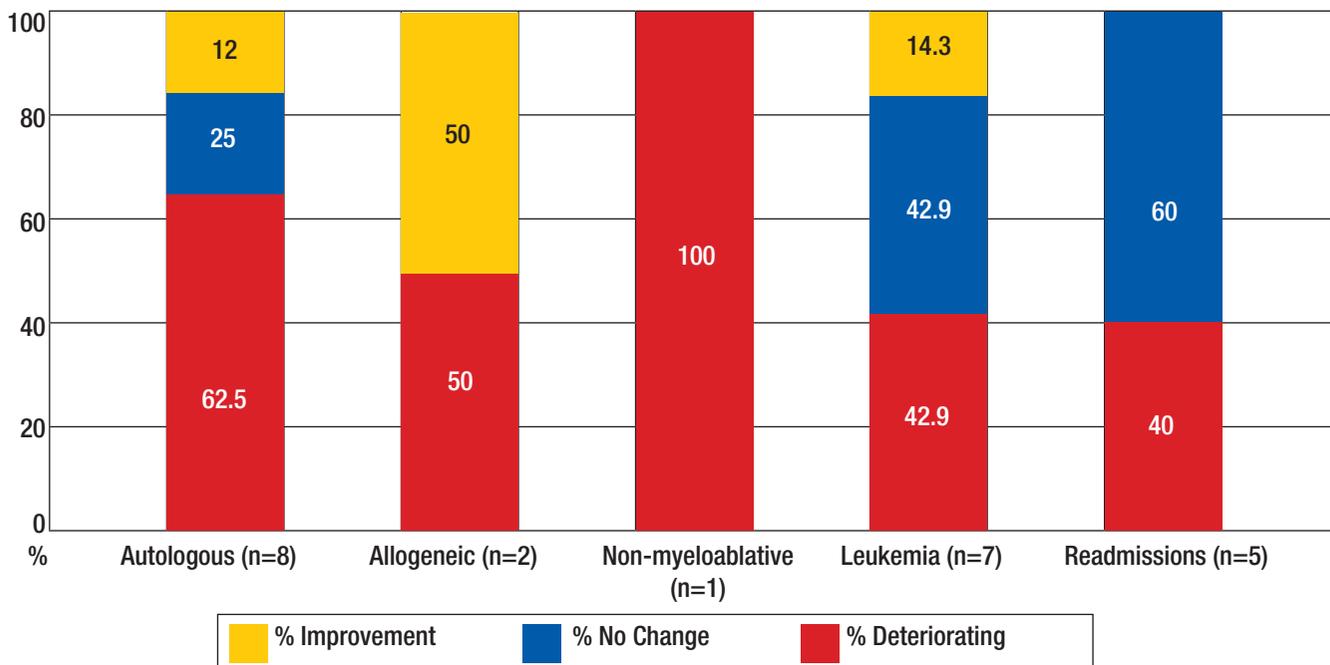
mucositis assessment tool included: repeatability of reassessment; ease of scoring; sensitivity to changes; evidence-based; feasibility; reliability and validity; and, includes objective and subjective manifestations. Eilers' Oral Assessment Guide (OAG) is reliable and valid, widely used in clinical practice, feasible, sensitive to changes, and was chosen for clinical use as the evidence-based oral mucositis assessment tool. Components of the OAG include: voice, swallow, lips, tongue, saliva, mucous membrane, gingiva, and teeth or dentures (Eilers, 2004; Eilers, Berger, & Petersen, 1988).

### Piloting the Practice Change

A pilot was completed on the ALBMT unit in August and September 2006. In December 2006, a retrospective chart audit was done for certain oncology patient populations on the ALBMT unit looking at charting parameters using the previous (Oral Mucosa) documentation order. Pilot data identified that 87% of patients had abnormal oral mucositis assessments, including all components or variables in the oral mucositis assessment tool. In addition, 62% of patients in the pilot had changes in oral mucositis assessment during the pilot (improving or deteriorating oral mucositis) (see Figures 3 and 4).

