

Teledentistry: Knowledge and Attitudes among Dentists in Udaipur, India

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Abstract

Background: Teledentistry is a synergistic combination of telecommunications technology; internet and dental practice which shows promising potential to be a highly effective mechanism for enhancing diagnosis and related treatment.

Aim: To assess the knowledge and attitudes regarding teledentistry among dentists of Udaipur.

Methods: A cross-sectional survey was conducted among the total of 105 dentists in Udaipur, India. A self administered structured questionnaire was used to assess their knowledge (8 items) and attitude (12 items) regarding teledentistry. The response format was based on 5-point Likert scale. Analysis of variance, t-test and multiple linear regression model was utilized for statistical analysis. Level of significance was fixed at $p \leq 0.05$.

Result: The mean scores for knowledge and attitudes were 25.61 ± 3.197 and 38.61 ± 4.742 respectively. Bivariate analysis revealed that work experience was significantly associated with both knowledge and attitude means scores ($p \leq 0.05$). Significant predictors of knowledge scores were work experience ($R=0.381$, $p=0.000$), qualification ($R=0.504$, $p=0.000$), internet access ($R=0.548$, $p=0.000$); for attitude scores it was only internet access ($R=0.261$, $p=0.007$).

Conclusion: An unbalanced knowledge of teledentistry among current dentists has suggested the need for awareness programmes to fill the knowledge gaps and instill positive attitudes.

Key Words: Attitude, Dentists, Knowledge, Oral Health Care, Teledentistry

Introduction

Health care has changed dramatically with the era of computers and tele-communication. Just as communication technology and uses of electronic information have developed over the years, the terms to describe health care services at a distance, such as “telehealth” and “e-health” came into reality that are currently used as umbrella terms [1]. Developing countries have opened up to telemedicine to address various issues which are being faced by the healthcare delivery system, like inadequate health infrastructure and clinical services, paucity of the qualified doctors, the almost non-availability of specialist care, the delay in the delivery of the treatment due to the greater time which is required for the transport of the patients to urban healthcare facilities and the provision of healthcare by inexperienced primary healthcare service providers.

Oral health is an integral part of general health. Nowadays dental care is being transformed by opportunities provided by technology and telecommunication. Teledentistry is a combination of telecommunication and dentistry which involves the exchange of clinical information and images over remote distances. Most teledentistry programs to date have focused upon distance management and administration of remote facilities, learning and continuing education, and consultation and referral services rather than supervision of auxiliaries or direct patient care [1].

Cook in 1997 defined "Teledentistry" as the practice of using video-conferencing technologies to diagnose and provide advice about treatment over a distance [2]. Due to growth of technological capabilities, teledentistry has potential to fundamentally change the current practice of dental care [2].

It is a rapidly forming subset of tele-health, a field that already has considerable impact on the health care industry [3]. Teledentistry can be greatly utilized with rural communities or those of underserved populations. It would increase the accessibility of specialists, besides decreasing time and cost associated with specialty consultations [4]. It also decreases isolation of practitioners by providing peer contact, specialist support and postgraduate education. General dentists will send patient records (images, text and sounds) to dental specialists, often enabling the specialist to make a diagnosis and develop a treatment plan without having to see the patient in person [3,5].

Teledentistry can be used in every branch of dentistry. Orthodontics is able to successfully help in the management of children with special needs [6]. According to Berndt et al. orthodontic treatment monitored from a distance via teledentistry systems has still been very promising in the management of occlusions in these children [7]. Aziz and Ziccardi stated that the advances and availability of smart phone technology have contributed to the feasibility and availability of telemedicine in oral and maxillofacial surgery [8]. Zivkovic et al. have demonstrated that there is no statistically significant difference in the interpretation of periapical lesions between the images viewed locally (using a viewbox) and images transmitted via a video-conferencing system and viewed on monitor screen [9].

