

## Teledentistry for Improving Oral Medicine Diagnosis: A Systematic Review

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### Abstract

Teledentistry is an application that delivers dental care, consultations, treatment plans, and follow-up through electronic transmission from distant locations that can be done in real-time or offline. This article presents a systematic review of the use of teledentistry to overcome diagnosis difficulties in the field of oral medicine.

Electronic databases were searched to find appropriate articles written in English that were published from March 2009 to March 2019. Literature searches were conducted from relevant databases, such as PubMed/Medline, SpringerLink, ProQuest, and Science Direct. The strategies consisted of subject and keywords searches.

Among the 100 potential articles observed, only 7 articles met the inclusion criteria. These articles demonstrated the ability of using teledentistry in the field of oral medicine in remote areas. Most of the studies used smartphone teledentistry applications to perform consultations and clinical examinations, diagnose oral lesions, and make oral medicine referrals.

This systematic review acknowledged scientific literature in the use of teledentistry as a method to enhance diagnosis in the field of oral medicine. Further study is needed to elaborate on teledentistry usage in oral medicine.

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### Introduction

Oral cancer is a type of head and neck cancer that is the 6th most common type of cancer in the world.<sup>1</sup> A study by Ghantous et al. stated that, in 2012, there were 369,200 new cases of oral cancer in the world. Two-thirds of all oral cancer cases were found in developing countries, with the highest incidence in South Asia and South East Asia.<sup>2</sup> Oral cancer patients often search for medical assistance when the disease had already reached an advanced stage, which eventually results in the high morbidity and mortality rate seen in these patients. However, when oral cancer is detected at an early stage or still in the form of a potentially malignant oral disease, a better prognosis is possible. In the last 10 years, few studies have been published about

oral cancer in Indonesia. In 2018, an Indonesian national health research study stated that only 0.1% of lesions were suspected as being oral cancer.<sup>3</sup>

There are several reasons for the delay of oral cancer detection in its early stage. Among those are people's lack of knowledge about oral soft tissue lesions that should be examined by a dentist<sup>4</sup> or the lack of dentists' awareness of oral mucosal lesions.<sup>5</sup> Dentists are the first line of medical staff who are supposed to be capable of detecting potentially malignant oral disease in its early stage. However, some studies have shown that dentists may find it difficult to do so. A study in Italy by Colella et al. found that dentists lacked knowledge about and awareness of oral cancer problems, and were less practiced in detecting them.<sup>6</sup> Kujan et al. studied the differences among general dentists and dental specialists in England and found a gap in the general dentists' awareness of oral cancer risk factors and the application of prevention procedures.<sup>7</sup> Zadik et al. found that dental specialists were less able to evaluate the presence of oral cancer in comparison to oral medicine specialists, when

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interpreting pictures of oral mucosal lesions.<sup>8</sup> To date, there are no studies on Indonesian dentists' capability to detect oral mucosal lesions, especially oral premalignant lesions, and the associated influencing factors. As an archipelago, Indonesia has 31 dental schools with 35,854 dentists, of which 89% are general practitioners and 4% are oral medicine specialists. The low number of Indonesian oral medicine specialists and the geographical condition of this archipelago country might contribute to the delayed detection of oral cancer in dental patients. These conditions are obstacles to implementing a dental safety net for populations in remote areas that are difficult for dental health services personnel to reach.<sup>9</sup>

The difficulties in accessing dental health services, especially dental specialists, are not just experienced in a developing country, such as Indonesia. Some developed countries that have vast remote areas, such as Australia, Ireland, and Canada, also experience the same problems.<sup>10-12</sup> In these developed countries, an improvement of information technology in dentistry, an application known as teledentistry, is used to overcome these problems.<sup>13</sup>

Teledentistry is an application that provides dental care, consultations, treatment plans, and follow-up in real-time or offline through electronic transmission from a distant location.<sup>14</sup> This application is used to establish diagnostic accuracy and to make referrals for health professionals in remote areas or those located far from a health specialist. Teledentistry can be a very useful, effective, and efficient tool in developed countries with vast, remote areas.

In the past few years, there have only been studies on using teledentistry to detect dental caries; few studies have reported on the use of teledentistry in oral medicine.

This article aims to present a systematic review of the literature on the use of teledentistry in the field of oral medicine in order to overcome diagnosis difficulties, especially in detecting oral lesions and potentially malignant oral disorders.

## Materials and methods

### Search Strategy

In this study, teledentistry in oral medicine is defined as the use of communication and information technologies to provide clinical services in the field of oral medicine from a

distance. Electronic databases were searched to find relevant articles, written in English, and published from March 2009 to March 2019. Literature searches were conducted using PubMed/Medline, SpringerLink, ProQuest, and Science Direct. The strategy included subject and keyword searches. The search query included teledentistry, oral medicine, oral lesion, oral disease, and diagnosis.

