

**Delays in diagnosis of oral cancer a public health crisis affecting surgical outcomes-A Review**<sup>1</sup>Dr. Aryan Pratap, BDS, Goregaon Dental Centre, Goregaon<sup>2</sup>Dr Anoli Agrawal, BDS, MDS, Public Health Dentistry, ACPM Dental College and Hospital, Dhule.**Corresponding Author:** Dr. Aryan Pratap, BDS, Goregaon Dental Centre, Goregaon**Citation of this Article:** Dr. Aryan Pratap, Dr Anoli Agrawal, “Delays in diagnosis of oral cancer a public health crisis affecting surgical outcomes-A Review”, IJDSIR – September – 2026, Volume – 9, Issue – 4, P. No. 62 – 71.**Copyright:** ©2026, Dr. Aryan Pratap, et al. This is an open access journal and article distributed under the terms of the creative common's attribution non-commercial License. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given, and the new creations are licensed under the identical terms.**Type of Publication:** Review Article**Conflicts of Interest:** Nil**Abstract**

Oral cancer is one of the world's most prevalent cancers, with 377,713 new cases and 177,757 deaths reported annually worldwide, 90% of which are histologically diagnosed as oral squamous cell carcinoma (OSCC). However, despite this burden, the overall survival of patients with OSCC has remained only at 50-60% for the past 20 years, in stark contrast to improvements seen for breast, prostate and colorectal cancers. Between 50% and 80% of patients with OSCC are first diagnosed at TNM stages III or IV, where five-year survival plummets to 20-30% compared with over 80% for stage I disease. Diagnostic delay is clinically relevant as it is mechanistically associated with tumour growth, stage migration, and ultimately, complexity of surgery and survival. Patient delay is a major problem in South Asia, and this is due to the interplay of low health literacy, geographical access challenges, economic vulnerability and resorting to TM and CM. Professional delay is the single most modifiable intervention target. Structured fast-track referral pathways that have followed the UK two-week wait approach or the Danish accelerated

pathway have proven that a reduction in time-to-treatment can be achieved without reducing quality of treatment and are replicable in resource-poor environments. Diagnostic delay is not so much a matter of administration as a major factor that will impact the surgical outcome and a health priority that requires a multi-stakeholder effort from providers, patients and policymakers.

**Keywords:** Oral Cancer, Diagnostic Delay, Time-To-Treatment Initiation, Health System Delay, Public Health Intervention**Introduction**

Oral cancer is one of the world's most prevalent cancers, with 377,713 new cases and 177,757 deaths reported annually worldwide, 90% of which are histologically diagnosed as oral squamous cell carcinoma (OSCC)<sup>1,2,3,4,5</sup>. The burden of disease is disproportionately borne by South Asia - especially India, Pakistan, Sri Lanka and Bangladesh - due to widespread use of smokeless tobacco, areca nut and betel quid<sup>6,7</sup>. OSCC is the most common cancer among Indian men and accounts for almost one-third of all cancers

registered nationwide<sup>6</sup>. However, despite this burden, the overall survival of patients with OSCC has remained only at 50-60% for the past 20 years worldwide, in stark contrast to improvements seen for breast, prostate and colorectal cancers<sup>2,8,9</sup>.

The main reason for this poor outcome is not that effective treatment is unavailable but that most patients present at an advanced stage of disease. Between 50% and 80% of patients with OSCC are first diagnosed at TNM stages III or IV, where five-year survival plummets to 20–30% compared with over 80% for stage I disease<sup>1,6,10</sup>. Paradoxically, the oral cavity is the most accessible anatomical site of any solid tumour, readily examinable by visual inspection and palpation without specialised equipment. This suggests a systems-level failure that has been increasingly recognised as diagnostic delay<sup>2,11</sup>.

Diagnostic delay is conceptually complex, and the literature has historically suffered from inconsistent terminology — a methodological limitation that has hampered cross-study comparison and meta-analysis<sup>8,11</sup>. The 2012 Aarhus Statement aimed to clarify this terminology by establishing four landmark events (first symptom, first presentation, referral, diagnosis) and the intervals that they define: the patient interval (or total patient delay), which includes the appraisal and help-seeking intervals between symptom recognition and first contact with a health professional; the diagnostic interval (professional or health-care system delay) between first presentation and histological diagnosis; and the pre-treatment interval between diagnosis and commencement of treatment, also known as time-to-treatment initiation (TTI)<sup>8,12</sup>. The total of the three is the overall time from awareness of symptoms to initiation of definitive treatment.

