5-2018

A Survey of the Implementation and Usage of Electronic Dental Records and Digital Radiographs in Private Dental Practices in Mississippi

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A thesis

presented to

the faculty of the Department of Allied Health Sciences

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Master of Science in Allied Health

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by

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May 2018

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Keywords: electronic health records, digital radiography, conventional radiography, dental, private practice, dental health records, electronic dental records

ABSTRACT

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Implementation of electronic health records by the Health Information Technology for Economic and Clinical Health has led to the implementation of electronic dental records (EDRs) and digital radiography in dental offices. The purpose of this study was to determine the state of the implementation and usage of EDRs and digital radiographs by the private general and pediatric dental practices in Mississippi as well as reasons why the dental practices are not moving forward with the advanced technology.

A survey was emailed to 712 dental practices: 116 responded (16% response rate), and 104 consented to participate (89.66%). Results indicated dental practices in Mississippi using EDRs was 46.07%, EDRs with paper records was 42.70%, and only paper records was 11.24%. Results indicated dental practices using digital radiography was 76.40%, conventional radiography was 13.48%, and both was 10.11%. Common reasons for not advancing were cost, insufficient training, computer/software issues, and “too old.”

DEDICATION

I dedicate this thesis to my husband, children, and parents. You are the most important aspect in my life, second only to my relationship with Jesus Christ. Without your constant support, understanding, and love during this process, I would not have been able to accomplish this milestone in my life. Thank you for your belief in me through this process.

ACKNOWLEDGEMENTS

I would like to express gratitude and appreciation to my thesis committee: Dr. Ester Verhovsek, Dr. Randy Byington, Dr. Susan Epps, and Dr. Deborah Dotson. Your knowledge, guidance, and assistance in the development and writing of this thesis was invaluable. Words cannot express my gratitude for the support you provided during my family's crisis. A special thanks to my chair, Dr. Verhovsek, for your constant encouragement. Our conversations came at the time I needed a boost of confidence. Thank you!

A special thank you to my coworkers at the University of Mississippi Dental Hygiene Program. Thank you for listening, encouraging, and providing guidance during the writing of this thesis. Thank you to Dr. Kim Tolbert and Lisa Owen, R.D.H. for your support and encouragement.

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CHAPTER 1

INTRODUCTION

An electronic health record (EHR) is an electronic version of every health-related event encountered by individuals over their lifetimes (HealthIT.gov., 2016; Nguyen, Bellucci, & Nguyen, 2014). EHRs provide different healthcare professionals instant access to documentation of a patient's medical history including diagnoses, treatment, surgeries, radiographs, allergies, immunization records, lab tests and results, and vital signs (Center for Medicare and Medicaid Services, 2016; HealthIT.gov. 2016). Usage of EHRs improves management of patient care, promotes evidence-based decision-making, and increases the efficiency of health care services by promoting effective communication and coordination between the different health care specialists. A decrease in medical errors exists with the implementation of EHRs due to the accuracy and transparency of the patient's record (Center for Medicare and Medicaid, 2012; Ghazisaeedi, Mohammadzadeh, & Safdari, 2014; HealthIT.gov., 2016).

In 1991, the Institute of Medicine issued a report advocating within ten years the implementation of EHRs in health systems (Dick, Steen, & Detmer, 1997). The implementation of EHRs by physicians increased from 18% in 2001 to 57% in 2010 (Hsiao, Hing, Socey, & Cai, 2011). On February 17, 2009, the Health Information Technology for Economic and Clinical Health (HITECH) was signed into law as part of the American Recovery and Reinvestment Act (ARRA). A primary objective of the HITECH was the nationwide implementation and usage of EHRs. The HITECH provided financial incentives to encourage providers to implement and use a certified EHR (Jamoom, Yang, & Hing, 2016; Kempfert & Reed, 2011; Thurston, 2014). The certified EHR must meet standards of the Meaningful Use Incentive Program established by the Centers for Medicare and Medicaid Services and the

Office of the National Coordinator for Health Information Technology (ONC) in order for providers to qualify for the incentive payments (Center for Medicare and Medicaid Services, 2016; HealthIt.gov, 2016; Jamoom et al., 2016; Thurston, 2014). The standards of the Meaningful Use Incentive Plan required the certified EHRs to:

1) Improve quality, safety, efficiency and reduce health disparities;

2) Engage patients and family

3) Improve care coordination, and population and public health

4) Maintain privacy and security of patient health information (Thurston, 2014, p. 511).

