



Addressing Patterns of Care and Unwarranted Variations in Head and Neck Cancer: A Rapid Review of the Current Evidence

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The Victorian Integrated Cancer Services (VICS) are Victoria's cancer services improvement network. They build relationships between healthcare providers and other cancer care stakeholders to develop, implement and evaluate initiatives that improve the way our member health services provide care and support people affected by cancer.

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Abbreviations

Abbreviation	Definition
COVID-19	Novel coronavirus, 2019 pandemic
CSS	Cancer-specific survival
DARS	Dysphagia and aspiration-related structures
DOI	Death of invasion
ENT	Ear, nose, throat
GP	General practitioner
HCP	Healthcare practitioner
HN-AS	Head and neck angiosarcoma
HNC	Head and neck cancer
HNL	Head and neck lymphoedema
HNSCC	Head and neck squamous cell carcinoma
HPV	Human papillomavirus
MDT	Multidisciplinary team
NEMICS	North Eastern Melbourne Integrated Cancer Service
OCP	Optimal Care Pathways
OPSCC	Oropharyngeal squamous cell carcinoma
OSCC	Oral squamous cell carcinoma
OTSCC	Oral tongue squamous cell carcinoma
PET	Positron emission tomography
PNI	Perineural invasion
PORT	Post-operative radiation therapy
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROM	Patient reported outcome measure
QI	Quality indicator
RT	Radiation therapy
SPM	Second primary malignancy
WDTC	Well-differentiated thyroid cancer
VICS	Victorian Integrated Cancer Services

Executive summary

Background

Head and neck cancer (HNC) is the sixth most common cancer worldwide. In 2023, HNC was the seventh most commonly diagnosed cancer in Victoria and the fifteenth most common cause of cancer-related deaths in this cohort. HNC patients who have advanced stage disease, metastasis or recurrent cancer have poor prognosis. Epidemiological studies have established tobacco use and alcohol consumption as primary risk factors for many of the head and neck cancers. However, human papillomavirus infection has been strongly associated with oropharyngeal cancer.

Due to the array of vital functions in the head and neck, treatment choices for HNC are characterised by a delicate balance between optimal oncological and functional outcome. In Australia, studies have shown that inter-hospital inequalities in HNC survival may exist due to variation in radiotherapy treatment-related factors. Identifying and addressing unwarranted variation can help improve health outcomes, system efficiency, effectiveness, and quality.

Aim

To explore the known patterns of HNC care and what strategies have been used to determine and address unwarranted variations in HNC in Australia. Implications for addressing unwarranted variation in an Australian HNC care context were also investigated.

Methodology

The rapid literature search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Articles with the terms 'patterns of care' and 'unwarranted variation' in the context of HNC were searched using three databases: Medline, PubMed and EMBASE. The search was performed on 10 April 2025. The articles selected were original research articles in the English language, completed in Australia, reporting on patterns of care and unwarranted variation in adult HNC populations published from 2019 onwards. Non-empirical literature such as opinion pieces, descriptions of protocols for clinical trials, abstracts with no available full-text, case reports, conference abstracts, letters to journal editors and editorials were excluded. Reference searches of the primary articles were also conducted to retrieve additional articles.

Findings

The search yielded 293 studies, of which 136 were screened in full. A total of 52 studies met the inclusion criteria, including three from the grey literature and four identified through hand searching. These studies were summarised in a table with the following details: first author, year, state/national focus, study design and duration, objectives, participant number (N), outcomes/results, and key findings. Just over half of the included studies (52%, n=27) were retrospective cohort analyses.

The majority of studies (40.4%, n=21) focused on patterns of care following initial treatment and into the recovery phase. Notably, none of the included studies examined end-of-life care for individuals diagnosed with HNC. Variations in care were frequently observed across patient demographic and clinical characteristics, geographic location, and hospital setting. No HNC-specific studies retrieved through this review utilised a formal framework to categorise unwarranted variation, despite the widespread citation of Wennberg's classification framework in the broader literature and its application in other cancer types,

such as colorectal cancer. While several studies employed statistical approaches to identify variation in care and offered suggestions for addressing these differences, most did not clearly define what constituted "unwarranted" variation. A lack of consensus on the parameters for identifying unwarranted variation limited the ability to distinguish between acceptable and unacceptable differences in care. Furthermore, there was limited evidence on the effectiveness of proposed strategies, with none of the studies definitively labelling observed variations as unwarranted.

Conclusion

This review highlights significant gaps in the Australian evidence base on unwarranted variation in HNC care. While numerous studies described patterns of care and reported variation by demographic, clinical, and geographic factors, few explicitly sought to define or categorise such variation as unwarranted. The absence of a consistent framework such as Wennberg's, limits the field's ability to distinguish between acceptable differences and those requiring intervention. Furthermore, no studies assessed end-of-life care or evaluated the effectiveness of proposed strategies to reduce variation. Addressing these evidence gaps is essential for informing equity-focused improvements in HNC care and for supporting the development of targeted, data-driven quality improvement initiatives within the Australian health system.

1. Introduction

Head and neck cancer (HNC), also an umbrella term for oral and oropharyngeal cancers, refers to the abnormal growth of cells that occur in the mouth, throat (pharynx and larynx), nasal or paranasal sinus, salivary glands, or skin of the head and neck (Figure 1) [1]. Collectively, these cancers represent the 7th most commonly occurring cancer globally.[2] Most oral and oropharyngeal cancers (approximately 90%) start in the mucosal lining of the mouth, nose or throat. These cancers are called mucosal squamous cell carcinomas. Some HNC arise in glandular cells, and many of these cancers are called adenocarcinomas.[3] Tobacco use and alcohol consumption have been long established as primary risk factors for many HNC. [4-6] More recently, human papillomavirus (HPV) infection, the same virus that causes cervical cancer, has been strongly associated with oropharyngeal cancer [7], while Epstein Barr virus (EBV) infection has been linked to nasopharyngeal cancer.[8]

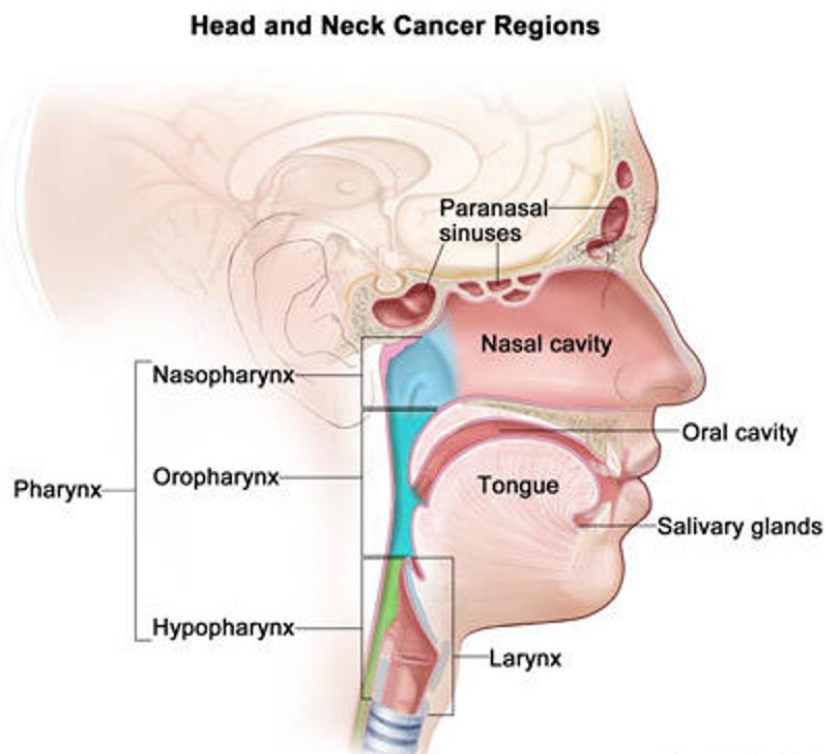


Figure 1. Head and neck cancer regions [9]

In 2023, 1221 Victorians were diagnosed with HNC and there were 319 deaths from this cancer [10] accounting for 2.3% of all cancer deaths in Victoria.[11] Of these there were 883 males and 343 females, representing 72% and 28% of the total Victorian HNC diagnoses, respectively. In 2023, HNC was diagnosed at a rate of 23 per 100,000 males and 8 per 100,000 females. In Victoria 1 in 51 males will be diagnosed with HNC before the age of 75 years compared to 1 in 160 females who will be diagnosed with HNC before the age of 75 years.[10] In 2023, the median age at diagnosis of HNC was 64 years in males and 67 in females. Accounting for 3.5% of all cancers diagnosed and 2.3% of all cancer-related deaths in 2023, HNC was the 7th most commonly diagnosed cancer and the 15th most common cause of cancer-related deaths in Victoria.[11] However, recent data shows that 5-year relative survival has improved between 2013-2017 and 2018-2022 from 73% (95% CI 71%-74%) to 75% (95% CI 73%-76%).[10]

Despite this progressive trend in survivorship, there are many survivors living with significant impacts on their lives brought about by strong treatment regimens as well as survivorship needs that are complex and under-recognised which if not addressed can negatively impact quality of life.[12] Furthermore, while the aged standardised incidence rate of HNC has stabilised in Victoria since 2008 [3] (associated globally with tobacco and alcohol consumption having considerably decreased) [13] there is variation between metropolitan and regional areas. During the period 2021-2023, regional Victorians had a significantly higher rate of diagnosis of head and neck tumours than Victorians residing in major cities (29 versus 21 cases per 100,000 males and 9 versus 8 cases per 100,000 females).[11] Furthermore, differences in age-standardised rates of HNC between males living in major cities and in regional areas of Victoria have persisted over the past six years (2018-2023).[11] Aboriginal and Torres Strait Islanders remain disproportionately affected by HNC having a 1.5 times higher incidence rate than their non-Indigenous counterparts (18.7/100 000 population verses 12.3/100 000 population).[14] Oral and oropharyngeal cancers disproportionately affect culturally diverse Victorians, with higher incidence rates observed in certain migrant groups compared to Australian-born individuals.[3]

Currently there are no effective population-based HNC screening tests or national screening programs for HNC. Detection primarily relies on timely symptom recognition by individuals and healthcare professionals, often through visual examination.[15] Targeted screening among high-risk populations, e.g. males, older adults, individuals with a history of tobacco or alcohol use, or a family history of cancer has been shown to be cost-effective. [15] Delays in diagnosis and treatment, especially among high-risk patients are presumed to negatively affect survival outcomes.[16] Contributing factors include both patient-related delays (e.g. failure to recognise symptoms as serious) and professional-related delays (e.g. waiting for additional imaging or diagnostic tests).[17] Timeliness of care is recognised as a fundamental component of quality cancer care for HNC.[18]

A recent Australian retrospective review reported that the absence of radiological or pathological investigations prior to referral, as well as early-stage disease, significantly influenced delays in management within HNC services.[19] Despite the evidence being equivocal regarding the broader impact of timeliness on prognosis and survival in HNC, longer wait times from diagnosis to the commencement of treatment have been demonstrated to have a negative impact on overall survival.[19]

In response to the growing cancer burden, the Australian government launched the Australian Cancer Plan in 2023.[20] The plan aims to improve cancer outcomes, particularly for key population groups, including Aboriginal and Torres Strait Islander people and those living in rural and remote areas.[20] The objectives of the Australian Cancer Plan also align with the current Victorian Cancer Plan, 2024-2028.[21] A central component of both the Australian Cancer Plan and the Victorian Cancer Plan is the implementation of the Optimal Care Pathways (OCPs).[22] The OCPs are frameworks for the delivery of consistent, safe, high-quality and evidence-based care for people with cancer, according to tumour type or population group, including HNC.[23] They cover every step of the cancer journey from prevention and early detection through to survivorship and end-of-life care.[22] The OCPs aim to address unwarranted variations in cancer care and for equitable care to be provided nationally.

Despite the adoption of the OCPs in policy, unwarranted variations in cancer care still exists.[23] There are multiple, diverse reasons behind variations in clinical practice, reflecting personal, organisational and systemic levels.[23] The reasons why gaps occur between evidence and practice are complex, and efforts to improve uptake are unlikely to be successful if they are one-dimensional or focus on individual health professionals.[23]

The Victorian Integrated Cancer Services (VICS) Optimal Care Summits program is a leading initiative of the VICS and is administered and managed by the North Eastern Melbourne Integrated Cancer Service (NEMICS). The purpose of the VICS Optimal Care Summits program is to identify unwarranted variations in tumour-specific or population-based cancer care and outcomes (including clinical practice variation) and to provide recommendations for the VICS to address at the state, network, and/or health service level. In 2025, the VICS Optimal Care Summits team will undertake a mixed-methods, state-wide consultation focused on HNC (Figure 2). Guided by an expert advisory group, the consultation will analyse administrative datasets, clinical audit data, and patient experience measures to identify evidence-informed priorities for reducing variation and improving outcomes across Victoria. To date, there has been no comprehensive synthesis of the evidence regarding patterns of care or the degree of unwarranted variation in HNC care in Australia or Victoria. For the purposes of this review, unwarranted variation is defined as the variation in the utilisation of health services that cannot be explained by differences in patient illness or preferences, that is a chance to improve the quality and equity of clinical care.[24] Decision-making and physician preferences are recognised factors in unwarranted variations in care and outcomes.

