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Knowledge, Attitudes, and Confidence Levels of Dental Hygiene Students Regarding Teledentistry: A Pilot Study

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ABSTRACT

Teledentistry provides a viable option for dental professionals to increase care in underserved areas. Dental hygiene students at a state university completed a course in teledentistry that includes performing oral health screenings on children using intraoral cameras and electronic submission of dental images to an off-site dentist for diagnosis. Purpose: The objectives of this study were to examine student knowledge, attitudes, and confidence levels before and after completion of a course on teledentistry. Method: A 5-point Likert scale survey consisting of 10 items was administered to students ages twenty-two to twenty-five (N=24) in a teledentistry course the first and last day of class. The survey included current knowledge of teledentistry, attitudes regarding effectiveness of teledentistry, and confidence in acquiring the necessary technical skills. Results: Survey results were analyzed using a matched-pairs t-test and Wilcoxon signed-rank test. There were significant increase in student knowledge, attitudes, and confidence in 9 of the 10 questions ($p < .01$). Conclusion: This study indicates that student attitudes were positively changed in their knowledge of the effectiveness of teledentistry in identifying dental needs in underserved areas, the role dental hygienists play in access to care, and confidence in acquiring and submitting dental images. These findings, in conjunction with research by other investigators, support continued implementation of teledentistry in dental hygiene education.

INTRODUCTION

Dental care is being transformed by the opportunities provided by technology and telecommunication.¹ Due to the growth of technological capabilities, teledentistry has the potential to fundamentally change the current practice of dental care.² Teledentistry is defined as the diagnosis and treatment of a dental patient using electronic and communication technologies.³ Dental professionals have used technology, such as intraoral cameras, in private practice for patient education and case acceptance, in addition to orthodontic screenings.⁴ However, teledentistry has been underused as a means of diagnosis and referral in dentistry.⁴

LITERATURE REVIEW

People living in rural or underserved areas often have substantial oral health care needs and limited access to providers.⁶ It has been estimated that 38% of the nation's rural counties do not have dentists.⁶ One of the advantages of teledentistry is its ability to increase access to dental care, as dentists will be able to use networked computers to deliver care in ways that do not require face-to-face contact with patients. If a dentist does not need to be physically present to perform an examination on a patient, a greater number of patients who are currently without dental care will be assessed and ultimately treated. Through this exchange of clinical information over distances, teledentistry can facilitate the provision of dental care in areas underserved by dental practitioners, and thus overcome social and geographic barriers.⁷

Teledentistry was first put into practice in the U.S. Army in 1994 by doing dental consultations on service personnel located more than 100 miles apart.⁷ Since then, various institutions and organizations in the United States and abroad have practiced

teledentistry, with varying degrees of success.⁷ A teledentistry project was implemented in Rochester, New York in six inner-city elementary schools and seven child-care centers. Using intraoral cameras, telehealth assistants recorded images of children's teeth and sent images to a pediatric dentist for review to provide referral and treatment recommendations.² In the first nine months of 2005, 123 children were screened, revealing that almost 40% of the children had active dental caries.² For the first time, many children attending those inner-city schools and child-care centers had their teeth examined at an early age and were given prompt feedback on the need for dental care.²

Another teledentistry project was implemented by the University of Minnesota School of Dentistry's to increase access to dental care for underserved populations in remote areas. Through their partnership with the Hibbing Community College that began in 2004, at least 10 dental school faculty members have been involved in the teledentistry project, including general dentists, specialists in TMJ, orofacial pain, oral medicine, health psychology, physical therapy, dental radiology, and endodontics to provide care to underserved families.⁸ Also in Minnesota, Apple Tree Dental is in its fifth year providing care to the community via teledentistry for organizations such as Head Start centers, local schools, nursing homes, group homes, and /or sheltered workshops.⁸ In 2002, 15 dental practices in Greater Manchester, UK, participated in a randomized trial to evaluate the validity of teledentistry screenings for new patient orthodontic referrals.⁹ They referred 327 patients over a 15 month period. They found teledentistry was a valid screening system for positively identifying appropriate new patient orthodontic referrals.⁹

In an effort to raise the dental hygiene student's awareness concerning the public and community health issues currently associated with access to care, a course in teledentistry was added to their curriculum. The purpose of the study reported in this paper was to expand the limited knowledge base related to educating dental hygiene students about the capabilities and benefits of teledentistry. The specific objective was to examine students' knowledge levels, attitudes, and confidence levels following completion of a teledentistry course.

