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The Effectiveness of a Teledentistry Educational Program

by

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submitted in partial fulfillment

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Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Melissa Ray Barham find it satisfactory and recommend that it be accepted.

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Thu, Apr 18, 2019, 2:21 PM

Dear Dr. Rogo:

First of all, congratulations on your grant!

The data collection and analysis you have described does not require IRB review. This constitutes program evaluation, not research.

Let me know if you have any questions or concerns.

Sincerely,

Ralph Baergen

Acknowledgement

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The Effectiveness of a Teledentistry Educational Program

Thesis Abstract-Idaho State University (2020)

ISU Department of Dental Hygiene received a HRSA subgrant to implement a Virtual Dental Home utilizing teledentistry (TD) and silver diamine fluoride (SDF) in Southeastern Idaho. The purpose of this program evaluation was to determine the effectiveness of an educational program on TD, SDF, and portable dental equipment. A pretest/posttest design using a convenience sample was implemented. A Likert scale questionnaire regarding knowledge, clinical confidence, and perspectives was administered to the 2020 senior dental hygiene students (n=22). The educational program included didactic, laboratory, and clinical education on TD, SDF, and portable dental equipment. Following the clinical experience at an assisted-living facility, the posttest was re-administered. Likert data were analyzed using Wilcoxon Signed Rank test and a Bonferroni correction of ($p=0.017$). There was a statistically significant difference between the pretest and posttest scores for knowledge, clinical confidence, and perspectives.

Keywords: virtual dental home, teledentistry, silver diamine fluoride, program evaluation

Chapter 1 Introduction

Historical Overview

In 2000 *Oral Health in America* was published by the Surgeon General acknowledging a sound connection between oral health and general health (U.S. Department of Health and Human Services [USDHHS], 2000). This connection promoted an increase in necessity for oral health care by professionals, government agencies, and the general public (USDHHS, 2000). Since this time significant measures have been made to improve the oral health of Americans, however significant gaps in care still exist (Association of State and Territorial Dental Directors [ASTDD], 2013). In an effort to improve oral health of Americans ASTDD developed the *Guidelines for State and Territorial Oral Health Programs* and established Ten Essential Public Health Services to Promote Oral Health (ASTDD, 2018). These essential services provide a road map for national and state programs to implement oral public health functions in the areas of assessment, policy expansion, and assurance (ASTDD, 2015).

Effective prevention and treatment programs are a major contributing factor in the improvement of the oral health of Americans (Office of Disease Prevention and Health Promotion [ODPHP], 2014). Sadly, many Americans still do not have access to these preventive services which puts them at greater risk of oral diseases such as caries, periodontal disease, and oral cancer (ASTDD, 2013). Factors such as age, gender, education level, socio-economic status, racial/ethnic disparities, access to insurance, and geographic location affect one's ability to gain access to oral health care (ASTDD, 2013). When oral diseases are left untreated, a person can experience pain, disability, poor nutrition, delayed growth, slow development, speech complications, concentration concerns, appearance dysfunction, poor self-esteem, missed school and work, and even death (ASTDD, 2013). Oral diseases produce a significant financial strain

worldwide, and are the fourth most expensive condition to treat in the United States (Idaho Department of Health & Welfare [IDHW], 2014). Increasing access to oral health care, and decreasing the financial strain associated with oral health conditions of all Americans, increases overall health and quality of life (IDHW, 2014).

Under the leadership of the Federal Interagency Workgroup, Healthy People 2020 was developed to identify key areas of emphasis where action must be taken if Americans are to achieve better health by the year 2020 (ODPHP, 2014). There are 17 main objectives in Healthy People 2020 related to oral health. These objectives aim to decrease caries in children 15 and younger; decrease untreated caries in children and adults; reduce extractions due to caries and periodontal disease in adults; increase oral and pharyngeal cancer detection at early stages; increase access to preventive care for children and adults; increase sealant placement on children 15 and younger; increase fluoridated water areas; increase preventive intervention to adults in areas of tobacco cessation; increase oral/pharyngeal cancer screening and glycemic control; increase referral and rehabilitation of infants and children with cleft lip and palate; and increase public health programs (ODPHP, 2014).

Idaho faces many of the challenges that affect residents' ability to access oral care, such as geographic location (approximately one third of Idaho is designated as a rural area, or 16 of the 44 counties), socio-economic status (the mean income of Idaho is \$47,015, about \$6000 below the national level and 11% of Idaho households are below poverty level), age (15.9% of Idaho residents are 65 and older), ethnic/racial disparities (12.7% of Idaho is Hispanic), education (only 25% of Idahoans aged 25 and older have a bachelor's degree or higher), and access to dental insurance (approximately 46% of Idahoans are uninsured) (IDHW, 2014).

Furthermore, Idaho has Dental Health Professional Shortage Areas (DHPSA) in 42 of the 44 counties (IDHW, 2019).

In response to this lack of care the Dental Hygiene Department at Idaho State University (ISU) applied for and received a Health Resources and Service Administration (HRSA) subgrant from the Idaho Oral Health Program, a division of Idaho Department of Health and Welfare. The HRSA subgrant provided funding to implement the concept of the Virtual Dental Home (VDH) utilizing teledentistry (TD) and silver diamine fluoride (SDF) in DHPSAs in Southeastern Idaho. The name of the VDH program is Bengal Smiles for Life (BSL), which focuses care on populations throughout the life span. The VDH concept allows for continuous oral health care in underserved populations. Supervised dental hygiene students provided preventive oral health care and virtual (teledentistry) data were sent to an off-site dentist who supervised care. Oral health care services provided on-site included cancer screenings, referrals, oral health education, dental prophylaxis, non-surgical periodontal therapy, varnish fluoride treatments, cleaning of full and partial dentures, and treatment of dental caries (decay) with SDF, using portable dental equipment.

Teledentistry is beneficial for many reasons, one being reduced cost of treatment (Troconis et al., 2018). Dental care costs are reduced by the use of SDF, students providing treatment, and the program being funded by a grant. Therefore, care will be more affordable and accessible to uninsured Idahoans. The BSL program addresses ASTDD Essential Public Health Service to Promote Oral Health (EPHSPOH) goal number seven, under assurance, which states, “Reduce barriers to care and assure utilization of personal and population-based oral health services,” by reducing the cost of care and transportation to a dental office (ASTDD, 2018, p. 28). In addition to addressing EPHSPOH, the BSL program addresses 10 of the 17 Healthy

People 2020 objectives; OH-1, OH-2, OH-3, OH-4, OH-5, OH-6, OH-7, OH-8, OH-12, and OH-14 (see table 1), as well as providing dental hygiene students with service-learning experiences.

Table 1

Oral objectives

Healthy People 2020
OH-1 Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth.
OH-2 Reduce the proportion of children and adolescents with untreated dental decay.
OH-3 Reduce the proportion of adults with untreated dental decay.
OH-4 Reduce the proportion of adults who have ever had a permanent tooth extracted because of dental caries or periodontal disease.
OH-5 Reduce the proportion of adults aged 45 to 74 years with moderate or severe periodontitis.
OH-6 Increase the proportion of oral and pharyngeal cancers detected at the earliest stage.
OH-7 Increase the proportion of children, adolescents, and adults who used the oral health care system in the past year.
OH-8 Increase the proportion of low-income children and adolescents who received any preventive dental service during the past year.
OH-9 Increase the proportion of school-based health centers with an oral health component.
OH-10 Increase the proportion of local health departments and Federally Qualified Health Centers (FQHCs) that have an oral health program.
OH-11 Increase the proportion of patients who receive oral health services at Federally Qualified Health Centers (FQHCs) each year.
OH-12 Increase the proportion of children and adolescents who have received dental sealants on their molar teeth.
OH-13 Increase the proportion of the U.S. population served by community water systems with optimally fluoridated water.
OH-14 Increase the proportion of adults who receive preventive interventions in dental offices.
OH-15 Increase the number of States and the District of Columbia that have a system for recording and referring infants and children with cleft lips and cleft palates to craniofacial anomaly rehabilitative teams.
OH-16 Increase the number of States and the District of Columbia that have an oral and craniofacial health surveillance system.
OH-17 Increase health agencies that have a dental public health program directed by a dental professional with public health training.

Note. OH=Oral Health Objective (ODPHP, 2014).

Teledentistry, a main component of the VDH, is a developing area of dentistry integrating the use of a cloud-based software system to transmit client assessed data from a

remote location to a supervising dentist at another location. The dentist can then complete a virtual examination by reviewing the data and make a diagnoses. This kind of technology has many benefits, but is particularly useful in providing services to populations where access to care is limited, such as those living in rural areas, or difficult, such as elderly individuals residing in assisted living facilities (McFarland et al., 2018). Connecting experienced practitioners with newly emerging professionals is another excellent service TD can provide as well as continuing education for all practitioners regardless of experience level (McFarland et al., 2018).

Elderly adults living in assisted care facilities are an underserved population that could benefit greatly from TD. These residents are at high risk of oral problems (Tynan et al., 2018). Elderly individuals should have regular oral assessments by dental professionals (Tynan et al., 2018). Unfortunately, several barriers exist to accessing care such as high cost of transportation, mobility issues, and removing residents from their familiar surroundings (Tynan et al., 2018). Teledentistry provides an avenue for screening, diagnosing, consulting, treatment planning, and mentoring in settings such as assisted-living facilities as well as rural, remote, and other underserved populations (Tynan et al., 2018). For this reason, BSL chose to implement the first rotation of the program at Caring Hearts, an assisted-living facility in Pocatello, Idaho.

Another service BSL offered is the placement of SDF, an effective adjunct to TD in treating underserved and remote populations. SDF is a light blue liquid effective in arresting and preventing carious lesions and the desensitization of dentin (Crystal et al., 2019). The application process of SDF is simple and efficient with little armamentarium needed. Individuals with exposed root surfaces are at a greater risk of decay, such as elderly individuals with dexterity disabilities (Schwendicke & Gostemeyer, 2017). Besides being clinically effective for treating

root caries, SDF is safe, cost-effective, and minimally invasive with very few adverse side effects (Schwendicke & Gostemeyer, 2017).

Any treatment rendered is only as good as the education and training of the clinician providing the care (McFarland et al., 2017). Therefore, a successful program providing TD and SDF services must have adequately educated and trained providers. Formal training is the best way to teach clinicians specific methods of approaching and handling the trials and opportunities that come with tele-technology (Pathipati et al., 2016). This form of education should be incorporated into the undergraduate dental hygiene curriculum. Creating new educational programs can be intimidating, but can easily be incorporated into an existing program (Pathipati et al., 2016).

Statement of the Problem

Access to oral health care in America is a continuing problem especially for children and elderly individuals (Bersell, 2017; US Senate Committee on Health, Education, Labor & Pensions, Subcommittee on Primary Health and Aging, 2012). Barriers to obtaining access to oral care include: low-income, lack of dental insurance, shortage of dental health professionals, low oral health literacy, fear and anxiety, transportation problems, work/school release, scheduling challenges, and personal mobility among others (Bersell, 2017; US Senate Committee on Health, Education, Labor & Pensions, Subcommittee on Primary Health and Aging, 2012). In 2012, 17 million children went without preventive dental care according to a large-scale Senate investigation (Bersell, 2017; US Department of Health and Human Services, 2014). More than 49 million Americans reside where there is a lack of dental providers (Bersell, 2017, US Department of Health and Human Services, 2014).