Each interval is regulated by different factors. The patient interval is largely determined by awareness, symptom recognition, cultural factors, socioeconomic status and health literacy<sup>7,8,13</sup>. The diagnostic interval is a function of the capacity and responsiveness of primary health providers (general dentists, primary care doctors, referral specialists), referral processes, and biopsy reporting times<sup>1,14,15,16</sup>. The pre-treatment interval is predominantly a reflection of the capacity of the health-care system: access to multi-disciplinary cancer care, theatre availability, radiotherapy availability, and moves in care between diagnostic and treatment sites<sup>10,12,17</sup>. When prolonged, each of these intervals permits tumour progression — including lymph node involvement and stage migration — that compromises the likelihood of curative resection, narrows treatment options, and worsens surgical outcomes including disease-free and overall survival<sup>10,17,18</sup>.

This review was conducted with three aims: first, to describe and quantify the global burden of diagnostic delay in oral cancers by examining the median length of the patient, professional and pre-treatment intervals in both high-income countries (HICs) and LMICs; second, to assess the evidence of the association between delays and disease stage, surgical complexity, lymph node metastases and survival; and third, to recommend evidence-supported, practical public health strategies, such as opportunistic screening, education of health professionals and standardised diagnostic pathways, that may promote earlier detection among targeted risk populations. This review, which synthesises 28 primary and secondary studies from Asia, Europe, the Americas and Australasia, aims to reposition diagnostic delay as a crucial factor in surgical success and a potentially modifiable public health issue, rather than a marginal administrative issue.

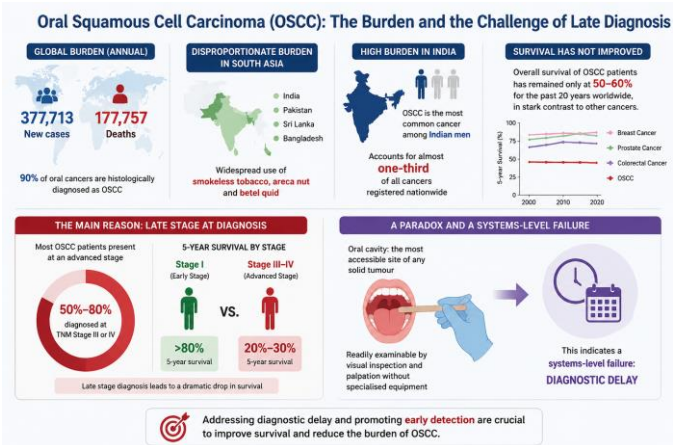


Figure 1

### Mapping The Global Landscape of Diagnostic Delay

The application of the Aarhus framework has enabled increasingly comparable estimates of diagnostic intervals across settings, yet wide geographic variation persists and reflects underlying healthcare system architecture. An analysis of 16 international studies published by Lauritzen and colleagues, which included 45,001 patients with OSCC from 14 countries, revealed considerable variation across studies, with the largest variance reported for patient delay<sup>10</sup>. A meta-analysis reported a weighted mean patient interval of 80.3 days (from 2,151 patients), with the shortest intervals (28-42 days) in Northern Europe and the longest (>150 days) in South Asia and Latin America<sup>8</sup>.