Teledentistry can serve as a good tool for educating postgraduate students and for providing continuing updates for the practicing dentists. In interactive video-conferencing, the patient information is evaluated first (with or without the patient's presence), which allows for the interaction and

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feedback between the educator and the students. The patient cases can be reviewed thoroughly and at the students' pace. The cases can be discussed at length after all the clinical data have been collected and transmitted, without the patient being present at the scheduled meeting. This enhances the students' enthusiasm and provides new learning opportunities for the dental students and the practicing dentists [10]. The educational efficacy of videoconferencing in dental CPD (continuing professional development), and its practicability (in terms of audience and teacher satisfaction and reliability of equipment) has been pilot tested in a project Postgraduate Regional On-line Videoconferencing in Dentistry (PROVIDENT) at London Dental Schools [11].

According to Census 2011, Udaipur city has a population of 4.5 lakhs and 455 villages with 18 Community Health Centres, 70 Public Health Centres and 527 sub-centres [12,13]. There is a definite inequality in delivery of health care because the majority of qualified dental manpower, especially specialists are concentrated only in urban areas. India, with its diverse landmass, huge rural population and existing health care delivery mechanism clubbed with advances in telecommunications technology, could be an ideal setting for teledentistry. It can have a significant contribution in bridging the gap between the demand and the supply [14-16].

Therefore, this shows the emerging need of teledentistry awareness and its development among dentists.

Aim

To assess current knowledge and attitudes regarding teledentistry among dentists of Udaipur.

Methods

Study design and population

A descriptive cross-sectional study was conducted among all the dentists (n=105) in Udaipur, India in the month of July 2012. List of dentists was obtained from the Indian Dental Association, Udaipur branch and telephone directory of the city of Udaipur. Study population consisted of dentists without postgraduate qualifications (n=65) and dentists with postgraduate qualifications (n=40) which includes private practitioners and teaching faculty of two dental colleges situated in Udaipur.

Ethical approval and official permission

The study protocol was reviewed by the Ethical Committee of Pacific Dental College and Hospital and was granted ethical clearance. An official permission was obtained from the Principals of dental colleges.

Pre-testing of questionnaire

A self administered structured questionnaire was developed and administered to a convenience sample of 10 dentists who were interviewed to gain feedback on the overall acceptability of the questionnaire in terms of length and language clarity. Based on their feedback the questionnaire did not require any correction. Cronbach's coefficient was found to be 0.68, which showed an internal reliability of the questionnaire. Mean Content Validity Ratio (CVR) was calculated as 0.87 based on the opinions expressed by a panel of four academicians.

Face validity was also assessed and it was observed that 92% of the participants found the questionnaire to be easy.

Questionnaire

A questionnaire, designed to obtain dental professionals' knowledge and attitudes towards teledentistry, consisted of three sections (Table 6).

• Section I

Solicited general demographic and professional background information. The dental professionals involved in active patient care were asked about years of experience in a dental clinic or university hospital and internet access time for health related purposes.

• Section II

Integrated 8 questions to collect information about knowledge regarding teledentistry.

• Section III

Comprised of 12 questions which aimed to assess the attitude of dentists regarding effectiveness of teledentistry.

The participant's responses were ranked according to how much they agreed with each statement that was based on the 5 point Likert scale with alternatives: strongly disagree, disagree, don't know/undecided, agree and strongly agree.

Methodology

On the pre decided days, investigator visited both dental colleges during college working hours and private clinics in evening hours, according to area distribution, for getting the questionnaire filled. Questionnaires were distributed among all dentists (n=105) who were requested to fill in the written informed consent form and were asked to rate each item of the questionnaire choosing the most appropriate response.

Statistical analysis

Completed questionnaires were coded and spreadsheets were created for data entry. The data was analyzed using SPSS 15 (SPSS Inc. Chicago, IL, USA) Windows software

Table 1. Profile of demographic characteristics of dentists.

