



Review

Knowledge, attitudes, barriers and practices concerning cancer therapy-associated oral mucositis amongst oncology nurses: A mixed methods systematic review

Feifei Zuo [#], Tong Li [#], Ying Chen, Mianmian Wen, Huijiao Cao ^{*}

VIP Inpatient Department, Sun Yat-Sen University Cancer Center, Guangzhou, China

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ABSTRACT

Objectives: To evaluate oncology nurses' knowledge, attitudes, barriers and practices regarding the prevention and management of cancer therapy-associated oral mucositis.

Methods: A systematic review was conducted by mixed-methods; searches were conducted in PubMed, EMBASE, Medline, CINAHL, Cochrane Library and Web of Science databases. The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines were followed for the systematic review. Searched relevant literature published in English between January 2000 and December 2023. The Mixed Methods Appraisal Tool was used to evaluate the quality of the studies.

Results: A total of 15 studies were included: 10 cross-sectional studies, 4 non-randomized controlled trials, and one qualitative study. This review provides an overview of the studies: nurses had limited knowledge of cancer therapy-associated oral mucositis; generally positive attitudes towards oral care; there is a slight difference in oral care practices. The main barriers of nurses' prevention and management of cancer therapy-associated oral mucositis were lack of time, lack of knowledge, and lack of staff.

Conclusions: Our results highlight the importance of training for oncology nurses regarding the management of cancer therapy-associated oral mucositis. It is suggested that oncology nurses should focus on strengthening and continuing education in oral care, adopting evidence-based practice and evaluation systems, implementing institution-specific written standards for oral care protocols, and promoting multidisciplinary team cooperation.

Introduction

Cancer is the leading cause of death in China and developed countries.¹ China is making efforts to confront its rapidly increasing cancer burden. However, rapid population aging and the accumulated effects of risk factor exposure creates many new challenges for cancer prevention. Multiple therapeutic approaches are used in the treatment of cancer, including surgery, chemotherapy, radiotherapy, targeted treatments, immunotherapy, and hematopoietic stem cell transplantation. Oral mucositis is one of the most common complications of cancer therapy, particularly chemotherapy and radiation. This complication is defined as an inflammation of the oral cavity and is characterized by erythema and mucous membrane degeneration, which then develops into ulcers and bleeding. It occurs in up to 40% of the cancer patients who received chemotherapy, and 80% of the cases of head and neck cancer received radiotherapy. The complication usually begins 3–5 days after the initial

dose of chemotherapy and reaches its peak within 14 days.² Radiation-induced mucositis has a chronic course over a 7-week period. The ulcerations arise due to radiation ranging from 2 Gy per day to 70 Gy per day. It can also last for 3–4 weeks after the completion of the treatment.² Severe oral mucositis (OM) may result in malnourishment and dehydration and a drastic reduction in their quality of life, increased risk for systemic infections due to the disrupted oral mucosal barrier, unscheduled and prolonged hospital stays, as well as interruptions of cancer therapies.^{3,4} Besides, severe mucositis may also have far-reaching psychological effects in that halitosis may lead to avoidance between the patient and a loved one, and dry, cracked lips may lead to difficulties in speaking and expressing affection.⁵

It is increasingly recognized that oral care is an essential part of the overall care of cancer patients. The updated clinical practice guidelines emphasize the important preventive and therapeutic dimensions such as basic oral care, developing a personalized treatment plan, patient

^{*} Corresponding author.

E-mail address: caohuijiao2000@163.com (H. Cao).

[#] These authors contributed equally to this work.

education about oral hygiene, patient assessment for malnutrition and developing a multidisciplinary therapeutic team.⁶ Because nurses are often front-line clinicians and spend more time with inpatients and their families than physicians, they have more opportunities for oral nursing. Nurses play a central role in preventing and managing oral mucositis and reducing its debilitating effects on patients. Therefore, our study will focus on the importance of oncology nurses for the knowledge, attitude barriers and practices of cancer therapy-associated oral mucositis. However, several studies revealed nurses possess insufficient knowledge regarding cancer treatment-associated mucositis and⁷ have an inadequate understanding of oral health status, signs and symptoms of abnormalities,⁸ and they have limited skills in oral care and OM assessment and management.⁹ Research also shows that oral problems are often underdiagnosed by physicians and not addressed by nurses, and that the implementation of an organized plan for oral care was relatively often overlooked by the oncology team.^{10,11}

All in all, it is essential to identify the oncology nurses knowledge, attitudes, barriers and practices regarding the prevention and management of cancer therapy-associated oral mucositis from previous studies, for providing basis for the development of health care worker-related education projects and oral mucositis prevention and control. Up to now, several studies have been conducted to assess the health knowledge, attitudes, and practices regarding cancer therapy-associated oral mucositis among nurses. However, a systematic review of these findings has not yet been undertaken. Given the lack of systematized literature in this field, this systematic review aims to characterize and synthesize current evidence on the oncology nurses' knowledge, attitudes, barriers and practices concerning cancer therapy-associated oral mucositis. This review may help establish appropriate nursing education and management strategies for cancer therapy-associated oral mucositis prevention and management so as to improve the oral health and quality of life of cancer patients.

Methods

Design

This study used the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement as a basis for reporting the systematic review findings.¹² Protocol of the systematic review has been developed and specified in advance, but the review protocol was not registered in any database. We used descriptive analysis methods to make quantitative analysis and used a results-based mixed-methods synthesis design thematic analysis to make quantitative and qualitative study's data synthesis.¹³ Three PICO questions were formulated. (1) Do oncology nurses possess related knowledge of oral mucositis in patients undergoing cancer therapy? (2) Do oncology nurses apply this knowledge in their daily work (attitudes and practices)? (3) What barriers do oncology nurses encounter in their practice? The research questions were based on the modified PICO strategy (PCO): P means population (oncology nurses), C stands for context (oral health prevention or management in cancer therapy-associated oral mucositis), and O refers to outcome (knowledge, attitudes, barriers and practices of the study population).