In high-income settings with universal healthcare and fast-track cancer pathways, both patient and system intervals are comparatively compressed. The Danish national cohort of 862 OSCC patients treated between 2000 and 2014 reported a median TTI of 31 days, which fell further to 27 days after the introduction of the 2007 fast-track programme mandating treatment initiation within 28–32 days of suspicion<sup>17</sup>. A large nationwide Taiwanese cohort of 5,743 cases from a population-based screening programme likewise reported a median treatment delay of 20 days, with 56.9% of patients treated within three weeks of histological diagnosis<sup>18</sup>. In

contrast, a cross-sectional study from Brazil of 182 OSCC and oropharyngeal cancer patients treated at a tertiary cancer centre in São Paulo found a median patient interval of 30 days, health system diagnostic interval of 90 days, and a pre-treatment interval of 90 days, resulting in a total interval that often exceeded 6 months.<sup>12</sup>

These figures are in contrast to those from South Asia. A prospective Indian study of 120 patients with OSCC at a tertiary cancer centre in Kerala reported a median primary (patient) delay of 90 days, a median secondary (professional) delay of 11 days and a total delay of 106 days, with more than half of patients presenting beyond three months after the onset of symptoms<sup>13</sup>. Another prospective study from North India including 150 patients found a median patient and professional delay of 60 and 45 days, and a median total delay of 120 days<sup>14</sup>. An Iranian observational study of 256 patients found an even longer mean patient delay of 8.2 months, but a much shorter professional delay of three weeks<sup>19</sup>. Most recent is a multi-centre Pakistani study of 152 OSCC patients, which used the Aarhus framework to calculate a median appraisal interval of 61 days, a patient interval of 89 days, and a diagnostic interval of 32 days, with 76.3% of patients having a patient delay of more than 30 days<sup>7</sup>.

The causes underlying these intervals differ substantially by setting. Across LMIC studies, four major causes of patient intervals are consistently reported: (1) lack of knowledge of early symptoms and risk factors of OSCC (up to 80% of Indian and Pakistani patients were not aware of oral cancer before diagnosis<sup>7,13,14</sup>; (2) use of traditional and complementary medicine (T&CM) before first visit, a factor unique to South Asia (65% of Pakistani patients used homeopathy, faith healing or herbal medicines before first contact with a medical practitioner; this confers a near six-fold increased risk of

help-seeking delay<sup>7</sup>; (3) rural living (quadruples the odds of appraisal delay in Pakistani data and lengthens total delay in Indian cohorts<sup>7,13,14</sup>; and (4) financial hardship and loss of income during illness (especially if the patient is the main earner in the family<sup>13,14</sup>. A review of 13 observational studies from both developed and developing countries found a lack of knowledge (among patients or professionals) to be the most frequent reported cause of delay globally<sup>1</sup>.

**Patterns in professional and system intervals** A UK case series of 35 delayed diagnoses of mouth cancers identified six common cases of red-flag symptoms being misdiagnosed: sudden-onset paraesthesia diagnosed as nerve compression, persistent swelling diagnosed as dental abscess, trismus and facial pain diagnosed as temporomandibular joint dysfunction, non-healing sockets following dental extraction, and facial fractures masking underlying malignancy<sup>10</sup>. These examples show professional delay is often not a result of negligence but due to overlapping diagnostic features between OSCC and benign oral pathology, which is compounded in a primary care environment where OSCC is rare. In the Brazilian São Paulo cohort, number of services visited prior to diagnosis was the strongest predictor of diagnostic interval delay, with hazard ratios for prolonged delay exceeding 10 in those who visited five or more services compared to those diagnosed at first visit<sup>12</sup>. The psychological component is also receiving attention: a scoping review of seven OSCC papers noted that cancerphobia (fear of diagnosis) is a cause of patient delay and reluctance of clinicians to both biopsy or deliver a cancer diagnosis<sup>20,21</sup>.

#### **Patient and Professional Determinants of Delays**

Understanding the determinants of delay is critical for implementing interventions. The evidence consistently identifies five modifiable patient-side determinants:

symptom appraisal, health literacy, socioeconomic status, cultural and psychological barriers, and access to primary dental care<sup>7,8,13,14,20,22,23</sup>. In the Swaminathan cohort from Kerala, literacy emerged as the sole statistically significant patient-side predictor ( $p=0.039$ ), with literate patients presenting with median total delays of 102 days compared with 126 days in illiterate patients<sup>13</sup>. Similarly, an Indian study of 226 OSCC patients found older age ( $>50$  years), single marital status, lower educational level, and monthly income less than ₹100,000 were independently associated with total delays of more than 40 days<sup>22</sup>. Patients at the highest socioeconomic disadvantage experienced a mean delay of 61.4 days compared with 48.7 days among those earning above ₹500,000.