Sample characteristics	Frequency (%)
Age (in years)	
20-30	50 (47.6)
30-40	48 (45.7)
40-50	7 (6.6)
Sex	
Males	69 (65.7)
Females	36 (34.3)
Qualification	
Dentists without postgraduation	65 (61.9)
Dentists with postgraduation	40 (38.1)
Work experience (in years)	
<5	72 (68.5)
5-10	19 (18.1)
>10	14 (13.3)
Internet access (in hours)	
0-2	65 (61.9)
2-4	36 (34.2)
4-6	4 (3.8)
Total	105 (100)

program. Each item of the questionnaire was coded from 1-5 (strongly disagree to strongly agree). Higher scores indicate positive appraisals towards knowledge and attitude regarding teledentistry while the lower scores indicate negative evaluation. A total score was calculated for each respondent by summing his or her responses [maximum score for knowledge (8×5=40) and attitude (12×5=60)]. Mean knowledge and attitude score, standard deviation, and frequency distribution were calculated. For frequency distribution strongly disagree and disagree responses were combined into one category (Disagree) and similarly agree and strongly agree responses (Agree). Descriptive statistics were used to summarize the demographic information and the survey data was analyzed using the student's t- test and one way ANOVA with Post Hoc Bonferroni test. Linear regression analysis model was used to check relation between independent (age, sex, qualification, and work experience and internet access) and dependent variables (knowledge and attitude). Level of significance was fixed at P ≤ 0.05.

Results

A total of 105 dentists with the mean age (in years) of 32.34 ± 5.424 participated in the survey. Demographic data showed that the majority of the respondents were dentists without postgraduate qualification (61.9%), males (65.7%) and in the age group of 20-30 years (47.6%). More than half of the study population (61.9%) had less than 2 hours of access to internet for health related purpose. Majority (68.5%) of the dentists had less than 5 years of work experience (Table 1).

The mean knowledge and attitude scores of the study population were evident as 25.61 ± 3.197 and 38.61 ± 4.742 respectively. Dentists with postgraduate qualification had significantly greater knowledge than dentists (p=0.007). Mean scores for dentists and dentists with postgraduate qualification were 26.37 ± 3.444 and 24.38 ± 2.295 respectively. Mean knowledge score decreased significantly with increased work experience (p=0.002) and internet access (p=0.003). When post hoc Bonferroni test was applied, mean knowledge score among those who had less than 5 years of experience (26.69 ±

Table 2. Assessment of mean knowledge and attitude score with demographic characteristics of dentists.

Categories	Knowledge		Attitude	
	Mean ± SD	p value	Mean ± SD	p value
Age (in years)				
20-30	25.88 ± 2.569	0.078	39.50 ± 4.234	0.085
30-40	25.71 ± 3.730		38.10 ± 5.313	
40-50	23.00 ± 2.380		35.71 ± 1.976	
Sex				
Male	25.52 ± 3.337	0.374	37.87 ± 4.215	0.181
Female	25.78 ± 2.948		40.03 ± 5.401	
Qualification				
Dentists without postgraduation	24.38 ± 2.295	0.007*	38.71 ± 5.288	0.142
Dentists with postgraduation	26.37 ± 3.444		38.45 ± 3.748	
Work experience (in years)				
<5	26.69 ± 3.139a	0.002*	39.43 ± 5.121 ^a	0.05*
5-10	24.94 ± 2.305		38.05 ± 3.519	
>10	22.64 ± 2.449a		35.14 ± 1.562 ^a	
Internet access (in hours)				
0-2	26.69 ± 3.201 ^a	0.003*	29.35 ± 6.148	0.127
2-4	23.94 ± 2.305 ^a		32.19 ± 4.996	
4-6	23.00 ± 2.380		30.00 ± 9.381	
Total	25.61 ± 3.197		38.61 ± 4.742	

Statistical tests applied: t test, one way ANOVA.

* indicates statistically significant difference at p ≤ 0.05.

Post hoc Bonferroni test: Groups with same letter (a) superscripted showed statistically significant difference.