Vulnerable populations such as children and the elderly have a greater barrier to accessing dental care because they are dependent upon caregivers for transportation, daily oral hygiene, and nutritional health (Bersell, 2017). Dental caries is the most common, preventable childhood disease affecting 60% of children over five, and 25% of children under five (Bersell, 2017). Although dental caries is avoidable through preventive care (sealants, fluoride, prophylaxis, etc.), access to that care is not available for many families (Bersell, 2017). Elderly individuals are at an increased risk for periodontal disease and dental caries with more active decay found in this population than the pediatric population (Bersell, 2017; Slack-Smith et.al., 2010).

The *Idaho Oral Health Action Plan 2015-2020* is an outline for improving the oral health of Idahoans (IOHAP, 2015). One of the main priorities is to increase access to care by providing permanent dental homes to all residents (IOHAP, 2015). Providing a VDH in assisted-living facilities and rural communities will provide access to preventive care for underserved and vulnerable populations. The BSL program was established to provide a VDH for populations not able to access dental services by traditional means in Idaho. For the BSL program to be successful, students who will be providing oral health care must be properly educated in the knowledge and clinical skills needed to operate a VDH, which include but are not limited to TD software, SDF, and operating portable dental equipment.

Purpose of the Program Evaluation

The purpose of this program evaluation was to determine the effectiveness of the VDH educational program on TD, SDF, and portable dental equipment to prepare entry-level dental hygiene students for clinical experience.

Significance of the Program Evaluation

This program evaluation is related to the American Dental Hygienists' Association (ADHA) National Dental Hygiene Research Agenda's (NDHRA, 2016) primary objective, which states the importance of giving visibility to research activities promoting health and well-being of the public. Further, this research addresses the professional development and educational areas, specifically focusing on evaluation within the discovery phase of research. Within the evaluation phase, "delivery and adaptation of educational programming for addressing evolving models of health care and practice" (p. 11) are examined. The dental hygiene profession will benefit from this program evaluation by discovering effectiveness of training for future programs and professionals. In addition, this program evaluation aligns with the American Dental Education Association's (ADEA, 2019-2022) strategic goals and objectives which states in part, "drive innovation and advance excellence in learning and discovery to prepare graduates to be competent practitioners and lifelong learners" (p. 1).

Research Questions

The following research questions guided the conduct of this program evaluation.

1. What is the senior students' knowledge of TD, SDF, and portable dental equipment before and after the TD educational program?
2. What is the senior students' clinical confidence using TD, SDF, and portable dental equipment before and after the TD educational program?
3. What is the senior students' perspectives of TD, SDF, and portable dental equipment before and after the TD educational program?

Hypotheses

The following null hypotheses were tested.

1. There is no statistically significant difference in the knowledge of senior students about TD, SDF, and portable dental equipment before and after the TD educational program.
2. There is no statistically significant difference in the clinical confidence of dental hygiene students about TD, SDF, and portable dental equipment before and after the TD educational program.
3. There is no statistically significant difference in the perspective of senior students about TD, SDF, and portable dental equipment before and after the TD educational program.

Conceptional Definitions

TD Educational Program

Learning experience designed to enhance knowledge, clinical skills, and values (perspectives). These experiences include didactic, laboratory, and clinical aspects of the TD program.

Knowledge

Recognizing, retrieving, and/or remembering facts and information from memory acquired by a person through experience and/or education; the foundation on which all learning is built according to Anderson and Krathwohl's (2001) model of the cognitive domain. Learning in the cognitive domain is a hierarchy of knowledge development. The lowest levels of the cognitive domain are remembering, understanding, and applying. Higher levels of knowledge construction include analyzing, evaluating, and creating.

Clinical Confidence

A feeling or belief that one can practice, perform, and conduct clinical skills to the ADHA standard of care.

Perspective

A particular attitude, appreciation, value, or emotion toward or way of regarding something; a point of view or belief that influences one's reactions, expressions, behaviors, and even personality.

Dental Hygiene Students

Students enrolled in the Bachelors of Science entry-level dental hygiene program at Idaho State University. Senior students are those individuals completing the second year of the professional program. Junior students are those individuals completing the first year of the professional program.

Virtual Dental Home

A permanent dental home, as described by Milgrom (2018), for clients where specially trained dental professionals collaborate with a supervising dentist to assess, treat as much as is authorized by scope of practice laws, and make referrals for clients at a community site. This virtual dental home also includes a frequent recare interval, based on the needs of the individual, and utilizes a system of technology to collect electronic dental records such as but not limited to radiographs, health histories, intra-oral photos, and hard and soft tissue charting.

Teledentistry (TD)

The use of telehealth systems and methodologies in dentistry. Telehealth refers to a broad variety of technologies and tactics to deliver virtual medical, health, and education services. Telehealth is not a specific service, but a collection of means to enhance care and education delivery (ADA, 2015).

Silver Diamine Fluoride (SDF)

Topically applied liquid used to treat tooth hypersensitivity and arrest cavitated carious lesions.

Portable Dental Equipment

Dental equipment that may be moved to any location to perform dental treatment, which include but is not limited to: prophylaxis, scaling and root planing, sealant placement, SDF placement, restorations, etc. The dental unit includes but is not limited to: power and water supply, suction (ISOLITE™) handpieces, X-ray equipment (Nomad™) intraoral cameras, ultrasonic instruments, patient and operator chairs, etc.

Operational Definitions

Knowledge

Knowledge level was determined using a self-designed questionnaire about TD, SDF, and portable dental equipment. In the questionnaire instrument there were 15 questions related to student's knowledge level for TD, SDF, and portable dental equipment, scored on a 7-point Likert scale with a range of 1-7. The range of knowledge scores of dental hygiene undergraduate students at Idaho State University (ISU) was 15-105.

Clinical confidence

Clinical confidence was determined using a self-designed questionnaire about TD, SDF, and portable dental equipment. In the questionnaire instrument there were 19 questions related to student's clinical confidence for TD, SDF, and portable dental equipment, scored on a 7-point Likert scale with a range of 1-7. The range of clinical confidence scores of dental hygiene undergraduate students at ISU was 19-133.

Perspectives

Perspective level was determined using a self-designed questionnaire regarding TD, SDF, and portable dental equipment. In the questionnaire instrument there were 16 questions related to student's perspective for TD, SDF, and portable dental equipment, scored on a 7-point Likert scale with a range of 1-7. The range of perspective scores of dental hygiene undergraduate students at ISU was 16-112.

Chapter 2 Literature Review

According to the *Idaho Oral Health Action Plan*, improvement is needed for access to oral health care across the population, including children, the elderly, low-income, and racial/ethnic minority populations (Idaho Department of Health and Welfare [IDHW], 2015). There are 42 (out of 44) counties in Idaho that have a health care provider shortage (IDHW, 2019). There is no dental school in Idaho, therefore acquiring an adequate number of licensed dental professionals is difficult especially in the rural counties, to reduce the number of dental health professional shortage areas. Populations in rural communities are negatively impacted by disparities related to access to oral health care (Troconis et al., 2018). Oral health is important to overall general health, therefore having poor oral health affects one's physical, physiological, and social health (Troconis et al., 2018).

TD can expand the reach of oral health care to areas and populations to improve access to care (Alabdullah & Daniel, 2017). SDF placement in conjunction with TD provides relatively inexpensive treatment for caries in rural and underserved or socioeconomically challenged cohorts (Antonioni et al., 2019). The success of any innovative advancement in the dental field requires a progressive training program for those involved in the delivery of care and use of the technology and products (McFarland et al., 2018).

The following sections are addressed in this literature review: TD; validity, accuracy/effectiveness, benefits, and acceptability by patients and practitioners; benefits and effectiveness of SDF in specific populations; and benefits and effectiveness of training programs for oral health care providers in TD and SDF Databases searched for the literature included Google Scholar, PubMed, and CINAHL, with key terms including “teledentistry,” “silver diamine fluoride,” and “educational programs” from 2014 -2020.

Teledentistry

The term “teledentistry” was first introduced at a conference in Baltimore, Maryland in 1989 (Alabdullah & Daniel, 2018). Teledentistry encompasses information technology and telecommunications for dental care. (Daniel & Kumar, 2014). Teledentistry has shown great value in its potential to reduce oral health care provider shortages; provide greater access to timely oral care through referrals, consultation, education, and preventive hygiene services; and improving the efficiency and effectiveness of oral care services (Daniel & Kumar, 2014). This literature review will discuss the validity, accuracy/effectiveness, benefits, and acceptability of TD by patients and practitioners.

A systematic review was completed in June of 2016 on the validity of TD in oral care examination and diagnosis (Alabdullah & Daniel, 2018). The purpose of this systematic review was to evaluate the validity of TD in oral examinations and diagnosis. This study included a search of three databases which were EBSCO host, PubMed/Medline, and Scopus in June of 2016. Search terms included teledentistry, validity, reliability, telemedicine, telecare, telehealth, teleconsultation, dentistry, and dental. Inclusion criteria included: related to teledentistry or telehealth, available in English, compared TD examination to a gold standard examination, and outlined clear statistics for validity. Exclusion criteria included articles not related to TD or telehealth, pilot studies with small sample sizes, studies with missing information, full text of the articles unavailable, insufficient data analysis, and no description of gold standard. The Quality Assessment of Studies of Diagnostic Accuracy was used to determine the quality of the studies by two reviewers. A study rating 60% or higher on this scale was considered high quality.

The search by Alabdullah and Daniel (2018), yielded 79 studies, of which 21 were duplicates. After screening titles and abstracts 14 received full text review, where nine met

criteria to be included in this systematic review. The research articles represented six different countries: United States, United Kingdom, Brazil, Portugal, Australia, and Germany. Random sampling was used in two of the studies and convenience sampling was used in the other seven.

The different types of equipment used to capture the images in the studies included intraoral cameras, digital extraoral cameras, and smartphones. A store and forward method was used to transmit the data in all the studies. The gold standard comparison in the majority of the studies was a visual examination. Eight out of nine studies reported sensitivity with values ranging from 25- 100%, and seven with specificity values from 68-100%. Positive predictive value of TD exams ranged from 57-100% and negative predictive values ranged from 50-100%. Conformity between the gold standard and TD exams ranged from 46-93%.

Exploring TD validity is vital in determining whether TD is as precise as traditional oral examinations and diagnosis. The two studies in this review that used the randomized trial design, which is preferable and provides stronger evidence, reported no significant difference from the TD group to the control group (gold standard) supporting the validity of TD. The authors concluded that most studies reported scores higher than 75% for sensitivity and specificity, indicating TD to be equivalent to traditional examinations. Due to the methodology variability among the investigations, generalization of the findings was challenging in this systematic review. The searched databases and terms might not have identified all studies related to this review. Future studies are needed to establish standards in cameras, examiners, settings, and type of statistical analysis of comparisons.

The systematic review by Alabdullah & Daniel (2018) concluded that TD examinations are valid, feasible, and comparable to visual examinations. This study concluded that TD can

reduce inappropriate referrals, and can be especially useful in school-based programs. Due to some studies having lower scores in sensitivity for TD, more research is warranted.