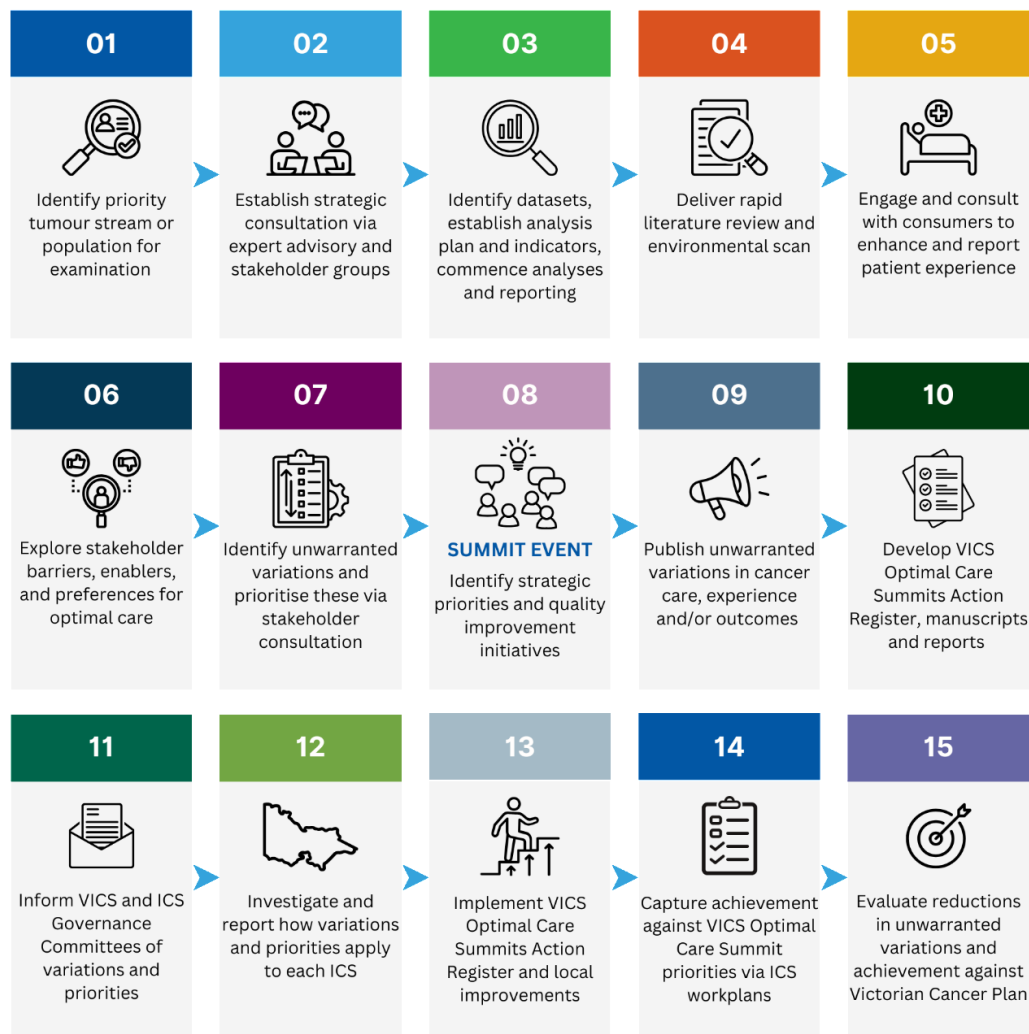


Figure 2. Steps undertaken pre and post of a VICS cancer summit event

2. Aim

The aim of this review is to inform the HNC strategic consultation by providing a synthesis of published evidence in relation to the following questions:

1. What are the known patterns of HNC care in Australia?
2. What approaches or strategies have been used to (a) identify/determine unwarranted variation, and/or (b) address unwarranted variation in HNC care in Australia?
3. What are the implications for addressing unwarranted variation in an Australian HNC care context?

3. Methods

A search of databases including PubMed, MEDLINE and Embase was conducted. The search was limited to contemporary literature (2019 onwards), published in English with a focus on any HNC specific care improvements occurring in Australia. Grey literature searches were conducted through targeted internet searches of state and federal government health websites, web search engines (Google), non-government cancer associations (e.g., state Cancer Council groups, Head and Neck Cancer Australia, Australian and New Zealand Head and Neck Cancer Society, Chris O'Brien Lifehouse, university research groups such as the University of Melbourne Head and Neck Tumour Stream Research Group, and manual hand searching of reference lists of included studies. The review was undertaken using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [25]. The search strategy is presented in Table 1.

2.1 Eligibility criteria

2.1.1 Inclusion criteria

- *Population*: adults (18 years and older) diagnosed with head and neck cancer.
- *Types of publication*: Publications in English language that report original primary empirical work published since 2019 (after the first summit) and are specific to Australian settings only.
- *Types of settings*: Public or private hospitals, general practice or other primary/community care facilities specific to Australian settings.
- *Types of study design*: Conceptual, theoretical, quantitative or qualitative studies of any research design.
- *Outcomes*: e.g., measures against the Optimal Care Pathway framework.
- Data regarding the identification and/or assessment of unwarranted variation in relation to any health care outcome specific to head and neck cancer.

2.1.2 Exclusion criteria

Non-empirical literature such as opinion pieces, narratives, systematic reviews, descriptions of protocols for clinical trials, abstracts with no available full-text, case reports, conference abstracts, studies conducted outside Australia or published in a language other than English, studies focusing on children ≤ 17 years, letters to journal editors and editorials.

2.2 Data extraction and synthesis

After the inclusion criteria was applied to titles and abstracts (including executive summaries of grey literature), full manuscripts were reviewed using Covidence, a systematic review workflow management system.[26] The following data were extracted:

first author, year, state/national, study design/duration, objective(s), participants (n), outcomes/results, and key findings.

Findings were analysed using a narrative empirical synthesis, conducted in stages based on the review questions. Initial descriptions and results of the eligible studies were summarised and presented (Table 2), structured according to the seven-steps of the OCP for HNC.[23] Patterns across the data were explored to identify consistent findings in relation to the study questions. Interrogation of the findings explored the influence on different outcome measures, methods, and settings on the resulting data.

3. Results

3.1 Results of the search

After removing duplications 293 studies were identified. Title and abstract screening resulted in 136 references that met the inclusion criteria and were assessed at full text level. A total of 52 publications were included in the review based on the inclusion and exclusion criteria. This included 45 studies identified from the database full text review, three studies retrieved from the grey literature and four further studies identified via head searching, as shown in Figure 3. A summary of the included studies is provided in Table 1. The studies were conducted across six Australian states: New South Wales ($n = 24$), Queensland ($n = 9$), Victoria ($n = 8$), Western Australia ($n = 5$), South Australia ($n = 2$) and Northern Territory ($n = 1$). Four studies were conducted at the national level.

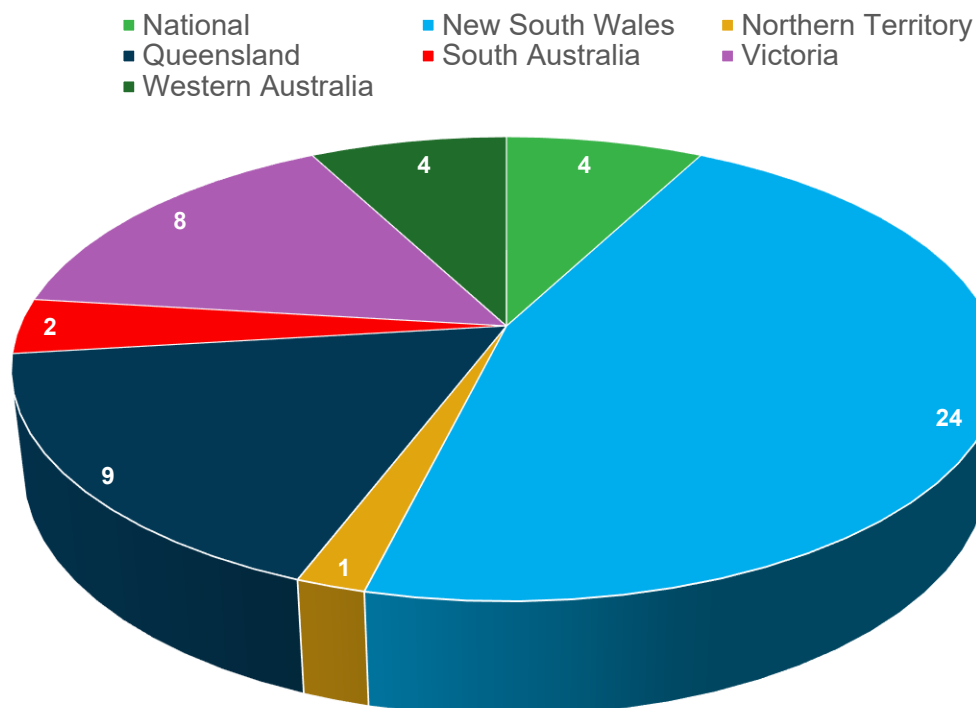


Figure 2. Number of studies either by Australian state or national that met the inclusion

Just under half of the included studies (40.4%, $n = 21$) focused on Step 5 of the Optimal Care Pathway (OCP): *Care after initial treatment and recovery*. This was followed by nine studies (17.3%) addressing Step 4: *Treatment*, seven (13.5%) examining Step 6: *Managing recurrent, residual or metastatic disease*, five (9.6%) on Step 3: *Diagnosis, staging and*

treatment planning, four (7.7%) on Step 2: *Presentation, initial investigations and referral*, and three (5.8%) on Step 1: *Prevention and early detection*. No studies were identified that focused on Step 7: *End-of-life care*.

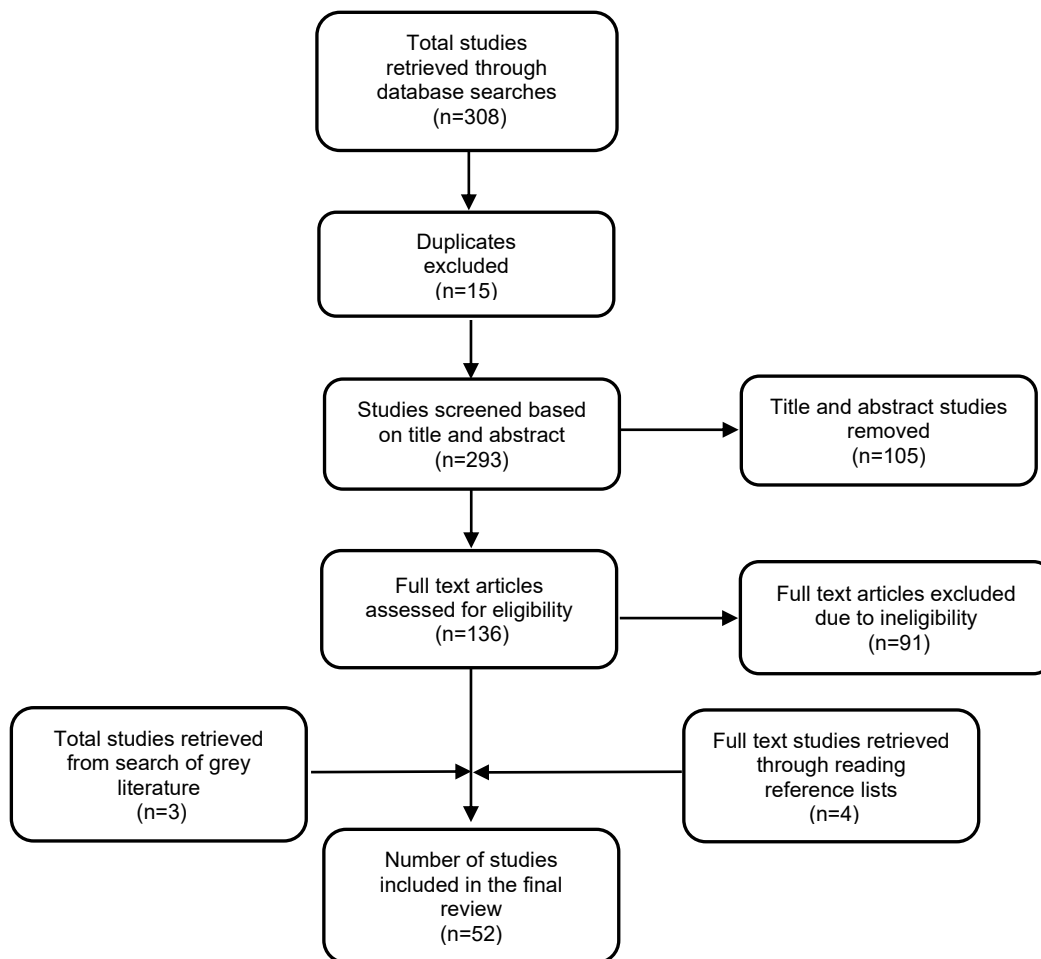


Figure 3. Flow diagram showing the selection process

3.2 Review findings

3.2.1 What are the known patterns of HNC care in Australia?

In Australia, HNC accounted for an estimated 3.2% of all new cancer cases and 2.5% of cancer-related deaths in 2022, with incidence continuing to rise due to population ageing and improvements in detection and treatment.[27] However, treatment outcomes are influenced by a range of sociodemographic and geographic factors, with marked disparities observed across population groups.