Table 3. Step wise multiple linear regression analysis with knowledge score as dependent variable among dentists.

Model	R	R ²	F	P
1	0.381(a)	0.145	17.507	0.000 (a)
2	0.504(b)	0.254	17.405	0.000 (b)
3	0.548(c)	0.300	14.457	0.000 (c)

^aPredictors: (Constant), work experience

^bPredictors: (Constant), work experience, qualification

^cPredictors: (Constant), work experience, qualification, internet access

Table 4. Step wise multiple linear regression analysis with attitude score as dependent variable among dentists.

Model	R	R ²	F	P
1	0.261(a)	0.068	7.549	0.007 (a)

^aPredictors: (Constant), internet access

Table 5. Percentage distribution of responses regarding knowledge and attitude towards teledentistry.

Knowledge	Agree n (%)	Neutral n (%)	Disagree n (%)
1. Teledentistry is the practice of use of computers, internet and intraoral camera technologies to diagnosis and provide advice about treatment over a distance.	93 (88.6)	11 (10.5)	1 (1)
2. Teledentistry is not a face to face interview.	60 (57.1)	24 (22.9)	21 (20)
3. Teledentistry will help to consult with an expert about specific patient's problem.	70 (66.7)	29 (27.6)	6 (5.7)
4. Teledentistry is good for dental education over internet and for training primary care dentists.	61 (58.1)	34 (32.4)	10 (9.5)
5. Teledentistry can help to monitor my patient's oral health.	57 (54.3)	33 (31.4)	15 (14.3)
6. Teledentistry can be applied in every branches of dentistry.	49 (46.7)	33 (31.4)	23 (21.9)
7. Teledentistry can be useful in improving the access to oral health care.	71 (67.6)	22 (21)	12 (11.4)
8. Teledentistry has a potential to be integrated into our current dental services.	55 (52.4)	29 (27.6)	21 (20)
Attitudes			
1. Teledentistry can provide me a good understanding of the patient's oral health problem over the internet.	72 (68.6)	21 (20)	12 (11.4)
2. Using teledentistry, I will be able to monitor my patient's condition well.	47 (44.8)	40 (38.1)	18 (17.1)
3. I think dental examinations are accurate via computers and intraoral camera as in the traditional office setting.	26 (24.8)	36 (34.3)	43 (41)
4. I think children and parents would be receptive to having a dental examination done via computers and intraoral camera.	36 (34.3)	43 (41)	26 (24.8)
5. Teledentistry is convenient form of oral health care delivery which makes dental examination easier.	49 (46.7)	39 (37.1)	17 (16.2)
6. Teledentistry will be a standard way of oral health care delivery.	27 (25.7)	39 (37.1)	39 (37.1)
7. Teledentistry can be an addition to the regular care we (the dentists) provide.	74 (70.5)	26 (24.5)	5 (4.8)
8. Teledentistry can reduce costs for the dental practices.	22 (21)	23 (21.9)	60 (57.1)
9. Teledentistry can save time for me.	35 (33.3)	32 (30.5)	38 (36.2)
10. I think teledentistry can increase accessibility of the specialists to rural and underserved communities for their dental needs.	71 (67.6)	19 (18.1)	15 (14.3)
11. Teledentistry can reduce isolation of practitioners by providing peer contact and specialist support.	82 (78.1)	18 (17.1)	5 (4.8)
12. In India, major challenges in teledentistry are illiterates, population below the poverty line and lack of infrastructure.	89 (84.8)	12 (11.4)	4 (3.8)

3.139) was found to be significantly greater than among those who had more than 10 years of experience (22.64 ± 2.449) ($p=0.001$). Also, a significant difference was evident among those who accessed internet for 2 hours daily (26.69 ± 3.201) than among those who accessed internet for 2-4 hours (23.94 ± 2.305) ($p=0.001$). Mean attitude score was significantly highest among the subjects who had less than 5 years of work experience (39.43 ± 5.121) followed by those who had 5-10 years of experience (38.05 ± 3.519) and lowest among those who had more than 10 years of experience (35.14 ± 1.562) ($p=0.05$). Post hoc Bonferroni test revealed a statistically significant difference among those who had less than 5 years of experience than among those who had more than 10 years of work experience ($p=0.05$) (Table 2).

