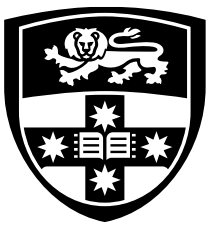

THE UNIVERSITY OF SYDNEY

Oral Health of Cancer Patients: Dentists' Perspectives and Challenges

Sheau Ling Low

A thesis submitted in fulfilment of the requirements for the degree of **Master of Philosophy**

School of Psychology

Faculty of Science

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This journey started with Cindy who caringly followed me up throughout my cancer journey. During her many visits, we spoke about the lack of dental care in cancer patients, and those conversations planted a seed in me.

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Statement of Originality

This is to certify that to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged. Further, this project adheres to ethical requirements set by The University of Sydney.

_____

Sheau Ling Low

15th of June 2025

Author Contributions

I, Sheau Ling Low (SL), conducted the research presented within this thesis during my MPhil candidature from October 2020 to June 2025 in the School of Psychology, Faculty of Science, The University of Sydney.

This research is supervised by my primary supervisor, Professor Joanne Shaw (JS), and my auxiliary supervisor, Professor Alexander Holden (AH).

Chapter 1: Introduction - The Growing Relevance of Cancer Treatment in Dentistry

SL wrote the chapter with guidance and feedback from JS. JS and AH read and approved the chapter.

Chapter 2: Aims and Objectives

SL wrote the chapter with guidance and feedback from JS. JS and AH read and approved the chapter.

Chapter 3: Study One - A Systematic Review of Dentists' Knowledge, Perception, Practice and Confidence in Managing Patients with Cancers

SL and JS conceived the research questions and the design of the systematic review. SL and JS screened articles for inclusion/ exclusion. SL and JS extracted data from the included articles and assessed the study quality. SL wrote the manuscript with guidance and feedback from JS. All authors (SL, AH, JS) read and approved the final manuscript.

Chapter 4: Study Two - Understanding Dentists' Views and Experience Managing the Oral Health of Patients with Cancers

SL co-designed the study with AH and JS. SL developed the survey questions with input from AH and JS. SL developed the interview guide with input from JS. SL conducted the interviews, and completed the study's quantitative and qualitative analysis. JS provided guidance and feedback on the quantitative analysis and cross-coded the qualitative analysis. SL wrote the manuscript with guidance and feedback from JS and AH, who also read and approved the final manuscript.

Chapter 5: Discussion and Conclusion - Insights from This Thesis: Relevance of Dentistry in Cancer Treatment

SL wrote the chapter with guidance and feedback from JS. JS and AH read and approved the chapter.

During the preparation of this thesis, ChatGPT and Grammarly were used for the purposes of text enhancements including sentence structure and grammatical checking. Where any text was modified by generative AI, the author then reviewed the resulting content for any errors or inaccuracies, and modified it as required. The author takes full responsibility for the submitted thesis and ensures the work is their own and has used generative AI within the parameters of use, see University of Sydney generative AI guide for researchers.

In addition to the statements above, in cases where I am not the corresponding author of the published article, permission to include the published material has been granted by the corresponding author.

As supervisors for the candidature upon which this thesis is based, we can confirm that the authorship contribution statements above are correct.

_____	_____
Professor Joanne Shaw	Professor Alexander Holden
20th of June 2025	20th of June 2025

Thesis Overview

Introduction

Cancer incidence is growing globally. Current treatment modalities are associated with adverse side effects including oral complications. Traditionally, dentists have been involved in managing the oral health of head-and-neck cancer patients as part of multidisciplinary teams. However, with the growing number of cancer patients undergoing various forms of cancer therapies and surviving, the broader involvement of dentists in oncology remains under-explored.

Aims

The Theoretical Domains Framework underpins this thesis. It aims to (i) explore existing literature on dentists' knowledge, perceptions, practice and confidence in managing the oral health of cancer patients; (ii) understand Australian dentists' experience in oncology, their knowledge of cancer therapies, confidence in managing cancer patients and factors impacting their engagement in oncology care.

Methods

This thesis includes two studies. Study one consists of a systematic review of the literature from 1990 to July 2023. Data were extracted from eligible studies using a framework approach and analysed using a narrative synthesis methodology. Study two is a mixed-methods study consisting of online surveys and semi-structured interviews of Australian dentists in clinical practice, conducted between October 2023 to March 2024. Quantitative data were analysed descriptively, and qualitative data were analysed thematically.

Results

Study one, a systematic review of the literature, found 53 studies met the eligibility criteria. Existing literature primarily investigated dentists' knowledge of oral cancer (k=28) and an additional two studies investigating knowledge of side effects of radiation therapy to the head-and-neck region. Five studies investigated the role of dentists in cancer care. Studies (k=14) exploring the management of cancer patients found specialist dentists had more involvement with cancer patients than general dentists. Overall, there were more barriers than facilitators identified for dentists to see oncology patients.

Study two, a mixed-methods study, recruited 88 participants for the survey, of which 28 participants were also interviewed. Despite the majority of participants having moderate to high cancer therapy knowledge and confidence, only a minority of participants had treated more than 10 cancer patients in the last 12 months. Thematic analysis of qualitative data revealed four main themes that influenced dentists' provision of patient-centred oral care to cancer patients: scope of practice, clinical practice interests, cancer care structure and patient-related factors.

Discussion and Conclusion

Given the complexity of cancer care, a shared care approach to oral health where dentists are recognised as part of an inter-disciplinary team is crucial for the provision of best practice patient-centred care. To implement this change, system and professional barriers must be addressed. Up-skilling general dentists to expand their scope of practice beyond head-and-neck cancers is critical.

Terminologies

This page provides context for some of the key words used in this thesis.

Cancer or **cancer more broadly**: refers to all types of cancer including head-and-neck and non-head-and-neck cancer.

Community dentist: refers to a dentist working in private or corporate, non-government practice within the community; this term does not include those working in government-funded clinics.

General dentist or **general dental practitioner:** refers to a dentist with a general registration with the Dental Board.

Head-and-neck cancer: refers to cancer involving the oral cavity structures as well as the sinuses and the larynx-pharyngeal regions. It excludes brain cancer and melanomas.

Inter-disciplinary: refers to health professionals, including medical professionals, collaborating across disciplines and with other health professionals.

Intra-disciplinary: refers to collaboration within a given profession. In this thesis, it refers to collaboration between dentists.

Multi-disciplinary team: refers to the existing team approach between the medical and other health professionals in a hospital setting. In this thesis, the terminology refers to the existing head-and-neck cancer care team.

Oral cancer: refers to cancer involving structures of the oral cavity such as the lip, the tongue, the mucosa and the salivary glands. It is a type of head-and-neck cancer.

Oral health provision: includes oral health screening (for example, examination of oral hard and soft tissues), management of oral hard and soft tissues, oral health promotion (for example, cigarettes/ alcohol cessation) and preventive advice (for example, fluoride application and oral hygiene instruction).

Primary care: refers to health professionals, including dentists, working primarily in the community providing preventive and management of ongoing health conditions.

Shared-care: refers to health professionals sharing care of a patient. The concept often applies to cancer patients in survivorship in the general medical practitioner models. In this thesis, reference to this terminology is made to include dentists in caring for cancer patients across the cancer continuum.

Specialist dentist: refers to a graduate dentist who has gone for further specialised training at a tertiary education facility and has a specialist registration with the Dental Board. In Australia, there are 13 recgonised specialised dental fields; dento-

maxillofacial radiology, endodontics, forensic odontology, oral and maxillofacial surgery, oral medicine, oral and maxillofacial pathology, oral surgery, orthodontics, paediatric dentistry, periodontics, prosthodontics, public health dentistry and special needs dentistry.

Chapter 1 – Introduction

The Growing Relevance of Cancer Treatment in Dentistry

Chapter Overview

This thesis seeks to understand Australian dentists' perspectives on managing cancer patients in the context of the increasing number of cancer diagnoses, the impact of cancer therapies on oral health and the broader lack of dental involvement in cancer care in Australia.

This chapter provides an overview of cancer prevalence, disease burden and cancer therapies. It examines how oral health is impacted by the different cancer therapies and provides an overview of the effectiveness of dental interventions. Further, it explores the available resources for dental professionals and attempts to identify research gaps.

The Problem

Cancer incidence globally was 20 million in 2022, and this rate is predicted to increase to 32.6 million cancer diagnoses by 2045 (1). In Australia, 165,000 new cases were diagnosed in 2023 and it is estimated that 1 million people are currently living with or beyond cancer (2). Cancer incidence in Australia is expected to rise due to general population increases combined with an ageing population to a total of 1.9 million cases between 2024 and 2033. The most commonly diagnosed cancers in Australia (excluding non-melanoma skin cancer) are breast, prostate, melanoma and colorectal cancer.

Despite increasing cancer incidence, mortality rates have fallen, with overall 5-year survival rates increasing from 53% in 1990-1994 to 71% in 2016-2020 (2) (see Figure 1.1). The improvement in survival is largely attributed to better cancer prevention and screening programs, improved vaccines and advancements in cancer therapies (3-5). The implementation of currently existing cancer diagnostic techniques such as positron emission tomography, X-ray computed tomography, magnetic resonance spectroscopy and molecular diagnostic techniques has enabled early detection of cancer and is instrumental for the therapeutic management of cancer patients (6). However, survival rates vary significantly between cancers. For example, in the last 20 years, the 5-year survival rate for breast cancer has improved from 79% (1991–1995) to 92% (2016–2020), and in colorectal cancer, from 56% (1991-1995) to 71% (2016-2020). In contrast, the survival rates for lung and brain cancers remain significantly lower with the current 5-year survival rates (2016-2020) of only 26% and 23%, respectively (7).

Figure 1.1: 5-year relative survival for all cancers combined in Australia (adapted from (7))

Despite these improvements in identification and treatment, cancer has the largest burden of disease, contributing to 16% of overall disease burden in Australia (7). Cancer accounts for 9.7% ($14.6 billion) of disease specific expenditure (7), and it is increasingly recognised that as more people live longer with cancer, the impacts of the disease and treatments are prolonged (8). Compounded with multiple rounds of treatment across treatment modalities, this results in more health service utilisation and costs to the health system.

Side Effects of Cancer

The primary goal of cancer treatment remains the elimination or control of the tumour, although cancer therapy may be preventive, curative or palliative, and can be used alone or in combination. These therapies include surgery, radiation therapy, chemotherapy, targeted therapy including immunotherapy, haematopoietic stem cell transplant (HSCT), hormonal therapy and bisphosphonates.

Each therapy interacts with the body differently, resulting in a range of side effects. Some are transient, while others are persistent and have a marked impact. Some adverse effects are more localised while others are more generalised. Amongst the reported adverse effects, nausea, vomiting, loss of appetite and fatigue are common (9-12). Additionally, negative emotions such as anxiety, depression, worry, fear, irritability, anger and guilt are also experienced by patients diagnosed with cancer (13-15). Subsequently, many patients reportedly have lower overall quality of life (16).

The following section will detail the common oral side effects of cancer therapies.

Oral Effects of Cancer Therapies

For patients with head-and-neck cancers, the impact of treatment on the oral cavity is particularly significant, with radiation therapy having short- and long-term complications to the oral structures (17). Further, surgical interventions in the head-and neck regions can result in significant aesthetic, functional, neurological, and psychological sequelae (18, 19).

However, for non-head and neck cancers, treatments are associated with adverse side effects that can directly or indirectly affect patients' oral health. It is reported that oral complications occur in 76% of patients receiving a stem cell transplant and 87% of patients receiving chemotherapy (20, 21). Although managing and eliminating tumour cells remain the primary goal of cancer treatment, oral complications can have a negative impact on the quality of life of patients (22). Whilst some of the complications are transient, others are irreversible.

Given the relatively recent introduction of targeted therapies, it remains unclear whether oral side effects of these drugs are under-reported or clinically significant (23), or if the oral manifestations are conflated with complications in radiation or chemotherapy (24, 25). However, a recent narrative review reports that patients on immunotherapy for selected relapsed or advanced cancers may experience oral immune-related adverse events such as lichenoid, pemphigoid and erythema multiforme reactions (26).

In this section, the adverse oral side effects of cancer therapies relevant to dentists are discussed. These are classified into primary and secondary effects of cancer therapies from existing literature.

Primary Effects of Cancer Therapies on Oral Health

Primary effects of cancer therapy typically begin at the start of therapy and persist for several weeks after therapy concludes (acute effects). Some of these primary effects may persist long-term or become significant months or years after cancer therapy (chronic effects). Common side effects are outlined in the following section.

Mucositis

One of the most significant side effects of cancer therapy is damage to the oral mucosa (oral mucositis). Mucositis affects the gastrointestinal tract including the oral cavity, causing pain and leading to altered oral function such as difficulty in eating, drinking, swallowing, speaking and malnutrition. Furthermore, mucositis is often associated with an increase of candida and an imbalance of oral micro-bacteria, leading to a more severe presentation with concurrent candidiasis (27). This may cause the patients to experience delays in their treatment and a reduction in their treatment dosage (28).

In patients undergoing radiation therapy to the head-and-neck region, mucositis typically begins during radiation therapy and persists for several weeks after the treatment concludes, and is strongly related to radiation dose as well as the addition of chemotherapy or targeted therapy (29, 30). Early radiation-induced changes are evident in the oral epidermis and mucosa, which may sometimes persist, leading to chronic changes (31). Histological evidence shows that 100% of head-and-neck cancer patients undergoing radiation therapy experience mucosal damage, though only 85% exhibit clinical symptoms (32).

Mucositis develops in approximately 20 to 40% of patients receiving conventional chemotherapy and 60 to 85% of patients undergoing hematopoietic stem cell transplantation (HSCT) (33). It is observed in 13.5% of patients after one cycle of chemotherapy (34). Also, poor oral hygiene and denture wear are found to be significantly associated with oral mucositis (34). Patients receiving combined chemotherapy and radiation therapy to the head-and-neck region encounter more severe and frequent mucositis (35). The presence of mucositis is significantly ($p<0.005$) related to poorer quality of life (specifically oral health-related quality of life) amongst patients undergoing chemotherapy (36).

Additionally, mucositis has been noted in patients on targeted therapy (23, 24). A review study of mammalian target of rapamycin (mTOR) inhibitors by Martins et al (37) observed that 73.4% of all patients (n=2033) had mucositis. Ulceration of the mucosa involves non-keratinised tissues such as the ventral surface of the tongue, floor of the mouth and labial and buccal mucosa. These ulcerations often are apthous-like lesions and reported to be milder in nature (38). The lesions are different to those observed in chemotherapy and radiation therapy and tend to resolve despite the continuation of targeted therapy (39).The ability to recognise mucositis clinically and understand its relation to drug therapy means that dentists are in a better position to educate and advise patients on appropriate management.

Salivary Glands Dysfunction

The salivary glands secrete saliva, a fluid composed of approximately 99% water and 1% electrolytes, proteins, mucins and other bioactive molecules, that regulate the oral environment and protect oral tissues including the dentition (40). There are three major salivary glands: the parotid, submandibular, and sublingual glands which account for 90% of saliva production, and numerous minor salivary glands scattered in the mucosa of the oral cavity which make up the remainder of saliva production (41).

Saliva serves several essential physiological functions. It lubricates both hard and soft tissues, facilitating oral function. Specifically, bicarbonate (HCO_3^-) serves as the primary buffering system, neutralising acids derived from food and bacterial metabolism. Additionally, proteins, glycoproteins, mucins and lipids contribute to forming the acquired enamel pellicle. This protective layer slows acid penetration and minimises enamel demineralisation, ultimately reducing the risk of cavities. Salivary

proteins and peptides exhibit anti-microbial activity, further supporting oral health. Mucins aid in bolus formation and swallowing, while α-amylase plays a role in carbohydrate digestion. Moreover, saliva dissolves taste substances in food and distributes them to taste receptors on the tongue (40).

An understanding of saliva's multifaceted functions underscores the critical role salivary glands play in taste perception, mastication, swallowing, and speech. Impairment of salivary gland function, whether due to local pathology (such as tumour) or systemic (such as drugs) factors, can result in reduced salivary flow (hyposalivation) and the sensation of dry mouth (xerostomia) (40). In particular, hyposalivation as a result of cancer treatment diminishes saliva's protective effects on the oral environment, increasing the risk of oral complications (41-43). Dentists have an important role in detecting and managing the effects of hyposalivation.

Following radiation therapy to the head-and-neck region, research has shown that the prevalence of xerostomia is lower where major salivary glands are spared from radiation (41, 44, 45). Studies have demonstrated that advanced techniques such as intensity modulated radiation therapy and 3-dimensional radiation therapy reduced the risk of hyposalivation (41, 45). When a 60 Gy radiation dose reaches the major salivary glands, the saliva flow rate decreases and continues to decline even after the radiation therapy ends, with little to no significant recovery (44). Furthermore, xerostomia may improve over time in patients whose parotid glands are spared (46). Although radiation to the body outside of head-and-neck region can alter the immune system, leading to the abscopal effect (47), its clinical significance in oral health is unknown. However, xerostomia has been reported amongst patients receiving total body irradiation (44).

In a recent cross-sectional study (n=169), almost 90% of chemotherapy patients experienced oral complications, with xerostomia being the most common complaint, followed by dysgeusia (altered taste) (21). Pre-conditioning cancer therapies before HSCT can also lead to salivary gland dysfunction (43, 48).

Oral Opportunistic Infection

An opportunistic infection is caused by an imbalance in the host's immune system, an altered microbiota, or a breach in the epithelium such as mucosal ulceration (27, 49). Patients with myelosuppression such as those undergoing chemotherapy, radiation and pre-conditioning therapy are particularly susceptible to oral opportunistic infections (27, 43). Additionally, hyposalivation reduces the anti-microbial properties of saliva, further increasing the risk of such infections (40).

A systematic review of virus infections in oncology patients (k=14) found an oral herpes simplex virus prevalence of 49.8% in neutropenic patients (50). Another common infection amongst cancer patients is candidiasis, a fungal infection (30, 51). Clinically, patients can present with a range of symptoms, from being asymptomatic to experiencing burning sensitivity, odynophagia (pain during swallowing), or dysgeusia. Diagnosing of candida can be challenging because the symptoms may overlap with

those of mucositis (30). In addition, an increase in cariogenic bacteria such as *Streptococcus mutans* has been observed during chemotherapy (52).

Awareness of the potential changes in microbes in oral flora help dentists to pre-empt potential problems and implement preventive strategies to manage opportunistic infection of cancer patients undergoing therapies.

Oral Bleeding

Bleeding is a common problem in cancer patients; it could be due to the tumour itself or myelosuppression from cancer therapy (53-55). Increased risk of bleeding is also associated with targeted therapies such as bevacizumab (Avastin) (55). Further, cancer patients may receive non-steroidal anti-inflammatory drugs (NSAIDs) or anticoagulants, which further predispose them to bleeding episodes (53). Spontaneous bleeding can occur if a patient's platelets count is less than $20{,}000 \times 10^6$ /L (55). In a study of bleeding episodes in advanced haematology malignancy patients (n=469), gingival bleeding (oral bleeding) was reported to occur in 19% of patients (56).

Awareness of potential bleeding episodes is pertinent to dentists to help them discern oral bleeding from cancer or cancer therapy, trauma to the oral tissues, or existing periodontal issues. Furthermore, some dental procedures such as extraction or subgingival scaling can further exacerbate bleeding. Therefore, dentists must be familiar with procedures and measures to manage and stabilise haemorrhagic episodes in clinical settings.

Dysgeusia

Dysgeusia, also known as altered taste, is an adverse oral effect of cancer therapies that is often overlooked (57). Although dysgeusia is not life-threatening, impaired taste is associated with poor nutritional intake, weight loss and consequently decreased quality of life (57). Altered taste is observed following radiation therapy to the head-and-neck region, chemotherapy and targeted therapy (17, 23, 55, 58). A systematic review exploring dysgeusia associated with cancer therapies (k=14) found a weighted prevalence of 56.3% for chemotherapy, 66.5% for radiotherapy, and 76% for combined radiation-chemotherapy (59).

While dysgeusia associated with chemotherapy often resolves six months after cessation of treatment (60), it appears to persist long term in 15% of patients post-radiation (59) and in patients receiving trastuzumab (a targeted therapy) (60). The mechanism of dysgeusia following cancer therapy is not fully understood and is likely to be multifaceted. It may involve dysfunction in the taste receptors and associated neural pathways (59), as well as hyposalivation (40). Moreover, chemotherapeutic drugs, due to their bitter tasting compound, may cause bitter and metallic sensations (59). A list of dysgeusia-associated drugs is presented in Table 1.1.

It is important for dentists to have an awareness of dysgeusia from cancer therapy as they can play a role in advising a healthy diet in cancer patients.

Dysphagia

Normal swallowing involves five phases: pre-oral, oral preparatory, oral transit, pharyngeal, and oesophageal phase. It is a complex biomechanical interaction requiring physiology of saliva and important anatomical structures such as musculature and the nervous system (61). Sensory elements such as taste and smell play an important role in swallowing (61). Disruption to the physiological and anatomical structures, such as the presence of a tumour, surgery, or cancer therapy, can lead to difficulty in swallowing (dysphagia) (62).

Dysphagia is a significant oral adverse effect in patients with head-and-neck cancer due to the effects of surgery, radiation, and/ or combination chemoradiation therapy (63, 64). Swallowing disorders have also been reported in non-head-and-neck cancer patients with oropharyngeal mucositis as a result of therapy toxicities associated with chemotherapy and targeted therapy (23, 24, 55, 62). Malnutrition and aspiration are complications of dysphagia affecting patients' quality of life (48). Notably, in a multivariate analysis of head-and-neck cancer patients (n=407), the severity of dysphagia was found as an independent predictor of survival (65).

Trismus

Trismus is a limited opening of the mouth at 35mm or less (66). Cancer-related trismus is common in head-and-neck cancer patients (17, 58, 67), and has been implicated in patients with Graft-versus-Host Disease (GVHD)-related sclerodermatous disease (68). A meta-analysis (k=15 studies, n=2786 patients) of head-and-neck cancer patients receiving surgery, radiation therapy and/ or chemotherapy found the weighted prevalence of trismus increased from 17.3% at the beginning of treatment, to a peak of 44.1% at 6 months, and 32.1% at 12 months, and stabilised at an average of 32.6% at 3-10 years (69). In a retrospective study (n=246) of head-and-neck cancer patients, trismus incidence was the highest for those treated for parotid gland tumours followed by nasopharyngeal cancers (70). This is possibly due to the location of tumours near the temporomandibular joint. Furthermore, poor oral function at baseline and radiation therapy dosage of greater than 50 Gray are related to the development of trismus (70). Severe trismus can impair oral functions such as mastication and speech (68).

Several mechanisms have been suggested for trismus. A detrimental effect of radiation therapy is the excessive production of reactive oxygen and nitrogen species, which can lead to cell dysfunction or apoptosis (cell death) (31). The disruption to normal cellular behaviour is thought to be the primary inducer of nonspecific fibrotic changes (31). One of the significant effects of this fibrosis on masticatory muscles that support the temporomandibular joint is the restriction of mouth opening. Other mechanisms

suggested in the fibrotic changes include microvascular damage and loss of stem cells necessary for tissue regeneration (71), and nerve damage (66). Trismus can impact a patient's oral hygiene practice and create challenges for performing dental procedures.

Dental Neurotoxicity

Dental neurotoxicity, or dental pain, is a persistent, deep aching, and burning pain that mimics a toothache, with no dental pathology (72). Although this complication is not widely reported, anecdotal evidence has been documented in cancer patients undergoing chemotherapy (73). Chemotherapy-induced dental neurotoxicity can present a diagnostic challenge for dentists, as it is based solely on symptoms, with no clinical signs or radiographic evidence of pathology (74). Table 1.1 summarises a list of chemotherapy drugs that could potentially cause oral side effects including dental neurotoxicity (55, 73, 75-80).

Table 1.1: Examples of chemotherapeutic drugs and oral side effects

Classification	Examples	Mechanism of actions	Oral side effects
Alkylating and alkylating-like agents	Platinum derivatives (eg oxaliplatin, cisplatin, carboplatin)	Selective inhibition of tumour DNA synthesis	Dysgeusia Myelosuppression Mucositis Candidiasis
	Busulfan		Hyperpigmentation
	Cyclosphosphamide		Dental neurotoxicity Dysgeusia Hyperpigmentation
Antimetabolites	Mustard gas derivatives (eg cyclophosphamide)	Interfere with DNA and RNA synthesis	Dental neurotoxicity Dysgeusia Hyposalivation
	Pyrimidine antagonist (eg 5-fluororacil)		Mucositis Dysgeusia Hyposalivation Hyperpigmentation Myelosuppression Candidiasis
	Purine antagonist		Mucositis
	Folic acid antagonists (eg methotrexate)		Mucositis Hyposalivation
	Hydroxyurea		Hyperpigmentation
Anti-tumour antibiotics	Anthracycline (eg, doxorubicin, epirubicin)	Interfere with RNA and DNA synthesis	Mucositis Dysgeusia Hyperpigmentation Hyposalivation
	Others (eg bleomycin)		Mucositis Hyperpigmentation
Plant alkaloids, also known as anti-microtubules	Vinca alkaloids	Inhibit mitosis by binding to microtubule proteins during metaphase	Mucositis Dental neurotoxicity
	Taxanes (eg docetaxel & paclitaxel)		Mucositis Dysgeusia

NB: Dental neurotoxicity is defined as toothache with no clinical sign

Graft-versus-Host Disease

Graft-versus-host disease (GVHD) is a unique complication arising in allogenic HSCT patients where the donor immune cells react with the host organs (55). There are two types of GVHD: acute and chronic GVHD. Historically, acute and chronic GVHD were believed to occur sequentially, with chronic GVHD emerging after 100 days post-transplant. However, they are now diagnosed based on clinical presentation and may arise in a non-sequential manner or occur concurrently. Chronic GVHD is a systemic disease with signs and symptoms that mimic autoimmune diseases (81). Oral manifestations are common and may include gingiva desquamation, erythema, lichenoid-like appearance mucosa atrophy, ulceration, mucocele, and salivary hypofunction (43, 81, 82). Notably, patients with chronic GVHD are at a higher risk of developing oral cancer (81).

Interestingly, immune checkpoint inhibitors, particularly ipilimumab, can induce toxicities that share many common features with chronic GVHD (23). Oral manifestations of GVHD in targeted therapy recipients may resemble those of autoimmune diseases including lichen planus and Sjogren syndrome. (23). Recognising the potential changes in oral health of these patients enables dentists to better identify clinical presentations and provide effective supportive care.

Facial Disfigurement

Facial disfigurement is one of the obvious consequences of surgery to remove tumour in the head-and-neck region. This disfigurement can significantly affect the quality of life of patients. Research has reported that oral cancer patients undergoing surgical and adjuvant therapy not only experience disfigurement but also reduced oral function, speech and swallowing resulting in issues with intimacy, poor emotional health, and fear of cancer recurrence (83). Similarly, a study involving head-and-neck cancer patients (n=30) undergoing reconstructive surgery also reported significant difficulties in oral function such as swallowing ($p < 0.001$) and speech ($p < 0.001$). Additionally, over 60% of patients were diagnosed with depression and anxiety (84).

Osteonecrosis of the Jaw

A significant side effect of anti-tumour drugs is medication-related osteonecrosis of the jaw (MRONJ). MRONJ is defined as “a condition of exposed bone or bone that can be seen through an intraoral or extra-oral fistula in the maxillofacial region, which occurs for more than 8 weeks in patients receiving drugs without a history of head-and-neck radiation therapy” (85). It is the cumulative delayed effect of specific cancer therapy drugs on oral health and often occurs post-extraction (86). A systematic review of the incidence of MRONJ (k=88) found that the incidence associated with bisphosphonates and denosumab is <0.001% in the general population but 1%-15% in oncology patients

where these drugs are administered in higher doses and at more frequent intervals (87). The duration to onset of bone necrosis is approximately 12 months parentally or 36 months orally (88). Although in a retrospective study of 29 oncology patients receiving bisphosphonates or denosumab, the onset of MRONJ was observed in as few as 5 doses, with an average onset after 51 doses of bone-modifying agents (89). In recent years, MRONJ has also been observed in cancer patients on newer cancer therapies such as targeted molecular and immunological drugs (85, 90). According to the Australian database of adverse event notifications, MRONJ has been reported in patients receiving bisphosphonates or denosumab concurrently and anti-neoplastic medications such as cyclophosphamide, docetaxel, lenalidomide and thalidomide (91).

Osteoradionecrosis of the jaw (ORNJ) can occur in patients post-radiation to the head-and-neck region. Whilst the aetiology for ORNJ is unknown, the patients must have a history of irradiation to the jaw (86). Clinically, patients with ORNJ or MRONJ present with exposure of necrotic bone, however, whilst MRONJ is commonly precipitated by extraction, this is not the case for ORNJ (92). Further, patients with ORNJ complained of more pain ($p=0.0108$) and experienced more pathological fractures ($p<0.0001$) and skin fistulae ($p<0.0001$) compared to patients with MRONJ (92).

Risk factors pertinent to dental considerations include: systemic disease factors such as age, diabetes, renal failure, use of cigarettes, concurrent use of chemotherapy drugs and immunosuppressants; and local risk factors include oral infection, intra-oral trauma, poor oral hygiene and invasive dental procedures (88). Performing invasive dental procedures such as placing an implant, periodontal debridement, tooth extraction and having an ill-fitting removable prosthetics (93) with limited understanding of the local and systemic risk factors can result in MRONJ causing discomfort and poor quality of life for patients (94).

Secondary Effects of Cancer Therapy on Oral Health

Secondary effects of cancer therapy are the indirect effects of cancer therapies due to primary effects disrupting patients' normal function.

Periodontal Disease

Cancer patients undergoing cancer therapies have been reported to have higher rates of periodontal disease (95-97). Although not a direct consequence of cancer therapy, periodontal disease can have a detrimental effect on oral health, leading to tooth loss and eventual loss of oral function. Systemic effects of cancer therapy such as nausea, vomiting and tiredness can contribute to poor oral hygiene practices, thereby exacerbating the risk of periodontal disease.

Periodontal disease encompasses a range of chronic inflammatory conditions affecting the gingiva, bone and periodontal ligaments that support the teeth. Gingivitis is an inflammation of the gingiva induced by plaque accumulation. If the presence of plaque

is left untreated, gingivitis can progress to periodontitis, which involves the destruction of the gingiva, bone and periodontal ligaments, leading to tooth loss (98). Factors contributing to periodontal disease in healthy individuals include the presence of plaque and a reduction in host defences. In head-and-neck cancer patients, ligament attachment loss was found to be greater within the field of radiation (99).

Research on periodontal disease following cancer therapy is scant. Further, it is difficult to quantify periodontal disease due to the variability in reporting methods and categorisation (95). However, one systematic review exploring dental disease in patients undergoing cancer therapy (k=3) found the weighted prevalence of severe gingivitis was 20.3% in patients post-chemotherapy (95).

Dental Caries

Another major dental complication following cancer therapy is dental caries (54). Dental caries is not a direct consequence of cancer therapy, but occur as a result of a loss of equilibrium in tooth demineralization-remineralization leading to mineral loss and damage to the organic phase of tooth structures, presenting clinically as cavitation (30). A review on dental diseases in cancer patients (k=64) found the weighted overall prevalence of dental caries is 28.1% following cancer therapy (95). This review included survivors of childhood cancer, highlighting the long-term impacts of cancer on dental health. For patients receiving head-and-neck radiation, the risk of dental caries (radiation-induced caries) is lifelong (35) with prevalence increasing from 36% at three years to 74% seven years after treatment (100).

Factors such as hyposalivation, altered diet, an increase in cariogenic bacteria and a reduction in immunity contribute to a heightened risk of dental caries (101). The decrease in quantity and altered quality of saliva impairs the teeth's protective mechanisms (102). Further, dysgeusia from cancer therapy often results in impairment of bitter and acid flavours more than the perception of salt and sweet flavours, leading to frequent craving for sweet foods and a poorer diet (35). Additionally, cariogenic bacteria, such as Lactobacillus and Streptococcus mutans, have been observed to increase in cancer patients, contributing to the development of caries (103). If caries becomes extensive, the affected tooth may be unrestorable, leading to inevitable tooth loss.

Tooth Loss

Tooth loss can be an indirect consequence of cancer therapy, occurring through hyposalivation-related dental diseases, particularly in patients who have received radiation to the head and neck region. (17). The rate of tooth loss following radiation therapy is dose-dependent, with significant tooth loss occurring in the first four years at doses greater than 40 Gy, and further tooth loss continuing in patients receiving doses greater than 60 Gy (see Figure 1.3) (17). The use of cetuximab (a targeted therapy) in

combination with radiation therapy has also been associated with significant tooth loss in a small cohort sample (17).

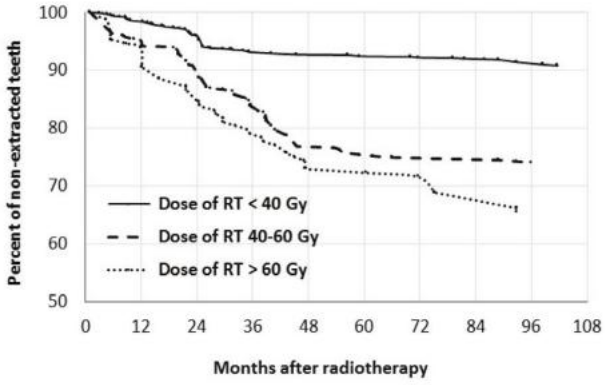

Figure 1.2: The number of teeth surviving as a percentage in patients with three differing radiotherapy (RT) doses (adapted from Kovarik, Voborna (17))

In summary, managing pre-existing dental diseases such as caries and periodontal diseases is crucial, as cancer therapy can exacerbate these conditions and lead to additional cancer-related oral complications. A retrospective audit of dental records (n=175) of head-and-neck cancer patients found 87% had pre-existing dental pathologies, which included carious lesions (66%), pulpal or periapical pathology (21%), gingivitis (20%) and periodontitis (71%) (104). Another cross-sectional analysis of women diagnosed with breast cancer (n=160) found that 48% had periodontal issues (36). These findings highlight the critical role of dentists in the early detection and management of dental disease prior to cancer therapy. Failure to address these conditions before treatment can worsen existing dental pathologies due to the detrimental effects of cancer therapy on oral health. Given the significant impact of oral complications on patient outcomes, timely dental interventions are essential in minimising risks and optimising oral health before, during, and after cancer treatment.

The following section will discuss the basis for dental involvement in patients undergoing cancer treatment.

The Effectiveness of Dental Involvement

Optimising oral health before cancer therapy is critical in preventing treatment-related oral complications. Since each treatment affects oral health to varying degrees, the need for active dental involvement will depend on the specific treatment. As patients complete their course of therapies, regular dental follow-ups are essential to maintain stable oral health, restore oral function and improve quality of life. This section will

incorporate the existing literature in discussing the effectiveness of dental involvement for cancer patients.

It is accepted that dentists are an essential part of multi-disciplinary teams in managing patients with head-and-neck cancers (18, 58, 105). However, fewer experimental studies provide evidence for the effectiveness of dental intervention. In a study by Nunez-Aguilar et al (106), the authors compared head-and-neck cancer patients who received dental monitoring and necessary intervention to manage dental diseases to patients who only received oral hygiene instructions, and found the intervention group had superior oral health post-treatment. Further, the authors found that the intervention group demonstrated more effective chewing abilities and consequently were able to eat an improved diet and quality of life compared to the control group (107). From an economic perspective, a review of health fund reimbursements showed that dentists' involvement in oral and oropharyngeal cancer resulted in lower costs and shorter treatment duration for acute complications (108).

The effectiveness of dental interventions in patients with cancer more broadly was first documented by Sonis and Kunz (109). In their 8-year retrospective study incorporating oral evaluation, aggressive elimination of existing or potential sources of dental infection, prophylactic antifungal regimens, oral hygiene instruction, use of topical fluoride and frequent follow-up reduced the overall prevalence of oral complications from 40% to 13% in patients with non-head-and-neck cancers receiving chemotherapy and/or radiation as adjuvant therapy. Since then, several studies have reported similar positive outcomes in reducing oral side effects of cancer therapy. For example, in a quasi-experimental study of bone metastasis patients treated with bisphosphonate therapy, patients receiving pre-therapy dental screening and necessary dental care (n=154) was compared to patients who received dental review only (n=812). There was a notable reduction in the incidence of MRONJ (from 3.2% to 1.3%) compared to the control groups (110). In a prospective study, breast cancer patients undergoing chemotherapy were randomised into a control group (n=14), who managed their own oral hygiene, or an experimental group (n=12), who were assessed weekly and monitored closely for their oral hygiene and diet. Both groups received pre-dental screening, and restorations, extractions and periodontal treatment were performed as necessary. The experimental group with regular monitoring of oral health experienced less mucositis and maintained their stable oral health status (111). In a multi-centre, retrospective, case-control study of patients undergoing thoracoscopic resection of oesophageal cancer (n=775), peri-operative oral care was associated with a reduction of post-operative pneumonia (112).

In the context of haematological cancer, there is some evidence that dental involvement in patient management results in positive results. In a prospective study, 41 haematological patients undergoing HSCT received pre-dental therapy screening while dental interventions such as restorations, extractions, periodontal scaling and root canal therapy were provided as needed. None of the patients developed odontogenic infection while they were immunosuppressed (113). However, the study

lacked a comparison group to determine its effectiveness. Similarly, Suwabe et al (114) compared an intensive oral care group (n=111), who received pre-therapy dental screening and necessary dental care, to a self-care group (n=95), where dental interventions were only provided when oral complications arose. This study found that the intensive oral care group had a significantly lower incidence of bloodstream infections (p=0.008). In another prospective study, 202 cancer patients who received pre-therapy dental screening and necessary dental care to ensure optimal periodontal health before HSCT, had reduced incidence of oral mucositis (115). Moreover, in a prospective study of 66 haematological cancer patients undergoing chemotherapy, patients were compared between those who completed the pre-dental screening protocol and care, and those who partially completed the protocol. Complete implementation of the dental intervention protocol was associated with fewer oral and systemic complications (116). Similarly, in a randomised control study of 34 leukaemia patients undergoing intensive chemotherapy, the dental care group with pre-therapy dental screening experienced less mucositis (114). Further, it is hypothesised based on extrapolation of the data that the intervention of dental treatment prior to HSCT would prevent 1.8 mortalities in every 100 patients and reduce systemic infections by approximately one-third (117).

The involvement of dentists in oral screening and provision of necessary care has been shown to be beneficial in patients undergoing cancer therapy, especially in reducing complications and exacerbations of existing dental conditions and improving quality of life.

Current Oral Health Care Practices

Patients with cancer outside of head-and-neck region do not routinely receive information about oral complications or oral care before treatment (80). Compounding this is that oral health care professionals are seldom included in the oncology team (80). A recently published Australian study found not all head-and-neck cancer units have dentists or established dental pathways (118). Moreover, to our knowledge, there is currently no data on the level of dental involvement in the care of non-head-and-neck cancer patients, both within and beyond hospital settings. In many cases, oncology staff are tasked with oral care assessment and oral hygiene instructions, and their lack of specialised knowledge means they are inadequately positioned to recognise adverse oral conditions (119, 120).

Research has shown the importance of pre-therapy oral health screening, regular monitoring, and long-term oral care throughout cancer treatment and into survivorship for cancer patients, particularly in reducing the risk of oral complications. Dentists play a crucial role in comprehensive care throughout the cancer treatment process (121). However, a recent Australian study found that cancer patients have poorer existing oral health status compared to the general population (97). Despite the importance of oral health, integration of dental care into oncology management plans is still inadequately

addressed within the healthcare system in Australia. This is evident in the recently published Australian Cancer Plan, which does not recognise the role of dentists and overlooks the need to incorporate oral health into optimal care pathways for cancer more broadly (122).

Integration of dental services within oncology care is further compounded by the fact that dental services tend to be dispersed across independent practices in the community and funded privately. In Australia, approximately 84% of dentists work in private practices, while only 16% are employed in the public sectors (123). Although there are a number of comprehensive cancer care services that include dental care, access to these services is limited. Publicly-funded dental care is generally restricted to patients with concession cards and has long wait lists, many cancer patients are unable to access these pathways until they have been to hospital and/ or commencement of medical intervention. The long wait lists and eligibility restrictions often force cancer patients to seek privately funded dental services, hence further complicating the integration of dental care into the oncology care continuum.

Existing Dental Guidelines for Clinical Dentistry

Internationally, dental guidelines have been developed to improve the management of the oral health of cancer patients. The National Institutes of Health and the National Institute of Dental and Craniofacial Research in the United States have developed evidenced-based dental guidelines for dentists on oral management of pre-, peri- and post-cancer therapies, specifically radiotherapy to the head-and-neck region, chemotherapy and HSCT. Similarly, the British Society for Disability and Oral Health has developed clinical guidelines for dentists to manage patients undergoing cancer therapies (124). The Canadian Dental Oncology Network Head and Neck Guidelines were established for patients undergoing head and neck radiation in 2021 (125), and McMaster University in Canada, together with support from Cancer Care Ontario created evidence-based care guidelines for oral issues from cancer therapies (126). The European Oral Care in Cancer Group has guidelines for the management of mucositis, a common side effect of cancer therapy (127).

More recently, the Multinational Association of Supportive Care in Cancer (MASCC) Oral Care Study Group, an international multidisciplinary cancer supportive group collaborative, has updated and developed evidence-based guidelines for oral complications from cancer therapies. To date, guidelines have been produced for the prevention of MRONJ (128), management of GVHD oral manifestations (129), management of xerostomia (130) and management of oral complications of targeted therapy (131). However, to our knowledge, there is no Australian guideline developed to assist dentists in the provision of cancer-related dental care. In the absence of guidelines, organisations such as Head-and-Neck Cancer Australia, Cancer Council, Australian Dental Association, Dental Health Services Victoria and South Australian Health have developed resources to support dentists providing oral cancer care. The

Oral and Dental Therapeutic Guidelines also contain limited content related to chemotherapy and radiation therapy to the head-and-neck cancers. However, the use of these resources by dentists is unknown.