In January 2016, the National Center for Health Statistics reported results from the 2014 National Electronic Health Records Survey. Data from the survey indicated the percentage of office-based physicians with a certified EHR system increased from 67.5% in 2013 to 74.1% in 2014 (Jamoom et al., 2016).

In the dental profession, chair-side computers function as the computer-based patient records (CPRs) which store and manage digital imaging and clinical data (Schleyer et al., 2006). Features of practice management systems (PMS) on chair-side computers include scheduling, billing, insurance processing, treatment planning, periodontal charting, and hard tissue charting (Schleyer et al., 2006). Being a paperless dental office indicates "all patient records are kept electronically with no paper backup" (Schleyer et al., 2013, p. 50). Data in the CPRs are backed up daily to avoid loss of patients' records in a fire, flood, tornado, or any other natural disaster. For security, off-site backup systems for CPRs encrypt the data during transmission. Protection of paper records requires scanning the documents or converting into microfilm or microfiches (American Dental Association, 2010; Leeuw, 2014; Shagam & Kleiman, 2011).

The Center for Dental Informatics conducted a survey in 2004 through 2005 to determine the percentage of general dentists in America using chair-side computers as well as the percentage of offices which are totally paperless. The results indicated that 25% of the general dentists had implemented chair-side computers in the office and 1.8% offices were entirely paperless (Schleyer et al., 2006). In 2006, data collected from a survey conducted by the American Dental Association (ADA) revealed that the implementation of chair-side computers had increased to 55.5% and the percentage of offices that were entirely paperless increased to 9.5% (American Dental Association Survey, 2007). On June 15, 2010, the Government and Public Affairs Division of the ADA posted a summary of the HITECH provisions providing information of interest to dentists. The summary acknowledged that the implementation and use of electronic dental records (EDRs) by the HITECH pertained to private practice dentists, the dental profession, and dental schools (American Dental Association, 2010). In 2013, Schleyer et al. conducted a survey to determine the use of EDRs by members of The Dental Practice-Based Research Network (DPBRN). The DPBRN members were "a consortium of dental practices with a broad representation of practice types, practitioners, and treatment philosophies" (Schleyer et al., 2013, p. 50). The data from the survey indicated that 73.8% of the solo practitioners used EDRs to store patients' information and 14.3% were entirely paperless. The results indicated that 78.7% of the group practitioners used EDRs and 15.9% were paperless (Schleyer et al., 2013). Over a period of eight years, the number of general dentists and dental groups using EDRs has grown from 25% to 75% which signifies the importance of incorporating the EDRs by every dental practice in Mississippi and throughout the United States.

According to the United States Surgeon General's report on *Oral Health in America*, "oral health is essential to the general health and well-being of all Americans" (U. S. Department of Health & Human Services, 2000, p. 1). The report included findings from studies that indicated an association between periodontal disease and systemic diseases such as cardiovascular disease, diabetes, immunocompromised diseases, stroke, and detrimental pregnancy outcomes (U. S. Department of Health & Human Services, 2000). Systemic factors such as diabetes, leukemia, genetic risk factors, systemic medications, hormonal alterations, and osteoporosis are significant risk factors for periodontal disease (Gehrig & Willmann, 2016). Therefore, dental and medical professions must collaborate to improve the management of care for patients with medically complex conditions (Fricton et al., 2011; Gehrig & Willmann, 2016). Collaboration using EHR systems benefits the patients as well as the dental and medical teams. Electronic medical records (EMRs), electronic dental records (EDRs) and personal health records (PHRs) are different types of EHR systems (Fricton et al., 2011). The proven relationships between systemic diseases and oral health conditions support incorporating EDRs in dental practices. The collaboration of the medical and dental professionals through EHR systems provide patients with the optimum health care.