Search strategy

A systematic literature search was carried out in the following databases: PubMed, EMBASE, Medline, CINAHL, Cochrane Library, and Web of Science databases. Searched relevant literature published in English between January 2000 and December 2023. The keywords used in the search were: oral mucositis, stomatitis, oral care, oral complications, oral health; nursing personnel, nursing staff, nurses, registered nurses, oncology nurses; knowledge, perception, attitude, opinion, practice, behavior, performance, concern, barriers; chemotherapy, oncology, cancer, and cancer therapy. Combinations of search terms were used,

including 'Boolean' operators (And/Or) and MeSH (Medical Subject Heading) terms. In addition, hand searching the list of references, citation tracking was used for finding more extra articles. The search strategy can be found in the [Supplementary material](#).

Eligibility criteria

The inclusion criteria were as follows: (1) Studies using a cross-sectional design, randomized controlled trial or quasi-experimental study design, qualitative study design, mixed methods research. (2) Studies conducted on registered nurses caring for adult or pediatric patients in oncology department or hospital. (3) Studies explored at least one study outcome (knowledge, attitudes, barriers, practices, or behaviors) toward cancer therapy-associated oral mucositis of oncology nurses.

Exclusion criteria included: (1) Studies reported in non-English language. (2) Conference proceedings, dissertations, systematic reviews, policies, letters, short reports, case studies, or position statements.

Quality assessment

The risk of bias and the quality of each study were individually assessed based on the Mixed Methods Appraisal Tool (MMAT)¹⁴ (Table 1). MMAT can assess the methodological quality of five types of studies: qualitative studies, randomized controlled trials, nonrandomized studies, quantitative descriptive analysis studies, and mixed methods research. Two authors (ZFF & LT) independently assessed the methodological quality of the included studies, and any discrepancies were resolved through discussion. Scores were assigned according to specific criteria for each type of study. For example, in the case of qualitative research studies, only qualitative research has five criteria in the category are scored. Assigned a value: yes = 1; no or cannot tell = 0 and divided studies into low (score ≤ 3) or high level (score > 3). "Cannot tell" means that the literature does not report relevant information that can be judged as "yes" or "no". We need to look for additional supporting information, if necessary, contact the author to request more information for further clarity, as far as possible.

Data extraction

A data extraction form was developed and piloted independently by two authors (ZFF & LT) and modified as required. The following variables were extracted: authors, year of publication, country, study design, target population, sample size, assessment measures, focus point, and key findings (Table 2). Disagreements were resolved through discussion between the two authors or by consulting a third author.

Results

Study characteristics

Of the 15 included studies, most of them were cross-sectional studies ($n = 10$) to capture the information on knowledge, attitudes, practices, and barriers of oncology nurses in relation to cancer therapy-associated oral mucositis and oral health care. A variety of questionnaires were used, only six studies used a reliable and validated questionnaire or items, while the remaining did not provide clear information in this area. Four were quasi-experimental studies, and only one was a qualitative study. Only one study focused on all healthcare providers, comprising of physicians, registered nurses, dentists, dental hygienists, pharmacologists, and other medical professionals. All the rest of the studies ($n = 14$) were focused on oncology nurses, among three of the studies focused on pediatric oncology nurses. The studies originated from 10 countries namely, United States of America ($n = 4$), Ireland ($n = 1$), India ($n = 2$), Jordan ($n = 1$), Turkey ($n = 2$), Singapore ($n = 1$), England ($n = 1$), Netherlands ($n = 1$), Sweden ($n = 1$), Ghana ($n = 1$). This global

Table 1
Summary of Mixed Methods Appraisal Tool (MMAT) methodological quality assessment.

Author (Year)	Study design	MMAT criteria for qualitative studies				
		1.1	1.2	1.3	1.4	1.5
Gerry J. Barker (2005)	Cross-sectional study	C	Y	C	N	C
Southern H (2007)	Cross-sectional study	Y	Y	Y	Y	Y
Adesegun Tewogbade (2008)	Cross-sectional study	C	Y	C	Y	C
Antiana D. Perry (2015)	Cross-sectional study	Y	N	Y	Y	Y
Radhika R. Pai (2015)	Cross-sectional study	Y	Y	Y	Y	Y
Jennifer A. Suminski (2017)	Cross-sectional study	Y	Y	Y	N	Y
Loai Abu Sharour (2019)	Cross-sectional study	Y	Y	Y	N	Y
Radhika R. Pai (2019)	Cross-sectional study	Y	Y	C	Y	Y
Fatma Gündogdu (2022)	Cross-sectional study	C	Y	Y	C	Y
Ruixiang Yee (2023)	Cross-sectional study	Y	Y	C	Y	Y
		2.1	2.2	2.3	2.4	2.5
Amanda Honnor (2002)	Nonrandomized controlled trials	C	N	C	N	C
Carin M.J. Potting (2008)	Nonrandomized controlled trials	Y	C	Y	C	Y
Inger Wardh (2009)	Nonrandomized, quasi-experimental design	Y	Y	Y	C	Y
Seyda Avci (2019)	Quasi-experimental, with a pre- and post-repeated measures design	N	C	Y	C	Y
		3.1	3.2	3.3	3.4	3.5
Barnabas Manlokiya Raymond (2023)	Qualitative study	Y	Y	Y	Y	Y

Y = Yes, N = No, C = Cannot tell, means that the paper does not report appropriate information to answer 'Yes' or 'No'.

distribution underscores the universal significance of addressing oral care practices in healthcare settings. Fifteen studies were included in the final review, PRISMA flow chart see (Fig. 1).

