J Cancer Allied Spec 2020;6(1):1

Review Article

# Tele-Oral Oncology: Reinvigorating Telemedicine in Oral Cancer Care

**Zaid H. Khoury, Ahmed S. Sultan**

Department of Oncology and Diagnostic Sciences, University of Maryland School of Dentistry, Baltimore, Maryland, USA

Received: 12 December 2019/Accepted: 19 December 2019



**Correspondence:** Ahmed S. Sultan, Department of Oncology and Diagnostic Sciences, University of Maryland School of Dentistry, Baltimore, Maryland, USA. Email: asultan@umaryland.edu

**Citation:** Khoury ZH, Sultan AS. Tele-Oral Oncology: Reinvigorating telemedicine in oral cancer care. J Cancer Allied Spec [Internet]. 2020 Jan.6; 6(1):XXX. https://doi.org/10.37029/jcas.v6i1.299



**Funding:** Nill.

**Competing interests:** Nill.

## Abstract

**Introduction:** In recent years, we have witnessed significant growth in the employment of technological advancements in health-care practices. These advancements have increased the practicality and utility of telemedicine applications. The aim of this focused review is to provide in-depth insights into the current state of telemedicine in oral oncology. **Observations:** Tele-oral oncology (TOO) is a rapidly emerging field and has provided new opportunities to transform oral cancer care into the 22nd century. This review will explore topics related to TOO as they pertain to consultation, oral cancer management in underserved areas, patient education and e-learning applications. **Conclusion and Relevance:** The utilisation of TOO is hindered by many challenges and this review addresses the potential limitations that prevent the integration of TOO in routine oral cancer care. A working model that circumvents the potential shortcomings of TOO is also proposed.

**Key words:** Digital medicine, head-and-neck cancer, oncology, oral oncology, telemedicine, teleoncology

## Introduction

Cancer is a global public health problem that continues to face treatment accessibility barriers in many medically underserved areas.[1] The Surveillance, Epidemiology and End Results program data of the National Cancer Institute indicate an overall increase in the number of cancer survivors.[2,3] Such an increase may be explained by improved health-care accessibility, particularly to remote and rural areas, and by enhanced methods of early detection. An important advancement that has contributed significantly to enhancing access to cancer care is the reemergence of telemedicine as a health-care delivery system.[4]

Telemedicine can generally be defined as using electronic telecommunication signals to transfer medical information from one clinician to another between distant locations for the purpose of facilitating the prevention, diagnosis and treatment of medical conditions or for the furtherance of research and education.[5,6] Early forms of telemedicine utilised telephone wires to transmit data. As technology advanced, the television was incorporated to facilitate medical consultations.[6] The mode by which these electronic signals are

transferred has shifted in recent years toward a more digitalised and wireless manner, accommodating the continuously evolving digital age we live in; hence, telemedicine now mostly relies (and soon exclusively) on high-speed internet. The Digital Medicine Society defines digital medicine as the field that supports and promotes the practice of medicine and human health using available high-end technological advances in software and hardware.[7] Applying the concepts of telemedicine to oncology is referred to as teleoncology. Teleoncology includes a spectrum of health-care services from consultation and diagnosis to treatment planning, follow-up and recall. Additional applications of teleoncology include research and education.[8]

Cancers of the head and neck account for the sixth most common cancer type worldwide, with the oral cavity being a common anatomic site of involvement.[9] Epidemiologic data on the incidence, morbidity and mortality of oral cancer are variable, especially across different populations, due to differences in genetic and environmental contributing factors.[10,11] In 2018, the International Agency for Research on Cancer estimated 354,864 new cases and 177,384 deaths from lip and oral cavity cancers with the highest incidence, 5-year prevalence and mortality being among Asian and European populations.[11]

While teleoncology has made significant strides in improving cancer-related quality of life, demonstrated adequate patient and provider satisfaction and has provided us with a multitude of potential applications,[1,8,12,13] there is limited information available about the extent and use of these technologies to advance oral oncology (Tele-oral Oncology [TOO]) in health care and academia.

The aim of this review is to provide focused in-depth insights into TOO to dental and medical specialists with an emphasis on consultation, oral cancer management in underserved areas, patient education and e-learning applications. In addition, light is shed on potential challenges and medicolegal considerations that health-care providers should consider when adopting TOO in their practices and of significance; future directions and a working model that circumvents the potential shortcomings of TOO will be proposed.

