

# Opportunities for Teledentistry in South Africa

SADJ September 2015, Vol 70 no 8 p342 - p346

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## ABSTRACT

Information, communication and technology (ICT) is a part of everyday life, and the constant evolution of technology has resulted in many opportunities for the health care sector. While health professionals globally have embraced the use of ICT to assist in the delivery of health care services and education there remains a lack of scientific evidence to support the practice. The uptake of ICT in low and middle-income countries has been slow, despite the fact that this is where a great need for innovative solutions is required to improve the delivery of health care services. ICT for health is being used throughout South Africa with promising results, and there is potential for the use of ICT in the field of Dentistry. This paper provides a background of ICT for health by highlighting the applications of telemedicine, teledentistry and mHealth and examples are given of the various uses of ICT in the various disciplines of Dentistry. The benefits and challenges of teledentistry are documented and recommendations about the use of teledentistry in South Africa are discussed.

**Key words:** Telemedicine, Teledentistry, Teleradiology, mHealth, eHealth

## INTRODUCTION

Low and middle-income countries account for the highest disease burden and are faced with the challenge of being under-resourced in terms of human and financial factors.<sup>1,2</sup> While Africa accounts for only 10% of the world's population, it has 25% of the global disease burden and 3% of the entire global health workforce.<sup>3</sup> Despite the relatively high national expenditure on health services, the health status of the South African population compares very poorly with that of many other countries.<sup>4</sup> The South African Government, with the assistance of various international organizations, has made many attempts to address the various challenges faced by the South African health system (e.g.

## ACRONYMS

**ICT:** Information, Communication and Technology

**NDoH:** National Department of Health

shortage of skilled and specialized health professionals, inaccessible health care and overburdened health system) by implementing numerous short, medium and long term measures. Among others, eHealth has been identified as a potential tool for addressing some of the challenges.

The provision of oral health services in South Africa has its challenges. One of these includes a lack of human resources - there are 2.19 dentists per 100 000 population and 0.28 dental specialists per 100 000 population.<sup>5,6</sup> Oral diseases prevalent in the country include dental caries, periodontal disease, oral mucosal lesions, oro-pharyngeal cancers, HIV/AIDS and oro-dental trauma.<sup>7</sup> Oral diseases are the most common of the chronic diseases and their impact on the quality of life of an individual and subsequent impact on society is high.<sup>8</sup> According to the World Health Organisation (WHO) dental caries is one of the major public health problems impacting on the lives of 60-90% of children globally.<sup>9</sup> The identification of the oral health service challenges and oral disease provides an opportunity for the development of innovative ICT solutions, such as teledentistry.

South Africa's dental health service has been plagued by a lack of access to health care, and unequal distribution of human resources for health. There have been no reported innovative ideas or solutions implemented using information and communication technologies (ICT) for the barriers affecting dental health services.<sup>10</sup> There are only a few dental specialists in South Africa and most work in the private sector in urban areas.

Teledentistry is the use of ICT to allow for the interchange of clinical data including images over remote distances for dental consultation and treatment planning.<sup>11</sup> Countries like Ireland have embraced the use of teledentistry where innovative approaches to triage oral medicine referrals not only support practitioners in rural areas but also decrease the potential waiting time for consultations.<sup>12</sup>

This review provides a definition of teledentistry and describes its potential applications. The benefits and challenges are discussed and recommendations are made regarding the possible uses of teledentistry in the South African context.