Inadequate knowledge of cancer therapy-associated oral mucositis

The majority of studies (11/15) explored the knowledge of cancer therapy-associated oral mucositis. The knowledge items encompassed various aspects of oral mucositis, including pathology, definition, symptoms, assessment, complications, scoring, oral care, treatment, management and patient education. These researches show that nurses' knowledge of oral mucositis was generally inadequate. Many studies reported that nurses have insufficient knowledge about OM management and oral care, especially using oral care protocols or chemotherapy-specific OM protocols, applying different practices, and following evidence-based practices.^{8,9,15,16} Some studies pointed out that a high percentage of participants had poor knowledge regarding pathology (64.3%)⁹ and anatomy (50%).¹⁷ A study conducted in Ireland showed that respondents' self-rated knowledge of oral care was poorest on saliva substitutes, oral health status, and signs and symptoms of abnormalities.⁸ Carin M.J. Potting's¹⁷ study reported that nurses showed knowledge gaps in assessing the different stages of oral mucositis. A similar study conducted by Honnor A reported that none of the nurses could identify severe mucositis.⁵ Meanwhile, some studies showed that most participants had knowledge on potential oral complications of cancer therapy.^{8,18,19} The majority of nurses did not know of international guidelines on oral care for oncology patients,¹⁸ or the percentage of nurses who followed practice guidelines were low.²⁰

Oral mucositis assessment

The majority of the studies reported an imbalance in knowledge on OM assessment among nurses. In addition, many studies revealed that oral care examinations performed were inconsistent and incomplete. The majority of them did not use a valid and reliable assessment instrument,^{7,9,16,21} or many mistakes (50%) were made with oral inspection.¹⁷ A qualitative study conducted by Raymond BM⁷ revealed that they had insufficient knowledge on the standardized tool for the assessment of OM. A survey conducted by Gerry J. Barker²¹ found that only 25% of respondents indicated that a standardized instrument is utilized to evaluate the oral condition on oncology patients. The study also shows that mucositis was scored using standardized scales by 60% (41) of respondents. The most common scales used were the World Health Organization (WHO) oral mucositis scale with or without

modifications (34%, $n = 14$) and the oral mucositis assessment scale (OMAS) (17%, $n = 7$).^{20,21} Fatma Gündogdu's²⁰ study also used the Oral Assessment Guide (OAG), the National Cancer Institute Common Toxicity Criteria (NCI-CTCAE 3.0) and the Oral Mucositis Index (OMI). Carin M.J. Potting's study¹⁷ reported the Daily Mucositis Score (DMS) (Donnelly et al., 1992) was the instrument used to assess oral mucositis on a daily basis. Adesegun Tewogbade's study²² used the oral assessment guide, which was adapted from Eilers (1988). Hilary Southern's⁸ research found that 61.1% ($n = 44$) strongly agreed that an oral assessment guide would be useful in the examination of the oral cavity. However, only 41.7% ($n = 30$) reported that they used a specific guide for this. Fatma Gündogdu's study²⁰ showed that most of the nurses (96.7%) who stated that they followed the MASCC/ISOO guidelines made an OM assessment, and 90.6% of the nurses who stated that they did not follow the MASCC/ISOO guideline made an OM assessment, and 63.0% of the nurses used an OM assessment scale.

Patient's education for preventing or reducing complications

Oncology nurses should ensure that they discuss and educate each person with cancer about oral mucositis before and during cancer treatment. Some studies have shown that nurses provided limited information in patient education,^{9,16} including education about oral care, oral complications during cancer treatment, preventive practices for good oral health,¹⁶ nutritional intervention, pain reduction⁹ and so on. Many studies have indicated inadequate education of nutritional support.^{9,18,20} The most common preventive recommendation in oral care given to patients was a general recommendation for thorough oral hygiene (47.2%).⁸ It is widely accepted throughout the literature that basic oral hygiene practices, such as brushing, flossing, and using mouth rinses, help in reducing the oral microbial flora in the mouth and preventing oral complications associated with the treatment of cancer.¹⁹ There were knowledge gaps in the specific oral hygiene practices conducive for oral health. Hilary Southern's⁸ study reported the most common preventive recommendation was for thorough oral hygiene ($n = 34$, 47.2%). Other preventive recommendations were to drink and rinse often ($n = 18$, 25%), use mouthwashes ($n = 4$, 5.6%), and use lip lubricants ($n = 4$, 5.6%). A study conducted by Raymond BM's study,²³ strategies for preventing mucositis such as using ice cubes, proper oral hygiene, cessation of smoking, flossing, tooth picking and using of soft toothbrush were highlighted, but paid little attention to the education on the possible side effect that includes OM. Another survey conducted by Fatma Gündogdu²⁰ showed that most of the nurses (99.4%) recommended mouthwash to patients, and 65.6% of them recommended mouthwash four

Table 2
Main characteristics of the studies included in the systematic review.