In May 2007, staff nurses working on the ALBMT unit were asked to complete an "Oral Health Knowledge Assessment" to assess knowledge regarding oral health for the patients in their care. Eight of 23 nurses returned the questionnaire (response rate 34.8%). From the knowledge assessment, nurses on the ALBMT unit reported feeling knowledgeable about use of the assessment

**Figure 4:**  
**Changes in Oral Health by Diagnosis – Pilot Data N=23 patients**



tool (3.3; 1-4 scale); being able to identify at risk patients using the assessment tool (3.3; 1-4 scale); the assessment tool accurately identifies patient changes (2.9; 1-4 scale); and the assessment enhanced quality care (2.8; 1-4 scale). Nurses were able to correctly identify components of the oral mucositis assessment tool 63% of the time with the majority identifying the consequences of oral mucositis (e.g., increased risk of infection, interrupted treatment, etc.) correctly 43-100% depending on the consequence. One-quarter or 25% of the nurses correctly reported that patients identify oral mucositis as the most distressing side effect of treatment (63% of nurses identified oral mucositis as the most painful side effect). All the nurses correctly identified that assessment of oral mucositis needs to include an assessment of pain (100%) which is documented separately within the computer documentation system. Unlike results from a national survey, most UIHC nurses (63%) were aware of national guidelines for prevention and treatment of oral mucositis (McGuire & Johnson, 2005).

Pilot data suggests that poor documentation can lead to missed opportunities for UIHC billing for care related to this diagnosis. Only eight inpatient and ambulatory patients were identified as being diagnosed with oral mucositis within the hospital billing system (ICD-9 code 528.01-oral mucositis) at UIHC from October 2006 through July 2007.

### Policy Development

Prior to piloting the use of the OAG on the ALBMT unit, a policy was drafted regarding use of the oral

mucositis assessment tool which specified applicable patient populations and frequency of assessment. The policy included references regarding use of the OAG. After the “pilot” policy was written, the policy was presented to the Professional Nursing Practice committee (the nursing policy and procedure committee) for approval before the pilot commenced on the ALBMT unit. A paper form for documentation of the oral mucositis assessment was created for use during the pilot.

After the pilot was completed, it was determined that the scoring system of the oral mucositis assessment tool needed to be changed before hospital wide roll-out of the assessment. Based on other assessment tools already in use within our organization, a score of “8” would not typically indicate a normal assessment as suggested by the original OAG tool. The Oral Mucositis Committee decided that a scoring system that ranged from 0-2 was more meaningful, for each of the 8 components of the OAG, which would mean a score of “0” indicated a normal oral mucositis assessment. However, during this time, the hospital purchased a new electronic documentation system, and the nursing informatics specialist on the Oral Mucositis Committee informed the group that the scoring system could only be used in one of the three current documentation systems. Different documentation systems existed for inpatient units, ambulatory care areas, and the intensive care units. With three diverse documentation systems, there were constraints as to number of characters for the documentation responses. The Oral Mucositis Committee felt that electronic documentation would

be more reliable, even with the constraints identified, than a paper documentation form until the entire hospital changed to one documentation system; the timeframe was unknown at that point.

After determining the documentation piece, the policy was revised and included information about how the “oral mucositis assessment” for oncology patients would be documented depending if the patient was on an inpatient unit, in an ambulatory care area, or on an intensive care unit. Once the revisions were complete, the policy returned to the Professional Nursing Practice committee for approval before hospital wide roll-out was planned.

### **Implementation**

An educational PowerPoint™ presentation regarding the oral mucositis assessment policy, including documentation implications, for oncology patients was created by the Oral Mucositis Committee and presented to the Staff Education Committee for approval. The presentation was posted on the hospital computer education system and live in-services were completed on the applicable units. The applicable units were given creative prompts (wind-up teeth) to help remind and engage staff regarding the change in practice.