Table 3 and 4 depicted the step wise multiple linear regression analysis to estimate the linear relationship between the dependent variables (knowledge and attitude score) and independent variables (age, sex, qualification, work experience and internet access for health related purpose). The best predictors in descending order for knowledge score were work experience, qualification and internet access with the corresponding variance of 14.5%, 25.4% and 30% respectively. Internet access was the only best predictor for attitude score with the variance amount of 6.8%.

Majority (88.6%) of dentists believed that teledentistry is the practice of use of computers, internet and intraoral camera technologies for diagnosis and providing advice about treatment over a distance (Table 5). Almost 58% dentists

agreed with the statement teledentistry is good for dental education over internet and for training of dentists. Nearly 68.6% of dentists agreed on providing a good understanding of patient's oral health problem over internet. However, some statements showed negative attitude, most of dentists (39%) believed that teledentistry won't be standard way of oral health delivery. Sixty percent and 38% of dentists also reported that teledentistry cannot reduce cost and save time respectively. Majority of the dentists (52.4%) supported the concept of teledentistry must be integrated to current oral health care services.

Discussion

The present cross-sectional questionnaire study has uncovered an interesting but new topic in relation to dynamic technology in dentistry (teledentistry) among dentists of Udaipur city. Dentistry, in a synergistic combination with telecommunications technology and the internet, has yielded a relatively new and exciting field that has endless potential. Teledentistry has been developing since 1994 as a means to allow dental professionals to communicate with one another over long distances. It allows collaboration by multiple practitioners. It involves the exchange of clinical information and images over remote distances for dental consultation and treatment planning [15].

In the present study, regression analysis showed that the strong predictors for knowledge about teledentistry were work experience, qualification and internet access. Dentists who had

Table 6: Questionnaire.

Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Teledentistry is the practice of use of computers, internet and intraoral camera technologies to diagnosis and provide advice about treatment over a distance.					
2. Teledentistry is not a face to face interview.					
3. Teledentistry will help to consult with an expert about specific patient's problem.					
4. Teledentistry is good for dental education over internet and for training primary care dentists.					
5. Teledentistry can help to monitor my patient's oral health.					
6. Teledentistry can be applied in every branches of dentistry.					
7. Teledentistry can be useful in improving the access to oral health care.					
8. Teledentistry has a potential to be integrated into our current dental services.					

Section I

Demographic Information

Name:

Age / Sex:

Qualification: With / without postgraduation

Years of Experience:

Computer and Internet Use for Health Related Purposes: Average time

Section II

Survey questions regarding knowledge (please mark with '✓' in appropriate boxes)

Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Teledentistry can provide me a good understanding of the patient's oral health problem over the internet.diagnosis and provide advice about treatment over a distance.					
2. Using teledentistry, I will be able to monitor my patient's condition well.					
3. I think dental examinations are accurate via computers and intraoral camera as in the traditional office setting.					
4. I think children and parents would be receptive to having a dental examination done via computers and intraoral camera.					
5. Teledentistry is convenient form of oral health care delivery which makes dental examination easier.					
6. Teledentistry will be a standard way of oral health care delivery.					
7. Teledentistry can be an addition to the regular care we (the dentists) provide.					
8. Teledentistry can reduce costs for the dental practices.					
9. Teledentistry can save time for me.					
10. I think teledentistry can increase accessibility of the specialists to rural and underserved communities for their dental needs.					
11. Teledentistry can reduce isolation of practitioners by providing peer contact and specialist support.					
12. In India, major challenge in teledentistry are illiterates, population below the poverty line and lack of infrastructure.					

more than 10 years of work experience had less knowledge than among those who had less than 5 and 5-10 years of work experience. As the teledentistry is a recent concept, dentists with more work experience might not be familiar with new technology. Smith et al. [17] reported that University of the West Indies (UWI) Dental School's old staff members had significantly lower computer literacy when compared with younger age groups which may impact on their utilization of the proposed information and communications technology system but most of the staff and students were supportive of introducing a computer based information system into the dental school curriculum and to manage clinics. The implementation of a computer-based information system is likely to have widespread acceptance among students and staff at the UWI Dental School [17].