Cognitive and psychological factors add further complexity. A systematic review of 13 studies examining the causes of delay in OSCC diagnosis, including in HIC and LMIC, identified that a lack of knowledge of the disease (especially the misinterpretation of persistent ulcers, red and white patches, or unexplained pain as benign lesions) was the most mentioned patient-related cause in all 13 studies<sup>1</sup>. Cancerphobia, denial, hope for self-resolution and self-treatment were less common but consistent themes<sup>1,20</sup>. Mauceri et al proposed that cancerphobia is a coping mechanism that shuns help-seeking even when there is an awareness of potentially serious symptoms in OSCC, and that this aspect is under-researched in OSCC compared to breast and cervical cancers<sup>20</sup>. COVID-19 has compounded this aspect, with downplaying of oral symptoms due to fear of contracting COVID-19 at hospital<sup>20</sup>.

On the professional front, there are four main causes of delay. First, lack of training in oral mucosal examination among primary care doctors and even general dentists results in non-recognition or misdiagnosis of

lesions<sup>1,6,14,15</sup>. In a North Indian prospective study of 150 OSCC patients, Sahu and colleagues report that 26 of 83 patients who had experienced professional delays of more than 1.5 months had visited doctors regularly but were treated with multivitamins, topical gels or analgesics instead of being advised biopsy<sup>14</sup>. Even for the 26 patients appropriately advised to undergo biopsy at the initial visit, diagnostic delays were more likely due to patient non-compliance, further prolonging the professional delay. Second, misdiagnosis of red-flag symptoms as common benign conditions (dental abscess, TMJD, traumatic ulceration, denture stomatitis) is evident in case-series reports and reflects a common cognitive bias of anchoring on more common differential diagnoses<sup>15</sup>. Third, biopsy and pathology turnaround time is a variable but potentially under-recognised factor. In a single-centre audit of 230 oral squamous cell carcinoma (OSCC) biopsies in India, turnaround times averaged 3.24 days for incisional biopsies and 11.88 days for excisional biopsies, with 10% of excisional biopsies taking longer than the target 14 days because of the need for deeper sections and bone decalcification<sup>16</sup>. Fourth, referral fragmentation - "service hopping" - in which patients seek care from more than one provider before being definitively diagnosed, can contribute. In Brazil, patients who consulted five providers had a 992% greater health system diagnostic interval than those diagnosed at first contact<sup>12,24</sup>.

A comparative observation emerges from studies explicitly examining dentist-versus-physician first contact. In Pakistan, patients with a first contact dentist had a significantly shorter appraisal delay than those consulting a physician, perhaps reflecting greater suspicion in the latter for oral mucosal lesions<sup>7,25</sup>. This has implications for the public health rationale for opportunistic screening by a dentist, as described below.

### **Impact on Staging, Surgical Outcomes, and Survival**

Diagnostic delay is clinically relevant as it is mechanistically associated with tumour growth, stage migration, and ultimately, complexity of surgery and survival. One meta-analysis of nine observational studies (934 early-stage and 961 advanced-stage cases) found that patients with a diagnostic delay had a greater likelihood of presenting with advanced stage (pooled odds ratio 1.32, 95% CI 1.07-1.62), and this effect was even more pronounced if delay was longer than one month (OR 1.69, 95% CI 1.26-2.77)<sup>3</sup>. The systematic review by Lauritzen and colleagues noted that three of six studies that evaluated patient delay and stage at diagnosis found a statistically significant association with advanced stage - and importantly, all three of these studies were from Asia (Thailand, India, Iran) where betel quid related buccal squamous cell carcinomas may behave differently<sup>10</sup>. By contrast, European/Australian studies were more likely to report no significant association, which was explained by shorter absolute delay times and increased tumour biological variability at presentation. At the individual patient level, the Swaminathan cohort found 55% of patients had T3 or T4 disease, 54% had nodal disease and the median total delay was 121 days in patients with advanced T-stage disease versus 83 days in T1-2 disease<sup>13</sup>. The Pakistan-based Amanat cohort also reported that advanced OSCC was associated with 5.4-fold and 7.7-fold increase in the odds of appraisal and patient delays respectively<sup>23</sup>. A Brazilian cohort of 182 patients found that 83.9% of the oral cavity squamous cell carcinomas (OCSCC) and 85.3% of oropharynx squamous cell cancers (OPSCC) were at stage III-IV, with prolonged health system diagnostic intervals and advanced disease<sup>12</sup>. The impact of these delays on survival is more complex and hinges on the interval considered. Time-to-treatment initiation