### **Evaluation Results-Hospital Wide**

A nursing documentation chart audit for the oral mucositis assessment was completed in July 2008. Results from the chart audit were entered into Survey Tracker, a software program, for analysis and reporting of results. Data analysis was completed using descriptive statistics.

Chart audits were completed for adult and pediatric inpatients on admission, day 1, and day 4. For pediatric bone marrow transplant (PBMT) and ALBMT patients, chart audits included admission, days 1, 4, 7, 10, and 16. Inpatient areas with completed audits demonstrated 100% documentation of oral mucositis assessment for pediatric and adult oncology patients at the selected intervals, if applicable (e.g., the patient had not already been discharged). Both the PBMT and ALBMT patient’s assessments demonstrated the worst oral mucositis on day 10.

Ambulatory care patients had oral mucositis assessment documentation audited for 1-3 clinic visits. Head and neck radiation patients have the highest known risk of oral mucositis among oncology patients (Avritscher, Cooksley, & Elting, 2004; Brown & Wingard, 2004) and nursing assessment of oral mucositis was documented 88% of the audited clinic visits for this patient population. The Pediatric Specialty Clinic had few patients complaining of oral mucositis symptoms, one patient with very mild symptoms had no nursing documentation using the oral mucositis assessment tool. The Holden Clinical

Cancer Center and Otolaryngology-Head and Neck Surgery Clinic have an opportunity for improving nursing assessment of oral mucositis.

The organization changed electronic medical record (EMR) systems in May 2009. The nursing documentation process and nursing orders, including charting elements, were significantly revised. An evaluation of the documentation of oral mucositis assessment was completed two to three months, depending on the area, after implementation of the new EMR. The time frame for auditing nursing documentation was based on allowing nurses time to learn the new documentation system and to maintain nursing quality for assessment of this important side effect of cancer treatment. For this round of chart audits, data for adult and pediatric inpatients were still collected on admission, day 1, and day 4 and data were collected on 1-3 clinic visits for the ambulatory care areas. However, for PBMT and ALBMT patients, chart audits only included admission, day 1, and day 4. Inpatient areas with completed audits demonstrated a documentation rate of 62% for pediatric and adult oncology patients. Documentation in the ambulatory care areas after implementation of the new EMR was 58% but only 45 audits were collected, the majority of which continued to come from radiation oncology. Additional education is planned to remind both inpatient and ambulatory staff to add the oral mucositis assessment tool to the appropriate documentation flow sheet and future chart audits will be done to monitor compliance. The new documentation system did allow the Oral Mucositis Committee to go back to the original OAG tool and request that the charting parameters for each category be built accordingly by the informatics team within our organization to more accurately reflect the evidence-base behind the tool.

### **Nursing Research Questions**

The evidence-based practice process has multiple feedback loops. Synthesis of the evidence to determine practice recommendations often leads to identifying gaps in knowledge and the use of evidence in practice often leads to identifying important clinical needs not sufficiently addressed through research. Through the work of the Oral Mucositis Committee, a number of research needs related to oral mucositis assessment were identified to improve care for oncology patients. Research is needed to determine the role of a variety of dental experts in initial and on-going oral assessment to determine patients at greatest risk for developing oral mucositis and the impact of coordinated assessments in care planning for prevention and treatment of oral mucositis. Additional research questions result from a comparison and use of oral mucositis assessment tools. Multiple tools have been developed for different purposes, a comparison of

tools for nursing assessment, interventions, and trending of results in a variety of clinical settings and patient populations would facilitate selection for healthcare organizations. Research is needed to determine how nursing assessment tools can facilitate use of scoring to determine severity groupings and appropriate treatment options based on severity. Additionally, appropriate treatments to address specific categories of an assessment tool (e.g., mucous membrane, gingiva, etc.) would be helpful in guiding practice. As nurses work to reduce the research-practice gap, feedback from practice to research is needed and continues to be an important feedback loop in the evidence-based practice process.