The study also revealed that dentists with postgraduate

qualifications showed a significantly greater mean knowledge score than dentists without postgraduate qualifications while no significant difference was observed in mean attitude score. The reason may be attributed to the familiarity of dentists with postgraduate qualifications in computers, internet and similar technology. Use of computers and internet are common in healthcare sector nowadays. Teledentistry uses dental health records; telecommunications technology, digital imaging and the internet to link dental health care providers to enhance communication, the exchange of health-related information and access to dental care [16,18]. The present study reported that around 62% dentists accessed internet at least 2 hours daily for health related purpose. This is comparable to the results of a study done in China by Jian Hu et al. who reported that 80.5% dental health professionals were using computers in their practice [19]. Walmsley et al. reported that 91% dental

professionals have computers at home and 68% have access to internet [20]. Findings of present study revealed that dentists who accessed internet more than 6 hours per day for health related purpose had poor knowledge regarding teledentistry because they might be using internet for their own studies or engrossed in their favorite topics.

In 2007, teledentistry program held at University of Minnesota Twin Cities campus through the School of Dentistry (SOD) in which approximately 10 specialists have been involved in the program, providing specialty consults for patients with orofacial disorders including TMD, orofacial pain, oral medicine, and oral pathology conditions such as xerostomia, burning mouth and oral lesions, behavioral dental issues, and physical therapy in rural areas of northern Minnesota. A provider satisfaction survey showed none of the providers had previous experience with the teledentistry system. In over 90% of the visits, specialists were satisfied with the teledentistry consult and said the trip to their office was saved. All providers felt "comfortable" during the live teleconference consults. A majority of providers reported "not much" technical skill was required to conduct teledentistry consults [21].

Approximately 58% dentists agreed with the statement that teledentistry is good for dental education over internet and for training of dentists. Around 70% of dentists showed positive attitudes toward teledentistry to understand patient's oral health problem over internet. Majority (88.6%) of dentists believed that teledentistry is the practice of use of computers, internet and intraoral camera technologies for diagnosis and to provide advice about treatment over a distance. Bauer and Brown reported that dentists can expect to encounter revolutionary changes as a result of the digital transformation. The Internet, the World Wide Web and other developments of the information revolution will redefine patient care, referral relationships, practice management, quality, professional organizations and competition [22].

In spite of good knowledge among dentists, responses to some statements showed that they had less favorable attitudes towards teledentistry which may be due to their unwillingness to adopt new strategies and preference to continue with basic oral health services. This suggested that the deficit is largely due to lack of training programmes. Following completion of teledentistry course, dental hygienists students' attitudes changed positively in their knowledge of the effectiveness of teledentistry in identifying dental needs in underserved areas [2].

Around 43% dentists disagreed on dental examinations accuracy via computers and intraoral camera as in the traditional office setting and around 39% of them believed that teledentistry won't be a standard way of oral health delivery. Sixty percent and 38% of dentists also reported that teledentistry cannot reduce cost and save time respectively. Kopycka-Kedzierawki et al. reported that teledentistry may be useful as a means to screen children for signs and symptoms of oral disease. Unlike, medicine, treatment cannot be prescribed remotely as the child needing oral health care must still be referred to a dentists. However, teledentistry still offers a practical and potentially cost-effective means to screen large numbers of children in field surveys of oral health [23]. It appears that dentists need to be educated

and convinced of the benefits of new technology through programmes conducted in universities, teaching hospitals, and medical institutions. Collaborations between academia, government and industry should also be encouraged for further elaboration of teledentistry. However, majority of them (52.4%) accepted that teledentistry should be integrated to current oral health care services.