(TTI) has received the most attention as it is the most amenable to change through health system reform. In the largest national study to date, Su et al tracked 5,743 Taiwanese OSCC patients diagnosed between 2004 and 2009 and found that a treatment delay of more than six weeks was associated with a 46% increase in the hazard of death in univariable analysis and an 18% increase in the hazard after multivariable adjustment (adjusted HR 1.18, 95% CI 1.04-1.33)<sup>18,26</sup>. Importantly, treatment delays between three and six weeks were not significant after adjustment, implying a threshold at six weeks. Their results were consistent with large cohort studies from the USA and the Netherlands showing hazard ratios between 1.07 to 1.23 for TTI greater than 60-67 days<sup>8,10</sup>. Yet the Danish study of 862 OSCC cases treated in a fast-track program found that a statistically significant five-day longer TTI for overall survival (HR 1.05, 95% CI 1.02-1.07) observed in the univariate analysis disappeared after adjustment for age, sex, smoking status, UICC stage, tumour sublocation, and Charlson comorbidity index<sup>17</sup>. The authors suggested that only 6.5% of their patients had TTI greater than 60 days, and that for systems that achieve low waiting times, additional compression may have limited benefit. This "waiting-time paradox", where patients with small tumours sometimes wait longer than those with large tumours, has been reported elsewhere, and precludes simple dose-response modelling<sup>17</sup>. A recent scoping review of systematic reviews by González-Moles concluded that the available evidence supports a large negative impact of TTI on survival, although it remains partially unadjusted for tumour biology (growth fraction, growth kinetics)<sup>11</sup>. Waiting-time impacts on surgical complication and reconstruction. More advanced OSCC demands major ablative surgery (segmental mandibulectomy, neck dissection, free-flap

reconstruction) with associated increases in functional morbidity (speech, swallowing, mastication), hospital length of stay and costs<sup>6,10,13,17</sup>. The Danish cohort reported much longer median TTI for primary radiotherapy versus surgery alone (42 days vs 27 days), reflecting the additional pre-treatment work-up required for radiation therapy-based treatment of advanced disease<sup>17</sup>.

### **Public Health Interventions and the Path Forward**

The review of evidence above suggests a three level intervention agenda that is feasible: patient, provider, and health system. Recognising early OSCC signs such as persistent ulcers that do not heal within 3 weeks, red or white spots in the mouth which have not been diagnosed or explained, non-healing sockets, unilateral facial pain with otalgia, unexplained tooth mobility, modestly improves when targeted at the individual patient level through public awareness campaigns, although effects on stage at diagnosis are modest when these campaigns are delivered alone<sup>1,6,8</sup>. Capturing high risk groups (such as tobacco users, areca nut chewers, alcohol users) with targeted messaging is more cost-effective than mass messaging.<sup>6</sup> Analogous to the breast self-examination programmes, oral self-examination programmes are suggested as low cost adjuncts, especially in situations where regular dental visits are not common<sup>6, 13, 19</sup>. At the provider level, capacity building for primary care doctors and general dentists is considered as the most feasible intervention in LMICs. The Indian study of Varanasi found that the "nodal point" of delay in the low-resource setting was when patients did reach care, but were not given a prompt biopsy or referral – a delay that was attributable to the physician<sup>14,72</sup>. There are documented advantages of systematic instruction in the areas of visual oral examination, biopsy technique and red flag recognition in high- and low-income dental settings that