## Conclusion

Use of an evidence-based oral mucositis assessment tool is the first step in a comprehensive program to reduce the impact of this highly distressing side effect of cancer treatment. Many patients suffer from oral mucositis, which may affect cancer therapy, risk for infection, pain, and other side effects. Nursing documentation of oral mucositis assessment is well integrated into nursing practice on the ALBMT and PBMT units. However, opportunities for improvement remain for the inpatient units and ambulatory care areas especially after introduction of the new EMR.

The current hospital billing system is not capturing the volume of patients currently experiencing oral mucositis at our organization. Prevention of oral mucositis with good oral hygiene is an important next step for this project team to address.

## Next Steps

Next steps include integration through quality improvement monitoring of the evidence-based oral mucositis assessment in areas with continued opportunity for improvement. Quality improvement activities include quarterly chart audits and distribution and evaluation of a nursing questionnaire that addresses assessment facilitation and knowledge of oral mucositis assessment.

Collaboration with an even larger multidisciplinary team has expanded for development of evidence-based guidelines for prevention and treatment of oral mucositis, specifically with regards to oral hygiene. Practice recommendations will be developed for inpatient and ambulatory adult and pediatric oncology patients. Once interventions are developed for prevention and treatment of oral mucositis, additional implementation and evaluation will be completed in the intensive care units.

## References

Andersson, P., Persson, L., Hallberg, I. R., & Renvert, S. (1999). Testing an oral assessment guide during che-

motherapy treatment in a Swedish care setting: A pilot study. *Journal of Clinical Nursing*, 8(2), 150-158.

Avritscher, E. B. C., Cooksley, C. D., & Elting, L. S. (2004). Scope and epidemiology of cancer therapy-induced oral and gastrointestinal mucositis. *Seminars in Oncology Nursing*, 20(1), 3-10.

Beck, S., Agutter, J., Dudley, W., Peterson, D., & McGuire, D. (2007). Developing an information visualization tool for oral mucositis. *Oncology Nursing Forum*, 34(2), 522.

Boxer, M., Forstner, D., Kneebone, A., Delaney, G., Koh, E. S., Fuller, M., et al. (2009). Impact of a real-time peer review audit on patient management in a radiation oncology department. *Journal of Medical Imaging and Radiation Oncology*, 53(4), 405-411.

Brown, C. G., & Wingard, J. (2004). Clinical consequences of oral mucositis. *Seminars in Oncology Nursing*, 20(1), 16-21.

Cawley, M., & Benson, L. (2005). Current trends in managing oral mucositis. *Clinical Journal of Oncology Nursing*, 9(5), 584-592.

Cella, D., Pulliam, J., Fuchs, H., Miller, C., Hurd, D., Wingard, J., et al. (2003). Evaluation of pain associated with oral mucositis during the acute period after administration of high-dose chemotherapy. *Cancer*, 98, 406-412.

Ciuraru, N., Braunstein, R., Sulkes, A., & Stemmer, S. (2008). The influence of mucositis on oral thermometry: When fever may not reflect infection. *Clinical Infectious Diseases*, 46, 1859-1863.

Cunningham, R. S. (2006). Clinical practice guideline use by oncology advanced practice nurses. *Applied Nursing Research*, 19(3), 126-133.

Dodd, M. J. (2004). The pathogenesis and characterization of oral mucositis associated with cancer therapy. *Oncology Nursing Forum*, 31(4 Suppl), 4-11.

Eilers, J. (2004). Nursing interventions and supportive care for the prevention and treatment of oral mucositis associated with cancer treatment. *Oncology Nursing Forum*, 31(4 Suppl), 13-23.

Eilers, J., Berger, A. N., & Petersen, M. C. (1988). Development, testing, and application of the oral assessment guide. *Oncology Nursing Forum*, 15(3), 325-330.

Elting, L., Avritscher, E. B. C., Cooksley, C., Cardenas-Turanzas, M., Garden, A., & Chambers, M. (2008a). Psychosocial and economic impact of cancer. *Dental Clinics of North America*, 52(1), 231-252.