### Selection Criteria

Studies were included if they addressed the use of information technology in the oral medicine field, such as smart phones and applications, digital photography, e-mail, and applications designed especially for teledentistry. Studies were excluded if they only investigated the management of oral hard tissue. Studies were also excluded if they provided insufficient information, only included the abstract, or were systematic reviews or case reports.

Based on the identified criteria, possible appropriate articles were determined first by examining the title and abstracts from the database searches. Complete articles were then retrieved and assessed for relevance. When the articles did not meet the inclusion criteria, they were excluded. The inclusion and exclusion criteria consistent with this review's purpose are outlined in Table 1.

Criterion	Inclusion	Exclusion
<b>Time period</b>	March 2009 to March 2019	Any study outside these dates
<b>Language</b>	English	Non-English
<b>Type of article</b>	Journals, articles, conference proceedings and availability of documents (free) and published through the field of dentistry and oral medicine	Other publication and paid
<b>Study focus</b>	Oral lesion, oral disease, oral medicine	Other lesions
<b>Area of interest</b>	Teledentistry	Non-teledentistry
<b>Setting</b>	Any	None

**Table 1.** Inclusion and exclusion criteria.

### Data Extraction and Outcome Measure

The articles were reviewed and a data extraction form was used to include details pertaining to the study quality, such as study design, country or location of the study, number of subjects, and the study result.

## Results

Initially, 103 records were identified, which resulted in 100 articles after duplicates were removed. Of these, 93 articles were excluded since they did not correspond to the aim of this systematic review. As shown in Figure 1, only 7 of the 100 eligible studies were retained and included in this study.<sup>15-21</sup> Since only 7 studies on the use of teledentistry in the field of oral medicine were published from 2010 to 2019, its use in the oral medicine field is both recent and infrequent Table 2.

### Location

Of the 7 studies analyzed, 3 were performed in developed countries: Italy, Australia, and Ireland. Four studies were performed in developing countries. Among the developed countries, three countries, Brazil, Australia, and India, have a vast area that encompasses more than 3 million square kilometers. Only Ireland can only be considered to be an archipelago country. These studies showed the ability of using teledentistry to reach remote areas.

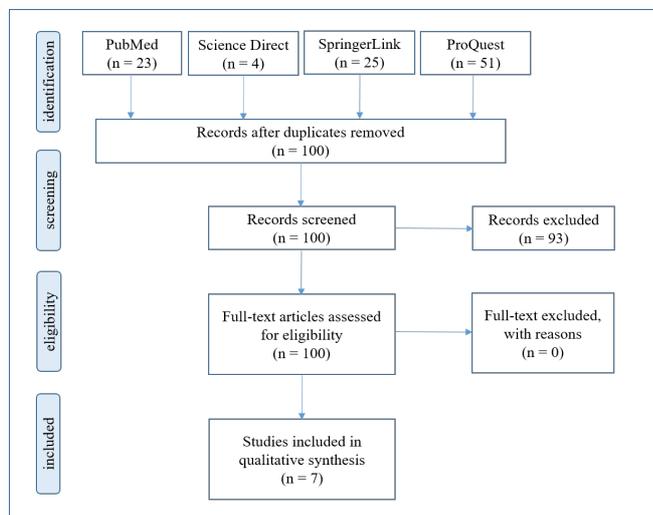


Figure 1. Selection process of the studies.

### Technology Used in Teledentistry

The studies in this literature review mostly investigated using the teledentistry application on a smartphone. Two studies used the WhatsApp® application, which showed the facilitation of faster communication provided by teledentistry,<sup>15</sup> with substantial agreement in comparison to clinical examination.<sup>17</sup> Two studies used a smartphone camera to take pictures of oral lesions to be sent or temporarily stored before being examined by

specialists in a distant location or at a different time.<sup>19,21</sup> One study used e-mail to send oral lesion pictures to a distant consultant, which achieved 80% sensitivity.<sup>18</sup> The study in Australia used an application especially designed for teledentistry, which was using a smartphone and cloud-based store-and-forward technology.<sup>19</sup>

### The Use of Teledentistry in Oral Medicine

Most of the studies used teledentistry in oral medicine for diagnostic purposes or for screening oral lesions and potentially malignant oral diseases. However, one study also used teledentistry to deliver continuing oral medicine education to improve dental professionals' knowledge about oral cancer detection.<sup>16</sup> All the studies involved dental or medical professionals applying teledentistry, but one study also involved patients;<sup>15</sup> that study found that WhatsApp and similar applications can facilitate daily interactions between patients and dentists.