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## DEFINING TELEMEDICINE AND TELEDENTISTRY

The prefix “tele” in Greek means “at a distance”, and the meaning of “telemicine” has been widely interpreted as consisting of any medical activity that is performed by two or more parties, separated by distance. A comprehensive definition of telemedicine, which was published in 2007, following a review of 104 peer-reviewed definitions, reads as follows: “Telemedicine, being a subset of telehealth, uses communication networks for delivery of health care services and medical education from one geographic location to another, primarily to address challenges such as inequitable distribution and shortage of infrastructural and human resources”.<sup>13</sup> Telemedicine is referred to as the use of information and communication technology (ICT) to provide health care service and delivery when distance separates the participants concerned.<sup>14</sup>

In 1997, teledentistry was referred to as the practice of using videoconferencing technologies to diagnose and provide advice about treatment over a distance.<sup>15</sup> A more recent definition is the “use of dental information transmitted from one site to another to improve oral health”.<sup>16</sup> An all-inclusive teledentistry definition in keeping with current advances is described as the use of ICT in dentistry for oral health services and education,<sup>17</sup> and encompasses all ICT including dental information systems and dental records, as well as the educational aspect (undergraduate, postgraduate and continued professional development) and oral health promotion.

## TELEDENTISTRY

The field of teledentistry has grown rapidly with the evolution of technology. The benefits of teledentistry include increased access to oral health information, online tools for record keeping, assisted diagnosis and monitoring, electronic records and charting, remote screening, skills training, continued learning and support.<sup>18</sup> It is used widely in developed countries and its advantages include decreasing unnecessary dental referrals especially for orthodontic services.<sup>19</sup> Teledentistry has been used successfully as an intervention system for periodontal health, as well as for the early diagnosis of oral diseases.<sup>20,21</sup> Two key advantages of teledentistry involve access to dental specialist services and enhancement of dental education using distance learning techniques.<sup>22</sup>

Cost savings or economic benefits are important for all aspects of health care and teledentistry not only saves costs, but also decreases waiting times to access specialists.<sup>23</sup> More remote areas were more likely to benefit from teledentistry.<sup>24</sup> An economic evaluation in the Scottish Highlands and Islands found cost saving benefits. However these were dependent on certain parameters including familiarity with the equipment being used.

Teledentistry has been described as “new”, “seductive” and a “superficially easy-to-use technology” and the assumption is that clinicians will use it and patients will accept it.<sup>25</sup> As with any new technology, there are associated limitations and barriers including compromising the relationship between the health professional and patient, breakdown in the relationship between health professionals, validity of information, organizational and bureaucratic difficulties.<sup>26</sup>

In addition, teledentistry has raised ethical and medico-legal concerns. However, ethical and legal principles do not change for telemedicine interactions (e.g. teledentistry) and should remain the same as for conventional face-to-face consultation. Patients are often concerned about privacy and confidentiality of their personal information and are reluctant to divulge these details or participate in teledentistry initiatives. Another growing concern among patients is not so much related to access to their information but rather that their information could be altered.<sup>27</sup> The need to address the concerns over security and confidentiality cannot be overemphasized as this could have a detrimental effect on future acceptance of teledentistry.<sup>28</sup>

Many health professionals have been resistant to technology. Some perceive that the technology will replace them while others feel that they will be economically comprised. Rural physicians perceive it as a threat to their livelihood as urban physicians will have access to their patient pool.<sup>29</sup> In addition, health professionals often feel that it is foisted upon by management - the “top down approach”. Technology in health should have a “bottom up approach” where the health professional is an integral part of the planning and policy development of the implementation of a telemedicine system.<sup>30</sup>

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The following provides a comprehensive overview of the various applications of teledentistry.

### SCREENING

Teledentistry screening services has become the chosen method of screening to ensure that dental problems are identified before they become dental emergencies, and to assist children and their families better access to connect with health services.<sup>15</sup> In Rochester, New York, within thirteen inner city child care centres, a telehealth centre was set up to perform oral screenings. It utilized an intraoral camera to take digital images of children's teeth that were transmitted to the Eastman Department of Dentistry, University of Rochester. Nearly half of children examined were diagnosed with dental caries and prompt feedback was provided regarding follow-up dental care.<sup>16</sup> A similar service could be beneficial in South African healthcare settings, where school nurses could be provided with basic training and the necessary equipment to conduct oral health screening services at schools. The information would be sent to oral health professionals who are able to assess the cases and allocate it to the necessary specialist. This simplistic service could have positive implications such as avoiding unnecessary referrals, decreasing waiting time for dental treatment and saving costs.