Author, year, country	Study design	Population	Instruments (assessment measures)	Focus point	KAP	Key findings
Gerry J. Barker, 2005, the United States of America	Cross-sectional study	$n = 74$ MASCC/ISOO members, their memberships are comprised of physicians, registered nurses, dentists, dental hygienists, pharmacologists, and other medical professionals	A questionnaire was designed to elicit information on referral policies with respect to treatment protocols and management strategies for preventive and palliative oral care at members' institutions by e-mailed/surface mailed. Unspecified validity and reliability.	To evaluate the knowledge and current practice for preventing and managing oral side effects associated with intensive chemotherapy (ICT), hematopoietic cell transplant (HCT), and radiation therapy to the head and neck	K, P	<p>a. The status of timing of referrals Approximately 75% stated that patients were referred for oral/dental care prior to head and neck radiation therapy (H&N RT) and ICT including HCT. However, integrated dental and medical services were reported available in only about 25% of the institutions, and most patients were referred to community-based dental professionals.</p> <p>b. Oral assessment instruments Only 25% of respondents indicated that a standardized instrument is utilized to evaluate the oral condition on oncology patients.</p> <p>c. Oral care measures The vast majority of respondents reported provision of basic oral hygiene instructions and recommendations, such as tooth brushing, use of mouth rinses during chemotherapy and radiation therapy, palliative care for dry mouth and mucositis, and use of fluoride for radiation therapy.</p> <p>d. Managing oral sequelae Respondents reported prescribing prophylactic antifungal agents for chemotherapy patients and radiotherapy patients (48% and 36%, respectively.) A palliative approach to mucositis-related pain was recommended by 93% ($n = 63$) of responders.</p>
Southern H, 2007, Ireland	Cross-sectional study	$n = 72$ general and cancer nurses employed in an oncology center	An oral care self-administered questionnaire Reliability: Cronbach's $\alpha = 0.93$ Validity: content validity by submitting it to a panel of experts and it was modified according to their responses	To determine the nurses' knowledge and education in relation to oral care and oral health assessment for patients undergoing cancer treatment.	K A P	<p>Data indicated that respondents' self-rated knowledge of oral care was poorest on saliva substitutes, oral health status, and signs and symptoms of abnormalities, and greatest on cleaning dentures</p> <p>a. Nurses placed a high degree of priority on oral care for patients with cancer. 61.1% ($n = 44$) strongly agreed that an oral assessment guide would be useful in examination of the oral cavity.</p> <p>b. The majority of respondents ($n = 41$, 56.9%) reported feeling comfortable in examining a patient's oral cavity. However, 30.6% ($n = 22$) of all nurses felt completely comfortable in doing this. A total of 58.3% ($n = 42$) reported that they were satisfied with the time available for giving oral care. Only 65.1% ($n = 47$) said that they would examine the patient's oral cavity daily, and 16.6% ($n = 12$) more often than daily.</p>
Adesegun Tewogbade, 2008, the United States of America	Cross-sectional study	$n = 33$ nurses on the pediatric cancer and blood disorders unit of Children's Medical Center	Formulation of the questionnaire involved a literature search to obtain information on oral complications of pediatric cancer and hematopoietic stem cell transplantation (HSCT) treatment Unspecified validity and reliability.	Evaluated nurses' current practices and understanding of oral health for hematology and oncology patients.	K P	<p>a. The study found that nurses were proficient in diagnosing obvious conditions including mucositis and pseudomembranous candidiasis, but they were less than proficient when diagnosing less easily recognizable conditions such as xerostomia.</p> <p>b. The nurses were found to have inadequate knowledge of the treatment and oral hygiene protocols for conditions that they could and could not diagnose.</p> <p>a. All nurses stated that they evaluated patients for mucositis. Most nurses ($n = 32$) used a flashlight or penlight to examine the oral cavity, but only 10 nurses used a tongue blade; 18 nurses stated that they used room light to evaluate the oral cavity.</p> <p>b. Twelve nurses had never made a dental referral.</p> <p>c. The frequency of nurses provided oral hygiene instruction (OHI): 9 and 18 nurses stated that they "always" provided OHI for</p>

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Table 2 (continued)

Author, year, country	Study design	Population	Instruments (assessment measures)	Focus point	KAP	Key findings
				patients with breast cancer.	P	<p>engaging in skills training, providing care, and collaborating with dental providers were positive. However, engagement in actual oral health-related care was reported to be less frequent.</p> <p>a. When asked how often they assessed specific oral health issues, only 22 (13%) of 10 or very often used an oral assessment guide during patient care. When patients presented with dental symptoms or requested an oral assessment, the absolute majority of nursing team members assessed the patients' oral health often or very often ($n = 113$ [69%] and $n = 101$ [62%], respectively).</p> <p>b. When asked about oral health-related behavior in general, the majority often or very often educated their patients about oral health ($n = 69$, 42%).</p> <p>c. The frequency with which the respondents engaged in interprofessional collaboration with a dental specialist was also low.</p>
					B	Lack of time, lack of staff, lack of knowledge, uncooperative patient, low importance of oral health, lack of interest, lack of resources.
					O	Increased oral health-related education and behavior correlated with the reported importance of increased oral health education for nurses.
Abu Sharour I, 2019, Jordan	Cross-sectional study	Phase I ($n = 140$, Knowledge test) Phase II ($n = 20$, Observation of care/practice performance) oncology nurses The response rate was 70%.	Phase I: A questionnaire based on literature and guidelines. The reliability of the test with Cronbach's α of 0.81, and the content validity index was excellent for all the subsections of the questionnaire (content validity index = 0.81–0.86). Phase II: An observation checklist was used to evaluate the oncology nurses' skills in providing oral care for patients with OM. The checklist had good internal consistency and reliability with Cronbach's α of 0.84, and the content validity index was excellent for all the subsections of the scale (content validity index = 0.78–0.87)	Tested oncology nurses' knowledge and practice of the oral mucositis management	K	Knowledge: The results show insufficient levels of knowledge and limited skills regarding oral care and OM assessment and management.
					P	A large percentage of the participants (60%) committed mistakes in performing an oral assessment (definition, assessment, scoring and treatment). Patient education and counseling were inadequate and brief.
					O	Nurses with a high education level had a higher score of knowledge and skill performance about oral mucositis.
Pai, Radhika R., 2019, India	Cross-sectional study	$n = 158$ staff nurses working in oncology-related areas The response rate was 79%.	Survey consisted of demographic proforma, practice, and barrier questionnaire. Unspecified validity and reliability.	To determine the nurses' practice and barriers regarding oral care in cancer patients undergoing chemotherapy and radiation therapy.	K	Only 54 (34.2%) of the staff nurses educated patients about oral complications during cancer treatment, whereas 117 (74.1%) of them expressed that their knowledge is inadequate to give any information to the patients regarding oral care.
					P	a. More than half of respondents [54 (34.2%)] did not perform oral care as a part of routine duties. b. Documentation audit revealed that nurses recorded oral care in the chart only when order was present in the care sheet, but oral problem assessment was not recorded at all. c. In all four hospitals surveyed, there was no protocol specifically designed for oral care of cancer patients.
					B	Lots of writing tasks [126 (79.7%)], low staffing [121 (76.6%)], different practices [119 (75.3%)], lack of time [115 (72.8%)], lack of knowledge [112 (70.9%)]

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Table 2 (continued)