Most of the dentists were aware about teledentistry, about its goals and advantages but have no idea about how to get involved into it [4]. Successful application requires training in both technical and educational methods [11,24]. Lack of reimbursement system in India for dental care is the major hindrance for practice of dentistry so Government of India should suggest some directions in dental curriculum regarding teledentistry which promotes the knowledge and produce positive attitude towards teledentistry.

More than half of dentists (84.4%) believed that challenges in teledentistry are illiteracy, population below poverty line and lack of infrastructure. A greater part of dentists (67.6%) of Udaipur city also believed that teledentistry can be useful in improving the access to oral health care. Teledentistry, a relatively new field, can change the dynamics of the dental care delivery system. It will bridge the gaps between general dental practitioners and specialists, tap into previously isolated manpower, and above all else, it will provide patients with affordable, accessible, quality dental care. This is especially encouraging for isolated populations who may have difficulty accessing the oral health care system due to distance, ability to travel, or lack of oral health care providers in their area.

It is not farfetched to imagine that in the near future teledentistry will be just another way to access an oral health care provider. In future, dentists with knowledge in teledentistry can be appointed at the primary health centers and community health centers to discuss about the diagnosis and treatment plan of the difficult cases with the specialists. The dental colleges with a predetermined catchment area could be ideal places to serve as hub sites for teledentistry consultation as they encompass all the specialists serving under a common roof. A team of specialists could communicate for a few hours on a daily basis with the dentists/hygienists/patients at the remote clinics [15,16].

Conclusion

Despite a positive knowledge, the attitudes of dentists regarding teledentistry suggested lack of training programmes and also many appeared unwilling to adopt new strategies and prefer to continue with basic oral health services. Hence, structured education programmes and courses to improve knowledge and attitude of dentists especially those with less qualification and work experiences is the need of the hour. This can be achieved by increasing scope of education regarding teledentistry at central government level through preparing legislation.

Declarations

Authors' contributions: RN contributed with the acquisition, analysis and interpretation of data and took part in drafting of the manuscript. PA contributed with the design, analysis and interpretation of data and took part in drafting of the

manuscript. AJS, KA and MT contributed with drafting of the manuscript, analysis and interpretation of data and revised it critically. PP, and NB contributed with analysis and interpretation of data, drafting of the manuscript and revised it critically. All authors listed on the title page have read the

manuscript, attest to the validity and legitimacy of the data and its interpretation, and agree to its submission.