Dentists' Readiness in Managing Patients with Cancers

Community-based dentists can effectively prevent and manage oral and dental complications associated with cancer treatment, provided there is appropriate communication and collaboration with oncology professionals (48). Adequately trained dentists are a valuable resource for the community by providing safe and effective oral care for cancer patients. Recent studies have explored dentists' readiness to treat patients with special needs (132-135), as well as the barriers to providing such care (136, 137). While the term 'special needs patients' encompass a broad spectrum including individuals with medical, physical, psychological, and/or social conditions (138), literature has not specifically investigated oncology patients.

However, in a qualitative study of Australian dentists working in publicly funded practices in Victoria, Lim et al (134) found that oncology patients were perceived as a particularly challenging group to manage. Despite this, most existing research focus has been on screening for oral cancers as well as knowledge and practice of head-and-neck cancer patients (139-142). The focus on head-and-neck cancer research highlights the gap in oral care and the role of dentists in oncology patient management in Australia in cancer other than head-and-neck cancers. This thesis will focus on exploring Australian dentists' views and willingness to provide oral care for cancer patients beyond head-and-neck cancers.

Chapter 2 – Aims and Objectives

Establishing the Basis for this Project

Introduction

With advancements in cancer care, the management of cancer has shifted beyond focusing solely on treatment to a more holistic approach to patient management (143). Increasingly, supportive care is recognised as an integral part of comprehensive cancer management, addressing the needs of patients throughout the disease continuum. The primary objectives of supportive care include reducing treatment toxicities, improving tolerance to therapy, and ultimately maximising quality of life (144).

Despite the increasing recognition of the role of dentists in supportive care of cancer patients (145-147), little is known about dentists' perspectives in managing patients with cancer. Oral health is an important yet often overlooked aspect of cancer care, even though cancer therapies often result in oral complications. While oral side effects may receive less attention in the context of wider cancer treatment, left untreated, they contribute to more severe secondary dental diseases such as caries, oral infection and tooth loss, and can affect oral function. This project focuses on the critical issues at the intersection of dentistry and oncology by examining the views of dentists in the context of cancer care.

Theoretical Framework

A major driver of change in clinical practice is individual health care practitioners (including dentists) willingness to modify their current practice to provide evidence-based cancer care. This thesis uses implementation science principles to explore behaviour change in dentistry. Implementation science is the systematic study of methods to promote the integration of research findings and evidence-based practices into routine practice, hence improving the quality and the effectiveness of healthcare (148). Specifically, this thesis seeks to understand the barriers and facilitators to the provision of supportive dental care for oncology patients in the context of dentistry using the Theoretical Domains Framework (TDF) to guide the research.

TDF can provide comprehensive insights into the factors influencing behaviours and serve as a foundation to promote change. TDF is a determinant framework that Nilsen (149) constructed based on synthesising 128 constructs related to behavioural change across 14 theoretical domains (150). Table 2.1 gives a brief overview of TDF's domains and their associated constructs. These widely researched domains help identify barriers and facilitators to implementation challenges in dentistry and support behavioural change in the context of supportive dental care into oncology care (151).

A previous scoping review using comprehensive TDF approach in the context of dentistry, specifically examining the delivery of preventive oral care amongst general dentists, identified the domains of knowledge, social/ professional role and identity, belief about capabilities, belief about consequences, environmental context and resources, and skills as most pertinent (152). Similarly, research applying the TDF to healthcare professionals' discussion of HPV-link with head-and-neck cancer patients

identified additional domains, including social influences and behavioural regulations (153). Guided by these findings, five domains selected were for this study: knowledge, skills, social/professional role and identity, beliefs about capabilities and environmental context and resources, although throughout the research other potential domains were considered.

The domains of knowledge and skills were included as they are essential for clinical practice, particularly in synthesising the implications of overall cancer treatment on dental treatment planning and patient management. The domain of beliefs about capabilities was selected as individual clinician perceptions influence whether they feel confident in applying their expertise, which is fundamental to understanding the likelihood of dentists' practicing in oncology. Furthermore, the professional role and identity domain is particularly relevant, as most dentists work in community-based private or corporate businesses rather than in regulated public hospitals. These varied practice environments, each shaped by unique business philosophies, underscore the domain's influence on the practice of dentistry. Finally, the environmental context and resources domain was selected as it influences whether dentists have the necessary tools and support to perform oncology-related tasks.

These five domains were chosen as part of an iterative process, to help inform systematic review questions, the results of which in turn influenced the focus of the mixed-methods study. Specifically, the research objectives of this thesis were framed to gain an understanding of dentists' perspectives on their cancer knowledge (including procedural knowledge), practice skills, perceived professional role, and self-confidence in managing cancer patients as well as the resources they have or may need to facilitate managing the oral health of people with an experience of cancer.

Table 2.1: Theoretical Domains Framework (adapted from Cane et al (150))

Domain	Definition	Constructs
Knowledge	An awareness of the existence of something	Knowledge (including knowledge of condition /scientific rationale) Procedural knowledge Knowledge of task environment
Skills	An ability or proficiency acquired through practice	Skills Skills development Competence Ability Interpersonal skills Practice Skill assessment
Social/ Professional Role and Identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	Professional identity Professional role Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organisational commitment

Domain	Definition	Constructs
Beliefs about Capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence Perceived competence Self-efficacy Perceived behavioural control Beliefs Self-esteem Empowerment Professional confidence
Optimism	The confidence that things will happen for the best or that desired goals will be attained	Optimism Pessimism Unrealistic optimism Identity
Beliefs about Consequences	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation	Beliefs Outcome expectancies Characteristics of outcome expectancies Anticipated regret Consequents
Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Rewards (proximal / distal, valued / not valued, probable / improbable) Incentives Punishment Consequents Reinforcement Contingencies Sanctions
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions Stages of change model Transtheoretical model and stages of change
Goals	Mental representations of outcomes or end states that an individual wants to achieve	Goals (distal/ proximal) Goal priority Goal / target setting Goals (autonomous / controlled) Action planning Implementation intention
Memory, Attention and Decision Processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory Attention Attention control Decision making Cognitive overload / tiredness
Environmental Context and Resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Environmental stressors Resources / material resources Organisational culture /climate Salient events / critical incidents Person x environment interaction Barriers and facilitators
Social Influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity Modelling

Domain	Definition	Constructs
Emotion	A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear Anxiety Affect Stress Depression Positive / negative affect Burn-out
Behavioural Regulation	Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring Breaking habit Action planning

Aims and Objectives

The oral care of cancer patients is an important component of dental practice. However, in Australia, dental care of cancer patients is still primarily centred on head-and-neck cancers. This is despite acknowledgement and advocacy for an expanded role of general dentists in caring for patients with cancers (145), both during and after cancer treatment. Little is known about the readiness and preparedness of practicing dentists to manage the oral health of cancer patients.

Therefore, this thesis aimed to:

a) synthesise the existing literature on dentists' perspectives of oral health provision to cancer patients using a systematic review methodology (study one in Chapter 3);
b) explore Australian dentists' views and experiences in managing cancer patients using both qualitative and quantitative methods (study two in Chapter 4); and
c) provide recommendations to enhance supportive care for cancer patients using study findings in relation to current research and practice (Discussion in Chapter 5).

Specifically, the objectives for study one (systematic review) were to:

a) systematically explore the literature on dentists' knowledge, perceptions, clinical practice, and confidence in treating cancer patients; and
b) identify the barriers and facilitators to dentists in providing oral health care.

The objectives for study two (mixed-method study) were to:

a) identify Australian dentists' knowledge of cancer therapy and oral health management of cancer patients;
b) understand Australian dentists' clinical experience and confidence in cancer care;
c) investigate Australian dentists' perceived role in managing cancer patients;
d) synthesise barriers and facilitators to managing cancer patients in Australia.

Outcomes and Significance of this Project

Global and Australian statistics demonstrate that cancer incidence is rising, and dentists will inevitably encounter an increasing number of cancer patients in their clinical practice. However, to date, research exploring dental involvement in cancer has primarily focused on head-and-neck cancers. This is despite therapies targeting cancers outside of the head-and-neck region having primary and secondary effects on oral health. The first step to implement change in clinical practice is to understand the current clinical practice of dentists in Australia. Therefore, this research will:

a) enhance our understanding of dentists' current clinical practice, their willingness and confidence in increasing participation in cancer care;
b) identify the factors that dentists perceive impact most on their ability and willingness to provide care to cancer patients, and therefore to inform strategies for practice change to meet the growing demand for oral health care in cancer patients; and
c) address the organisational, professional and patient-level barriers to increasing dental involvement in cancer care, to improve the oral health care provided as part of holistic oncology supportive care within the Australian health setting.

Chapter 3 – Study One

A Systematic Review of Dentists' Knowledge, Perception, Practice and Confidence in Managing Patients with Cancers.

Chapter Overview

As the number of patients diagnosed with cancer continues to increase and more people are living with and beyond a cancer diagnosis, dentists will inevitably encounter cancer patients in their clinical practice. The first step to understand dentists' perspectives on treating cancer patients is to evaluate the existing literature. This study aimed to systematically synthesise the current research exploring dentists' knowledge, confidence, perceptions and practice in the management of oncology patients.

In preliminary database searches, specific search terms, such as 'knowledge', 'perspective', 'practice', and 'confidence', were used. However, this yielded limited relevant literature. Consequently, after consultation with The University of Sydney Librarian, broader search terms were adopted for the comprehensive capture of available literature (see Figure 3.1).

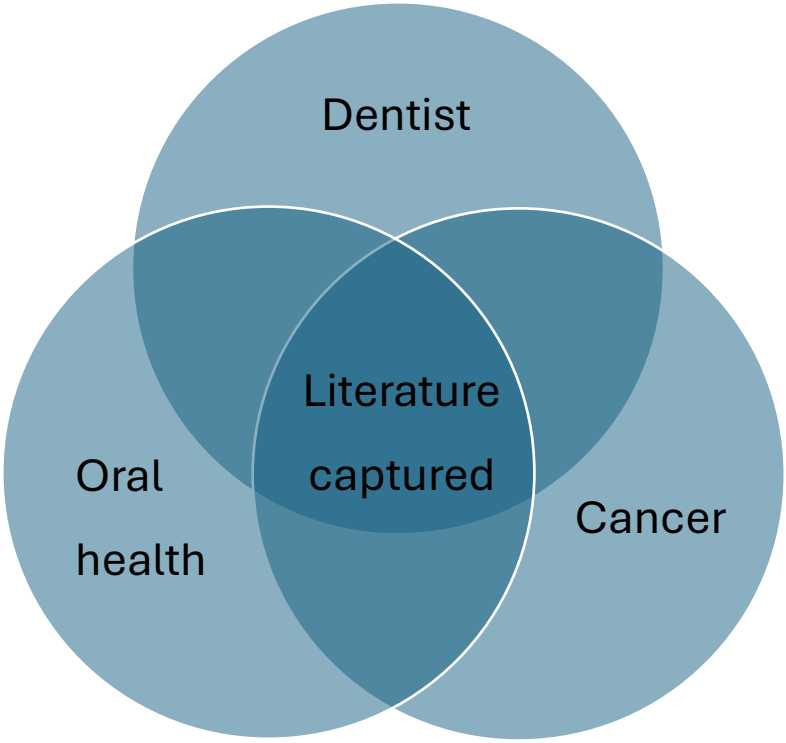

Figure 3.1: Venn diagram: key words aim to capture existing literature for the research aims

Our search strategy was limited to the perspectives of dentists, meaning dental auxiliaries such as hygienists, oral health therapists, dental assistants, dental prosthetists and dental students were excluded from the review. This is because dental

auxiliaries' scope of practice and the degree of clinical interactions with patients differ from that of registered dentists in Australia. Additionally, this study includes only adult oncology patients, excluding paediatric oncology patients due to their distinct needs.

This review was published in BMC Health Services Research (refer to Appendix A for the published article and Appendix B for the supplementary files) and presented at the following scientific meetings:

Presentations:
Low SL, Holden A, Shaw J (2022) A systematic review of dentists' perceptions and practices towards dental care management in patients undergoing cancer therapies. Oral presentation, *Cancer Research Network Postgraduate Student Symposium*. 17th November, Sydney, New South Wales, Australia.

Low SL, Holden A, Shaw J (2023) A systematic review of dentists' knowledge, perception, practice and confidence in managing patients with cancers. Poster presentation, *The New South Wales Cancer Conference*. 18-19th Sept, Sydney, New South Wales, Australia.

Publication details:
Low SL, Holden A, Shaw J (2024). BMC Health Services Research (2024) A systematic review of dentists' knowledge, perception, practice and confidence in managing patients with cancers. *BMC Health Services Research* 24:1277. https://doi.org/10.1186/s12913-024-11676-8

Abstract

Purpose: Little is known about dentists' preparedness in managing oral side effects in patients undergoing cancer therapy (CTx). The purpose of this systematic review is to identify barriers and facilitators of dentists in managing oral health of cancer patients (CPs).

Methods: The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was Prospero registered (CRD42022333055). CINAHL, Embase, Medline, PsycInfo and Scopus databases were searched using keywords and MeSH terms: dentists, oral health, cancer. The outcomes were analysed descriptively and thematically.

Results: Of the 2303 articles screened 53 met eligibility criteria. Most of articles (n=50) reported on head and neck cancer (HNC) management. Dentists' oral cancer (OC) knowledge varied across studies (27% to 81%, n=35). Regardless of their knowledge level, the majority of dentists expressed interest in further cancer education. Across studies, dentists perceived that their role included providing dental treatment for OC patients. However, of the few studies (n=3) that explored dentists' confidence in managing CPs, less than half of dentists felt confident providing advice to patients with HNC. More barriers than facilitators are identified in providing dental care provision to CPs.

Conclusion: This review demonstrates gaps in dental care for patients with non-HNCs and highlights a need for methods to involve dentists in managing dental health of CPs.

*Keywords***:** dentist; oral health; cancer patient; barriers

1. Introduction

Patients undergoing CTx have unique oral and dental needs as cancer and its treatment often have direct and indirect impacts on oral health. Attentive dental care tailored to the needs of CPs reduces oral complications (109, 115, 154), improves quality of life (107, 155), reduces mortality (117, 156) and healthcare costs (157). To facilitate better oral care, internationally there have been a number of best practice guidelines developed (for example Elad, Cheng (158)), however the oral health of CPs receiving CTx is often overlooked and patients do not receive timely information about oral complications or oral care (80).

Traditionally, oncology patients have been managed in specialised cancer centres, however most cancer centres do not have a dental department (159), and dentists are seldom included in the oncology multidisciplinary team (80) unless treatment is focused specifically on the head and neck (H&N) region. This occurs despite patients with solid tumours outside of H&N region also experiencing chemotherapy-related mucositis, apthous ulcers and xerostomia (160); patients receiving bone modifying agents, targeted and immunotherapies being at increased risk of osteonecrosis of the jaw (85, 161); patients on targeted therapies experiencing oral pain, dry mouth and stomatitis (162); and survivors of allogenic haemopoetic stem cell transplant (HSCT) patients experiencing long term oral side effects as a result of immune response to the transplantation.

With the increasing number of patients being diagnosed with cancers each year and undergoing CTx, there is an increasing need for dentists to be included in managing the oral health of these patients. Dentist's understanding the potential oral side effects is critical as this knowledge will ensure dentists are able to discern dental disease from the transient effects of therapies and take appropriate precautions when managing oral health of these patients (147, 163). Given the important and yet under-utilised role dentists have in the care of CPs, the aim of this review was to understand the barriers and facilitators of dentists' management of the dental health of CPs undergoing cancer treatment. Specifically, this systematic review explored dentists' cancer knowledge, perceptions, clinical practice and confidence of treating CPs.

2. Methodology

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (164) and was preregistered with the International Prospective Register for Systematic Reviews (CRD42022333055). It included both qualitative and quantitative studies capturing dentists' knowledge, perception, clinical practice and confidence in managing the oral health of cancer patients.

Search Strategy

Medline, Embase, CINAHL, PsycInfo and Scopus were searched using keyword and MeSH terms: "dentist*", "dental specialist*", "dental surgeon*", "oral health

professional*", "dental practi*"; "oral health*", "dental care", "oral care", "oral hygiene", "mouth hygiene"; "neoplasm", "cancer*", "oncology*", "malignan*". Broad search terms were used as our preliminary search with narrow terms did not capture relevant studies. The search was conducted in 2022 and updated in July 2023. Reference lists of review articles were also manually searched. An example of search strategy is included in supplementary file 3.1 in Appendix B.

Inclusion and exclusion criteria

Studies were included if they were in adult population and published in English between 1990 and July 2023. Review articles, conference abstracts or expert opinions were excluded.

Participants

This review included studies with general dentists (GDPs) and specialist dentists (SDs), while excluding studies involving dental students and dental auxiliaries such as hygienists, oral health therapists and dental assistants.

Study Designs

We included qualitative and quantitative studies reporting dentists' knowledge, perceptions, practice and confidence related to cancer screening, management and clinical practice.

All search results were initially uploaded into EndNote X20 (Clarivate, Philadelphia, PA, USA, 2022) and duplicates removed. Abstracts were uploaded into Covidence (Veritas Health Innovation, Melbourne, Australia) and two reviewers (SL and JS) independently screened titles and abstracts. For studies that appeared to meet criteria, full text articles were retrieved and reviewed against the eligibility criteria. Disagreements were resolved through discussion.

Data Extraction

Data extraction was conducted using a purpose-designed template (SL) and 20% of articles were reviewed by a second reviewer (JS) to assess accuracy. Data extracted included: participants' characteristics (age, gender, experience, training background, recency of continuing education (CE), location of practice and workplace characteristics); study characteristics (country, research methods, recruitment strategies, sample size, cancer population) and outcomes of interest (dentists' cancer and CTx knowledge, perceptions on education, role in cancer management, clinical practice, and confidence). Quality was assessed based on the Mixed Methods Assessment Tool (MMAT) (165).

Data Analysis

Quantitative data were summarised descriptively, qualitative data were analysed using content analysis. Reported barriers and facilitators were categorised as: environmental/ context, dentist-related and patient factors.

3. Results

Database searches identified a total of 3,979 studies, with additional 20 abstracts found through hand searching. After removing duplicates, a total of 2,303 titles and abstracts screened. Full text review of 70 articles resulted in 53 articles identified for inclusion in the review (see Figure 3.2 for PRISMA diagram).

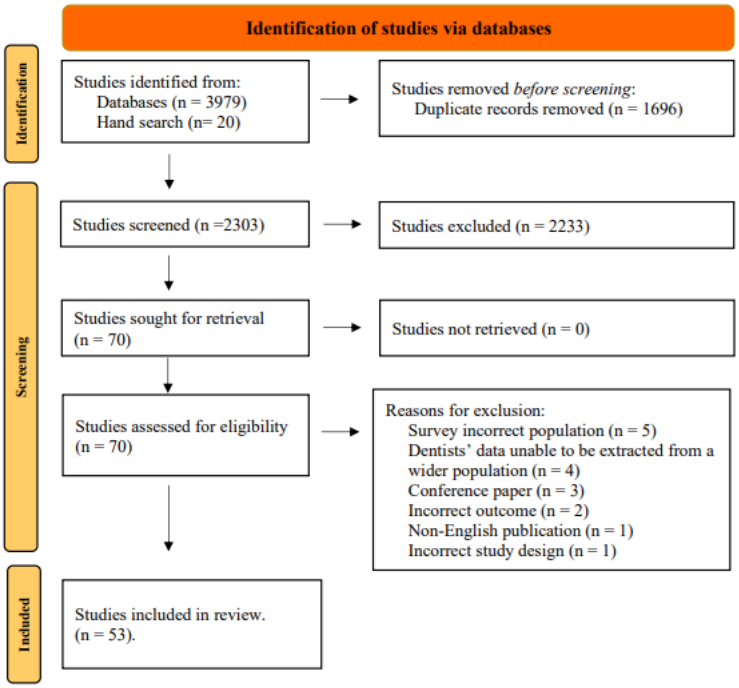

Figure 3.2: Systematic reviews and meta-analyses (PRISMA) flow chart

Study characteristics

Of the 53 studies identified, the majority (n=50) focused on H&N regions. Of the non-HNCs (n=3), 1 study explored management of leukemia patients (166) and 2 studies (167, 168) explored treatment of oncology patients more broadly. The study designs were primarily surveys (n=51), with 1 study using a qualitative focus group methodology (169) and 1 study using a mixed methods approach (139). Seven studies focused solely on oral screening practices (142, 170-175).

Mean sample size was 315 (range 32-3200). Studies were most commonly surveying dentists from USA (n=16), Middle East (n=11) or UK (n=7). Five studies were conducted

in Asia, with studies also conducted in Brazil (n=4), Spain (n=2), Australia (n=2), Africa (n=2), Canada (n=1), and Italy (n=1). Additionally, 2 studies conducted in combined regions: Australia/ Japan and Australia/ New Zealand. Study characteristics are summarised in Table 3.1.

Table 3.1: Study characteristics

ID	Authors, publican year	Aims	Country	Research methods	Recruitment strategies	Actual sample size	Cancer population	Data analysis
1	Ahmed & Naidoo (2019)(176)	To determine dentists' knowledge, attitudes, and practices in the prevention and early detection of OCs. To evaluate CE needs.	Khartoum, Sudan	Quantitative (survey)	130 GDPs working in public dental clinics.	n=113 (87% RR)	OC	T t-test, Mann-Whitney U test & Chi-square tests.
2	Akbari et al (2015)	To assess the GDPs' and dental SDs' knowledge about OC in South Khorasan, Iran.	Iran	Quantitative (survey)	80 practicing GDPs & SDs taking part in CE.	N=73 (91% RR)	OC	Descriptive analysis. Chi square, t-test.
3	Alhazzazi (2021)(177)	To assess the knowledge & behaviour of dentists toward screening & managing patients with HNC.	Saudi Arabia	Quantitative (survey)	n=723 GDPs & SDs.	N = 206 (28.5% RR)	HNC	Descriptive analysis. Chi-square test.
4	Alonge et al (2004)(178)	To determine dentists' OC knowledge & OC screening practices, & preferred methods for OC CE.	Texas, USA	Quantitative (survey)	398 Texas dentists practicing along the Texas-Mexico border.	n=158 (40% RR)	OC	Bivariate analysis (Chi-square test).
5	Alqahtani et al (2021)(179)	To investigate the knowledge & awareness among dentists in Saudi Arabia towards oral & dental assessment and management of HNC patients pre and post-RT.	Saudi Arabia	Quantitative (survey)	Google form via an online link though WhatsApp or Social Media Platforms.	370 responded	HNC	Descriptive analysis.
6	Alqutaibi et al (2021)(170)	To assess prosthodontists' knowledge of & screening practices for OC and potentially malignant oral lesions.	Saudi Arabia	Quantitative (survey)	n=250 eligible prosthodontists	n =143 (57% RR)	OC	Descriptive analysis using Chi-square test.
7	Borhan-Mojabi (2012)(180)	To evaluate the degree of knowledge of physicians and GDPs on OC within the context of developing an appropriate under- & post-graduate education programme to optimize early detection & prevention of OC.	Qavzin, Iran	Quantitative (survey)	Dentists: n=100, Physicians: n=100	Dentists n=86 (86% RR); Physicians n=66 (66% RR)	OC	Descriptive analysis using t-test, chi-squared, ANOVA, Pearson correlation.
8	Calvert et al (2014)(181)	To record the current practice of restorative dentistry consultants in immediate, initial, & long-term management of patients diagnosed HNC.	UK	Quantitative (survey)	315 restorative consultants from General Dental Council website.	n=132 (43% RR), 60 of the 132 treated H&N patients.	HNC	Not reported. Data presented as charts and histograms.
9	Canto et al (2001)(182)	To assess dentists' knowledge of risk factors and diagnostic procedures for OC.	Maryland, USA	Quantitative (survey)	1000 GDPs selected from ADA Maryland mailing list.	n=508 usable questionnaires (54% RR).	OC	Descriptive analysis & logistical analysis.
10	Clovis et al (2002)(183)	To assess and describe Canadian dentists' understanding of risk & diagnostic factors related to OC and to determine their opinions about their professional preparation to prevent & control OC.	British Columbia & Nova Scotia	Quantitative (survey)	Systematic random sample of 817 licensed dentists from British Columbia n=?? from Nova Scotia	n=670 (55.2% RR) [n=401 (50.4%RR) British Columbia; n = 269 (64.4%) Nova Scotia]	OC	Descriptive analysis using ANOVA.
11	Colella et al (2008)(184)	To investigate dentists and physicians' level of knowledge, attitudes, & behaviours towards OC.	Campania region, Italy	Quantitative (survey)	1000 professionals attending 22 randomly selected association meetings.	n=457 (45.7% RR) [Dental: n=225 Medical: n=232]	OC	Descriptive analysis.
12	Cruz et al (2005)(171)	To examine OC prevention and early detection practice patterns in OHPs. To examine if there were any variables that were associated with lower adherence to recommended health behaviour counselling.	NY, USA	Quantitative (survey)	Stratified random sample of licensed dentists (n=904) and DHs (n=963).	Dentists: n=496, DHs: n=630	OC	Descriptive Bivariate analysis.

13	Daley et al (2011)(169)	To assess awareness among OHP regarding the HPV-OC link. To elicit OHP attitudes & perceived role to screen for HPV-related oral lesions, & to discuss HPV as OC risk factors & HPV vaccine with patients.	Florida, USA	Qualitative (focus group)	Dentists or DHs recruited from local dental & dental hygiene professional associations.	dentists: 3 focus groups (total n=17) dental hygienists: 2 focus groups (total n=21)	OC	Qualitative analysis. Coding of data.
14	Dang et al (2022)(167)	To assess dental practice patterns in oral care of medical oncology patients & to identify potential barriers to recommended care in the state of Massachusetts.	Massachu setts, USA	Quantitative (survey)	Registered dentists at Massachusetts Dental Society. n=3394.	n=363 (10.7%RR)	All cancers	Descriptive analysis. Qualitative coding for free text responses.
15	Dewan et al (2014)(185)	To investigate the approach of restorative dentists in the treatment & dental rehabilitation of OC patients in the UK.	UK	Quantitative (survey)	Delegates at the conference (n=94).	n=65 (69.1% RR)	OC	Descriptive analysis.
16	Dixon et al (2021)(139)	To investigate and evaluate the knowledge, attitudes and behaviour of general dentists in respect of providing dental treatment for HNC patients.	New Zealand & Australia	Mixed method (survey & interview)	Survey: 800 random NZ GDPs from Dental Council. Interview: 4 Sydney West Cancer Network HNC Clinic.	n=154 (20.4% RR) (survey) n =4 (interview)	HNC	Survey: descriptive analysis. Interview: thematic analysis.
17	Ekici (2020)(186)	To evaluate knowledge and awareness of OC among dentists in Ankara, Turkey	Turkey	Quantitative (survey)	n=350 dentists in 7 oral & dental health centres in Ankara.	n=294 (84% RR)	OC	Descriptive analysis.
18	Fidele et al (2022)(187)	To evaluate the knowledge, attitude, and practice of dentists about OC in Democratic Republic of Congo.	Africa	Quantitative (survey)	Dentists (public or private) in primary oral health care centres.	n=162	OC	Descriptive analysis using Chi-square test.
19	Frydrych et al (2012)(140)	To examine actual and self-perceived knowledge & clinical expertise regarding dental management of OC patients receiving RT among Western Australian dentists.	Australia	Quantitative (survey)	Australian Dental Association (ADA) Western Australia. n=963 (GDPs only)	n=146 (20% RR)	OC	Descriptive analysis using Chi-square test.
20	Gajendra et al (2006)(188)	To assess the knowledge, practices and opinions of dentists and dental hygienists among a random sample of practicing dentists and dental hygienists in NY State regarding OC prevention and early detection.	NY, USA	Quantitative (survey)	Random selection from the lists of licensed dental practitioners in NY. Dentists (n=904); dental hygienists (n=963).	Dentists: n=499 (55% RR); DHs: n=630 (65% RR)	OC	Descriptive analysis.
21	Guneri et al (2008)(189)	To determine the level of knowledge on HNC among a group of GDPs, SDs & final year dental students in Turkey. To determine is the effect of demographic characteristics and the type of duration of clinical practice on the level of knowledge.	Izmir, Turkey	Quantitative (survey)	380 GDPs, SDs, final year dental students at School of Dentistry, Izmir.	Final sample: n=204 GDPs: n=113 (45% RR); final year dental students: n=37 (74% RR); SDs: n=54 (67% RR)	HNC	Descriptive using stratified and logistic analyses.
22	Haresaku et al (2018)(141)	To investigate the practices, knowledge, confidence, & attitude among Japanese oral health professionals and to identify Japanese-specific problems of oral cancer practices by comparing them between Japan (JP) & Australia (Aus).	Australia and Japan	Quantitative (survey)	Recruitment from members who treated OC patients & were of Japan Health Care Dental Association or ADA Victorian.	JP dentists (n=82, 62.6% RR); JP DHs (n=55, 42% RR). Aus dentists (n=214, 9.3% RR); Aus DHs (n=45, 22.9% RR)	OC	Descriptive analysis using Chi-square & Mann-Whitney U tests.
23	Hashim et al (2018)(190)	To evaluate the knowledge, opinions and practices of dentists in United Arab Emirates (UAE) regarding the early detection OC and to explore potential educational needs.	UAE	Quantitative (survey)	n=370 GDP and SDs in Abu Dhabi, Dubai & Sharjah, & members of Ministry of Health.	n=298 dentists (80% RR)	OC	Descriptive analysis.
24	Horowitz et al (2000)(191)	To determine the opinions and practices regarding prevention and early detection among US dentists in general practice.	USA	Quantitative (survey)	6400 eligible GDPs randomly selected in the US.	3200 usable questionnaires (50% RR)	OPC	Descriptive using Bivariate and logistic analyses.

25	Husein et al (2011)(192)	To investigate GDP's views on their perceived roles regarding dental care of patients following H&N radiotherapy. To determine how GDPs managed these patients, perceived barriers to providing treatment & their roles in specific aspects of dental care for these patients.	UK	Quantitative (survey)	369 GDP were selected from Mersey Postgraduate Dental Deanery database.	n=198 (59% RR)	OC	Not reported. Results presented descriptively.
26	Joseph et al (2012)(193)	To assess dentists' knowledge, diagnostic, practices & opinions regarding OC prevention & early detection.	Kuwait	Quantitative (survey)	200 randomly selected dentists.	n=153 (76.5% RR)	OC	Chi-square test & Spearman's test.
27	Kogi et al (2019)(194)	To assess the knowledge, practice, confidence, & potential barriers for OC screening among teaching faculty.	Japan	Quantitative (survey)	132 faculty dentists at Iwate Medical University.	n=110 (83% RR)	OC	Descriptive using Chi-square test.
28	Kujan et al (2006)(172)	To survey OC awareness and screening practice of potential OC patients by consultants & specialists in oral surgery, oral medicine, surgical dentistry & GDPs in the UK.	UK	Quantitative (survey)	305 consultants & specialists, & 200 GDPs from the General Dental Council.	n=338 (66.9% RR) GDPs (n=143, 71.5% RR); SDs: (n=195, 63.9% RR).	OC	Descriptive using Cross-tabulations and Chi-square tests.
29	Leão et al (2005)(195)	To assess GDPs' knowledge and attitudes with regards to certain aspects of oral malignancy relevant to the primary health care setting.	Brazil	Quantitative (survey)	129 dentists from local health authority & the Pernambuco General Dental Council.	n=129 (100% RR)	OC	Descriptive using Bivariate analysis with Chi-square test.
30	LeHew et al (2010)(173)	To assess dentists' OC examination procedures & the frequency of performance. To clarify practice behaviours & to identify facilitators for thorough OC examination.	USA	Quantitative (survey)	n=241	n=102 (42.3% RR)	OC	Descriptive using Chi-square test and ANOVA.
31	Lopez-Jornet et al (2010)(196)	To study dentists' opinions and knowledge on the early detection of OC.	Spain	Quantitative (survey)	1000 questionnaires were sent to GDPs. 205 undelivered/ returned.	n=340 (42.7% RR)	OC	Bivariate analysis with chi-square test.
32	Marino et al (2017)(142)	To investigate OC screening practices of OHPs in Victoria, Australia as well as evaluate their OC-related opinions and attitudes; and to identify factors associated with the likelihood of an OHP performing an OC screening examination.	Australia	Quantitative (survey)	4781 registered OHPs (3715 dentists, 585 DH/ DT/ OHTs)	n=335 OHPs (7% RR). Dentists (n=241), DHs (n=46), OHTs (n=41), DTs (n=7).	OC	Descriptive analysis using Chi-square analysis, ANOVA & Stepwise logistics regression analysis.
33	Martins et al (2021)(197)	To investigate the level of awareness of radiation-related caries among physicians, dentists, & survivors of HNC.	Brazil	Quantitative (survey)	Group 1: Physicians. Group 2: Dentists; Group 2A: dentists in oncology. Group 2B: dentists not in oncology. Group 3: HNC patients received RT.	Group 1: n=124 Group 2: n=280 (2A: n=160, 2B: n=120) Group 3: n=58	HNC	Descriptive analysis using Chi-square tests.
34	Maybury et al (2012)(198)	To investigate the association between dentists' OC risk factors knowledge and diagnostic procedures & their perception of their OC education, training, and the currency of their knowledge	USA	Quantitative (survey)	1189 dentists in Maryland (Maryland State Dental Association). After excluding retired dentists n=1169.	n=463 (40.1% RR)	OC	Descriptive using Multivariate logistic regression.
35	McCann et al (2000)(199)	To determine the OC-related levels of knowledge, current practices and perceived training needs of Scottish GDPs & community dental officers.	Scotland, UK	Quantitative (survey)	n=232 private GDPs; n=99 community dental officers.	Community dental officers: n=73 (74% RR); GDPs: n=152 (66% RR).	OC	Descriptive using Chi-square tests.
36	Nazar et al (2022)	To assess the current knowledge, opinions, attitudes, & practices on OC among new graduate dentists.	Kuwait	Quantitative (survey)	310 dentists working in the Ministry of Health & attend CE.	n=310 (100% RR)	OC	Chi-square, T-test & ANOVA.

37	Nazar et al (2019)(200)	To assess the level of OC knowledge, opinions, attitudes, and practices among dentists working at the primary oral health care centres in Kuwait.	Kuwait	Quantitative (survey)	410 dentists working at the primary oral health care centres.	n=289 dentists (71% RR)	OC	Descriptive using T-test, ANOVA & Pearson correlation.
38	Nicholls & Ilankovan (1998)(201)	To find out what preventive care was offered to patients after radiotherapy in dentate patients.	UK	Quantitative (survey)	274 senior fellows of British Association of Oral and Maxillofacial Surgeons	n=117 (43% RR). 96/117 completed both sides of the questionnaires.	OPC	Not reported.
39	Patel et al (2012)(202)	To evaluate knowledge and current practice within the state of Michigan for preventing and managing the oral health & complications of patients undergoing H&N RT. To identify potential barriers to management of HNC patients.	USA	Quantitative (survey)	749 (email) & 300 (mail) dentists from the Michigan Dental Association; 156 radiation oncologists.	Dentists: n=502 (47.9% RR); Radiation oncologists: n=29 (22.3% RR)	OC	Descriptive analysis.
40	Patton et al (2006)(203)	To assess and compare the self-reported adequacy of training in OPC early intervention activities among 4 healthcare provider groups: dentists, DHs, family physicians, and nurse practitioners.	North Carolina, USA	Quantitative (survey)	Dentists: n=1115 DHs: n=1223 Family physicians: n= 1058 Nurse practitioners: n=967	Dentists: n=584 (52.4% RR); DHs: n=651 (53.2% RR); physicians: n=273 (25.8% RR); nurse: n=294 (30.4% RR)	OC	Descriptive analysis.
41	Pavão Spaulonci et al (2018)	To assess dentists' knowledge about OC, and to compare the knowledge level among junior or newly graduated (0 to 5years of professional practice) and senior dental clinicians (above 30 years of experience).	Brazil	Quantitative (survey)	20154 Dentists from the database of the Regional Dentistry Council of Sao Paulo.	n=477 (2.36% response)	OC	Descriptive using Chi-square tests & multiple logistic regression analysis.
42	Reed et al (2010)(204)	To assess dentists and physicians' knowledge of OPC risk factors, conduct of OPC preventive practices, awareness of new tobacco cessation resources, & interest in receiving training in OC screening & tobacco cessation counselling.	South Carolina, USA	Quantitative (survey)	497 dentists (GDPs, SDs), 497 Physicians, 25 Oral surgeons	Dentists: n=288 (58% RR); physicians: n= 221 (45%RR)	OC	Descriptive using Chi-square tests.
43	Saleh et al (2014)(205)	To determine the dentists' perception of their role & current practices in promoting prevention & early detection of OC. To identify the motivation & barriers associated with the practice of prevention and early detection of OC.	Malaysia	Quantitative (survey)	988 practicing dentists who attended 2 major dental conferences organised by the Malaysian Dental Association.	n=362 (36.6% RR)	OC	Descriptive using Chi-square & Kruskal-Wallis tests.
44	Seals (1990)(206)	To evaluate the preparedness of recent dental school graduates for addressing the needs of cancer patients.	Texas, USA	Quantitative (survey)	339 recent graduates from 3 dental school in Texas.	n=133 (39.2% RR)	OC	Not reported. Descriptive tables.
45	Seoane et al (2006) (174)	To evaluate GDPs' experience, skills and the level of accuracy for opportunistic screening of oral precancer and malignant lesions.	Galicia, Spain	Quantitative (survey)	32 of 70 randomly selected GDPs at the primary care network of the National Health System.	n=32 (100% RR)	OC	Descriptive analysis.
46	Shadid & Habash (2023)(207)	To investigate dentists' knowledge, opinions, and clinical practices of OC prevention & screening practices dentists.	Palestine	Quantitative (survey)	650 GDPs & SDs.	n=254 (39.1% RR)	OC	Descriptive using ANOVA.
47	Strey et al (2022)(175)	To evaluate dentists' adoption of preventive measures for OC in routine practice, attitude toward performing biopsies, & opinion about oral medicine undergraduate training.	Rio Grande do Sul, Brazil	Quantitative (survey)	3086 dentists working in primary health in the 497 municipalities of Rio Grande do Sul.	n=192 (6.2% RR)	OC	Descriptive using Student t-test and Spearman's test.
48	Taheri et al (2018)(208)	To assess the knowledge of GDPs about oral precancerous lesions and OC risk factors.	Tehran, Iran	Quantitative (survey)	200 randomly selected private GDPs at a local dental congress.	n=153 (76.5% RR)	OC	Descriptive analysis.

49	Tami-Maury et al (2016)(209)	To examine practices of dentists in Texas providing dental/ oral care to patients suffering from various chronic conditions including cancer.	Texas, USA	Quantitative (survey)	6588 dentists from Texas Dental Association & 2461 from Texas Academy of General Dentistry.	n=655 (7.2% RR)	OC	Descriptive analysis using multivariable logistic regression.
50	Vijay Kumar et al (2012)	To assess the OC knowledge, attitude and screening practices among GDPs.	Bangalor, India	Quantitative (survey)	250 private dentists selected by cluster random sampling	n=240 (96% RR)	OC	Descriptive analysis.
51	Wong & Toljanic (2009)(166)	To find out how experienced clinicians prioritize dental treatment for leukemia patients who are scheduled to receive chemotherapy.	NY & Texas, USA	Quantitative (survey)	132 members of the American Academy of Maxillofacial Prosthetics via mail.	n=86 (65% RR)	Leukaemia patients	Not reported. Data presented in tables.
52	Wright et al (2011)(210)	To determine the degree of involvement of the Salaried Dental Services in England in the provision of oral care for patients with malignancy.	UK	Quantitative (survey)	111 managers of salaried dental services	n=83 (75% RR)	Cancer patients	Not reported. Data presented in tables.
53	Yellowitz et al (1998) (211)	The purpose of this project was to pilot test a questionnaire designed to assess the level of knowledge, opinions & practices regarding OC among GDPs.	USA	Quantitative (survey)	500 randomly selected GDPs (AmDA and non-AmDA members) in the USA.	n=267 (51% RR) but 24 non-usable	OC	Not reported. Data presented in tables & charts.

Note: ADA = Australian Dental Association; AmDA = American Dental Association; CE = continuing education; DH = dental hygienist; DT = dental therapist; GDP = general dental practitioner; H & N = head and neck; HNC = head and neck cancer; OC= oral cancer; OCE = oral cancer examination; OHP = oral health practitioner; OPC = Oropharyngeal cancer RR = response rate; RT = radiation therapy; SD = specialist dentist

Participants Characteristics

Studies included participants who were GDPs (n=34), SDs (prosthodontists, restorative dentists and maxillofacial surgeons) (n=5); or a combination of GDPs and SDs (n=14). Studies reporting gender participants (n=36), 38% were female (range 11 - 79.9%). Forty studies reported participant's clinical practice experience. Among 24 studies reporting range of years, 10 studies reported 32.6% of participants had <5 years dental experience, 20.9% had 6-10 years and 46.3% had ≥10 years' experience. Additionally, 10 studies reported a mean clinical practice duration of 11.9 +/- 5.1 years.