With the implementation of EDRs by the HITECH, digital radiographs within private dental practices have become an essential part of the EDR. Digital dental radiography refers to a digital dental image acquired by a "filmless" technique. The two types of "filmless" techniques are direct digital imaging and indirect (semi-direct) imaging (Greco, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009). Direct digital imaging captures the image by using a sensor receptor which transmits a latent electronic image to the computer resulting in a visible image (Greco, 2014; Iannucci & Howerton, 2017; Muhamedagic &

Muhamedagic, 2009). Indirect digital imaging captures the image by a phosphor plate system (PSP). The main components of indirect digital imaging are an intraoral dental x-ray unit, a scanner, a PSP plate, and a computer with imaging software (Greco, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009). The up-to-date imaging software digitizes and processes the information received from the sensor or PSP. The visible digital image is stored, easily accessed, printed, or emailed through the imaging software (Greco, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009).

In 1983, the American College of Radiology (ACR) and The National Electrical Manufacturers Association (NEMA) formed a committee to develop Digital Imaging and Communication in Medicine (DICOM) which is a standard for acquiring, transmitting, storing, printing, and displaying digital images and other medical data in the medical field. The standard pertains to digital images systems in which the acquired images are transmitted between computers and various other devices and through the Internet (Burgess, 2015; Howerton & Mora, 2008). The American Dental Association became part of the DICOM committee in 1996. At that time, standards were formulated to incorporate the use of DICOM Standard in dentistry (Burgess, 2015). The implementation of DICOM into dentistry is another reason digital radiographs have become an essential component of the electronic dental record.

Statement of Problem

Emerging from the implementation of HITECH, the number of dental offices using EDRs is growing and digital radiographs taken within the private dental practices have become an essential part of the patient's EDR. However, the state of Mississippi has been slow at making the transition to EDRs and digital radiographs.

Purpose of the Study

The purpose of this study was to determine the state of the implementation and use of digital radiographs and EDRs by the private general and pediatric dental practices in Mississippi as well as reasons why the dental practices are not moving forward with the advanced technology.

Research Questions

The following research questions framed this study:

1. Are private dental practices in Mississippi currently using EDRs?
2. What factors influence the selection of paper dental records or EDRs by private dental practices in Mississippi?
3. Are private dental practices in Mississippi currently using digital radiography?
4. What factors influence the selection of radiography exposure technique, digital or conventional, by private dental practices in Mississippi?
5. What factors influence the selection of the type of digital radiography, direct or indirect, by private dental practices in Mississippi?

Significance of Study

The study provided an overview of the implementation and use of the modern technology of digital radiography and EDRs by the private general and pediatric dental practices in Mississippi. Dissemination of the study results among dental practitioners in the state of Mississippi may raise awareness and thus encourage more dentists to embrace digital radiography and EDRs.

Delimitations

The study was delimited to general and pediatric private dental practices in Mississippi. Specialist practices such as periodontists, endodontists, orthodontics, and oral surgeons are not participants.

Limitations

The potential limitations of the study were:

1. Lack of certainty of collecting all email addresses from the method of compiling the addresses for the private general and pediatric dental offices in Mississippi. The method involved searching for the general dental offices per county on the Mississippi State Board of Dental Examiners' website as well as the pediatric dental offices while eliminating other specialty practices such as periodontal, endodontic, and oral surgery offices.
2. The percentage of dental practices who chose not to respond to the survey.
3. All participants may not have provided the factors that influence the selection of the type of radiography technique used in their office.

Assumptions

I made the following assumptions in conducting this study: 1) that the participants could read and understand the survey and 2) that the participants would answer the survey honestly.