Author, year, country	Study design	Population	Instruments (assessment measures)	Focus point	KAP	Key findings
Fatma Gündogdu, 2022, Turkey	Cross-sectional study	$n = 157$ oncology nurses	The questionnaire was applied online. The data collection form was prepared by the researchers by the literature and collected through the 'oral mucositis Practices assessment form. Content validity: The scores of five experts were evaluated by scope validity analysis (S-CVI) and S-CVI was found 0.99. Unspecified reliability.	To explore the practices of oncology nurses in the management of chemotherapy-related oral mucositis (OM) by MASCC/ISOO guidelines.	P B	a. Most of the nurses (94.3%) reported that they provided OM management/prevention training to patients/caregivers before chemotherapy. b. More of the nurses (59.9%) had a written protocol for managing OM in their institutions, 38.9% of them used the MASCC/ISOO guideline, and 63.0% of them used an OM assessment scale. c. Most of the nurses (99.4%) recommended mouthwash to patients and 65.6% of them recommended mouthwash four times and more a day. 54.1% of the nurses recommended saline (10.8%) or carbonate (36.9%) or a mixture of saline and carbonate (6.4%) solutions for mouthwash. d. 82.0% of nurses who followed MASCC/ISOO guidelines recommended to patients implement oral care four times and more a day, while 55.2% of them who did not follow MASCC/ISOO guidelines recommended four times and more a day. 24.8% of nurses stated that insufficient knowledge was an obstacle in the management of OM, while 18.5% stated lack of time, and 17.8% stated lack of staff.
Ruixiang Yee, 2023, Singapore	Cross-sectional study	$n = 63$ pediatric oncology nurses	A self-administered anonymized questionnaire based on a literature search of studies involving nurses and oral health care. Unspecified validity and reliability.	To explore oral health-related knowledge, abilities, attitudes, practices, and barriers of pediatric oncology nurses.	K A P B	Fifteen participants had > 80% of the knowledge questions correct. The majority (97.3%) felt they play an important role in maintaining patients' oral health. 75.8% of participants felt need for training in giving oral health advice. 74.6% checked patients' mouths at least once daily but only 57.1% felt adequately trained. Though a high proportion (> 90%) of nurses felt confident to assist with oral care, only 65% would assist patients to do so. "Uncooperative patient" was the major barrier reported. This was followed by staff and operational factors.
Amanda Honnor, 2002, England	Quantitative, Intervention: using an audit to change practice	$n = 26$ Oncology nurses and health care assistants	Using self-completed and anonymous questionnaire developed by Adams (1996) as part of a study to assess nurses' knowledge of oral care within a medical unit. Unspecified validity and reliability.	To measure the extent of oral problems in cancer patients, current mouth care practices, and staff knowledge.	K P	The knowledge deficits identified in this audit was assessment of the oral cavity, recognition of common problems, knowledge of tools and solutions, and drugs that affect the oral cavity. The findings showed that oral problems were common, but were: underreported by patients, underdiagnosed by doctors and nurses, inadequately treated, and inadequately documented.
Carin M.J. Potting, 2008, Netherlands	Quantitative, intervention: oral care education sessions	Base line $n = 31$ nurses Follow-up $n = 29$ nurses	Knowledge test: The knowledge test was a 32-item questionnaire including open-ended and multiple-choice questions and eight photographs of the mouth illustrating different stages of oral mucositis. Validity: Pilot test by a team of experts. Observation of skills: A self-developed list, consisting of 44 observations points was used to evaluate nurses' oral care skills. Nursing record test. Unspecified validity and reliability.	To investigate if knowledge and skills about oral care improve when education in oral care is provided to nurses in charge of patients who are at risk of oral mucositis.	K P	a. At baseline, only 30% of the nurses knew all the characteristics of mild mucositis, whereas 60% of the nurses were able to describe severe mucositis. Most of the nurses knew the most important risk factors for development of oral mucositis. Only half of the nurses gave correct answers to the questions on anatomy and pathology. With more than 50% of the nurses being unable to offer advice to a patient with oral mucositis and dental prostheses. Three out of eight photographs showing various stages of oral mucositis were assessed correctly by 75% of the nurses. b. The difference in the increase in mean knowledge was 56.9, 95% CI: [15.7; 98.0], indicating a relevant positive effect of education on knowledge. a. At baseline, almost half of the nurses assessed the patient's oral cavity without knowing the previous oral status. Many mistakes (50%) were made with oral

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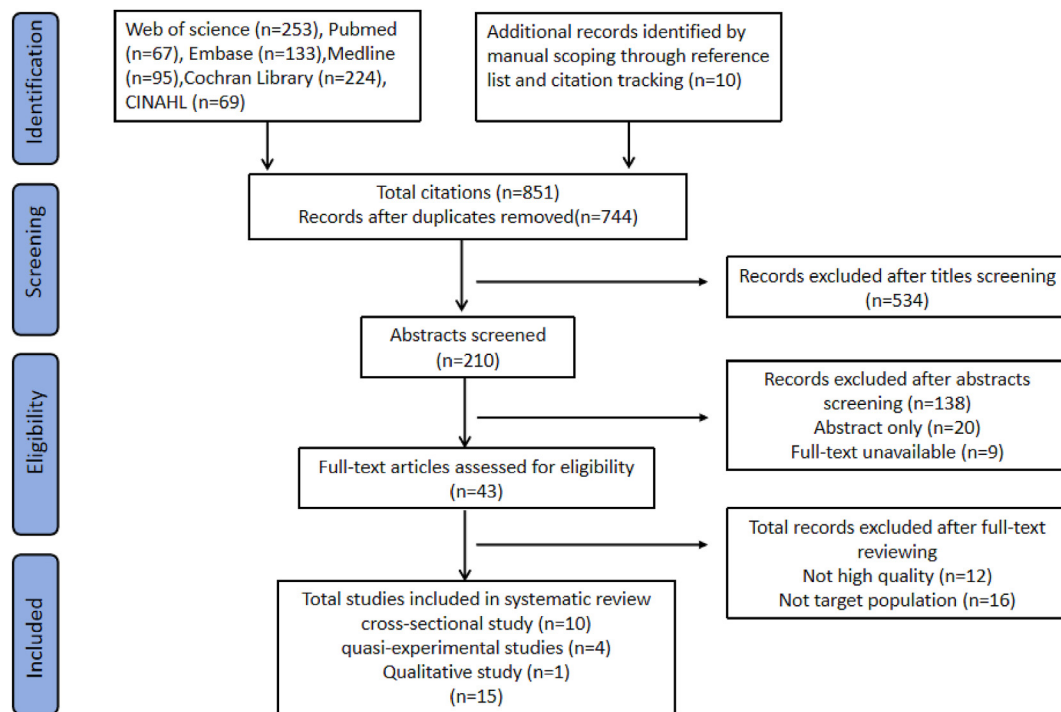