Of the studies reporting workplace characteristics (n=30), 10 studies recruited participants from solo, partner, salaried, employee and community practices; 21 studies classified workplaces based on funding models (public vs private), of which 54.1% of dentists worked in public sector, 41.3% worked in private sector and 4.4% worked in both public and private settings.

Fourteen studies reported on the recency of OC CE, with approximately half of dentists reporting undertaking CE within the last 5 years (172, 173, 183, 184, 186, 188, 190, 193, 198, 199, 205, 211-213).

Participant characteristics are summarised in Table 3.2.

Table 3.2: Participants characteristics

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
1	Ahmed & Naidoo (2019)(176)	NR	n=77 (68.1%)	3-5 years (35.4%), 6-10 years (42.5%), 11-15 years (11.5%) >15 years (10.6%).	GDPs	NR	NR	Public: n=113 (100%)
2	Akbari et al (2015)(212)	NR	n=36 (49%)	1-4 years: n=31 (42.5%), 5-9 years: n=11 (15.1%), 10-14 years: n=10 (13.7%), 15-19 years: n=5 (6.8%) >20 years: n=16 (21.9%).	GDPs: (n=55, 75%), SDs: (n=18, 25%)	24.7% attended OC CE courses.	NR	NR
3	Alhazzazi (2021)(177)	NR	n=81 (39%)	0-2 years: 96 (47%), >2-5 years: 31 (15%), >5-10 years: 18 (9%), >10 years: 61 (30%).	GDPs: n=119 (58%), SDs: n=14 (7%), dental consultants: n=49 (24%), dental residents: n=14 (7%), others: n=3 (5%)	NR	NR	Public: n=50 (24%), Private: n=61 (30%), University hospital: n=69 (33%), Mixed public & private: n=8 (4%), mixed university & private: n=16 (8%).
4	Alonge & Narendran (2004)(178)	20-29 years (n=5, 3%), 30-39 years (n=35, 22%), 40-49 years (n=48, 31%), 50-59 years (n=44, 28%), 60-69 years (n=17, 11%), 70-79 years (n=7, 5%), missing data (n=2).	n=21, 14% missing data (n=2, 1%)	0-8 years (n=25, 16%), 9-18 years (n=46, 30%), 19-28 years (n=48, 31%), 29-38 years (n=35, 23%)	GDPs	NR	NR	Solo: n=114 (72%) Others: n=44 (28%)
5	Alqahtani et al (2021)(179)	NR	n=113 (31%)	<5 years: n=185 (49.5%), 5-10 years: n=120 (32.4%), >10 years: n=67 (18.1%)	GDPs: n=144 (39%), oral surgeons/ oral meds/ oral pathologists: n=57 (15%), endodontists: n=34 (9%), periodontists: n=21 (9%), other specialists: n= 87 (23%)	NR	NR	Public: n=352 (95.1%); Private: n=18 (4.9%).
6	Alqutaibi et al (2021)(170)	NR	n=36 (25%)	<10 years: n=79 (55%); ≥10 years: n=64 (45%)	Prosthodontists: 100%; master degree: n=49 (34.3%); board certified: n=42 (29.4%); PhD: n=52 (36.4%)	NR	NR	Public: n=120 (84%); Private: n=23 (16%).
7	Borhan-Mojabi (2012)(180)	GDPs: 37.93 +/- 9.22 years	Data not separated for GDPs	GDPs: 9.67 +/- 9.05 years	GDPs	NR	NR	NR
8	Calvert et al (2014)(181)	NR	NR	NR	Restorative dentists	NR	NR	NR

9	Canto et al (2001)(182)	NR	19%	>25years: 23%; 16-25years: 28%; 6-15years: 34%; <=5 years: 15%.	GDPs	NR	NR	Solo: 60%, partner: 17%, salaried/ contractor: 19%, all other: 4%
10	Clovis et al (2002)(183)	NR	n=117 (17.9%)	> 27 years): n=88 (13.3%); 18-27 years: n=196 (29.6%); 8-17 years: n= 229 (34.5%); ≤7 years: n=150 (22.6%).	GDPs	~60% attended OC CE in the last 5 years,	NR	Solo: n=370 (55.4%), partner: n=177 (26.5%), salaried or contractor: n=93 (13.9%), others: n=28 (4.2%)
11	Colella et al (2008)(184)	NR	n=80 (17.5%)	≤15 years: n=186 (40.7%); 16-20 years: n=99 (21.7%); 21-25 years: n=80 (17.5%); 26-30 years: n= 67 (14.7%); >30 years: n=25 (5.4%). Mean years of graduation is 18 years	Dentists (graduates from medical school: n=232, 50.8%; graduates from dental school: n=225, 49.2%). GDPs: 53%, oral surgeons: 17.9%, restorative dentists/ endodontists: 9.9%, orthodontists: 7.4%, periodontics: 5.9%, oral pathologists: 3.5%, prosthetists: 2.4%.	96.1% received OC information & 20.6% attended CE course on OC in the last 12 months. Main sources of info were educational (72.4%), scientific journals (22.8%).	NR	Solo: n=155 (33.9%) non-solo: n=302 (66.1%)
12	Cruz et al (2005)(171)	20-39years: 19%; 40-59 years: 62%; 60 & older: 98%.	13%	Median years since graduation: 24 years	Dentists and DHs	NR	NR	Solo practice: 60%; partner/ employee: 26%; independent contractor: 4%; specialty practice: 4%; public health/ government/ other: 5%.
13	Daley et al (2011)(169)	28-66 years (mean age 45 years)	n=8 (47%)	3-43 years (mean 19 years)	Accredited US program Dentists, DHs	NR	NR	NR
14	Dang et al (2022)(167)	NR	NR	NR	Dentists	NR	NR	Private practice: 89%, community health centre: 4%, Hospital-based: 4%, dental school-based practice: 3%
15	Dewan et al (2014)(185)	NR	NR	NR	Consultants or senior lecturers: n=30 (46.1%); specialist registrars: n=27 (41.5%). SDs in restorative dentistry: n=8 (12.3%).	NR	NR	NHS posts (public): 73%; Academic posts: 27%
16	Dixon et al (2021)(139)	46.8/13.7	n=76 (49.35%)	<10years: n=37 (24%); 10-19years: n=29 (18.8%); 20-29 years: n=31 (20.1%); 30-39 years: n=35 (22.7%); 40-49 years: n=19 (12.3%); >50 years: n=3 (1.9%).	NZ trained dentists: n=103 (66.9%). Interviews: 4 dentists in Sydney West Cancer Network	NR	Urban: n =131 (85.1%); Rural: n =23 (14.9%)	Public: n=7 (4.5%); Private: n=129 (83.8%); Working in both public & private: n=14 (9.1%); Not practicing: n=4 (2.6%); Public experience: n=21 (14%).
17	Ekici (2020)(186)	25-34 years: n=67 (22.8%); 35-44 years: n=104 (35.4%); 45-54	n=199 (60.2%)	1-5 years: n=33 (11.2%); 6-10 years: n=35 (11.9%); 11-15 years: n=69 (23.5%); 16-20	GDPs	10% had OC training in the past 5 years.	NR	Public (n=294/ 100%)

		years: n=108 (36.7%); ≥55: n=15 (5.1%)		years: n=48 (16.3%); >20 years: n=109 (37.1%)				
18	Fidele et al (2022)(187)	Mean: 33.2 +/- 4.3 years. 23-29 years: 3.7%; 30-39 years: 54.3%; 40-49 years: 25.9 %; 50-59 years: 11.1%; >60 years: 4.9%.	n=56 (34.6%)	<5 years: 30.9%; 5-10 years: 50.6%; 11-15 years: 9.9%; >15 years: 8.6%.	General practice: 81.5%; Specialty practice: 18.5%.	NR	NR	NR
19	Frydrych et al (2012)(140)	NR	NR	0-5 years: 27.1%; 6-10 years): 12.6%; 11-15 years: 12.6%; 16-20 years: 5.3%; 21-25 years: 10%; >25 years: 31.1%; Unknown: 1.3%.	GDPs, SDs were excluded for analysis (n=5)	NR	Urban (n=140/ 76%); Rural (n=44/ 23.90%).	Public: n=19 (10.30%); Private: n=166 (89.70%).
20	Gajendra et al (2006)(188)	20-39 years: 19%; 40-59 years: 61%; 60 or older: 20%.	13%	Median years of experience 24 years.	Dentists, DHs	80% of dentists attended OC prevention CE courses in past 5 years.	NR	Solo: 59.8%; specialty practice: 4.1%; public health/ government: 2.5%; partner: 17%; employee: 9.4%; independent contractor: 4.3%; other: 2.9%.
21	Guneri et al (2008)(189)	32.76 years (this includes students).	n=92 (45%)	1-35 years (mean 11.29 years)	GDPs: n=113 (55.35%); final year dental students: n=37 (18.13%); SDs: n=54 (26.47%)	NR	NR	NR
22	Haresaku et al (2018)(141)	Most dentists in Japan & Australia were > 46 years of age (23.8-40.2 %).	Japanese: 7.3%; Australia: 45.8%.	NR (data cannot be separated from hygienists)	Not specified. The study excluded Australian specialists who did not see OC patients.	NR	NR	NR
23	Hashim et al (2018)(190)	<30 years: n=204 (68.2%); >30 years: n=81 (27.1%).	n=169 (57%)	<15 years: n=275 (92.3%); >15 years: n=23 (7.7%)	Bachelor degree: n=256 (85.6%); MSc/ PhD: n=41 (13.7%). GDPs & SDs.	48% attended an OC CE within the past 5 years.	NR	Public: n=31 (10.50%); private: n=267 (89.50%).
24	Horowitz et al (2000)(191)	NR	14%	16-20 years: 22%; 11-15 years: 28%; 6-10 years: 33%; 0-5years: 17%.	GDPs	NR	NR	Solo: 68%; partnership: 12%; others: 6%.
25	Husein et al (2011)(192)	NR	NR	>10 years: n=161 (81%); 5-10 years: n=19 (10%); <5 years: n=18 (9%).	UK graduates GDPs: n=177 (89%)	NR	NR	GDPs working in mixed, mainly NHS practice: 55%; GDPs working in solely private practice: 5%.
26	Joseph et al (2012)(193)	<40 years: 60.6%; >40 years: 39.4%.	n=35 (22.9%)	>15 years: 44.4%; =<15 years: 55.6%.	Dentists	30% attended OC CE within the last 5 years.	NR	Public: n=153 (100%)
27	Kogi et al (2019)(194)	NR	28.2%	<1 year: 35.5%; 2-5 years: 20.9%; 6-15 years: 20.9%; >16 years: 26.4%.	Restorative dentists (operative, endodontics, periodontics, prosthodontics): 60.9%; non-restorative dentists (dental	NR	NR	NR

					anaesthesiology, dental public health, dental radiology, orthodontics, paediatric): 39.1%.			
28	Kujan et al (2006)(172)	NR	NR	43-52 years: n=1 (3%); 33-42 years: n=50 (14.8%); 23-32 years: n=104 (30.8%); 13-22 years: n=113 (33.5%); 0-12 years: n=66 (19.5%).	GDPs and SDs	52.3% SDs & 26.3% GDPs attended OC CE in the last 12 months.	NR	NR
29	Leão et al (2005)(195)	40.4 years/ 12.9	52%	Mean: 16 years	GDPs	NR	Urban: n=129 (100%)	Public: 38%; Private or public/private: 62%.
30	LeHew et al (2010)(173)	NR	n=28 (27.5%)	Median: 13 years (range 0-50 years)	GDPs: 90%; SDs (orthodontics, oral surgery, endodontics, peadiatrics, prosthodontics): 10%.	37.3% never attended OC CE.	NR	NR
31	Lopez-Jornet et al (2010)(196)	NR	40.3%	Mean: 13.3 years (1- 42 years)	GDPs	NR	NR	NR
32	Marino et al (2017)(142)	≤25 years: 7.4%; 26-35 years: 19%; 36-45 years: 23.2%; 46-55 years: 25.2%; >55 years: 25.2%.	44.2%	≤5 years: 15.7%; 6-10 years: 12.4%; 11-15 years: 11.6%; 16-20 years: 9.9%; 21-25 years: 9.9%; >25 years: 40.5%.	GDPs: 63.6%; SDs: 8.4%; DHs: 13.7%; Oral health therapists: 12.2%; Dental therapists: 2.1%.	NR	Urban: 76.60%; Rural: 23.40%.	NR
33	Martins et al (2021) (197)	20-30 years: 41.07%; 31-40 years: 34.64%; 41-50 years: 14.28%; 51-60 years: 6.7%; >60 years: 3.21%. Most were 20-40 years.	n=195 (69.64%)	Time in specialty: <5 years = 43.92%; 5-10 years = 12.85%; 10-20 years = 18.21%; >20 years = 25%.	Group A: n=160 (57.14%) working in oral oncology. Group B: n= 120 (42.86%) OMFS (n=25), orthodontics (n=21), oral rehabilitation/ prosthodontics (n=20), paediatric dentistry (n=14), endodontics (n=13), dentistry specialists (n=11), periodontics (n=10), forensic/social legal dentistry (n=6).	NR	NR	NR
34	Maybury et al (2012)(198)	NR	n=107 (24%)	<10 years: 14%; 10-19 years: 15%; 20-29 years: 35%; 30-39 years: 34%; ≥40 years: 2%.	GPDs	OC CE course: Within the last 12 months: 29%; 2-5 years: 54%; ≥5 years: 15%. Never taken a course: <1%.	NR	Solo practice: 62%; group private practice: 36%; community health centre: 1%; other: 1%.
35	McCann et al (2000)(199)	NR	NR	NR	GDPs	GDPs: 44% had OC training in the last 2 years, 25% had OC	NR	Public: n=73 (32%); private: n=152 (68%).

						training in 3-5 years, 17% had no OC training for > 10 years.		
36	Nazar et al (2022)(214)	25.8 +/- 2.4 years	n=139 (44.8%)	Mean: 1.5 +/- 1.7 years	Bachelor degree: 94.5%; Master degree: 2.6%; MFDS: 1.9%; MEGD: 0.3%; PhD: 0.6%.	NR	NR	100% of participants worked at polyclinics, specialty dental centres and School of Oral Health Program clinics as part of their rotation.
37	Nazar et al (2019)(200)	35.2/ 10.9 years	n=109 (37.7%)	Mean: 11.7/ 11.3 years	Bachelor degree: 75%; Master degree, MEGD or PhD: 25%	NR	NR	Public: n=289 (100%)
38	Nicholls & Ilankovan (1998)(201)	NR	NR	NR	Oral maxillofacial surgeons	NR	NR	NR
39	Patel et al (2012)(202)	NR	NR	<10 year: n=65 (15.9%); 10-19 years: n=62 (15.1%); 20-29 years: n=121 (29.5%); 30-39 years: n=109 (26.6%); ≥40 years: n=53 (12.9%).	Dentists & Radiation oncologists.	NR	NR	NR
40	Patton et al (2006)(203)	NR	NR	NR	Dentists, DHs, physicians, nurse practitioners.	NR	NR	NR
41	Pavão Spaulonci et al (2018)(213)	NR	NR	NR	Junior dentists: 55.9% GDPs, 38.1% specialists; Senior dentists: 56.2% specialists, 21% GDPs, 15.2% Master degree, 7.6% PhD.	Attended OC CE: 15.9% in the last year, 23.3% in the last 2 years, 37.6% > 2 years ago.	NR	NR
42	Reed et al (2010)(204)	Not separated for dentists	NR	NR	GDPs & SDs, physicians & medical specialists.	NR	NR	NR
43	Saleh et al (2014) (205)	≤30 years: 35.1%; 31-40 years: 26.2%; 41-50 years: 19.9%; 51-60 years: 15.2%; 61-70 years: 2.8%; 71-80 years: 0.8%.	n=247 (68.2%)	50.8% graduated >10 years ago	Place of graduation: Malaysia (72.4%), Asia (18%), Oceanic (4.1%), UK (2.8%), Others (2.8%). Postgraduate training 21.5%	Number of OC CE attended: 0: 26.5%; 1-5: 67.4%; >5: 6.1%.	NR	Public: 50.3%; private: 48.6%; both public & private: 1.1%.
44	Seals (1990)(206)	NR	NR	NR	Recent graduate dentists	NR	NR	NR
45	Seoane et al (2006) (174)	NR	NR	Mean: 9.1/ 5.9 years	GDPs	NR	NR	NR
46	Shadid & Habash (2023)(207)	>30 years: 65.7%	43.7%	≤5 years: 33.5%; 6-15 years: 42.5%; >15 years: 24%.	GDPs: 79.9%; SDs: 20.1%.	NR	NR	Public: n=8 (3.20%); private: n=205 (80.70%); both public & private: n=41 (16.1%)
47	Strey et al (2022)(175)	37.6 +/- 10.4 years (range 22-66 years)	79.7%	14.2 +/- 10.4 years (1-42 years). Public system experience: 9.2 +/- 8.2 years.	Dentists	NR	NR	Public: 100%

48	Taheri et al (2018)(208)	36.8 years (range 25-60 years)	n=80 (52%)	Mean: 9.88 (1-35 years)	GDPs	NR	NR	Private: 100%
49	Tami-Maury et al (2016)(209)	51-65 years: 62%	32%	NR	Dentists	NR	NR	NR
50	Vijay Kumar & Suresan (2012)(215)	20-39 years: 30%; 40-59 years: 62%; 60 & above: 8%.	45%	NR	Private dentists. Post-graduate qualification: 24%.	NR	NR	Private: 100%. Solo: 44%; partnership: 25%; employee/ contractor: 24%; others: 7%.
51	Wong & Toljanic (2009)(166)	NR	NR	NR	Maxillofacial dentists	NR	NR	NR
52	Wright et al (2011) (168)	NR	NR	NR	Managers of dentists	NR	NR	Public: n=83 (100%). 100% Salaried dentists
53	Yellowitz et al (1998) (211)	NR	11%	Range from 1-30 years	GDPs	53% attended OC CE within the past 5 years.	NR	Solo practitioners: 68%

Note: CE = continuing education; DH = dental hygienist; GDP = general dental practitioner; NR = not reported; OC = oral cancer; SD = specialist dentist.

Study Outcomes

Knowledge

Thirty-five studies explored dentists' cancer knowledge, with no studies exploring cancers outside of H&N regions. Twenty-eight evaluated OC knowledge, 24 surveyed OC identification skills, 25 assessed OC risk factors and 2 studied CTx side effects (see supplementary file 3.2 in the Appendix B).

Cancer Knowledge: There was significant variability in dentists' overall OC knowledge across studies, with correct responses ranging from 27% (178) to 81.3% (214). In 4 of 5 studies, >90% of dentists recognised that early detection of OC improves patient survival rates (183, 196, 203, 211). Several factors were identified to be positively associated with OC knowledge. Recent CE (n=7) (173, 180, 182, 184, 193, 195, 198), recent dental graduates (n=7) (176, 182, 205, 207, 208, 212, 213), SDs in oral surgery/ pathology (n=2) (179, 184) and dentists with experience in public settings (n=4) (179, 195, 205, 213) reportedly had significantly better OC knowledge. Dentists who rated their undergraduate OC training favourably were more likely to agree that their OC knowledge was current (196), and 2.2 times more likely to score higher on knowledge of OC (213). In terms of gender, 3 studies found female dentists faired significantly better in OC knowledge (198, 205, 214), while others found no significant influence of gender on OC knowledge (189, 196, 207).

Cancer Identification Skills: To evaluate OC identification skills, the domains assessed included knowledge of sites, signs and symptoms of OC. There was a considerable degree of variability in survey responses. Notably, recent CE (n=2) were found to positively correlated with skills in OC identification (183, 184). Nevertheless, our findings showed divergent relationship between clinical experience and cancer identification skills amongst dentists. Two studies found recent graduates had better skills (183, 207) while 2 studies indicated that dentists with more clinical experience (187, 198) were better at OC identification. Additionally, Maybury, Horowitz (198) found that dentists working in a group private practice were more likely to have better OC identification skills than dentists working in solo private practice.

OC Risk Factors: Of the studies that explored common OC risk factors such as alcohol and tobacco use (n=23), 19 studies reported >80% of participants identified alcohol (178, 182, 183, 186-188, 190, 193, 196, 198-200, 205, 207, 208, 211, 213-215) as a risk factor while 21 studies reported >80% of participants identified tobacco as a risk factor for OC (141, 178, 182-184, 186-188, 190, 193, 196, 198-200, 204, 205, 207, 208, 211, 213, 214). In all 12 studies (178, 182-184, 186, 187, 190, 193, 196, 198, 207, 211) exploring prior OC risk, >80% of participants were aware of its significance. Among the 18 studies investigating older age, 11 studies reported >60% of participants correctly identified older age as a risk factor (182, 183, 187, 190, 193, 196, 198, 199, 207, 208, 213). Of the 16 studies that explored Human Papilloma Virus (HPV), 9 out of 15 reported that >60% of participants were aware of the association between HPV and OC (176, 177, 186, 190, 193, 198, 205, 207, 213), although a focus group study revealed that dentists had limited knowledge (169). In contrast, of the 10 studies investigating

consumption of fruit/ vegetables, 8 studies reported <50% of participants identified low consumption as a risk factor (176, 182-184, 188, 198, 207, 213).

CTx Side Effects and Management: In two studies that assessed dentists' knowledge of H&N radiation therapy (RT) and side effects, >80% of dentists were able to identify radiation-related caries as an oral complication following RT (189, 197). Dentists working in the field of H&N RT were more aware of radiation related complications than dentists not working in the clinical area (197).

Perceptions

Twenty-one studies surveyed dentists' perception of their cancer knowledge, 5 studies assessed dentists' perceived role in cancer management, 14 studies investigated dentists' role in OC screening, and 33 studies examined the adequacy and interest in further cancer training (see supplementary file 3.3 in the Appendix B).

Perceived Knowledge: In studies investigating dentists' perception of cancer knowledge, knowledge was categorised into perceived (i) currency and (ii) sufficiency. On average, 56.9% dentists (n=13) perceived their OC knowledge was current (176, 182, 183, 187, 188, 193, 196, 198, 200, 203, 211, 214, 215). However, 35.3% of dentists (n=3) found their OC knowledge was sufficient (180, 194, 205). Furthermore, an average of 60.4% of dentists (n=3) perceived their OC prevention knowledge was sufficient (176, 186, 205). Two studies found there was no correlation between perceived and actual knowledge (195, 211), while other studies reported a positive correlation (205, 213). Additionally, 2 studies investigated dentists' perceived cancer management knowledge, with one study reporting 37.1% of dentists felt their knowledge was current (140) and the other study found dentists with more experience were more likely to treat CPs (139).

Perceived Role of Dentists in Managing CPs: Two studies reported >75% of participants agreed that GDPs should provide dental treatment for OC patients (139, 140). However, dentists' willingness to provide dental treatment to H&N CPs receiving RT varied; <50% of dentists expressed comfort in managing these patients (192), and the preference to refer these patients to dentists who specialised in the field ranged from 32.9% (140) to 77.1% (197). A study exploring dentists' perceived roles in treating patients with a history of cancer, found that 91% of GDPs were happy to provide dental treatment to cancer survivors (209).

Perceived Role of Dentists in Cancer Screening: On average, 88.3% of dentists (n=7) acknowledged the role of dentists in OC screening (141, 170, 173, 196, 199, 205, 207). However, some dentists believed that oral screening should be performed selectively, with an average of 71.6% of dentists (n=5) perceiving dentists have a role in performing OC screening in high-risk patients (177, 179, 196, 211, 215), and in one study 78% of dentists indicated a role in screening patients with a history of HNC (177).

Perceived Adequacy of Training: On average, 63.6% of dentists (n=4) perceived their OC training was sufficient (175, 178, 191, 198), 59.6% of dentists (n=17) perceived their OC screening practice was sufficient (170, 172, 176, 184, 186, 187, 191, 193, 196, 200, 203, 206, 207, 211, 213-215), while 47% of dentists (n=4) perceived they were adequately

trained to treat CPs (139, 140, 167, 202). With regards to further training needs, studies consistently reported a strong inclination among dentists for further training. On average, 87% of dentists (n=2) were interested in receiving OC CE (184, 186), 81.7%% dentists (n=11) were interested in specific training on OC detection (176, 178, 182, 183, 187, 190, 200, 204-206, 214), and 92.5% of dentists (n=2) were interested in training on managing CPs (140, 192).

Practice

Studies that surveyed practice of dentists can be grouped in oral screening practice (n=33), management of suspicious oral lesions (n=13), managing CPs (n=14) and communication with other health professionals (n=7) (see supplementary file 3.4 in the Appendix B).

Oral Screening Practice: In clinical practice, an average of 53.4% of dentists (n=16) reportedly performed oral screening examinations on every patient (141, 142, 170, 173, 176, 177, 180, 184, 187, 194, 199, 200, 207, 211, 213, 215), while 71.8% of dentists (n=9) selectively screened high risk patients (171, 178, 186-188, 191, 205, 207, 211). Recent graduates (n=2) (178, 205) or dentists who perceived to have adequate training (n=3) (196, 203, 205) were more likely to perform OC examinations on their patients.

Management of Suspicious Oral Lesions: Majority of dentists refer suspicious lesions to a SD to confirm diagnosis. Only 36.7% of GDPs (n=4) performed the biopsy on patients with suspicious oral lesions (172, 186, 193, 215).

Management of CPs: Of the studies that explored SDs (n=4), over 60% of restorative specialists (181, 185) and over 78% of oral maxillofacial surgeons (201) managed H&N CPs in their clinical practice. In one study, 55% of oral maxillofacial surgeons reportedly reviewed leukaemia patients pre-chemotherapy (166). However, among studies of GDPs (n=6), 4 studies found >50% of dentists saw CPs undergoing CTx (140, 167, 168, 192, 202) although one study reported GDPs rarely see CPs (206). Location of practice (metropolitan or urban) (140), gender, age and duration of practice (187) reportedly was not associated with dentists seeing CPs. However, a study suggests place of graduation influenced if a GDP would refer patients with HNCs to a SD for dental management (139).

Communication with Other Health Professionals: Amongst the studies with GDPs (n=3), majority of dentists who treated CPs communicated with the oncology team (140, 167), however they rarely received updates from the oncology team (167). A study reported that 88.5% GDPs reported that having a referral guideline could improve the quality of referrals (176). Amongst the studies of restorative specialists (n=2), 52% attended multi-disciplinary meetings (MDTs) (181) and most patients seen at oncology assessment clinics were referred from MDTs (185). A study on dentists in management roles found that 13% of dental managers believed dental service for CPs can be improved by having earlier referral for dental care (168).

Confidence

Three studies explored dentists' beliefs in their capabilities in managing CPs. In two studies, <50% felt confident in treating HNC patients (139, 140). One study reported that GDPs were most comfortable with performing non-invasive or less complex procedures on CPs (192).

Barriers and Facilitators

Content analysis of free text responses or qualitative data within studies reporting barriers and facilitators to providing oral care to CPs, identified professional, organisational and patients' factors that influence dentists' willingness to provide dental care to CPs.

Professional Barriers and Facilitators:

Lack of training (180), knowledge and skills (167, 202) were identified in 3 studies as a barrier to providing dental treatment for patients undergoing CTx. The increased time required to manage oral health of CPs (181) and the short timelines to perform dental screening between diagnosis and commencement of CTx (167, 181, 202) were also highlighted as barriers.

The complexity and consideration of CTx needed before performing dental treatment could pose as barrier for dentists to treat CPs (185). For example, a survey of dentists managing CPs with bone modifying agents found that 94% of dentists considered risk of extracting a tooth (osteoradionecrosis), 81% of dentists considered the prognosis of the tooth (extension of caries) and 76% of dentists considered success of conservative management (restorability of tooth) in their dental treatment planning for patients undergoing RT (185).

Organisational Barriers and Facilitators

Structural barriers also impact on dentists' ability to provide dental care to patients. Studies (n= 2) highlighted that the medical team does not prioritise or refer patients for dental screening prior to treatment or provide information to patients (167, 202). One study reported the need for inclusion of oral health and referral pathways in the overall care plan of CPs (202). The short time frame between diagnosis and treatment commencing also restricts time available for screening (181). Similarly, dentists lack clear guidance on safe treatment options (202). Having referral sources and a policy to provide long-term continuing care for patients following completion of CTx was highlighted as a potential facilitator to the continuity of care for patients (168).

Lack of communication between dentists and the cancer team was also a barrier to care. For example, in one study, 31% of dentists reported a lack of correspondence with the patient's oncology team (167) and other studies (n=2) reported weak links with oncology services and primary care providers impacted on timely communication (168, 202).

Funding models were also highlighted as a barrier to dental care for many. For example, in two US studies it was reported 1/5 of dental practices did not accept CPs on Medicaid (167, 202) and insurers do not provide cover for dental treatment (n=2) as it is not viewed as necessary for cancer management (166, 202). UK managers also highlighted need for specific funding for dental treatment of CPs (168).

Patients' Barriers and Facilitators

Patients' lack of awareness can also be a barrier to accessing care. For example, in one study 56% of dentists reported a lack of patient education on oral complications (167) and a second study reported inadequate patient education of oral risks associated with RT (202).

Quality of Studies

Overall, most studies (n=43) scored over 71% on MMAT. The quality assessment can be found in supplementary file 3.5 in Appendix B. No studies were excluded from the review based on their quality assessment. The review did identify a high-risk potential bias in one paper included in our analysis (201). This risk is related to lack of details about how recruitment processes were conducted. Given we used a narrative synthesis to summarise study results in this review, it is unlikely inclusion of this study resulted in mis-representation or inflation of the review findings. Fifty-one of the 53 studies were surveys, it is worth noting that these survey-based studies have their limitations including self-selecting samples, small sample size and low response rate which increased the risk of selection bias. Further, most studies adopted study specific questionnaires due to a lack of standardization in outcome measures. Hence, this review is classified as level V primarily relying on descriptive and qualitative research.

4. Discussion

This is the first systematic review that synthesizes the perspective of dentists in managing CPs. In our review, 94% (n=50) of studies limited their focus to HNC. This is despite all CPs potentially experiencing short and long-term treatment related oral complications.

It is well known that having clinical guidelines alone are not sufficient to change practice; rather multi-level factors are required to implement evidence-based research into clinical practice (216). In this review we sought to map the current literature to the Theoretical Domains Framework (150), to provide a conceptually robust exploration of factors that may influence clinical practice change among dentists. We specifically focused on the domains of knowledge, skills, professional role and identity, beliefs about capabilities, and environmental context and resources.

The review found that there is great variability in dentists' OC knowledge. This is likely to due to a lack of standardised measures and variation in how knowledge was assessed. Across studies, while there was a high percentage of respondents who were able to identify alcohol and tobacco are associated with OC, they showed less awareness of other risk factors and myths. Not surprisingly, higher cancer knowledge was linked to

clinical exposure, prior cancer education and positive perception of cancer training. Regardless of their current knowledge or perception, dentists expressed desire in further CE in deepening their cancer knowledge, OC detection and CTx.

Our review found that while dentists view their responsibilities as including OC screening and management, fewer conduct screening in their clinical practice. This pattern is also observed in managing patients with OC, possibly due to insufficient oncology training in dentistry programs. There is limited information on dentists' perceptions of their role in non-HNC management. With evolving CTx and side effects such as opportunistic infection (49), dental caries, gingivitis and febrile episodes from odontogenic origin (95), the need for managing patients with non-HNCs is becoming crucial.

In our review, GDPs reported lower proficiency in giving advice to CPs (139, 140) and were reportedly less comfortable performing complex dental procedures for such patients (192), in comparison to SDs (181, 185, 201). However, after implementation of education programs in Texas (217, 218), there was a notable change, with majority (91%) of GDPs in recent local survey providing dental treatment to patients undergoing CTx or with a history of cancer (209). This highlights the benefits of cancer-specific training.

Our review found where dental treatment is dictated by third parties (such as insurance companies or government agencies), dental care in patients with non-HNCs was not a necessity. Previous research also found 56% of cancer centres did not have a dental department (159). This is despite research demonstrating a 26% reduction of oral complications following implementation of dental services to patients with non-HNCs (109). Furthermore, research demonstrated that dental intervention reduced blood stream infection in patients following allogenic HSCT (114), decreased incidence of osteonecrosis in patients with bone metastases treated with bisphosphonates (110), and lowered risk of mucositis in breast CPs undergoing chemotherapy (111).

Dentists working in the community have an important role in cancer care. A hospital-based dental intervention demonstrated positive outcomes in reducing adverse oral side effects in patients with HSCT, however there was a 86% drop-out rate at the 3-month follow-up due to the distance patients were required to travel to the hospital (115). This highlights the need for accessible dental care closer to patients' home, ensuring continuity of care and leveraging existing rapport with their dentists during cancer treatment. Our review found that 92.5% of dentists were willing to receive further training on managing CPs. This affirms Fantozzi, Monopoli (147) view that adequately trained dentists working in the community are critical to providing safe and effective oral care for CPs.

A limitation of this study is that most literature focused on HNCs, resulting in over-representation of HNCs. Given this study is on patients with all forms of cancer, it might not reflect dentists' perspective on managing CPs more broadly. Secondly, a lack of standardised questionnaires in assessing outcomes across studies could leading to challenges in drawing consensus results. Furthermore, utilising study-specific and non-

validated questionnaires can lead to misinterpretation of the results. For example, Martins, Palmier (197) assumed “radiation-related caries leads to osteonecrosis” while in fact, it is the extraction of carious teeth in the irradiated bone rather than having caries that leads to osteonecrosis of the jaw. In another study (195), the authors introduced uncommon terminologies “initiating” and “promoting” factors for OC and pointed out participants could not differentiate between the two. This can result in potentially inaccurate data being collected. Lastly, no studies were excluded based on their quality or biases. Results were based on data reported by the studies.

5. Conclusion

This review highlights the paucity of research related to dentists’ knowledge, perception, practice and confidence in treating CPs outside of H&N regions. There is a need for future studies to understand barriers that hinder dental involvement with oncology patients and to identify strategies to facilitate clinical practice amongst dentists to be in alignment with advancement in cancer treatments.

Declaration

Funding: The authors did not receive any funding for this systematic review.

Chapter 4 – Study Two

Understanding Dentists' Views and Experiences Managing the Oral Health of Patients with Cancers.

Rationale:

The objective of this research was to investigate Australian dentists' views and experiences in managing the oral health of patients with cancers. The systematic review found that of the 53 studies that met the eligibility criteria, all but three studies were focused on dentists' knowledge of, or experience in, managing head-and-neck cancer. The existing literature also predominantly examined dentists' oral cancer screening practice and oral cancer risk factors, with limited literature investigating perceived oral cancer knowledge and oral cancer training. Only two studies were identified that explored knowledge related to cancer therapy and the management of side effects associated with radiation therapy to the head-and-neck region. The review failed to identify any studies investigating dentists' knowledge of cancer therapies and side effects more broadly.

The systematic review identified several factors associated with higher oral cancer knowledge: recent continuing education, time since graduation and experience working in public hospital settings. The review also found that overseas studies reported barriers to dentists' involvement in treating patients with cancer, including lack of cancer-specific training or resources/ guidelines, perceived limited knowledge, the increased time required to manage cancer patients as well as the short timelines to the commencement of cancer therapy. Further, studies also reported a lack of referral and poor communication with the oncology team. Finally, dental funding models may also influence their willingness to provide dental care for cancer patients.

To better understand the barriers and facilitators of current oral healthcare practices amongst dentists in Australia, a mixed-methods study was conducted.

Chapter Overview

In this chapter, the findings from a mixed-methods study are reported. Data collection was conducted from October 2023 to March 2024. A national survey of 88 dentists in clinical practice and registered with the Australian Health Practitioner Regulation Agency (AHPRA) participated in the online survey. Of these, 28 were interviewed to gain further qualitative insights.

The survey questions were developed after reviewing relevant literature, with Multinational Association of Supportive Care in Cancer (MASCC) recommendations serving as the primary framework for oral care practices. Survey questions were refined with researchers (AH and JS) and clinicians in cancer care, and then piloted with dentists (n=6) working across different clinical settings. The interview guide was developed iteratively by the research team and refined as the interviews progressed to capture any new information emerging from the interviews.

The University of Sydney Human Research Ethics Committee approved the study (HREC 2023/498). Approved documents can be found in Appendix C.

The study manuscript has been prepared for submission to the "Community Dentistry and Oral Epidemiology" Journal (refer to Appendix D for the supplementary files) and was presented at the following scientific meetings.

Presentations:

Low SL, Holden A, Shaw J (2024) Improving Oral Health of Cancer Patients: Dentists' Perspectives. Oral presentation, *2024 Psychology HDR Symposium*. 14th of June, Sydney, Australia.

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Abstract

Objective: Research consistently demonstrates dental involvement has a positive impact on the oral health and quality of life of cancer patients (CPs). However, little is known about Australian dentists' involvement in cancer care. This study aims to identify dentists' perspectives on the management of CPs' oral health.

Methods: This mixed-methods study comprised an online survey and semi-structured interviews. Dentists were eligible to participate if they were working clinically in Australia. The study included questions related to knowledge, confidence, cancer experience, perceived role and barriers to providing oral care. Quantitative data were analysed descriptively, regression analysis was used to identify predictors of knowledge and confidence, and qualitative data were analysed thematically using a Framework Approach.

Results: Of the 88 dentists who participated in the survey, 28 participated in telephone interviews. Fifty-six percent were female, with a mean of 20 years of clinical experience. The majority (87%) were general dentists (GDPs) primarily working in metropolitan areas (72%), and in private practice (67%). The majority of participants had moderate to high confidence (93%) in managing CPs and moderate to high cancer knowledge (86%), although only a minority (21%) reported seeing more than 10 CPs in the last 12 months. Recent cancer continuing education (CE) predicted the level of cancer knowledge ($p=0.015$) and the number of CPs seen predicted confidence ($p<0.001$). Thematic analysis identified four main themes that influenced patient-centred oral care: (i) scope of practice, (ii) clinical practice interest, (iii) cancer care structure, and (iv) patient-related factors.

Conclusions: Despite dentists having the knowledge and confidence, the provision of oral care to CPs is dependent on dentists' willingness to provide care, which is influenced by their clinical interest, access to resources and the practice set-up. Participants highlighted the need for better integration of community and hospital-based care pathways, as well as understanding the psychosocial needs of CPs.

Key words: dentist, cancer, perspective, barrier, knowledge, confidence, oral care

Introduction

An estimated 20 million cancer cases were diagnosed globally in 2022 (219). With improved prevention, early detection and treatment of cancer, the survival rate for some cancers have been steadily increasing (220, 221). In Australia, in line with developed countries globally, the 5-year survival rate for all cancers has improved from 58% to 70% in the last three decades (7).

Despite the decline in mortality rate, cancer therapy, often systemic in nature, can lead to a multitude of side effects. While the oral effects of therapies to the head-and-neck (H&N) region are well documented, the oral health of patients with cancers more broadly is often overlooked. Oral side effects of cancer therapy include primary effects of mucositis, mouth ulcers, dry mouth and bone necrosis, and secondary adverse effects such as caries and periodontal issues (91, 222-224). Despite research showing that dental input mitigates oral side effects (109, 225), its integration in cancer care remains largely underexplored.

To date, research into dentists' involvement in oncology has been primarily focused on H&N cancers (226). In Australia, despite the advocacy for general dentists to manage CPs (145), little is known about dentists' involvement in these patients more broadly. This study investigates dentists' experiences and perspectives on managing the oral health of CPs in Australia.

This study is guided by the Theoretical Domains Framework (TDF) (150), a 14-domain framework used to implement improvement in healthcare practice. Its development is underpinned by five domains, namely cancer knowledge, practice skills, perceived professional role, self-confidence in managing CPs, and resources to facilitate oral health management of CPs. The aim is to explore Australian dentists' (i) knowledge of cancer treatment and oral management, (ii) clinical experience and confidence in treating patients with cancers, (iii) perceived role in treating patients with cancers, (iv) resources used to guide treatment and (v) barriers and facilitators to managing CPs.

Methodology

Study design

This mixed-methods study included an online survey and qualitative telephone interviews. Interviews were analysed thematically using a Framework Approach (227). The study received HREC approval from The Sydney University Human Ethics Committee [HREC 2023/498].

Participants

Clinically active dentists, registered with the Dental Board of Australia, were eligible to participate. We aimed to recruit dentists from across Australia with a range of clinical experience working with CPs.

Survey measures

The survey questions, developed by the research team, were developed after reviewing relevant literature, with Multinational Association of Supportive Care in Cancer (MASCC) recommendations serving as the primary framework for oral care practices. The survey was piloted with six dentists. The final survey included demographic and clinical practice items (age, gender, qualifications, years of practice, further training, location and type of practice), experience, confidence and knowledge of managing CPs as well as the perceived role of dentists in cancer care.

Interview Guide

The interview guide was developed iteratively by the research team. Initial questions were piloted and amended based on feedback from dentists, and further refined during the interviews as new information emerged from participants. The interview guide included questions adapted from the survey, focusing on participants' experiences, their willingness to provide care, and the challenges they faced in delivering care within their practice settings.

Together the survey responses and interview data provided insights into the barriers and facilitators to dentist involvement in cancer care.

Procedures

Participants were recruited via advertisements circulated to members of the Australian Dental Association (ADA) in New South Wales (NSW), Victoria, Queensland and Western Australia. Participants were also recruited from Australian dental professional Facebook groups and through snowballing. A reminder invitation was circulated 3 months after the initial approach. Eligible participants provided online consent before accessing the REDCap survey (228).

Participants were also asked to indicate if they would like to participate in a telephone interview and provided contact details. A range of clinical experience, location, type of practice, expertise was used to identify potential interview participants from the wider sample. This purposive sampling was used to ensure a range of views were obtained. A trained qualitative researcher (SL) from within the research team conducted the semi-structured interviews, and interviews were recorded and transcribed verbatim. Interview participants were recruited until data saturation was reached. See supplementary file 4.1 COREQ checklist and supplementary file 4.2 STROBE checklist in Appendix D.