ID	Year of publication	Year range of the study	Country of the study	Technology used in teledentistry	Main study finding
Bradley et al.	2010	2010	Northern Ireland	Video, digital photography	Teledentistry can be used in the management of patients with oral mucosal disease
Torres-Pereira et al.	2012	2012	Southern Brazil	E-mail	The sensitivity of tele-diagnosis using e-mail from distant consultants can achieve 80% sensitivity
Estai et al.	2015	2015	Australia	Smartphone and cloud-based store and forward technology	Good concordance between teledental and face-to-face oral assessment
Petruzzi et al.	2016	2013-2015	Italy	WhatsApp	WhatsApp and similar applications can facilitate daily patient-doctor interaction and provide faster clinical communication between oral health professionals
Roxo-Goncalves	2017	2014-2015	Brazil	e-learning education platform	Teledentistry can be used to deliver continuing oral medicine education to improve better knowledge in oral cancer detection
Haron	2017	2017	Malaysia	Mobile phone	Teledentistry can be integrated into clinical settings for patient management
Vinayagamorthy	2019	Jan-Jun 2017	India	WhatsApp	Screening for OPMD comparison between clinical exam and WhatsApp resulted in a substantial agreement

Table 2. Details of the included set of articles in the systematic review.

## Discussion

The findings of this systematic review show that teledentistry is a new approach that can overcome the difficulty in the field of oral medicine felt by dental health professionals. Despite the differences or variations used in each study, all used the advancement in

telecommunication services and technology to alleviate the difficulty of experienced by health services personnel, especially in oral medicine, in rural or remote areas. Variations in the uses of smartphones, e-mails, and special applications designed for teledentistry can be attributed to the ability and provided resources of each study.

WhatsApp is a common smartphone application that can be used by health professionals and patients to enhance communication on a daily basis; it is also useful in terms of teledentistry.<sup>15,17</sup> Smartphones with a digital camera are useful for taking photos, sending them for distant consultation, or storing them before the specialist can access and review them. The use of mobile phones or smartphones with applications, such as WhatsApp, seems to enhance the ability of dental practitioners to use teledentistry in their daily practice.

The reviewed studies showed that the use of teledentistry may enhance the accuracy for screening potentially malignant oral disorders.<sup>17,21</sup> Teledentistry can also be used to promote continuing dental education in oral medicine, which has been shown to improve health professionals' ability to detect oral cancer.<sup>16</sup> Teledentistry is offered to solve the problem of uneven dentist distribution throughout vast areas of a country to enhance the early diagnosis of oral cancer premalignant oral lesions. The low ability of general practitioner dentists to diagnose oral lesions causes a delay in identifying them or referring patients for care; this is especially true for malignant oral lesions, resulting in high morbidity and mortality in patients. A study to determine the types of difficulties faced by general practitioner dentists could help design the appropriate model of teledentistry to be applied. A systematic review by da Costa Flores et al. assessed the efficacy of teledentistry to improve care related to diagnosis and management of oral lesions, but it also admitted the need for further study regarding this matter.<sup>22</sup>

Despite all the advantages of teledentistry, existing concerns and challenges should be carefully considered.<sup>23</sup> Revisiting regulations, developing guidelines, and reaching consensus among countries should be encouraged to overcome any disadvantages that might occur in mobile health. Technical issues, the lack of funding, consent issues, and cognitive impairment of personnel involved in teledentistry

are other challenges that might be barriers to implementing teledentistry.<sup>24</sup> Integration of teledentistry in primary oral health care has the potential to address the dental needs and access-to-care of rural communities.<sup>10</sup>

More research is needed to provide evidence of the benefits of teledentistry, especially in Indonesia, which is one of the largest archipelagos where oral health is still a burden.<sup>25,26</sup> Exploration of dentists' perceptions, willingness, preparedness, and concerns, and the development of an appropriate model of teledentistry are focus areas of studies that need to be conducted as a basis of teledentistry implementation in Indonesia.

## Conclusions

This systematic review identified scientific literature on the use of teledentistry in the field of oral medicine. Most of the reviewed studies used teledentistry for consultations, clinical examinations, diagnosing oral lesions, and making oral medicine referrals.

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## Declaration of Interest

The authors report no conflict of interest.