Elting, L., Keefe, D., Sonis, S., Garden, A., Spijkervet, F., Barasch, A., et al. (2008b). Patient-reported measurements of oral mucositis in head and neck cancer patients treated with radiotherapy with or without chemotherapy. *Cancer*, 113, 2704-2713.

Elting, L. S., Cooksley, C. D., Chambers, M. S., & Garden, A. S. (2007). Risk, outcomes, and costs of radiation-induced oral mucositis among patients with head-and-neck malignancies. *International Journal of Radiation Oncology, Biology and Physics*, 68(4), 1110-1120.

Epstein, J. B., & Schubert, M. M. (2004). Managing pain in mucositis. *Seminars in Oncology Nursing*, 20(1), 30-37.

- Fulton, J., Middleton, G., & McPail, J. (2002). Management of oral complications. *Seminars in Oncology Nursing*, 18(1), 28-35.
- Harris, D. J., Eilers, J. G., Cashavelly, B. J., Maxwell, C. L., & Harriman, A. (2007). Mucositis Oncology Nursing Society: PEP cards. Retrieved February 29, 2008, from <http://www.ons.org/outcomes/volume2/mucositis.shtml>
- Jaroneski, L. A. (2006). The importance of assessment rating scales for chemotherapy-induced oral mucositis. *Oncology Nursing Forum*, 33(6), 1085-1093.
- Jones, J. A., Avritscher, E. B. C., Cooksley, C. D., Michelet, M., Bekele, B. N., & Elting, L. S. (2006). Epidemiology of treatment-associated mucosal injury after treatment with newer regimens for lymphoma, breast, lung, or colorectal cancer. *Supportive Care in Cancer*, 14, 505-515.
- Jones, J. A., Qazilbash, M. H., Shih, Y. C., Cantor, S. B., Cooksley, C. D., & Elting, L. S. (2008). In-hospital complications of autologous hematopoietic stem cell transplantation for lymphoid malignancies: Clinical and economic outcomes from the Nationwide Inpatient Sample. *Cancer*, 112(5), 1096-1105.
- Kedikoglou, S., Syrigos, K., Skalkidis, Y., Ploiarchopoulou, F., Dessypris, N., & Petridou, E. (2005). Implementing clinical protocols in oncology: quality gaps and the learning curve phenomenon. *European Journal of Public Health*, 15(4), 368-371.
- Lalla, R., Sonis, S., & Peterson, D. (2008). Management of oral mucositis in patients who have cancer. *Dental Clinics of North America*, 52(1), 61-77, viii.
- Luke, M. (2006). Identification of an oral assessment tool and development of a patient education guide to oral mucositis. *Oncology Nursing Forum*, 33(2), 430.
- Mangione-Smith, R., DeCristofaro, A., Setodji, C., Keesey, J., Klein, D. J., Adams, J., et al. (2007). The quality of ambulatory care delivered to children in the United States. *New England Journal of Medicine*, 357(15), 1515-1523.
- McCann, S., Schwenkglenks, M., Bacon, P., Einsele, H., D'Addio, A., Maertens, J., et al. (2009). The prospective oral mucositis audit: Relationship of severe oral mucositis with clinical and medical resource use outcomes in patients receiving high-dose melphalan or BEAM-conditioning chemotherapy and autologous SCT. *Bone Marrow Transplantation*, 43, 141-147.
- McGlynn, E. A., Asch, s. M., Adams, J., Keesey, J., Hicks, J., DeCristofaro, A., et al. (2003). The quality of health care delivered to adults in the United States. *New England Journal of Medicine*, 348(26), 2635-2645.
- McGuire, D., & Johnson, J. (2005, June). *Developing an educational resource for mucositis: Using the MASCC/ISOO mucositis guidelines in planning health professional and patient education in clinical practice*. Paper presented at the MASCC/ISOO 17th International Symposium: Supportive Care in Cancer, Geneva, Switzerland.