Operational Definitions

Electronic health records (EHRs): "Digital version of a patient's chart. EHRs are real-time, patient-centered records that make information available instantly and securely to authorized users" (HealthIT.gov, 2016, para 1)

Digital Imaging and Communication in Medicine (DICOM): "Standard within Medicine for the transmission of radiologic images and other medical information between computers and

various devices that acquire images also between various equipment and software systems that are produced by different manufacturers" (Burgess, 2015, p. 330).

Conventional radiography: Refers to film-based imaging (Wilkins, 2013).

Digital radiography (image): Refers to the "method of capturing an image using a sensor, breaking it into electronic pieces, and presenting and storing the image using a computer and related imaging software" (Iannucci & Howerton, 2017, p. 288).

Indirect or Semi-direct digital imaging: Requires a phosphor plate to create the image (Muhamedagic & Muhamedagic, 2009; Wilkins, 2013).

Direct digital imaging: Requires a sensor to create the image (Muhamedagic & Muhamedagic, 2009; Wilkins, 2013).

Electronic dental records (EDRs): Refer to the patient's dental records which are electronically created, stored, and shared (Wilkins, 2013).

Personal health records (PHRs): Refer to electronic records with "information entered by the doctor and patient" (Nguyen, Bellucci, & Nguyen, 2014, p. 781).

Paper records: Refer to the dental patient's records which are handwritten and stored in a folder referred to as a chart (Wilkins, 2013).

Private practices: Dental practices in which the dentist or dentists practice the dental profession independently.

General Dentist: A dentist who provides oral health care to adults and children (American Dental Association, 2016).

A pediatric dentist: A dentist who provides oral health care to only children (American Dental Association, 2016).

CHAPTER 2

LITERATURE REVIEW

Paper-based clinical documentation of patient medical and dental records at times has been inaccurate, damaged, misplaced, disorganized, and illegible (Thurston, 2014). Advancements in electronic technology have enhanced clinical documentation and led to the integration of patients' personal information and medical records via electronic health records (EHRs) (Centers for Medicare & Medicaid, 2016; Thurston, 2014). Through the use of computer software programs and the accessibility of the internet, EHRs "have provided a faster, more convenient, and better-organized mode of information gathering and preserving" (Wilkins, 2013, p. 101). In private dental practices, advancements in electronic technology have resulted in the implementation of electronic dental records (EDRs). Use of EDRs in private dental practices has enhanced the clinical documentation enabling digital radiographs within the private dental practices to become an essential part of the electronic dental record (Wilkins, 2013).

Electronic Health Records

As previously stated, the Health Information Technology for Economic and Clinical Health's (HITECH) primary objective was the nationwide implementation and use of EHRs. The Meaningful Use (MU) Incentive Program was established to encourage providers to adopt and implement certified EHR systems (Jamoom et al., 2016; Kempfert & Reed, 2011; Thurston, 2014). Thurston (2014) discussed the programs of the Meaningful Use (MU) Incentive Program as well as the criteria a provider must follow to receive the incentive payments. The Center for Medicare and Medicaid Services (CMS) regulated the incentives according to the eligibility of the providers. Eligible providers (EPs) must show a "meaningful use" of a certified EHR

system. The MU incentive process consists of two programs: Medicare MU program and Medicaid MU program. Eligible providers can only participate in one program (Centers for Medicare and Medicaid Services, 2017). Thurston (2014) reported that "based on a review of literature, evidence exists that EHR use can improve outcomes of care, reduce clinical errors, and serve as a cost-saving clinical system" (p. 512).

Ghazisaeedi et al. (2014) established in their review that EHRs have the potential to be an effective and efficient avenue for communication among the medical team members and patients' case management. Additionally, EHRs were established to be a valuable supply of medical evidence as well as health information such as clinical findings, clinical manifestations, diagnostic assessments, diagnosis, and etiology. Finally, they indicated several significant factors that determine the success of implementation of EHRs: communication, users, change in management, leadership, training, and design of the EHRs (Ghazisaeedi et al., 2014).