Aboriginal and Torres Strait Islander people bear a significantly greater burden of HNC compared to non-Indigenous Australians. A 2024 study by Khan et al. reported that Aboriginal and Torres Strait Islander people had more than twice the age-standardised incidence (29.8 vs 14.7 per 100,000) and over 3.5 times the mortality rate (14.2 vs 4.1 per 100,000). While mortality declined among non-Indigenous Australians between 1998 and 2015, the decline was not statistically significant among Aboriginal and Torres Strait Islander people. These disparities were consistent across all states and remoteness categories, with a national five-year survival rate 25% lower for Aboriginal and Torres Strait Islander patients.[14]

Geographic remoteness also plays a critical role in shaping outcomes. People living in rural and remote areas experience delays in diagnosis and treatment, reduced access to multidisciplinary team (MDT) care, and are more likely to be readmitted to a different facility than where primary treatment was delivered. Although one study found no significant difference in two-year survival despite these barriers, access inequities remain concerning.[28]

These disparities are particularly pronounced in the Northern Territory, where Aboriginal and Torres Strait Islander people comprise 28% of the population, with the majority living in remote areas. A ten-year analysis of HNC in the NT revealed significantly lower five-year survival rates than the national average, especially among Aboriginal and Torres Strait Islander people and remote residents. Most Aboriginal and Torres Strait Islander patients (72%) were diagnosed at an advanced stage (III or IV), with two-thirds offered palliative care at diagnosis, highlighting the urgent need for targeted strategies to improve early detection, access to care, and culturally appropriate treatment pathways.[29]

No studies were identified in this review that undertook a detailed analysis of the impact of immigration on aspects of the care pathways of people with HNC across Australia. This is despite some HNC such as nasopharynx cancer while relatively rare in most parts of the world, is endemic within certain regions, including southern China.[30] Research into how HNC care is impacted by country of birth will assist health services to undertake targeted and local relevant service delivery improvement for people with HNC living in Australia of non-English speaking backgrounds.

3.2.1.1 OCP Step 1: Prevention and early detection

- **Tobacco and Alcohol as Key Modifiable Risk Factors**

Alcohol consumption and tobacco use are recognised risk factors for HNC, leading to a 2.5-fold increase in the risk of HNC compared with non-users.[31] While national trends show a decline in smoking and alcohol misuse since 1991 (from 24% to 11% in 2019),[32] prevalence remains disproportionately high in remote areas.[32] For example, a 2024 study in the Northern Territory, which is classified as regional, remote or very remote reported that 91% of HNC patients were smokers and 73% consumed alcohol excessively.[29] An Australian pooled cohort study estimated that smoking contributes to 30.6% of the HNC burden, alcohol (≥ 2 standard drinks/day) to 12.9%, and jointly these exposures account for 38.5% of future HNC cases — highlighting the ongoing need for targeted prevention efforts, particularly in high-burden communities.[33]

3.2.1.2 OCP Step 2: Presentation, initial investigations and referral

- **Impact of Geographic Remoteness on Outcomes**

Geographic remoteness contributes to delayed diagnosis, reduced access to multidisciplinary team (MDT) care, and prolonged time to treatment. A NSW study found patients living over 100 km from an MDT had a 1.5-fold higher risk of advanced-stage diagnosis.[34] In Queensland, rural patients were significantly less likely to receive MDT review, begin treatment within 30 days, or receive any treatment at all. Yet, MDT review remains critical—especially in identifying patients with high-risk disease and comorbidities, as demonstrated in metropolitan tertiary hospitals.[28, 35] Conversely, in Victoria regional and rural patients were more likely to be accepting of telemedicine consultations during the COVID pandemic, citing savings in travel time and the minimal disruption to normal day-to-day activities.[36] Non-English speaking background patients, who require the input of interpreter

services were not captured in this study.[36] There were no Victorian studies which showed a significant correlation between diagnostic delay and survival outcomes found in this patient cohort and the impact of geographic remoteness; there was also no significant influence on recurrence rates.

Qualitative research in regional NSW further highlights barriers to care, including limited specialist services and the burden of travel, which delay help-seeking and pre-treatment intervals.[35]

- **Role of General Practitioners and Geographical Barriers**

General practitioners (GPs) are often the first point of contact in cancer care.[37] However, HNC is relatively uncommon in primary care, and referral practices vary by region.[37] A NSW-based vignette study showed metropolitan GPs typically referred patients to HNC subspecialists, whereas regional GPs were divided between ENT and general surgeons, often influenced more by local service availability than clinical presentation.[37] Awareness of government referral resources was generally low across all regions.[37]

- **Timeliness of Diagnosis**

Timeliness of diagnosis and treatment significantly affects HNC outcomes.[34] Delays prior to biopsy are often overlooked but constitute a critical component of total wait time.[34] A Western Australian study found that the referral-to-biopsy interval accounted for nearly 30% of overall delays. [34] Patients with hoarseness, laryngeal cancer, or those treated with definitive radiotherapy experienced longer delays.[34] However a Victorian study reported that socio-economic factors such as non-English speaking backgrounds did not negatively impact timeliness in the management of HNC.[19]

3.2.1.3 OCP Step 3: Diagnosis, staging and treatment planning

- **Impact of COVID-19 on HNC Care**

Globally, the COVID-19 pandemic had widespread impacts on cancer care of HNC.[38] In Australia, reduced outpatient and elective surgery capacity impacted cancer pathways, raising concerns about diagnostic and treatment delays.[39] Referral delays are particularly concerning in HNC due to their association with a threefold increase in mortality risk.[40] However, a Victorian-based study of 127 HNC patients found no significant differences in cancer stage, treatment delays, or survival outcomes between pre- and post-COVID periods.[39] Importantly, telehealth use increased from 1.6% to 14.3% during the pandemic, offering a promising strategy for rural care delivery. [39] While telemedicine supported initial consultations and treatment planning, concerns remain about deferring aerosol-generating procedures (e.g., nasendoscopy), which are critical for diagnosis and survivor follow-up.[39]

3.2.1.4 OCP Step 4: Treatment

- **Treatment Patterns and Prognosis**

HNC treatment is increasingly influenced by tumour stage, patient age, comorbidities, and evolving systemic therapies.[41] Treatment selection is based on the location and stage of the tumour. Early-stage tumours are usually treated with surgery or radiation therapy (RT), whereas advanced tumours are usually require multimodal treatment, often including systemic agents.[42] Systemic therapies such

as such as immunotherapy are being used earlier in the treatment of head and neck cutaneous squamous cell carcinoma (HNSCC).[43] A NSW study reported that over 60% of patients with surgically treated pT3/4 HNSCC were disease-free at five years, emphasising the importance of integrating surgical outcomes into treatment planning.[43] Adjuvant therapies should be considered for patients with poor prognostic factors, such as positive margins or previous treatment.[43]

- **Diagnostic Complexity and Genomic Advances**

The histologic and immunohistochemical features of OSCC and HNSCCs are similar making it difficult to identify the primary site in cases of metastases. An Australian study comparing their genomic landscapes identified significant differences, with HNSCC showing a higher tumour mutational burden (TMB) and a UV-related mutation signature (COSMIC SBS 7), while OSCC displayed mutation signatures SBS 1, 2, and 13.[44] These genomic distinctions may influence tumour behaviour and support tailored treatment strategies in recurrent or metastatic disease settings.[44]

- **Chemoradiotherapy and Emerging Alternatives**

Concurrent chemoradiotherapy with high-dose cisplatin remains a standard for locally advanced HNSCC.[45] However, due to toxicity, non-standard regimens such as weekly low-dose cisplatin, carboplatin/paclitaxel, or cetuximab are increasingly used.[45] Victorian researchers found that weekly low-dose cisplatin offers similar efficacy to high-dose regimens, with lower toxicity, underscoring the need for randomised trials and alternative treatments for cisplatin-ineligible patients.[45]

- **Rare HNC Subtypes and Surgical Margins**

Some HNCs such as head and neck angiosarcoma (HN-AS) are a rare and aggressive malignancy representing <1% of all head and neck malignancies.[46] A New South Wales study showed better outcomes for patients receiving surgery and radiotherapy compared to chemoradiotherapy, though selection bias was noted due to disease severity.[46] In oral tongue SCC (OTSCC), histological margin status remains a critical prognostic factor. A Victorian study demonstrated that margins >5mm significantly reduced locoregional failure and mortality, establishing this threshold as the surgical aim.[47-49]

- **Treatment Timeliness and Coordinated Care**

Advanced stage HNSCC is managed curatively with primary surgery and post-operative radiation therapy (PORT) or chemoradiation.[50] Delays in commencing PORT are associated with reduced survival and higher recurrence rates.[51] Despite evidence supporting timely treatment, a Queensland study found PORT delays persist, highlighting the need for improved care coordination, electronic referral systems, and culturally appropriate support for Aboriginal and Torres Strait Islander patients.[52]

Perineural spread in HNSCC is another challenge. A New South Wales study reported improved survival outcomes when patients underwent surgery with clear proximal nerve margins, followed by adjuvant radiotherapy.[53] These findings support surgical resection as a primary approach in selected cases.[53]

- **Prognostic Markers and Delays in Management**

Histopathological features such as perineural invasion (PNI), depth of invasion (DOI), and extranodal extension (ENE) are critical in guiding adjuvant therapy.[54] Multifocal PNI, in particular, is a strong predictor of mortality comparable to nodal metastases without ENE in OSCC patients.[54]

The timeliness of HNC management can have significant effects on a patient's staging, available treatment options, prognosis and quality of life.[19] A Victorian MDT review study found that lack of radiological or pathological workup before referral and early staging influenced timeliness.[19] Socioeconomic factors such as non-English speaking backgrounds, distance, or social support did not significantly affect timeliness of HNC management in a Victorian study.[19] Similarly, a South Australian study showed delays were most pronounced for patients receiving primary radiotherapy due to pre-treatment logistics such as PET scans, dental reviews, and gastrostomy tube placements. Only 72% of patients began treatment within the recommended 56 days, with a median time of 45.5 days from referral to treatment initiation.[55]

- **Guidelines and Regional Disparities**

The Australian *Optimal Care Pathway (OCP)* for HNC recommends initiating curative treatment within 56 days of referral, as delays beyond 45 days are associated with higher mortality.[23, 56] High-volume treatment centres are increasingly managing complex cases, but regional disparities persist. Barriers include limited local services, patient comorbidities, and institutional constraints. While decentralisation has been proposed to address these inequities, it must account for geographic, cultural, and governance complexities.[57-59]

Surgeon volume also impacts outcomes. A South Australian study found that patients treated by high-volume surgeons had a 60% lower mortality risk. A threshold of 20 cases per year was suggested to maintain surgical competency in OSCC.[60]

Regional disparities in the proportion of Victorian patients receiving dietetic care and regional patients treated locally with radiotherapy were identified as key variations in HNC care compared to metropolitan patients treated in metropolitan centres.[16]

3.2.1.5 OCP Step 5: Care after initial treatment and recovery

- **Dysphagia Assessment and Radiotherapy Planning**

There is marked variability in the assessment of post-treatment dysphagia in the literature. A New South Wales study found that dose-volume parameters for dysphagia and aspiration-related structures (DARS) varied depending on radiotherapy timing and outcome measures used.[61] Developing relative risk profiles before radiotherapy may support tailored care decisions, such as prophylactic feeding tube placement or targeted resource allocation. Additionally, radiotherapy protocols that consider treatment setting and timing may reduce long-term swallowing dysfunction.

- **Head and Neck Lymphoedema (HNL) Management**

Head and neck lymphoedema (HNL) is increasingly recognised for its impact on quality of life and functional outcomes. However, limited Australian data exist, with most published studies from the U.S. and U.K. A New South Wales study demonstrated that HNL can be effectively managed in outpatient settings using

therapist-led and self-administered techniques such as manual lymphatic drainage, massage, and exercise.[62] Given the variability in adherence to home-based regimens, prospective studies are needed to identify optimal timing, intensity, and strategies for HNL therapy.

- **Health Literacy and Timeliness of Diagnosis**

Health literacy plays a critical role across the HNC care continuum—from symptom recognition and help-seeking to diagnosis, treatment, and follow-up. Individuals with lower health literacy may experience delays in diagnosis and treatment due to difficulties understanding and navigating health information. While this relationship remains underexplored, a 2023 New South Wales study found negative correlations between most domains of patient health literacy and diagnostic intervals, suggesting that higher health literacy facilitates timelier progression along the pathway to HNC diagnosis.[63] These findings highlight the importance of health literacy-sensitive services in promoting equitable access to timely care.[63]

- **Multidisciplinary Models and Nutrition Care**

Survivorship care and long-term follow-up are increasingly important as the number of people living with and beyond cancer rises. An Australian pilot study found that integrating a best-practice, patient-centred dietetic model of care within a HNC multidisciplinary team (MDT) significantly improved outcomes. Patients receiving this model were more likely to complete radiotherapy and systemic therapy, experienced fewer unplanned admissions, and incurred lower healthcare costs.[64] Clinical teams also reported improved communication, coordination, and integration of care.

Malnutrition is recognised as being prevalent in patients with HNC, impacting outcomes. Despite the availability of published nutrition care evidence-based guidelines, evidence-based gaps exist.[64] Another Australian study highlighted the importance of coordinated messaging from doctors and nurses to reinforce adherence to nutrition plans, improving patient preparedness for nutritional challenges.[65] Clinics promoting treatment continuity and collaboration among dietitians, speech pathologists, nurses, and doctors may further enhance the nutritional care experience.[65]

- **Translation of Guidelines into Practice**

While evidence-based clinical guidelines are known to improve cancer outcomes, their implementation is often inconsistent. A study of Australian dietitians familiar with HNC guidelines found high levels of agreement, adoption, and adherence.[66] The study also recommended the use of wiki-based platforms to support future guideline implementation and bridge the evidence-to-practice gap in dietetics.[67]

- **Quality of Life and Risk Prediction Post-Treatment**

Quality of life following complex surgical treatment for HNC, such as free flap reconstruction, is influenced by several factors including age, comorbidity, surgery duration, and length of stay.[68] To address these issues, researchers advocate for the routine use of validated patient-reported outcome measures (PROMs), better access to psychological support, and regular symptom monitoring via in-person and remote methods.

However, when the American College of Surgeons National Surgical Quality Improvement Program risk calculator was applied to Australian patients, it

demonstrated poor predictive accuracy for complications and length of stay.[69] Notably, the ablative surgical component better predicted hospital stay than the reconstructive element, indicating the need for locally validated risk tools.