## The Current State of TOO

Many studies have concluded that telemedicine is viable and enhances health-care efficiency and other studies have acknowledged telemedicine as a promising complimentary approach when used alongside in-person consultations.[14] On the contrary, some studies argue that the effectiveness of telemedicine is considered highly variable depending on the field evaluated, with limited and inconsistent data on its effectiveness.[14] In the majority of studies, teleoncology is deemed beneficial in terms of screening, supportive and emotional care, palliative care, diagnosis and treatment[15] with some reported potential disadvantages necessitating further research to improve the discipline.[16] Although there is a paucity of studies that focus on TOO exclusively, an emergence of teleoncology in the past decade has become apparent. Moreover, the potential of TOO and its implications on health care and education will be discussed in the succeeding sections.

## Patient Education and Care

Teleoncology has been shown to be an effective and acceptable model to deliver cancer-related education and real-time monitoring post-diagnosis and post-treatment to patients through phone messaging, calls and video communications.[13,17] The patient acceptance has been positive due to the immediate access, reduced waiting times to communicate with their provider, the reduced cost (e.g., travelling long distances to appointments) compared to face-to-face appointments and the accessibility of medical advice and treatment planning from a multidisciplinary health-care team.[13,17,18] To establish optimal oral cancer care through TOO, a multidisciplinary team trained in telehealth models is crucial and this team would ideally consist of a gamut of dental and medical specialists such as oral medicine specialists, oral and maxillofacial pathologists, oral radiologists, oral and

maxillofacial surgeons, oncologists and maxillofacial prosthodontists. Such a multidisciplinary approach is crucial for comprehensive high-quality patient care and large specialty teams of this nature, especially in underserved areas, are otherwise difficult to achieve without telemedicine. Figure 1 proposes one such multidisciplinary TOO model. Although established virtual care centres for oral oncology currently operate in institutions in some countries,[19] disparities in health-care across countries have limited their widespread implementation.

## Outreach Services to Underserved Areas

Access to high-speed internet is central for delivering teleoncology services. Rural medically underserved populations exist in both developing and developed countries and represent the main challenge to TOO accessibility. High-income countries – such as the U.S., Germany, Norway, Japan, Australia and others – have adopted teleoncology services proposed to serve remote and rural populations.[1] While the primary focus of most reviews on the effectiveness of teleoncology has not been on rural populations,[15] there has been a multitude of initiatives in low- and middle-income countries that have gained success, such as in Brazil, India, Jordan, Russia and other countries.[1] Some telemedicine networks are provided by high-income countries to various countries of the developing world for clinical purposes in two areas; disaster relief and for second opinions.[20] Interestingly, the lack of high-speed internet services is not the only factor that hinders teleoncology services in remote areas, but rather, the demand for telemedicine in developing countries is not being met largely due to human factors such as perceiving a lack of value in these services and the lack of appropriately qualified telemedicine experts in these areas.[1,20] Likewise, such factors will indeed affect TOO adoption by developing countries, emphasising a crucial need for seminars and continuing education programs that spread awareness of the benefits of TOO for