Nguyen et al. (2014) conducted a systemic literature review of 98 peer-reviewed scholarly journal articles to identify the impact of implementing EHRs and contingent factors in the development and implementation of EHRs in an organizational environment. Implementation of EHRs among the healthcare profession continues to grow at a steady slow rate and hospitals are the primary users of EHRs; however, in the United States (U.S.), implementation has significantly increased in the primary care environment (Nguyen et al., 2014). Data collected by the Office of the National Coordinator for Health Information Technology (ONC) in 2015 from the American Hospital Association established that 84% of the hospitals in the U.S. had implemented EHRs which is a 56% increase since 2011 (Henry, Pylypchuk, Searcy, & Patel, 2016). According to the National Ambulatory Medical Care Survey (NAMCS), the percentage of office-based physicians who had implemented EHRs increased

from 18% in 2001 to 78% in 2013 (Hsiao & Hing, 2014). Additionally, Nguyen et al. (2014) established the contingent factors in developing and implementing EHRs were the absence of uniform standards and guidelines when developing EHR systems and the lack of training and educational sessions for the clinicians and other users.

The particular type of health care professional using the EHR determines the data components and the application of the EHRs. A nurse records medication summary, treatment plans, vital signs, symptoms, and other data related to their responsibilities. A radiologist uses the EHR to review a patient's medical history before taking radiographs and then uploads the radiographs into the patient's EHR. Physicians use the data provided by the radiologist and nurse in the EHR to determine a diagnosis and treatment for the patient. Therefore, each health professional needs data components based upon their job responsibilities. EHR designs vary; however, few studies of the structure of EHRs have been published (Hayrinen, Saranto, & Nykanen, 2008).

EHRs are known by different, but interchangeable, names: electronic medical record (EMR), electronic patient record (EPR), computerized patient record (CPR), electronic dental record (EDR), and patient health record (PHR). Electronic health records, EMRs, and CPRs are often interchangeable; EPR and PHR are interchangeable as well (Fricton et al., 2011; Hayrine et al., 2008; Lobach & Detmer, 2007). In the hospital setting, PHRs contain personal information the patient can edit, and EMRs are categorized according to the medical department treating the patient such as emergency care records, intensive care records, or anesthesia records (Hayrine et al., 2008). The EMR refers to a patient's medical record used by a particular healthcare profession, and EDR refers to a patient's dental record used by a specific dental professional.

Electronic Medical Records

Benefits of EMRs are an improvement in the efficiency and effectiveness of the patient's care, legible documentation, and increased productivity (Strauss, 2015). Connecting databases from different departments within a hospital provide the capability to enhance patient care and function as a mechanism to analyze the data (Birtwhistle & Williamson, 2015). Improvement in the efficiency and effectiveness of the patient's care transpires through the availability of data such as recorded vital signs, medication history, and laboratory test results. Additionally, data in the EMRs serves as a valuable source for "research, disease surveillance, and practice quality improvement" (Birtwhistle & Williamson, 2015, p. 239).

Along with the benefits of EMRs, there are also drawbacks such as privacy and security risks. Although EMRs are password protected, individuals can gain unauthorized access to a patient's record. Organizations must have a compliance policy in place for all employees which governs the privacy and security of a patient's EMR (Strauss, 2015). While use of EMRs have the potential to improve patient's care, enforcement of privacy and security protocol is a must.

Electronic Dental Records

A variety of software provides an electronic instrument to document the clinical record, digital radiographs, photographs, and to submit insurance claims electronically. Dental and periodontal assessments are recorded manually or using automated, voice-activated recordings. Therefore, integration of patient's records is an advantage for the total practice. The EDR contains the patient's complete information, appointment schedules, medical alerts, insurance information, and financial features. Hard copies of the record are available for patients to share with specialists or when changing dental care provider due to relocating, dissatisfaction with a current dental care provider, or insurance preferred provider option plan changes (American

Dental Association, 2010; Wilkins, 2013). The ADA Standards Committee on Dental Informatics (SCDI) provides dentists with information about selecting software and hardware, digital radiography, and data security. Efficient training of the dentist and staff is necessary for the EDR to be successful. Training courses are available from software companies and through continuing educational (CE) courses which the ADA provides online and at meetings (American Dental Association, 2017).