### EXPERT ADVICE

Providing expert oral health advice in a resource constrained setting like South Africa is beneficial. Several expert oral health advice initiatives have been reported in the literature. One such initiative was at a primary care clinic in Brazil, where digital images of oral lesions were sent via email to two oral medicine specialists who showed a 60% agreement on the diagnoses. The authors recommended that distant diagnosis can be an effective approach especially when there are no local specialist services.<sup>21</sup>

In 2004 in Arizona, dental hygienists were allowed to enter into affiliated practice with a dentist to provide oral health services without direct supervision.<sup>31</sup> This prompted the Northern Arizona University to develop a teledentistry-affiliated practice dental hygiene model. The purpose was to provide oral screening and appropriate teledentistry dental hygiene services for children participating in 'First Things First' health care event. The activities took place at remote sites within Arizona and children were screened and referred to dentists. This model was easy to implement with existing technologies and offered oral health services to underserved populations. Patients were positive as it not only saved them unnecessary travelling, time off from work or school, but also allowed for quicker access to specialists. Furthermore, the dental hygienists also felt more empowered.<sup>31</sup>

### EDUCATION AND ORAL HEALTH PROMOTION

An important area which should be further explored is the use of information and communication technology for oral health promotion and education. eLearning has been implemented in health sciences with great success and the dental fraternity could draw from these valuable lessons.<sup>32-34</sup> The expectations of Fourth year dental students regarding eLearning were evaluated by means of questionnaires and comparing online tests to traditional examinations. Students indicated that they expect the quality of studies to improve

and online tests would be beneficial for self-performance rating.<sup>35</sup> The Paediatric Dentistry Department at the University of the Western Cape, Cape Town, South Africa implemented an online learning platform to supplement didactic and clinical teaching. Most of the students accessing the online platform gave positive feedback.<sup>36</sup>

Social media, internet and mobile applications provide opportunities to disseminate oral health information in a more user-friendly and cost-effective manner. The use of text messaging and pamphlets was compared to determine the value in distributing health education to mothers of preschool children. Pre- and post-intervention assessment involved evaluating the knowledge, attitude and practices of mothers and assessing the plaque levels of their children. Text messaging had a greater positive impact on knowledge, attitude and practices of mothers than the use of conventional pamphlets. However, there was no significant difference when comparing the reduction in plaque scores between the text messaging and pamphlet groups.<sup>37</sup> Short Message Service (SMS) has also been used as patient reminders with the aim of improving dental appointment attendance and were found to significantly reduce the non-attendance.<sup>38</sup>

### ORTHODONTICS

It has been shown that orthodontic services can be made accessible to disadvantaged children through sufficiently prepared dentists who are supervised remotely by orthodontists.<sup>39</sup> In the UK, orthodontist consultants were surveyed regarding how they would feel about providing orthodontic advice to dental practitioners via electronic means and the majority supported the idea.<sup>40</sup> Furthermore, new orthodontic patient referrals using the teledentistry system as a screening platform has also been shown to be effective.<sup>41</sup> This was demonstrated by a randomized controlled trial in the UK. Fifteen dental practices in Manchester were randomly allocated to either a test group (n=8) or control group (n=7). During a 15-month period 327 patients were referred to two consultant orthodontists. In the test group dental practitioners took photographs of the patients to be referred and sent these images via email to one of the two consulting orthodontists using the "store-and-forward" method. This process in telemedicine involves the non-interactive transmission of information from one site to another. The same patient was seen in a new patient clinic – "conventional" – and the outcomes of the two methods of consultation were compared. In the control group, patients were referred using a referral letter. In the test group there were only 8.2% unnecessary referrals whereas in the control group there were 26.2% unnecessary referrals.<sup>41</sup> The study highlighted the advantage that unnecessary referrals could be avoided and visits to specialists can be reduced, especially where hospitals are far from the rural areas.