Since this publication, Queyroux et al. (2017) published a study on the validity of TD compared to face-to-face examination. The purpose of this study was to evaluate the accuracy of TD for diagnosing dental pathology and chewing ability of elderly individuals in assisted living facilities.

Queyroux et al. (2017) conducted a 2-year cross-sectional study involving 235 participants in eight assisted living homes in France and Germany. Inclusion criteria included residents with oral complaints, willing to receive dental preventive care, able to provide written informed consent, able to communicate, understand, and comply with the interviewer. Participants were excluded if they had a documented history of an examination within the last 12 months prior to signing the consent form, a condition that would result in confinement to a bed, and any preexisting health condition that would interfere with a resident's ability to complete the study.

A dental assistant recorded the oral cavity of each participant with a Pack X endoscope camera and placed images on an SD card. A dental surgeon reviewed the videos and provided a diagnosis on dental pathologies, chewing ability, gingival inflammation, and rehabilitation status of dental prosthesis. Within seven days the patient was examined by the same surgeon in person.

This study by Queyroux et al. (2017) showed excellent results in the sensitivity (93.8%) and specificity (94.2%) for diagnosing oral pathologies among aging individuals in assisted living care facilities using face-to-face examination as a gold standard. The main outcome measured was dental pathology. The results were slightly lower for the sensitivity (85.0%) and specificity (82.8%) of TD for the evaluation of chewing ability. Lastly, the specificity (90.3%) of

TD for assessing the rehabilitation status of dental prostheses was greater than the sensitivity (87.8%). The TD evaluations were also completed in less time (12 minutes) than the face-to-face examinations (20 minutes).

This study by Queyroux et al. (2017) suggests that TD can improve the oral health for many individuals who physically and medically cannot travel to see a provider. These examinations were done in the comfort of the resident's home. In this study the diagnostic sensitivity and specificity of TD was greatest with diagnosing oral pathologies. This study by Queyroux et al. (2017) was valuable for its large sample size among a high-risk population for dental pathologies and poor chewing function that leads to poor nutrition.

Another population with limited access to oral health care are those living in rural and remote areas. A systematic review on the impact (benefits) of TD on dental services in rural areas was conducted in 2018 (Troconis et al., 2018). For this review, five databases were searched (PubMed/Medline, Scopus, Embase, Ovid MEDLINE, and ScienceDirect) for papers written in English on the impact of TD in rural areas. Key terms searched were teledentistry, dental telehealth, oral telehealth, dental telecommunication, rural patients, rural community, rural zones, rural areas, and rural population. Inclusion criteria were papers in English evaluating physical evaluation, education, diagnosis, and treatment planning with TD in rural areas. Exclusion studies included cost-savings evaluations of TD, systematic reviews, comprehensive reviews, congress abstracts, and editor's letters. Methodological quality was assessed using an adapted version of the New Castle Ottawa scale.

The search resulted in 50 articles, of those, 24 were excluded due to repetition, after screening, four papers fulfilled all requirements. Studies were conducted between 2016-2018 in the United States, Australia, and India. The selected papers determined that TD programs had a

positive impact on diagnosis and/or treatment planning in rural areas. Early diagnosis has an important impact on progression and outcome of oral diseases such as caries, periodontitis, and oral cancer (Troconis et al., 2018). Therefore, providing greater access to care through TD services can facilitate early diagnosis and treatment planning, which is similar to or superior to a visual dental examination as long as quality equipment is used (Troconis et al., 2018). TD has a vital role in early diagnosis and treatment of many dental diseases such as caries, periodontitis, and oral cancer (Troconis et al., 2018). The authors concluded that TD programs and services have a positive effect on early access to dental care which benefits rural areas (Troconis et al., 2018). However, this study was limited in the number of studies that fulfilled inclusion criteria, indicating a need for further research.

Individuals with limited mobility and complex medical conditions are restricted in access to oral care which can lead to poor oral health. Because of poor oral health their quality of life and overall health can be affected (Tynan et al., 2018). Tynan et al. (2018) conducted a mixed methods comparison study, completing 252 clinical audits among nine residential aged care facilities in Australia, with and without access to individual oral health programs. Oral health quality of life surveys were completed by 27 eligible residents. Qualitative data collection included one focus group discussion and eight in-depth interviews with key staff and managers at the facilities. The focus group and in-depth interviews lasted 45-60 minutes and discussed the experience and perceived oral health needs within the facilities with suggested recommendations. A total of 40% of residents from residential aged care facilities without the program and 43% with the individual oral health programs had a score lower than 50 indicating poor oral health quality of life. The results of the audit of clinical charts with an individual oral health plan (n=111) and without (n=141) an oral health care plan in place (94.6%; 86.5%) were: oral health

care plan satisfactory (82.2%; 75.2%), last dental visit recorded (70.3%; 17.2%), dentist of record (70.3%; 69.1%), toothbrush available (92.8%; 93.6%), and toothbrush replaced regularly (85.6%; 68.8%).

The qualitative data were collected in one focus group discussion and eight in-depth interviews. The facilities without the individual oral health program revealed several barriers and enablers influencing the performance of managing oral health. Key themes included importance placed on oral health, access to external health services, implications for residents with high care needs, and training in oral health at the facility. Respondents (residents) from the individual oral health program stated it was helpful having expert advice from oral health therapists and having care plans developed on the spot. The visibility of oral health as a priority in the facility became more apparent. Staff also felt the oral health needs of residents were being attended to more promptly and had important benefits to residents with high care needs. The confidence of the respondents (staff) increased with practical observation of the oral health therapist and hands-on training. The access through TD improved communication of treatment and intervention needs with the dentist by decreasing travel and waiting times, and cost of travel, which was particularly beneficial for high needs and limited mobility patients (Tynan et al., 2018).

The qualitative and quantitative data in this study by Tynan et al. (2018) indicated positive benefits by implementing an individual health program, incorporating oral health therapists, and TD in aged care facilities. Both the access to the dentist through the TD and the improved communication through the integrated oral health program with the oral health therapists were equally important to the results. The quantitative data showed improvements in the facilities where the individual oral health program was implemented in such items as plaque

score and dentist referral. The qualitative data indicated benefits to the individual through reduced travel and care being provided in familiar environments, which decreased resident's distress, mobility issues, and cost.

Teledentistry must be accurate and efficient to be a beneficial service. A qualitative systematic review completed by Irving et al. (2016) revealed a high acceptability for TD with clinicians and patients, with efficiency in time for both patients and clinicians, and a reduction in travel costs. Furthermore, TD was useful for mentoring newer practitioners at a lower cost (Irving et al., 2016). Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines a systematic search of nine databases along with grey literature, including MEDLINE, CINAHL, PsychINFO, AMED, EBM Reviews, ERIC, Global Health and PREMEDLINE was conducted for teledentistry. Articles were included if the study utilized telemedicine techniques within a general and specialty dental practice. A modified Downs and Black criterion scale was used to determine, validity, bias, and power. Studies were categorized by outcome measures as "accuracy" or "efficiency" of TD. The qualitative data analysis was reviewed of all included studies, through thematic synthesis of the results and conclusions. For each paper all text under the heading "results/findings" and "conclusion/discussion" were entered verbatim into Hyperresearch 2.8.3 software. A grounded theory approach, including a negative case analysis, was used to attain a higher level of analytical abstraction. The ideas were examined for similarities, variations, and relationships with one another.

The search by Irving et al. (2016) yielded 6898 articles, 1705 were duplicates and excluded, 5111 were ineligible after title and abstract review. Thirty-nine studies were eligible after full-text review. Nineteen studies were about accuracy of TD, 10 on effectiveness of TD, and 10 were case studies or clinical reviews. The articles ranged in date from 1998 to 2014. Two

methods of TD were used among the studies; store and forward, and real-time communication. The average accuracy score, using the modified Downs and Black out of a possible 33 was 23 (70%), average effectiveness of TD was 22 (66%), and overall average for all studies was 23 (69%). Due to the descriptiveness of the majority of the studies it was challenging to assess the quality of the papers against demanding methodological checklists.

All 19 studies concluded TD to be accurate for screenings, examinations, and referrals with quality equipment. Ten studies on the assessment of effectiveness reported TD to be an efficient method for referrals, consultations, treatment planning, diagnosing, and improving periodontal health.

Five themes were identified in the qualitative analysis by Irving et al. (2016) on the application of TD in dental practices:

- a. information and communication technology in TD; all studies acknowledged that communication technologies have become less expensive, more common, and easier to use.
- b. regulatory and system improvements in TD; majority of the studies suggested need for supporting policies and procedures, dedicated personnel to assist, and secure integrated electronic health records.
- c. accuracy of TD; majority of the studies reported TD was as reliable as face-to-face clinical observation.
- d. efficiency of TD; majority of the studies reported effectiveness in cost savings, increased access to services, timeliness, and high acceptability with clinicians and patients.
- e. building and increasing capacity of the dental workforce; many studies reported TD was great for increasing clinician's skills through education sessions, professional development forums, multidisciplinary health models, shared patient responsibility, and peer support.

This qualitative systematic review conducted by Irving et al. (2016) revealed that TD programs are cost effective and can use already integrated technologies. TD increases access to

oral health care, dental specialists, and has a high acceptance rate by clinicians and patients due to the effectiveness in travel and cost. Teledentistry is valuable for its educational aspects for new clinicians, and providing quality care in rural and remote locations. Effective and efficient oral examinations, screenings, diagnosis, consultations, treatment planning, and mentoring are provided by TD. It is widely accepted by both patients and practitioners. The limitations of this study included many of the studies being of only fair quality, a high chance for publication bias due to expressed optimism, and TD programs that were not successful were most likely abandoned and not published.

The literature has shown that TD is valid, accurate, efficient and has many benefits. The research was thorough, up-to-date, and included several systematic reviews. The literature indicates that TD is a promising option to increase access to care.

Silver Diamine Fluoride

Silver diamine fluoride is an inexpensive topically applied liquid used to arrest caries and decrease tooth sensitivity (Antonioni et al., 2019). It has been shown to be safe, effective, and is a recommended treatment by the American Academy of Pediatric Dentistry (AAPD, 2018) and the American Dental Association (ADA, 2018). Barriers to acceptance of this treatment include discoloration of the treated tooth, number of applications needed for optimal arrest, and other minimal side effects, such as mucosal staining and burning. Application of SDF is fast and easy and can be done in a variety of settings with very little equipment. The following section discusses SDF's effectiveness, benefits, and barriers.

Duangthip et al. (2017) conducted a study comparing the adverse effects and parental satisfaction after placement of different concentrations of SDF on preschool children. This study was conducted on 888 preschool children aged 3-and 4-years old (369 girls and 519 boys) with at

least one carious lesion. The children in this study were located within 37 different preschools in Hong Kong. Two study groups of children participants were developed based on low or high caries rate. Less than three caries were considered low caries rate and three or greater were considered a high caries rate. The children were then randomly placed into one of four groups with 222 children in each group.