Fig. 1. PRISMA flow diagram. PRISMA, Preferred Reporting Items for Systematic reviews and Meta-Analyses.

times or more a day. Some studies reported that the most commonly recommended mouthwashes for patients on chemotherapy are saline or sodium bicarbonate or chlorhexidine (25%).^{20,21} Soft or extra-soft toothbrushes were suggested most often.^{18,21} Besides, common oral health aids advised were foam brushes, mouthwash, and lip balm.²² However, Loai Abu Sharour's⁹ study about skill performance showed that many nurses did not offer lip balm or petroleum jelly, did not use high-fluoride toothpaste/foam/gel/tray, did not use 0.9% sodium chloride/salt water rinse. Besides, another study conducted by Carin M.J. Potting¹⁷ showed that, with more than 50% of the nurses being unable to offer advice to a patient with oral mucositis and dental prostheses. A survey conducted by Ruixiang Yee¹⁸ found that less than three-quarters knew that fluoride toothpaste should be used, and less than half knew that toothbrushing should continue regardless of platelet counts.

Attitude

Some studies showed that nurses have positive attitudes towards oral care for cancer therapy patients. In a survey conducted by Jennifer A. Suminski,²⁴ reported attitudes concerning the importance that nurses learn or know about oral health issues, have oral health-related skills, and engage in oral health-related behavior were on average positive. Hilary Southern's⁸ study reported 41 (56.9%) of respondents reported feeling comfortable in examining a patient's oral cavity, and 22 (30.6%) of all nurses felt completely comfortable doing this. On the other hand, some studies revealed that nurses recognized the importance of oral hygiene. A survey conducted by Ruixiang Yee¹⁸ concluded that all participants believed that oral hygiene is important, and the majority (93.7%, $n = 59$) felt they play an important role in maintaining patients' oral health. Despite the fact that the majority of nurses recognize the importance of oral care, there are differences in confidence in oral assessments. Some studies revealed that most respondents were confident to examine the health of teeth/gums, presence of oral pathology and oral pain and providing oral hygiene instructions.^{18,19} In contrast, some respondents expressed they had little confidence in oral health relevant assessments and inspection. A survey conducted by Jennifer A. Suminski²⁴ found that only 58 (35%) felt that they had sufficient knowledge

and confidence to perform oral health assessments. A survey conducted by Antiana D. Perry²² found that less than half of respondents reported that they were very confident in their ability to examine the health of teeth and gums for complications of trismus, dysphagia, and xerostomia. Similar to a study conducted by Ruixiang Yee,¹⁸ just over 60% were confident in identifying specific problems like trismus and dysphagia.

Practice

Oral examinations

Oral examination is highly warranted, including assessing mucosal integrity, color, bleeding, and lesions and other factors. There was a slight variation among nurses in their daily practices regarding oral cavity examinations. The common frequency was to examine the patient's oral cavity daily,^{8,16,18,19,22} or more often than daily,⁸ performing examinations during every shift,²² assessing patients' oral health on admission or arrival for an appointment and prior to initiating a new anticancer therapy,²⁴ examining following physician's instructions. Many studies have shown that when patients present with dental symptoms or request an oral assessment, the absolute majority of nursing team members paid more attention to oral symptoms and assessed the patients' oral health often or very often.^{16,22-24} When asked what tools they use to provide oral evaluations, they frequently use a flashlight, penlight, or tongue blade to examine the oral cavity.²²⁻²⁴ In addition, as mentioned above, inadequate OM assessment knowledge led to the lack of relative practice. Loai Abu Sharour's⁹ study showed that many nurses did not assess risk factors or check previous oral status before facilitating an oral assessment. A survey conducted in Turkey also revealed that 75% of respondents stated that they do not diagnose OM regularly.²⁵

Dental referrals and nursing document

Some studies reported on the timing of referrals, indicating that patients undergoing chemotherapy and/or radiation therapy were referred to hospital dentists for oral/dental care.^{18,21,22} A survey conducted by Fatma Gündođdu²⁰ found that it was determined that 49.7% of the nurses referred patients to the dentist before chemotherapy. Besides, some studies reported the frequency with which the respondents engaged in

interprofessional collaboration with a dental specialist was low.²⁴ Ruixiang Yee's¹⁸ study showed that the most common barriers to dental referral were beliefs that it is not the nurses responsibility or authority, followed by inadequate knowledge of dental conditions to refer for. Most nurses knew the appropriate timing for referrals, but few had initiated referrals, with more than half citing that they had no authority or responsibility to do so. This might be related to local policies and practices where doctors are deemed responsible for referrals.¹⁸ A survey conducted in England revealed that oral problems were inadequately documented.⁵ In Carin M.J. Potting's study,¹⁷ only records of patients at risk for oral mucositis were included in the nursing record test. In contrast, Radhika R Pai's¹⁶ study showed that most [118 (74.7%)] of the staff nurses expressed that they have recorded oral care in the nursing chart. According to Hilary Southern's⁸ study, most nurses always documented findings when there were complications or changes in the oral cavity, the study also showed those who always documented or reported findings gave a greater degree of priority to oral care and showed a greater level of oral care knowledge.

Barriers

After synthesizing all studies, the barriers of oncology nurses' prevention and management of cancer therapy-associated OM were summarized. The majority of the studies reported that lack of time was expressed as a main barrier, as nurses had many other priority tasks to perform.^{8,16,18,20,24} In addition, lack of staff^{16,18,20,24} and lack of knowledge^{16,18,20,24,25} were the second main barriers. Other barriers, including uncooperative patient,^{18,24} the absence of standard OM diagnosis parameters in the clinic,²⁵ intensive working environment (excessive workload),²⁵ the low importance of oral health,²⁴ lack of interest,²⁴ lack of resources,^{16,24} lots of writing tasks,¹⁶ different practices,¹⁶ lack of multiprofessional collaboration,¹⁶ insufficient evidence-based information,¹⁶ patient being unwell or having a sore mouth,¹⁸ etc.