- **Rehabilitation and the Role of Allied Health**

Rehabilitation following HNC treatment is complex due to biomechanical effects on swallowing, often necessitating alternative nutrition and hydration strategies. Speech pathologists are considered essential members of the HNC MDT, alongside other allied health professionals such as dietitians, dentists, social workers, and psychologists.[58, 70] Early and ongoing involvement of speech pathologists is crucial for assessing swallowing function and ensuring safe dietary practices.

Advances in MDT care and treatment technology have improved survival in oral squamous cell carcinoma, particularly with early detection. These findings reinforce the value of routine screening by community health practitioners to facilitate early diagnosis and intervention.[71]

- **Barriers to Post-Acute Care in Rural Areas**

People with HNC living in rural areas face significant barriers to accessing post-acute rehabilitation services, including speech pathology. A Queensland-based study explored perspectives of patients, carers, clinicians, and service managers, identifying telehealth as a key solution to geographic limitations.[72] Additional models such as asynchronous app-based dysphagia therapy and electronic screening tools may support remote monitoring and care delivery.[72-75]

- **Unmet Supportive Care Needs and the Role of Support Groups**

Despite treatments for HNC being widely acknowledged in the cancer community to be amongst the toughest on patients, with substantial social, vocational, aesthetic, functional and psychosocial effects linked to HNC diagnosis, treatment and recovery,[76] supportive care models such as cancer support groups remain underutilised in this population.[77] Most established support groups focus on breast and prostate cancer.[76, 77] A study of 103 patients diagnosed with HNC and their carers' living in New South Wales demonstrated that many would like to be involved in a support group.[78] Furthermore this study highlighted areas of unfulfilled information and support needs, along with preferred group characteristics.[78]

- **Impact on Carers and Need for Psychosocial Screening**

Carers of people with HNC also experience substantial emotional strain. A Western Australian study exploring their lived experiences found high levels of unexpressed stress and emotional burden, with many carers choosing to conceal their distress to avoid burdening the patient.[79] The study recommended routine screening for carer distress at treatment initiation to recognise the essential role carers play in patient outcomes, while ensuring they maintain their own health and wellbeing.[79]

- **Telehealth and Outreach Services: Addressing Access Barriers**

Travel distance and associated costs remain significant barriers to accessing care, particularly for rural HNC survivors. Australian studies have highlighted the potential of telehealth and outreach services to address these barriers. One study found that rural HNC patients strongly supported telemedicine due to its convenience and reduced disruption to daily life.[36, 80] However, technological barriers including

internet quality and digital literacy can affect telehealth uptake.[81] Preferences for phone over video consultations should also be considered in service design.[36]

Outreach models offering regional access to surgical and follow-up care have also shown promise. A New South Wales study evaluating a regional outreach service for HNC surgery over a six-month period reported high patient satisfaction and positive experiences, reinforcing the value of delivering services closer to home.[82] Patient-centred evaluation of these models is essential to inform workforce planning and ensure services meet evolving survivorship and follow-up needs.

- **Financial Toxicity and Socioeconomic Burden**

The intensity of HNC treatment often results in high healthcare utilisation, placing considerable financial strain on patients.[83] Financial toxicity, defined as the hardship or distress that arises from the financial burden derived from cancer treatment has increasingly been recognised as a determinant of poor quality of life and suboptimal clinical outcomes.[84] A cross-sectional survey of HNC patients at a Queensland regional hospital found that financial toxicity was linked to poorer health-related quality of life, with out-of-pocket costs within the first year of diagnosis ranging widely.[85] While some incurred no costs, others reported a median expenditure of AUD \$1,796.[85] Patients from lower socioeconomic backgrounds reported lower costs, likely due to government support and bulk-billing, whereas rural patients faced higher expenses, particularly for travel, dental care, medications, and nutritional supplements.[85]

- **Leveraging Real-World Data and Predictive Tools**

The large volume of clinical data collected through Oncology Information Systems (OIS) offers opportunities to evaluate care pathways and predict patient outcomes. Machine learning (ML) has emerged as a valuable tool for analysing real-world data and supporting clinical decision-making.[86, 87] Given that HNC patients face a high risk of cancer-specific death within two years of treatment, researchers in New South Wales developed and validated ML models and a nomogram using routinely collected hospital data to predict 2-year cancer-specific survival (CSS).[88] These tools demonstrated strong predictive performance and are now publicly available to support prognosis and guide individualised treatment planning.

3.2.1.6 OCP Step 6: Managing recurrent, residual or metastatic disease

Although diagnostic and therapeutic advances have improved locoregional control in head and neck squamous cell carcinoma (HNSCC), overall survival has not substantially improved. One contributing factor is the elevated risk of developing a second primary malignancy (SPM), linked to lifestyle factors such as tobacco and alcohol use, genetic predisposition, and treatment modality.[89] A retrospective study in Western Australia found that 5.9% of HNSCC patients developed SPMs, with 3.7% classified as synchronous and 2.3% as metachronous malignancies. Metachronous SPMs were associated with significantly poorer survival outcomes, highlighting the need for ongoing surveillance and risk stratification in long-term follow-up care.[90]

3.2.1.7 OCP Step 7: End-of-life care

No studies identified in this review directly addressed end-of-life care for patients with HNC in the Australian setting although a study from the grey literature did indicate that six per cent of 920 Victorians diagnosed with oropharynx cancer between 2012 and 2016 received palliative treatment.[16] This gap underscores the urgent need for local research and policy

development to determine best practices for identifying those most in need of palliative care and ensuring timely referral to appropriate services.

3.2.2 What approaches or strategies have been used to (a) identify/determine unwarranted variation and/or (b) address unwarranted variation in HNC care?

No studies specific to HNC were found that applied conceptual frameworks such as Wennberg's classification, widely used to understand unwarranted variation in other cancers like colorectal [91], breast [92], and ovarian cancer.[93] However, two broad groups of studies were identified that explored approaches to identifying variation in HNC care, with some offering insights into potential strategies to address these variations.

3.2.2.1 Mixed Methods Approaches

Two studies employed a mixed methods design to explore care variation in HNC patients.[64, 94]

- *Nutrition Care Model Implementation*: One study assessed the feasibility and impact of implementing a patient-centred, evidence-based model of nutrition care. It used a pre-post design underpinned by implementation science frameworks. The intervention led to improved adherence to nutritional guidelines, reductions in critical weight loss, fewer unplanned admissions, and overall lower healthcare costs.[64] While not statistically powered for secondary outcomes such as weight change, the findings are promising, especially given the high baseline malnutrition prevalence in the post-implementation cohort.
- *Post-Treatment Recovery and Rural Disparities*: The second study focused on post-discharge needs, comparing metropolitan and rural patient experiences. Quantitative findings highlighted greater recovery burdens in rural patients, with increased appointments, travel, and missed consultations. Qualitative data underscored heightened psychological distress due to access barriers, compounding treatment-related stress.[94]

3.2.2.2 Statistical Identification of Variation

Forty-six studies applied quantitative approaches to identify variation in HNC care. These included retrospective (27), prospective (4), cross-sectional (1), and descriptive qualitative designs (11).

- *Descriptive and Comparative Statistics*: Most studies (34) used basic descriptive statistics and comparative tests such as chi-square and Fisher's exact test to explore care differences.[14, 19, 29, 34-37, 39, 43, 44, 46, 49, 52, 53, 56, 62-64, 66-68, 71, 72, 78-80, 82, 85, 90, 94-98]
- *Multivariate Modelling*: Twelve studies applied regression models to adjust for covariates and examine potential unwarranted variation based on deviations from guidelines or expected norms.[28, 33, 41, 45, 54, 55, 60, 61, 88, 99-101]
- *Key Variation Areas*: Variation was frequently noted in comorbidity profiles and estimated survival [68], access to health services [28, 29] and treatment initiation.[55]

Despite these findings, most studies did not confirm whether the observed variation was clinically unwarranted.

3.2.2.3 Efforts to Address Unwarranted Variation

Most studies emphasised identifying variation, with relatively fewer offering actionable strategies for addressing it. The approaches identified include:

- *Audit and Feedback*: While no studies used structured audit databases, online surveys explored the value of clinician feedback.[58, 101] For example, a survey on preferences for low-risk well-differentiated thyroid cancer (WDTC) management revealed variation by clinician type and MDT participation. MDT involvement correlated with preferences for de-escalation in both treatment and follow-up.[101]
- *Consensus Guideline Development*: One study used surveys to inform new radiation therapy guidelines for HNC treatment at emerging centres, highlighting the challenges of treating complex cases at low-volume sites, despite telehealth support from higher-volume centres.[58]
- *Linked Data Analysis*: An analysis of linked oncology datasets across NSW revealed variation in radiotherapy dose and survival outcomes. Deviations from eviQ guidelines, particularly in EQD2T dosing, were associated with reduced mortality. However, limitations in routinely collected data hindered comprehensive survival variation analysis, emphasising the need for better data collection and case-mix adjustment.[100]
- *Clinical Vignettes*: A study using vignettes to examine GP referral behaviours found geographic differences in HNC referral intentions, with persistent variation despite investments in regional services. Low awareness of referral resources was noted, suggesting a need for better education and support.[37]
- *Benchmarking and Quality Indicators*: Benchmarking was used to assess care quality against predefined QIs in Queensland.[67] High compliance was observed across most indicators except smoking cessation, time to post-operative radiotherapy (PORT), and post-treatment dental review—highlighting systemic barriers like variable dental access.

3.2.2.4 Grey Literature: Unpublished Theses and Report

Two Australian theses provided valuable insights:

- *Diagnostic and Treatment Pathways*: A NSW-based thesis explored disparities in diagnosis and treatment timelines for regional HNC patients. Regional patients experienced longer delays, poorer adherence to guidelines, and reduced access. Barriers included travel distance, health literacy, and perceived disengagement by healthcare providers. A narrative review within the thesis emphasised the need for multi-system interventions to address these disparities.[102]
- *Dysphagia and Radiotherapy Toxicities*: A Queensland thesis evaluated dysphagia and other toxicities from helical intensity-modulated radiotherapy. It found a high risk of grade 3 dysphagia in patients with advanced tumours and recommended stratifying patients for targeted speech pathology support.[103]

A published Victorian report summarised data from the 2018 Victorian HNC Summit.[16] The Summit aimed to identify unwarranted variation across the Optimal Care Pathway (OCP) and prioritised areas for action. Seven local variations were identified, primarily related to appropriateness, timeliness of treatment, and supportive care (e.g., dietetics). However, the report lacked transparency on the criteria used for prioritisation and did not

outline specific improvement mechanisms such as an action register setting out initiatives for addressing unwarranted variation.

4. Implications

This review highlights that while there is substantial documentation of variation in HNC care across Australia, there remains a limited capacity to distinguish between warranted and unwarranted variation. This is largely due to the lack of application of formal conceptual frameworks and the predominance of retrospective data, which limit causal inference and real-time quality improvement.

To address these challenges, several health system and service-level changes are required:

- i. **Standardisation of Definitions and Frameworks:**
There is an urgent need for the national adoption of a standardised framework, such as Wennberg's classification of variation, tailored for oncology. This would enable consistent identification of unwarranted variation and support benchmarking across services and jurisdictions.
- ii. **Investment in Real-Time, Linked Data:**
Improved integration of data sources, including administrative, clinical, and patient-reported outcome data, is essential to monitor variation. Data linkages across cancer registries, radiotherapy centres, and primary care could support timely audits, feedback, and intervention.
- iii. **Strengthening Rural and Regional Access:**
Disparities in access to MDTs, allied health, and follow-up care for rural and remote patients must be addressed. Investment in telehealth infrastructure, regional outreach services, and care navigator roles should be prioritised. Additionally, decentralisation of low-complexity treatments should be explored through the development of regional protocols and workforce capability.
- iv. **Implementation of Quality Indicators:**
Mandated use of QIs related to timeliness, guideline adherence, and supportive care (e.g., dietetics, speech pathology, dental) should be embedded in service agreements and cancer plan reporting. Services performing below benchmarks should receive targeted support.
- v. **Focus on End-of-Life Care and Palliative Pathways:**
The absence of studies on end-of-life care in HNC represents a significant research and service gap. Future initiatives must include palliative care as an integral component of the HNC OCP and fund models that facilitate early referral and integrated care planning.
- vi. **Consumer and Primary Care Engagement:**
Building the capacity of general practitioners in early detection, particularly for oral cancers, is critical. Educational interventions such as the Victorian Oral Cancer Screening and Prevention Program and the RACGP's e-learning module should be expanded and evaluated. Consumer-led service planning, especially in survivorship and supportive care, can ensure services are aligned with patient needs.
- vii. **Embedding Equity into Quality Improvement:**
All interventions must explicitly address equity by targeting known access gaps and involving communities historically underserved. This includes funding for Aboriginal community-controlled health organisations to co-design culturally safe models of HNC care.

5. Conclusion

This rapid literature review synthesises a complex and evolving body of evidence on HNC care in Australia. It demonstrates that while progress has been made in defining patterns of care, substantial gaps remain in identifying and addressing unwarranted variation. Most notably, the absence of a consistent conceptual framework and a lack of studies on end-of-life care impede system-wide improvements. Persistent inequities in access, outcomes, and survivorship highlight the need for coordinated action across the health system.

To advance equitable and high-quality HNC care, health services and policymakers must invest in frameworks, data infrastructure, and targeted service innovations. Future research must prioritise real-time monitoring, prospective evaluations of interventions, and the lived experiences of diverse populations. Only through such systemic and integrated approaches can unwarranted variation be reduced and the aspirations of the OCPs realised.