Table 2

SDF concentration and application sequence

Group 1	Group 2	Group 3	Group 4
12% SDF	12% SDF	38% SDF	38% SDF
Applied annually	Applied biannually	Applied annually	Applied biannually

An independent dentist, blinded to treatment groups, placed SDF or placebo. Groups 1 and 3 received SDF at baseline, 12, and 24 months, and a saline solution/placebo at 6, 18 and 30 months. Groups 2 and 4 received SDF each time (baseline, 6, 12, 18, 24, and 30 months). Follow-up exams were conducted every 6 months by a single examiner to assess color and carious changes. A lesion was considered arrested if the surface was smooth and hard on probing. Presence of color in the tooth was noted as yes or no. A parental questionnaire was administered within a week after placement of SDF/placebo to determine tooth or gingival (gum) pain, gingival swelling, gingival bleaching, and systemic toxicity. Parental satisfaction with their child's dental appearance and dental health was collected through a self-rated questionnaire.

At final examination 799 children were evaluated (10% dropout rate with moving to another school being the main reason for leaving). Table 3 reports the study's findings.

Table 3*Effects of SDF*

Findings at Final Examination	Number Observed	Percentage Observed
Gingival or Tooth Pain	52	5.8%
Gingival Swelling	21.2	2.3%
Gingival Bleaching	42	4.7%
Active Lesions	843	25.8%
Arrested Lesions	2425	74.2%
Total Lesions Treated	3268	

Children treated with 38% SDF had a greater risk of black lesions and those treated biannually had the greatest number of black lesions (95%). Despite the black stain more than half the parents were satisfied or very satisfied with their child's dental health.

This study by Duangthip et al. (2017) adds to previous knowledge of the safety regarding SDF treatment and efficacy among children. No incidence of serious adverse effects/systemic illness related to SDF application occurred during the study period. There is .33mg fluoride in each application of SDF. The probable toxicity dose is suggested as 5mg/kg. The weight of a very small 3-year old could be as low as 10kg. A child this size could receive 20 applications of SDF without being in a toxic level. The authors of this study concluded that the risk of developing minor side effects post SDF application are very low. This study is valuable for its large sample size, long follow-up period, and it is very promising for the arresting effects of SDF in carious lesions. The results conclude SDF is a safe, effective treatment.

In a systematic review completed by Contreras et al. (2017), SDF was evaluated for its effectiveness in preventing and arresting carries in primary teeth and permanent first molars. A systematic literature search of three databases was conducted in PubMed, ScienceDirect, and

Scopus. Filters applied were clinical trial, published in the last 10 years (2005-2016), English, and dental journals. Inclusion criteria were randomized controlled trials using SDF as an intervention, cohort of children with primary dentition and/or permanent first molars. Exclusion criteria included studies in languages other than English and published outside of target timeframe, randomized controlled trials not using SDF, and/or children or adults with full permanent dentitions.

The search resulted in 1136 articles, and 315 were eliminated due to duplication. Of the remaining 821 manuscripts 33 met inclusion criteria, but 25 of those were eliminated due to exclusion criteria. After full-text review seven studies were included in the systematic review.

Three studies compared SDF with other treatment interventions, such as fluoride varnish, glass ionomer cement, and cross-toothbrushing technique. One study assessed the effectiveness of SDF at different concentrations (10%, 12%, 30%, and 38%), application frequencies (annually, biannually), and follow-up intervals. Two studies compared SDF at different application frequencies (annually and biannually) with other interventions, and one study compared SDF applied semiannually to a control group.

The majority of the studies reviewed by Contreras et al. (2017) agreed that 38% SDF was most effective in caries arrest than other interventions, and significantly more effective for caries prevention in primary teeth (80% fewer lesions) and first molars (65% fewer lesions) compared to a control group. Additionally, the caries arrest rate was higher (53%) when 38% SDF was applied biannually as opposed to annually (37%). It was shown that 38% SDF was more effective in caries arrest in primary teeth at 6 and 12-month applications, when compared to a 12% SDF and a control group. SDF was 1.73 times more effective in arresting caries than an interim restorative technique.

A 38% and 30% SDF solution has been reported as a minimally invasive, low-cost, and effective treatment for caries arrest and prevention by this systematic review. The determination of optimal SDF application frequency was inconclusive because of differences in study design among the qualifying studies.

The main side effects reported with SDF were dental staining, oral soft tissue irritation, and pulpal irritation. One study demonstrated that black staining could be reduced by incorporating potassium iodide to SDF during application. Studies showed that using a lower concentration of SDF reduced the adverse effects, however the benefits were reduced as well. Mucosal irritation was rare and not commonly reported.

This systematic review by Contreras et al. (2017) was limited by reviewing only English articles, as SDF is used in many countries. Additional limitations include the authors could not contact the primary authors to clarify issues related to risks and adverse events, and the limited number of manuscripts. The study also lacks a qualitative systematic review including important factors such as parents' perception and children's acceptance of treatment.

Contreras et al. (2017) concluded in this systematic review that SDF in concentrations of 30% and 38% was more effective than other preventive management strategies for arresting and preventing dental caries in primary teeth and first molars. More studies using standardized protocols for study designs, detection criteria, outcomes, and statistical designs are needed to assess the effectiveness of SDF in caries prevention and control, to establish the appropriate application frequency, and establish treatment guidelines.

Silver diamine fluoride is accepted and recommended by the ADA. In a recent systematic review by Slayton et al. (2018), several options for arresting and reversing cavitated and non-cavitated carious lesions on primary and permanent teeth were reviewed and guidelines

were created. The purpose of this review and establishment of clinical guidelines was to aid practitioners in choosing which types of non-restorative interventions could be used to arrest or reverse existing non-cavitated and cavitated carious lesions in children and adults.

An expert panel was assembled including general, public, and pediatric dentists and cariologists by the ADA Center for Evidence-Based Dentistry. Appraisal of Guidelines for Research and Evaluation Reporting Checklist II and Guidelines International Network-McMaster Guideline Development Checklist were followed in the development of the guidelines and manuscript. A systematic review was conducted by methodologists at the ADA Center for Evidence-Based Dentistry and network meta-analysis of the literature by searching MEDLINE and Embase via Ovid, Cochrane CENTRAL, and Cochrane identifying randomized controlled trials on nonrestorative treatments for both cavitated and non-cavitated carious lesions. The Grading of Recommendations Assessment, Development and Evaluations method was used to evaluate the certainty in the evidence and make decisions for the guidelines.

Three clinical questions were asked and answered with the information obtained from the literature. “Question 1. To arrest cavitated coronal carious lesions on primary or permanent teeth, should we recommend SDF, silver nitrate, or sealants?” (Slayton et al., 2018, p.839). The literature which included seven reports and 2,115 participants showed the use of 38% SDF applied biannually was effective in arresting advanced cavitated carious lesions in primary teeth. No evidence was found on the effect of silver nitrate or sealants for cavitated lesions. The panel strongly recommended SDF for primary teeth and conditional recommendation for permanent teeth as there is limited evidence.

Question 2. To arrest or reverse non-cavitated coronal carious lesions on primary or permanent teeth, should we recommend sodium fluoride (NaF), stannous fluoride,

acidulated phosphate fluoride (APF), difluorinated, ammonium fluoride, polyols, chlorhexidine, calcium phosphate, amorphous calcium phosphate (ACP), casein phosphopeptide (CPP)-ACP, nano-hydroxyapatite, tricalcium phosphate, or prebiotics with or without 1.5% arginine, probiotics, SDF, silver nitrate, lasers, resin infiltration, sealants, sodium bicarbonate, calcium hydroxide, or carbamide peroxide? (Slayton et al., 2018, p. 841)

The panel recommended using sealants plus 5% NaF varnish application every 3-6 months to arrest or reverse non-cavitated carious lesions on the occlusal surface of primary and permanent teeth. This recommendation was based on eight studies which included 726 participants.

Question 3. To arrest cavitated root carious lesions or arrest or reverse non-cavitated root carious lesions on permanent teeth, should we recommend sodium fluoride (NaF), stannous fluoride, acidulated phosphate fluoride (APF), difluorinated, ammonium fluoride, polyols, chlorhexidine, calcium phosphate, amorphous calcium phosphate (ACP), casein phosphopeptide (CPP)-ACP, nano-hydroxyapatite, tricalcium phosphate, or prebiotics with or without 1.5% arginine, probiotics, SDF, silver nitrate, lasers, resin infiltration, sealants, sodium bicarbonate, calcium hydroxide, or carbamide peroxide? (Slayton et al., 2018, p. 843)

After reviewing eight studies containing 584 participants the panel gave equal recommendations to SDF, 5% NaF varnish and 5000 parts per million fluoride (1.1% NaF) toothpaste used daily.

Although there are several options to arrest and reverse carious lesions, the ADA recommended the use of SDF as a viable treatment. The ADA also recommended SDF for patients who have limited access to care, are uncooperative and have concerns with anesthetics.

The ADA highly encourages more randomized controlled trials on nonrestorative treatments to strengthen the data.

The use of SDF is cost effective, non-invasive and decreases the need for general anesthesia or sedation in pediatric patients. In a study by Johnson et al. (2019), the cost-effectiveness of Medicaid programs' using SDF to stop the progression of dental caries in children from the ages of 1-5 was compared to traditional restorative procedures. Two main outcomes were evaluated: caries-related visits and the cost associated and the cost effectiveness ratio of SDF treatment on averted restorative visits.

Estimated expenditures came from the 2010-2012 Medicaid Analytic Extract files for seven US states which included: Alabama, North Carolina, South Carolina, Connecticut, Massachusetts, New Hampshire, and Vermont. A Monte Carlo simulation was used to estimate averted restorative visits and associated costs for varying SDF effectiveness and intervention penetration levels. The current standard of care for treating caries which include, amalgam restorations, crowns, pulpotomy and/or pulpal debridement with sedation of nitrous oxide, oral sedation, intravenous sedation, or general anesthesia when needed. Reimbursement for SDF placement was averaged from \$30-\$52 per application (Johnson et al., 2019).

The results of the study varied from state to state, and from year to year. Mean total averted expenditures during the study period of three years ranged from the least being \$2.1M in Vermont to the greatest being \$48.5M in North Carolina (Johnson et al., 2019).

In children aged 1-5, SDF not only arrested caries, but also averted costly restorative visits. SDF also reduced the exposure to the use of general anesthesia and other forms of sedation (Johnson et al., 2019). Medicaid program dental care expenditures can be reduced by

averting more costly treatment. The benefit of providing SDF treatment outweighed the expenditures associated with its application (Johnson et al, 2019).

The limitations of this study include the authors relying on previous systematic reviews on the effectiveness of SDF that lacked sufficient control groups and specific application timing and dosage of SDF. Another limitation was the assumption of when sedation was needed along with the reimbursement amount for SDF. This study also lacked consideration of the quality of life and/or parental acceptance associated with the black staining caused by SDF.

Silver diamine fluoride can be a less expensive caries management option for pediatric populations. Expenditures for state Medicaid programs can decrease significantly when SDF is used and restorative visits are averted. In addition to cost, SDF could also prevent health risks associated with the use of general anesthesia or sedation (Johnson et al., 2019).

Silver diamine fluoride could also be beneficial in an older population with more root exposure. In 2017, Schwendicke and Gostemeyer conducted a study to assess the cost-effectiveness of different root caries preventive measurements.