Nurses's education

Adequate oral health knowledge was also significantly associated with other factors, such as a higher level of education and having received oral health training. Some studies have mentioned that education has produced a positive effect on oral health knowledge,^{8,9,17} skills^{9,17} or behavior.²⁴ For example, Loai Abu Sharour's⁹ study reported that nurses with a postgraduate degree had a higher level of knowledge and skill than nurses with a bachelor degree or a diploma degree. The majority of the studies have shown an inadequate level of oral education among nurses.^{5,8,15,18,19,24} Common forms of education including training related to oral health care in nursing school or continuous education in-service training. Some studies reported that most oral health knowledge has been learned in clinical settings or in-service training.^{18,24,25} Another study stated that approximately half of the nurses (47.2%) received training on OM management, and 10.2% of them received training for approximately 5 h or more.²⁰ By contrast, Hilary Southern's⁸ study found the majority of nurses (69%) had not attended any continuing education course in oral care within the past year. Antiana D. Perry's¹⁹ reported that about 60% did not have a clinical requirement regarding the assessment of the teeth and gums during their nursing school education. Some respondents reported the courses they learned contain a topic on basic oral care; however, the curriculum did not contain anything specific related to oral care in cancer patients, such as cytotoxic drugs or radiation treatments.^{8,15} A number of nurses expressed a need for regular training and education about oral care,^{5,8,9,15,19} or realized the importance of learning oral health-related knowledge.²⁴

Discussion

Poor oral health is a common problem in patients undergoing cancer treatment. Pretreatment oral assessment and intervention, followed by

oral care provided during and after cancer treatment can reduce, at least in part, the adverse impact of oral complications. The focus of this review was to provide a synthesis of current evidence on the knowledge, attitudes, practices, and barriers of nurses with cancer therapy-associated oral mucositis. Overall, the results of this review show that a majority of nurses have limited knowledge of cancer therapy-associated oral mucositis, positive attitudes toward oral care for cancer therapy patients, slight variation in their daily practices regarding oral care and face various barriers in the prevention and management of cancer therapy-associated OM.

Limited knowledge of cancer therapy-associated oral mucositis

As far as knowledge is concerned, we found that nurses had relatively adequate knowledge and practice on routine oral care. However, they lacked adequate knowledge of oral assessment and had difficulty with the diagnosis and management of xerostomia, trismus, and dysphagia and other severe complications. The nurse's main duty is to inform the dental staff or doctors when a patient is likely to run the risk of oral problems and rather than waiting until serious problems are already present. Every nurse providing care to patients who have developed OM should rate its severity and assess the risks by prioritizing preventive measures for OM.⁸ Although the significance of diagnosing OM is well known, clinical observations suggest that there are problems in the way nurses monitor routine OM diagnoses.²⁶ The majority of nurses did not recognize the importance of managing OM or did not use a valid and reliable OM assessment instrument. Our review also showed that there were knowledge gaps in the patient's education for preventing or reducing complications. Lack of knowledge can be related to inadequate training during their undergraduate study or lack of continuing education post-graduation at their medical institutions. The majority of nurses relied on previous experience or basic nursing training as a primary source of information on oral health care. However, Ruixiang Yee's¹⁸ study showed that experience did not improve oral health knowledge scores, underscoring the importance of including formalized oral health training as part of nursing training programs. An important part of daily oral care is to assess the oral cavity of patients at risk for oral mucositis. To standardize this assessment, nurses should be trained in the application of standardized tools for screening and assessment in order to be proficient in using such instruments.

Generally positive attitudes towards oral care

The oncology nurses generally have positive attitudes toward oral care or OM management for cancer treatment patients. It is heartening that high proportion of nurses felt confident enough to assist with oral care, including toothbrushing, and did not find it an unpleasant task. They showed strong willingness to help keep patients oral health and expressed that oral health is included in nurses' duties.²⁷ Although most of them believe oral hygiene is important, and they express a willingness to learn the latest standard protocols and apply them to improve their daily practice, their poor knowledge levels regarding severe OM complications could significantly impact their confidence in OM assessment and oral care. A study showed that oncology nurses have positive attitudes toward learning about oral health-related care, engaging in skills training, providing care, and collaborating with dental providers. However, engagement in actual oral health-related care was reported to be less frequent.²⁴ In addition, a paucity of oral health education may be one reason why nursing team members consider oral health problems to have a relatively lower priority compared to treatment side effects such as pain, nausea, and dyspnea.²⁸ These attitudes may indicate that nursing team members underestimate the impact of negative oral side effects of anticancer treatments, such as mucositis and xerostomia; in turn, this may result in limited proactive oral health-related educational behavior.²⁴ As the KAP model expresses, knowledge is the basis of behavior change; attitude is the driving force of behavior change.

Therefore, we should use a variety of methods to improve the relative knowledge of OM and reduce gaps in knowledge, so as to motivate nurses' enthusiasm and confidence.

A slight difference in oral care practices

There is a slight difference between the practices of oncology nurses in oral care and OM management, primarily concerning basic knowledge. However, most of them did not apply formalized oral care protocols or used evidence-based protocols. Seyda Avcı's study²⁵ reported 91.7% of the nurses stated that they had not performed any evidence-based practices. A study conducted by Fatma Gündoğdu²⁰ showed the standards for oral care were not consistently implemented, and advice on oral care frequency varies from 'once every shift' to 'only if patient requests it. It is thought that the heterogeneity of nurses' practices related to oral care, prevention, and treatment of mucositis is due to the absence of written OM protocols, failure to apply evidence-based intervention, and lack of following the clinical guidelines.²⁰ Standardization ensures a common understanding among all the nurses and establishes the expectation for nurses' roles in providing oral hygiene for patients. The utilization of a standardized oral care protocol for mucositis management reduces the incidence, duration, and severity of mucositis as well as its overall negative effects. A formalized protocol is highly recommended for identifying high-risk patients for OM, as observed by Huang et al.²⁹ who reported the necessity of having formalized oral care protocols in place before starting cancer treatment. The implementation of oral health care in nursing should be based on evidence-based knowledge, which requires continuous and routinely updated oral healthcare education. Evidence-based oral mucositis management among cancer patients can be achieved by educating the patients and nursing staff using the latest guidelines and dentists' comprehensive dental and oral hygiene examinations.³⁰ In conclusion, establishing protocols and setting standards of oral health care are important; nurses' practices should not be guided by habit and experience. More information is needed on evidence-based oral care standards and that an oral care protocol is necessary to standardize and improve oral care practices.