Table 1. Search strategy

Search #	Limits English, Journal Article, Humans, Publication Date from 2019, Australian
1.	exp "Head and Neck Neoplasms"/an, di, dg, dh, ep, et, ge, hi, mo, pp, pc, px, rt, rh, su, th [Analysis, Diagnosis, Diagnostic Imaging, Diet Therapy, Epidemiology, Etiology, Genetics, History, Mortality, Physiopathology, Prevention & Control, Psychology, Radiotherapy, Rehabilitation, Surgery, Therapy]
2.	((head and neck) adj3 (neoplas* or cancer* or malignan* or metastat* or tumo?r*)).ti,ab,kf.
3.	((facial or eyelid or mouth or gingival or oral leukoplakia or hairy leukoplakia or lip or palatal or salivary gland or parotid or sublingual or submandibular or tongue or otorhinolaryngologic or parathyroid or thyroid or tracheal or ear or nose or maxillary sinus) adj3 (neoplas* or cancer* or carcinoma* or malignan* or metastat* or tumo?r*)).ti,ab,kf.
4.	1 or 2 or 3
5.	"delivery of health care"/ or health services accessibility/ or health equity/ or healthcare disparities/ or practice patterns, pharmacists'/ or practice patterns, dentists'/ or practice patterns, nurses'/ or practice patterns, physicians'/
6.	"quality of health care"/ or guideline adherence/ or quality assurance, health care/ or quality improvement/ or quality indicators, health care/ or "standard of care"/ or "health care quality, access, and evaluation"/
7.	"delivery of health care".ti,ab,kf.
8.	health care delivery.ti,ab,kf.
9.	health care system.ti,ab,kf.
10.	(health adj2 access*).ti,ab,kf.
11.	health equity.ti,ab,kf.
12.	(health* adj2 disparit*).ti,ab,kf.
13.	practice pattern*.ti,ab,kf.
14.	"quality of health care".ti,ab,kf.

15. guideline adherence.ti,ab,kf.
16. (health* adj3 quality).ti,ab,kf.
17. quality improvement.ti,ab,kf.
18. "standard of care".ti,ab,kf.
19. (variation* adj3 (unwarranted or warranted or clinical)).ti,ab,kf.
20. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19
21. exp Australia/
22. (Australia* or Oceania or Canberra or ACT or NSW or New South Wales or QLD or Queensland or TAS or Tasmania or SA or South Australia* or WA or Western Australia or NT or Northern Territory).ti,ab,kf.
23. 21 or 22
24. 4 and 20 and 23
25. limit 25 to (english language and yr="2019 -Current")
26. 24 and 25

Table 2. Summary of the evidence base – head and neck cancer (N=50)

First author	Year	State/National	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Alamgeer M [45]	2023	Victoria	Step 4: Treatment	Retrospective cohort study	To evaluate the efficacy and safety of SOC and non-SOC regimens in all patients with LA-HNSCC undergoing definitive chemoradiotherapy with a hypothesis that non-SOC regimens are noninferior to SOC regimens.	235	Median age was 61 years (IQR 55–67), and 87% were male. Most had oropharyngeal tumours (85.5%) and p16-positivity was frequent (80%). About 56% received non-standard regimens: weekly cisplatin = 79 and non-cisplatin = 48. These patients had higher Charlson Comorbidity Index (CCI; $p < .001$) and lower European Cooperative Oncology Group (ECOG)-0 ($p = .003$). There was no difference in 2-year FFS (hazard ratio [HR] = 1.16; 95% confidence interval – [CI] 0.65–2.05), hospitalisation and grade-3 toxicity rates between the two regimens. Nausea and vomiting were lower in the non-standard regimen (3.0% vs. 16%, $p < .001$). Dose reductions, adjusted for age, sex, and CCI, were less likely in the non-standard regimen (OR = 2.36; 95%-CI: 1.01–5.49, $p = .007$)	The researchers demonstrated similar efficacy of lower dose weekly cisplatin and carboplatin/paclitaxel regimens and better safety profile of weekly cisplatin compared to standard HD cisplatin regimens for LA-HNSCC. Multicentre randomised control trials are required in high-dose (HD) cisplatin-ineligible patients.
Charters E [95]	2022	New South Wales	Step 5: Care after initial treatment and recovery	Prospective	To evaluate the recovery of swallowing function following the implementation of an exercise-based approach to dysphagia rehabilitation.	10	Ten participants were recruited over a 6-month period, all of whom had oropharyngeal dysphagia confirmed on VFSS. At the conclusion of the 10-week intervention period, DIGEST (Dynamic Imaging Grade of Swallowing Toxicity) scores improved significantly for both safety and efficiency components. Four of seven participants who had a percutaneous endoscopic gastrostomy tube at baseline were no longer reliant on it for their nutrition, hydration or medication at the completion of the therapeutic period. While four participants continued to aspirate on thin fluids, none developed aspiration pneumonia.	Oropharyngeal dysphagia as a consequence of HNC treatment is challenging to rehabilitate; however, in selected patients, it is responsive to intensive and individualised rehabilitation programs.
Charters E [61]	2022	New South Wales	Step 5: Care after initial treatment and recovery	Prospective	To compare the relationship between dose to dysphagia and aspiration-related structures (DARS) and swallowing function in those undergoing definitive versus PORT. Patient- and clinician-reported outcome measures were assessed longitudinally from baseline to 24 months post radiotherapy and analysed according to baseline patient, tumour, and treatment factors.	93	Ninety-three participants who received radiotherapy for HNC were included in the analysis (n=49 definitive radiotherapy for laryngeal/ pharyngeal primary tumours and n=44 postoperative PORT for predominantly oral cavity/salivary gland tumours). Participants undergoing PORT had lower doses to DARS than those undergoing definitive RT. High dose to the pharyngeal constrictors and base of tongue for definitive RT and the oesophageal inlet, supraglottic larynx and cervical oesophagus for the PORT group were associated with worse swallowing function.	Radiation dose to DARS is associated with post-treatment swallowing outcomes. These dose/outcome relationships may vary between the definitive and postoperative settings.
Charters E [78]	2021	New South Wales	Step 5: Care after initial treatment and recovery	Cross-sectional design survey	To compare and analyse interest in and preferences for a support group for both patients with a diagnosis of head and neck cancer, and their caregivers.	A total of 389 surveys were distributed, 119 were completed and the 103 patient responders were included in the analysis	Most respondents (81.5%) were male patients, with a median age of 68 treated with radiotherapy. Fifty-one-point-five percent indicated that they would like to and 25.2% indicated uncertainty about being involved in a support group. A face-to-face group (69.6%) was the most preferred format followed by an online forum (30.4%). Topics relating to nutrition, new approaches to head and neck cancer treatment, emotional wellbeing and swallowing were the frequently cited topics of interest. Few respondents were aware of other support groups available to them.	While several limitations in the design limit how widely these results can be generalised, this data provides trends as to what type of support could be provided for those recovering from treatment for head and neck cancer.
Chen H [58]	2024	Queensland	Step 4: Treatment	Retrospective; online survey tool	To propose a novel framework outlining the	N/A	The findings of this retrospective study demonstrate the patient outcomes in oropharyngeal HNSCCs treated at a new	This consensus recommendation aims to improve RT utilization whilst advocating

First author	Year	State/National	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
				for development of recommendations	necessary components required to set-up a new radiation therapy HNC treatment.		Australian cancer centre on the Sunshine Coast were comparable with historical outcomes documented in the literature. These frameworks have incorporated expert opinions from several external radiation oncologists (ROs) with over 5 years post-training experience specialising in HNC RT and currently or previously have imparted their knowledge at high-volume facilities.	for optimal patient outcomes by presenting a framework for new radiation therapy centres ready to step up and manage the treatment of head and neck cancer patients. We propose these evidence-based consensus guidelines endorsed by external HNC radiation oncologists.
Chilkuri M [67]	2022	Queensland	Step 5: Care after initial treatment and recovery	Retrospective	To determine the quality of care provided to patients with HNC at a single institution by analysing compliance with QIs and to explore the feasibility and utility of collecting this data.	537	Overall, compliance with pre-treatment, treatment and posttreatment QIs was high, with the exception of smoking cessation support (66%), post-treatment dental review and time to post-operative RT (33% of patients within 6 weeks). The 5-year overall survival was 69.4% (CI; 64– 73.2%). The cumulative incidence of locoregional relapse for the overall study cohort was 18% (CI; 14.8–21.4%).	Collecting and evaluating quality metrics is feasible and helps identify areas for improvement. Centres treating HNC patients should strive towards monitoring quality against benchmarks and demonstrate transparency in outcome data.
Clohessy J [99]	2022	New South Wales	Step 3: Diagnosis, staging and treatment planning	Retrospective cohort study	To investigate the relationship between a patient's residential distance from a tertiary referral regional multidisciplinary team (MDT) and the clinical staging of their head and neck cancer (HNC) at presentation.	286	There were 286 observations; 230 patients were male and 56 were female. The mean age of the cohort was 66.52 years. The average residential distance from the MDT was 68.16 km. Regression analysis, while not statistically significant, indicated that those living more than 100 km (range 102– 592 km) from the MDT had a 1.49 times increased risk of being diagnosed with an advanced stage of cancer when compared to those living less than 100 km away.	This study provides insights into the potential adverse effect geographic remoteness has on initial staging of HNC and the need for further strategies to serve this at-risk population.
Connell J [56]	2020	South Australia	Step 4: Treatment	Retrospective cohort study	To identify and rectify preventable delays.	91	Ninety-one new cases of head and neck squamous cell carcinoma were treated with curative intent therapy. Seventy-five underwent surgery, 13 received primary radiotherapy with adjuvant chemotherapy and 3 received primary radiotherapy alone. The mean TTI from initial ENT surgical consultation to definitive treatment was 39.43 days (Standard Deviation 24.43.) There was a statistically significant disparity in treatment times (P<0.001) between surgical treatment (34.41 days) and non-surgical treatment (65.44 days). Factors that contributed to a prolonged treatment time included lack of diagnostic imaging at first consultation, invasive diagnostic procedures under general anaesthesia and inefficient scheduling of outpatient encounters.	Head and neck cancer treatment is time and resource intensive process where delays can negatively impact patient outcomes. Strategies to reduce treatment times should remain a priority for all head and neck cancer departments. A streamlined pathway with effective communication and innovative diagnostic techniques can improve patient outcomes.
Cook L [55]	2022	South Australia	Step 4: Treatment	Retrospective cohort	To assess whether head and neck cancer treatment was delivered within these timeframe guidelines at our institution and identify factors associated with treatment delays.	72	The median time from specialist referral to treatment initiation was 45.5 days (IQR 29–61), with 72% meeting the 56 days guideline. On univariate logistic regression, patients undergoing primary radiotherapy treatment were less likely to meet this guideline than those undergoing primary surgery (OR 8.8, 95% CI 2.6–28.9, p < 0.001), as were those requiring prophylactic gastrostomy tube insertion (OR 3.1, 95% CI 1.1– 9.0, p < 0.05). Treatment initiation beyond 56 days had no significant impact on 12 months overall survival or disease-free survival.	The findings of this study demonstrate that primary radiotherapy treatment is associated with delays in head and neck cancer treatment initiation, likely related to time consuming pre-treatment factors such as gastrostomy tube insertion.
Daniell J [49]	2020	Victoria	Step 6: Managing recurrent, residual or metastatic disease	Retrospective	To assess the effect of the histological margins (HM) upon locoregional failure (LRF) and overall survival (OS) for oral tongue squamous cell carcinoma (OTSCC).	258	The median follow-up period was 4.8 years. The 5-year OS and freedom from LRF were 69% and 75% respectively. The Cox-proportional hazards model adjusted for age, DOI and LVI showed increasing risk of mortality and LRF with decreasing HM widths of <5 mm.	HM >5 mm were associated with a risk reduction of both LRF and mortality in OTSCC. This study supports >5 mm HM being the oncologic goal of surgery.