METHODS

A questionnaire to examine students' knowledge, attitudes, and confidence levels was used as the outcome measures to assess education in teledentistry. Human subject approval was obtained from the Institutional Review Board, Minnesota State University, Mankato. Informed consent was obtained from all students.

The teledentistry course was a one-credit, fifteen-week course in the fall of 2005 for senior dental hygiene students. The first four weeks of the course involved didactic and clinical education to attain proficiency in utilizing Schick intraoral cameras (768 x 494 pixels) and storing the images on CDR-Dicom computer software. After four weeks of instruction and practice, students were evaluated on their ability to assemble the intraoral camera, locate the correct window on the computer software, capture thirteen standardized intraoral images of a classmate, and store photographs in an assigned folder on the computer software. The quality of the images was evaluated to ensure the photographs were clear, sharply focused, and color-balanced. Competency regarding students' technical ability to capture intraoral photographs was assessed by the investigators.

Students used their acquired intraoral camera skills to perform screenings on children during the fall semester of their senior year in the dental hygiene program. A total of 36 children, ages 3 to 5 years, participated in teledentistry examinations between September and December 2005. The parents of each child provided written consent. Students captured thirteen intraoral images on the children including separate occlusal views of the right and left maxillary and mandibular first and second molars, and lingual views of the canine, lateral, and central incisors. Images also included a "smile" view of maxillary and mandibular teeth. The images were saved using the Dicom software images then exported via the internet to an off-site dentist. The dentist evaluated the images from her computer, and provided referral and treatment recommendations for each child.

A questionnaire was administered to all students on the first day of the teledentistry course, prior to communication of any didactic information or clinical experience with intraoral cameras. An identical questionnaire was administered on the last day of the class. Students did not place their name on the questionnaire. For purposes of evaluating pre- and post-course scores, students were randomly assigned a number and told to place the number on both questionnaires. One hundred percent of the students responded to both questionnaires (N=24). The questionnaire was developed by the investigators of this study.

The questionnaire was a voluntary, ten-item, paper and pencil survey. It was distributed and collected in the same class session. The time required to complete the survey was approximately five minutes. Oral instructions were provided in addition to written instructions. To determine knowledge, attitudes, and confidence levels in teledentistry, students were asked to respond to a series of questions. To assess their level of knowledge regarding teledentistry, students were asked to respond to the first four questions listed in Table 1. To assess their attitudes regarding teledentistry, students were asked to respond to the following five questions listed in Table 1. The last question listed in Table 1 was used to determine the perceived confidence levels of the

student to learn the technical skill of capturing intraoral images, storing the images on computer software, and sending the images to an off-site dentist. Survey answers were recorded using a Likert-item response with five categories (strongly disagree = 1, disagree = 2, neutral or unsure = 3, agree = 4, strongly agree = 5). An attitude that represented a lack of confidence was defined as a response of "strongly disagree" or "disagree". A confident attitude was defined as a response of "strongly agree" or "agree". A response of "not sure" was equated with uncertainty. No validity or reliability testing of the questionnaire was conducted.

Table 1. Survey questions concerning knowledge, attitudes, and confidence in teledentistry

Knowledge
I understand what the term <i>teledentistry</i> means.
I understand what the phrase <i>access to care</i> means.
I understand the role intraoral cameras play in teledentistry.
I know how to make a difference in the access to care problem.
Attitude
I want to make a difference in the access to care problem.
I think use of teledentistry could make a difference in the access to care problem.
I think it is possible to do dental exams via computers and intraoral cameras.
I think dental exams are as accurate via computers and intraoral cameras as in the traditional office setting.
I think children and parents would be receptive to having a dental exam done via computers and intraoral cameras.
Technical skill
I can effectively learn how to capture, store, and transmit intraoral photographs to an off-site dentist.

Data were collected and analyzed by SPSS Version 10.0. Given the nature of the data, both parametric and nonparametric tests were run. Completed questionnaires were analyzed and tabulated using matched-pairs *t*-test and Wilcoxon signed-rank test. Statistical significance for both tests was set at $p < 0.05$.