In this study by Schwendicke and Gostemeyer (2017) four different treatments were compared over a 10-year span. The four treatments were: no treatment, 225-800 parts per million (ppm) fluoride rinses self-applied daily, chlorohexidine varnish applied twice a year by a dental care professional, and SDF varnish applied twice yearly. Efficacy of treatments were utilized from a systematic review. The outcome in terms of health was years the teeth were caries free. The cost was estimated from item catalogues or based on market prices. Populations with different number of teeth and risk level were studied. Two groups were established those with a high number of at-risk teeth (24 teeth), and those with a low number of at-risk teeth (16 teeth).

In populations with a low number of at-risk teeth for root caries, no treatment was the least expensive, however it was the least effective. SDF was found to be the most cost-effective option, as it was the least expensive while still being highly effective. The CHX and daily fluoride rinse were not more effective than SDF, but were more costly. In high-risk populations no treatment was less effective and more costly. As with the low-risk population SDF was the most effective treatment and the least expensive.

This study by Schwendicke and Gostemeyer (2017) showed SDF to be a cost-effective treatment for root caries. However, there were limitations to the study such as the data on root caries incidence rate were collected from different settings, in different populations, using different clinical criteria. Secondly, the data were limited on the efficacy of the different preventive products compared. Third, data on root caries restoration retention and performance were scarce. Fourth, the study model was a simplification of clinical reality and did not reflect the long-term effects of root caries restoration failure. Long-term failure increases cost of treatment. Last, the cost estimates are only good in the German healthcare system and the German fee scale. These limitations were noted and acknowledged by the authors.

Schwendicke & Gostemeyer (2017) found SDF to be less expensive and more effective than the competitors in preventing root caries. Recommending SDF for prevention of root caries can be a cost saving benefit for the patient.

This concludes the literature review on SDF. This review of SDF has shown SDF to be an effective, cost saving prevention and treatment of cavitated and non-cavitated carious lesions on various teeth from primary to root surfaces. Furthermore, SDF provides additional benefits such as no need for anesthesia, decreased chair time, and decreased sensitivity.

Teledentistry Educational Program

The American way of life is in the midst of a life changing transformation with health care in the center of the change, telemedicine will be the cornerstone of the change (Pathipati et al. 2016). The potential of this technology cannot be maximized without a proper educational program (Pathepati et al. (2016). The success of any program requires effective educational training (McFarland et al., 2018). Dental hygiene programs play an important role in preparing oral health professionals in the use of TD and SDF by providing proper and adequate training (McFarland et al., 2018). McFarland et al. (2018) conducted a 36-month study to measure the effectiveness of a TD training program at the University of Nebraska Medical Center; College of Dentistry.

Formative evaluation data were collected using a self-administered questionnaire following completion of the training on 93 participants, consisting of 35 dental students, 19 dentists, 11 dental assistants, 6 dental hygienist, and 21 other health professionals. A 6-point Likert scale rating the level of agreement/disagreement was used to evaluate the effectiveness of the training. Participants rated the training based on seven statements. The seven items were as follows:

1. The competencies to be gained through this course were clearly identified in the syllabus.
2. The training was effective in helping me gain the competencies.
3. The training was relevant for my work.
4. The training increased my knowledge of the subject.
5. The readings and/or handouts added to my understanding of the topics covered.
6. The amount of knowledge I gained in this course was worth the effort I put forth.

7. I gained knowledge in this training that I can use in the future.

The majority of respondents in the McFarland et al. (2018) study agreed or strongly agreed on all seven Likert items. The overall rating for the educational program was positive. The participants rated the training favorable with regard to content, presentation, and skills. The mean rating for program effectiveness in helping to gain competencies differed greatly among the group, with the dental personnel rating this item the highest. There was a significant difference in the mean rating for the “training increasing the participant’s knowledge,” “the reading and/or handouts adding to the understanding of the topic,” “the amount of knowledge gained being worth the effort put forth by the participant,” and “gaining knowledge that can be used in the future by the participant,” with hygienists and assistants rating all of these items the highest. Dentists and hygienist rated the program the highest in overall effectiveness.

The majority of the participants in this study by McFarland et al. (2018) rated the TD educational program for health professionals favorable. Reliability was addressed by collecting the information immediately following program completion. The program was valuable in significantly increasing the number of practitioners educated to provide care using TD equipment and technology; thereby increasing the number of patients in the TD program.

The success of TD requires effective education of professionals. The effectiveness of these programs requires the measure of learning. Limitations of this study by McFarland et al. (2018) include lack of pre-evaluation and lack assessment of results and/or outcomes on quality and services provided by the TD program. A control group should be used to strengthen the results. Further studies need to be conducted to explore such items.

In 2011, Summerfelt published an article on how TD was being applied at Northern Arizona University (NAU) and the training that was completed to carry out the TD program. The

purpose of this article was to summarize the Northern Arizona University (NAU) TD educational experience and clinical workforce model program.

The initial TD program began in 2009 with the purchase of two sets each of management software, digital imaging software, intraoral cameras, digital x-ray film scanner, Nomad portable handheld radiograph systems, laptop computers, projectors, and storage equipment. All participating dental hygiene students (n=10) were provided a total of six hours of training which included, reading the manufacturer's educational materials for the Nomad system and successfully passing the manufacturer's supported examination, learning to use all of the new equipment, including how to transfer digital data onto thumb drives, portable hard disks, burned disks as well as assemble and disassemble all of the portable digital equipment. Students practiced using the equipment on mannequins and each other (Summerfelt, 2011).

One objective of the project was to study the diagnostic quality of radiographs exposed by students after six hours of clinical training. Students performed digital radiographs on patients at two remote locations. Patients were chosen using a stratified random method, grouped by age, and assigned a random number to either Remote Location 1 (n=20) or Remote Location 2 (n=21). Eight dentists participated in the evaluation of the diagnostic quality of the radiographs. A Wilcoxon signed rank test was used to analyze the results ($\alpha=.05$). No statistically significant difference in the diagnostic quality of the digital radiographs was found between the two locations. The radiographs from the two remote locations were then compared with radiographs taken at the Kiddie Clinic in the NAU clinical x-ray lab, which served as a control group. No statistically significant difference was found between the diagnostic quality of the radiographs taken at these three sites.

The faculty and students of the NAU dental hygiene department participated in 13 TD workforce programs over the course of one year in remote sites in Arizona providing care to 183 children (Summerfelt, 2011). The TD program eliminated the need for children to travel 450 miles round trip for oral health care consultations and services such as referrals and application of fluoride varnish. The benefits of TD in remote and underserved areas in terms of cost and time were demonstrated through this program.

This TD program at NAU showed that dental hygiene students can be educated to adequately utilize equipment and provide oral health care to reach underserved and remote populations (Summerfelt, 2011). Teledentistry also offers additional employment options for dental hygienists to function as mid-level providers, and benefits participating dentists by contributing additional patients to their practice (Summerfelt, 2011).

The research in TD educational programs is very limited, therefore expanding the literature search to telemedicine was necessary. In a study by Bauer et al. (2020) district nurses participated in a telemedicine educational program in palliative care. The authors defined palliative care as the care for all patients suffering from life-threatening illnesses. The purpose of this study was to discover and explore the views of district nurses on a telemedicine palliative care education program and to provide information for further implementation of such programs. This study also aimed to contribute to the knowledge and inter-professional education of telemedicine programs.

District nurses (n=15) in four municipalities in South Jutland, Denmark logged on to a 30-minute lecture conducted by a member of a specialized palliative care team member (n=6), which included physicians, nurses, social workers, physiotherapists, and psychologists followed by a question and answer period conducted via a chat function. All slides used during

transmission were distributed to the participants via email. Focus group interviews were conducted and one group interview with the specialized palliative care team member teacher to discover experiences and gather opinions of the nurses on the telemedicine educational program. Inclusion criteria included district nurses employed in one of the four municipalities. A sample was recruited aiming for maximum variation in age, municipality, postgraduate education, and years of experience in palliative care.

Four areas of focus resulted from the data: teaching methods in palliative care, expectations and adaptations, organizational set-up and technology. The majority of the district nurses reported an increase in self-assurance and knowledge base of telemedicine in palliative care. All participants found the topics relevant to clinical practice; however, many found the level to be too basic. Participants reported that when compared to face-to-face, the telemedicine training and teaching had more challenges such as the ability to gauge participants' responses. The program helped reduce professional isolation and instilled renewed focus on topics in palliative care.

The educational program conducted by Bauer et al. (2020) had different configurations in the different municipalities, which through comparison lead to the optimal set-up. A key factor Bauer et al. (2020) recommended when establishing a telemedicine program was keeping the software systems simple to use while still maintaining data protection. While many of the district nurses and specialized palliative care team members adapted quickly to the technology, others found the system overly challenging and complicated which affected their motivation in the program. Choosing user friendly systems are key in maintaining participant motivation and educational program sustainability.

Limitations to the study recognized by the authors were the use of self-reporting

from the participants which can contain recall bias. Another limitation identified by the authors was the small number of district nurses who participated in the program. This study also lacked a pre-and post-measurement tool.

This study on a telemedicine educational program by Bauer et al. (2020) aided in enhancing the knowledge and skills in palliative care to district nurses. The authors recommended addressing increased interaction, organizational endorsement, district nurses' diverse educational needs, specialized palliative care team's training requirements and supporting key nurses' roles in furthering knowledge dissemination for future implementation of a program. The authors also acknowledge that more studies are needed and future studies should contain pre- and post-program interviews with patients and participants.

Medical education must recognize the differences in the practice of traditional medicine and that of telemedicine and adequately educate and train the students (Pathipati et al., 2016). Pathipati et al. (2016) discussed in their article *Telemedical education: Training digital natives in telemedicine, the importance of formal training of telemedicine in medical school*. A model was suggested for incorporating telemedicine training at Stanford University School of Medicine. Pathipati et al. (2016) explained how to incorporate telemedicine by taking a small amount of time each year in the four-year curriculum that is spent on face-to-face clinical training and devote that time to telemedicine training. The clinical reasoning lectures that take place before the clinical sessions would address the actions necessary on how to conduct a safe and effective virtual exam. Dental hygiene can follow the lead of medicine in incorporating formal training in telecommunications into the curriculum.

Summary of Chapter 2

There have been a significant number of studies conducted on the effectiveness and benefits of TD and SDF. There are very few studies performed on the effectiveness of a TD and SDF educational program. A gap in the literature has been recognized regarding the effectiveness of improving the knowledge, clinical confidence, and participant perspectives of those involved in TD programs following an educational program and implementation of the program. Due to this lack of information a clear need exists for further analytical research.

Chapter 3 Methodology

Design

The purpose of this program evaluation was to determine the effectiveness of a VDH educational program on TD, SDF, and portable dental equipment for dental hygiene students at ISU. Chapter one provides the background of the program evaluation along with the problem statement, significance of the program evaluation, purpose of the program evaluation, research questions, hypothesis, and important definitions. Chapter two provides literature reviews of current research on TD, SDF and TD educational programs. This chapter describes the methodology of this program evaluation including the research design; description of the setting and sampling method; description of the instruments; limitations; and procedure for data collection and analysis.

Research Question(s)/Hypothesis

The following research questions guided the conduct of this program evaluation:

1. What is the senior students' knowledge of TD, SDF, and portable equipment before and after the TD educational program?
2. What is the senior students' clinical confidence using TD, SDF, and portable dental equipment before and after the TD educational program?
3. What is the senior students' perspectives of TD, SDF, and portable dental equipment before and after the TD educational program?