First author	Year	State/National	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Dhillon K [36]	2022	Victoria	Step 5: Care after initial treatment and recovery	Cross-sectional	To evaluate acceptability, satisfaction and perceptions of telemedicine technology among outpatients for head and neck oncologic surveillance.	100	One hundred and fifteen patients were invited to participate, and 100 were included in the final analysis; 95% of patient's had a positive experience with telemedicine appointments and were willing to have future telemedicine appointments. Regional and rural patients were more accepting of telemedicine consultations, citing savings in travel time and the minimal disruption to normal day-to-day activities. All participants had access to telecommunication devices, with 63% having three or more devices. Issues identified include a lack of physical examination by clinician for 65% of participants and the inability to self-examine for 88% of participants.	The study demonstrates patients' acceptance of telemedicine appointments as a component of outpatient surveillance for head and neck surgical oncology. This has benefits during the COVID-19 pandemic in addition to increasing accessibility for rural patients.
Douglas C [68]	2023	New South Wales	Step 5: Care after initial treatment and recovery	Cross-sectional	To investigate the quality of life (QoL) impacts following head and neck surgery for advanced stage head and neck cancer.	27 out of 61 invited to participate	The majority of participants (N = 27; 55% male; mean (standard deviation) age: 62.6 (13.8) years; mean time since operation: 801 days) had a squamous cell carcinoma (88.9%) and free flap repair (100%). Time since operation was significantly (P < 0.05) associated with higher rates of depression (r = -0.533), psychological needs (r = -0.0415) and physical/daily living needs (r = -0.527). Length of surgery and length of stay were significantly associated with depression (r = 0.442; r = 0.435) and length of stay was significantly associated with speaking difficulties (r = -0.456). There was a significant association between work and education scores with age (r = 0.471), length of surgery (r = 0.424), Comorbidity Index (r = 0.456) and estimated 10-year survival (r = -0.523).	Age, time since operation, length of surgery, length of stay, Comorbidity Index and estimated 10-year survival were the outcomes associated with QoL. Patient-reported outcome measures and psychological support could be included in the standard care pathway for head and neck cancer patients to ensure holistic management of their condition.
Edwards A [66]	2022	Queensland	Step 5: Care after initial treatment and recovery	Evaluation questionnaire	To evaluate the implementation of the Evidence-based guidelines for the nutritional management of adult patients with head and neck cancer among Australian dietitians providing clinical care to this population.	43 respondents	Of the 43 initial respondents, n = 28 completed the questionnaire, with n = 24/28 (86%) meeting full eligibility criteria for analysis. Median (range) scores for all four domains were high: awareness (4.0 [3.2-4.8]), agreement (4.4 [4.1-4.7]), adoption (3.5 [3.1-3.9]), and adherence (4.3 [4.1-4.9]). However, perception of guideline awareness and use among multidisciplinary team colleagues was low (mean 3.2/5.0 and 3.1/5.0, respectively). Dietitians with < 10 years' experience had significantly higher perceptions of the guidelines' ability to positively influence practice; support evidence-based practice; and enhance dietitian credibility (p=0.04) vs dietitians with ≥ 10 years' experience.	Dietitians demonstrated high rates of guideline implementation and positive perceptions for its use in clinical practice. Future implementation strategies and evaluation should expand to engage the wider multidisciplinary team and more experienced clinicians.
Finlay M [64]	2020	New South Wales	Step 5: Care after initial treatment and recovery	Mixed methods	To implement and evaluate the integration of a patient-centred, best-practice dietetic model of care into an HNC multidisciplinary team (MDT) to minimise the detrimental sequelae of malnutrition.	100 patients (pre-implementation phase); 34 patients (implementation phase)	The baseline clinical audit (n = 98) revealed barriers including reactive nutrition care, lack of familiarity with EBGs or awareness of intensive nutrition care needs as well as infrastructure and dietetic resource limitations. Post-implementation data (n = 34) demonstrated improved process and clinical outcomes: pre-treatment dietitian assessment; use of a validated nutrition assessment tool before, during and after treatment. Patients receiving the new model of care were significantly more likely to complete prescribed radiotherapy and systemic therapy. Differences in mean percentage weight change were clinically relevant. At the system level, the new model of care avoided 3.92 unplanned admissions and related costs of \$AUD121K per annum	Focus groups confirmed clear support at the multidisciplinary team level for continuing the new model of care. Implementing an evidence-based nutrition model of care in patients with HNC is feasible and can improve outcomes. Benefits of this model of care may be transferrable to other patient groups within cancer settings.
Flukes S [34]	2019	Western Australia	Step 2: Presentation, initial investigations and referral	Retrospective review	To describe total wait time for head and neck cancer patients in our institution, to define a more accurate representation of the clinically relevant pre-treatment wait time,	294	Mean total wait time from initial referral to treatment initiation was 71.6 (median 61) days. The period from referral to biopsy represented 29% of mean total wait time. Factors predictive of increased wait time included presenting symptom of hoarseness, laryngeal cancer and treatment with definitive radiotherapy.	This study demonstrates that time from referral to biopsy represents a significant portion of total wait time, and we suggest that this be incorporated into future wait time metrics for improved clinical relevance. Furthermore, we have identified factors predicting increased wait

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					and to evaluate predictive factors for prolonged wait times.			time which can be targeted for future service improvement.
Foley J [28]	2023	Queensland	Step 3: Diagnosis, staging and treatment planning	Retrospective	To undertake a detailed analysis of the impact of rurality on aspects of the care pathway of people with HNC across Queensland, Australia.	1991	Regression analysis revealed remoteness significantly ($p < 0.001$) impacted access to MDT review, receiving treatment, and time to treatment commencement, but not readmission or 2-year survival. Reasons for readmission did not differ by remoteness, with dysphagia, nutritional inadequacies, gastrointestinal disorders and fluid imbalance indicated in the majority of readmissions. Rural people were significantly ($p < 0.0001$) more likely to travel to care and to readmit to a different facility than provided primary treatment	This study provides new insights into the health care disparities for people with HNC residing in regional/rural areas.
Foley J [72]	2022	Queensland	Step 5: Care after initial treatment and recovery	Qualitative methodology using semi-structured interviews	To explore the perceptions of people with HNC, their carers' and speech pathology staff regarding the challenges of accessing and/ or delivering speech pathology rural HNC services, as well as ways to address/improve these challenges.	28	Two themes were identified from the consumer group including (a) navigating health services for head and neck cancer management and (b) burden of accessing head and neck cancer care. Speech pathology staff/managers interviews raised 3 themes: (a) transfer of care and access to local services, (b) workforce and workload and (c) travelling impacts the service our patients can receive. An integrative theme across both groups highlighted the perceived disparity in health care access that existed for people with head and neck cancer in rural areas.	In rural areas, consumers face multiple barriers navigating the head and neck cancer treatment pathway, while health services encounter specific challenges ensuring access and equity in care. Despite the complexities, possible avenues for service change and service enhancement are proposed. Speech pathology services in rural areas need to proactively evaluate services and address existing disparities in order to enact positive change for people with head and neck cancer living outside metropolitan locations.
Foley J [94]	2021	Queensland	Step 5: Care after initial treatment and recovery	Prospective mixed-methods longitudinal cohort study	To map the multidisciplinary post-acute health care service access, utilization, needs, and experiences of people with HNC from metropolitan and regional/remote areas and examine if differences exist by rurality	11	Rural participants attended a significantly greater number of appointments ($p = 0.012$), higher cancelled/missed appointments ($p = 0.013$), and saw more professionals ($p = 0.007$). Rural participants reported higher stress and burden due to service access barriers and unmet needs.	Through mapping the post-acute journey, this study has illustrated the complexity of the health care journey for people recovering from HNC treatment and the difficulties encountered in managing the number of professionals and services needed. Importantly, the results also highlight the disparity in service access and utilization between people with HNC living in metropolitan and rural areas. This disparity culminated in increased levels of distress and unmet need for rural participants. Future investigations into the barriers and facilitators impacting rural HNC care access and service delivery, especially for allied health professions who are central to managing the post-acute recovery, provide an opportunity to enhance the post-acute care journey for people with HNC living in rural areas.
Grover P [96]	2022	Western Australia	Step 3: Diagnosis, staging and treatment planning	Retrospective cohort study	To examine the clinicopathological features, mortality and morbidity in high-risk cutaneous squamous cell carcinoma (cSCC) patients in Western Australia (WA).	129	Patients were predominantly older males (84%) with significant comorbidities (Charlson Comorbidity Index (CCI) ≥ 5 ; 76%) and history of previous nonmelanoma skin cancer (57%) with advanced disease (57% stage IV without distant metastasis; American Joint Committee on Cancer, 7th edition). Pathological high-risk features were common including nodal extracapsular extension (47%) and cranial nerve involvement (16%). Clinical morbidity was significant with a median of 2 (range 0–13) excisions and 2 (range 0–21) cSCC-related hospitalisations for any cSCC event following the index case discussion. Recurrences of the primary index lesion occurred in 60% of patients and 20% had ≥ 2 recurrences. Median	Advanced cSCC has a high burden of disease and represents an area of unmet clinical need. Its increasing incidence and prevalence calls for further research to better understand its epidemiology and pave the way for more refined management options.

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							overall survival for patients with nonmetastatic disease was 39.8 (range 25.9–53.7) months and 16.1 (range 0.2–32.0) months for metastatic disease. CCI ≥ 5 , advanced nodal stage and ≥ 2 recurrences were significantly associated with mortality on multivariable analyses ($P < 0.05$). Nodal extracapsular extension and any recurrences were identified as significant risk factors for disease-specific mortality on multivariable analyses ($P < 0.05$).	
Gupta G [44]	2023	New South Wales	Step 6: Managing recurrent, residual or metastatic disease	Pathology investigation	To investigate and compare the genomic landscape of oral squamous cell carcinoma (OSCC) and head and neck cutaneous squamous cell carcinoma (HNSCC) to identify diagnostically useful biomarkers.	37	Whole-genome sequencing data from 57 OSCC and 41 HNSCC patients were obtained for tumour and matched normal samples. Tumour mutation burden (TMB), Catalogue of Somatic Mutations in Cancer (COSMIC) mutational signatures, frequent chromosomal alterations, somatic single nucleotide, and copy number variations were analysed. The median TMB of 3.75 in primary OSCC was significantly lower ($P < .001$) than that of 147.51 mutations/Mb in primary HNSCC. The COSMIC mutation signatures were significantly different ($P < .001$) between OSCC and HNSCC. OSCC showed COSMIC single-base substitution (SBS) mutation signature 1 and AID/APOBEC activity associated signature 2 and/or 13. All except 1 HNSCC from hair bearing scalp showed UV damage associated COSMIC SBS mutation signature 7. Both OSCC and HNSCC demonstrated a predominance of tumour suppressor gene mutations, predominantly TP53. The most frequently mutated oncogenes were PIK3CA and MUC4 in OSCC and HNSCC, respectively. The metastases of OSCC and HNSCC demonstrated TMB and COSMIC SBS mutation signatures similar to their primary counterparts.	The combination of high TMB and UV signature in a metastatic keratinizing squamous cell carcinoma suggests HNSCC as the primary site and may also facilitate decisions regarding immunotherapy. HNSCC and OSCC show distinct genomic profiles despite histologic and immunohistochemical similarities. Their genomic characteristics may underlie differences in behaviour and guide treatment decisions in recurrent and metastatic settings.
Ha J [90]	2019	Western Australia	Step 6: Managing recurrent, residual or metastatic disease	Retrospective	To report the incidence of SPM (synchronous and metachronous) in HNSCC patients and association between the epidemiological risk factors and the survival outcomes.	790	The commonest head and neck squamous cell carcinoma (HNSCC) was lip and oral cavity (37.8%), followed by oropharynx (28.1%) and larynx (26.5%). Of the 790 patients, 55.9% were smokers, 36.8% had a smoking history of over 50 pack-years, and 41.1% had a history of alcohol use. Primary treatment included surgery, surgery/radiotherapy, chemotherapy, surgery/chemotherapy, surgery/chemo-radiotherapy, radiotherapy, chemo-radiotherapy, and palliative, or no treatment. Synchronous tumour occurred in 29 patients (3.7%). Eighteen patients (2.3%) had metachronous tumour: median follow-up period was 25 months; 178 patients (22.5%) were dead at the end of follow-up.	While this study found a lower rate of secondary primary malignancies in patients with HNSCCs than other studies, there was a clear association between patients with significant smoking histories and the development of HNSCCs. Progression to synchronous or metachronous malignancy was associated with a poorer overall survival rate.
Halkett G [79]	2020	Western Australia	Step 5: Care after initial treatment and recovery	Qualitative	To explore the lived experiences of carers of patients diagnosed with head and neck cancer.	20	Key themes identified were: Silent Suffering, Gamut of Emotions, Causal Attribution, Changing Priorities, Gaining Support, and Coping. The changing priority themes highlights that carers prioritised (a) being available for their loved one and (b) taking an active role in managing head and neck cancer symptoms and side effects.	Carers of patients diagnosed with head and neck cancer experience distress. Instead of seeking support, carers often elected to suffer in silence. Implications for practice include screening for carer distress and providing specific interventions focused on caring for someone diagnosed with head and neck cancer.
Hasmet S [54]	2019	New South Wales	Step 6: Managing recurrent, residual or metastatic disease	Prospective	To update our analysis of STM and to determine its prognostic effect in a larger group of patients.	535	Of the 535 patients, 275 (51.4%) had STM. After adjustment for the effects of age, tumour location, number of metastatic deposits, and adjuvant radiotherapy, both STM (hazard ratio [HR], 1.55; 95% confidence interval [CI], 1.08–2.22; $p = 0.018$) and ENE (HR, 1.56; 95% CI 1.10–2.22; $p = 0.013$) were shown to be independent predictors of reduced OS, with similar size of effect.	In metastatic cSCC of the head and neck, STM is an independent predictor of reduced survival and has an impact on survival similar to that of ENE.