- National Cancer Institute. (2003). Cancer therapy evaluation program, common terminology criteria for adverse events. from [http://ctep.cancer.gov/protocolDevelopment/electronic\\_applications/docs/ctcae3.pdf](http://ctep.cancer.gov/protocolDevelopment/electronic_applications/docs/ctcae3.pdf)
- Nonzee, N., Dandade, N., Markossian, T., Agulnik, M., Argiris, A., Patel, J., et al. (2008). Evaluating the supportive care costs of severe radiochemotherapy-induced mucositis and pharyngitis. *Cancer*, 113, 1446-1452.
- Peterson, D. E., Bensadoun, R.-J., & Roila, F. (2008). Management of oral and gastrointestinal mucositis: ESMO clinical recommendations. *Annals of Oncology*, 19 (Supplement 2), ii122-ii125.
- Peterson, D. E., Keefe, D. M., Hutchins, R. D., & Schubert, M. M. (2006). Alimentary tract mucositis in cancer patients: Impact of terminology and assessment on research and clinical practice. *Supportive Care in Cancer*, 14, 499-504.
- Potting, C., Blijlevens, N., Donnelly, J., Feuth, T., & Van Achterberg, T. (2008). A scoring system for the assessment of oral mucositis in daily nursing practice. *European Journal of Cancer Care*, 15, 228-234.
- Putwatana, P., Sanmanowong, P., Oonprasertpong, L., Junda, T., Pitiporn, S., & Narkwong, L. (2009). Relief of radiation-induced oral mucositis in head and neck cancer. *Cancer Nursing*, 32(1), 82-87.
- Quinn, B., Stone, R., Uhlenhopp, M., McCann, S., & Blijlevens, N. (2007). Ensuring accurate oral mucositis assessment in the European group for blood and marrow transplantation prospective oral mucositis audit. *European Journal of Oncology Nursing*, 11, S10-S18.
- Silverman, S. (2007). Diagnosis and management of oral mucositis. *The Journal of Supportive Oncology*, 5(2 (Suppl 1)), 013-021.
- Sonis, S. T., Oster, G., Fuchs, H., Bellm, L., Bradford, W. Z., Edelsberg, J., et al. (2001). Oral mucositis and the clinical and economic outcomes of hematopoietic stem-cell transplantation. *Journal of Clinical Oncology*, 19(8), 2201-2205.
- Stokman, M. A., Spijkervet, F. K., Boezen, H. M., Schouten, J. P., Roodenburg, J. L., & de Vries, E. G. (2006). Preventive intervention possibilities in radiotherapy - and chemotherapy-induced oral mucositis: Results of meta-analyses. *Journal of Dental Research*, 85(8), 690-700.
- Titler, M. G., Kleiber, C., Steelman, V. J., Rakel, B. A., Budreau, G., Buckwalter, K. C., et al. (2001). The Iowa Model of Evidence-Based Practice to Promote Quality Care. *Critical Care Nursing Clinics of North America*, 13(4), 497-509.
- Tomlinson, D., Gibson, F., Treister, N., Baggott, C., Judd, P., Hendershot, E., et al. (2009). Designing an oral mucositis assessment instrument for use in children: Generating items using a nominal group technique. *Supportive Care in Cancer*, 17(5), 555-562.
- Vera-Llonch, M., Oster, G., Ford, C. M., Lu, J., & Sonis, S. (2007). Oral mucositis and outcomes of autologous hematopoietic stem-cell transplantation following high-dose melphalan conditioning for multiple myeloma. *The Journal of Supportive Oncology*, 5(5), 231-235.

Cover art is of Michele Farrington, the primary author of this article (foreground) and a mother, patient and another health care provider. Michele works in the Department of Nursing Services and Patient Care on a Pediatric Hematology-Oncology, Renal, Endocrine, Solid Organ Transplant, Gastrointestinal, Urology, Neurosurgery, Bone Marrow Transplant and Trauma Unit.