The following null hypotheses will be tested.

1. There is no statistically significant difference in the knowledge of senior students about TD, SDF, and portable dental equipment before and after the TD educational program.

2. There is no statistically significant difference in the clinical confidence of dental hygiene students about TD, SDF, and portable dental equipment before and after the TD educational program.
3. There is no statistically significant difference in the perspective of senior students about TD, SDF, and portable dental equipment before and after the TD educational program.

Variables

The dependent variables to be tested were senior undergraduate dental hygiene students' knowledge, clinical confidence, and perspective on TD, SDF, and portable dental equipment. The independent variable was the TD educational program.

Research Method

This program evaluation employed a pretest/posttest design using a convenience sample of senior (n=32) dental hygiene students, at ISU. This design is practical, affordable, and feasible (LoBiondo-Wood & Haber, 2014). A pretest/posttest design is appropriate for a program evaluation (LoBiondo-Wood & Haber, 2014). Students completed a self-generated questionnaire assessing knowledge, clinical confidence, and perspectives with regards to TD, SDF, and portable dental equipment; participated in didactic, laboratory, and clinical training; and completed the same self-generated questionnaire at the end of the Spring semester.

Setting Description

The didactic training for this educational program evaluation was performed at the dental hygiene building classroom 301 on the ISU, Pocatello campus. The classroom contained 41 desks with unattached chairs. A podium was stationed in the front of the classroom with a laptop, which feeds into an overhead projector onto a screen. A second door on the left of the classroom opens to a laboratory. The laboratory contains four rows of bench-like table units, with eight

stations in each row. There was a table in front with a computer that feeds into two flat screen wall mounted televisions.

The clinical portion of the training was conducted at building one of Caring Hearts, an assisted-living facility. Caring Hearts is a three-building facility with a total of 46 beds. The staff provides long-term care for elderly patients with mobility, memory, and medical issues. This facility is ideal for this project because it delivers care to a population with limited access to oral care due to a variety of factors such as medical complications, cognitive limitations related to dementia, mobility problems, and lack of dental insurance.

The pre-questionnaire and post-questionnaire were available for students to complete in Qualtrics. The link to the questionnaire was emailed to students. The students were able to complete the questionnaire at their convenience within a two-week time period.

Research Participants

Sample Description

For this thesis research during the 2109-2020 academic year, a convenience sample of ISU Department of Dental Hygiene baccalaureate program's second-year (senior) dental hygiene students was used. The sample size was 32 participants, however only 22 completed the posttest questionnaire.

Inclusion Criteria

Participants were senior students actively enrolled in ISU's dental hygiene baccalaureate program. The senior participants in the program evaluation must have completed DENT 4403/4403C and completed one clinical rotation at Caring Hearts during DENT 4404C as these clinical courses included the didactic, laboratory, and clinical experiences with the VDH educational program related to TD, SDF, and portable equipment.

Exclusion Criteria

Exclusion criteria established for the program evaluation were any senior student who withdrew or was removed from ISU's dental hygiene baccalaureate program over the course of the program evaluation, was not over the age of 18, and did not successfully complete the clinical components up until the stay-at-home order executed by Governor Brad Little.

Human Subjects' Protection

The research was exempt from the human subject's protection because it was a program evaluation. Dr. Ralph Baergen, Chairperson of the ISU Human Subjects Committee made this determination, which was verified by the thesis advisor who communicated via email with him.

Data Collection

Procedure and Protocol

A 50-statement self-generated questionnaire (Appendix) using a 7-point Likert scale was administered electronically via Qualtrics to senior students (n=32) in DENT 4403 Advanced Clinical Theory I. The questionnaire contained 15 questions assessing knowledge, 19 questions assessing clinical confidence, and 16 questions assessing perspectives regarding TD, SDF, and portable dental equipment. Following the pretest, the senior students received 90 minutes of didactic lecture on the history, composition, benefits, side effects, application process, and precautions of SDF. The students then moved into the laboratory for 30 minutes where they reviewed the application process and applied SDF on extracted teeth set in plaster.

The senior students received 30-minutes of didactic instruction on set-up and maintenance procedures of the portable dental equipment. This session included set-up and break down of the patient and operator chairs, set-up and break down of the Aseptico™ unit (a fully functional dental unit containing air, water, suction, and power) and attachment of the

ISOLITE™ (a suction device that isolates a quadrant of the mouth, holds the mouth open, and provides light). The students then rotated through three 10-minute stations (one with patient and operator chair, one with the Aseptico™ unit, and one with ISOLITE™) practicing these procedures.

The training for the Nomad® digital x-ray device included watching (online at their convenience) a 30-minute manufacturer's video on radiation safety, maintenance, and operation procedures. A 26 question, true/false and multiple-choice manufacturer's test was administered, also on-line, and an 80 % pass rate was required. Following completion of the test, a classroom lecture of 30-minutes was given after which the students moved to the clinic for a 90-minute session to set-up, operate, and expose radiographs with the Nomad®. Each student successfully exposed one high-quality diagnostic periapical and one bite-wing radiograph on a partner, using and demonstrating all manufacturer's safety recommendations and precautions.

The TD software to be used was iDentalSoft™. Students received one hour of didactic lecture in the classroom with demonstration on the overhead screen. Following the oral presentation, the students were given 30-45 minutes to log on to the software, set-up individual user passwords, and navigate through the software. Training on iDentalSoft™ continued on-site for each of the students. Four students and two instructors rotated one time per week for eight hours to gain their clinical experience with the BSL TD program at an assisted-living center. When the students arrived on-site at Caring Hearts, the equipment, which was stored in the manager's office, was set up in the activity area which had doors that could be closed for privacy. Two students began reviewing the residents' health histories, taking vital signs, performing extra and intra-oral exams, exposing radiographs, providing oral health education, and dental hygiene care, while two students continued training on the software with an instructor.

Students rotated positions from patient care, (one being the operator, one being the assistant) to on-site software training throughout the day. Each student had one clinical session at Caring Hearts. Each student provided care for one patient for one and a half hours. A total of four patients were treated per session.

Following the didactic, laboratory and clinical education the senior students completed the same questionnaire (Appendix) through Qualtrics as the posttest at their convenience within a two-week period. The data collected on the pretest and posttest-questionnaire were compared.

Instruments

A 50-item pretest/posttest self-generated questionnaire assessing knowledge, clinical confidence, and perspectives concerning TD, SDF, and portable dental equipment was administered digitally through Qualtrics software. Each statement had seven possible choices on a Likert-type scale: strongly disagree, moderately disagree, disagree, neutral, agree, moderately agree, strongly agree). The data were stored in an electronic file for analysis.

Validity and Reliability

Validity for this program evaluation was assessed using the item content validity index (I-CVI). I-CVI was a respectable choice for this situation because it is easily understood and interpreted (Polit et al., 2007). The questionnaire was sent to ten experts in the field to assess validity of each question. Any statement that received an I-CVI rating of .80 or less was rewritten or eliminated. A question received an I-CVI rating of 0.80 or higher when eight out of the 10 experts rate the question a 3, or 4 on a 4-point scale where 1=*not relevant*, 2=*somewhat relevant*, 3=*quite relevant*, and 4=*highly relevant*. There was also a request for expert advice on rewording suggestions.

Reliability was established through a test-retest method. The reliability of an instrument is shown when the same results are produced on repeated measures (LoBiondo-Wood & Haber, 2014). Reliability's greatest concern is consistency (LoBiondo-Wood & Haber, 2014). A reliable instrument will produce the same results each time tested (LoBiondo-Wood & Haber, 2014). For this research the questionnaire was administered to 10 junior dental hygiene students and re-administered two weeks after completing the first questionnaire. Items rating below 0.80 were reviewed and/or revised. The level of agreement for the test-retest reliability was computed by comparing each person's response to each statement on the test and retest. When the two responses are more than one point different on the Likert scale, the statement receives a zero score. When the two responses are the same or within one point on the Likert scale, the statement receives one point. Eight of ten persons must score one point for each statement to meet the 0.80 agreement level; otherwise, the statement was reviewed and/or revised.

Limitations

A pretest/posttest program evaluation is limited in the ability to make a clear cause-and-effect statement (LoBiondo-Wood & Haber, 2014). Replication of such evaluation is important to support evidence obtained through pretest/posttest research (LoBiondo-Wood & Haber, 2014).

Use of a convenience sample has the greatest risk of bias because participants are convenient and accessible (LoBiondo-Wood & Haber, 2014). Cautions should be applied when using a convenience sample when analyzing and interpreting the data, because this form of sampling produces the weakest evidence and generalizability (LoBiondo-Wood & Haber, 2014). Although a convenience sample may not always be the best, sometimes it is the most appropriate as was the case for this program evaluation (LoBiondo-Wood & Haber, 2014).

Statistical Analysis

Data related to knowledge, clinical confidence, and perspectives were analyzed using descriptive statistics, which included frequency and percentages. Data from each questionnaire were downloaded into an Excel file for analysis. The analysis revealed that the variances of the pretest and posttest scores for each of the three variables (knowledge, clinical confidence, and perspectives) were not equal; therefore, the most appropriate test to compare the scores based on the ordinal data was the Wilcoxon Signed Rank test (Vogt, 2005). Bonferroni adjustment was made to the 0.05 alpha level ($0.05/3=0.017$) to determine whether the differences between the pretest/posttest scores were significant and to decrease the likelihood a Type I error (Vogt, 2005).

Conclusion of Chapter 3

A pretest/posttest program evaluation using a convenience sample of ISU senior dental hygiene students was utilized to assess an educational program on TD, SDF, and portable dental equipment at ISU. A self-generated questionnaire assessing knowledge, clinical confidence, and perspectives regarding TD, SDF, and portable dental equipment was administered prior to any education, and after the education was completed.

Findings from this program evaluation contributed to and enhanced the BSL, TD, and SDF grant program, as well as other educational programs. Results and discussion were reported in the form of a manuscript to be submitted for publication in *Annals of Long-Term Care*. The remaining sections of the thesis reflect the manuscript specifications outlined in the author guidelines located at <https://www.managedhealthcareconnect.com/content/author-guidelines>

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Appendix

Bengal Smiles for Life Teledentistry Educational Program Questionnaire

The purpose of this questionnaire is to determine students' CURRENT knowledge, clinical confidence, and perspectives related to the teledentistry technology and equipment for the *Bengal Smiles for Life* Program.

The results of the questionnaire will provide valuable information for the development of the teledentistry training program. Please answer the statements as honestly as possible. You should be able to complete the questionnaire in 8 to 10 minutes.

If you have questions of concerns, please contact Dr. Ellen Rogo at rogoelle@isiu.edu

Please type your first name and last initial: i.e. "Benny B."