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Hazzard E [65]	2021	New South Wales	Step 5: Care after initial treatment and recovery	Qualitative longitudinal	To explore patient experiences of nutritional care, including involvement with a clinic that combines the services of specialist oncology nurse, dietitian and speech pathologist, while undergoing treatment for HNC in regional Australia.	10	Ten participants completed a total of thirty-six interviews. The findings were grouped into four categories: "preparing for nutritional challenges", "multidisciplinary care directed by patient needs", "the battle to eat", and "incongruence between patient values and nutritional priorities".	These findings highlight the nutritional burden associated with HNC and barriers to patients accepting nutritional support from healthcare professionals. Information provided by doctors and nurses prior to treatment may help patients prepare for the nutritional challenges ahead and accept support from dietitians. Furthermore, clinics that promote continuity through treatment and allow dietitians to lead aspects of nutritional care, in collaboration with nurses, speech pathologists and doctors, may also enhance the nutritional care experience. More qualitative research within HNC teams would provide further insight on enhancing the implementation of nutritional EBGs to improve outcomes for these patients.
Irawati N [46]	2022	New South Wales	Step 4: Treatment	Retrospective chart review	To review the clinical outcomes of HN-AS from two high volume head and neck cancer units in Australia.	26	A total 26 patients were identified, consist of predominantly male patients (81%) with a mean age of 77 years. Most of the HN-AS arises from the scalp (62%). The 5-year overall survival (OS) and disease-free survival (DFS) were 41% and 15%, respectively. Patients treated with upfront surgery with adjuvant therapy has better OS and DFS compared with patients receiving upfront chemoradiotherapy (median OS 3.63 vs. 0.53 years, $P = 0.011$ and median DFS 1.19 vs. 0.33 years, $P = 0.001$). There is no difference in OS or DFS for the sites of HN-AS or age of patients. Recurrences were noted in 15 patients (57.7%). For those with metastatic disease, the most common site was the lung (80%) with a median time to development of distant disease of 2.7 years (range 1.8–3.6 years). In patients who underwent salvage treatment, the median survival (post-salvage) was 1.3 years (0–2.8 years).	This is the first Australian report of treatment patterns and outcomes of patients with HN-AS. Our cohort confirms that HN-AS is a slowly progressive disease with poor survival. Patients treated with surgery and adjuvant radiotherapy in this series had better outcomes compared with those treated with chemoradiotherapy alone. The role of neoadjuvant chemotherapy is an area of ongoing research.
Khan L [14]	2024	National	Step 1: Prevention and early detection	Retrospective	To assess and compare the HNC trends between the Aboriginal and Torres Strait Islander and non-Indigenous population.	N/A	Aboriginal and Torres Strait Islander people had over twice the age-standardised incidence (2013; 29.8/100,000 vs. 14.7/100,000) and over 3.5 times the age-standardised mortality rates (2015; 14.2/100,000 vs. 4.1/100,000) than their non-Indigenous counterparts. Both populations saw a decline in mortality, but the decline was only statistically significant in non-Indigenous Australians (17.1% decline, 1998: 4.8/100,000, 2015: 4.1/100,000; $p < 0.05$). Across all remoteness levels and states, Aboriginal and Torres Strait Islander people consistently had higher age-standardised incidence and mortality rates. Furthermore, the five-year survival rate was lower by 25% in Aboriginal and Torres Strait Islander people.	Aboriginal and Torres Strait Islander people continue to shoulder a disproportionate HNC burden compared to non-Indigenous Australians.
Kotevski D [100]	2023	National	Step 4: Treatment	Retrospective	To investigate inter-hospital variation in data collection, primary radiotherapy treatment, and survival in HNC patients from an Australian setting.	3182	Inter-hospital variation in data collection, primary radiotherapy dose, and five-year HNC-related death was detected. Completion of eleven fields ranged from 66%-98%. Primary radiotherapy treated Tis-T1N0 glottic and any stage oral cavity and oropharynx cancers received significantly different time-corrected biologically equivalent dose in two gray fractions (EQD2T) by hospital, with observed deviation from Australian radiotherapy guidelines. Increased EQD2T dose was associated with a reduced risk of five-year HNC-related death in all patients and those treated with primary radiotherapy. Hospital, tumour site, and T and N classification were also	Unexplained variation exists in HNC-related death in patients treated at Australian hospitals. Available routinely collected data in OIS are insufficient to explain variation in survival. Innovative data collection, extraction, and classification practices are needed to inform clinical practice.

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							identified as independent prognostic factors for five-year HNC-related death in all patients treated with radiotherapy.	
Kotevski D [88]	2023	New South Wales	Step 6: Managing recurrent, residual or metastatic disease	Prognostic analysis	To develop and validate machine learning models and a nomogram for the prediction of 2-year CSS in patients with HNC using real-world data collected by major teaching and tertiary referral hospitals in New South Wales (NSW), Australia.	2953	Machine learning models demonstrated highest performance (C-index) in the larynx and nasopharynx cohorts (0.82), followed by the oropharynx (0.79) and the hypopharynx and oral cavity cohorts (0.73). In the whole HNC population, C-indexes of 0.79 and 0.70 and Brier scores of 0.10 and 0.27 were reported for the machine learning and nomogram model, respectively. Cox regression analysis identified age, T and N classification, and time-corrected biologic equivalent dose in two gray fractions as independent prognostic factors for 2-year CSS. N classification was the most important feature used for prediction in the machine learning model followed by age.	Machine learning and nomogram analysis predicted 2-year CSS with high performance using routinely collected and complete clinical information extracted from oncology information systems. These models function as visual decision-making tools to guide radiotherapy treatment decisions and provide insight into the prediction of survival outcomes in patients with HNC
Kwok M [19]	2023	Victoria	Step 4: Treatment	Retrospective review	To investigate the factors associated with the timeliness of managing HNC.	228	The median duration from referral to the commencement of treatment was 48 days. Lack of radiological or pathological investigations prior to referral to a HNC service as well as early staging were found to significantly impact timeliness in management. Socioeconomic factors such as non-English speaking backgrounds, distance from the hospital and lack of social supports were not found to negatively impact timeliness of management.	The management of patients with HNC require careful consideration of all patient and non-patient related factors which may affect timeliness in management, particularly investigations performed prior to their referral to a HNC service.
Laaksonen M [33]	2021	National	Step 1: Prevention and early detection	Pooled cohort	To quantify future head and neck cancer burden in Australia attributable to individual and joint causal exposures and assessed whether these burdens differ between population subgroups.	367,058	Contemporary levels of current and former smoking contribute 30.6% (95% CI, 22.7%–37.8%), alcohol consumption exceeding two standard drinks per day 12.9% (95% CI, 7.6%–17.9%), and these exposures jointly 38.5% (95% CI, 31.1%–45.0%) to the future head and neck cancer burden. Alcohol-attributable burden is triple and smoking-attributable burden is double for men compared with women. Smoking-attributable burden is also at least double for those consuming more than two alcoholic drinks daily or doing less than 150 minutes of moderate or 75 minutes of vigorous activity weekly, and for those aged under 65 years, unmarried, with low or intermediate educational attainment or lower socioeconomic status, compared with their counterparts.	Two-fifths of head and neck cancers in Australia are preventable by investment in tobacco and alcohol control.
Liu T [71]	2020	New South Wales	Step 6: Managing recurrent, residual or metastatic disease	Retrospective survival analysis	To provide updated multi-institutional data on the survival of patients with oral SCC in Australia.	771	Survival analysis included 771 patients with oral SCC. Five-year OS and DSS were 66.1% and 79.7%, respectively. Stage I and II oral SCC had significantly better survival than higher stages. Five-year OS and DSS for patients with stage I SCC were 79.7% and 93.4%, respectively, and for patients with stage IVB they were 37.9% and 54.3%, respectively. Two hundred forty-nine patients had disease recurrence (32.3%), with 66 patients (26.5% remaining disease-free post salvage treatment.	Survival outcomes for oral SCC among Australian patients have improved, possibly due to advances in multidisciplinary care. Early detection of oral SCC leads to highly favorable prognosis; there is therefore an opportunity for routine <u>oral cancer screening</u> to be performed by <u>community health practitioners</u> with the aim of improving survival from oral SCC.
Liu T [60]	2019	New South Wales	Step 4: Treatment	Retrospective	To quantify the impact of surgeon volume on the treatment outcome of oral squamous cell carcinoma (OSCC) patients.	534	Independently, the negative predictors for patient survival were age, perineural invasion, worsening tumour staging, and extracapsular spread. High-volume surgeon was determined to be most significant at 20 cases per annum and significantly associated with improved RFS (HR: 0.67), OS (HR: 0.44), and DSS (HR: 0.39).	Results from this study support the rationalisation of OSCC management at high-volume centres and in the hands of experienced surgeons for better patient survival. Head and neck surgeons should perform a minimum of 20 OSCC cases per year to maintain competency in OSCC ablation.
Marwah R [52]	2022	Queensland	Step 5: Care after initial treatment and recovery	Retrospective	To evaluate treatment delays, factors contributing to those delays and to explore	94	The study included 94 patients of which 70% experienced PORT delay. Surgery at an external facility (81% vs 56%, P = 0.006) and longer postoperative length of stay (P = 0.011) were significantly associated with a higher incidence of PORT delay. Aboriginal and Torres Strait Islander patients had a	This study demonstrates that the prevalence of PORT delay for patients with head and neck squamous cell carcinoma HNSCC remains high with room for improvement. Potential

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					strategies to mitigate them.		higher rate of PORT delay (89% vs 68.2%, $P = 0.198$). Significant delays were noted from time of surgery to radiation oncology (RO) consult and from RO consult to commencement of radiation treatment.	strategies to improve delays include developing effective care coordination, addressing specific needs of Indigenous patients, implementing reliable automated tracking and communication systems between teams and harnessing existing electronic referral systems.
Phung D [53]	2022	New South Wales	Step 5: Care after initial treatment and recovery	Retrospective	To present an institution's experience and survival outcomes for patients with head and neck cutaneous squamous cell carcinoma (HNSCC) and perineural spread (PNS).	45	Median follow-up was 16.1 months (range 1–107). The trigeminal nerve was most frequently involved ($n = 30$, 66.6%) followed by facial nerve ($n = 13$, 28.9%). Most patients underwent surgery followed by radiotherapy ($n = 33$, 73%) and eight received definitive radiotherapy. The median overall survival (OS) was 4.5 years (95% CI 3.71–5.38), median disease-specific survival 5.1 years (95% CI 4.21–5.97) and median disease-free survival (DFS) was 1.7 years (95% CI 1.11–2.22). The estimated 5-year OS and DFS were 45% and 25%, respectively. Patients treated with surgery and adjuvant radiotherapy with a clear proximal nerve margin had favourable DFS ($P = 0.035$) and trended towards better OS ($P = 0.134$) compared with patients with an involved nerve margin. Patients treated surgically with involved proximal nerve margins had similar outcomes compared with patients with treated definitive radiotherapy (HR 0.80, 95% CI 0.29–2.22, $P = 0.664$).	The likelihood of achieving a clear proximal nerve margin should be a strong consideration in the selection of appropriate patients for primary surgery
Pradhan P [80]	2025	New South Wales	Step 5: Care after initial treatment and recovery	Cross-sectional survey	To investigate unmet needs and healthcare utilisation of survivors of HNC in regional areas.	117	One hundred and seventeen responses were received (19% response rate). Participants were predominantly male (65%), had oropharynx cancer (52%), with mean age of 70.2 years. Some 54% of participants reported at least one unmet need, and 40% rated these unmet needs as 'strong'. Top unmet needs included concern about recurrence (24%), access to local services (15%), and financial support (15%). 94% of participants reported seeing their GP, while 62% visited a dental clinic; only 10% sought professional psychosocial support despite prevalent unmet needs.	Rural survivors of HNC in Australia have substantial unmet psychosocial needs yet demonstrate low utilisation of professional psychosocial support. This may reflect the limited availability or accessibility of services for this population, which could be addressed with shared models of care utilising both GP-led and telehealth services.
Reyes-Chicuellar N [29]		Northern Territory	Step 1: Prevention and early detection	Retrospective	To analyse Head and neck, salivary glands and aerodigestive tract cancers (HNACs) epidemiology, risk factors and survival outcomes in the NT, focusing on Indigenous and non-Indigenous Australians.	524	Of 612 potential cases, 524 were analysed, with 35.5% identifying as Aboriginal or Torres Strait Islanders. Predominantly affecting males (median age: 62 years), HNACs showed an age-standardised incidence of 21.9 per 100 000, with stable trends. The 5-year survival rate was 39.6%, notably lower in Indigenous Australians (25%) and remote areas (18%) vs the national average (68%). Oropharyngeal malignancies were common (36% survival). High-risk behaviours such as alcohol use (73%) and smoking (91%) prevailed. Most patients (73%) presented with advanced disease (stages III–IV), with one-third offered palliative care at diagnosis. P16-negative tumours predominated, with increasing P16-positive cases in non-Indigenous patients.	HNACs survival rates in the NT are significantly lower than the national average, especially among Indigenous Australians and remote residents. Targeted interventions are needed to improve service planning and delivery, considering identified risk factors and cultural sensitivities, and promoting Indigenous participation.
Shepard S [41]	2020	Victoria	Step 5: Care after initial treatment and recovery	Retrospective	To assess the relationship between age, comorbidities and post-operative outcomes in a tertiary head and neck unit.	253	A total of 253 (38.9%) patients were aged ≥ 70 years and 398 (61.1%) patients were ≤ 69 years. Age alone did not predict prolonged post-operative stay, perioperative complications nor perioperative mortality. Congestive cardiac failure and/or complicated diabetes were significantly associated with poor outcomes, as was male sex.	Patients of any age with cardiac failure or complicated diabetes have a higher rate of post-operative complications in head and neck surgery.
Smith J [85]	2023	Queensland	Step 5: Care after initial treatment and recovery	Cross-sectional survey	To quantify and describe the financial toxicity and out-of-pocket costs for	57	Of the 57 participants included in the study, 41 (72%) reported out-of-pocket expenses at a median of AUD 1796 (IQR AUD 2700) and a maximum of AUD 25,050. The median FIT score was 13.9 (IQR 19.5) and patients with high financial toxicity (n	Financial toxicity is associated with poorer HRQoL for many patients with HNC following treatment. Further research is needed to investigate interventions aimed