Data analysis

Quantitative Analysis

Quantitative survey data were analysed descriptively (percentages, means and standard deviations). Stepwise regression analyses were performed to explore associations within the data. All analyses were conducted using SPSS.

Knowledge: Six study-specific knowledge questions were included in the survey. Participants were asked to indicate common oral side effects of cancer treatments and appropriate treatments. Participant response to each question was evaluated with a maximum possible score of 30.

Confidence: Eight questions assessed participant confidence in providing patient advice, communication with the oncology team, and therapy side effects and management. Each question was scored from 1-5 (not confident to most confident) using a 5-point Likert Scale, with a maximum possible score of 40.

For both knowledge and confidence, total scores of <50% indicated low knowledge/confidence and >75% indicated high knowledge/confidence.

To identify predictors of higher knowledge and confidence, recent cancer CE, number of CPs treated in the last 12 months, type of practice (public vs private), other health qualifications and specialist dental degree were entered into a stepwise regression.

Qualitative Analysis

The study utilised a reflexive thematic analysis using a Framework Approach (227), and triangulated the interview data with free text results from the survey. A combination of deductive (codes pre-selected based on TDF) and inductive approaches (codes generated from the data) were used to code the data. An initial coding framework was developed based on 5 initial interviews (SL and JS) and applied to subsequent interview transcripts. The research team met frequently and made amendments to the coding framework based on a constant comparative approach as the interviews progressed. The data were summarised by charting codes and thematically analysed. See Table 4.1.

Table 4.1: Process of thematic analysis

Steps	Description
1) Transcription	Recorded audio interviews were verbatim transcribed using Trint software. Transcripts were checked for accuracy by cross-referencing with the audio-recordings, noting any pauses and verbal expressions.
2) Familiarisation	Researchers reviewed and familiarised the transcriptions. Initial impressions with the data set were noted.
3) Coding	Researchers independently reviewed and preliminarily coded the transcripts.
4) Developing working framework	Researchers met to discuss the codes and their definitions from the first five transcripts. Similar codes were grouped into themes and sub-themes, and a working framework was developed supported by illustrative quotes.
5) Applying the analytical framework	The framework was iteratively applied to subsequent interview transcripts and open-ended survey responses, which were coded systematically onto an Excel Spreadsheet. Researchers met to discuss any new codes or uncertainties and resolve the discrepancies.
6) Charting data into framework matrix	Meaningful quotes were extracted to support the themes/ subthemes of the analytical framework.
7) Interpretation of data	Researchers identified the emerging key themes and their relationships to each other.

	A flowchart was developed and refined through discussions.

Note: For Steps 2 to 6, researchers repeated these processes for every five sets of interviews. After 28 transcripts were completed, the researchers met to proceed with step 7.

Results

Data were collected from October 2023 to March 2024. Of the 134 participants who accessed the survey link, 103 met the eligibility criteria and 88 participants completed the survey and were included in the data analysis. Twenty-eight dentists participated in the telephone interviews.

Fifty-six percent of participants were female, the mean age was 44 years (±12 years) and the mean clinical practice years was 20 years (± 12 years). The majority of participants were GDPs (88%), working in metropolitan (72%) and in private practice (67%). Table 4.2 presents participant demographic information (see Supplementary File 4.3 for interview participants' characteristics in Appendix D).

A majority of participants (79%) reported seeing less than 10 CPs in the last 12 months. Notably, 67% had not engaged in any cancer-specific CE. However, a majority of participants indicated they referred to guidelines (60%) and/ or consulted colleagues (57%) as required. Table 4.3 summarises the participants' cancer experience.

Table 4.2: Demographic characteristics

Characteristics (n)		**Participants n (%) or mean+/- SD**
Gender (n=88)	Male	39 (44.3%)
	Female	49 (55.7%)
Age (n=87)		43.9 ± 11.8 years
Years since graduation from bachelor degree (n=88)		19.7 ± 12.2 years
Specialist degree (n=88)	Yes	11 (12.5%)
	No	77 (87.5%)
Years since graduation from specialist degree (n=11)		14.9 ± 12.6 years
Other qualifications (n= 88)	Yes	53 (60.2%)
	Health related	32 (52.8%)
	Non-health related	19 (37.2%)
	No	35 (39.8%)
Location of practice (n=88)	Metropolitan	63 (71.6%)
	Regional/ rural	25 (28.5%)
State (n=79)	NSW	47 (59.5%)
	Victoria	17 (21.5%)
	Queensland	6 (7.6%)
	South Australia	2 (2.5%)
	Western Australia	5 (6.3%)
	Tasmania	2 (2.5%)
	Northern Territory	0
Primary type of practice (n=88)	Private	59 (67%)
	Public	29 (33%)

Table 4.3: Participants' cancer experience

Characteristics (n)		Participants n (%)
Number of CPs seen in the last 12 months (n=87)	0	11 (12.6%)
	1-5	14 (16.1%)
	6-10	44 (50.6%)
	11-20	2 (2.3%)
	>20	16 (18.4%)
*Recent cancer CE in the last 12 months (n=88)	No	59 (67%)
	Yes	29 (33%)
	In-person	12 (13.6%)
	Online	21 (23.9%)
	Reading journals	6 (6.8%)
	Workplace	3 (3.4%)
*Resources used prior to seeing CPs (n=88)	Guidelines	53 (60.2%)
	Colleagues	50 (56.8%)
	Own research	19 (21.6%)
	Unsure	17 (19.3%)
The usefulness of having cancer resources (n=88)	Yes	82 (93.2%)
	No	6 (6.8%)

*More than 1 response could be selected

Cancer knowledge and confidence

Over half the participants reported high cancer knowledge and confidence in managing CPs. The mean knowledge score was 20.6 (± 5.0), with participants scoring highly on oral side effects of cancer treatments. The mean confidence score was 23.4 (± 4.5). Participants were most confident managing the oral side effects of radiation to the H&N (see supplementary file 4.4 in Appendix D).

Multivariate Analysis

To assess if education and experience influenced knowledge and confidence, regression analysis was conducted. Knowledge and confidence variables were tested separately against five independent variables: recent cancer CE, number of patients seen, type of practice (public vs private), other health qualifications and specialist dental degree.

Multivariate analysis found that completion of education in the last 12 months was associated with higher knowledge (B 0.26, $p<.05$), but only accounted for 6.9% of the variance. Similarly, greater exposure to CPs in the last 12 months was associated with higher confidence scores (B 0.35, $p<0.001$), accounting for 12.3% of the variance (see supplementary file 4.5 in Appendix D).

Perceived Role of Dentists in Cancer Oral Health Management

Most participants perceived dentists' roles in cancer management to span across all settings, with GDPs in both hospitals (81.8%) and private practice (77.3%) playing particularly significant roles (see supplementary file 4.6 in Appendix D).

Qualitative analysis

Qualitative analysis identified four themes that facilitated participation in the provision of oral health care to CPs and underpinned patient-centred care: (i) scope of practice, (ii) clinical practice interests, (iii) cancer care structure and (iv) patient-related factors. Illustrative quotes are provided in the text, with further supporting quotes provided in Supplementary File 4.7 in Appendix D.

Theme 1: Scope of practice

Participants highlighted that dentists have a duty of care to their patients. They perceived dentists' willingness to manage cancer-related oral health is dependent on their knowledge, skills, training and the availability of local specialised dental services.

1.1 Duty of care.

The majority of participants expressed a commitment to providing oral care based on their patients' needs.

> *"I run a private practice so as much is dependent on the life experiences of my patients. My philosophical intent which is person centred health care and preventive." ~#66*

This duty of care was particularly important in non-metropolitan areas. Non-metropolitan participants perceived the lack of specialised dental oncological services, required them to assume an expanded duty of care for their patients, including those diagnosed with cancer.

> *"One of the things about regional practice is, there is basically no specialists to refer to..... So we're very much used to stepping up and doing what we can." ~#77*

A few experienced participants emphasised that with adequate training, those working in private community clinics could manage patients with cancer more broadly. Similarly, the majority of participants reported a duty of care to refer patients if the appropriate care was beyond their expertise.

> *"Knowing my own limitations, where I don't feel I can give the care then I'll refer on to someone else." ~#66*

Furthermore, survey participants indicated that the fear of harming patients prevented them from taking on patients diagnosed with cancers.

1.2 Need for knowledge and skills acquisition

Linked to duty of care was participants' need for additional clinical knowledge to manage CPs effectively.

> *"The honest truth is the lack of [cancer] information … because treating CPs isn't sexy. There's not as much information out there that's commonly available." ~#25.*

In the absence of cancer resources to guide practice, participants generally sought guidance from other more experienced colleagues. A participant noted:

> *"A lot of it was just discussing with specialists and kind of learning on the job." ~#88*

The benefits of clinical guidance were highlighted by the majority of participants. At the same time, they noted that undergraduate training provided insufficient practical skills in managing oral health of CPs, although a few specialist participants reported it was part of postgraduate specialist training.

> *"I think that lack of knowledge and the lack of protocol, regimen, because undergraduate training didn't prepare us for this." ~#101*

Theme 2: Clinical practice interests

Willingness to treat CPs was not only based on perceived duty of care, but for some, willingness was also linked to clinical practice interests. Having an interest in medically-complex patients attracted some dentists to the field of oncology. Additionally, the funding model dentists practiced within influenced their ability to provide appropriate oral care to CPs.

2.1 Complexity of cancer care

The majority of participants actively engaged in cancer care acknowledged the multi-faceted considerations necessary when providing dental care. A participant reflected:

> *"I think one of the biggest things for me when I started working in a cancer hospital, I was so overwhelmed with all the different diagnoses and the different types of treatments." ~#124*

They emphasised that the complexity of dental treatment planning extends beyond dentition assessment to include cancer prognosis, therapy-related side effects, and psychosocial and financial challenges.

Experienced participants further highlighted the need for and difficulty in making decisive actions for dental treatment planning, in the absence of the patient's overall medical plan. Additionally, participants highlighted the considerable time required for

routine dental procedures and the interdisciplinary co-ordination with the oncology team, along with the emotional burden in supporting CPs.

> *"We don't have the luxury of the historical knowledge of patients. So, we sort of coming in at a point in time when there's a lot of other things going on in their lives and often having to make pretty quick and aggressive... ... being very decisive about the dental treatment plan. So, often people are dealing not only with their cancer diagnosis and what's coming up with their cancer treatment, but then having to deal with losing teeth and all the other functional challenges that come along with that." ~#124*

> *"When you are caring for cancer patients, there's so much energy to go into those patients in a way because they are unwell, physically, emotionally." ~#96*

Although all participants acknowledged that dentists have a role in treating cancer patients, only a few participants reported their long-standing interest in the medical side of patient care.

> *"I thought it would be a very rewarding part of dentistry to work with CPs... .... And it was." ~#34*

Consequently, these participants gravitated towards a clinical load that involved treating CPs, regardless of their practice settings.

2.2 Feasibility within the business model

For some, the structure of a dental practice influenced the feasibility of treating CPs, as profitability often dictated the types of dental services they could provide. As one participant explained:

> *"That's really challenging because it's not actually a very effective way to make money out of CPs. It's not cosmetic treatment, it's high intensity preventative treatment." ~ #53*

In contrast, participants working in hospitals are not constrained by cost but are faced with managing patients with more complex needs.

> *"90% of our patients are H&N CPs." ~#83*

Theme 3: Structure of cancer care

The accessibility of dental care to CPs is largely impacted by the structure of the healthcare system.

3.1 Care Co-ordination

Participants reported that the different policies for accessing dental care for CPs across jurisdictions in Australia influenced their ability and willingness to provide oral care for CPs.

> *"It varies a lot around the country depending on what services are available to individuals, that's an unfortunate part of the lottery of our health system in Australia." ~#77*

These variations ranged from all CPs being eligible for public dental care to limited access for specific cancer diagnoses. Given the varying funding models, dental referrals largely depend on coordination within the broader healthcare system, with H&N doctors more likely to involve dentists in patient care. Some participants highlighted fragmentation between medical and dental teams. A participant explained:

> *"I think that oral care is often seen as an afterthought depending on the severity of the cancer." ~#45*

Further, to improve cancer care, a participant summarised that:

> *"There is a need for greater integration of dentists and oral health within the multidisciplinary team approach is really important and also documentation of such." ~ #45*

Moreover, some hospital-based participants reported that caring for the oral health of CPs also requires collaboration between dentists.

> *"Having the [dental] support in the community, being able to send a patient off to a particular clinic, knowing that they are going to be seen in a timely manner and receive appropriate treatment. That's a really big challenge." ~#124*

This highlights the need for co-ordinated, inter-disciplinary care where information and responsibilities are shared.

Theme 4: Influence of perceived patient-related factors

Many participants highlighted patient-level factors that influence their ability to provide oral care, such as patient's awareness of oral side effects, lack of prioritisation of dental health amidst cancer diagnosis and the affordability of dental care.

4.1 Awareness of the importance of oral care

Some participants highlighted that CPs are sometimes not aware of the role dentists can play in managing oral side effects of cancer. A participant remarked:

> *"That lack of awareness of the oral side effects and how fast they progress… most people aren't aware of those side effects and the fact that they are lifelong." ~#53*

This lack of awareness is reportedly further compounded by the fear of dentistry and pre-existing negative oral health habits prior to a cancer diagnosis.

4.2 Prioritisation of cancer care

Stemming from the lack of awareness of the importance of oral care, participants reported other factors at play.

> *"Time, mental capacity, it's hard to commit to multiple medical practitioners if you've got something that's potentially life threatening." ~#45*

The burden of medical care makes it difficult for CPs to prioritise dental care and commit to additional dental appointments.

4.3 Affordability of dental care

The burden of care was not just limited to time for appointments. For some, the cost of seeking private dental services is prohibitive, impacting on the quality of cancer care.

> *"There's a huge cohort of patients in the community that are not eligible for concession cards, or they don't have the financial capacity to see private dentists. They are just really struggling to get any kind of dental care." ~#124*

Triangulating the survey and interview data (see Figure 4.1), this mixed-methods study identified that the provision of patient-centred oral care for CPs is influenced by dentists' clinical practice interests and the business model that they operate in. Furthermore, dentists' views about their scope of practice are underpinned by their duty of care as well as appropriate knowledge and skills. Finally, the structure of cancer care and dental care both influence patients' engagement and prioritisation of oral care during cancer.

Figure 4.1: Determinants of patient-centred oral care

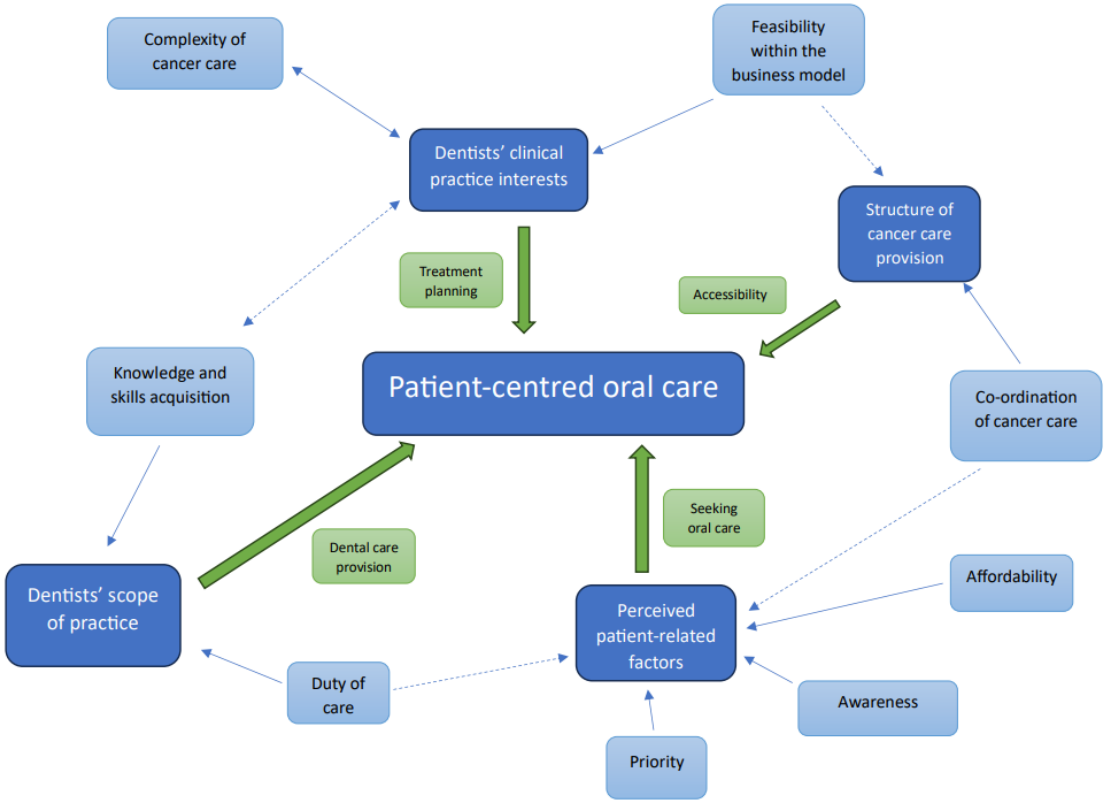

Figure 4.1 illustrates how the four themes identified in our study collectively shape patient-centred oral care. Dotted lines highlight sub-themes with dual influences, such as 'knowledge and skills acquisition' affecting both 'dentists' scope of practice' and 'dentists' clinical practice interests'. Similarly, 'duty of care' and 'co-ordination of cancer care' impact whether CPs receive dental care, while the 'feasibility within the business model' impact on 'structure of cancer care provision'.

Discussion

This study found that while survey participants had strong cancer knowledge, clinical exposure to CPs remains low despite the prevalence of cancer in Australia. Participants indicated that dentists collectively have a role in cancer management across different settings and specialties. Regression analysis revealed continuing education predicted better cancer-related knowledge, while the number of cancer patients treated predicted perceived confidence. Possessing knowledge alone is insufficient to change practice. Several inter-linking variables including organisational, professional and patient-related factors were identified as contributing to this low clinical exposure.

A key factor influencing access to patient-centred oral care is the structure of cancer care. Unlike medical care, dental care in Australia is not universally supported by

government funding (229). Further, state jurisdiction determines whether patients with cancers receive dental care. Patients with H&N cancers typically receive some form of oral care due to the cancers being close to the oral cavity (230). However, for a majority of patients, given the scarcity of government-funded dental care and long wait lists, private dentistry is their only option. For dentists in private settings, the set-up of business models influences the accommodation of CPs. Moreover, the reliance on health insurance reimbursements incentivise private dentists to focus on dental procedures rather than patient-centred care towards CPs (231). Patient-centred oral care requires 'soft skills' such as understanding the medico-psycho-social needs, which are not recognised as reimbursable care. This is further compounded as dental care delivery has little external oversight and clinical decisions are made by individual dentists (216). With cancer accounting for 16% of the overall disease burden in Australia and costing 9.7% ($14.9billion) of the total health expenditure (7), there is an urgent need for an alternative pathway to meet the supportive care needs of CPs.

At the professional level, dentists' clinical practice interests and the business model they work in influence their willingness to embrace cancer care complexities. With 84% of Australian dentists working in the private sector (123), the complexity of cancer disincentivises some dentists from developing the clinical skills required to appropriately manage CP's oral health. Recognising the need for the skills and knowledge to care for these patients influences dentists' decisions to undertake further oncology training, however there is little emphasis on managing patients with complex needs in undergraduate programs (232, 233). For a minority of dentists involved in cancer care in public settings, existing multi-disciplinary structures help provide this clinical support, however a lack of interdisciplinary collaboration means that dentists working in the community are not afforded similar collegial learning opportunities. For some, in the absence of support, a sense of duty to provide safe dentistry deters them from treating CPs, given the complexity of cancer care.

This research did not interview CPs, however our participating dentists identified several perceived patient-related factors that may hinder CPs' oral care-seeking behaviours. Driving patient factors is the fact that around 50% of Australians do not visit a dentist regularly, with cost the major barrier to accessing care (234, 235). As a result, CPs have low awareness of oral health, and limited financial capacity to pay for care over and above cancer out-of-pocket expenses, hence they do not prioritise dental care. This is despite oral side effects being a prominent unmet need reported by CPs (21, 35). Our findings are consistent with previous research highlighting a 20% reduction in dental care attendance in patients diagnosed with cancer during peri-cancer therapy and into survivorship (156), perhaps being influenced by a lack of knowledge about oral side effects and potential interventions or feeling overwhelmed by the multiple medical treatments.

Our interviews identified several measures to support dentists, including providing appropriate training focusing on understanding the effects of cancer and its treatments in general dentistry practice and establishing appropriate resources and mentorship

networks for GDPs. A review highlighted the positive outcomes of mentoring programs on patient care in dentistry (236). Additionally, a qualitative study exploring intra-disciplinary mentoring between dental specialists and GDPs (and an oral health therapist) found such mentoring improves access and quality of care for patients with complex needs (237). Further, integrating GDPs into cancer teams, akin to models proposed for general medical practitioners (238), can facilitate communication and enhance comprehensive patient care. Evidence demonstrated incorporating dental care into inter-disciplinary settings resulted in improved patient quality of life and reduced symptom burden (239).

Limitations of this study include the relatively low number of survey participants, with 54% of target recruitment, despite nationwide advertising and follow-up reminders. Given the small sample size, the study may have attracted practitioners with a particular interest in the field, potentially resulting in higher overall knowledge and confidence levels. Furthermore, as the majority of participants worked in the private sector, the findings may not be representative of dentists in the public sector. However, the inclusion of interviews to gain a deeper understanding of dentists' perspectives provided meaningful insights. Additionally, since the study focused on five key domains to investigate dentists' perspectives, other factors influencing dentists' perceptions of oral care provision for CPs may have been excluded. Despite these limitations, this is the first study to explore the perspectives of Australian dentists toward providing oral care to CPs.

Conclusion

There is an urgent need to address the organisational, professional and patient related barriers to provision of oncology-specific dental care in Australia. Despite recognising the need to address the oral health of CPs, this study found that having cancer knowledge alone is insufficient for dentists to expand their scope of practice to managing CPs. Establishing a formal professional link between community-based dentists and oncology is critical to facilitate ongoing case discussions, mentorship, and improved continuity of care. Additionally, addressing the funding models to facilitate greater incentives to treat complex clinical problems and facilitate patient access to care is crucial to shift to more patient-centred cancer-specific oral health care.

Declaration

No funding was received for this study.

Chapter 5 - Discussion and Conclusion

Insights from This Research: Relevance of Dentistry in Cancer Treatment

Chapter Overview

Oral side effects are common across cancer therapies (17, 78, 162). However, much of the focus has been limited to head-and-neck cancers (105, 139, 140). International bodies such as the Multinational Association of Supportive Care in Cancer (MASCC) have advocated for raised awareness of the importance of managing the oral health of all cancer patients. Despite this, Australia has made little progress in recognising and managing the oral health of cancer patients. As a result, cancer patients with non-head-and-neck cancers are vulnerable to poor oral health outcomes and face barriers to accessing appropriate dental care. This chapter will discuss the overall research outlined in this thesis in light of current literature.

Thesis Aims and Findings Overview

Thesis Aims:

The over-arching aim of this research was to explore the interface between dentistry and cancer care. Specifically, the research objectives were to:

(a) conduct a systematic review to synthesise both quantitative and qualitative research examining dentists' cancer knowledge, perceptions, clinical practice and confidence in treating cancer patients, and

(b) explore Australian dentists' views and experiences in managing cancer patients.

Findings Overview

To our knowledge, this thesis is the first to attempt to understand dentists' role in managing cancer patients beyond head-and-neck cancers. Overall, the systematic review confirmed research primarily focused on head-and-neck cancers. In the context of current Australian practice, our mixed-methods study found dentists perceived they have a role in managing cancer patients, although their involvement is currently very limited. To facilitate greater integration of dentistry and cancer care, there are significant barriers that need to be addressed.

Study 1: Systematic Review

Chapter 3 reports the findings of a systematic review of the literature to explore dentists' cancer knowledge, perceptions, clinical practice and confidence in treating cancer patients.

This review found that of the 53 studies included, only a few (k=3) addressed dentists' perspectives outside of head-and-neck cancers (226). Of these, one study explored the management of leukemia patients, while two studies explored the treatment of oncology patients across cancer types.

The review findings also highlight that within the literature, assessment of dentists' knowledge (k=35) has primarily focused on oral cancer screening and risk factors, with only two studies investigating knowledge of head-and-neck radiation therapy side effects. There was also considerable variability in oral cancer identification skills and awareness of oral cancer risk factors reported. In the two studies that assessed recognition of radiation-related caries, dentists working in the field were found to have greater awareness of radiation-related complications.

The review also found that in studies exploring dentists' role (k=7), oral cancer screening was considered fundamental to routine dental examinations. However, the practice of dentists varied significantly across studies with only half the dentists reporting that they performed oral screening on every patient. Nevertheless, dentists consistently showed interest in further training to improve their knowledge and skills in this area. Additionally, in studies that assessed the role of dentists in providing dental treatment for oral cancer patients, willingness to do so varied with less than half of dentists expressing comfort in managing these patients and preferring to refer them. Further training was identified to contribute to dentists' confidence.

Seven studies addressed issues that influenced the provision of dental care for cancer patients. These issues can be broken down into organisational, professional and patient-level issues/factors. Organisational factors included lack of referral, lack of clear guidelines on safe treatment options, the short time frame between diagnosis and medical treatment commencing, poor communication and funding models. Professional factors included lack of knowledge, training, skills, the perceived complexity of cancer care and short time frame to perform dental screening. Reported patient factors included lack of awareness and associated risks from cancer therapy.

The systematic review findings underscored the need to explore dentists' perspectives, knowledge, and experiences in oncology more broadly within the Australian healthcare setting.

Study 2: A Mixed-Methods Study - Survey and Qualitative Interviews

To improve understanding of Australian dentists' perspectives and clinical practice in managing cancer patients, a national mixed-methods study was conducted involving an online survey and individual telephone interviews (see Chapter 4). Participants were recruited through dental professional organisations including Australian Dental Association (ADA) state branches, dental professional social media groups and snowballing.

Eighty-eight dentists completed the survey and 28 participants, purposively sampled based on speciality, type of dental practice, location of practice and experience, participated in telephone interviews. The thematic analysis of interviews triangulated data from the survey. Four themes were identified that appeared to influence dentists' provision of patient-centred oral care to cancer patients: scope of practice, clinical practice interests, the structure of cancer care and patient-related factors.

The study found that dentists understood they have a duty of care to patients diagnosed with cancer. However, their scope of practice was predominantly limited to managing head-and-neck cancer patients, with few having experience treating patients with other cancers. Non-metropolitan dentists reported a broader scope of clinical practice that included managing cancer patients more generally due to a lack of referral options in non-metropolitan Australia. Additionally, fear of practicing outside their scope deterred some dentists from treating cancer patients.

It was demonstrated that assessed knowledge of cancer therapy and oral health management was high, and approximately half of all participants were confident in their clinical capacity to manage the oral health of cancer patients. Despite this, few (20.7%, n=18) had treated more than 10 cancer patients in the past 12 months.

Regression analysis confirmed that continuing education predicted cancer-related knowledge, whereas the number of cancer patients treated predicted perceived confidence. Participants indicated that dentists collectively have a role in cancer management across different settings and specialties. However, they reported a need for oncology-specific resources to guide the management of these patients.

The research findings also highlighted that participants generally perceived managing medically-complex cases as a skill acquired through on-the-job experience and continuing education, which helped them to refine their ability to treatment plan for this group of patients. The majority of experienced participants acknowledged the multifaceted considerations involved in treatment planning, particularly the time constraints associated with completing necessary dental procedures before head-and-neck radiation. Moreover, the structure of private practice business models often prioritised income-generating cosmetic procedures over the more time-consuming care required for medically-complex patients.

Factors influencing access to dental care included the coordination of cancer care and the structure of dental business models. Patients with head-and-neck cancers were more likely to be referred to dentists for oral health management. Participants working within multi-disciplinary teams highlighted the benefits of understanding the overall plan for cancer patients. In contrast, those practicing independently in the community reported challenges in oral management due to the lack of clear guidelines and coordination with the oncology teams. Additionally, access to publicly funded oral health care for cancer patients varied based on state jurisdictions.

Moreover, study participants reported perceived patient-related factors in seeking oral care, including affordability, awareness and priority. It was noted that medical treatment took priority over oral health. It was also highlighted that many patients were unaware of the impact of cancer therapies on oral health, while the lack of funding for accessible dental care further limited their ability to seek treatment.

Together the results of this systematic review and mixed-methods study highlight barriers that prevent dentists from providing oral care to cancer patients. However, the interviews uncovered deeper issues relating to patient-centred care, since possessing

knowledge and skills alone were found to be insufficient to drive oral care provision. Systemic factors such as care coordination; professional factors such as business model, clinical practice interests, complexity of cancer care and duty of care; as well as patient-related factors such as priority, awareness and affordability, all influence the delivery of patient-centred oral care. The thematic insights presented here may represent just the tip of the iceberg, highlighting the need for further research to fully elucidate and address the multifaceted obstacles to optimal oral health care for cancer patients.

Individual Professional-level Implications for Improving Oral Health of Cancer Patients

The overarching aim of this thesis was to understand the factors influencing dentists' involvement in cancer care underpinned by the five domains in the Theoretical Domains Framework (TDF): knowledge, skills, social/ professional role and identity, beliefs about capabilities, and environmental context and resources. Based on the results synthesised from this research, four key concepts emerged as integral to dental practice: the role of dentists, the scope of practice, the delivery of patient-centred care and the need to upskill dentists. This section will discuss how the TDF domains inform the implications for dental practice.

1) Establishing the Potential Role of Dentists in Cancer Care

As health professionals specialising in the oral cavity, dentists play both individual and collective roles in managing the oral health of cancer patients. The role of dentists in head-and-neck cancers is well recognised, with Australian Dental Association (ADA) endorsing oral screening practice for detection of early cancerous lesions (240). However, the role of dentists for other cancers has not formally been established in Australia. To expand dental involvement requires shifts in both individual and system-level conceptualisation of clinical practice. A key driver of this change is how healthcare professionals perceive their professional 'role and identity'.

Our systematic review (study one) found that while studies reported that most dentists understood their preventative role in screening for oral cancer, in the limited data available, fewer than half felt comfortable managing the oral health of patients undergoing radiation therapy after an oral cancer diagnosis. Many preferred to refer these patients to others with greater specialisation. In study two, our survey participants endorsed the role of dentists in managing the oral health of patients with cancer. However, despite half of the participants reporting high confidence in managing cancer patients, in practice, only a minority of dentists managed them in their practice.

In a broader context, the limited practice of dentists in oncology is shaped by how cancer management is structured and how national guidelines define their

contribution. Guidance documents, such as the Australian Cancer Plan and associated Optimal Care Pathways (122), reinforce this limited role by failing to outline dentists' contributions to cancer care. For example, in the management of head-and-neck cancer, despite the recognised importance of pre-treatment dental screening (124), the guidelines do not mention the role of dentists in the diagnostic pathway. Similarly, for other cancer types, the supportive care guidelines omit *any* reference to dental involvement. This is despite the potential contribution of dentists across the cancer care continuum.

Prevention, Early Detection and Referrals

While all health professionals have a role in identifying and educating people about cancer prevention and care, and dentists in particular contribute through early detection and multi-disciplinary management of oral cancers, their role in broader cancer prevention should not be overlooked. As oral healthcare providers, dentists have regular direct access to the oral cavity, making them uniquely positioned for oral cancer screening and prevention. Screening for abnormalities in the oral cavity as well as addressing modifiable lifestyle risk factors are integral aspects of dental care (241). Cigarette smoking and alcohol consumption, risk factors consistently recognised by dentists in our systematic review, are not only associated with head-and-neck cancer (242), but are also established risk factors for other cancers such as breast, colorectal and lung cancer (243, 244). Additionally, these risk factors contribute to periodontal disease in the mouth and general health (245, 246). As such, by incorporating oral screening, lifestyle risk assessment and counselling into routine dental practice, dentists can play a valuable role in cancer prevention and in promoting general health beyond the oral cavity.

Research has also shown that having access to regular dental care is associated with a reduced incidence of oral cancer in the general population (247). Despite oral cancers accounting for 4.7% of all global cancer cases (219), they are often diagnosed after metastasis has occurred (248), suggesting routine screening during dental visits remains inconsistent. In our systematic review, only half of the dentists reported performing oral cancer screenings. The diagnostic delay is strongly linked to poorer prognosis and lower quality of life (249). Given dentists have direct visualisation and access to the oral cavity, their role is crucial in ensuring the timely referral to the head-and-neck oncology teams for early diagnosis and intervention.

Moreover, emerging research highlights the growing role of dentists in addressing Human Papilloma Virus (HPV), a major preventable risk factor, for cancers of cervix, genital and oral cavity (250). Our systematic review found that only two-thirds of dentists recognised HPV as a risk factor for oral cancers, indicating potential gaps in knowledge and awareness. Given their regular patient interactions, dentists are well-positioned to educate patients on the link between HPV and cancer, discuss associated risk factors, and advocate for HPV vaccination. However, there is limited research on the acceptability of this expanded role among dentists. One qualitative study found that

dentists felt under-informed and hesitant in discussing the link between HPV and oral cancer with patients (169). Daley et al (251) further identified factors that could influence these discussions such as practice settings, fee-for-service models and the stance of dental professional bodies.

Before and During Cancer Therapies

Dentists play a crucial role in managing both head-and-neck and non-head-and-neck cancer patients prior to starting and during cancer treatment. The primary goal of pre-therapy dental screening is to establish a stable and infection-free oral environment, ensuring that pre-existing dental diseases do not exacerbate oral complications arising from cancer therapy. Additionally, proactive dental management helps prevent subsequent complications such as osteonecrosis of the jaw. In selected oncology patients where facial aesthetic or oral function may be impacted, specialist dentists such as prosthodontists, maxillofacial prosthodontists (supported by anaplastologists) and maxillofacial surgeons may be necessary (252).

Recent studies found that oncology patients had poorer oral health compared to the average population during pre-therapy screening (97, 253). Furthermore, oncology patients with no prior regular dental follow-up required significantly (67.5%) more restorations, and those with cigarette usage were 3.4 times more likely to require tooth extraction (253). International guidelines emphasise the important role of dentists before therapy for all cancer patients (124, 254). This proactive role includes dental health assessments with radiographs to screen for dental diseases, implementation of preventive measures, advice regarding potential therapy-related oral side effects and education about the importance of diet and oral self-care. Additionally, the American Dental Association recommends cancer patients see a dentist four weeks before cancer therapy to allow for healing if any dental work needs to be performed (254). There is also evidence that dental input for patients undergoing radiation and/ or chemotherapy significantly reduces the incidence of oral complications (95, 113, 117). For example, Wuketich et al (224) reported that improving oral hygiene and addressing lifestyle risk factors such as tobacco use reduced the severity of chemotherapy-induced mucositis. Therefore, pre-therapy dental screening should be conducted on all cancer patients (255).

Despite the importance of pre-therapy dental screening, it presents practical challenges. Participants in our interviews frequently highlighted difficulties in pre-therapy dental treatment planning, particularly in the decision-making process regarding whether a tooth should be extracted before cancer treatment, the tooth's long-term prognosis under the impact of therapy, and the patient's ability to maintain its hygiene. A number of participants also reported needing to consult peers or independently research newer or unfamiliar cancer therapies and their implications for oral health. Similarly, community-based dentists with no prior hospital exposure expressed confidence in managing patients with a history of cancer, but felt less

prepared to manage patients during their active treatment phase. This indicates gaps in care coordination and support for dentists managing cancer patients.

During therapy, international guidelines suggest dentists play a supportive role (124, 254), including monitoring and managing oral side effects, reinforcing oral self-care (for example, using an extra-soft toothbrush and bland mouth rinse), bringing awareness to cariogenic diet and preventative fluoride application, as well as symptomatic management of mucositis and hyposalivation. Furthermore, United States guidelines recommend that dentists liaise with oncologists before invasive procedures to ensure stable platelet and white cell counts, and consult on antibiotic prophylaxis for patients with implanted vascular access devices (254). Despite the potential important role dentists have in managing oral health during cancer treatment, our interview study confirmed that few dentists played an active role as part of a multi-disciplinary team during cancer treatment and patients were less likely to seek dental care. This is consistent with a study by Smith et al (156), which reported a 20% reduction in dental visits during treatment, with the authors suggesting that the cancer diagnosis itself was a major influencing factor. Despite overseas guideline recommendations suggesting there is a need for continued dental care upon cancer diagnosis, there is a gap in clinical attendance.

Survivorship and Beyond

Given dentists have an important role in oral healthcare, they play a collective role in the cancer survivorship of patients (54, 256). Research has shown that simple preventative measures such as regular dental attendance, adherence to dietary advice, use of a high fluoridated toothpaste and oral hygiene instruction prevented the formation of caries in high-risk head-and-neck patients (257). Additionally, dentists have a unique role in oral rehabilitation for head-and-neck cancer patients including the use of dental prosthesis (118). They can also have a role in oral cancer surveillance in all cancer survivors, particularly those at heightened risk. This includes patients who have undergone allogenic haematopoietic transplant with high-dose chemotherapy (48, 54, 72) and patients with a history of oral cancer (258).

However, hospital-based dentists in our study reported difficulties in finding appropriate follow-up dental care for cancer patients once they have completed active cancer treatment. This highlights the need to upskill dentists, particularly those working in community settings, to ensure the provision of ongoing and appropriate dental care. The challenge of inconsistent follow-up dental care is not unique to Australia (156) and persists despite international guidelines recommending all cancer patients have follow-up dental care post-cancer treatment (72, 124, 254).

2) Expanding the Scope of Practice

An aspect of 'professional identity and role' is the idea of professional boundaries, which includes the ethical practice of health professionals (151). A health professional's scope of practice is defined as "the professional activities for which they are educated in (including their skills and knowledge), for which they are competent, authorised and accountable" (259). It is dynamic and is shaped by the healthcare settings of the individual professional.

In Australia, there are 26 special needs dentists nationwide treating medically-complex patients such as cancer patients (260). This is far from sufficient to meet the growing oncology demand. Furthermore, more than a decade ago, Gallagher and Fiske (261) foresaw that as the ageing population retained more of their natural dentition, survival rates for individuals with co-morbidities increased, and cancer incidence rose, special needs dentists would become increasingly over-burdened. To address this gap, the authors advocated for integrating aspects of oral healthcare for medically-complex patients into general dental practice. Given there are 26,200 general dentists in Australia (123), this group with a broader scope of practice appears to be the next logical group to address the needs of cancer patients.

However, our thematic analysis revealed one of the common hesitations general dentists have for treating cancer patients is the fear of practicing outside of their scope. A recent review of primary care found that supporting health professionals to extend their scope of practice could improve the future of primary care in Australia (259). This review advocates for the benefits of expanding primary care provider's scope of practice, leading to improved healthcare experiences for the consumers, greater access to care, and a more efficient healthcare system. However, this review did not address dental professionals, an oversight in recognising them as part of the overall healthcare team.

In this research, we have identified business models and their influence on the provision of oral care to cancer patients. Further, the structure of both private corporations and privately owned dental practices in the community often places pressure on dentists to meet financial targets (231). The majority of dentists (84%) work in private practice in Australia (123), and this target-driven approach conflicts with the time needed to understand patients' medico-psycho-social needs and limits the time necessary for thorough consultations to attain an understanding of the complex needs of cancer patients. Consequently, in this business model many dentists may be disincentivised to treat more complex patients. In contrast, publicly funded hospital dentists are generally not bound by such financial pressures and can prioritise comprehensive patient care within a multi-disciplinary health care environment.

Walsh (262) highlighted the importance of general dentists being equipped to manage the oral health of oncology patients . However, these patients often present with complex needs that may fall outside the usual scope of general dental practice. A more recent survey found that only 50% of dentists felt adequately trained and confident in

treating medical oncology patients (167). Despite the growing number of people living with and beyond cancer, expanding the role of general dentists in the care of these patients has received limited attention. For example, our research found that 79% of dentists had treated less than 10 cancer patients in the last 12 months. Given the number of people living with and beyond cancer, this suggests that cancer patients are not presenting for dental care and/or dentists are unaware of important health considerations for their patients. The barriers we identified included concerns related to practice in the absence of evidence-based resources, a fear of practicing out of scope and uncertainty about appropriate referrals if they deem management of an individual patient was beyond their scope of practice. This suggests that dentists need greater support if they are to provide optimal care to all their patients.

The need for further resources was a key driver highlighted in our research as influencing dentists' willingness to expand their scope of practice. This is consistent with the findings of a recent Scottish study by Wemyss et al (263) which found dentists specifically sought resources concerning unified oral health advice, a summary of cancer therapies and associated side effects, precautions and contraindications of dental examination and guidance on treatment planning. According to the TDF, behaviour change is only possible if dentists perceive they have the knowledge and skills as well as a belief in their capabilities to not only recognise cancer-related oral health complications but also the expertise to manage them.