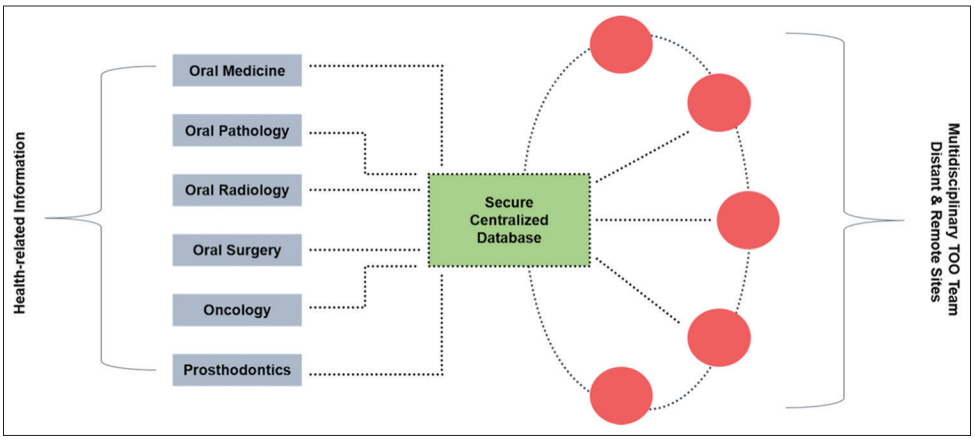


**Figure 1:** A working model for TOO. This proposed model consists of a secure entralized database that contains deidentified diagnostic and health-related information from the patient's primary site of oral cancer care. The primary site inputs health-related information from different individual databases. Oral medicine inputs the clinical images of the lesion and the relevant clinical history. Oral pathology inputs a virtually scanned histopathology slide (and slides with other diagnostic markers if applicable). Oral radiology inputs the radiographic images. Oral surgery inputs the tumour stage and proposed surgical plan. The oncology team inputs any genomic information and the proposed chemoradiation and/or immunotherapy plan. Maxillofacial prosthodontics inputs information of the proposed reconstruction plan. Experts from multidisciplinary specialties at remote or distant sites then access this secure entralized database that contains the holistic patient record. International experts from different disciplines of the multidisciplinary TOO team will be registered on a global database. This database will be used to locate experts with the relevant expertise to provide consultations. The TOO multidisciplinary team engages in consensus and provides expert consultation and treatment recommendations ensuring a precision medicine-centred approach. Note the dotted lines reflect the transfer of data

oral cancer patients in these countries. Dental hygienists and general dentists are often the first health professionals to detect abnormalities in the oral cavity, and hence, their awareness of the significance of TOO is indispensable. In fact, one study highlighted the importance of smart mobile phones as a reliable platform that facilitated consultation in cases related to oral medicine for general dentists and dental hygienists.[21] In this study, the agreement between tele-oral medicine diagnosis and the definitive clinicopathologic diagnosis issued by experts was 71% for premalignant and malignant lesions through using WhatsApp as the telemedicine platform.[21]

### Learning

Both developed and developing countries use telemedicine for either interactive or long-distance learning.[20] Indeed, internet-based resources are available for dental and medical students and residents who are involved in oral cancer health care. Examples include online case sharing websites such as Case of the Month by pathologyoutlines.com, surgical pathology cases by webpathology.com, the Image Challenge section of the New England Journal of Medicine and Case of the Month Archives offered by the University of Washington Dental School. Video conferences are also being used by consultants and senior health-care professionals to monitor the medical training of junior medical professionals involved in care administration in rural areas in real time.[22] Distant learning and training supervision can also be applied to TOO. The Bulletin Board for Oral Pathology is a platform where oral and maxillofacial pathologists, oral medicine specialists and other health specialists share opinions and announcements about oral health practices, research and teaching.

### Consultation

Oral and maxillofacial pathology and oral medicine are closely related specialties that are vital to oral cancer diagnosis and management; hence, clinicopathological correlation is important to reach a definitive diagnosis. This is particularly important when subjective macroscopic and microscopic criteria exist for the diagnosis of potentially malignant oral mucosal abnormalities or when complex cases of undifferentiated epithelial and mesenchymal malignancies occur. For example, a white well-demarcated flat lesion with no apparent cause can present microscopically as keratosis of unknown significance, epithelial dysplasia, carcinoma *in situ* or invasive squamous cell carcinoma, the most common malignancy of the oral cavity proper. Each of these microscopic diagnoses harbour a degree of intra- and inter-observer variability, and based on the diagnosis rendered, they can be managed differently[23] from minimally invasive treatments to extensive surgery and/or chemoradiation. Such lesions are often peer-reviewed or brought to consensus conferences for discussion which might need the input of experts at distant sites. This is a rather common scenario that outlines the significance of tele-oral medicine and pathology; two crucial components of TOO. Fortunately, histopathologic slides can be scanned (through Aperio ScanScope for instance) and shared on a common interactive platform. To date, there is a lack of regional, national and international platforms shared by health-care institutes that enable histopathology consults remotely.

### Limitations and Medicolegal Considerations

Potential barriers for TOO providers are likely to be related to differences in practice licenses' requirements between states and countries to render diagnoses and the absence of a sustainable reimbursement model for practitioners.[24] The initial financial cost of establishing TOO networks and platforms in developing countries is likely a significant limiting factor.[8] Experts in telehealth should be consulted when building TOO networks for the projected model to be sustainable and cost effective in the long run and to promote widespread implementation.[20,25,26]

The availability of specialists with relevant expertise is a notable limiting factor, especially

in underserved or rural areas. Therefore, in our proposed model [Figure 1], to overcome this human resource barrier, we envisage a registered database of global experts of all disciplines of the multidisciplinary TOO team that can provide consultation for cases from underserved or rural areas.