### TELERADIOLOGY IN DENTISTRY

Radiology equipment is expensive but a vital tool to assist with diagnosis. Most radiology equipment is digitized and used extensively to save costs. The use of teleradiology in dentistry has had an ambivalent reaction from dental practitioners and specialists with regards to its reliability. Baker *et al.* (2000) compared radiographs transmitted and viewed using a video conferencing system with the images seen on a conventional view box. Two endodontists assessed 30 images for the presence of apical lesions. There was



no statistical difference between the evaluators identifying periapical bone lesions using the conventional radiographs or those transmitted on a screen.<sup>42</sup> While this study supports the use of teleradiology in dentistry, a comparative study undertaken by Jacobs, Edmonton and Lowry (2002) suggested that teleradiology should be used selectively. Ten facial radiographs with fractures and 10 without fractures were evaluated by eight oral and maxillofacial surgeons and eight accident and emergency doctors. The fractures were accurately diagnosed using plain radiography whereas the diagnosis using telemedicine was poor.<sup>43</sup>

## TELEMEDICINE IN SOUTH AFRICA

The first known telemedicine initiative in South Africa dates back to 1998, when the first phase of the implementation of South African telemedicine began, guided by the National Strategy for Telemedicine. The objectives of the strategy focussed on providing high-quality and cost-effective health care and education, improving recruitment and retention of health professionals, delivering health care at a distance, and making specialist health care much more accessible than it had been in the past.<sup>45</sup> The South African Government identified telemedicine as a crucial strategic initiative to improve the delivery of equitable health care and services. The Medical Research Council (MRC) and the South African National Department of Health (NDoH) initiated the Telemedicine Lead Programme in 1999. The purpose of this joint partnership was to ensure that relevant research was conducted that will inform the sector and to coordinate the telemedicine environment.

In the past decade over eighty-eight telemedicine projects were initiated by the NDoH and implemented in various parts of South Africa.<sup>44</sup> The majority of them are now defunct, mainly due to lack of funding. It was anticipated that the telemedicine projects would be integrated into routine health service provision. However, such integration has not occurred. Only a few telemedicine services at provincial level are still functioning, such as teleradiology and teledermatology.

## RECOMMENDATIONS FOR SOUTH AFRICA

This review has shown that there have been many successful initiatives globally that describe the benefits of teledentistry, some of which could be implemented in South Africa where appropriate. Common challenges in oral health service delivery include undiagnosed oral health diseases and inaccessible oral health services,<sup>46-48</sup> and therefore it would be beneficial to implement basic teledentistry screening initiatives targeting school learners, the elderly, physical and mentally challenged individuals and health-comprised individuals. Such services could be provided at minimal cost in terms of infrastructure and equipment. In addition, improving the availability of specialist services for patients could strengthen the South African health system by reducing cost, enhancing quality of life, decreasing unnecessary referrals and decreasing long waiting times. Teledentistry is a potential solution to make dental services in most rural areas in South Africa more accessible.

South Africa has not been successful in the implementation of telemedicine and the reasons for this are varied. However many lessons have been learnt and technology has evolved and improved. The NDoH has embraced the use of ICT's and one such example has been the successful implementation of MomConnect.

After the assessment of previous ICT projects, government officials, academics and ICT for health researchers investigated mechanisms to ensure sustainable scalable ICT solutions for health. Various working groups and committees were initiated and a substantial amount of progress has been made towards the development of an eHealth and mHealth for South Africa.

Health professionals, decision makers and academics can no longer continue to work without embracing technology. Technology is rapidly evolving and providing smarter, more effective hardware and software. However, while technology will never replace the need for face-to-face contact with a health professional, ICT4H, eHealth and teledentistry are ways of enabling oral health service delivery and education, and potentially improving health outcomes and service delivery.

**Conflict of interest:** None declared

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