Whilst there are advocacy efforts and resources for oral and dental management of head-and-neck cancer patients both locally and internationally (264, 265), the scarcity of well-designed clinical trials beyond head-and-neck presents a significant barrier to developing evidence-based clinical guidelines for broader dental oncology practice. Such guidelines are essential for building confidence in expanding dentists' scope of practice to include the management of cancer patients. For example, MASCC guidelines for managing oral health in cancer patients are primarily based on expert opinion rather than robust evidence from randomised controlled trials. As a result, although there are many opinion papers (18, 266, 267), controversial opinions in terms of the best dental practice for cancer patients still exist. For example, there is disagreement on the safety of gingival probing in leukemia patients due to the risk of systemic infections (268) and the provision of basic oral care in haemato-oncology patients and HSCT in terms of mouthwash and toothbrush use (269). In radiation therapy to the head-and-neck region, despite clinical preference for aggressive pre-treatment extractions, a systematic review by Schuurhuis, Stokman (270) found inconclusive evidence supporting this approach. In light of this, the International Society of Oral Oncology-Multinational Association for Supportive Care in Cancer (ISOO-MASCC) and the American Society of Clinical Oncology (ASCO) developed recommendations for prevention and management of osteoradionecrosis based on available research, which was predominately retrospective studies (75%) with few (< 8%) randomised controlled trials (271). Given the lack of clear evidence-based guidelines and the constraints imposed by some private practice business models, general dentists may be less inclined to provide oral healthcare for cancer patients.

A key challenge to expanding the scope of practice of dentists is not only the development of evidence-based guidelines but also variable adherence to them in dental settings (272). The concept of clinical governance, a framework for evaluating dental services, is relatively new in dental practice compared to other healthcare professionals (273). In primary care dentistry, where practices operate as independent small businesses, the organisational focus is often shaped by commercial imperatives rather than clinical oversight. This differs from hospital settings, where dental care delivery is embedded within a broader healthcare system and overseen by formal governance structures. A systematic review (k=15) of clinician's attitudes towards oncology clinical practice guidelines found that having access to treatment facilities that endorsed these guidelines is a facilitator to following them (274). As pointed out by the experienced participants in the interviews, mentorship and formal professional links to cancer centres are vital in navigating the complexities, controversies and safe practice in oral health cancer care.

3) Providing Patient-Centred Care

The practice of dentistry emphasises an evidence-based practice approach to clinical problems and views the body as a physical entity (275, 276). However, to ensure optimal care for cancer patients, dentists need to shift their practice from a treatment-oriented approach to a patient-centred approach (277), especially in the context of cancer care. Healthcare providers including dentists have a moral imperative to engage in holistic care that supports cancer patients through their cancer journey (278). This involves providing dental care that not only encompasses knowing the medical history of the patients, but also understanding and acknowledging the patient's lived experience of cancer (279). While patient-centred care is well-established in medicine, it remains under-explored in dentistry (280). This is primarily due to the lack of consensus on its definition and implementation in dental clinical practice (281).

Despite the variations of patient-centred care models in dentistry, a review found consensus on the importance of understanding the patients' social context and their experience of the disease (280). In the context of dental oncology, patient-centred care begins with dentists having a fundamental understanding of the oral and general implications of a patient's cancer therapy. This knowledge enables dentists to provide appropriate information and guidance. Beyond this, dentists must be aware of evidence-based treatment options, including pharmacological interventions, self-care strategies, professional dental intervention options, and in some instances a decision for non-intervention. Importantly, these treatment decisions must be considered within the broader context of a patient's psychosocial well-being and overall medical prognosis and treatment, ensuring that cancer patients are empowered to make informed choices about their oral health.

However, a complex issue in patient-centred dentistry is the shared decision-making between the patient and the dentist (280). Unlike medicine, where shared treatment

decisions often involve pharmacological or procedural interventions determined by choice of treatment, dental treatment planning is more nuanced, requiring patients to take an active role in their care rather than being passive recipients. Effective shared decision-making in dentistry involves patient responsibilities, such as adherence to preventive and ongoing self-care. This is because even though dental diseases such as caries and periodontal issues are preventable, the prevention of dental diseases largely relies on patient's self-care behaviour such as oral hygiene practices, diet and smoking habits (282). In providing and deciding on dental treatment options, dentists must consider not only the patient's preferences but also their ability to manage the treatment and any risk factors that may compromise the success of the procedure.

In oncology, our experienced participants indicated that decisions must often be made swiftly prior to the commencement of cancer therapy. For instance, prophylactic tooth extractions in the irradiated jaw may be necessary before head-and-neck radiation therapy to prevent future complications such as radiation-related caries/ tooth loss and osteoradionecrosis. While these interventions may be clinically necessary, patients may not always recognise their importance, adding to the challenge of aligning treatment plans with both clinical feasibility and patient acceptance. The application of fluoride as a preventive measure is another instance that is resisted by some patients who view fluoride as a harmful chemical (283). Thus, patient-centred dental care requires understanding patients' perspectives and the provision of appropriate shared decision-making within time-sensitive constraints.

Another challenge in delivering patient-centred care is that dentistry operates separately from the broader healthcare system (277). However, beyond individual competencies, study two identified TDF domain of 'environmental context and resources' such as oncology specific support and inter-disciplinary collaboration are essential for effective patient-centred care. The complexity of oncology care demands structured shared care models amongst health professionals. Without understanding the contextual knowledge of the patient, dentists risk a narrow, dental-focused treatment plan that may overlook patients' overall needs.

In study two, our participants noted patient-related barriers included affordability, awareness and priority. This highlights that when the knowledge of the impact of cancer therapy oral side effects is lacking among the treating oncology team, they may not adequately communicate the importance of oral health care to patients, which leads to oral care being de-prioritised. Addressing these barriers is crucial to ensuring that cancer patients continue to receive necessary oral healthcare.

Given that most patients rely on their community dentists as their primary oral health care provider, these dentists play a critical role in ensuring continuity of care, including those newly diagnosed with cancers. At this time, patients require greater connection and communication, to feel empowered and valued (284). Establishing a strong dentist-patient connection allows timely intervention and tailored care as patient's needs arise. Further, community dentists often build rapport not only with patients but also with their families, which is essential in the context of patient-centred care (283). In

oncology, where cancer affects the entire family, involving them in care decisions is essential for patient-centred dentistry.

4) The Need for Training to Upskill Dentists

For dentists in the community to provide effective patient-centred oral care to cancer patients, they need adequate training and support to expand their scope of practice. Previous research has highlighted a lack of knowledge and training, reliance on clinical rather than evidence-based practice, inconsistency or absence of oral assessments and lack of standardised oral care practices all contribute to a lack of confidence and skill in treating cancer patients (167, 222). Similarly, our systematic review identified that much of the focus of training has been limited to head-and-neck cancer. In our mixed-methods study, despite over half of survey participants reporting high knowledge and confidence in oncology, only a minority managed patients with cancer. The disconnect between theory and practical skills may indicate flaws in oncology training in dentistry. Epstein et al (157) highlighted the complexity of the disease and its treatment and emphasised the need for educated and experienced dentists to manage cancer patients more broadly. Without appropriate practical experience gained through appropriate mentorship or cancer-specific skills development, even well-meaning dentists may unintentionally risk patient's safety or provide inappropriate dental treatment.

An area for improvement in current training programs highlighted by our research was the perceived lack of standardised oncology training at both the undergraduate and postgraduate levels. As dental professionals increasingly encounter cancer patients, specialised oncology knowledge becomes important to delivery of appropriate oral care. It would empower general dentists to practice to the full extent of their clinical scope if undergraduate oncology training were to move beyond its current focus on biopsies and diagnosis of oral lesions to a greater understanding of the effects of cancer therapies, and an increased emphasis on the practical skills needed for graduate dentists to treat cancer patients across the dental curriculum. Our results are consistent with a study by Rosen et al (285) which highlighted the lack of practical skills for general dentists in their training programs. Equipping new graduate dentists with general skills to manage oral health issues arising from cancer therapies and exposing them to working in inter-disciplinary settings will help to address some of the knowledge and practice gaps identified in our research.

In addition to its inclusion in the dental teaching curriculum, there is an urgent need to expand the availability of continuing education in oncology for dentists (209). Our research found that most participants gained expertise and confidence through hands-on practical experience, often by shadowing or receiving mentorship from more experienced dentists. This was due to the complexity of cancer care and the nuanced nature of dental treatment planning for these patients. Internationally, while some argue for onco-dentists with specialised skills to solely manage the oral health needs of

cancer patients (26, 146), others advocate establishing targeted training programs to upskill general dentists to meet the unique needs of cancer patients (147). For example, a one-year dental oncology training program for general dentists in inter-disciplinary settings is offered in at Memorial Sloan Kettering Cancer Centre in New York, Princess Margaret Cancer Centre in Toronto and High Point University in North Carolina.

However, to our knowledge, no such training programs for general dentists currently exist in Australia. Given that the majority of dentists work in small businesses, a continuing education program that enables them to maintain their community practice while gaining exposure to multi-disciplinary settings may be more practical. In this way, upskilling initiatives will ensure that community-based dentists can enhance their scope of practice and build inter-professional relationships without disrupting their clinical work and patient relationships.

Healthcare System-level Implications for Improving Oral Care in Cancer Patients

In implementation science, 'environmental context and resources', a domain in TDF, examines how a person's situation or environment encourages the development of skills or abilities. In addition to changing individual dentists' behaviours, our study identified that to facilitate greater engagement of dentists in cancer care, there is a need to improve the Australian healthcare system.

1) The Need for Inter-disciplinary Collaboration (Shared Care)

Dentistry is often an 'after-thought' or it operates in silos separate from the oncology team. While informing patients about side effect management is the remit of the oncology team, lack of integration and recognition of oral health by oncology teams can result in adverse patient outcomes. To address this, a shared oncology management plan that is accessible to all health professionals, including dentists would facilitate better communication and coordination. Additionally, a streamlined system for direct consultation with oncology teams would enable dentists to seek clarification when needed.

Ward et al (286) found that while medical oncologists expressed confidence in managing severe dental complications such as osteonecrosis, they felt underqualified to identify early-stage oral health issues that require intervention. Additionally, when asked about integrating preventive dental care, such as fluoride varnish applications, into medical oncology follow-ups, oncologists agreed that it was feasible but would require both education and financial support. This highlights the critical role dentists play in cancer care. However, a recent qualitative study exploring practice and beliefs about managing cancer patients in primary dental care settings highlighted some patients had been advised by oncology teams to avoid dental appointments before or

during their treatment (263). This inconsistent advice underscores the need for inter-disciplinary bi-directional collaboration with both medical and dental professionals working together to complement their expertise to achieve holistic care for patients (287).

As highlighted across interviews, dentists working in the public system encounter more cancer patients and often have access to multi-disciplinary oncology teams, which help them in treatment planning. However, dentists working in the community reported more difficulties in treatment planning in the absence of an overall medical management plan provided through multi-disciplinary care. A universally accessible oncology plan would bridge this gap, ensuring that dentists in the community can make informed clinical decisions based on the patient's cancer treatment and prognosis. In the absence of an integrated care plan, the timely provision of the care plan to patients to provide to their dentists would be an interim step to facilitate optimum care.

Integrating dental care into mainstream cancer care is challenging due to the current structure of the dental profession. TDF's "skills" domain emphasises the importance of interpersonal skills, a form of clinical skill that can only be acquired through clinical exposure to achieve proficiency. The majority of junior dentists begin their careers in private practice settings, with little experience collaborating with other health professionals. This is in contrast with the medical program where newly graduated doctors regardless of their future clinical practice aspirations, are required to have one year of hospital internship experience where inter-professional collaboration is fostered. Expanding this collaborative model to private community dental practices is essential as more cancer care services involve the private sector. In the context of non-head-and-neck cancer, where patients may seek healthcare from different localities, shared care models that facilitate cross-disciplinary communication is crucial.

A key finding from our research was the importance dentists place on learning from their peers. This suggests a key role for more experienced clinicians in imparting their knowledge and clinical skills with less experienced clinicians. However, it also highlights an opportunity for enhanced inter-disciplinary collaboration. Medical counterparts are valuable resources in helping dentists stay informed about evolving cancer therapies, their implications and the complexities in cancer care. Our results confirmed that whilst dentists are well-versed in dentistry, the implications of newer cancer treatments can be difficult to track without direct oncology support. Nevertheless, this knowledge is essential for expanding the scope of dentists to safely develop a treatment plan for cancer patients. A shared oncology plan that includes key dental considerations would ensure that dentists remain informed and can confidently plan treatment in alignment with the overall cancer care objectives.

Inter-disciplinary collaboration should extend beyond medical to include other health professionals. For instance, dietitians working with cancer patients can offer practical knowledge for dentists, as nutrition is closely linked to oral functions. Likewise, insights from nursing professionals on patients' cancer therapy schedules will better inform dentists' planning pre-therapy screening and schedule dental procedures appropriately

to optimise cancer care. Similarly, dentists could gain valuable insights from pharmacists on safe practices when treating patients undergoing chemotherapy, as they routinely advise patients on the safe handling of their bodily fluid waste (288). By incorporating an oncology plan accessible to all relevant health professionals and establishing clear lines of communication for all professionals involved, dentists would be better equipped to navigate the complexities of cancer care, safely deliver care, and ultimately improve patient outcomes.

Lastly, several experienced participants in our mixed-methods study identified that treating cancer patients is draining, a finding consistent with research showing that burn-out is a significant issue in oncology (289, 290). In a systematic review (k=25) exploring teamwork and health professionals' occupational well-being found that health professionals perceived positive teamwork is linked to better well-being and less burn-out amongst health professionals (291). This highlights the benefits to dentists' wellbeing of an inter-disciplinary approach over a siloed approach in managing cancer patients.

2) The Need for Intra-professional Collaboration

Collaboration within the dental profession is also vital to ensure patient-centered oral health care. Most general dentists recognise the importance of referring patients to specialist dentists when a case is beyond their scope of practice, ensuring that patients receive the best possible care. Our survey findings indicate that both general and specialist dentists collectively play a role in managing cancer patients, reinforcing the necessity of intra-professional collaboration. Referrals to specialist dentists are particularly important when cases involve complex dental procedures beyond the capabilities of general dentists. According to our interview participants, this collaboration already exists, particularly for head-and-neck cancer patients. In these cases, pre-therapy dental assessments and extractions are routinely performed by general dentists, with referrals to maxillofacial surgeons for procedures requiring specialised surgical expertise.

However, another aspect of intra-professional collaboration is the collaboration between general dentists across different health settings. Overwhelmingly, our study participants highlighted that general dentists based in the community have a role in cancer care. However, our interviews revealed concerns among hospital-based dentists regarding gaps in dental care pathways, particularly the lack of structured pre-cancer therapy assessments and follow-up care after hospital discharge. A recent Australian study corroborated the need for private community dentists to collaborate and alleviate the burden on public health (118). This finding resonated with a recent focus group study in Scotland where dentists working in the hospital had difficulty transitioning care from hospital settings to dentists in the community (263). Similarly, a recent qualitative study of general dental practitioners (n=15) working in the community reported barriers such as poor communication between settings, a lack of guidance and financial disincentives in continuing dental care for head-and-neck cancer patients (292).

Addressing this gap requires stronger collaboration between hospital and community dentists. A coordinated approach, akin to the survivorship models employed by general medical practitioners following acute hospital treatment (238, 293), would necessitate upskilling general dentists to manage the ongoing oral health needs of cancer patients. By strengthening collaboration between public and private dental practitioners, community-based general dentists would be better positioned to provide appropriate oral care for cancer patients.

3) The Need for Subsidised Oral Care

The World Health Organisation (WHO) global strategies for oral health emphasise the need to reform healthcare systems to incorporate oral health into universal healthcare (294). In Australia, the decision to exclude dentistry from Medicare has posed significant challenges for oral health to be included as universal care for patients. As alluded to in this research, the current financial structure of dental care in Australia can be a disincentive for dentists and cancer patients. Unless they have the economic means to seek private dental care, few patients can access dental care as government support is limited to healthcare card holders and wait lists are extensive for public dental care in most state jurisdictions. Due to a lack of subsidised dental care, those without dental coverage are 49% less likely to seek dental care (156). This is despite demonstrated cost-effectiveness of dental care in reducing oral complications in cancer patients (108). This underscores the perception of study participants that there is a need for government-backed initiatives to support trained general dentists to provide essential dental care for cancer patients.

In Australia, past efforts, such as the 'Chronic Disease Dental Scheme' where patients with chronic medical conditions could seek private dental care with government-subsidised funding have been short-lived (229). Several reasons have been identified for the abandonment of the scheme; poor inter-professional communication between doctors and dentists, the poorly defined eligibility criteria leading to a cost blow-out and the inherent pressures placed by patients on doctors and dentists that undermined their professional autonomy (295).

In 2019, Grattan Institute identified cost as a major barrier to accessing dental care in Australia. The independent report urged for publicly funded universal dental care to be re-instated through Medicare with the goal of first prioritising people of low socio-economic status and children, in collaboration between individual dentists working in the community (private) and hospital (public) dentists (296). Moreover, a recent survey found two-thirds of dentists supported the expansion of government-funded medical care (Medicare) to include basic dental services in Australia (297). Although not singled out in the Grattan Institute report, people with an experience of cancer often encounter financial difficulties as a result of treatment related out of pocket expenses and impact of their diagnosis and treatment on their ability to work. To successfully reintegrate dentistry into subsidised cancer care requires well-defined and mutual goals at both the governmental and professional levels.

Future directions for dental research

A key priority for oral health is in strengthening data-driven decision-making through robust monitoring and evaluation systems (294). Implementation researchers have also identified that to implement a change in clinical practice, system, professional and patient-related barriers need to be addressed (298, 299). The following sections will explore future opportunities for cancer-specific dental research.

1) The Need for Research to Establish Best Dental Practice

Epstein et al (54) found that oral complications from cancer therapies are under-researched, under-reported and under-recognised from treatment to survivorship. This challenge is further complicated by the rapid development of novel targeted therapies, which introduce new and evolving side effects that may impact oral health. To ensure optimal patient-centred care, dentists must stay informed about emerging oncology treatments and their potential oral complications.

While the effects of traditional cancer treatments are well-documented (30, 78), further research is needed to understand the oral side effects of newer cancer therapies, such as immune checkpoint inhibitors, tyrosine kinase inhibitors, and monoclonal antibodies. Investigating these therapies' impact on oral tissues could provide valuable insights for improving preventive and management strategies in dental oncology.

As modern dental medicine relies on strong evidence not only to guide best practice but also to inform healthcare policy, there is a continuous need for high-quality randomised-control trials to evaluate effective interventions for preventing and managing oral complications in cancer patients.

Finally, for dentists to safely manage cancer patients, particularly those undergoing chemotherapy, clear guidelines on the safe handling of patients and their salivary waste products are essential. While resources are available for patients, to our knowledge, there are currently no specific safety guidelines for managing chemotherapy patients in the dental setting. This is concerning, as chemotherapy by-products are known to pose a risk to others during treatment and up to seven days after the last dose (300).

2) Research to Enhance Dentists' Skills in Primary Care

This thesis has demonstrated that knowledge alone is not sufficient to drive changes in clinical practice when managing cancer patients. Moreover, even experienced participants acknowledged that having strong dental skills does not fully prepare them for the complexities of treating oncology patients, given the challenges of cancer care coordination and the nuanced approach for dental treatment planning. There is an

urgent need for clinically appropriate training programs to upskill general dentists in cancer care.

Internationally, training programs have been established to bridge this gap (301-303). In Australia, future research should explore the feasibility of implementing short-term training programs for general dentists at major cancer hospitals. These programs could provide structured clinical exposure, enabling dentists to develop practical skills in oncology-related dental care. Additionally, future studies should evaluate the effectiveness of such training initiatives by measuring key outcomes, such as the number of cancer patients treated in primary care, patient-reported outcomes and the competencies of dentists following training. Embedding these training programs within cancer centres will help establish professional links between trained general dentists and cancer centres to provide ongoing clinical support and mentorship, and ultimately improve the integration of dental care into oncology services.

3) Patient-Centred Oral Health Care in Oncology

This thesis specifically explored five domains of the TDF. Future research should investigate the domain of 'social influences' to understand the impact of professional bodies on dentists' clinical practice. The ADA has a policy statement on oral cancer, advocating the role of dentists in oral cancer prevention and early detection (240), however the ADA policy does not address managing the side effects of cancer therapy. This suggests there is a need to explore the stance of professional bodies and how policies shape individual dental practice.

This thesis provides insights into dentists' perspectives on the barriers and facilitators to the provision of patient-centred oral care. However, an important aspect of patient-centred care is understanding the experiences and perspectives of the patients themselves. A study of cancer patients' utilisation of Australian healthcare found that patients with a history of cancer were more likely to seek a range of health professionals, including dentists (304). However, as this study was based on the National Health Survey data, the timing or purpose of these visits in relation to a cancer diagnosis was not explored. Understanding the experiences of patients is critical if services are to meet the needs of patients. Future research to identify barriers and facilitators to accessing dental care in the context of cancer are required. By incorporating patients' perspectives, researchers can uncover barriers that may not be apparent to healthcare providers. In oncology, even though patients may have the same cancer, the experience of each patient is very different underscoring a patient-driven approach to improving oral healthcare delivery.

4) Incorporating Oral Health in the Shared Care Model for Oncology Patients

Cancer Australia recognises the importance of shared follow-up care (305). Shared care is a formalised arrangement in which oncology specialists and primary care providers

have specific roles and responsibilities in managing cancer patients (293), and is increasingly recommended for ongoing management in cancer survivorship (306-308). In a systematic review (k=11) exploring survivorship shared care, there was no difference in quality of life, mental health outcomes, unmet needs or clinical outcomes between shared care and usual hospital care (306). Furthermore, shared care is more cost-effective and preferred by cancer patients (293, 306). In Australia where geographical area poses challenges to healthcare access, shared care has been successfully implemented in paediatric oncology patients, with qualitative research indicating positive reception by patients and families (307).

Shared care models currently do not include primary care dentists. However, given the acute and long-term effects of cancer therapy on oral health, and with many chronic diseases being managed in primary care settings with a team-based approach, opportunities exist for dentists to be part of this team (309). Future research should investigate expanding shared care to include dentists in primary care settings (community). This research could assess the effectiveness of integrating dentists into cancer care from the time of diagnosis, evaluating outcomes from pre-therapy dental screening through to survivorship. A comparative approach could examine whether patients receiving shared dental care experience better outcomes than those receiving conventional care, which in some cases involves no dental care. Key outcome measures may include the incidence of oral complications and overall quality of life in cancer patients. Future research should prioritise cancer patients at higher risk of developing oral complications. Once effective shared care management strategies are established, research can be expanded to assess the broader applicability of the shared care model.

Several considerations must be addressed when integrating dentists into shared care models. Primary care providers have highlighted the need for additional training, clear follow-up protocols, and improved communication between primary and hospital-based providers (308). Future research should explore strategies to overcome these barriers, such as developing standardised training programs, implementing structured referral pathways, and leveraging digital health technologies to enhance collaboration. Increasingly in healthcare, technology plays a crucial role in improving inter-disciplinary care, particularly by facilitating communication across geographically dispersed locations (310). The communication facilitated by technology could help establish stronger links between community dentists and oncology teams. Developing and evaluating shared care models that incorporate trained primary care dentists into inter-disciplinary cancer care teams is pivotal to changing how care is delivered. Pilot programs using a hub and spoke approach to outreach to community dentists in local health districts may provide information on the implementation strategies required for later rollout into nationwide randomised controlled trials assessing patient outcomes and integration within existing cancer care pathways.

Considerations and Limitations

The findings of this thesis need to be considered in light of several limitations.

The findings of this thesis, drawn from both systematic review and mixed-methods study, are therefore primarily based on experience in head-and-neck cancer patients. This was because our systematic review found few studies (k=3) investigating dental management of cancer patients outside of head-and-neck region. Therefore, the results synthesised were mainly based on oral cancers. Of the studies (k=50) that focused on oral cancers, few investigated cancer therapy-related side effects. Similarly, the experiences of the participants in our mixed-methods study were primarily gained through head-and-neck cancers, reflecting the current oncology practice in Australia.

The sample size for the survey was lower than anticipated, representing less than 1% of dentists registered in Australia. Recruitment was initiated primarily through the ADA and via posting on the social media of dental professional groups. However, not all ADA branches agreed to distribute the study advertisements, which may result in the under-representation of the views of dentists in some states and territories. Additionally, participants in the mixed-methods study were offered no financial incentives or compensation for clinical time lost which may have led to participation from dentists with a clinical interest in the research. This could have introduced bias, as dentists with similar views may have been over-represented. Nonetheless, purposive sampling for the interviews ensured a diverse range of participants and clinical experiences were included.

This thesis investigated the perspectives of practicing dentists and excluded dental students, hygienists, oral health therapists and dental assistants. Consequently, some views regarding undergraduate dental training programs may not be reflective of the current curriculum. Furthermore, this study did not investigate the potential role that dental auxiliaries, such as hygienists, could play in facilitating oral health care in oncology.

The views of oncology teams and patients were not included in this thesis. Therefore, system and patient-related factors are examined solely through the lens of dentists. As such, the findings of this thesis should be considered within the broader context of oncology care needs.

Lastly, this thesis excludes paediatric cancer populations, as cancer in this group has other implications including growth-related issues. Additionally, haematological cancers are common in children, whereas oral cancers are rare. Furthermore, unlike adults, children are not typically exposed to risk factors such as alcohol and tobacco. Therefore, the findings of this thesis apply specifically to oral health in the adult cancer population.

Despite these limitations, this thesis is the first research to explore the current and future role of dentists in provision in cancer-specific dental care.

Conclusion

To provide comprehensive patient-centred care, dentistry must be considered an integral part of the oncology team. Despite the supportive care movement started decades ago (311), the inclusion of dental care in the context of cancer in Australia is lagging behind international standards. To facilitate greater integration of dentistry and cancer care, there are significant barriers that need to be addressed. In the context of current Australian practice, this research found dentists perceived they have a role in managing cancer patients, however there is an urgent need to upskill general dentists working in the community to expand their scope of practice to meet the growing demand for cancer-specific oral health care. The research also confirmed that having cancer knowledge alone is insufficient to promote dental involvement in management of people living with and beyond cancer. There is an urgent need to review funding models for dental care to firstly better support patient access to care and secondly to recognise the funding implications of providing complex care in private practice. Additionally, establishing a formal professional link between community-based dentists and oncology is critical to facilitate ongoing case discussions, mentorship, and improved continuity of care.

Future research should explore effective strategies for implementing a shared-care model, integrating oral health within oncology treatment pathways, and evaluating the impact of professional collaboration on patient outcomes. Moreover, upskilling general dentists and leveraging digital health technologies to enhance inter-disciplinary communication could further strengthen the role of dentistry in oncology care.

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Appendices

Appendix A: Published Article

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BMC Health Services Research

SYSTEMATIC REVIEW Open Access

A systematic review of dentists' knowledge, perception, practice and confidence in managing patients with cancers

Sheau Ling Low[1], Alexander Holden[2,3] and Joanne Shaw[1,4*]

Abstract

Purpose Little is known about dentists' preparedness in managing oral side effects in patients undergoing cancer therapy (CTx). The purpose of this systematic review is to identify barriers and facilitators of dentists in managing oral health of cancer patients (CPs).

Methods The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was Prospero registered (CRD42022333055). CINAHL, Embase, Medline, PsycInfo and Scopus databases were searched using keywords and MeSH terms: dentists, oral health, cancer. The outcomes were analysed descriptively and thematically.

Results Of the 2303 articles screened 53 met eligibility criteria. Most of articles ($n=50$) reported on head and neck cancer (HNC) management. Dentists' oral cancer (OC) knowledge varied across studies (27% to 81%, $n=35$). Regardless of their knowledge level, the majority of dentists expressed interest in further cancer education. Across studies, dentists perceived that their role included providing dental treatment for OC patients. However, of the few studies ($n=3$) that explored dentists' confidence in managing CPs, less than half of dentists felt confident providing advice to patients with HNC. More barriers than facilitators are identified in providing dental care provision to CPs.

Conclusion This review demonstrates gap in dental care for patients with non-HNCs and highlights a need for methods to involve dentists in managing dental health of CPs.

Keywords Dentist, Oral health, Cancer patient, Barriers

Introduction

Patients undergoing CTx have unique oral and dental needs as cancer and its treatment often have direct and indirect impact on oral health. Attentive dental care tailored to the needs of CPs reduces oral complications [1–3], improves quality of life [4, 5], reduces mortality [6, 7] and healthcare costs [8]. To facilitate better oral care, internationally there have been a number of best practice guidelines developed (for example Elad, Cheng [9]), however the oral health of CPs receiving CTx is often overlooked and patients do not receive timely information about oral complications or oral care [10].

*Correspondence:
Joanne Shaw
joanne.shaw@sydney.edu.au
[1]School of Psychology, The University of Sydney, Sydney, Australia
[2]School of Dentistry, The University of Sydney, Sydney, Australia
[3]Sydney Dental Hospital and Oral Health Services, Sydney Local Health District, Sydney, Australia
[4]Psycho-Oncology Co-Operative Research Group, Sydney, Australia

Traditionally, oncology patients have been managed in specialised cancer centres, however most cancer centres do not have a dental department [11], and dentists are seldom included in the oncology multidisciplinary team [10] unless treatment is focused specifically on the head and neck (H&N) region. This occurs despite patients with solid tumours outside of H&N region also experiencing chemotherapy-related mucositis, apthous ulcers and xerostomia [12]; patients receiving bone modifying agents, targeted and immunotherapies being at increased risk of osteonecrosis of the jaw [13, 14]; patients on targeted therapies experiencing oral pain, dry mouth and stomatitis [15]; and survivors of allogenic haemopoetic stem cell transplant (HSCT) patients experiencing long term oral side effects as a result of immune response to the transplantation.

With the increasing number of patients being diagnosed with cancers each year and undergoing CTx, there is an increasing need for dentists to be included in managing the oral health of these patients. Dentist's understanding the potential oral side effects is critical as this knowledge will ensure dentists are able to discern dental disease from the transient effects of therapies and take appropriate precautions when managing oral health of these patients [16, 17]. Given the important and yet under-utilised role dentists have in the care of CPs, the aim of this review was to understand the barriers and facilitators of dentists' management of the dental health of CPs undergoing cancer treatment. Specifically, this systematic review explored dentists' cancer knowledge, perceptions, clinical practice and confidence of treating CPs.

Methodology

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [18] and was preregistered with the International Prospective Register for Systematic Reviews (CRD42022333055). It included both qualitative and quantitative studies capturing dentists' knowledge, perception, clinical practice and confidence in managing the oral health of cancer patients.

Search strategy

Medline, Embase, CINAHL, PsycInfo and Scopus were searched using keyword and MeSH terms: "dentist*", "dental specialist*", "dental surgeon*", "oral health professional*", "dental practi*"; "oral health*", "dental care", "oral care", "oral hygiene", "mouth hygiene"; "neoplasm", "cancer*", "oncology*", "malignan*". Broad search terms were used as our preliminary search with narrow terms did not capture relevant studies. The search was conducted in 2022 and updated in July 2023. Reference lists of review articles were also manually searched. An example of search strategy is included in supplementary file 1.

Inclusion and exclusion criteria

Studies were included if they were in adult population and published in English between 1990 and July 2023. Review articles, conference abstracts or expert opinions were excluded.

Participants

This review included studies with general dentists (GDPs) and specialist dentists (SDs), while excluding studies involving dental students and dental auxiliaries such as hygienists, oral health therapists and dental assistants.

Study designs

We included qualitative and quantitative studies reporting dentists' knowledge, perceptions, practice and confidence related to cancer screening, management and clinical practice.

All search results were initially uploaded into EndNote X20 (Clarivate, Philadelphia, PA, USA, 2022).

and duplicates removed. Abstracts were uploaded into Covidence (Veritas Health Innovation, Melbourne, Australia) and two reviewers (SL and JS) independently screened titles and abstracts. For studies that appeared to meet criteria, full text articles were retrieved and reviewed against the eligibility criteria. Disagreements were resolved through discussion.

Data extraction

Data extraction was conducted using a purpose-designed template (SL) and 20% of articles were reviewed by a second reviewer (JS) to assess accuracy. Data extracted included: participants' characteristics (age, gender, experience, training background, recency of continuing education (CE), location of practice and workplace characteristics); study characteristics (country, research methods, recruitment strategies, sample size, cancer population) and outcomes of interest (dentists' cancer and CTx knowledge, perceptions on education, role in cancer management, clinical practice, and confidence). Quality was assessed based on the Mixed Methods Assessment Tool (MMAT) [19].

Data analysis

Quantitative data was summarised descriptively, qualitative data were analysed using content analysis. Reported barriers and facilitators were categorised as: environmental/ context, dentist-related and patient factors.

Results

Database searches identified a total of 3,979 studies, with additional 20 abstracts found through hand searching. After removing duplicates, a total of 2,303 titles and abstracts screened. Full text review of 70 articles resulted in 53 articles identified for inclusion in the review (see Fig. 1 for PRISMA diagram).

Study characteristics

Of the 53 studies identified, the majority (n=50) focused on H&N regions. Of the non-HNCs (n=3), 1 study explored management of leukemia patients [20] and 2 studies [21, 22] explored treatment of oncology patients more broadly. The study designs were primarily surveys (n=51), with 1 study using a qualitative focus group methodology [23] and 1 study using a mixed methods approach [24]. Seven studies focused solely on oral screening practices [25–31].

Mean sample size was 315 (range 32–3200). Studies were most commonly surveying dentists from USA (n=16), Middle East (n=11) or UK (n=7). Five studies were conducted in Asia, with studies also conducted in Brazil (n=4), Spain (n=2), Australia (n=2), Africa (n=2), Canada (n=1), and Italy (n=1). Additionally, 2 studies conducted in combined regions: Australia/ Japan and Australia/ New Zealand. Study characteristics are summarised in Table 1.

Participants characteristics

Studies included participants who were GDPs (n=34), SDs (prosthodontists, restorative dentists and maxillofacial surgeons) (n=5); or a combination of GDPs and SDs (n=14). Studies reporting gender participants (n=36), 38% were female (range 11—79.9%). Forty studies reported participant's clinical practice experience. Among 24 studies reporting range of years, 10 studies reported 32.6% of participants had < 5 years dental experience, 20.9% had 6–10 years and 46.3% had ≥ 10 years' experience. Additionally, 10 studies reported a mean clinical practice duration of 11.9 ± 5.1 years. Of the studies reporting workplace characteristics (n=30), 10 studies recruited participants from solo, partner, salaried, employee and community practices; 21 studies classified workplaces based on funding models (public vs private), of which 54.1% of dentists worked in public sector, 41.3% worked in private sector and 4.4% worked in both public and private settings.

Fourteen studies reported on the recency of OC CE, with approximately half of dentists reporting undertaking CE within the last 5 years [27, 28, 33, 40, 41, 43–51].

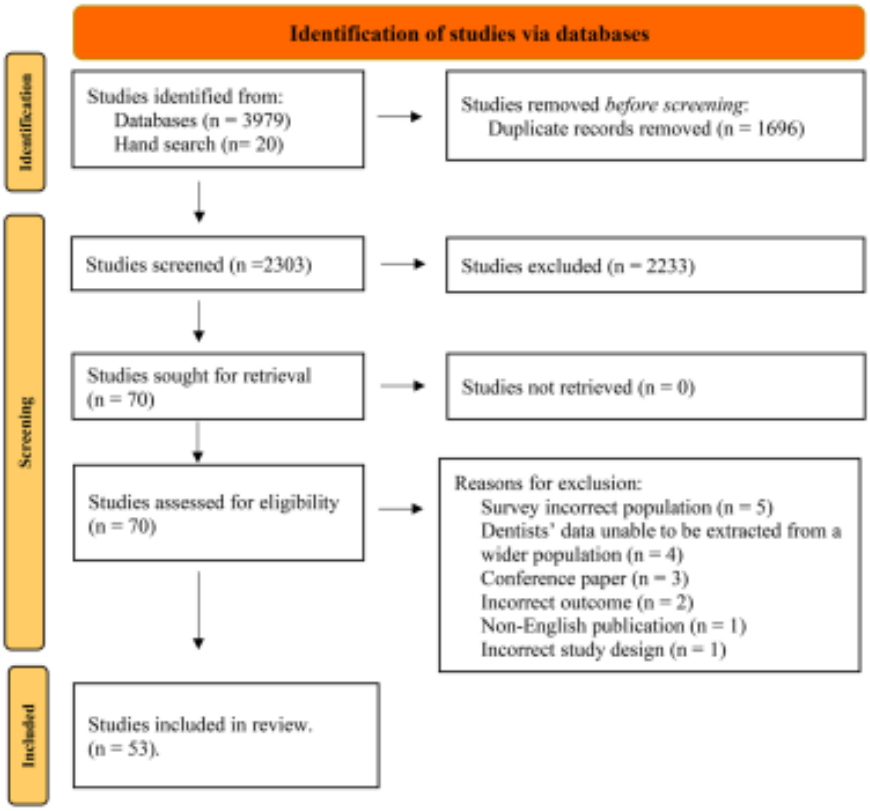

Fig. 1 Systematic reviews and meta-analyses (PRISMA) flow chart

Table 1 Study characteristics

ID	Authors, publican year	Aims	Country	Research methods	Recruitment strategies	Actual sample size	Cancer population	Data analysis
1	Ahmed & Naidoo (2019) [32]	To determine dentists' knowledge, attitudes, and practices in the prevention and early detection of OCs. To evaluate CE needs	Khartoum, Sudan	Quantitative (survey)	130 GDPs working in public dental clinics	*n* = 113 (87% RR)	OC	T t-test, Mann–Whitney U test & Chi-square tests
2	Akbari et al. (2015) [33]	To assess the GDPs' and dental SDs' knowledge about OC in South Khorasan, Iran	Iran	Quantitative (survey)	80 practicing GDPs & SDs taking part in CE	*N* = 73 (91% RR)	OC	Descriptive analysis. Chi square, t-test
3	Alhazzazi (2021) [34]	To assess the knowledge & behaviour of dentists toward screening & managing patients with HNC	Saudi Arabia	Quantitative (survey)	*n* = 723 GDPs & SDs	*N* = 206 (28.5% RR)	HNC	Descriptive analysis. Chi-square test
4	Alonge et al. (2004) [35]	To determine dentists' OC knowledge & OC screening practices, & preferred methods for OC CE	Texas, USA	Quantitative (survey)	398 Texas dentists practicing along the Texas-Mexico border	*n* = 158 (40% RR)	OC	Bivariate analysis (Chi-square test)
5	Alqahtani et al. (2021) [36]	To investigate the knowledge & awareness among dentists in Saudi Arabia towards oral & dental assessment and management of HNC patients pre and post-RT	Saudi Arabia	Quantitative (survey)	Google form via an online link though WhatsApp or Social Media Platforms	370 responded	HNC	Descriptive analysis
6	Alqutaibi et al. (2021) [25]	To assess prosthodontis' knowledge of & screening practices for OC and potentially malignant oral lesions	Saudi Arabia	Quantitative (survey)	*n* = 250 eligible prosthodontists	*n* = 143 (57% RR)	OC	Descriptive analysis using Chi-square test
7	Borhan-Mojabi (2012) [37]	To evaluate the degree of knowledge of physicians and GDPs on OC within the context of developing an appropriate under- & post-graduate education programme to optimize early detection & prevention of OC	Qavzin, Iran	Quantitative (survey)	Dentists: *n* = 100, Physicians: *n* = 100	Dentists *n* = 86 (86% RR); Physicians *n* = 66 (66% RR)	OC	Descriptive analysis using t-test, chi-squared, ANOVA, Pearson correlation
8	Calvert et al. (2014) [38]	To record the current practice of restorative dentistry consultants in immediate, initial, & long-term management of patients diagnosed HNC	UK	Quantitative (survey)	315 restorative consultants from General Dental Council website	*n* = 132 (43% RR), 60 of the 132 treated H&N patients	HNC	Not reported. Data presented as charts and histograms
9	Canto et al. (2001) [39]	To assess dentists' knowledge of risk factors and diagnostic procedures for OC	Maryland, USA	Quantitative (survey)	1000 GDPs selected from ADA Maryland mailing list	*n* = 508 usable questionnaires (54% RR)	OC	Descriptive analysis & logistical analysis
10	Clovis et al. (2002) [40]	To assess and describe Canadian dentists' understanding of risk & diagnostic factors related to OC and to determine their opinions about their professional preparation to prevent & control OC	British Columbia & Nova Scotia	Quantitative (survey)	Systematic random sample of 817 licensed dentists from British Columbia *n* = ?? from Nova Scotia	*n* = 670 (55.2% RR) [*n* = 401 (50.4%RR) British Columbia; *n* = 269 (64.4%) Nova Scotia]	OC	Descriptive analysis using ANOVA
11	Colella et al. (2008) [41]	To investigate dentists and physicians' level of knowledge, attitudes, & behaviours towards OC	Campania region, Italy	Quantitative (survey)	1000 professionals attending 22 randomly selected association meetings	*n* = 457 (45.7% RR) [Dental: *n* = 225 Medical: *n* = 232]	OC	Descriptive analysis

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Table 1 (continued)

ID	Authors, publican year	Aims	Country	Research methods	Recruitment strategies	Actual sample size	Cancer population	Data analysis
12	Cruz et al. (2005) [26]	To examine OC prevention and early detection practice patterns in OHPs. To examine if there were any variables that were associated with lower adherence to recommended health behaviour counselling	NY, USA	Quantitative (survey)	Stratified random sample of licensed dentists ($n=904$) and DHs ($n=963$)	Dentists: $n=496$, DHs: $n=630$	OC	Descriptive Bivariate analysis
13	Daley et al. (2011) [23]	To assess awareness among OHP regarding the HPV-OC link. To elicit OHP attitudes & perceived role to screen for HPV-related oral lesions, & to discuss HPV as OC risk factors & HPV vaccine with patients	Florida, USA	Qualitative (focus group)	Dentists or DHs recruited from local dental & dental hygiene professional associations	dentists: 3 focus groups (total n=17) dental hygienists: 2 focus groups (total $n=21$)	OC	Qualitative analysis. Coding of data
14	Dang et al. (2022) [21]	To assess dental practice patterns in oral care of medical oncology patients & to identify potential barriers to recommended care in the state of Massachusetts	Massachusetts, USA	Quantitative (survey)	Registered dentists at Massachusetts Dental Society. $n=3394$	$n=363$ (10.7%RR)	All cancers	Descriptive analysis. Qualitative coding for free text responses
15	Dewan et al. (2014) [42]	To investigate the approach of restorative dentists in the treatment & dental rehabilitation of OC patients in the UK	UK	Quantitative (survey)	Delegates at the conference ($n=94$)	$n=65$ (69.1% RR)	OC	Descriptive analysis

ADA Australian Dental Association, *AmDA* American Dental Association, *CE* Continuing education, *DH* Dental hygienist, *DT* Dental therapist, *GDP* General dental practitioner, *H & N* Head and neck, *HNC* Head and neck cancer, *OC* Oral cancer, *OCE* Oral cancer examination, *OHP* Oral health practitioner, *OPC* Oropharyngeal cancer, *RR* Response rate, *RT* Radiation therapy, *SD* Specialist dentist

Participant characteristics are summarised in Table 2.