Teledentistry

My current level of **knowledge** on teledentistry can be used as an effective means of assessing treatment needs in underserved populations.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current level of **knowledge** on using a teledentistry cloud-based software program can be used to transmit patient data to dentists.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current level of **clinical confidence** in using a teledentistry cloud-based software program to transmit patient data to dentists.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Teledentistry technology provides an effective means of securely transmitting patient data to dentists.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Teledentistry technology enhances collaboration between dental hygienists and off-site dentists.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A teledentistry program is an efficient and effective means to provide oral health care to patients in underserved areas.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A teledentistry program is an efficient and effective means to screen and refer patients in underserved areas for the diagnosis of dental caries.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A teledentistry program is an efficient and effective means to screen and refer patients in underserved areas for the diagnosis of oral diseases such as periodontal disease and oral cancer.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A teledentistry program is an efficient and effective means to screen and refer patients in underserved areas to other health providers (e.g. physicians, nutritionists, etc.) for overall health concerns.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Silver Diamine Fluoride (SDF)

My current **knowledge** on the *purpose* of SDF for the prevention and arrest of dental caries is sufficient.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** can be used to assess the *risks* and *benefits* of SDF.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** can be used on the *proper application procedures* for SDF.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current level of **clinical confidence** about identifying patients who would benefit from SDF placement.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current level of **clinical confidence** about thoroughly discussing the benefits and risks of SDF with patients and parents of caregivers.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your **clinical confidence** in properly applying SDF.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SDF is a valuable material for preventing and arresting dental caries in **adults**.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SDF is a valuable material for preventing and arresting dental caries in **children**.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SDF is a valuable material for preventing and arresting dental caries in **elderly patients with special health needs**.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Portable Dental Equipment (patient and operator chairs, ISOLITE, suction, handpiece, rheostat, air-water connection, external water supply)

My current level of **knowledge** about set-up procedures of the portable dental equipment is sufficient.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** of infection control procedures following OSHA guidelines can be used for the portable equipment in a mobile teledentistry setting.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** about efficiently and effectively setting up the portable dental equipment.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** in infection control procedures following OSHA guidelines for the portable dental equipment in a mobile teledentistry setting.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** about breakdown procedures and storage of the portable dental equipment.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Having portable dental equipment helps provide access to oral care for underserved populations.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Portable dental equipment is essential to a mobile teledentistry program for the effective and efficient provision of care.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

It is important to properly maintain portable dental equipment to provide high-quality oral care.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Portable X-Ray Equipment (Nomad)

My **knowledge** regarding radiation safety about the use of portable x-ray equipment can be used with the Nomad.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** about infection control procedures can be used for the portable x-ray equipment (Nomad).

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** about how to effectively and efficiently expose diagnostic radiographs can be used with portable x-ray equipment (Nomad).

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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My current **knowledge** about the maintenance procedures of the portable x-ray equipment (Nomad) is sufficient.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** about the radiation safety procedures for the portable x-ray equipment (Nomad).

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** about the maintenance procedures for the portable x-ray equipment (Nomad).

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** on exposing diagnostic radiographs using portable x-ray equipment (Nomad) on **adults**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** on exposing diagnostic radiographs using portable x-ray equipment (Nomad) on **children**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** on exposing diagnostic radiographs using portable x-ray equipment (Nomad) on **elderly patients with special health needs**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Portable x-ray equipment (Nomad) is a valuable tool for assessing oral health problems.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Portable x-ray equipment (Nomad) is a valuable tool for gathering assessment data for collaboration between dental hygienists and dentist.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Intraoral Camera (MouthWatch)

Rate your current **knowledge** about set-up procedures for the intraoral camera.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** about infection control procedures can be used for the intraoral camera.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** can be used to effectively and efficiently take a diagnostic picture with the intraoral camera.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My current **knowledge** can be used regarding maintenance procedures of the intraoral camera.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your **clinical confidence** about the set-up procedures of the intraoral camera.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your **clinical confidence** about infection control procedures for the intraoral camera.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your **clinical confidence** about maintenance procedures for the intraoral camera.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** in taking a diagnostic intra oral photo using the intraoral camera on **adults**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your **current clinical** confidence in taking a diagnostic intraoral phot using the intraoral camera on **children**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** intaking a diagnostic intraoral photo using the intraoral camera on **adults**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your current **clinical confidence** intaking an intraoral photo using an intraoral camera on **elderly patients with special health needs**.

Not at all confident	Barely confident	Slightly confident	Neither	Confident	Moderately confident	Highly confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

An intraoral camera is a valuable tool for assessing oral health conditions and problems.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

An intraoral camera is a valuable tool for gathering assessment data for collaboration between dental hygienists and off-site dentists.

Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Demographic Information

Please identify your role in the Department of Dental Hygiene:

Junior dental hygiene student
Senior dental hygiene student
Part-time faculty member
Full-time faculty member
Dentist

What is your age?

18-21 years
22-25 years
26-29 years
30 + years

What is your ethnicity?

American Indian or Alaska Native
Asian
Black or African American
Hawaiian Native or Other Pacific Islander
Hispanic of Latino
White
Other

What gender do you most identify with?

Woman
Man
Nonbinary
Other
Prefer not to say

What is the highest degree or level of education you have completed?

High School or equivalent
Associate's degree
Bachelor's degree
Master's degree
Doctoral degree

Have you previously provided care in a teledentistry program?

Yes
No

Have you previously applied Silver Diamine Fluoride?

Yes
No

Have you previously set-up, used, and broken down portable dental equipment?

Yes
No

Have you previously exposed radiographs using portable x-ray equipment?

Yes
No

Have you previously taken pictures using an intraoral camera?

Yes
No

Title Page of Manuscript

Teledentistry educational program improves access to care for older adults in assisted-living
facility

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Keywords: teledentistry, silver diamine fluoride, educational program, assisted-living, dental
hygienists.

Manuscript Abstract

Title of the Article: Teledentistry educational program improves access to care for older adults in assisted-living facility.

Older adults residing in assisted-living (AL) facilities encounter numerous challenges when accessing oral health care. Idaho State University Department of Dental Hygiene implemented a teledentistry (TD) program utilizing silver diamine fluoride (SDF). By bringing oral health care professionals to AL facilities, many barriers to obtaining oral care were overcome. The purpose of this program evaluation was to determine the effectiveness of an educational program on TD, SDF, and portable dental equipment. Senior dental hygiene students (n=32) completed training before participating in a clinical rotation at the AL facility. Using a pretest/posttest design, data were collected on knowledge, clinical confidence, and perspectives of TD, SDF, and portable dental equipment using a self-generated questionnaire. Likert data were analyzed (n=22, 69%) using Wilcoxon Signed Rank test and a Bonferroni correction of $p=0.017$. All three variables were shown to be statistically significant; with knowledge and clinical confidence reporting a maximum size effect ($p<.001$), while perspectives resulted in a medium size effect ($p=.003$). The educational program was effective for increasing knowledge, clinical confidence, and perspectives.

Keywords: teledentistry, silver diamine fluoride, educational program, assisted-living, dental hygienists.

Introduction

Access to oral health care in America is an ongoing problem especially for older adults living in residential care facilities.¹ *Improving Access to Oral Healthcare for Vulnerable and Underserved Populations*, a report from the Institute of Medicine (IOM), recognized several disparities that older adults residing in assisted-living (AL) facilities encounter when trying to obtain oral healthcare.² Disparities for this vulnerable population are influenced by barriers to healthcare including complex medical conditions, limited mobility, impaired cognitive function, reliance on other individuals for transportation, and cost of treatment.³ These barriers restrict access to oral care, which can lead to poor oral health in older adults.¹ Because of this health status, quality of life and overall health can be affected.² The IOM established that the first step to improving oral health was to expand access to oral healthcare.²

One way to increase access to care is through the implementation of a teledentistry (TD) program. TD as defined by the American Dental Association (ADA), is

the use of telehealth systems and methodologies in dentistry. Telehealth refers to a broad variety of technologies and tactics to deliver virtual medical, health, and education services. Telehealth is not a specific service, but a collection of means to enhance care and education delivery.⁴

TD provides an avenue for screening, diagnosing, consulting, treatment planning, and mentoring in settings such as AL facilities as well as to rural, remote, and underserved populations.³ TD can be accomplished through live video conferencing, or storing and forwarding of data for non-real-time consultation.³ TD has been shown to be efficient, accurate, and cost-effective which makes this delivery system ideal for long-term care settings.⁵

Moreover, a TD program with oral health practitioners who place silver diamine fluoride (SDF) provides relatively inexpensive treatment for caries in vulnerable and underserved cohorts.⁶ SDF is an inexpensive topically applied liquid used to arrest caries and decrease tooth sensitivity.⁶ Application of SDF is fast, easy, and can be completed in a variety of settings with minimal equipment without the discomfort of the traditional “drill and fill” treatment.

Older adults have higher caries rates, increased prevalence of periodontal disease, and decreased oral health.⁷ These disease rates are worse in older adults with dementia.⁷ Dementia as defined by the World Health Organization, “is an umbrella term for several diseases that are mostly progressive, affecting memory, other cognitive abilities and behaviour, and that interfere significantly with a person’s ability to maintain the activities of daily living.”⁸ Oral hygiene performed every day is considered an activity of daily living. Due to the functional changes from dementia, people with cognitive decline are reliant on others to perform biofilm removal. Behavioral changes and decreased verbal communication skills increase the difficulty for others to perform daily oral hygiene care on these individuals.⁷ Persons suffering from dementia have significantly lower submandibular salivary flow rates which causes a significant increase in the caries rate.⁹ Furthermore, increased consumption of carbohydrate rich foods is related to the reduced motor skills needed for chewing and swallowing.⁷ Moreover, the decline in motor skills influences the ability to easily transport individuals to receive healthcare.⁷ Because of changes in brain function, individuals suffering from dementia have even greater barriers in access to care and an increased risk for oral diseases, which makes TD programs in long-term care facilities an effective means for oral health practitioners to provide care.

Program Planning and Implementation

The Department of Dental Hygiene at Idaho State University (ISU) was awarded a Health Resources and Service Administration subgrant from the Idaho Oral Health Program, a division of the Idaho Department of Health and Welfare in the Spring of 2019. The intent of the grant was to improve access to care in a dental health professional shortage area by implementing a TD program. Grant funds were used to purchase two sets of portable dental units, operator chairs, high speed evacuation systems, portable x-ray devices, and TD software. The TD software allowed the collection of patient data in a cloud-based system, which was reviewed (asynchronously) by a supervising dentist at the campus clinic. The university's Health Insurance Portability and Accountability Act (HIPAA) compliance officer evaluated the TD software to ensure that the patients' personal health information was protected.

The TD program was named Bengal Smiles for Life, which focuses care on vulnerable and underserved populations over the lifespan. The target populations envisioned to participate were adolescents attending public school in a low socioeconomic area or older adults in long-term care facilities. Various sites were contacted to participate in the TD program; however, the administrators at Caring Hearts, a local AL facility showed extreme interest. Caring Hearts is a 46 bed, for-profit entity for residents who require memory care.

The university clinic coordinator met with the AL manager to plan the logistics of the clinical rotation for the senior students during the 2019-2020 academic year. When specific information related to the rotation was organized, the details of the TD program were presented to the residents and legal guardians by the university clinic coordinator and other faculty members, including the supervising dentist. Residents and legal guardians were provided an opportunity to ask questions before consenting to participate in the program.

An educational program was developed to improve the senior dental hygiene students' knowledge, clinical confidence, and perspectives of the TD program. More specifically, students received 4 hours of lecture presentations, 3 hours of laboratory instruction, and 8 hours clinical training on portable equipment, dental software, and products used during patient care. The training began with students learning to set up and break down the portable dental equipment. In addition, students trained on the Nomad® portable x-ray equipment and received a manufacturer certification after completing an online quiz and hands-on demonstration of skills. Second, students received instruction on the use and application of SDF. Training concluded with the introduction of the TD software. Students learned to navigate the software system in the classroom setting and continued on-site learning during patient care at AL facility.