RESULTS

The questionnaire was distributed to all students in the teledentistry course who were twenty-four white females ages twenty-one to twenty-five. Students' responses to the survey are shown in Table 2. Wilcoxon signed-rank tests were used to test for significant differences in students' knowledge, attitudes, and confidence levels.

Table 2. Differences in students' knowledge, attitude, and confidence before and after teledentistry course

Specific area	Z	P
Knowledge of teledentistry	-4.172**	.000
Knowledge of access to care issue	-3.051*	.002
Knowledge of intraoral cameras role in teledentistry	-3.078*	.002
Knowledge of how to make a difference in access to care issue	-3.419*	.001
Attitude towards making a difference in access to care issue	-1.890	.059
Attitude towards teledentistry making a difference in access to care issue	-4.073**	.000
Attitude towards teledentistry dental exams done via computers and intraoral cameras	-3.632**	.000
Attitude towards accuracy of teledentistry dental exams done via computers and intraoral cameras	-4.111**	.000
Attitude towards children and parents reception to teledentistry dental exams	-3.404*	.001
Confidence in learning technical skills involved in teledentistry	-3.160*	.002

Note: Z score from Wilcoxon Signed-Rank Test. * $p < .01$ level; ** $p < .001$. Knowledge, attitude, and confidence levels based on 5-point likert scale: strongly agree, somewhat agree, unsure or neutral, somewhat disagree, strongly disagree.

Wilcoxon signed-rank tests revealed an increase in confidence in 9 of the 10 categories which were statistically significant at $p < .01$. Student knowledge categories included their current understanding of teledentistry, access to care issues, the role of intraoral cameras in teledentistry, and if they knew how to make a difference in access to care. Student attitude categories included their desire to make a difference in the access to care issue, the ability of teledentistry to make a difference in the problem of access to care, how accurate they perceived teledentistry examinations to be in relation to conventional dental examinations, and perceived reaction of children and parents to teledentistry examinations. Student confidence level categories

included their ability to capture, store, and send intraoral photographs to an off-site dentist. Students did not significantly change their attitude regarding their desire to make a difference in the access to care issue ($p < .06$).

DISCUSSION

The results indicate that providing teledentistry education for dental hygiene students enhanced the confidence of students concerning teledentistry content, the ability to acquire the technical skills, and the course also augmented their attitude toward teledentistry's role in access to care. Pre- and post-course questionnaires revealed an increase in nine of the ten questions relating to knowledge, attitudes, and confidence levels concerning student knowledge and attitudes related to teledentistry and their perceived ability to acquire this technical skill. However, data analysis from the questionnaire showed the students did not show an increase in their desire to make a difference in the issue of access to care. However, this question had a pre-test mean of 4.667 on the five point scale and a post-test mean of 4.875, and thus there was very little room for improvement because of the students' pre-existing disposition. These findings suggest that students already possessed a desire to help those individuals not receiving regular dental treatment, even prior to receiving education regarding teledentistry and the role it could play in access to care.

Follow-up evaluation is needed to determine if students are able to effectively implement teledentistry skills acquired in this course if opportunity in the community would arise. It would also be of interest to examine ways dental professionals utilize teledentistry in those areas where it is practical and prudent to do so.

LIMITATIONS

This study has several limitations that preclude generalization to other populations. The assessment instrument utilized to measure pre- and post-knowledge levels, attitudes, and confidence levels was not validated. The student number ($N=24$) is a relatively small sample size and the students were from the same geographic area. Additionally, they were all the same race, approximately the same age, and probably from a similar culture. Further study is needed to confirm these findings with other dental hygiene students enrolled in a teledentistry course. However, this pilot study contributes to the dental literature by documenting the impact of teledentistry training on one group of students participating in a required course for graduation at a U.S. dental hygiene school.

CONCLUSIONS

Much evaluation is yet to be done within dental education regarding teledentistry. This pilot study represents a preliminary and limited investigation of the degree to which a teledentistry course can modify perceptions of their knowledge, attitudes, and confidence levels related to this patient care innovation. This study represents the first work of its kind in assessing knowledge, attitudes, and confidence levels regarding teledentistry among dental hygiene students who received education in this form of technologically-based health care delivery.

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