Study outcomes

Knowledge

Thirty-five studies explored dentists' cancer knowledge, with no studies exploring cancers outside of H&N regions. Twenty-eight evaluated OC knowledge, 24 surveyed OC identification skills, 25 assessed OC risk factors and 2 studied CTx side effects (see supplementary file 2 in the Appendix).

Cancer knowledge

There was significant variability in dentists' overall OC knowledge across studies, with correct responses ranging from 27% [35] to 81.3% [62]. In 4 of 5 studies, >90% of dentists recognised that early detection of OC improves patient survival rates [40, 51, 60, 66]. Several factors were identified to be positively associated with OC knowledge. Recent CE ($n=7$) [28, 37, 39, 41, 46, 47, 59], recent dental graduates ($n=7$) [32, 33, 39, 49, 50, 69, 70], SDs in oral surgery/ pathology ($n=2$) [36, 41] and dentists with experience in public settings ($n=4$) [36, 49, 50, 59] reportedly had significantly better OC knowledge. Dentists who rated their undergraduate OC training favourably were more likely to agree that their OC knowledge was current [60], and 2.2 times more likely to score higher on knowledge of OC [49]. In terms of gender, 3 studies found female dentists faired significantly better in OC knowledge [47, 50, 62], while others found no significant influence of gender on OC knowledge [54, 60, 69].

Cancer identification skills

To evaluate OC identification skills, the domains assessed included knowledge of sites, signs and symptoms of OC. There was a considerable degree of variability in survey responses. Notably, recent CE ($n=2$) were found to positively correlated with skills in OC identification [40, 41]. Nevertheless, our findings showed divergent relationship between clinical experience and cancer identification skills amongst dentists. Two studies found recent graduates had better skills [40, 69] while 2 studies indicated that dentists with more clinical experience [47, 52] were better at OC identification. Additionally, Maybury et al. [47] found that dentists working in a group private practice were more likely to have better OC identification skills than dentists working in solo private practice.

OC risk factors

Of the studies that explored common OC risk factors such as alcohol and tobacco use ($n=23$), 19 studies reported >80% of participants identified alcohol [35, 39, 40, 43–52, 60, 62, 63, 69, 70, 72] as a risk factor while 21 studies reported >80% of participants identified tobacco as a risk factor for OC [35, 39–41, 43–52, 55, 60, 62, 63, 67, 69, 70]. In all 12 studies, [35, 39–41, 43, 45–47, 51, 52, 60, 69] exploring prior OC risk, >80% of participants

Table 2 Participants characteristics

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
1	Ahmed & Naidoo (2019) [32]	NR	*n* = 77 (68.1%)	3–5 years (35.4%), 6–10 years (42.5%), 11–15 years (11.5%) > 15 years (10.6%)	GDPs	NR	NR	Public: *n* = 113 (100%)
2	Akbari et al. (2015) [33]	NR	*n* = 36 (49%)	1–4 years: *n* = 31 (42.5%), 5–9 years: *n* = 11 (15.1%), 10–14 years: *n* = 10 (13.7%), 15–19 years: *n* = 5 (6.8%) > 20 years: *n* = 16 (21.9%)	GDPs: (*n* = 55, 75%), SDs: (*n* = 18, 25%)	24.7% attended OC CE courses	NR	NR
3	Alhazzazi (2021) [34]	NR	*n* = 81 (39%)	0–2 years: 96 (47%), > 2–5 years: 31 (15%), > 5–10 years: 18 (9%), > 10 years: 61 (30%)	GDPs: *n* = 119 (58%), SDs: *n* = 14 (7%), dental consultants: *n* = 49 (24%), dental residents: *n* = 14 (7%), others: *n* = 3 (5%)	NR	NR	Public: *n* = 50 (24%), Private: *n* = 61 (30%), University hospital: *n* = 69 (33%), Mixed public & private: *n* = 8 (4%), mixed university & private: *n* = 16 (8%)
4	Alonge & Narendran (2004) [35]	20–29 years (*n* = 5, 3%), 30–39 years (*n* = 35, 22%), 40–49 years (*n* = 48, 31%), 50–59 years (*n* = 44, 28%), 60–69 years (*n* = 17, 11%), 70–79 years (*n* = 7, 5%), missing data (*n* = 2)	*n* = 21, 14% missing data (*n* = 2, 1%)	0–8 years (*n* = 25, 16%), 9–18 years (*n* = 46, 30%), 19–28 years (*n* = 48, 31%), 29–38 years (*n* = 35, 23%)	GDPs	NR	NR	Solo: *n* = 114 (72%) Others: *n* = 44 (28%)
5	Alqahtani et al. (2021) [36]	NR	*n* = 113 (31%)	< 5 years: *n* = 185 (49.5%), 5–10 years: *n* = 120 (32.4%), > 10 years: *n* = 67 (18.1%)	GDPs: *n* = 144 (39%), oral surgeons/ oral meds/ oral pathologists: *n* = 57 (15%), endodontists: *n* = 34 (9%), periodontists: *n* = 21 (9%), other specialists: *n* = 87 (23%)	NR	NR	Public: *n* = 352 (95.1%); Private: *n* = 18 (4.9%)
6	Alqutaibi et al. (2021) [25]	NR	*n* = 36 (25%)	< 10 years: *n* = 79 (55%); ≥ 10 years: *n* = 64 (45%)	Prosthodontists: 100%; master degree: *n* = 49 (34.3%); board certified: *n* = 42 (29.4%); PhD: *n* = 52 (36.4%)	NR	NR	Public: *n* = 120 (84%); Private: *n* = 23 (16%)
7	Borhan-Mojabi (2012) [37]	GDPs: 37.93 ± 9.22 years	Data not separated for GDPs	GDPs: 9.67 ± 9.05 years	GDPs	NR	NR	NR
8	Calvert et al. (2014) [38]	NR	NR	NR	Restorative dentists	NR	NR	NR
9	Canto et al. (2001) [39]	NR	19%	> 25years: 23%; 16-25years: 28%; 6-15years: 34%; < = 5 years: 15%	GDPs	NR	NR	Solo: 60%, partner: 17%, salaried/ contractor: 19%, all other: 4%

Table 2 (continued)

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
10	Clovis et al. (2002) [40]	NR	$n=117$ (17.9%)	>27 years): $n=88$ (13.3%); 18–27 years: $n=196$ (29.6%); 8–17 years: $n=229$ (34.5%); ≤ 7 years: $n=150$ (22.6%)	GDPs	~60% attended OC CE in the last 5 years,	NR	Solo: $n=370$ (55.4%), partner: $n=177$ (26.5%), salaried or contractor: $n=93$ (13.9%), others: $n=28$ (4.2%)
11	Colella et al. (2008) [41]	NR	$n=80$ (17.5%)	≤ 15 years: $n=186$ (40.7%); 16–20 years: $n=99$ (21.7%); 21–25 years: $n=80$ (17.5%); 26–30 years: $n=67$ (14.7%); > 30 years: $n=25$ (5.4%). Mean years of graduation is 18 years	Dentists (graduates from medical school: $n=232$, 50.8%; graduates from dental school: $n=225$, 49.2%). GDPs: 53%, oral surgeons: 17.9%, restorative dentists/ endodontists: 9.9%, orthodontists: 7.4%, periodontics: 5.9%, oral pathologists: 3.5%, prosthetists: 2.4%	96.1% received OC information & 20.6% attended CE course on OC in the last 12 months Main sources of info were educational (72.4%), scientific journals (22.8%)	NR	Solo: $n=155$ (33.9%) non-solo: $n=302$ (66.1%)
12	Cruz et al. (2005) [26]	20-39years: 19%; 40–59 years: 62%; 60 & older: 98%	13%	Median years since graduation: 24 years	Dentists and DHs	NR	NR	Solo practice: 60%; partner/ employee: 26%; independent contractor: 4%; specialty practice: 4%; public health/ government/ other: 5%
13	Daley et al. (2011) [23]	28–66 years (mean age 45 years)	$n=8$ (47%)	3–43 years (mean 19 years)	Accredited US program Dentists, DHs	NR	NR	NR
14	Dang et al. (2022) [21]	NR	NR	NR	Dentists	NR	NR	Private practice: 89%, community health centre: 4%, Hospital-based: 4%, dental school-based practice: 3%
15	Dewan et al. (2014) [42]	NR	NR	NR	Consultants or senior lecturers: $n=30$ (46.1%); specialist registrars: $n=27$ (41.5%). SDs in restorative dentistry: $n=8$ (12.3%)	NR	NR	NHS posts (public): 73%; Academic posts: 27%
16	Dixon et al. (2021) [24]	46.8/13.7	$n=76$ (49.35%)	<10years: $n=37$ (24%); 10-19years: $n=29$ (18.8%); 20–29 years: $n=31$ (20.1%); 30–39 years: $n=35$ (22.7%); 40–49 years: $n=19$ (12.3%); > 50 years: $n=3$ (1.9%)	NZ trained dentists: $n=103$ (66.9%). Interviews: 4 dentists in Sydney West Cancer Network	NR	Urban: $n=131$ (85.1%); Rural: $n=23$ (14.9%)	Public: n = 7 (4.5%); Private: $n=129$ (83.8%); Working in both public & private: $n=14$ (9.1%); Not practicing: $n=4$ (2.6%); Public experience: $n=21$ (14%)
17	Ekici (2020) [43]	25–34 years: $n=67$ (22.8%); 35–44 years: $n=104$ (35.4%); 45–54 years: $n=108$ (36.7%); ≥ 55: $n=15$ (5.1%)	$n=199$ (60.2%)	1–5 years: $n=33$ (11.2%); 6–10 years: $n=35$ (11.9%); 11–15 years: $n=69$ (23.5%); 16–20 years: $n=48$ (16.3%); > 20 years: $n=109$ (37.1%)	GDPs	10% had OC training in the past 5 years	NR	Public ($n=294$/ 100%)

Table 2 (continued)

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
18	Fidele et al. (2022) [52]	Mean: 33.2 ± 4.3 years. 23–29 years: 3.7%; 30–39 years: 54.3%; 40–49 years: 25.9%; 50–59 years: 11.1%; > 60 years: 4.9%	*n* = 56 (34.6%)	< 5 years: 30.9%; 5–10 years: 50.6%; 11–15 years: 9.9%; > 15 years: 8.6%	General practice: 81.5%; Specialty practice: 18.5%	NR	NR	NR
19	Frydrych et al. (2012) [53]	NR	NR	0–5 years: 27.1%; 6–10 years): 12.6%; 11–15 years: 12.6%; 16–20 years: 5.3%; 21–25 years: 10%; > 25 years: 31.1%; Unknown: 1.3%	GDPs, SDs were excluded for analysis (*n* = 5)	NR	Urban (*n* = 140/ 76%); Rural (*n* = 44/ 23.90%)	Public: *n* = 19 (10.30%); Private: *n* = 166 (89.70%)
20	Gajendra et al. (2006) [44]	20–39 years: 19%; 40–59 years: 61%; 60 or older: 20%	13%	Median years of experience 24 years	Dentists, DHs	80% of dentists attended OC prevention CE courses in past 5 years	NR	Solo: 59.8%; specialty practice: 4.1%; public health/ government: 2.5%; partner: 17%; employee: 9.4%; independent contractor: 4.3%; other: 2.9%
21	Guneri et al. (2008) [54]	32.76 years (this includes students)	*n* = 92 (45%)	1–35 years (mean 11.29 years)	GDPs: *n* = 113 (55.35%); final year dental students: *n* = 37 (18.13%); SDs: *n* = 54 (26.47%)	NR	NR	NR
22	Haresaku et al. (2018) [55]	Most dentists in Japan & Australia were > 46 years of age (23.8–40.2%)	Japanese: 7.3%; Australia: 45.8%	NR (data cannot be separated from hygienists)	Not specified. The study excluded Australian specialists who did not see OC patients	NR	NR	NR
23	Hashim et al. (2018) [45]	< 30 years: *n* = 204 (68.2%); > 30 years: *n* = 81 (27.1%)	*n* = 169 (57%)	< 15 years: *n* = 275 (92.3%); > 15 years: *n* = 23 (7.7%)	Bachelor degree: *n* = 256 (85.6%); MSc/ PhD: *n* = 41 (13.7%). GDPs & SDs	48% attended an OC CE within the past 5 years	NR	Public: *n* = 31 (10.50%); private: *n* = 267 (89.50%)
24	Horowitz et al. (2000) [56]	NR	14%	16–20 years: 22%; 11–15 years: 28%; 6–10 years: 33%; 0-5years: 17%	GDPs	NR	NR	Solo: 68%; partnership: 12%; others: 6%
25	Husein et al. (2011) [57]	NR	NR	> 10 years: *n* = 161 (81%); 5–10 years: *n* = 19 (10%); < 5 years: *n* = 18 (9%)	UK graduates GDPs: *n* = 177 (89%)	NR	NR	GDPs working in mixed, mainly NHS practice: 55%; GDPs working in solely private practice: 5%
26	Joseph et al. (2012) [46]	< 40 years: 60.6%; > 40 years: 39.4%	*n* = 35 (22.9%)	> 15 years: 44.4%; = < 15 years: 55.6%	Dentists	30% attended OC CE within the last 5 years	NR	Public: *n* = 153 (100%)

Table 2 (continued)

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
27	Kogi et al. (2019) [58]	NR	28.2%	< 1 year: 35.5%; 2–5 years: 20.9%; 6–15 years: 20.9%; > 16 years: 26.4%	Restorative dentists (operative, endodontics, periodontics, prosthodontics): 60.9%; non-restorative dentists (dental anaesthesiology, dental public health, dental radiology, orthodontics, paediatric): 39.1%	NR	NR	NR
28	Kujan et al. (2006) [27]	NR	NR	43–52 years: *n* = 1 (3%); 33–42 years: *n* = 50 (14.8%); 23–32 years: *n* = 104 (30.8%); 13–22 years: *n* = 113 (33.5%); 0–12 years: *n* = 66 (19.5%)	GDPs and SDs	52.3% SDs & 26.3% GDPs attended OC CE in the last 12 months	NR	NR
29	Leão et al. (2005) [59]	40.4 years/ 12.9	52%	Mean: 16 years	GDPs	NR	Urban: *n* = 129 (100%)	Public: 38%; Private or public/private: 62%
30	LeHew et al. (2010) [28]	NR	*n* = 28 (27.5%)	Median: 13 years (range 0–50 years)	GDPs: 90%; SDs (orthodontics, oral surgery, endodontics, peadiatrics, prosthodontics): 10%	37.3% never attended OC CE	NR	NR
31	Lopez-Jornet et al. (2010) [60]	NR	40.3%	Mean: 13.3 years (1 - 42 years)	GDPs	NR	NR	NR
32	Marino et al. (2017) [29]	≤ 25 years: 7.4%; 26–35 years: 19%; 36–45 years: 23.2%; 46–55 years: 25.2%; > 55 years: 25.2%	44.2%	≤ 5 years: 15.7%; 6–10 years: 12.4%; 11–15 years: 11.6%; 16–20 years: 9.9%; 21–25 years: 9.9%; > 25 years: 40.5%	GDPs: 63.6%; SDs: 8.4%; DHs: 13.7%; Oral health therapists: 12.2%; Dental therapists: 2.1%	NR	Urban: 76.60%; Rural: 23.40%	NR
33	Martins et al. (2021) [61]	20–30 years: 41.07%; 31–40 years: 34.64%; 41–50 years: 14.28%; 51–60 years: 6.7%; > 60 years: 3.21%. Most were 20–40 years	*n* = 195 (69.64%)	Time in specialty: < 5 years = 43.92%; 5–10 years = 12.85%; 10–20 years = 18.21%; > 20 years = 25%	Group A: *n* = 160 (57.14%) working in oral oncology Group B: *n* = 120 (42.86%) OMFS (*n* = 25), orthodontics (*n* = 21), oral rehabilitation/ prosthodontics (*n* = 20), paediatric dentistry (*n* = 14), endodontics (*n* = 13), dentistry specialists (*n* = 11), periodontics (*n* = 10), forensic/social legal dentistry (*n* = 6)	NR	NR	NR
34	Maybury et al. (2012) [47]	NR	*n* = 107 (24%)	< 10 years: 14%; 10–19 years: 15%; 20–29 years: 35%; 30–39 years: 34%; ≥ 40 years: 2%	GPDs	OC CE course: Within the last 12 months: 29%; 2–5 years: 54%; ≥ 5 years: 15%. Never taken a course: < 1%	NR	Solo practice: 62%; group private practice: 36%; community health centre: 1%; other: 1%

Table 2 (continued)

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
35	McCann et al. (2000) [48]	NR	NR	NR	GDPs	GDPs: 44% had OC training in the last 2 years, 25% had OC training in 3–5 years, 17% had no OC training for > 10 years	NR	Public: n = 73 (32%); private: n = 152 (68%)
36	Nazar et al. (2022) [62]	25.8 ± 2.4 years	n = 139 (44.8%)	Mean: 1.5 ± 1.7 years	Bachelor degree: 94.5%; Master degree: 2.6%; MFDS: 1.9%; MEGD: 0.3%; PhD: 0.6%	NR	NR	100% of participants worked at polyclinics, specialty dental centres and School of Oral Health Program clinics as part of their rotation
37	Nazar et al. (2019) [63]	35.2/ 10.9 years	n = 109 (37.7%)	Mean: 11.7/ 11.3 years	Bachelor degree: 75%; Master degree, MEGD or PhD: 25%	NR	NR	Public: n = 289 (100%)
38	Nicholls & Ilankovan (1998) [64]	NR	NR	NR	Oral maxillofacial surgeons	NR	NR	NR
39	Patel et al. (2012) [65]	NR	NR	< 10 year: n = 65 (15.9%); 10–19 years: n = 62 (15.1%); 20–29 years: n = 121 (29.5%); 30–39 years: n = 109 (26.6%); ≥ 40 years: n = 53 (12.9%)	Dentists & Radiation oncologists	NR	NR	NR
40	Patton et al. (2006) [66]	NR	NR	NR	Dentists, DHs, physicians, nurse practitioners	NR	NR	NR
41	Pavão Spaulonci et al. (2018) [49]	NR	NR	NR	Junior dentists: 55.9% GDPs, 38.1% specialists; Senior dentists: 56.2% specialists, 21% GDPs, 15.2% Master degree, 7.6% PhD	Attended OC CE: 15.9% in the last year, 23.3% in the last 2 years, 37.6% > 2 years ago	NR	NR
42	Reed et al. (2010) [67]	Not separated for dentists	NR	NR	GDPs & SDs, physicians & medical specialists	NR	NR	NR
43	Saleh et al. (2014) [50]	≤ 30 years: 35.1%; 31–40 years: 26.2%; 41–50 years: 19.9%; 51–60 years: 15.2%; 61–70 years: 2.8%; 71–80 years: 0.8%	n = 247 (68.2%)	50.8% graduated > 10 years ago	Place of graduation: Malaysia (72.4%), Asia (18%), Oceanic (4.1%), UK (2.8%), Others (2.8%). Postgraduate training 21.5%	Number of OC CE attended: 0: 26.5%; 1–5: 67.4%; > 5: 6.1%	NR	Public: 50.3%; private: 48.6%; both public & private: 1.1%
44	Seals (1990) [68]	NR	NR	NR	Recent graduate dentists	NR	NR	NR
45	Seoane et al. (2006) [30]	NR	NR	Mean: 9.1/ 5.9 years	GDPs	NR	NR	NR

Table 2 (continued)

ID	Authors (publican year)	Age	Gender (female n/%)	Experience	Training background	Recency of oncology CE	Location of practice (n/%)	Workplace characteristics (n/%)
46	Shadid & Habash (2023) [69]	> 30 years: 65.7%	43.7%	≤ 5 years: 33.5%; 6–15 years: 42.5%; > 15 years: 24%	GDPs: 79.9%; SDs: 20.1%	NR	NR	Public: *n* = 8 (3.20%); private: *n* = 205 (80.70%); both public & private: *n* = 41 (16.1%)
47	Strey et al. (2022) [31]	37.6 ± 10.4 years (range 22–66 years)	79.7%	14.2 ± 10.4 years (1–42 years). Public system experience: 9.2 ± 8.2 years	Dentists	NR	NR	Public: 100%
48	Taheri et al. (2018) [70]	36.8 years (range 25–60 years)	*n* = 80 (52%)	Mean: 9.88 (1–35 years)	GDPs	NR	NR	Private: 100%
49	Tami-Maury et al. (2016) [71]	51–65 years: 62%	32%	NR	Dentists	NR	NR	NR
50	Vijay Kumar & Suresan (2012) [72]	20–39 years: 30%; 40–59 years: 62%; 60 & above: 8%	45%	NR	Private dentists. Postgraduate qualification: 24%	NR	NR	Private: 100%. Solo: 44%; partnership: 25%; employee/ contractor: 24%; others: 7%
51	Wong & Toljanic (2009) [20]	NR	NR	NR	Maxillofacial dentists	NR	NR	NR
52	Wright et al. (2011) [22]	NR	NR	NR	Managers of dentists	NR	NR	Public: *n* = 83 (100%). 100% Salaried dentists
53	Yellowitz et al. (1998) [51]	NR	11%	Range from 1–30 years	GDPs	53% attended OC CE within the past 5 years	NR	Solo practitioners: 68%

CE Continuing education, *DH* Dental hygienist, *GDP* General dental practitioner, *NR* Not reported, *OC* Oral cancer, *SD* Specialist dentist

were aware of its significance. Among the 18 studies investigating older age, 11 studies reported > 60% of participants correctly identified older age as a risk factor [39, 40, 45–49, 52, 60, 69, 70]. Of the 16 studies that explored Human Papilloma Virus (HPV), 9 out of 15 reported that > 60% of participants were aware of the association between HPV and OC [32, 34, 43, 45–47, 49, 50, 69], although a focus group study revealed that dentists had limited knowledge [23]. In contrast, of the 10 studies investigating consumption of fruit/ vegetables, 8 studies reported < 50% of participants identified low consumption as a risk factor [32, 39–41, 44, 47, 49, 69].

CTx side effects and management

In two studies that assessed dentists' knowledge of H&N radiation therapy (RT) and side effects, > 80% of dentists were able to identify radiation-related caries as an oral complication following RT [54, 61]. Dentists working in the field of H&N RT were more aware of radiation related complications than dentists not working in the clinical area [61].

Perceptions

Twenty-one studies surveyed dentists' perception of their cancer knowledge, 5 studies assessed dentists' perceived role in cancer management, 14 studies investigated dentists' role in OC screening, and 33 studies examined the adequacy and interest in further cancer training (see supplementary file 3 in the Appendix).

Perceived knowledge

In studies investigating dentists' perception of cancer knowledge, knowledge was categorised into perceived (i) currency and (ii) sufficiency. On average, 56.9% dentists (*n* = 13) perceived their OC knowledge was current [32, 39, 40, 44, 46, 47, 51, 52, 60, 62, 63, 66, 72]. However, 35.3% of dentists (*n* = 3) found their OC knowledge was sufficient [37, 50, 58]. Furthermore, an average of 60.4% of dentists (*n* = 3) perceived their OC prevention knowledge was sufficient [32, 43, 50]. Two studies found there was no correlation between perceived and actual knowledge [51, 59], while other studies reported a positive correlation [49, 50]. Additionally, 2 studies investigated dentists' perceived cancer management knowledge, with

one study reporting 37.1% of dentists felt their knowledge was current [53] and the other study found dentists with more experience were more likely to treat CPs [24].

Perceived role of dentists in managing CPs

Two studies reported >75% of participants agreed that GDPs should provide dental treatment for OC patients [24, 53]. However, dentists' willingness to provide dental treatment to H&N CPs receiving RT varied; < 50% of dentists expressed comfort in managing these patients [57], and the preference to refer these patients to dentists who specialised in the field ranged from 32.9% [53] to 77.1% [61]. A study exploring dentists' perceived roles in treating patients with a history of cancer, found that 91% of GDPs were happy to provide dental treatment to cancer survivors [71].

Perceived role of dentists in cancer screening

On average, 88.3% of dentists (n=7) acknowledged the role of dentists in OC screening [25, 28, 48, 50, 55, 60, 69]. However, some dentists believed that oral screening should be performed selectively, with an average of 71.6% of dentists (n=5) perceiving dentists have a role in performing OC screening in high-risk patients [34, 36, 51, 60, 72], and in one study 78% of dentists indicated a role in screening patients with a history of HNC [34].

Perceived adequacy of training

On average, 63.6% of dentists (n=4) perceived their OC training was sufficient [31, 35, 47, 56], 59.6% of dentists (n=17) perceived their OC screening practice was sufficient [25, 27, 32, 41, 43, 46, 49, 51, 52, 56, 60, 62, 63, 66, 69, 72, 73], while 47% of dentists (n=4) perceived they were adequately trained to treat CPs [21, 24, 53, 65]. With regards to further training needs, studies consistently reported a strong inclination among dentists for further training. On average, 87% of dentists (n=2) were interested in receiving OC CE [41, 43], 81.7%% dentists (n=11) were interested in specific training on OC detection [32, 35, 39, 40, 45, 50, 52, 62, 63, 67, 73], and 92.5% of dentists (n=2) were interested in training on managing CPs [53, 57].

Practice

Studies that surveyed practice of dentists can be grouped in oral screening practice (n=33), management of suspicious oral lesions (n=13), managing CPs (n=14) and communication with other health professionals (n=7) (see supplementary file 4 in the Appendix).

Oral screening practice

In clinical practice, an average of 53.4% of dentists (n=16) reportedly performed oral screening examinations on every patient [25, 28, 29, 32, 34, 37, 41, 48, 49, 51, 52, 55, 58, 63, 69, 72], while 71.8% of dentists (n=9) selectively screened high risk patients [26, 35, 43, 44, 50–52, 56, 69]. Recent graduates (n=2) [35, 50] or dentists who perceived to have adequate training (n=3) [50, 60, 66] were more likely to perform OC examinations on their patients.

Management of suspicious oral lesions

Majority of dentists refer suspicious lesions to a SD to confirm diagnosis. Only 36.7% of GDPs (n=4) performed the biopsy on patients with suspicious oral lesions [27, 43, 46, 72].

Management of CPs

Of the studies that explored SDs (n=4), over 60% of restorative specialists [38, 42] and over 78% of oral maxillofacial surgeons [64] managed H&N CPs in their clinical practice. In one study, 55% of oral maxillofacial surgeons reportedly reviewed leukaemia patients pre-chemotherapy [20]. However, among studies of GDPs (n=6), 4 studies found >50% of dentists saw CPs undergoing CTx [21, 22, 53, 57, 65] although one study reported GDPs rarely see CPs [73]. Location of practice (metropolitan or urban) [53], gender, age and duration of practice [54] reportedly was not associated with dentists seeing CPs. However, a study suggests place of graduation influenced if a GDP would refer patients with HNCs to a SD for dental management [24].

Communication with other health professionals

Amongst the studies with GDPs (n=3), majority of dentists who treated CPs communicated with the oncology team [21, 53], however they rarely received updates from the oncology team [21]. A study reported that 88.5% GDPs reported that having a referral guideline could improve the quality of referrals [32]. Amongst the studies of restorative specialists (n=2), 52% attended multi-disciplinary meetings (MDTs) [38] and most patients seen at oncology assessment clinics were referred from MDTs [42]. A study on dentists in management roles found that 13% of dental managers believed dental service for CPs can be improved by having earlier referral for dental care [22].

Confidence

Three studies explored dentists' beliefs in their capabilities in managing CPs. In two studies, < 50% felt confident in treating HNC patients [24, 53]. One study reported that GDPs were most comfortable with performing non-invasive or less complex procedures on CPs [57].

Barriers and facilitators

Content analysis of free text responses or qualitative data within studies reporting barriers and facilitators to

providing oral care to CPs, identified professional, organisational and patients' factors that influence dentists' willingness to provide dental care to CPs.

Professional barriers and facilitators

Lack of training [37], knowledge and skills [21, 65] were identified in 3 studies as a barrier to providing dental treatment for patients undergoing CTx. The increased time required to manage oral health of CPs [38] and the short timelines to perform dental screening between diagnosis and commencement of CTx [21, 38, 65] were also highlighted as barriers.

The complexity and consideration of CTx needed before performing dental treatment could pose as barrier for dentists to treat CPs [42]. For example, a survey of dentists managing CPs with bone modifying agents found that 94% of dentists considered risk of extracting a tooth (osteoradionecrosis), 81% of dentists considered the prognosis of the tooth (extension of caries) and 76% of dentists considered success of conservative management (restorability of tooth) in their dental treatment planning for patients undergoing RT [42].

Organisational barriers and facilitators

Structural barriers also impact on dentists' ability to provide dental care to patients. Studies ($n=2$) highlighted that the medical team does not prioritise or refer patients for dental screening prior to treatment or provide information to patients [21, 65]. One study reported the need for inclusion of oral health and referral pathways in the overall care plan of CPs [65]. The short time frame between diagnosis and treatment commencing also restricts time available for screening [38]. Similarly, dentists lack of clear guidance on safe treatment options [65]. Having referral sources and a policy to provide long-term continuing care for patients following completion of CTx was highlighted as a potential facilitator to the continuity of care for patients [22].

Lack of communication between dentists and the cancer team was also a barrier to care. For example, in one study, 31% of dentists reported a lack of correspondence with the patient's oncology team [21] and other studies ($n=2$) reported weak links with oncology services and primary care providers impacted on timely communication [22, 65].

Funding models were also highlighted as a barrier to dental care for many. For example, in two US studies it was reported 1/5 of dental practices did not accept CPs on Medicaid [21, 65] and insurers do not provide cover for dental treatment ($n=2$) as it is not viewed as necessary for cancer management [20, 65]. UK managers also highlighted need for specific funding for dental treatment of CPs [22].

Patients' barriers and facilitators

Patients' lack of awareness can also be a barrier to accessing care. For example, in one study 56% of dentists reported a lack of patient education on oral complications [21] and a second study reported inadequate patient education of oral risks associated with RT [65].

Quality of studies

Overall, most studies ($n=43$) scored over 71% on MMAT. The quality assessment can be found in supplementary file 5. No studies were excluded from the review based on their quality assessment. The review did identify a high risk potential bias in one paper included in our analysis [64]. This risk is related to lack of details about how recruitment processes were conducted. Given we used a narrative synthesis to summarise study results in this review, it is unlikely inclusion of this study resulted in mis-representation or inflation of the review findings. Fifty-one of the 53 studies were surveys, it is worth noting that these survey-based studies have their limitations including self-selecting samples, small sample size and low response rate which increased the risk of selection bias. Further, most studies adopted study specific questionnaires due to a lack of standardization in outcome measures. Hence, this review is classified as level V primarily relying on descriptive and qualitative research.

Discussion

This is the first systematic review that synthesizes the perspective of dentists in managing CPs. In our review, 94% ($n=50$) of studies limited their focus to HNC. This is despite all CPs potentially experiencing short and long-term treatment related oral complications.

It is well known that having clinical guidelines alone are not sufficient to change practice; rather multi-level factors are required to implement evidence-based research into clinical practice [74]. In this review we sought to map the current literature to the Theoretical Domains Framework [75], to provide a conceptually robust exploration of factors that may influence clinical practice change among dentists. We specifically focused on the domains of knowledge, skills, professional role and identity, beliefs about capabilities, and environmental context and resources.

The review found that there is great variability in dentists' OC knowledge. This is likely to due to a lack of standardised measure and variation in how knowledge was assessed. Across studies, while there was a high percentage of respondents who were able to identify alcohol and tobacco are associated with OC, they showed less awareness of other risk factors and myths. Not surprisingly, higher cancer knowledge was linked to clinical exposure, prior cancer education and positive perception of cancer training. Regardless of their current knowledge

or perception, dentists expressed desire in further CE in deepening their cancer knowledge, OC detection and CTx.

Our review found that while dentists view their responsibilities as including OC screening and management, however, fewer conduct screening in their clinical practice. This pattern is also observed in managing patients with OC, possibly due to insufficient oncology training in dentistry programs. There is limited information on dentists' perceptions of their role in non-HNC management. With evolving CTx and side effects such as opportunistic infection [76], dental caries, gingivitis and febrile episodes from odontogenic origin [77], the need for managing patients with non-HNCs is becoming crucial.

In our review, GDPs reported lower proficiency in giving advice to CPs [24, 53] and were reportedly less comfortable performing complex dental procedures for such patients [57], in comparison to SDs [38, 42, 64]. However, after implementation of education programs in Texas [78, 79], there was a notable change, with majority (91%) of GDPs in recent local survey providing dental treatment to patients undergoing CTx or with a history of cancer [71]. This highlights the benefits of cancer-specific training.

Our review found where dental treatment is dictated by third parties (such as insurance companies or government agencies), dental care in patients with non-HNCs was not deemed as a necessity. Previous research also found 56% of cancer centres did not have a dental department [11]. This is despite research demonstrating a 26% reduction of oral complications following implementation of dental services to patients with non-HNCs [3]. Furthermore, research demonstrated that dental intervention reduced blood stream infection in patients following allogenic HSCT [80], decreased incidence of osteonecrosis in patients with bone metastases treated with bisphosphonates [81], and lowered risk of mucositis in breast CPs undergoing chemotherapy [82].

Dentists working in the community have an important role in cancer care. A hospital-based dental intervention demonstrated positive outcomes in reducing adverse oral side effects in patients with HSCT, however there was a 86% drop-out rate at the 3-month follow-up due to the distance patients were required to travel to the hospital [2]. This highlights the need for accessible dental care closer to patients' home, ensuring continuity of care and leveraging existing rapport with their dentists during cancer treatment. Our review found that 92.5% of dentists were willing to receive further training on managing CPs. This affirms Fantozzi et al. [16] view that adequately trained dentists working in the community are critical to providing safe and effective oral care for CPs.

A limitation of this study is that most literature focused on HNCs, resulting in over-representation of HNCs. Given this study is on patients with all forms of cancer, it might not reflect dentists' perspective on managing CPs more broadly. Secondly, a lack of standardised questionnaires in assessing outcomes across studies could leading to challenges in drawing consensus results. Furthermore, utilising study-specific and non-validated questionnaires can lead to misinterpretation of the results. For example, Martins et al. [61] assumed "radiation-related caries leads to osteonecrosis" while in fact, it is the extraction of carious teeth in the irradiated bone rather than having caries that leads to osteonecrosis of the jaw. In another study [59], the authors introduced uncommon terminologies "initiating" and "promoting" factors for OC and pointed out participants could not differentiate between the two. This can result in potentially inaccurate data being collected. Lastly, no studies was excluded based on their quality or biases. Results were based on data reported by the studies.

Conclusion

This review highlights the paucity of research related to dentists' knowledge, perception, practice and confidence in treating CPs outside of H&N regions. There is a need for future studies to understand barriers that hinder dental involvement with oncology patients and to identify strategies to facilitate clinical practice amongst dentists to be in alignment with advancement in cancer treatments.

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

Code availability

Not applicable

Authors' contributions

All authors (SL, AH and JS) were involved in conceptualising the review. SL carried out initial database searches. SL and JS screened initial results and articles that met inclusion criteria. Any disagreements were resolved with AH. All authors contributed to quality review of a subset of included reviews. SL wrote the first draft of the manuscript. JS and AH made contributions to subsequent drafts. All authors read and approved the final manuscript.

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Availability of data and materials

These are submitted as supplementary files.