A potential limitation of image sharing in TOO is the production of low quality or out-of-focus photos to convey the clinical picture to distant health practitioners.[21] In addition, the lesion's consistency, texture, margins and involvement of surrounding structures may be difficult to ascertain without clinical palpation. Further, another shortcoming of TOO is that lymph node examination cannot be performed, thus limiting a thorough head-and-neck examination. When clinical or histologic static images are used as compared to real-time conferencing, a limited view angle or visual field of view can obscure key diagnostic features.[21,27] In addition, using imaging modalities for evaluating pigmented lesions can result in misdiagnosis of some cases (e.g., amelanotic melanoma).[27]

There has been a surge in the number of informal consultations on social media platforms such as Twitter; therefore, caution should be taken when accessing information from unverified sources.[28] In addition, the distinction between obtaining an informal virtual curbside consult and a formal consult should be established at the outset, as in the latter case, more serious medicolegal considerations exist. It is imperative that the patient's consent is obtained before sharing clinical information and importantly, the patient sensitive information or identifiers should not be shared when informal TOO consults are obtained. Moreover, diagnostic opinions that are shared publicly, especially if incorrect, may result in diagnostic delays and negative psychosocial consequences for patients. A cautious approach must be taken when interpreting opinions on diagnoses provided by respondents as the level of training and expertise can vary significantly between respondents and some may not be experts in the field.

The sharing of patient information across geographical locations is limited by institutional and sometimes jurisdictional policies. These policies are there to safeguard patient sensitive information. Hence, considerations of cybersecurity to prevent data breaches of the patient information must be taken into account when implementing TOO systems. Furthermore, stakeholders should maintain the privacy of patients' information when operating through TOO systems in a manner similar to in-person appointments by applying strict Health Insurance Portability and Accountability Act (HIPAA) standards. Adopting these practices should give patients a sense of trust in TOO systems that their health records are safely accessible and confidential.[8,29]

## Conclusions and Future Directions

TOO is expected to advance oral cancer care in the near future. Adopting TOO systems require the acceptance of all stakeholders involved while maintaining the same standards of health-care policies and regulations that govern personalised and confidential oral cancer management. This might necessitate centralising data and diagnostic material pooled from all arms of the multidisciplinary TOO team, into a digitalised seamless interactive platform [Figure 1]. Barriers such as initial cost, licensure hurdles and establishing universally accepted HIPAA compliant systems prevent the integration of TOO in routine oral cancer care. Nevertheless, with an anticipated increase in demand for TOO and with the progressive advancements in internet-based technologies, new policies and regulations issued by institutional and/or governmental bodies through the guidance of International Health Organizations are needed to initiate the widespread access of multisite HIPAA compliant TOO systems. This will ensure access to patient electronic health information to all members of the multidisciplinary TOO team across different national and international sites.

## Conflicts of Interest

The authors declare that there are no conflicts of interest.