can significantly increase diagnostic yield<sup>6,15</sup>. The recommendation by Daniel and Rogers for the UK case series was to increase awareness and discussion of red-flag presentations, including those with sudden onset of paraesthesias and non-healing sockets after tooth extraction – and to refer any such cases to another dentist or medical practitioner after two weeks or less<sup>15,28</sup>. Pathology services: In the Priyadharshini single institution study at Chennai, a measurable quality improvement target was 'Turnaround time' which was defined as four days for incisional and 14 days for excisional biopsies<sup>16</sup>. The most impactful structural intervention at the health system-level is standardised referral pathways. The Cancer National Institute for Health and Care Excellence two-week wait rule, which specifies a 14-day period for specialist referral when cancer is suspected with persistent lesions of the mouth that last for more than three weeks, has been correlated with a mean decrease in diagnostic interval of around 21 days in cancer types<sup>8,15</sup>. The Danish fast-track pathway was implemented in 2007, and was found to lead to a 37% decrease in median TTI from 43 days before the pathway to 27 days after the pathway.<sup>17</sup> These guided pathways solve the issue of fragmented care that Martínez-Ramírez and colleagues reported in Brazil, in which diagnosis was delayed with multiple provider visits<sup>12</sup>. In particular, opportunistic screening should be considered in LMICs where population-based screening has been found to be cost-inefficient. Mohan and colleagues suggested that dental colleges spread across the districts in India could be used as a node to conduct opportunistic potentially malignant oral lesion (OPMLD) screening using existing patient traffic without the need for additional facilities<sup>6</sup>. Although the scope of the Kerala cluster-randomised trial was limited, the evidence it provided for the reduction in OSCC mortality for high-

risk tobacco and alcohol users using visual screening underpinned the subsequent high-risk screening programmes in Taiwan and Sri Lanka<sup>6,11</sup>. Another advantage of OPMD detection at routine dental visits is that lesions like leukoplakia, erythroplakia and submucous fibrosis can be found before they become symptomatic and during the window of opportunity for intervention, which is likely to be over 5-10 years prior to malignant transformation<sup>6,11</sup>. The use of digital and telemedicine approaches are becoming significant aids. A pilot study on the use of teledentistry for triage of suspicious oral lesions has been carried out in India and Brazil, and the use of AI for image classification in OPMD screening is a current research project<sup>2,12</sup>. Mobile health platforms are being used to conduct screening by CHWs in rural districts in India, providing a scalable approach in areas with low specialist density<sup>6</sup>.

## Conclusion

Diagnostic delay of oral cancer is a worldwide public health issue with quantifiable impact on oral cancer diagnosis, surgical complexity and survival. This evidence collated from 28 studies across five continents shows that the health system diagnostic interval (HDI) is the biggest contributor to the interval in hospital-based pathways, often taking 90 to 270 days, while the patient interval (PI) is the major contributor to the interval in LMICs, and is frequently this long. The delay in treatment initiation beyond 6 to 8 weeks is a separate risk factor in several large cohorts ranging between 1.04 to 1.46 Hazard Ratios, depending on setting and threshold. There are three conclusions that have implications for clinical practice and health policy. Patient delay is a major problem in South Asia, and this is due to the interplay of low health literacy, geographical access challenges, economic vulnerability and resorting to TM and CM. Interventions that address awareness alone

without the accompanying actions to increase access to health care and structural factors influencing help-seeking are unlikely to be effective. Second, while patient stories are more often given attention, professional delay is the single most modifiable intervention target. Capacity building of primary care physicians and general dentists, alongside solid referral protocols and auditing of turnaround times for pathology, are tangible gains that can be made within the current health system architecture. Third, structured fast-track referral pathways that have followed the UK two-week wait approach or the Danish accelerated pathway have proven that a reduction in time-to-treatment can be achieved without reducing quality of treatment and are replicable in resource-poor environments. The window for curative intervention in OSCC is broad, with tumour doubling times of about 99 days and malignant transformation interval of possibly 5-10 years for oral potentially malignant disorders offering ample opportunity to detect the disease if systems are set up to take advantage of this opportunity. The fact that there are so many patients who present with mutilating and advanced disease is not a reflection of the biology, it is a reflection of the design of health systems. Diagnostic delay is not so much a matter of administration as a major factor that will impact the surgical outcome and a health priority that requires a multi-stakeholder effort from providers, patients and policymakers.

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