Declarations

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Publisher's Note

Appendix B: Supplementary Files from Chapter Three (Systematic Review)

Supplementary File 3.1: An Example of Database Search Strategy

MEDLINE database search

1.	Dentist*.mp.
2.	exp dentist/
3.	dental specialist*.mp.
4.	dental surgeon*.mp. or dental surgeon/
5.	oral health professional*.mp.
6.	dental practi*.mp.
7.	1 or 2 or 3 or 4 or 5 or 6
8.	oral health*.mp.
9.	dental care.mp.
10.	(dental care* or dental health* or oral care*).mp.
11.	oral hygiene.mp. or exp mouth hygiene/
12.	oral hygiene*.mp.
13.	8 or 9 or 10 or 11 or 12
14.	exp neoplasm/
15.	(neoplasm* or cancer*).mp.
16.	oncology*.mp. or exp oncology/
17.	malignan*.mp or malignant neoplastic disease/
18.	14 or 15 or 16 or 17
19.	7 and 13 and 18
20.	limit 19 to yr="1990-Current"

Supplementary File 3.2: Knowledge Outcome

ID	Authors, publication year	Knowledge (% correct answers)			
		Oral cancer	**Oral cancer identification**	**Risk factors associated with oral cancers**	**Cancer therapy side effects and management**
1	Ahmed & Naidoo (2019)	Recent graduates were more likely to identify correctly the most common type of oral cancer (p=0.02).	Common sites: buccal mucosa (30%), lips (22%), tongue (20%), FOM (20%) S & S: non-healing ulcers (83%), red/ white patches (81%), no pain (87%), possible swelling (43%).	Risk factors: Tobacco & alcohol (40%), onset >60yrs (35%), low consumption of fruits & vegetables (29%), viral infection (60%). Non-risk factors: family history of cancer (35%), poor denture fit (58%).	NR
2	Akbari et al (2015)	Knowledge score between general & specialist not significant (p=0.09): 67.3% general dentists had desirable score, 100% dental specialists favourable score. Graduates with 1-4 years of experience have the highest OC knowledge compared to those with >20 years of experience (p=0.001).	Diagnostic skills knowledge score between general & specialist dentists not significant: General dentists scored 2.7, specialist dentists scored 3.4. No difference between diagnostic skills and work experience (p=0.3).	NR	NR
3	Alhazzazi (2021)	SCC is the predominant form of HNC (90%). Overall, 35% were knowledgeable, 35% slightly knowledgeable, 29% less knowledgeable.	Common sites: tongue (65%), FOM (65%). S & S: cancer is not always painful (84%).	Risk factor: HPV is a risk factor (75%). Non-risk factor: poor OH (41%).	NR
4	Alonge & Narendran (2004)	27% had high OC knowledge index. SCC is the most common form of cancer (84%).	Common sites: tongue & FOM (51%).	35% had high OC risk factor knowledge index. Risk factors: Tobacco (99%), alcohol (91%), prior OC experience (96%). Non-risk factors: family history of cancer (14%), poor denture fit (33%), poor OH (42%).	NR
5	Alqahtani et al (2021)	Oral surgery/ medicine/ pathology, prosthodontists and periodontists showed higher OC knowledge than GDPs & endodontists.	NR	NR	NR

		GDPs or dental specialists working in universities or public hospitals had higher knowledge compared to those working in the private clinics and health care centres.			
6	Alqutaibi et al (2021)	NR	Prosthodontists with > 10 years of experience were better at detecting and referring suspicious oral lesions.	NR	NR
7	Borhan-Mojabi (2012)	Significant relationship noted between recency of oral cancer course and high OC knowledge.	Common sites: tongue (91.9%), FOM (37.2%), lips (37.9%).	NR	NR
8	Calvert et al (2014)	NR	NR	NR	NR
9	Canto et al (2001)	SCC is the most common OC (80%). Recent graduates were more likely to score better in OC knowledge. Dentists who had taken a course in the past 12 months were better at diagnostic procedures for OC.	35% had low, 44% had medium & 20% had high OC identification knowledge. 80% knew how to examine tongue & surrounding areas for signs of OC and that OC could be painless in the early years.	Risk factors: Tobacco (99.8%), prior OC (96.9%), alcohol (94.5%), older age (64.8%), low fruits & vegetables (30.1%). 30% had low, 35% had medium & 35% had high OC risk knowledge.	NR
10	Clovis et al (2002)	Erythroplakia and leukoplakia are most likely to associate with OC (<50%). Early detection improves 5-year survival rate (>90%).	Recency of graduation and timing of recent CE were significant associated with correct identification procedure ($p<0.001$).	Risk factors: Tobacco (99.4%), prior oral cancer (96.6%), alcohol (90.4%), older age (78.7%), sun exposure (70.1%), HPV (53.1%), low consumption of fruit and vegetables (34%). Non-risk factors: family cancer history (8.8%), poor denture (39.9%), poor OH (46.3%), spicy food (57%), hot beverages & foods (69.4%), obesity (71.3%). Greater OC risk knowledge noted in recent graduates than experienced dentists ($p<0.001$).	NR
11	Colella et al (2008)	Erythroplakia/ leukoplakia are likely to develop into OC (53.8%). SCC is the most common form of OC (50.5%).	Common sites: tongue/ FOM (32%). Dentists who attended a course in the previous 12 months were more likely to identify the most common form of OC and of the early OC lesions.	Risk factors: Tobacco (94.1%), prior OC (89.5%), alcohol (79.2%), older age (47.9%), low fruits & vegetables consumption (25.8%).	NR

		Knowledge was significantly higher for dentists graduated from longer period of time (p<0.0001); with an oral surgery/ pathology background (p=0.034); attended CE on oral cancer in the last 12 months.			
12	Cruz et al (2005)	NR	NR	NR	NR
13	Daley et al (2011)	NR	NR	Limited knowledge regarding the HPV-OC link. Limited knowledge regarding the HPV vaccines.	NR
14	Dang et al (2022)	NR	NR	NR	NR
15	Dewan et al (2014)	NR	NR	NR	NR
16	Dixon et al (2021)	Mean knowledge was strongly associated with the volume of HNC patients that respondents reported seeing in practice over the previous year. Participants who had been in practice for 30-39 years had the highest mean knowledge score, while those who had been in practice for longest had lower-than-average knowledge scores.	.NR	NR	NR
17	Ekici (2020)	Correctly answered the 10 most common OC (58.5%). Correctly answered 5-year survival is below 70% (24.1%). Correctly answered OC is preventable (49%). SCC is most the most common form of OC (55.8%). Leukoplakia is the most common premalignant lesions (44.2%).	Common sites: tongue (35%).	Risk factors: Tobacco (93.5%), prior OC (90.1%), alcohol (86.7%), exposure to UV light (83.7%), radiotherapy history (82.3%), HPV (76.9%), older age (52.4%).	NR

18	Fidele et al (2022)	Identified the most common types of OC (80.6%).	Identified the common sites of OC (33.3%). Identified the S & S of OC (38.3%). Dentists with >10 years of experience had high knowledge of clinical presentation for OC (p=0.04).	Risk factors: Tobacco (92%), alcohol (100%), prior OC (80%), older age (68%), HPV (35%). 2.3% able to identify common conditions associated with OC. Experienced dentists with >10 years had higher OC risk factor knowledge compared to recent graduates (p=0.04).	NR
19	Frydrych et al (2012)	NR	NR	NR	NR
20	Gajendra et al (2006)	NR	>2/3 of dentists knew that LNs in OC patients were hard, painless, can be mobile or fixed.	Risk factors: >60 years (33%), sun exposure (<60%), tobacco (90%), alcohol (>80%), low consumption of fruits and vegetables (25%), betel quid chewing (52%), Gutka consumption (16%).	NR
21	Guneri et al (2008)	Knowledge was not related to duration of practice (p=0.99).	NR	NR	GDPs: causes of rapid dental decay after H & N radiation therapy (97.62%); oral complications following radiation therapy (97.56%), prophylactic measures of pre-cancer treatment when performing oral evaluation (18.6%), timing of dental procedures in relation to OC treatment (30%). Dental specialists: Population most likely to experience oral complications from cancer therapy (98.15%), oral complications from

					radiation therapy (96.23%), oral evaluation required in pre-cancer treatment (9.3%), the timing of dental procedures in relation to cancer treatment (30.43%), dental considerations before chemotherapy began (39.22%). Both GDPs & dental specialists: considerations before a dental procedure in a chemo patient (54.9%), timing of dental procedures in relation to cancer treatment (39.3%), prophylactic measures a dentist shall take during a pre-cancer treatment oral evaluation (14.71%).
22	Haresaku et al (2018)	NR	NR	Risk factors: Smoking (both J & A >90%), chewing tobacco (J: 85%, A: 97%), chewing betel nut (J: 25%, A 97%), alcohol (J: 52%, A: 93%), HPV (J: 38%, A: 92%). Non-risk factors: HSV (J: 91%, A: 70%), family history of cancer, caffeine (J: 85%, A: 92%), family history (J: 23%, A: 22%) *NB: J = Japanese dentists, A = Australian dentists*.	NR
23	Hashim et al (2018)	NR	Common sites: tongue (31.1%), FOM (18.7%). Common S & S: persistent ulcer (87.6%), enlarged LN (82.9%), white lesions	Risk factors: tobacco (99%), prior OC (92.3%), alcohol (87.3%), HPV (76.6%), sun exposure (73.2%), older age (60.9%), poor diet (43.8%).	NR

			(79.9%) red lesions (63.2%), non-healing socket (35.1%), dysphagia & limited tongue mobility (68.6%).		
24	Horowitz et al (2000)	NR	NR	NR	NR
25	Husein et al (2011)	NR	NR	NR	NR
26	Joseph et al (2012)	Dentists who attended a recent CE course had higher knowledge score ($p<0.05$).	Common sites: tongue & FOM (85%). Common S & S: hard/painless/mobile or fixed (70%), asymptomatic in early stage (91%), red/ white lesions (93%).	Risk factors: Tobacco (100%), prior OC (97%), alcohol (89%), older age (60%), Betel quid chewing (89%), UV exposure (83%), viral infection (71%), low consumption of fruits (53%). Non-risk factors: hot food/ beverages (61%), eating spicy food (40%), obesity (74%), poor OH (40%), poor dentures fit (25%), family history of cancer (9%), chronic infection (71%). Dentists who graduated< 15 years (30%) higher risk factors knowledge than > 15 years.	NR
27	Kogi et al (2019)	NR	NR	NR	NR
28	Kujan et al (2006)	NR	NR	NR	NR
29	Leão et al (2005)	Identified the aetiological agents of OC (11%). Differentiated between the initiating and promoting factors associated with OC aetiology (31%). Dentists who had been dentally qualified for 16 or more years, older than 37 years old, working in the public sector or had attended post-graduate courses were found to have better knowledge of OC.	Identified the main features of OC (34%).	NR	NR

30	LeHew et al (2010)	Recency of CE and statistically significantly related to transformed OC knowledge (p=0.0394). The more recent the last CE, the greater the dentists' knowledge.	NR	NR	NR
31	Lopez-Jornet et al (2010)	Early detection improves 5-year survival rates from OC (98.5%). SCC is the most frequent form of OC (90.6%). Oral leukoplasia & erythroplasia were the most frequent precancerous lesions (95%). Age, gender and year of graduation had no influence over OC knowledge.	Common sites: lip (89.1%), tongue & FOM (89.1%). Common S & S: asymptomatic early stages (95.6%).	Risk factors: Tobacco (100%), alcohol (96.4%), prior OC (95.5%), older age (69.4%), low consumption of fruits & vegetables (52.6%). Non-risk factors: obesity (14.4%), spicy foods (40.8%), poorly prostheses fit (95.5%), poor OH (77.6%).	NR
32	Marino et al (2017)	NR *(The authors did not separate dentists' data from other oral health professionals)*	NR	NR	NR
33	Martins et al (2021)	NR	NR	NR	Radiation related caries toxicity (81.78%) [oral med or dentists working in cancer facilities scored 97% while dentists who did not focus their activities on management of oncology patients scored 46%]. RRC can lead to osteoradionecrosis (74.64%).
34	Maybury et al (2012)	SCC is the most common form of OC (83%). Tongue is the 2nd most common site after lip (59%). Erythroplakia & leukoplakia are the two commonest pre-cancerous lesions (42%). Recency of graduation (<10 years), women and working in group private practice are	Common sites: ventral-lateral border of tongue (72%). Common S & S: early lesions are small, painless & red (81%), asymptomatic in early stages (80%), hard/ painless/fixed or mobile LNs (77%). 39.2% dentists scored highly on OC identification procedures.	Risk factors: Tobacco (>80%), prior OC (>80%), alcohol (>80%), HPV (>80%); older age (>60%), UV light exposure (>60%); low consumption of fruits & vegetables (>40%), >60 years (>40%). Non-risk factors: hot beverages & food, obesity & use of spicy foods (>60%); familial clustering & poor	NR

		predictors of high score on OC knowledge.	Dentists with 20-29 years of experience, female and dentists working in a group practice are more likely to get a high score on diagnostic procedures.	oral hygiene (>40%); poor dentures fit & family history (<20%). 37.8% dentists scored highly for OC risk factors knowledge.	
35	McCann et al (2000)	Leukoplakia is a predisposing factor to OC (80%). Erythroplakia is a predisposing factor to OC (69%).	NR	Risk factors: Smoking (94%), alcohol (90%), age (63%), viral infection (35%).	NR
36	Nazar et al (2022)	Answered the OC knowledge questions (81.3%). Identified the most common form of OC (94.2%). Identified the most likely lesions associated with OC (91.6%). Recognised the features of OC metastases (82.9%). Female (61.9%) scored better in OC knowledge (p=0.026). No significant difference in knowledge based on age, nationality or level of education.	Identified the common site of oral cancer (93.5%). Identified the symptoms of late stage OC correctly (91.6%). Identified the early stage of OC correctly (50.6%).	Risk factors: Tobacco & alcohol (95.8%), older age (41.3).	NR
37	Nazar et al (2019)	Correctly answered the OC knowledge questions (73.4%). Common form of OC (80.6%). Likely lesions associated with OC (87.9%). OC knowledge scores were significantly correlated with age (p<0.001) and years of experiences (p<0.001). No difference in OC knowledge with different level of education.	Identified late stage of OC symptoms (83.7%). Identified the early stage of OC symptoms (31.3%).	Risk factors: Alcohol & smoking (99.7%), older age (37.3%).	NR
38	Nicholls & Ilankovan (1998)	NR	NR	NR	NR
39	Patel et al (2012)	NR	NR	NR	NR

40	Patton et al (2006)	Early detection improves 5-year survival rate (98.8%).	NR	NR	NR
41	Pavão Spaulonci et al (2018)	19% new graduates vs 6.7% senior clinicians obtained significantly better grade in OC knowledge. Junior dentists were 2.1 higher in knowledge than senior dentists. Professionals with public experience were 2.3 times more aware about OC. Participants who performed self-assessment and reported having satisfactory OC knowledge were 2.2 times more likely to have higher knowledge level.	NR	Risk factors: Alcohol (98.4%), tobacco (100%), older age (88.4%), HPV (88.9%), low fruits & vegetables consumption (40.2%). Significant difference was noted between senior and junior dentists knowledge in risk factors. Significantly more senior dentists than junior dentists incorrectly thought that poorly fitting dentures, poor dental status, poor OH & hot beverages are risk factors.	NR
42	Reed et al (2010)	NR	NR	Risk factors: Smoking (90%), chew/snuff (88%), alcohol (45%), diet (6%), HPV (26%).	NR
43	Saleh et al (2014)	Knowledge on early signs and symptoms of OC were significantly associated with age (31-40 years), gender (female), recency of graduation (<10 years) and nature of clinical practice (public).	Common S & S: red/ white patches (93.1%), non-healing ulcers (97%), bleeding gum as potential sign (67.1%).	Risk factors: Smoking (99.4%), betel quid (99.2%), alcohol (88.9%), HPV (67.2%). Non-risk factor: family history of OC (17.5%).	NR
44	Seals (1990)	NR	NR	NR	NR
45	Seoane et al (2006)	NR	NR	NR	NR
46	Shadid & Habash (2023)	70.1% had poor OC knowledge. Common form of OC (76%). Dentists with < 5 years clinical experience were more likely to have better knowledge compared to more experienced dentists (0<0.05). No difference in gender or place of work.	Common sites of OC (37.5%). Common S & S (31.1%). Early signs of OC (80.3%). Dentists with < 5 years clinical experience were more likely to have better diagnostic skills compared to more experienced dentists (0<0.05). No difference in gender or place of work.	Risk factors: low fruits& vegetables consumption (39.8%), sun exposure (86.2%), older age (67.3%), HPV (74.8%), prior OC (92.9%), tobacco (97.2%), alcohol (92.9%). Non-risk factors: family history (10.2%), poorly fitting dentures (25.6%), consumption of spicy food (49.6%), hot beverages/food (65.7%), poor OH (31.1%), obesity (19.3%).	NR

47	Strey et al (2022)	NR	NR	NR	NR
48	Taheri et al (2018)	Recognised precancerous lesions were the more potentially malignant (59.5%). Identified the most common type of precancerous lesions (57.5%). Recent graduates (<10 years) scored significantly better than those graduated 10 years or more.	Correctly answered the most common signs of cancerous lesions (54.9%).	Risk factors: Alcohol & tobacco (86.9%), older age (67.3%).	NR
49	Tami-Maury et al (2016)	NR	NR	NR	NR
50	Vijay Kumar & Suresan (2012)	SCC is the most common form of OC (96%). Early detection improves 5-year survival rates from OC (44.5%).	Non-scrapable white lesions are potentially malignant (82%).	Risk factors: Alcohol (99%), tobacco (78%), UV light (45%), older age (59%). Non-risk factors: poor denture fit (54%).	NR
51	Wong & Toljanic (2009)	NR	NR	NR	NR
52	Wright et al (2011)	NR	NR	NR	NR
53	Yellowitz et al (1998)	Inconsistent responses on knowledge about OC. Identified erythroplakia and leukoplakia as the most common predisposing conditions to OC (87%). Early detection improves 5-year survival rates (97%).	Recognised early lesions were asymptomatic (73%).	Risk factors: Tobacco (99.6%), alcohol (91%), UV light exposure (98%), prior OC (96%), >60 years (30%) Non-risk factors: poor denture fit (35%), poor OH (53%), family history of cancer (80%).	NR

Note: ENT = Ear Nose and Throat Specialists; GDPs = General Dental Practitioners HCPs = Health Care Professionals; HNC = Head and Neck Cancer; H & N = Head and Neck; HPV = Human Papilloma Virus; HSV = Herpes Simplex Virus; LNs = Lymph Nodes; NR = Not Reported; OC = Oral cancer; OCE = Oral Cancer Examination; OH = Oral Hygiene; SCC = Squamous Cell Carcinoma; S & S = Signs and Symptoms; UV = Ultra-Violet.

Supplementary File 3.3: Perception Outcome

ID	Authors, publication year	Perceptions (% positive response)			
		Perceived adequacy of cancer knowledge	**Perceived role in cancer patient management**	**Perceived role in OC prevention & OCE**	**Perceived adequacy of training/ further training**
1	Ahmed & Naidoo (2019)	OC knowledge is current (26.7%). Oral cancer prevention knowledge is sufficient (65%).	NR	NR	Sufficient training in OC diagnosis (33.6%). Interested in further CE regarding prevention and early detection of OC (95.6%).
2	Akbari et al (2015)	NR	NR	NR	NR
3	Alhazzazi (2021)	NR	NR	Performed OCE for HNC patients (78%). Performed OCE HNC high risk patients (17%).	NR
4	Alonge & Narendran (2004)	NR	NR	NR	Adequate undergraduate OCE training (75%). Interested in oral cancer CE (81%).
5	Alqahtani et al (2021)	NR	NR	NR	NR
6	Alqutaibi et al (2021)	NR	NR	Prosthodontists believed OCE should occur at: initial exam (96.5%), recall (84.6%); targeted at high risk group (85.3%). Prosthodontists role to perform OCE (72%). Prosthodontists with <10 years experience showed significantly better attitude in regards to OC screening (p=0.011).	Prosthodontists believed they were adequately trained to detect oral cancer (58%).
7	Borhan-Mojabi (2012)	OC knowledge is sufficient (59.3%).	NR	NR	NR

8	Calvert et al (2014)	NR	NR	NR	NR
9	Canto et al (2001)	OC knowledge is current (78%).	NR	NR	Interested in OC CE (81%).
10	Clovis et al (2002)	OC knowledge is current (56.7%).	NR	NR	Interested in further OC CE (77%).
11	Colella et al (2008)	NR	NR	NR	Adequately prepared to advise patients with suspicious oral lesions (63.1%). Adequately trained to inform OC risk factors (41.6%). Adequately trained to provide tobacco cessation (80.9%). Adequately trained for alcohol cessation (76.5%). Adequately trained to perform OC exam (53.6%). Adequately trained to perform LN exam (66.8%). Interested in receiving further OC training (96.1%).
12	Cruz et al (2005)	NR	NR	NR	NR
13	Daley et al (2011)	NR	NR	OHP responses varied regarding whether or not their role should be to discuss the HPV-OC link and/or HPV vaccines with patients. Concerns about the appropriateness of HPV-OC discussions with patients due to confidentiality and gender roles results in some OHP discomfort.	A desire for additional guidance from their professional organisations on ways to manage screening for HPV-related OC.

14	Dang et al (2022)	NR	NR	NR	Adequately trained to treat oncology patients (50%).
15	Dewan et al (2014)	NR	NR	NR	NR
16	Dixon et al (2021)	New Zealand graduates and trained dentists who saw greater numbers of HNC patients in the prior year were more likely to trust their own advice.	Dental treatment for HNC patients falls within the scope of practice for a general dentist (75%).	NR	Adequately trained to treat HNC patients (25%). Public sector experience was associated with having undertaken HNC professional development in the previous 5 years.
17	Ekici (2020)	Sufficient OC detection & prevention knowledge (29.3%).	NR	NR	Adequate undergraduate training on oral malignant and premalignant lesions (38.1%). Interested in further OC training (77.9%).
18	Fidele et al (2022)	OC knowledge is current (35.8%).	NR	NR	Adequately trained to perform OCE (35.8%). A need for additional training in the early detection of OC (85%).
19	Frydrych et al (2012)	Knowledge in managing OC patients is current (37.1%).	Refer OC patients for a pre-radiation therapy dental assessment (32.9%). Refer patients to a specialist for management of post completion OC treatment (25.7%). GDPs should be able to provide dental treatment for OC patients (77.7%). Dental adverse effects can be prevented in OC patients with radiation therapy (73.7%).	NR	Adequately trained to manage cancer patients (42.3%). Interested in further CE on the management of OC patients (92.9%).

20	Gajendra et al (2006)	OC knowledge is current (72%).	NR	NR	75% dentists reported taking OC CE course in the last 5 years. As a result of taking course, 34% dentists reported making changes in their practice of OC prevention.
21	Guneri et al (2008)	NR	NR	NR	NR
22	Haresaku et al (2018)	NR	NR	A significantly more J than A felt dentists should routinely perform OCE (J: 76.8%, A: NR) ($p<0.001$). *NB: J = Japanese dentists, A = Australian dentists*.	Japanese-dentists felt they needed additional training in OCE compared to Australian-dentists ($p<0.001$).
23	Hashim et al (2018)	NR	NR	NR	Need further training on OC detection (84.9%)
24	Horowitz et al (2000)	NR	NR	Tobacco cessation education on patients (71%). Alcohol cessation counselling (50%).	OC dental education was good/very good (78%). Adequately trained to examine OC patients (88%). Adequately trained to palpate LNs (72%). Adequately trained to provide tobacco cessation education (28%). Adequately trained to provide alcohol cessation education (11%).
25	Husein et al (2011)	NR	GDPs were comfortable managing H & N cancer patients (47%). >50% GDPs perception in managing: caries (88%), xerostomia (56%), detecting	NR	Interested in postgraduate training in managing H & N cancer patients (92%)

			recurrence (77%), smoking-cessation advice (80%), trismus (28%) & mucositis (38%). Perceived role in OC management (thematic analysis): prevention of caries, dietary advice, guidance & moral support. OC patients should be treated at: joint care (85%), dental hospital (71%), maxillofacial unit (69%), salaried dental service (55%), general practice (67%).		
26	Joseph et al (2012)	OC knowledge is current (52%).	NR	NR	Adequately trained for OCE (58%)
27	Kogi et al (2019)	OC knowledge & skills are sufficient (11%).	NR	NR	NR
28	Kujan et al (2006)	NR	NR	National-based OCE program would decrease morbidity and mortality (47.6%) [GDPs: 52.4%, dental specialists: 35.4%]	Adequately trained for OCE (51%)
29	Leão et al (2005)	There was no correlation between actual and perceived knowledge of oral cancer. A higher percentage of wrong answers (actual knowledge) were found among those who considered themselves with higher knowledge (perceived knowledge) on	NR	NR	NR

		the 5-point ordinal Likert scale.			
30	LeHew et al (2010)	NR	NR	Dentists should be trained for OCE (99%).	NR
31	Lopez-Jornet et al (2010)	OC knowledge is current (49.7%). Dentists who rated their undergraduate OC training favourably were more likely to agree that their OC knowledge was current.	NR	OCE for patients >40 years (89.7%). Dentists are qualified to perform OCE (94.7%).	Adequately trained to provide tobacco cessation education (41.5%). Adequately trained to provide alcohol cessation education (27.6%). Adequately trained to palpate cervical LNs in cancer patients (52.6%).
32	Marino et al (2017)	NR	NR	NR	NR
33	Martins et al (2021)	NR	HNC RT patients to be evaluated by a dentists trained in the field (77.14%)	NR	NR
34	Maybury et al (2012)	OC knowledge is current (74%).	NR	NR	Majority agreed they were adequately trained to provide tobacco and alcohol cessation counselling. Adequate OC education (83%).
35	McCann et al (2000)	NR	NR	Role to prevent OC (90%).	NR
36	Nazar et al (2022)	OC knowledge is current (53.9%). Dentists with a master degree had higher mean opinion score (felt they were better trained for OCE, their knowledge was current) compared to those with	NR	NR	Adequate training to perform OCE (37.4%). Interested in OC CE (95.8%).

		only a bachelor degree (p = 0.006).			
37	Nazar et al (2019)	OC knowledge is current (55%).	NR	NR	Adequate training to perform OCE (38%). Interested in attending OC CE (92.4%).
38	Nicholls & Ilankovan (1998)	NR	NR	NR	NR
39	Patel et al (2012)	NR	NR	NR	Adequate undergraduate training in taking care of HNRT patients (45%). No correlation between years of graduation and adequacy of training.
40	Patton et al (2006)	OC knowledge is current (70.5%).	NR	NR	Adequately trained for OCE (89.4%). Adequately trained to palpate LNs (77.4%). Adequately trained to provide tobacco cessation education (30.5%). Adequately trained to provide alcohol cessation education (13.5%).
41	Pavão Spaulonci et al (2018)	OCE knowledge is sufficient (52.9) Dentists with self-reported satisfactory OC knowledge were more likely to have satisfactory OC knowledge.	NR	NR	70.2% junior dentists vs 43.8% senior dentists reported adequate OCE during undergraduate degree (average 55.6%).
42	Reed et al (2010)	NR	NR	NR	Interested in receiving OCE training (40%).

					Preferred training format: annual state association meeting (25%), local professional meeting (21%), local office visit (8%), computer module (17%), continuing medical education credit (15%), conference (6%).
43	Saleh et al (2014)	OC detection knowledge is sufficient (35.6%). OC risks knowledge is sufficient (45.7%). Perception of OC knowledge is consistent with actual OC knowledge.	NR	OCE can prevent & early detection of OC (90.6%).	Interested in further CE regardless of their practice of OCE or confidence levels (70%).
44	Seals (1990)	NR	NR	NR	Adequately prepared to detect and diagnose oral lesions (86.5%). Adequately trained to manage and provide dental care for cancer patients (72.9%). Interest in OC CE (95.5%).
45	Seoane et al (2006)	NR	NR	NR	NR
46	Shadid & Habash (2023)	NR	NR	Dentists with >15 years' experience had more positive opinions towards OCE than those of less experience ($p<0.05$). Role of dentists to screen for oral pathology (94.9%). OCE should be performed all new patients (82.7%) OCE should be performed for recall patients (74.4%).	Adequately trained in OCE (44.9%).
47	Strey et al (2022)	NR	NR	Dentists refer biopsies to other specialists (90%).	Sufficient OC training (55.21%) Dentists with more years of experience after graduation than

					recent graduates found undergraduate OC theoretical & practical training to be insufficient ($p<0.05$).
48	Taheri et al (2018)	NR	NR	NR	NR
49	Tami-Maury et al (2016)	NR	GDPs provide dental treatment to patients undergoing cancer therapy or with a history of cancer (91%).	NR	NR
50	Vijay Kumar & Suresan (2012)	OC knowledge is current (43%).	NR	Annual OCE for patients >40 years (68%). Referral to specialists if OC was suspected (98%).	Adequately trained to perform OCE (68%).
51	Wong & Toljanic (2009)	NR	NR	NR	NR
52	Wright et al (2011)	NR	NR	NR	NR
53	Yellowitz et al (1998)	OC knowledge is current (73%). Most dentists perceived their knowledge to be current and accurate however this was not reflected in their actual OC knowledge score.	NR	Annual OCE for patients >40 years (98%).	Adequately trained to perform OCE (88%).

Note: CE = Continuing education; ENT = Ear nose and throat specialists; GDPs = General dental practitioners; HCPs = Health care professionals; HNC = Head and neck cancer; H & N = Head and neck; HPV = Human Papilloma Virus; HSV = Herpes Simplex Virus; LNs = Lymph nodes; NR = Not reported; OC = Oral cancer; OCE = Oral cancer examination; OH = Oral hygiene; OHPs = Oral health professionals; RT = Radiation therapy; SCC = Squamous Cell Carcinoma.

Supplementary File 3.4: Practice Outcome

ID	Authors, publication year	Practice (% positive response)			
		OC screening	**Managing suspicious lesions**	**Experience in managing cancer patients**	**Communication other health professionals**
1	Ahmed & Naidoo (2019)	Performed OCE (46%): Of these, took medical history (14%), performed intraoral exam (51%), performed extraoral exam (41%), palpated LNs (57%), performed biopsy (27%), took x-ray (20%). Counselled patients of OC risk factors (36%).	GDPs referred 1-5 patients for suspicious lesions in the last 12 months (52%).	NR	GDPs believed development of referral guidelines can improve the quality of referrals (88.5%).
2	Akbari et al (2015)	NR	NR	NR	NR
3	Alhazzazi (2021)	Performed OCE as their daily exam protocol (13%).	Dentists detected patients with HNC/ suspicious lesions requiring further attention in their practice (55%). Dentists referred patients to an OMFS (64.07%), a colleague who known to deal with such cases (17.45%) & an oncologist (11.15%).	Dentists followed-up with HNC patients: one year (8%), two year (12%), five year (14%), life-long (57%).	NR
4	Alonge & Narendran (2004)	Screened patients >40 years at initial exam (67%). Performed OC exam at recall (59%). OCE included examination of cervical LN (36%). Dentists graduated in 1980 or later performed OCE more frequently than pre-1980 graduates (p=0.228).	NR	NR	NR
5	Alqahtani et al (2021)	NR	NR	NR	NR

6	Alqutaibi et al (2021)	Assessed new patients for mucosal lesions (79%). Performed OCE on patients at recall (58%). Screened high risk patients (62%).	NR	NR	NR
7	Borhan-Mojabi (2012)	Routinely performed OCE patients for OC (79.15%). Routinely performed OCE on high risk patients (96.5%). Regularly advised patients regarding OC risk factors (30.2%).	NR	NR	NR
8	Calvert et al (2014)	NR	NR	Restorative consultants spent approximately 1/4 of their clinical time treating oncology patients (61%) Restorative dentists spent >75% of their clinical time treating oncology patients (13%). Restorative dentists treated >50 cases/ year (29%) Restorative treated <10 cases/ year (32%).	Restorative dentists attended multidisciplinary team meeting (52%).
9	Canto et al (2001)	NR	NR	NR	NR
10	Clovis et al (2002)	NR	NR	NR	NR
11	Colella et al (2008)	Oral surgeon/ oral pathologist routinely performed OCE (51.3%). GDPs and other specialists routinely performed OCE (63.5%).	NR	NR	NR

		Solo practitioners (50.3%) & non-solo practice (60.6%) routinely performed OCE.			
12	Cruz et al (2005)	Performed OCE on patients >40 years at initial appointment & recall (86%). Enquired patients about tobacco use & advised to quit (61%). Took alcohol consumption history (33%); advised patients to stop drinking (26%). Dentists' readiness to provide OCE Pre-contemplation stage: 3% Contemplation stage: 7% Planning stage: 3% Action stage: 3% Maintenance stage: 82%	NR	NR	NR
13	Daley et al (2011)	NR	NR	NR	NR
14	Dang et al (2022)	NR	NR	GDPs provided care to patients undergoing cancer therapy (93%). Of the 93% GDPs, 82% saw 1-20 oncology patients/ year, 13% saw 21-40 oncology patients/ year, 3% saw 41-60 patients/ year, 2% saw >61 patients/ year. Time required for dentists to complete essential dental care in oncology patients: 1-week (33%), 2-week (40%). GDPs counselled patients on oral complications associated with cancer therapy/ long term care (81%).	GDPs reported that they either rarely or never received correspondence from the oncology team (31%).

				GDPs followed the recommendations by NIDCR (54%).	
15	Dewan et al (2014)	NR	NR	Restorative dentists carried out clinical work in H & N oncology patients (77%). Of these 77%, 90% participated in 1 or 2 sessions of oncology clinics. Restorative having a protocol for oncology patients at review appointment (68%). Among the ones who had a protocol, 20% saw patient within one month, 40% within 1-3 months. Restorative using dental implants in rehabilitation of post cancer surgery (91%).	The patients seen at oncology pre-assessment clinics were referred mainly from a member of the MDT (95%).
16	Dixon et al (2021)	NR	NR	New Zealand graduates were also less likely to refer a HNC patient to a specialist for dental management.	NR
17	Ekici (2020)	Performed OCE on high risk patients (34%). OCE included examination of oral mucosa regularly (70.7%), LNs (47.3%).	GDPs took biopsy of suspected lesions (34.7%).	NR	NR
18	Fidele et al (2022)	Performed OCE on every patient (19.8%). Performed OCE on high-risk patients (95.1%). OCE included examination of LNs (39.5%). Advised about OC risks (98.8%)	NR	NR	NR
19	Frydrych et al (2012)	NR	NR	Number of OC patients seen by GDPs in the last 12 months: none (36.8%), 1 (19.7%), 2	GDPs always communicated with radiation oncologist (52.2%).

				(22.4%), 3 (6.6%), 4 (3.3%), 5 (2.6%), >6 (5.3%). No difference between rural or urban GDPs in OC care practices.	GDPs routine communicated with other clinicians (GMPs, Oral meds, oral path, oral surgeon, perio/ pros, peers, pain specialists, oncologists, ENT, dietician, speech, physio, others) (70.3%).
20	Gajendra et al (2006)	Performed OCE to >80% of their patients > 40 years (85%).	NR	NR	NR
21	Guneri et al (2008)	NR	NR	Gender (p=0.967), age (p=0.977) and duration of practice (p=0.99) were not significantly correlated to practice.	NR
22	Haresaku et al (2018)	Performed OCE in every patient (A: 52.8%, J: 9.8%, p<0.001). Discussed OC risk factors OC with every patient (A: 4.7%), J: 2.4%, p<0.001). Factors influencing OCE included patient complaints (J: 79.3%, A: 32.7%), medical history (J: 34.1%, A: 27.6%), age of patient (J: 29.3%, A: 33.6%). OCE included visual inspection of oral cavity (J: 89.3%, A: 98.4%), extra-oral examination (J: 35.7%, A: 80.5%), visual inspection of oropharynx (J: 10.7%, A: 23.8%), palpation of neck (J: 10.7%, A: 50.8%). *NB: J = Japanese dentists, A = Australian dentists*.	NR	NR	NR
23	Hashim et al (2018)	NR	NR	NR	NR
24	Horowitz et al (2000)	OCE included asking about cancer history (91%), tobacco use (90%), family history (65%),	NR	NR	NR

		alcohol use (60%), past alcohol use (50%), palpation of LNs (35%). Performed OCE on edentulous patients (14%). Performed OCE on patients > 40 years (81%). Graduates from 1980-1995 (recent graduates) were 1.5-2.0 more likely to get a high score for their efforts in screening patients for risk factors and to comply with the recommended OC examination practices; 2.5 more likely to get high score for screening and examining patients.			
25	Husein et al (2011)	NR	NR	GDPs managed >1 patient who had received radiotherapy to H&N in the last 5 years (75%). GDPs had managed >5 patients in the last 5 years (12%). GDPs would recommend the use of fluoride mouthwash or toothpaste (50%). GDPs recall their patients at 1-3 months (41%). GDPs recall their patients at 4-6 months (54%).	NR
26	Joseph et al (2012)	Provided OC risk factors advice to patients (43%). OCE included asking asked tobacco history (65%), alcohol intake (22%),oral mucosa examination (86%).	Dentists referred suspicious lesions to OMFS (77%). Dentists took a biopsy suspicious lesion (63%).	NR	NR

27	Kogi et al (2019)	Performed overall visual inspection of oral cavity for OCE (77.3%). Performed specific detailed exam for OCE (<50%). The most common risk factors assessed were: history of cancer (52.7%), tobacco use (41.8%), advancing age (21.8%), history of HPV (18.2%), alcohol consumption (13.6%) and poor diet (10.1%).	NR	NR	NR
28	Kujan et al (2006)	Counselled on risks of tobacco & alcohol habits for patients with excessive use (59.2%). Significantly large number of dental specialists (72.3%) than GDPs (41.2%) provided such counselling ($p<0.05$).	Referred suspicious pre-cancer and cancer lesions to OMFS (65%), oral surgeons (14%), oral med (19.5%), ENT (0.7%), dermatologist (0.7%).	NR	NR
29	Leão et al (2005)	Dentists who devoted more than half of the patient's initial consultation to clinical examination of the oral cavity were more likely to have possibly detected suspicious lesions than those who did not undertake such careful examination (P= 0.039).	GDPs referred suspicious lesions to a secondary health care providers (83.7%). GDPs performed biopsy on suspicious lesions (25%).	GDPs had at least one patient with possible OC in their professional lifetime (62%). GDPs provided clinical review (40%).	NR
30	LeHew et al (2010)	Performed OCE on asymptomatic patients (89.2%). OCE always included palpation of cervical LNs (42%), FOM (27%), lateral borders of tongue (29%) & dorsal of tongue (23%), visualisation of dorsal borders of tongue (69%).	NR	NR	NR
31	Lopez-Jornet et al (2010)	Perceived favourable undergraduate OC training were	NR	NR	NR

		1.8 times more likely to perform OC examination on all patients aged 40 and over.			
32	Marino et al (2017)	Provided comprehensive OCE (51.7%). Discussed OC risk factors with patients (5.8%). Factors influencing decision to perform OC screening: patient complains (32.2%), age of patient (31.4%), medical history (26.9%). OCE included extra-oral visual inspection of cavity (80.4%), visual inspection of oral cavity (98.1%), visual inspection of oropharynx (50.5%), neck palpation (25.5%)	NR	NR	NR
33	Martins et al (2021)	NR	NR	NR	NR
34	Maybury et al (2012)	OCE included examination of tongue (85%).	NR	NR	NR
35	McCann et al (2000)	Performed OCE on patients > 16 years (58%). Factors influencing OCE included age (83.7%), smoking history (86%), alcohol use (62.8%), presence of pre-existing oral conditions (84.9%). Recalling patients with high risk of OC for OCE (78%).	NR	NR	NR
36	Nazar et al (2022)	Reviewed patients' risk factors for OC (12.9%). OCE included asking about tobacco use (53.2%), alcohol consumption (8.7%).	GDPs referred patient with suspicious lesion to a specialist (57.1%).	NR	NR

37	Nazar et al (2019)	Performed OCE and managing OC according to the best practice (48%). Reviewed their patients' OC risk factors (32%).	GDPs referred a suspicious lesion to a specialist (56% always, 25% usually).	NR	NR
38	Nicholls & Ilankovan (1998)	NR	Diagnosis of oropharyngeal cancer (94% OMFS).	OMFS were responsible for treatment of oropharyngeal cancer (78%). Number of patients seen: 23/ year.	OMFS had GDPs in the team (39%). OMFS had oral surgeon in the team (85%). OMFS had hygienists (64%). OMFS communicated with GDPs (80%).
39	Patel et al (2012)	NR	NR	Dentists saw patients for pre-radiation dental evaluation (74%). Dentists managed patients during HNRT (68%). Dentists recommended topical fluoride therapy for patients starting HNRT (23%). Dentists provided mucosal guard (11%). Dentists provided all dental treatment needed post HNRT (31%). Dentists performed cleaning and restorations (39%). Dentists referred extraction to an oral surgeon (19%).	NR
40	Patton et al (2006)	OCE included past tobacco use (78%), alcohol use (51.7%), patient's history of cancer (91.1%), family history of cancer (64%). Dentists who felt they had adequate training in tobacco cessation were significantly more	NR	NR	NR

		likely to assess past, and type and amount of tobacco on patient medical histories. (p<0.05). Dentists who felt adequately trained in the cessation had more than twice the likelihood of assessing alcohol for current use, for past use and for type and amount on medical histories.			
41	Pavão Spaulonci et al (2018)	Performed OCE on first appointment (82.5%).	Dentists referred the diagnosis of suspected lesions (17.9% junior dentists, 2.4% senior dentists). Referral to stomatology (66.7%), dental school (9.5%), specialised hospital (4.2%), physician (2%).	NR	NR
42	Reed et al (2010)	OCE included examine tongue and mucosa (81%), smoking/ tobacco history (70%). Counselled patients on tobacco use (41%).	NR	NR	NR
43	Saleh et al (2014)	Performed opportunistic OCE (84.8%). Counselled patients on excessive drinking of alcohol, smoking, betel quid/ paan chewing (>80%). OCE were associated with recency of graduation (<10 years) and attending CE on OC.	NR	NR	NR
44	Seals (1990)	NR	NR	Recent graduates providing dental care for cancer patients: frequently (2.3%), occasionally (30.1%), rarely (67.7%).	NR
45	Seoane et al (2006)	Performed OCE which included examination of soft tissues (87.5%).	NR	NR	NR

		Counselled on alcohol and tobacco use (84.4%).			
46	Shadid & Habash (2023)	Performed OCE on patients routinely (29.9%). Only performed OCE on high-risk patients (43.3%). Offered smoking cessation advice (80.3%) No difference with gender or workplace in performing OCE.	Dentists referred suspicious lesions to a specialist (74.4%).	NR	NR
47	Strey et al (2022)	Performed OCE including full mouth examination (96.9%). Counselled on tobacco cessation (87.5%), alcohol use (51%), sun exposure (59.9%), diet (69.3%).	Dentists working in primary healthcare referred suspicious lesions for biopsy to specialists from public system (81.3%), specialists from universities (7.8%). Dentists working in primary healthcare performed biopsy on suspicious lesions (8.3%).	NR	NR
48	Taheri et al (2018)	NR	NR	NR	NR
49	Tami-Maury et al (2016)	Taught patients self-oral examination (20%). Counselled on tobacco cessation advice (68%).	NR	NR	NR
50	Vijay Kumar & Suresan (2012)	Performed complete OCE on all patients (37%). Counselled patients on the adverse effects of tobacco and alcohol use (31%). OCE included taking patient's medical history related to alcohol and tobacco use (68%).	GDPs performed biopsy on suspicious lesions (24%). GDPs referred suspicious lesions to a specialist (12%).	NR	NR
51	Wong & Toljanic (2009)	NR	NR	OMFS indicated their protocol included pre-chemotherapy oral exam in leukaemia patients (95%) Of these, 95% differentiated	NR

				between acute and chronic dental diseases; 53% recommended treatment of all dental pathologies prior to chemotherapy; 49% recommended treating all carious lesions prior to chemotherapy while 46% only treated large carious lesions; all advocated periodontal prophylaxis (gingivitis). Approach to caries pre-chemotherapy: treat all caries lesions (49%), treat only large caries lesions (46%), no treatment (5%). Approach to severe periodontitis pre-chemotherapy: extract severe periodontally involved teeth (72%), performed root planning (28%). Approach to asymptomatic apical radiolucency pre-chemotherapy: endodontic therapy (76%), extract (12%), no treatment (12%)	
52	Wright et al (2011)	NR	NR	Dental centres providing oral care for cancer patients (84%). Dental centres providing long-term dental care for cancer patients (77%). Mean number of cancer patients seen in each centre = 29 (2-100).	Dental service can be improved by earlier patient referral for dental care (13%). Managers of dentists believed a need for greater emphasis upon oral health in the overall care plan of cancer patients (16%). Managers of dentists believed a need for clear care pathways for cancer patients (8%). Referrals received: post-operative stage of cancer

					therapy only (19%), pre-operative & other stages of therapy (70%), pre-operative stage of cancer therapy (6%).
53	Yellowitz et al (1998)	Performed OCE to all patients 18-39 years (74%). Performed OCE >40 years (70%). OCE included palpation of patient's cervical LNs (one third). Dentists tended to address their patient's use of alcohol less frequently than tobacco use.	NR	NR	NR

Note: ENT = Ear nose and throat specialists; GDPs = General dental practitioners; HCPs = Health care professionals; HNC = Head and neck cancer; H & N = Head and neck; HPV = Human Papilloma Virus; HSV = Herpes Simplex Virus; LNs = Lymph nodes; NIDCR = National Institute of Dental and Craniofacial Research, NR = Not reported; OC = Oral cancer; OCE = Oral cancer examination; OH = Oral hygiene; SCC = Squamous Cell Carcinoma.