## References

1. Warnakulasuriya S. Global epidemiology of oral and oropharyngeal cancer. *Oral Oncol.* 2009;45(4-5):309-16.
2. Ghantous Y, Abu Elnaaj I. Global incidence and risk factors of oral cancer. *Harefuah.* 2017;156(10):645-9.
3. Kemenkes RI. Laporan Nasional\_RKD2018\_FINAL.pdf. *Riskesmas* 2018. 2018:182-3.  
[http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan\\_Nasional\\_RKD2018\\_FINAL.pdf](http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf). Indonesian.
4. Mcleod NMH, Saeed NR, Ali EA. Oral cancer: Delays in referral and diagnosis persist. *Br Dent J.* 2005;198(198):681-4.
5. Ergun S, Özel S, Koray M, Kürklü E, Ak G, Tanyeri H. Dentists' knowledge and opinions about oral mucosal lesions. *Int J Oral Maxillofac Surg.* 2009;38(12):1283-8.
6. Colella G, Gaeta GM, Moscariello A, Angelillo IF. Oral cancer and dentists: Knowledge, attitudes, and practices in Italy. *Oral Oncol.* 2008;44(4):393-9.
7. Kujan O, Duxbury A, Glenn A, Thakker N, Sloan P. Opinions and attitudes of the UK's GPs and specialists in oral surgery, oral medicine and surgical dentistry on oral cancer screening. *Oral Dis.* 2006;12(2):194-9.
8. Zadic Y, Orbach H, Panzok A, Smith Y, Czerninski R. Evaluation of oral mucosal diseases: Inter- and intra-observer analyses. *J Oral Pathol Med.* 2012;41(1):68-72.

9. Edelstein B. The dental safety net, its workforce, and policy recommendations for its enhancement. *J Public Health Dent.* 2010;70 Suppl.1:S32-9.
10. Emami E, Kadoch N, Homayounfar S, et al. Patient satisfaction with E-Oral health care in rural and remote settings: a systematic review protocol. *Systematic Reviews.* 2017;6(1):174.
11. Skelton-Macedo MC, Haddad AE, Antoniazzi JH. Teledentistry in Brazil. *Teledentistry.* 2015:87-100.
12. Inquimbert C, Malthierry E, Arzens G, et al. Teledentistry in France: Example of the e-DENT Project. *E-Health Care in Dentistry and Oral Medicine.* Springer International Publishing; 2018:143-54.
13. Jampani N, Nutalapati R, Dontula B, Boyapati R. Application of teledentistry: a literature review and update. *J Int Soc Prev Community Dent.* 2011;1(2):37-44.
14. Estai M, Kruger E, Tennant M. Optimizing patient referrals to dental consultants: Implication of teledentistry in rural settings. *Australas Med J.* 2016;9(7):249-52.
15. 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(3):248-54.
16. Roxo-Gonçalves M, Strey JR, Bavaresco CS, et al. Teledentistry: A tool to promote continuing education actions on oral medicine for primary healthcare professionals. *Telemed e-Health.* 2017;23(4):327-33.
17. Vinayagamoorthy K, Acharya S, Kumar M, Pentapati KC, Acharya S. Efficacy of a remote screening model for oral potentially malignant disorders using a free messaging application: A diagnostic test for accuracy study. *Aust J Rural Health.* 2019;27(2):170-6.
18. Torres-Pereira CC, de Almeida Castro Morosini I, Fonseca BB. Teledentistry and the distant diagnosis of oral mucosal disease. In: Kumar S. (eds) *Teledentistry.* Health Informatics. Springer, Cham. 2015: p.13-21.
19. Estai M, Kanagasigam Y, Xiao D, et al. A proof-of-concept evaluation of a cloud-based store-and-forward telemedicine app for screening for oral diseases. *J Telemed Telecare.* 2016;22(6):319-25.
20. Bradley M, Black P, Noble S, Thompson R, Lamey PJ. Application of teledentistry in oral medicine in a Community Dental Service, N. Ireland. *Br Dent J.* 2010;209(8):399-404.
21. Haron N, Zain RB, Nabillah WM, et al. Mobile phone imaging in low resource settings for early detection of oral cancer and concordance with clinical oral examination. *Telemed e-Health.* 2017;23(3):192-9.
22. da Costa Flores AP, Lazaro SA, Molina-Bastos CG, de Oliveira Guattini VL, Umpierre RN, Goncalves MR, Carrard VC. Teledentistry in the diagnosis of oral lesions: A systematic review of the literature. *J Am Med Info Assoc.* 2020;27(7):1166–72.
23. Marya A, Venugopal A, Karobari MI, Messina P, Scardina GA, Subramanian AK. The exponential rise of teledentistry and patient-oriented protective measures in Southeast Asian dental clinics: Concerns, benefits, and challenges. *Int J Dent.* 2021:9963329.
24. Tan SHX, Lee CKJ, Yong CW, Ding YY. Scoping review: Facilitators and barriers in the adoption of teledentistry among older adults. *Gerodontology.* 2021;38(4):351-65.
25. Agustanti A, Rosalien R, Hutami DF, Septalita A, Rahardjo A, Maharani DA. Dental caries in 12-year-old school children living in Jakarta. *J Int Dent Med Res.* 2018;11(1):238–42.
26. Badruddin IA, Muthia K, Darwita RR, Setiawati F, Adiatman M, Maharani DA, Rahardjo A. Relationship between oral health status and stunting in 5-year-old children in Indonesia. *J Int Dent Med Res.* 2021;14(3):1039–43.