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					patients with HNC in regional Australia and to consider their relationship with quality of life. 2. Materials and Method		= 14) reported poorer HRQoL (76.5 vs. 114.5, $p < 0.001$). Patients who were not married had higher FIT scores (23.1 vs. 11.1, $p = 0.01$), as did those with lower education (19.3 vs. 11.1, $p = 0.06$). Participants with private health insurance had lower financial toxicity scores (8.3 vs. 17.6, $p = 0.01$). Medications (41%, median AUD 400), dietary supplements (41%, median AUD 600), travel (36%, median AUD 525), and dental (29%, AUD 388) were the most common out-of-pocket expenses. Participants living in rural locations (≥ 100 km from the hospital) had higher out-of-pocket expenses (AUD 2655 vs. AUD 730, $p = 0.01$).	at reducing financial toxicity and how these can best be incorporated into routine clinical care
Tan H [39]	2021	Victoria	Step 2: Presentation, initial investigations and referral	Retrospective	To assess the impact of the COVID-19 pandemic on the time to definitive management for head and neck cancer in a regional setting.	127	A total of 127 patients were identified, 64 in the pre-COVID and 63 in the post COVID period. In the post-COVID period, more patients (14.3%) had their first clinic appointment with telehealth compared to the pre-COVID period (1.6%). There was also no significant difference in time from referral to first clinic appointment or time from first clinic appointment to date of definitive treatment decision or multidisciplinary meeting. There was no significant difference in definitive treatment modality between groups.	Despite increased adoption of telemedicine and increased public health considerations, there was no increase in time to definitive treatment from the time of referral to a regional head and neck cancer service.
Thomas A [97]	2021	Victoria	Step 3: Diagnosis, staging and treatment planning	Retrospective	To examine data on a previously reported cohort of 101 patients with oral squamous cell carcinoma diagnosed at a single institution between 2008 and 2010.	100	The mean diagnostic delay was 4 months, mean overall survival was 5 years 6 months, and mean disease-specific survival was 4 years 9 months. No significant correlation was found between diagnostic delay and overall survival, disease-specific survival, or recurrence rates. Patients with node-positive disease were more likely to be diagnosed earlier, whereas women and non-smokers were more likely to have a delayed diagnosis. Inherent tumour biology is likely an important prognostic factor separate to diagnostic delay.	Public education efforts should focus on symptom recognition and encourage early presentation for investigation of oral lesions, particularly for females and non-smokers, so that more aggressive tumours can be treated sooner to give the best chance at survival.
Venchiarutti R [63]	2024	New South Wales	Step 5: Care after initial treatment and recovery	Prospective	To examine associations between patient health literacy (HL) and time intervals (defined in the Aarhus statement) along the pathway to treatment of head and neck cancer (HNC)	100	Health literacy quality (HLQ) Domain 2 (sufficient information to manage health) was significantly negatively associated with four intervals: the patient interval (first symptom to first presentation), primary care interval (first presentation to referral to secondary care), diagnostic interval (first presentation to diagnosis), and total interval (first symptom to treatment onset); correlation coefficients 0.25 to 0.27 ($P < 0.05$). Domain 8 (ability to find good information) was significantly negatively associated with three intervals (primary care interval, diagnostic interval, and total interval; correlation coefficients 0.23 to 0.34; $P < 0.05$).	Higher education, age, and comorbidity levels were associated with shorter patient and diagnostic intervals.
Venchiarutti R [82]	2023	New South Wales	Step 5: Care after initial treatment and recovery	Survey	To explore patient-reported experiences and satisfaction with regional outreach services for head and neck surgery in Australia.	128 (56% response rate)	Mean age 67.2 years, 46.1% female). Compared to the 2020 NSW survey, a higher proportion of patients in our cohort responded positively to 14 of the 26 questions, with the greatest differences observed for questions regarding waiting area comfort (+12.1%, $p = 0.008$), being informed about different treatment options (+9.5%, $p = 0.04$), and issues relating to parking (+9.5%, $p = 0.03$). A lower proportion of our sample responded positively to the question about whether health professionals knew enough about their medical history (-19.3%, $p < 0.001$). Respondents appreciated having a local clinic that helped them avoid travel to major cities and associated expenses and highlighted benefits of expert consultation and timeliness of investigations. However, cost of appointments and level of reimbursements remain barriers for some patients.	Patients had a high level of satisfaction with regional outreach clinics for head and neck surgery across most domains, indicating patients highly value this service
Venchiarutti R [62]	2023	New South Wales	Step 5: Care after initial	Retrospective	To describe the model of care and outcomes of HNL management at	100	Among the 100 patients referred for management of HNL, surgery was the most frequent treatment modality (80%; 70% with neck dissection) and 69% underwent radiotherapy.	Standardized, prospective measurement of treatment approaches and outcomes is needed to further evaluate the service.

First author	Year	State/National	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
			treatment and recovery		our institution, a high-volume centre for treatment of HNC in Australia, to inform other clinicians and institutions about current management patterns and treatment outcomes.		Manual lymphatic drainage (MLD) was most often prescribed (96%), followed by self-MLD (93%). Small but significant improvements in Assessment of Lymphoedema of the Head and Neck (ALPHA) measurements were observed for 50 patients (50%). Only 5/29 (17%) patients had post-treatment improvements on The M. D. Anderson Cancer Centre (MDACC) scale.	
Venchiarutti R [35]	2022	New South Wales	Step 3: Diagnosis, staging and treatment planning	Qualitative interview	To explore experiences of patients and carers of the pathway to diagnosis and treatment of head and neck cancer (HNC), focusing on differences based on remoteness of residence.	39 patients and 17 carers	Facilitators of timely diagnosis and treatment included a sense of urgency from health care professionals (HCPs), advocacy by the HCP or carers, and leveraging social capital. Distance to services, financial costs, and a perceived lack of emotional investment by HCPs arose as barriers to timely diagnosis and treatment. Participants were often able to rationalise that not all delays were negative, depending causes and expected impact on cancer management.	The findings highlight the complex nature of factors facilitating and impeding early HNC diagnosis and treatment that may be targeted in interventions to support patients and meet important benchmarks for high-quality cancer care.
Venchiarutti R [37]	2022	New South Wales	Step 2: Presentation, initial investigations and referral	Cross-sectional survey	To investigate the effect of geographical location of GPs on management of patients with symptoms suggestive of HNC.	196 out of 1803 GP's samples	A total of 1803 GPs were sampled, of which 196 responded (45 regional GPs and 151 metropolitan GPs). Less than half (48%) of regional GPs reported patients could expect to be seen by a specialist within 2 weeks of referral, compared to 70% of metropolitan GPs (p = 0.001). Most metropolitan GPs stated they would refer a patient with suspected HNC to a surgeon subspecialising in HNC. Regional GPs were split between ear, nose, and throat (ENT) and general surgeons	Availability of services was the most common factor influencing referral practices for regional GPs, whereas for metropolitan GPs, this was the patient's symptoms. Awareness of government resources for cancer referrals was generally low.
Venchiarutti R [98]	2020	New South Wales	Step 3: Diagnosis, staging and treatment planning	Retrospective cohort study	To examine geographic variations in survival and time intervals leading up to treatment for HNC at two tertiary referral centres in New South Wales.	224	Median time from symptom onset to treatment was longer for regional/remote patients with oropharynx SCC (4.7 vs. 3.8 months, P = 0.044) and oral cavity SCC (6.4 vs. 3.3 months, P = 0.003). Median time from diagnosis to treatment was longer for regional/ remote patients with oropharyngeal SCC (47 days vs. 36 days, P = 0.003). Time from surgery to adjuvant radiotherapy was longer among regional/remote patients with oral cavity SCC (66 vs. 42 days, P = 0.001). Overall survival did not differ based on remoteness.	Regional/remote HNC patients experienced longer times to diagnosis and treatment, and regardless of remoteness of residence, fewer than half of patients were treated within guideline recommended timeframes. Despite this non-adherence to guidelines, there were no differences in survival outcomes among this cohort. However, the impact of not meeting guidelines on patient outcomes other than survival warrants further investigation.
Widjaja W [101]	2023	New South Wales	Step 6: Managing recurrent, residual or metastatic disease	Online survey	To describe parameters associated with less than total thyroidectomy, and discharge from specialist follow-up in patients with low-risk well-differentiated thyroid cancer (WDTC) in Australia	119	The majority (59%) of respondents recommended less than total thyroidectomy and omission of RAI in patients with WDTC 90% of clinicians would continue specialist follow-up for at least 5 years. The majority of clinicians felt that patients experienced disproportionate fear of recurrence and were reassured by follow-up. After multivariable analysis, clinicians who participated in multidisciplinary teams (MDTs) were more likely to choose de-escalated care for both initial treatment (p = 0.005) and follow-up care (>5 years, p = 0.05).	Clinician attitudes captured by this survey reflect recent changes in guidelines towards hemithyroidectomy for low-risk WDTC, particularly amongst MDT attendees. There is a need to further examine the impact of de-escalated care on fear of recurrence and quality of life in thyroid cancer survivors.
Yung A [43]	2022	New South Wales	Step 4: Treatment	Retrospective	To describe the real-world outcomes, including complications and prognosticators of recurrence and survival, in a large dataset of patients with pT3/4 head and neck cutaneous squamous cell carcinomas	104	A total of 104 patients (median age 74, range 41–94 years) were included, 90% of which had pT3 tumours; 36.5% received adjuvant radiotherapy. Median follow-up was 24.3 (range 1.0–84.3) months. LRC at 5 years was 62.0%, DSS at 5 years was 83.7%, and OS at 5 years was 71.9%. Median time to recurrence was 8.4 months. LRC was reduced in the presence of margin involvement and previous treatment (radiotherapy/surgery). The major surgical complication rate was 9.6%.	More than 60% of patients treated surgically for pT3/4 head and neck cSCC were alive and free of disease at 5 years posttreatment. High-risk features such as margin involvement and having had previous treatment (radiotherapy/surgery) should be used to guide adjuvant therapy.

First author	Year	State/National	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
					(HNSCC) in the current era			
Yung A [69]	2022	New South Wales	Step 5: Care after initial treatment and recovery	Retrospective cohort study	To assess the validity of the surgical risk calculator (SRC) in patients undergoing microsurgical free flap reconstruction at an Australian tertiary referral centre.	200	For both ablative and reconstructive components, the SRC discriminates well for pneumonia and urinary tract infection, and it is calibrated well for readmission and sepsis, but it does not discriminate and calibrate well for any single outcome. SRC-predicted hospital LOS and actual LOS did not correlate well for the reconstructive component, but they correlated strongly for the ablative component.	The SRC is a poor predictor of postoperative complication rates and hospital LOS in patients undergoing head and neck microsurgical reconstruction.

Table 2. Summary of the evidence base – Grey literature (N=3)

First author	Year	State/National	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Department of Health [16]	2021	Victoria	Report	To present a summary of the analyses prepared for the Head and Neck Cancer Summit held in Melbourne on 12 October 2018.	N/A	The report highlighted several key variations for action as follows: 1. Many centres provide treatment for less than 10 patients per year (39 surgical, 12 RT). 2. Many patients have treatment outside their ICS of residence. 3. The proportion of patients with evidence of an MDM discussion was lower in BSWRICS and LMICS. 4. Fewer regional patients treated locally (66%) start their RT within eight weeks of diagnosis than regional patients treated in metropolitan (76%) and metropolitan patients treated in metropolitan centres (80%). 5. Of all patients having adjuvant RT, only 37% started within six weeks of surgery, with lower rates in BSWRICS and GICS and in one metropolitan and one regional centre. 6. The proportion of patients receiving dietetic care may be lower in regional treatment centres. 7. There was poorer survival for oropharyngeal cancer patients who were treated with RT only compared with other treatment types.	This work highlighted areas of care requiring further investigation and action to reduce variation and improve experiences and clinical outcomes for head and neck cancer patients across Victoria.
Moroney L [103]	2019	Queensland	Thesis	The overall objective of this thesis was to evaluate the incidence and severity of dysphagia and related toxicities of patients undergoing HIMRT +/- chemotherapy to inform speech pathology management practices. A secondary objective was to use this information to develop and then evaluate a new clinical pathway of care. These objectives were addressed in a series of 4 studies.	261	A high proportion of patients experienced grade 3 dysphagia with comparable or lower incidence of most other toxicities compared with traditional IMRT. Symptoms peaked in the final week of treatment and improved thereafter. However, most symptoms had not returned to baseline by 12 weeks post-treatment. Grade 3 dysphagia was twice as common for patients with T3-4 tumours compared to T2 tumours. The findings of Chapter 3 confirm the OPSCC patient group continue to be at "high risk" for dysphagia despite advances in conformal radiotherapy and should be prioritised for intensive speech pathology support. Findings confirmed that a very low proportion of patients experienced dysphagia or related toxicity requiring speech pathology support. If present, symptoms peaked in week 5 of treatment and resolved rapidly. The findings confirm this patient group is indeed at "low risk" for dysphagia and related toxicities during radiation treatment and represent a subgroup likely amenable to an alternative service delivery model.	This thesis provides information detailing the incidence, severity, and temporal pattern of dysphagia and related toxicities experienced by patients with HNC undergoing H-IMRT +/- chemotherapy to optimise supportive care and enhance patient education. These findings can be used to inform the timing and intensity of patient centred speech pathology service delivery models that meet the specific needs of patient subgroups and can form the basis of future guidelines for speech pathology support.
Venchiarutti, R [102]	2021	New South Wales	Thesis	To examine pathways to diagnosis and treatment of patients with HNC in New South Wales (NSW) with focus on the impact of remoteness of residence.	224	Three primary studies were conducted. A retrospective cohort study reports on 224 patients treated for oropharyngeal or oral cavity cancer at two centres from 2008-2013. Regional patients had longer times to treatment and post-operative radiotherapy (PORT) compared to metropolitan patients. Guideline adherence for timely treatment was generally poor regardless of residence. In a prospective cohort study conducted from 2018 to 2020, quantitative data from 100 patients showed regional patients still experience longer times to treatment, however time to PORT appears to be improving. Health literacy negatively correlated with several pre-treatment intervals as well as care coordination. Qualitative data showed facilitators to early diagnosis and treatment included availability of services, social capital, and experience with the health system; barriers included travel/distance to services, lack of emotional investment from healthcare providers (HCP), and symptom appraisal/interpretation by HCPs. A survey of general practitioners (GPs) showed 42% of regional GPs expected a patient to be seen by a specialist within two weeks of referral compared to 70% of metropolitan GPs.	Service availability was a driver of regional GPs' decision of where to refer to, though metropolitan GPs perceived patients' symptoms as the driving factor. Lastly, a narrative systematic review addresses the question of how health systems can be redesigned to address diagnostic and treatment intervals. In summary, the pathways to diagnosis and treatment of HNC are complex, requiring multidisciplinary and multi-system interventions to address disparities.

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