References

1. Teledentistry as a method to improve oral health access in Florida. SOHIP teledentistry workgroup. Available at: http://www.doh.state.fl.us/family/dental/sohip/workgroup/Teledentistry_Whitepaper.pdf.
2. Cooper BR, Engeswick LR. Knowledge, attitude and confidence level of dental hygienists students regarding teledentistry. A pilot study. *The Internet Journal of Allied Health Science and Practices* 2007; **5**: 1-4.
3. Bhambal A, Saxena S, Balsaraf SV. Teledentistry: potentials unexplored! *Journal of International Oral Health* 2010; **2**: 1-7.
4. Sanchez DE, Lefebvre C, Abeyta K. Teledentistry in the USA: a new horizon. *International Journal of Dental Hygiene* 2004; **2**: 161-164.
5. Teledentistry in Arizona initial development. Arizona Department of Health Services, Office of Oral Health. Nov 2009. Accessed (2012 January 17) at: <http://www.azdhs.gov/phs/owch/ooh/pdf/Teledentistry-in-Arizona.pdf>.
6. Mihailovic B, Miladinovic M, Vujicic B. Telemedicine in dentistry (teledentistry). In Grasczew G and Roelots TA (editors). Advances in telemedicine: applications in various medical disciplines and geographical area. 2011. Accessed (2012 January 17) at http://cdn.intechopen.com/pdfs/14328/InTechTelemedicine_in_dentistry_teledentistry_.pdf.
7. Berndt J, Leone P, King G. Using teledentistry to provide interceptive orthodontic services to disadvantaged children. *American Journal of Orthodontics and Dentofacial Orthopedics* 2008; **134**: 700-706.
8. Aziz SR, Ziccardi VB. Telemedicine using smartphones for oral and maxillofacial surgery consultation, communication and treatment planning. *Journal of Oral and Maxillofacial Surgery* 2009; **67**: 2505-2509.
9. Zivkovic D, Tosic G, Mihailovic B, Miladinovic M, Vujicic B. Diagnosis of periapical lesions of the front teeth using the Internet. *PONS: Medical Journal* 2010; **7**: 138-143.
10. Reaching out to underserved children in childcare. The Teledentistry in Childcare Project joins the Eastman Dental Center's (EDC) 2000. Accessed (2012 January 17) at: <http://www.urmc.rochester.edu/news/story/index.cfm?id=784>.
11. Eaton KA, Francis CA, Odell EW, Reynolds PA, Mason RD. Participating dentists' assessment of the Pilot Regional Online Videoconferencing in Dentistry (PROVIDENT) project. *British Dental Journal* 2001; **191**: 330 -334.

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12. National rural health mission, Udaipur – 2011. Accessed (2012 October 5) at: <http://nrhmrajasthan.nic.in/district%20pip/Udaipur.pdf>.
13. Udaipur city census data. Accessed (2012 October 5) at: <http://www.census2011.co.in/census/city/92-udaipur.html>.
14. Chang SW, Plotkin DR, Mulligan R, Polido JC, Mah JK, Meara JG. Teledentistry in rural California: a USC initiative. *Journal of the California Dental Association* 2003; **31**: 601-608.
15. Reddy KV. Using teledentistry for providing the specialist access to rural Indians. *Indian Journal of Dental Research* 2011; **22**: 189.
16. Chhabra N, Chhabra A, Jain RL, Kaur H, Bansal S. Role of Teledentistry in Dental Education: Need of the Era. *Journal of Clinical and Diagnostic Research* 2011; **5** (Suppl-2): 1486-1488.
17. Smith W, Bedayse S, Lalwah SL, Paryag A. Computer literacy and attitudes of dental students and staff at the University of the West Indies Dental School. *European Journal of Dental Education* 2009; **13**: 179-183.
18. Ata S, Ozkan S. Information technology in oral health care: attitudes of dental professionals on the use of teledentistry in Turkey. European and Mediterranean conference on information system 2009. Accessed (2012 October 10) at: <http://www.iseing.org/emcis/cdrom%20proceedings%20refereed%20papers/proceedings/presenting%20papers/c48/c48.pdf>.
19. Hu Jain, Yu H, Luo E, Song E, Xu X, Tan H et al. Are Chinese Dentists Ready for the Computerization of Dentistry? A population investigation of China's Metropolises. *Journal of the American Medical Informatics Association* 2009; **16**: 409-412.
20. Walmsley AD, White DA, Eynon R, Somefield L. Use of the internet within a dental school. *European Journal of Dental Education* 2003; **7**: 27-33.
21. Chan H, Friction J. Teledentistry: seeing the doctor from a distance. *Northway Dent* 2007; **86**: 27-28.
22. Bauer JC, Brown WT. The digital transformation of oral health care. Teledentistry and electronic commerce. *Journal of the American Dental Association* 2001; **132**: 204-209.
23. Kopycka-Kedzierawski DT, Billings RJ, McConnochie KM. Dental screening of preschool children using teledentistry: a feasibility study. *Pediatric Dentistry* 2007; **29**: 209-213.
24. Blignault I, Kennedy C. Training for telemedicine. *Journal of Telemedicine and Telecare* 1999; **5** (Suppl 1): S112-114.