Our study found that various barriers exist in the prevention and management of cancer therapy-associated OM, oral examination, and dental referral. Lack of time emerged as one of the most important challenges facing oncology nurses. A study reported that individuals who were satisfied with the available time showed a greater level of knowledge regarding signs and symptoms of abnormalities compared to their dissatisfied counterparts.⁸ Besides, lack of knowledge and staff were mentioned many times. This may be attributed to the heavy workload of nurses, making them less likely to engage in active learning or lacking the energy to strictly adhere to every step of the guidelines. Nurses play a significant role in preventing and managing OM and decreasing its adverse effect on patients' health status, has been acknowledged as an important factor in the treatment plan for OM.²³ Some of the nurses did not view the oral hygiene of the patients as one of the priorities in planning patient care. Thus, this led to some of the nurses not performing and enforcing the new oral hygiene practices.²⁶ As mentioned above, busy clinical work can also lead nurses to have inadequate practice on dental referrals and poor nursing documentation quality. Therefore, we recommend that cooperation between specialists from multidisciplinary groups, such as medical oncologists, dentists, nurses, and others. It can not only reduced the workload of nurses, but also the needs of patients can be best met by integrated dental and medical programs where dental providers understand the disease and its medical management and are knowledgeable about the prevention and treatment of oral complications through all phases of cancer therapy and who closely interacts with medical providers.²¹ Interprofessional collaboration between nurses and healthcare professionals is crucial for enhancing patients' oral health. It has been shown that interprofessional collaboration, with nursing and dental professionals, positively affects the quality of care, patient satisfaction, effectiveness of health care services, health care costs, and communication among health care professionals.²⁷ Besides, an

interdisciplinary team approach to symptom management, particularly with dentists and dental hygienists, may improve patients' overall quality of life during anticancer treatment.²⁴ However, in the present survey, integrated dental services were reported to be available in only a few of the centers. Though establishing such cooperation requires dealing with many challenges, we appeal to the medical system to pay attention to the network of cooperation among nurses, to collect feedbacks of nurses and to strengthen channels of interdisciplinary communication and cooperation. Finally, leadership should make their best efforts to address administrative and clinical barriers. These endeavors are valuable in guiding the development of an evidence-based training program and oral care guidelines for oncology nurses.

Strengthening continuing education in oral care

To sum up, we concluded that education has produced a positive effect on oral health knowledge, attitudes, and practices. The benefits of patient education for OM self-management includes increased knowledge and awareness, allowing patients to be more empowered and involved in their oral care. This would facilitate the attainment of desired patient behaviors, such as increased adherence to oral care regimens.^{31,32} We believe that patient education is based on nurses' knowledge of basic oral care strategies, learning these protocols serve to increase the awareness of both patients and staff about the importance of good oral hygiene, potentially leading to fewer and less severe oral complications. According to the above studies, we found that oral health education for nurses is not optimally provided. An improvement can occur in the patients' quality of life when nurses use a regular training program to fully inform them and their families about one of the most important side-effects of oral mucositis after chemotherapy.³⁰ As Gündoğdu F's²⁰ study stated, training nurses in the management of OM may improve the implementation of oral care practices as well as the prevention and management of mucositis. All in all, the lack of training could have contributed to the knowledge gap, education, as the main promotive tool, can be tailored to address gaps in knowledge and standardize the practices of nurses. It is necessary to find innovative ways to motivate nurses to adhere to attend the oral health care curricula. It is suggested that nurse practitioners not only learn oral health-related information during their schooling, but also receive oral health-related training regularly and continuously on the job to improve and update their oral care knowledge. Besides, we recommend the development of a more structured curriculum that ensures nurses with different levels of knowledge, take appropriate nursing courses. With the continuous updating of evidence-based guidelines, it is crucial for leadership to conduct targeted learning of OM knowledge regularly and to strengthen supervision of compliance with the latest clinical criteria.

Limitations

There are several limitations of our study. Firstly, the studies in the review vary in quality and have several methodological limitations, because to ensure as comprehensive as possible results, we did not exclude low methodological quality studies. Secondly, varying questionnaires used to measure study outcomes, limited validated questionnaires, and inadequate discussion of confounding factors that may have affected the finding, it was hard to make a meaningful data comparison between the knowledge, attitudes, practices, and barriers statistical level of nurses for cancer therapy-associated OM. Finally, our retrieved literature was limited to the English language and published articles, this may have resulted in not capturing all research conducted in other countries or primary research studies.

Conclusions

Assessment of the mouth, early recognition and treatment of common problems, and good oral hygiene are essential to prevent potential life-

threatening infections and maintain quality of life. The current results indicated insufficient oral care knowledge can to some extent be attributed to failure in the structure of the training program. Consequently, they also lack confidence in assessing or treating more severe oral complications and reported a slight difference in practicing oral care. Our results highlight the importance of continuing education and training for oncology nurses about the use of a standard protocol for OM assessment and care. Therefore, in the management of OM, it is suggested that oncology nurses should strengthen continuing education in oral care, establish evidence-based information, multidisciplinary team cooperation, institution-specific written standards, oral care protocol, and evidence-based practice and evaluation systems.

CRedit authorship contribution statement

Study design and conception: ZFF, LT, CHJ; Data acquisition: ZFF, LT, WMM; Data analysis and interpretation: ZFF, LT, CY; Manuscript preparation: ZFF, CHJ; Writing of the manuscript: ZFF. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Declaration of competing interest

The authors declare no conflict of interest.

Data availability statement

Data availability is not applicable to this article as no new data were created or analyzed in this study.

Declaration of Generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Appendix A. Supplementary data

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