Supplementary File 3.5: Mixed-Methods Tools

Quantitative studies

ID	Authors, publican year	Are there clear research questions?	Do the collected data allow to address the research questions?	Is the sampling strategy relevant to address the research question?	Is the sample representative of the target population?	Are the measurements appropriate?	Is the risk of non-response bias low?	Is the statistical analysis appropriate to answer the research question?	% score
1	Ahmed & Naidoo (2019)	Yes	Yes	Yes	Yes	Can't tell	No	Yes	71.43
2	Akbari et al (2015)	Yes	Yes	Yes	No	Yes	No	Yes	71.43
3	Alhazzazi (2021)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
4	Alonge & Narendran (2004)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
5	Alqahtani et al (2021)	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes	85.71
6	Alqutaibi et al (2021)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
7	Borhan-Mojabi (2012)	Yes	Yes	Yes	Can't' tell	Can't' tell	No	Yes	57.14
8	Calvert et al (2014)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
9	Canto et al (2001)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
10	Clovis et al (2002)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
11	Colella et al (2008)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
12	Cruz et al (2005)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
14	Dang et al (2022)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
15	Dewan et al (2014)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
16	Ekici (2020)	Yes	Yes	Yes	Yes	Yes	No	Yes	71.43
17	Fidele et al (2022)	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes	85.71
18	Frydrych et al (2012)	Yes	Yes	Yes	Yes	Can't tell	No	Yes	71.43
19	Gajendra et al (2006)	Yes	Yes	yes	Yes	Yes	No	Yes	85.71
20	Guneri et al (2008)	Yes	Yes	Yes	Yes	Yes	No	Can't tell	71.43
21	Haresaku et al (2018)	Yes	Can't tell	yes	Can't tell	Can't tell	No	Yes	42.86
22	Hashim et al (2018)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
24	Horowitz et al (2000)	Yes	Yes	Yes	Yes	Can't tell	No	Yes	71.43
25	Husein et al (2011)	Yes	Yes	Yes	Yes	Yes	No	Can't tell	71.43
26	Joseph et al (2012)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
27	Kogi et al (2019)	Yes	Yes	No	Can't tell	Yes	No	Yes	57.14
28	Kujan et al (2006)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71

29	Leão et al (2005)	Yes	Yes	Yes	Can't tell	Can't tell	No	Yes	57.14
30	LeHew et al (2010)	Yes	Yes	No	Can't tell	Can't tell	No	Yes	42.86
31	Lopez-Jornet et al (2010)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
32	Marino et al (2017)	Yes	Yes	Yes	Yes	Can't tell	No	Yes	85.71
33	Martins et al (2021)	Yes	Yes	Yes	Can't tell	Can't tell	Can't tell	Yes	57.14
34	Maybury et al (2012)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
35	McCann et al (2000)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
36	Nazar et al (2022)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
37	Nazar et al (2019)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
38	Nicholls & Ilankovan (1998)	Can't tell	Can't tell	No	Can't tell	Can't tell	No	Can't tell	0.00
39	Patel et al (2012)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
40	Patton et al (2006)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
41	Pavão Spaulonci et al (2018)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
42	Reed et al (2010)	Yes	Yes	Yes	Yes	Can't tell	No	Yes	85.71
43	Saleh et al (2014)	Yes	Yes	Yes	No	Yes	No	Yes	71.43
44	Seals (1990)	Yes	Yes	Yes	Yes	Yes	No	Can't tell	71.43
45	Seoane et al (2006)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
46	Shadid & Habash (2022)	Yes	Yes	Yes	Yes	Yes	No	Yes	85.71
47	Strey et al (2022)	Yes	Yes	Yes	Can't tell	Can't tell	No	Yes	71.43
48	Taheri et al (2018)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
49	Tami-Maury et al (2016)	Yes	Yes	Yes	Yes	Can't tell	No	Yes	57.14
50	Vijay Kumar & Suresan (2012)	Yes	Yes	Yes	Can't tell	Yes	No	Yes	71.43
51	Wong & Toljanic (2009)	Yes	Yes	Yes	No	Yes	No	Yes	71.43
52	Wright et al (2011)	Yes	Yes	Yes	Can't tell	Can't tell	No	Yes	71.43
53	Yellowitz et al (1998)	Yes	Yes	Yes	Yes	Yes	No	Can't tell	57.14

Qualitative studies

ID	Authors, publican year	Are there clear research questions?	Do the collected data allow to address the research questions?	Is the qualitative approach appropriate to answer the research question?	Are the qualitative data collection methods adequate to address the	Are the findings adequately derived from the data?	Is the interpretation of results sufficiently substantiated by data?	Is there coherence between qualitative data sources, collection, analysis and	% score

					research question?			**interpretation?**	
13	Daley et al (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100.00

Mixed method studies

ID	**Authors, publican year**	**Are there clear research questions?**	**Do the collected data allow to address the research questions?**	**Is there an adequate rationale for using a mixed methods design to address the research question?**	**Are the different components of the study effectively integrated to answer the research question?**	**Are the outputs of the integration of qualitative and quantitative components adequately interpreted?**	**Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?**	**Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?**	**% score**
23	Dixon et al (2021)	Yes	Yes	Yes	Yes	Can't tell	Can't tell	Can't tell	57.14

Appendix C: The University of Sydney Ethics Approval Documents for the Mixed-Methods Study

Ethics Approval Letter

THE UNIVERSITY OF SYDNEY

Research Integrity & Ethics Administration
Human Research Ethics Committee

Thursday, 24 August 2023

Assoc Prof Joanne Shaw
Psychology; Faculty of Science
Email: joanne.shaw@sydney.edu.au

Dear Joanne,

The University of Sydney Human Research Ethics Committee (HREC) has considered your application.

After consideration of your response to the comments raised your project has been approved.

Approval is granted for a period of four years from **24/08/2023 to 24/08/2027**

Project No.: **2023/498**

Project Title: **Understanding dentists' views and experience managing the oral health of patients with cancers.**

Authorised Personnel: **Shaw Joanne; Holden Alexander; Low Sheau-ling;**

First Annual Report due: 24/08/2024

Documents Approved:

Date Uploaded	Version number	Document Name
11/08/2023	Version 2	PCF (clean)
11/08/2023	Version 2	PIS (clean)
11/08/2023	Version 2	Social media advertisement (clean)
11/08/2023	Version 2	Study advertisement (clean)
11/08/2023	Version 2	Study advertisement reminder (clean)
20/07/2023	Version 1	CI Declaration
23/06/2023	Version 1	Interview schedule
23/06/2023	Version 1	Survey questions
23/06/2023	Version 1	Study Protocol

Condition/s of Approval

- Research must be conducted according to the approved proposal.
- An annual progress report must be submitted to the Ethics Office on or before the anniversary of approval and on completion of the project.
- You must report as soon as practicable anything that might warrant review of ethical approval of the project including:
  - Serious or unexpected adverse events (which should be reported within 72 hours).
  - Unforeseen events that might affect continued ethical acceptability of the project.

THE UNIVERSITY OF SYDNEY

- Any changes to the proposal must be approved prior to their implementation (except where an amendment is undertaken to eliminate *immediate* risk to participants).
- Personnel working on this project must be sufficiently qualified by education, training and experience for their role, or adequately supervised. Changes to personnel must be reported and approved.
- Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, as relevant to this project.
- Data and primary materials must be retained and stored in accordance with the relevant legislation and University guidelines.
- Ethics approval is dependent upon ongoing compliance of the research with the *National Statement on Ethical Conduct in Human Research*, the *Australian Code for the Responsible Conduct of Research*, applicable legal requirements, and with University policies, procedures and governance requirements.
- The Ethics Office may conduct audits on approved projects.
- The Chief Investigator has ultimate responsibility for the conduct of the research and is responsible for ensuring all others involved will conduct the research in accordance with the above.
- The Clinical Trials Support Office has been notified as outlined in the University's Clinical Trials Policy where a clinical trial is being undertaken.

This letter constitutes ethical approval only.

Please contact the Ethics Office should you require further information or clarification.

Sincerely,

Associate Professor Helen Mitchell
Chair
Human Research Ethics Committee (HREC 1)

The University of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) current National Statement on Ethical Conduct in Human Research (2018) and the NHMRC's current Australian Code for the Responsible Conduct of Research (2018).

Ethics Approval Letter to Recruit Participants from Other Sources

THE UNIVERSITY OF SYDNEY

Research Integrity & Ethics Administration
HUMAN RESEARCH ETHICS COMMITTEE

Tuesday, 17 October 2023

Assoc Prof Joanne Shaw
Psychology; Faculty of Science
Email: joanne.shaw@sydney.edu.au

Dear Joanne,

Your request to modify this project, which was submitted on 4/10/2023, has been considered.

project has been approved to proceed with the proposed amendments.

Protocol Number:	**2023/498**
Protocol Title:	**Understanding dentists' views and experience managing the oral health of patients with cancers.**

Special Condition/s of Approval

The Committee approved this modification in the absence of ethical objections and on the basis of satisfactory scientific merit. The **special conditions of approval** are as follows:

- It is a condition of approval that you obtain any permissions required from moderators of closed Facebook groups to post recruitment messages. You should keep this evidence on file, but it does not need to be submitted in IRMA.

Please contact the ethics office should you require further information.

Sincerely,

Dr Marinda Taha
Chair
Modification Review Committee Chair (MRC 1)

The University of Sydney of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2018) and the NHMRC's Australian Code for the Responsible Conduct of Research (2018)

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Study Advertisement

Research Study: Understanding dentists' views and experience managing the oral health of patients with cancers.

Associate Professor Joanne Shaw (chief investigator)
School of Psychology, Faculty of Science
Phone: +61 2 9351 3761 | Email: joanne.shaw@sydney.edu.au
Dr Sheau Ling Low (MPhil student) | Email: sheauling.low@sydney.edu.au

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We are conducting a research study aiming to understand dentists' views and experience managing the oral health of patients with cancers. We would really appreciate your help in participating in the study. This study is comprised of two parts: online survey and telephone interview.

We are seeking dentists in clinical practice and registered with Australian Health Practitioner Regulation Agency (AHPRA) to complete the survey. Dental students, non-practicing or retired dentists, and dentists working solely in academia are excluded.

You are invited to participate in both an online survey and telephone interview. The online survey is anonymous and will take approximately 10 minutes to complete. If you wish to also participate in the interview, please leave your contact details so we can contact you for an approximately 30 minutes follow-up interview. You may participate in the online survey without participating in the interview.

Please contact Sheau Ling Low (MPhil student) Email: sheauling.low@sydney.edu.au or Associate Professor Joanne Shaw (chief investigator) Email: joanne.shaw@sydney.edu.au if you have any questions about this study.

To take part in this study, please click the following link:
https://redcap.sydney.edu.au/surveys/?s=9CKNPH3RF4LTY3J8

Or scan:

This study has been approved by the Human Research Ethics Committee (HREC) of The University of Sydney [2023/498].

Social Media Study Advertisement

We want to know about your views and experience managing the oral health of patients diagnosed with cancer.

The study involves completing an online survey that will take approximately 10 minutes. You are also invited to participate in an interview lasting approximately 30 minutes.

You may be suitable if you:

- ✓ are a dentists registered with Australian Health Practitioner Regulation Agency (AHPRA) and
- ✓ are in clinical practice.

To find out more, visit: https://redcap.sydney.edu.au/surveys/?s=9CKNPH3RF4LTY3J8

Or Scan:

Participant Information Statement

Understanding dentists' views and experience managing the oral health of patients with cancers.

Associate Professor Joanne Shaw (Responsible researcher)
School of Psychology, Faculty of Science
Phone: +61 2 9351 3761 | Email: joanne.shaw@sydney.edu.au
Dr Sheau Ling Low (MPhil student) | Email: sheauling.low@sydney.edu.au

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1. What is this study about?

We are conducting a research study to help understand dentists' views and experience managing the oral health of patients diagnosed with cancers. This project will help understand the nature of dental care provision for patients with cancers. Taking part in this study is voluntary.

Please read this sheet carefully and ask questions about anything that you do not understand or want to know more about. If you would like to keep a copy of this Participant Information Statement, you may bookmark or print this page.

2. Who is running the study?

The study is being carried out by the following researchers:

- Associate Professor Joanne Shaw, School of Psychology, Faculty of Science. Chair of Psycho-Oncology Co-operative Research Group (PoCoG).
- Associate Professor Alexander Holden, *Head of Specialist Services Sydney Dental Hospital and Oral Health Services. Senior Clinical Specialist in Public Health Dentistry (Community Dentistry).*
- Dr Sheau Ling Low, MPhil student at The University of Sydney. Sheau Ling is conducting this study to fulfill her requirement for the degree of MPhil.

3. Who can take part in the study?

We are seeking dentists currently in clinical practice registered with Australian Health Practitioner Regulation Agency (AHPRA) to participate. Dental students, non-practicing or retired dentists, and dentists working solely in academia are excluded.

4. What will the study involve?

This study comprises of an online survey and an optional interview.

If you decide to take part in this study, you will be asked to make every attempt to answer all the questions in this survey. This study will take approximately 10 minutes to complete and the closing date for this study is 30th November 2023.

If you are also interested in taking part in the interview, we ask that you leave your contact details in the consent form for a researcher to contact you. You may complete the survey without participating in the interview. The telephone interview will be conducted at a time that is suitable to you. The interview is expected to take approximately 30 minutes. The interview will be audio-recorded so that the responses can be transcribed accurately. If you do not want your voice to be recorded, then please do not agree to participate in this part of the study.

5. Can I withdraw once I've started?

Participation in this study is completely voluntary. By submitting your survey, you indicate consent to participate. You may withdraw from the study at any point before submitting your responses. However, once your survey is submitted, it cannot be withdrawn due to the anonymous nature of the online survey. We will not be able to distinguish your specific responses from others.

You may indicate if you want to participate in the telephone interview on the consent form. If you choose to take part in an interview, you may refuse to answer any questions that you do not wish to answer. If you decide to withdraw from the interview, we will not collect any more information from you. However, if you decide to withdraw once the interview has already commenced, any responses up to that time may be included as part of the study.

6. Are there any risks or costs?

Aside from giving up your time, we do not expect that there will be any risks or costs associated with taking part in this study.

7. Are there any benefits?

You will not receive any direct benefits from participating in the study.

8. What will happen to information that is collected?

By providing your consent, you are agreeing to us collecting information about you for the purpose of this study.

Information collected from the online survey will be anonymous. However, if you consent to be interviewed, data will be re-identifiable. The re-identification is necessary as researchers may need to follow-up with the participants to clarify any unresolved data. Your audio-recording will be transcribed using a secure online audio transcription service called TRINT (https://trint.com/team). TRINT is a secure platform with a standard confidentiality agreement in place with the University of Sydney. It will, at licensee's request, permanently delete all files so access to recordings and transcripts after completion of the project will be minimised; these data will be cross-checked and analysed by a member of the research team. While the transcription is occurring and being checked, the data will be stored in the USA.

Any information you provide us will be stored securely and we will only disclose identifiable information with your permission, unless we are required by law to release information. We are planning for the study findings to be published and presented. You will not be individually identifiable in these publications or presentations.

All data will be stored at The University of Sydney storage platform which is username and password protected. Only researchers involved in the study will have access to the data. After the study is completed, the information will be archived for a 5-year period. After this period, the data will be deleted.

9. Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. Since the data will be anonymous or de-identified, it will not be possible to provide individual feedback, instead it will be in the form of a brief lay summary. If you are interested in receiving the results of this study, please leave your email address. You will receive this feedback when the study is completed.

10. What if I would like further information?

If you have further questions and wish to discuss it further, please contact Sheau Ling Low at sheauling.low@sydney.edu.au or Associate Professor Joanne Shaw at joanne.shaw@sydney.edu.au.

11. What if I have a complaint or any concerns?

The ethical aspects of this study have been approved by the Human Research Ethics Committee (HREC) of The University of Sydney [2023/498] according to the *National Statement on Ethical Conduct in Human Research (2007)*.

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the University:

Human Ethics Manager
human.ethics@sydney.edu.au
+61 2 8627 8176

Participant Consent Form

Understanding dentists' views and experience managing the oral health of patients with cancers.

Associate Professor Joanne Shaw (chief investigator)
School of Psychology, Faculty of Science
Phone: +61 2 9351 3761 | Email: joanne.shaw@sydney.edu.au
Dr Sheau Ling Low (MPhil student) | Email: sheauling.low@sydney.edu.au

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I agree to take part in this research study. In giving my consent, I confirm that that:

- The details of my involvement have been explained to me, and I have been provided with a written Participant Information Statement to keep.
- I understand the purpose of the study is to understand the nature of dental healthcare delivery for patients diagnosed with cancers.
- I acknowledge that the risks and benefits of participating in this study have been explained to me to my satisfaction.
- I understand that in this study I will be required to make every attempt to answer all the questions in the online survey to the best of my knowledge and can choose to participate in the interview.
- I understand the interview will be audio-recorded.
- I understand that being in this study is completely voluntary.
- I understand that I am free to withdraw from this study at any time and that I can choose to withdraw any information I have already provided (unless the data has already been de-identified or published).
- I have been informed that the confidentiality of the information I provide will be protected and will only be used for purposes that I have agreed to. I understand that information identifying me will only be told to others with my permission, except as required by law.
- I understand that the results of this study may be published, and that publications will not contain my name or any identifiable information about me.

I have read the Participant Information Sheet and give my consent to participate in the **online survey**:

☐ Yes

☐ No

Additionally, I would like to participate in the **interview**.

I consent to being contacted to schedule an interview Yes ☐ No ☐

I consent to audio-recording during the interview Yes ☐ No ☐

My contact details are:

Preferred name: _____

Best time to contact me: _____

Phone number: _____

Email: _____

Would you like feedback on the overall results of this study? Yes ☐ No ☐

(If yes, please provide your email address)

_____

Survey Questions

Are you a dentist currently registered with Australian Health Practitioner Regulation Agency (AHPRA)?

☐ Yes

1. Are you in clinical practice?

☐ Yes → please proceed.
☐ No → thank you, no further questions.

☐ No → thank you, no further questions.

I have read the Participant Information Sheet and give my consent to participate in the online survey.

Q1) What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer not to say

Q2) What is your age? _____ years

Q3) Which year did you obtain your dental degree? _____

Q4) Do you have a dental specialist degree?

- ☐ Yes
  - ☐ Dento-maxillofacial radiology
  - ☐ Endodontic
  - ☐ Forensic odontology
  - ☐ Oral medicine
  - ☐ Oral pathology
  - ☐ Oral surgeon
  - ☐ Oral maxillofacial surgeon
  - ☐ Orthodontic
  - ☐ Paediatric dentistry
  - ☐ Periodontic
  - ☐ Prosthodontic
  - ☐ Public health dentistry
  - ☐ Specialist in special needs dentistry
  - ☐ Other. Please specify?____
    - Which year did you graduate? ____
- ☐ No

Q5) Do you have any other Bachelor or higher degree qualifications?

- ☐ Yes
  - ☐ Please specify _____
- ☐ No

Q6) What is your primary location of practice?

- ☐ Remote/ rural. Postcode ___
- ☐ Metropolitan. Postcode ____
- ☐ Regional. Postcode _____

Q7) What is your <u>primary</u> type of practice?

- ☐ Government (for example defence, public hospital or community clinic)
- ☐ Private

Q8) In the last 12 months, approximately how many patients undergoing cancer therapy (eg radiation, chemotherapy and targeted therapy) have you treated in your clinical practice? This encompasses patients who are about to start cancer therapy and patients already receiving cancer therapy.

- ☐ None
- ☐ 1-5
- ☐ 6-10
- ☐ 11-20
- ☐ >20
- ☐ Unknown

Q 9) Have you completed any continuing education on cancer in the last 12 months?

- ☐ Yes.

  Which methods of continuing education did you participate in?

  - ☐ In-person courses
  - ☐ Online
  - ☐ Journals
  - ☐ Other

    Please specify _____

- ☐ No

Q 10) A patient is about to start cancer therapy and attends for an oral health (dental and periodontal) pre-screening. What resources would you refer to?

- ☐ Guidelines
  - ☐ Please specify _____
- ☐ Colleague with expertise in the area
  - ☐ Please specify _____
- ☐ Other
  - ☐ Please specify _____
- ☐ Unsure

Q 11) I am comfortable advising of the potential impact cancer therapy may or may not have on my patients' oral health if my patients tell me they have been diagnosed with cancer.

strongly disagree	disagree	neutral	agree	strongly agree
○	○	○	○	○

Q 12) I feel confident communicating with the medical oncology team to discuss the overall management plan for my patients if my patients tell me they have been diagnosed with cancer.

strongly disagree	disagree	neutral	agree	strongly agree
○	○	○	○	○

Q 13) Which cancer therap(ies) can cause oral side effects? Please tick the appropriate box(es).

- ☐ Chemotherapy
- ☐ Haematopoietic stem cell transplant
- ☐ Hormone therapy
- ☐ Immunomodulatory therapy
- ☐ Radiation therapy (head and neck)

- ☐ Radiation therapy (non-head and neck)
- ☐ Targeted therapy
- ☐ Unsure

Q 14) Which of the following are potential short or long-term oral side effects from cancer therapies? Tick all that apply.

- ☐ Candidiasis
- ☐ Dysgeusia (altered taste)
- ☐ Dysphagia (difficulty swallowing)
- ☐ Gingival hyperplasia
- ☐ Hyperpigmentation
- ☐ Mucositis
- ☐ Neuropathy
- ☐ Osteonecrosis
- ☐ Salivary dysfunction
- ☐ Trismus

Q 15) Which of the following are potential short and long-term oral side effects experienced by patients undergoing radiation therapy to the head and neck region (>60Gy radiation)? Tick all that apply.

- ☐ Candidiasis
- ☐ Dysgeusia (altered taste)
- ☐ Dysphagia (difficulty swallowing)
- ☐ Gingival hyperplasia
- ☐ Hyperpigmentation
- ☐ Mucositis
- ☐ Neuropathy
- ☐ Osteonecrosis

☐ Salivary dysfunction

☐ Trismus

Q 16) I usually recommend the following regimen when I see a patient experiencing dry mouth as a result of cancer therapy. (free text):

_____

_____

Q 17) Patients diagnosed with cancer other than head and neck cancer do not benefit from a pre-therapy dental screening prior to commencing cancer therapy.

☐ True

- ☐ Please specify _____

☐ False

- ☐ Please specify _____

☐ Unsure

Q 18) Patients who have recently completed chemotherapy usually experience prolonged oral side effects due to therapy.

☐ True

☐ False

☐ Unsure

Q 19) In my opinion, the oral health of patients undergoing cancer therapy should be managed by (you may tick more than one box):

☐ General dentists in private practices

☐ Dental specialists in private practices

☐ Government funded general dentists in community clinics

☐ Hospital-based general dentists

☐ Hospital-based dental specialists

☐ Cancer centres

☐ Other. Please specify _____

Q 20) Select how much you agree or disagree with the following sentences:

I feel confident discussing the potential oral adverse effects of radiation therapy to the head-and-neck regions with patients.

strongly disagree disagree neutral agree strongly agree

○ ○ ○ ○ ○

I feel confident discussing the potential oral adverse effects chemotherapy with patients.

strongly disagree disagree neutral agree strongly agree

○ ○ ○ ○ ○

I feel confident managing dental caries in patients undergoing cancer therapy.

strongly disagree disagree neutral agree strongly agree

○ ○ ○ ○ ○

I feel confident managing periodontal issues in patients undergoing cancer therapy.

strongly disagree disagree neutral agree strongly agree

○ ○ ○ ○ ○

I feel confident giving advice to patients with mucositis (inflammation and ulceration of oral mucosa) from cancer therapy.

strongly disagree disagree neutral agree strongly agree

○ ○ ○ ○ ○

I feel confident giving advice to patients with dry mouth from cancer therapy.

strongly disagree disagree neutral agree strongly agree

○ ○ ○ ○ ○

Q 21) For non-head-and neck cancer patients, would you provide the following dental treatment for patients who are going through cancer therapy?

Endodontic therapy

never rarely sometimes often always

○ ○ ○ ○ ○

Extraction

never rarely sometimes often always

○ ○ ○ ○ ○

Fixed prosthodontic treatment (for example crown, bridge and implant)

never rarely sometimes often always

○ ○ ○ ○ ○

Periodontal treatment

never rarely sometimes often always

○ ○ ○ ○ ○

Restorative treatment

never rarely sometimes often always

○ ○ ○ ○ ○

Removal prosthodontic treatment (for example denture)

never rarely sometimes often always

○ ○ ○ ○ ○

Q 22) For head-and-neck cancer patients, would you provide the following dental treatment for patients who are going through cancer therapy?

Endodontic therapy

never rarely sometimes often always

○ ○ ○ ○ ○

Extraction

never rarely sometimes often always

○ ○ ○ ○ ○

Fixed prosthodontic treatment (for example crown, bridge and implant)

never rarely sometimes often always

○ ○ ○ ○ ○

Periodontal treatment

never rarely sometimes often always

○ ○ ○ ○ ○

Restorative treatment

never rarely sometimes often always

○ ○ ○ ○ ○

Removal prosthodontic treatment (for example denture)

never rarely sometimes often always

○ ○ ○ ○ ○

Q 23) What challenges do you perceive dentists face in providing dental care to patients undergoing cancer therapies? This may include patient factors, professional factors or clinical practice factors.

_____

_____

_____

Q 24) What would make it easier for dentists to provide dental care to patients undergoing cancer therapies? This may include patient factors, professional factors or clinical practice factors.

_____

_____

Q 25) Do you think having dental resources on cancer therapy would be beneficial in your clinical practice?

- ☐ Yes
  - ☐ Please specify the type of resources _____
- ☐ No

Thank you for completing the survey.

Interview Schedule

Hi. Can I speak to ____ (*name)*?

(If available) Hi, my name is Sheau Ling. I am a masters student at The University of Sydney in the School of Psychology, conducting a research to explore dentists' views and clinical experiences treating the oral health concerns of cancer patients. Would this be a good time to ask you a few questions?

(If the participant does not agree to continue at this time) Is there a more convenient time for me to call you back?

(If the participant agrees) If you recall, a while ago, you filled out an online survey related to your perceptions and experiences providing oral healthcare to cancer patients. The purpose of today's interview is to gain a better understanding of the factors that may influence dentists' views and experience managing the oral health of patients with cancers. This interview will take approximately 30mins.

Before we begin, I need to let you know that anything we discuss today is confidential. You can choose not to answer any questions, or you can withdraw from the interview at any point.

Are you happy for me to record today's interview to help me accurately recall the interview content?

Do you have any questions about the study before we proceed?

(No: proceed with the interview)

(Yes: answer participant's questions)

Can you tell me a little about your experience providing oral care to patients with cancers?

Prompts:

> *What types of cancers have you encountered in your patients (e.g. head and neck, other cancer)?*
>
> *What types of cancer therapies have you encountered when treating patients with cancers (e.g. radiation, chemotherapy, targeted therapy, immuno-suppressant therapy)?*

Do you perceive that dentists working in the community have a role providing oral care for patients undergoing cancer therapies?

Prompts: *If so, what do you see their role as*

If not, why not

Are there any factors that influence your willingness to provide oral care to cancer patients?

If one of your regular patients told you they were about to start cancer therapy (radiation or chemotherapy). How do you go about managing these patients dentally?

Prompts: *What about for non head and neck cancers?*

Tell me about your pre-cancer therapy dental involvement before they started cancer therapy?

How much involvement did you have when the patient was going through cancer therapy? What advice did you give? What dental procedures did you provide for the patients?

What is your involvement after the patient finished with cancer therapy?

In your experience, what are some of the challenges dentists working in the community face providing oral care in patients undergoing cancer therapy?

Prompts: *Professional factors: lack of training, lack of clinical importance, lack of time, lack of financial incentives, lack of guidelines.*

Organizational factors: lack of communication with the oncology team, third party insurance limiting oral care for patients with cancers, workplace set-up.

What are some of the factors you think might stop the patients with cancers from seeing a dentist to manage their oral health?

Prompts: *Patients' factors: lack of patient's education about the potential adverse effects of cancer therapies on oral health, patient's financial obstacle insurance.*

Are there factors that you perceive would make it easier to provide dental care to patients undergoing cancer therapy?

Prompts: *Professional factors: continuing education, cancer training in undergraduate program, dentist's willingness to see patients with cancers.*

Patient's factors: patient education booklet informing them of potential oral adverse effect with cancer therapies.

Organisational factors: structure of working environment, referral from the oncologist/ oncology team.)

(Prompt: contact colleagues/ specialists, therapeutic guidelines, search reliable sources eg ADA, Medline, international guidelines)

Do you perceive you currently have sufficient knowledge to feel comfortable providing oral care to cancer patients?

If you were asked to do so, and needed more information, are there any resources you would use (or know of) that can help dentists deliver better oral care to these patients?

Prompts: *Are these resources sufficient or is there a need for more information?*

This brings me to the end of our interview. Is there anything that is important we haven't discussed or you would like to clarify? Do you have any questions you would like to ask me? Thank you for your time today, if you are interested, at the end of the study I can send you the results of the study.

Appendix D: Supplementary Files from Study Two (Mixed-Methods Study)

Supplementary File 4.1: Consolidated Criteria for Reporting Qualitative Studies (COREQ): 32-item Checklist

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal Characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	SL
Credentials	2	What were the researcher's credentials? E.g., PhD, MD	MPhil student
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	Female
Experience and training	5	What experience or training did the researcher have?	N/A
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	N/A
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g., personal goals, reasons for doing the research	2 (in participant information sheet approved by HREC 2023/498)
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? e.g., Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientationand Theory	9	What methodological orientation was stated to underpin the study? e.g.,grounded theory, discourse analysis, ethnography, phenomenology, content analysis	2
Participant selection			
Sampling	10	How were participants selected? e.g., purposive, convenience, consecutive, snowball	3
Method of approach	11	How were participants approached? e.g., face-to-face, telephone, mail, email	3
Sample size	12	How many participants were in the study?	4
Non-participation	13	How many people refused to participate or dropped out? Reasons?	N/A
Setting			
Setting of data collection	14	Where was the data collected? e.g., home, clinic, workplace	N/A
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	N/A
Description of sample	16	What are the important characteristics of the sample? e.g., demographic data, date	4
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	N/A
Repeat interviews	18	Were repeat interviews carried out? If yes, how many?	N/A

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	3
Field notes	20	Were field notes made during and/or after the interview or focus group?	N/A
Duration	21	What was the duration of the interviews or focus group?	N/A
Data saturation	22	Was data saturation discussed?	3
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	3
Description of the coding tree	25	Did the authors provide a description of the coding tree?	N/A
Derivation of themes	26	Were themes identified in advance or derived from the data?	6
Software	27	What software, if applicable, was used to manage the data?	N/A
Participant checking	28	Did participants provide feedback on the findings?	N/A
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g., participant number	6-10
Data and findings consistent	30	Was there consistency between the data presented and the findings?	6-10
Clarity of major themes	31	Were major themes clearly presented in the findings?	10
Clarity of minor themes	32	Is there a description of diverse cases or a discussion of minor themes?	6-10

Supplementary File 4.2: STROBE Statement—Checklist of Items that Should Be Included in Reports of *Cross-sectional Studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	2-3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	3
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	3
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	NA
		(*b*) Describe any methods used to examine subgroups and interactions	3
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	4 & Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 2 & Supplementary file 3
Outcome data	15*	Report numbers of outcome events or summary measures	4-5
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	6 & Supplementary file 4
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary File 4.3: Interview Participants' Characteristics

Characteristics (n=28)		**Participants n (%) or mean+/- SD**
Gender	Male	14 (55%)
	Female	14 (55%)
Age		47.6 ± 13.3 years
Years since graduation from bachelor degree		22.8 ± 14.9 years
Specialist degree	Yes	6 (21.4%)
	No	22 (78.6%)
Years since graduation from specialist degree (n=6)		20.0 ± 14.4 years
Location of practice	Metropolitan	20 (71.4%)
	Regional/ rural	8 (28.6%)
State	NSW	13 (46.4%)
	Victoria	8 (28.6%)
	Queensland	4 (14.3%)
	South Australia	1 (3.6%)
	Western Australia	1 (3.6%)
	Tasmania	1 (3.6%)
	Northern Territory	0
Primary type of practice	Private	19 (67.9%)
	Public	9 (32.1%)
Number of patients seen	10 or less	19 (67.9%)
	>10	9 (32.1%)

Supplementary File 4.4: Knowledge and Confidence Score Ranking

Table 4.4a: Cancer knowledge score

Question	Mean (SD)
Cancer therapy having oral side effects*	3.47 (1.17)
Oral side effects of cancer therapy**	6.73 (1.68)
Oral side effects of radiation therapy***	5.47 (1.79)
Management of dry mouth**	4.17 (2.16)
Pre-dental screening prior to cancer therapy****	0.89 (0.32)
Chemotherapy having long term oral side effects****	0.11 (0.32)

Maximum scores: *5; **8; ***7; ****1

Knowledge ranking (score)	N (%)
Low (0-14)	12 (13.6%)
Medium (15-22)	32 (36.4%)
High (23-30)	44 (50%)

Table 4.4b: Confidence score

Question (n)	Mean (SD)
Oral adverse effects in H&N radiation (n=88)	3.92 (0.85)
Oral adverse effects in chemotherapy (n=87)	3.67 (0.91)
Managing caries (n=88)	3.77 (0.91)
Managing periodontal issues (n=88)	3.58 (0.91)
Managing mucositis (n=86)	3.47 (1.00)
Managing dry mouth (n=88)	3.84 (0.80)
Advice on oral health (n=88)	3.73 (0.96)
Communicating with medical oncology team (n=87)	3.63 (1.12)

NB: Maximum score 5

Confidence ranking (score)	N (%)
Low (0-19)	6 (6.8%)
Medium (20-29)	36 (40.9%)
High (30-40)	46 (52.3%)

Supplementary File 4.5: Multivariate Analysis

Supplementary Table 4.5a: Knowledge regression analysis

Independent variable tested	Beta coefficient	t-stat	Probability
Recent continuing education	0.263*	2.485*	0.015*
Type of practice (private vs public)	0.176	1.497	0.138
Number of patients seen	0.132	1.195	0.236
Specialist dental degree	0.71	0.664	0.508
Other health qualifications	-0.065	-0.601	0.549
NB: dependent variable is knowledge			

The model R^2 is 0.069 and F-stat is 6.176

Supplementary Table 4.5b: Confidence regression analysis

Independent variable tested	Beta coefficient	t-stat	Probability
Number of cancer patients seen	0.351*	3.413*	<0.001*
Recent continuing education	0.204	1.926	0.058
Specialist dental degree	-0.083	-0.802	0.425
Other health qualifications	0.033	0.312	0.756
Type of practice (private vs public)	0.023	0.217	0.829
NB: dependent variable is knowledge			

The model R^2 is 0.123 and F is 11.652

Supplementary File 4.6: Perceived Role of Dentists in Cancer Management

Description	Participant n (%)
General dentists in private practices	68 (77.3%)
Specialist dentists in private practices	49 (55.7%)
Government funded general dentists in community clinics	52 (59.1%)
Hospital-based general dentists	72 (81.8%)
Hospital-based specialist dentists	52 (59.1%)
Cancer centres	61 (69.3%)

(n=88) *NB: can choose >1 response*

Supplementary File 4.7: Quote Bank

Theme 1: Dentists' scope of practice	
Sub-themes	**Illustrative Quotes**
Duty of care	#53 "Dentistry is a big scope as you probably found yourself. Some things interest you more than others… But, you are going to get some elderly patients and you are going to get some with immune compromised and people are living longer, and some of these things are sort of being seen as more difficult cases and have to be referred to a special needs dentist. I think all of us should be really looking after those patients a bit more in general practice."
	#45 "I think it's also imperative for general dentists to keep up to date with cancer treatment and just the effects of cancer on our oral health and the importance of maintaining optimal oral health to be able to provide up to date treatments and the best treatments we can for our patients, especially preventative options. I think that's incredibly important."
	#42 "I do refer them to a specialist… I mean you can do all the prevention stuff, fluoride and that sort of thing, but if their teeth keep breaking off because of caries around the root surface, they really can't do much except to have them out. That's a lot for a person [dentist] to take on, this sort of post radiation."
	#83 'I had a chat with oncologist and I said, look, it sounds like there was some type of neuropathic pain triggers by trying to eat, and that it's not something that I can treat. But I do know there's the pain clinic in [Name of hospital] that may be able to help.'
	#47 "If I feel like I'm not confident in getting this information reliably or I am not understanding it, or I don't have the time to work it out that I might seek to refer them."
	#77 'If we're looking at at-risk people, the idea of having to do everything through private practices where we're not necessarily equipped to do things well and as well as people who do this all day every day, and more familiar with it, arguably there could be better treatment outcomes for people.'
	#124 'I've been a dentist for (number) years, so I've got a lot of general dental skills. I've worked in the public sector for many years. But, still, there was a steep learning curve when I moved to [Name of Cancer Centre]. So, I've learned a lot just from having very experienced clinicians around me, and people that I can refer to for a second opinion.'
	#47 "I think probably dentists don't get enough information during their training… We get a lot of information about pathology and the various types of cancers, and the treatment that is provided by the maxfac [maxillofacial] or reconstructive or oncologists, and it's very theoretical. It's not actually, well, okay, after all of that stuff are done,

	because obviously the general dentist aren't involved in that, after all, what challenges or difficulties, or potential problems are there in providing regular everyday dental care in patients either undergoing treatment or after their treatment.”
	#96 “I wish there was more, you know, lectures and training. Like conferences or even conferences if it was covered better. They mostly cover, I think conferences I feel, how to pick up on the precancerous lesions and when to biopsy, when to refer, but not much about the management of cancer patients in detail. Like a bit of a neglected subject.”
Theme 2: Dentists’ clinical practice interests	
Sub-themes	**Illustrative Quotes**
Complexity of cancer care	#96 ‘I think the procedure itself is quite similar for all patients, but treatment planning is sometimes different... whether they received radiotherapy to that high radiation with that area, I'll be treatment planning different to someone who hasn't received radiation.’
	# 91 ‘Certainly there's extra consideration that you take into account. Are they immuno-compromised? Can they cope with the treatment? I think you have to be a little bit more careful when treating cancer patients.’
	#85 “Communication is challenging not just for cancer specialists, but for generalists and everybody because everyone is so busy treating patients and dealing with clinical workloads. Communication tends to be something that gets sandwich in between patients or done when we've got a spare minute or somewhat of an afterthought, which it shouldn't be. But there's only so many hours in a day. If you've got to write letters or make phone calls or whatever that you have to do it in non-clinical time, in your lunch break or if there's a break between patients or something like that. So, that's definitely a challenge.”
	#34 ‘I was always interested in medicine, and I liked the idea of getting more involved in the medical side of, still being a dentist with the patients, but looking at the medical side of things as well. I thought it would be a very rewarding part of dentistry to work with cancer patients. So, I was asked if I would like to be the understudy of the dentist who was the cancer care dentist before me. And it was at a time when I was a little bit bored with general dentistry and looking for something different. I was approached as to whether that would be something that would interest me. And it was.’
	#96 “If there were more courses on cancer that would be really good. But I feel like it's a minority of things, and I don't know how much people are interested in those courses. I don't know how successful, whereas if you go implants, everyone signs up.”
Feasibility within the business model	#57 ‘Dentists they focus more financially focus on more cosmetic dentistry rather than the health of the patients.’
	#73 ‘They said I'm not very keen on doing that part of the specialise area. They would rather focus on Invisalign, crowns and bridges, which is more financially beneficial for them... I've paid off my debts, so it's a little bit different for me.’
Theme 3: Structure of cancer care provision	
Sub-themes	**Illustrative Quotes**

	#75 ‘There's a general fragmentation of care, which is something that is very normal to dentistry. But obviously for patients with complex medical conditions can really have a big hit.’
	#24 ‘We couldn't do anything, even though by doing something would improve the prognosis. But I couldn't because it had to be approved by the oncologist so the difficult thing I found was communicating with them because they weren't available. So even though they were available 24 hours, they weren't available 24 hours. So, for the (tooth) avulsion case, the tooth couldn't be replanted until we got the approval. So, by the time we got the approval, the tooth had a really hopeless prognosis.’
	#77 ‘Good communication from doctors and that sort of stuff to let us know what's going on and what to expect if there's some written information as to where they're going, what they're doing, what sort of the treatment plan it is or anything that they think we need to be aware of, it certainly makes life easier.’
	#45 ‘Clinical summation records compiled on all patients with treatment options, modalities, what's chosen and just that being provided to the general [dental] practitioner would be much helpful. Instead of the dentist having to ring around and try to find out who's the person to talk… and the patients not really knowing the exact answers to the questions we're looking for.’
Theme 4: Perceived patient-related factors	
Themes	**Illustrative Quotes**
Awareness	#84 ‘They just overlook it and ignore it because they are not aware of the (impact) for them to pursue their dental work.’
	#97 ‘General fear of dentists that people have. If a patient is afraid to see dentist, whether they've got cancer or not, that's a different issue. So, having the cancer doesn't increase their fear of going to the dentist. If I had that fear initially, it'll just remain the same.’
	#88 ‘The other challenge is getting the patients who care about their oral health when they may have not in the past. All of a sudden, we're saying it's important, you need to do ABC, and they've never done that. They've never done that in their whole life. Often, it's challenging to get a patient to make that change. Oral hygiene, diet, smoking even.’
Priority	#63 ‘depending on the type of cancer and the prognosis that you're given, dental factors might fall down the list of your priorities If you've been given two years to live or three years to live or whatever it might be. So I think for a lot of people the dentistry would fall down the list of priorities. So they would think, well, I am not interested in having dental work done because I've got bigger fish to fry.’
	#91 ‘I think sometimes they have got too much on their plate and they can't cope with other issues.’
	#88 ‘I guess they're just still dealing with the diagnosis, let alone having to do all the things that they have to do to get ready to start radiotherapy. So, a lot of them don't even think of dental, especially if they need like extensive dental treatment, they kind of just think, oh my gosh, I just can't do it. So, you see, a lot of patients were overwhelmed with just what they have to do before even starting.’

	#83 ‘They're overloaded with the number of appointments. So, between the oncologist, the GP, they have to see the speech pathologist, and there's the dietician and there's the mask fitting and then there's the peg or the ring or whatever. So, I think our cancer patients have been overloaded with a number of appointments and I could see why teeth possibly can be the last thing that they worry about, even though the oncologist emphasise the importance of them.’
	#53 “I get some of, a lot of my patients are now on chemo or on immunotherapy or whatever because of their age and their history and a lot of them now, they're not eligible for public dental services, so they need to be treated in the private sector.”
	#124 “A lot of this is ongoing. Like they might have to self-fund for some particular therapies. They might draw on their superannuation for some things. Who knows, and then you have other patients who have been told that they've got six months to live and they go and sort out all their financial affairs and go on a big holiday and spend up, and then suddenly there's a new therapy and they're still alive five years later. So, it's a really evolving landscape with cancer treatment.”