To further prepare the students, the AL manager and attending physician completed a two-hour session on-campus with the students to prepare them for working with the memory care residents. The purpose of the session was to help the students understand the challenges of delivering care to an older adult population with dementia and review specific scenarios they were most likely to encounter. The students asked questions for the last portion of the meeting.

The on-site clinical experience consisted of four students and two instructors completing one eight-hour rotation at the AL facility. When the team arrived on-site at Caring Hearts students set up the portable dental equipment in a private room used for activities. The residents who were scheduled for the day were escorted to the dental hygiene students by the Caring Hearts staff. Two students began patient care while two students continued training on the TD software and reviewed the next patient's medical information with an instructor and AL staff. Students rotated positions from patient care, (one student was the clinician while the other

student was an assistant) to on-site software training and review of patient medical records throughout the day. A total of four patients were treated per day.

The oral care provided by the students included an extra-oral and intra-oral assessment with intra-oral photos, periodontal assessments, radiographs, dental cleanings, non-surgical periodontal therapy, application of SDF, full and partial denture cleanings, and daily self-care education. The supervising dentist reviewed the assessed data via the TD software and rendered a diagnosis and treatment plan within the scope of dental hygiene practice. Although students did not have the additional opportunity of providing restorative treatment due to COVID-19, they did gain an interprofessional opportunity with the staff at the AL facility.

The interprofessional collaboration began with reviewing each resident's health history including medication regimen by students, faculty, and AL staff prior to initiating oral care. This interaction during the review of the inclusive document fostered the partnership and communication between medical and dental hygiene providers to ensure the safe and comprehensive care of residents.

Program Evaluation Methods

The TD program evaluation was exempt from review by the university's Institutional Review Board. A pretest/posttest design with a convenience sample of senior dental hygiene students at ISU, was implemented. To determine the effectiveness of the TD educational program, a 50-statement questionnaire was developed by the researchers to evaluate three variables related to TD, SDF, and portable dental equipment: knowledge, clinical confidence, and perspectives. The questionnaire contained 15 knowledge statements rated on a 7-point Likert scale with *1=strongly disagree*, *4=neutral* and *7=strongly agree*. Therefore, the possible range of scores was 15-105. The variable clinical confidence was assessed by 19 statements on a Likert

scale with 1=*not at all confident*, 4=*neither confident or not confident* and 7=*highly confident*. The range of scores for this variable was 19-133. Lastly, the questionnaire contained 16 statements related to perspectives with the same Likert scale as the knowledge statements. The range for perspectives was 16-112. Questions were developed to collect demographic data and previous experience with TD, SDF and portable dental equipment.

The content validity index (I-CVI) was used to establish the validity of the questionnaire.¹⁰ I-CVI was a reasonable choice for this situation because it is easily understood and interpreted.¹⁰ The questionnaire was sent to ten experts in the field to assess validity of the content. Each statement was rated as 1=*not relevant*, 2=*somewhat relevant*, 3=*quite relevant*, and 4=*highly relevant*. The number of experts rating a statement as 3 or 4 was computed as a percentage. Statements receiving <0.80 were rewritten or eliminated. Suggestions for rewording the statements was also solicited.

Reliability was established through a test-retest method using 10 junior dental hygiene students at ISU. The 50-statement questionnaire was administered one week and then re-administered to the same students two weeks later. The percentage of agreement between the responses from the first questionnaire and the second questionnaire was computed. Items rating below 0.80 were reviewed for revision.

The pretest/posttest questionnaires were managed through an online survey tool, Qualtrics. Data from each questionnaire were downloaded into an Excel file for analysis. The analysis revealed that the variances of the pretest and posttest scores for each of the three variables (knowledge, clinical confidence, and perspectives) were not equal; therefore, the most appropriate test to compare the ordinal data was the Wilcoxon Signed Rank test.¹¹ Bonferroni adjustment was made to the 0.05 alpha level ($0.05/3=.017$) to determine whether the differences

between the pretest and posttest scores were significant and to decrease the likelihood a Type I error.¹¹

Program Evaluation Results

A total of 32 senior dental hygiene students met the inclusion criteria; however, only 22 participants completed both the pretest and posttest (n=22) yielding a response rate of 69%. The majority of the participants were between the ages of 21-25 years of age, Caucasian, female, and had not previously participated in a TD program. Demographic information is highlighted in Table I.

Knowledge of TD, SDF, and portable dental equipment before and after the educational program was examined and is summarized in Table II. The mean score of knowledge prior to the program implementation was 57 (sd=21), which increased to 94 (sd=8) following the educational program. The Wilcoxon Signed Ranks test analysis determined a statistically significant difference between the pretest and posttest knowledge of the participants ($p<.001$). The Rank Biserial Correlation established the effect size at 1.00, a maximum effect size.

Participants were asked to rate their clinical confidence of TD, SDF, and portable dental equipment before and after training was received. The results are reported in Table II. The mean score of clinical confidence before the educational program was 53 (sd=24), and 114 (sd=13) after. The Wilcoxon Signed Ranks test determined there was a statistically significant difference between the pretest and posttest clinical confidence of the group ($p<.001$). A maximum effect size of 1.0 was computed using the Rank Biserial Correlation indicating a maximum difference between pretest and posttest.

Lastly, the perspectives regarding TD, SDF, and portable dental equipment before and after the program are presented in Table II. The pretest mean score was 95 (sd=12) and 106

(sd=8) for the posttest. The Wilcoxon Signed Ranks test showed statistically significant difference in the pretest and posttest perspectives ($p=.003$). A medium effect size was indicated by the Rank Biserial Correlation.

Discussion

The TD educational program in which the senior dental hygiene students participated was shown to be an effective program in increasing students' knowledge, clinical confidence, and perspective of TD, SDF, and portable dental equipment. Very few TD program evaluations exist, especially programs implemented in AL facilities; therefore, information in this evaluation is valuable in pioneering new TD programs to improve access to care for underserved populations. Furthermore, long-term care administrators benefit from dissemination based on the importance of raising awareness and understanding of the value a TD program provides, especially for residents in memory care facilities. The implementation of TD programs is an innovative delivery system to improve the oral health of this vulnerable population.

During the COVID-19 pandemic and the challenges AL facilities encounter with limited access of non-essential persons, TD provides an opportunity to establish an interprofessional collaborative approach to oral care. Oral health providers can teach AL administrators or nursing staff to use the technology for consultation and diagnosis of oral diseases and conditions. In addition, recommendations can be made for the use of products and prescriptions to combat these problems.¹² When oral health providers are allowed to enter facilities, SDF, a non-invasive, non-aerosol producing treatment, can be applied to arrest dental caries and reduce oral problems such as dental abscesses, pain, and eating difficulties.

In a similar TD program evaluation medical providers such as school nurses collaborated with dental students and other oral health providers in a community health-based setting.¹³ Their

program evaluation successfully increased the knowledge, clinical skills, and competency of the participants as well as provided an interprofessional teamwork experience.¹³ The education received from this TD program helped improve access to care and improve the oral health of populations who access care in community settings.¹³ Another TD program following a mid-level dental hygiene model, predominately serving pediatric populations, was implemented and the outcomes of the educational program were similar to the previous study.¹⁴ The present program evaluation supports the effectiveness of TD educational programs integrated into a dental hygiene curriculum.

When students have the opportunity to learn in community-based programs tailored to diverse underserved populations such as older adults in AL facilities, they are more likely to continue working with these populations after graduation.¹⁵ Not only do these programs increase and improve students' knowledge and skills as this program evaluation demonstrated, the potential exists to improve care to vulnerable and underserved populations and improve oral health outcomes.

The clinical rotation at the AL facility provided valuable experiences for senior dental hygiene students to provide care and more importantly to understand the challenges this population faced. These experiences included interactions with the residents during meal time, planned activities, and movies. Time spent with residents of AL facilities affected with dementia can improve relationships, mood, and quality of life as well as slow the rate of cognitive decline.¹⁶ By spending time with the residents during meals and other activities the working relationship was improved for all involved with the TD program including students, residents and staff of the AL facility.

An additional positive outcome of the program was an opportunity for interprofessional collaboration between students and the interaction with the AL nurses and care providers while reviewing residents' medical histories during patient care. Through this partnership, students were able to gain a greater understanding and awareness of the individuals' medical and emotional needs and abilities. Additionally, this collaborating experience provided students an opportunity to share oral care knowledge and strategies with the nursing staff to enrich and improve the oral health care provided for the residents in the future. Collaboration between the nursing staff of AL facilities and dental providers can improve the oral care provided to residents.¹⁷

While there were many positive outcomes of the program evaluation, it was not without challenges and limitations. Finding a TD software meeting HIPAA compliance requirements proved to be very challenging and created a delay to starting the program for several months. In addition, community sites for program implementation were difficult to secure based on a lack of understanding of TD programs and the benefits afforded to those individuals who receive care. Furthermore, the second phase of the program to provide restorative care for dental caries was suspended due to COVID-19 restrictions.

Limitations of this program evaluation included one university's experiences with a TD educational program, which is not generalizable. Additionally, the collection of data using the online questionnaire in Qualtrics was a limitation. Students had difficulty inputting their responses; therefore, a higher percentage of students did not complete the posttest questionnaire, which resulted in the 69% response rate.

Recommendations for future research includes a focus on training AL staff to use the TD equipment and software for consultation, diagnosis, and recommended care for residents during

situations such as the COVID-19 pandemic. Moreover, studies are needed to determine the effectiveness of dental hygienists providing care to residents in AL facilities using TD technology. Care within the dental hygiene scope of practice includes dental caries arrest with SDF and the placement of interim restorations. The ongoing evaluation of innovative delivery models to vulnerable and underserved populations is vital to the oral health of the nation.

Conclusion

Older adults living in AL facilities encounter several challenges when trying to maintain oral health and obtain oral health services. TD can decrease these challenges by expanding access to care, thus improving the oral health status of older adults. Successful TD programs are implemented with proper educational training of individuals participating in delivering the TD services. An effective educational program includes didactic, laboratory, and clinical experiences at the AL facility as demonstrated by this evaluation.

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Table 1.0 Demographic Data

Characteristics	n (%)
Age	
22-25	17
26-29	4
30+	1
Ethnicity	
Asian	1
Hispanic or Latino	3
White	18
Gender	
Male	0
Female	22
Education	
High School or equivalent	13
Associate's degree	7
Bachelor's degree	2
Previous experience with a TD program	
Yes	0
No	22
Previous experience applying SDF	
Yes	1
No	21

Previous experience with portable dental equipment, portable x-ray equipment, and intra-oral camera	
Yes	1
No	21

Table II Program Evaluation Results

Results	Knowledge		Clinical Confidence		Perspectives	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Possible range	15-105		19-133		16-112	
Actual range	15-91	81-105	19-93	89-132	76-112	82-112
Mean	57	94	53	114	95	106
Standard deviation (sd)	21	8	24	13	12	8
p value	p<.001		p<.001		p=.003	