## References


1. Hazin R, Qaddoumi I. Teleoncology: Current and future applications for improving cancer care globally. Lancet Oncol 2010;11:204-10.
2. Bluethmann SM, Mariotto AB, Rowland JH. Anticipating the "silver tsunami": Prevalence trajectories and comorbidity burden among older cancer survivors in the United States. Cancer Epidemiol Biomarkers Prev 2016;25:1029-36.
3. Phillips SM, Padgett LS, Leisenring WM, Stratton KK, Bishop K, Krull KR, *et al*. Survivors of childhood cancer in the United States: Prevalence and burden of morbidity. Cancer Epidemiol Biomarkers Prev 2015;24:653-63.
4. Bashshur RL, Reardon TG, Shannon GW. Telemedicine: A new health care delivery system. Annu Rev Public Health 2000;21:613-37.
5. Perednia DA, Allen A. Telemedicine technology and clinical applications. JAMA 1995;273:483-8.
6. World Health Organization. Telemedicine: Opportunities and Developments in Member States: Report on the Second Global Survey on eHealth 2009. Geneva: World Health Organization; 2009.
7. Digital Medicine Society (DiMe). Available from: https://www.dimesociety.org. [Last accessed on 2019 Dec 12].
8. Wysocki WM, Komorowski AL, Aapro MS. The new dimension of oncology. Teleoncology ante portas. Crit Rev Oncol Hematol 2005;53:95-100.
9. Argiris A, Karamouzis MV, Raben D, Ferris RL. Head and neck cancer. Lancet 2008;371:1695-709.
10. García-Martín JM, Varela-Centelles P, González M, Seoane-Romero JM, Seoane J, García-Pola MJ. Epidemiology of oral cancer. In: Oral Cancer Detection. Berlin, Germany: Springer; 2019. p. 81-93.
11. International Agency for Research on Cancer. Available from: https://www.gco.iarc.fr. [Last accessed on 2019 Dec 12].
12. Datta NR, Rajasekar D. Improvement of radiotherapy facilities in developing countries: A three-tier system with a teleradiotherapy network. Lancet Oncol 2004;5:695-8.
13. Wolfgang K. Telemedicine Expands Oncology Care Options. Philadelphia, PA: LWW; 2019.
14. Khairat S, Haithcoat T, Liu S, Zaman T, Edson B, Gianforcaro R, *et al*. Advancing health equity and access using telemedicine: A geospatial assessment. J Am Med Inform Assoc 2019;26:796-805.
15. Hailey D, Paquin MJ, Maciejewski O, Harris L, Casebeer A, Fick G. The Use and Benefits of Teleoncology. Canada: Inst Heal Econ.; 2007.
16. Brigden M, Minty A, Pilatzke S, Vedova LD, Sherrington L, McPhail K. Strengths and weaknesses of teleoncology. Oncol Exch 2008;7:8-12.
17. Kidd J, Raphael D, Cassim S, Black S, Blundell R, Egan R. Health service provider responses to indigenous peoples with cancer: An integrative review. Eur J Cancer Care (Engl) 2019;28:e12975.
18. Sabesan S, Kelly J. Are teleoncology models merely about avoiding long distance travel for patients? Eur J Cancer Care (Engl) 2014;23:745-9.
19. Varkey P, Liu YT, Tan NC. Multidisciplinary treatment of head and neck cancer. In: Seminars in Plastic Surgery. New York: Thieme Medical Publishers; 2010. p. 331-4.
20. Wootton R. Telemedicine support for the developing world. J Telemed Telecare 2008;14:109-14.
21. Petruzzi M, De Benedittis M. WhatsApp: A telemedicine platform for facilitating remote oral medicine consultation and improving clinical examinations. Oral Surg Oral Med Oral Pathol Oral Radiol 2016;121:248-54.
22. Cameron M, Ray R, Sabesan S. Remote supervision of medical training via videoconference in Northern Australia: A qualitative study of the perspectives of supervisors and trainees. BMJ Open 2015;5:e006444.
23. Villa A, Woo SB. Leukoplakia-a diagnostic and management algorithm. J Oral Maxillofac Surg 2017;75:723-34.
24. Majeed A, Lakhani M, Ashraf A, Grewal US, Thirunagari P, Wahab A, *et al*. Teleoncology: Prospects and challenges for cost effective cancer care. J Clin Oncol 2019;37 Suppl 15:e23182.
25. Wootton R, Bonnardot L. Telemedicine in low-resource settings. Front Public Health 2015;3:3.
26. Vassallo DJ, Swinfen P, Swinfen R, Wootton R. Experience with a low-cost telemedicine system in three developing countries. J Telemed Telecare 2001;7 Suppl 1:56-8.
27. Coates SJ, Kvedar J, Granstein RD. Teledermatology: From historical perspective to emerging techniques of the modern era: Part II: Emerging technologies in teledermatology, limitations and future directions. J Am Acad Dermatol 2015;72:577-86.
28. Terry M. Twittering healthcare: Social media and medicine. Telemed J E Health 2009;15:507-10.
29. Parimbelli E, Bottalico B, Losiouk E, Tomasi M, Santosuosso A, Lanzola G, *et al*. Trusting telemedicine: A discussion on risks, safety, legal implications and liability of involved stakeholders. Int J Med Inform 2018;112:90-8.


## Authorship Contributions

Conceived and designed the analysis; ZHK, AS, Collected the data; N/A, Contributed data or analysis tools; N/A, Performed the analysis; N/A, Wrote the paper; ZHK, AS.