Implementation and use of electronic records by the HITECH pertain to private practice dentists, the dental profession, and dental schools (American Dental Association, 2010). For a general dentist to participate in the Meaningful Use (MU) Incentive Program, the dentist must be enrolled in the Medicaid Program (Centers for Medicare & Medicaid Services, 2016). Unfortunately, dentists are not eligible to participate in the Medicare Program. The MU Incentive Program provides financial incentive payments to EPs registered in the Medicaid or Medicare program who are using EHRs in a "meaningful" way which impacts patient care. To receive the financial incentives, the dentist must be using an EDR and meet the core objectives and menu objectives of the MU Incentive Program excluding the objectives which are not applicable to dentists such as immunizations records (See Appendix A) (Centers for Medicare & Medicaid Services, 2016).

The implementation of EDRs has several advantages; terminology within the record is standardized and entry of the information into EDRs can be quicker and more efficient as well as more comprehensive than in paper records. Improvements include easier, faster access to clinical information, and improved legibility of the documentation as well as the accountability and efficiency of the staff. The accessibility of information through electronic records improves communication between patients and providers and during consultations with dental specialists

or other multidisciplinary team members (Wilkins, 2013). To determine the advantage of using EDRs data for research, Liu, Acharya, Alai, and Schleyer (2013) conducted a data-mapping study. The mapped data from the Cancer Data Standard Registry and Repository and the Dental Information Model V.1.0 repository and found "that about 40% of the data elements in general dental patient records are potentially re-usable for research" (p. 95S). Data collected from EDRs can be a valuable complement to conventional clinical research (Liu et al., 2013).

EDRs and medically complex conditions. With the proven relationships between systemic diseases and oral health conditions, educating dental professionals about the complex health problems related to dental health is essential. Therefore, dental and medical professions must collaborate to improve the management of care for patients with medically complex conditions (Fricton et al., 2011; Gehrig & Willmann, 2016). Little literature exists on the integration of patients' records by the medical healthcare providers and the dental care providers to assist in providing the optimum health and dental care; however, a collaboration among the providers can be beneficial for the patients. Collaboration between the medical healthcare providers and dental care providers can increase patient safety, decrease the change of medication errors, and notify the dental providers of patient's allergies and health issues. Additionally, knowledge of the patient's health history increases the patient's confidence in the dental care provider (Younai, 2009).

Fricton et al. (2011) conducted a two-year randomized clinical study to determine the effect of using EDRs in clinical settings for patients with medically complex conditions. Fifteen dental clinics were randomly selected from the HealthPartners Dental Group (HPDG) and divided into three groups. Clinics in the first group received alerts through the EDR when a patient had a medically complex condition. In the second group, patients with medically

complex condition received alerts from the HPDG. The alert notification sent via email, mailed letter, or PHR recommended to the patients to confer the condition with their dental care provider. The patients and the dental care providers in the control group did not receive alerts. The study provided alert notifications for the following complex medical conditions: diabetes mellitus, xerostomia caused by medications or a salivary condition, congested heart failure, and chronic obstructive pulmonary disease. When receiving alerts, 63-73% of the dental care providers reviewed the clinical care guidelines for patients with medically complex conditions. The alert notification received by the dental care provider was more effective than relying on the patient to bring it to the provider's attention. Overall, results of the study showed that the use of an EDR system by dental care providers improved decision making and increased the efficiency and effectiveness of the care of patients with medically complex conditions (Fricton et al., 2011).

EDRs and digital radiography. Electronic dental records, digital radiography, and the internet are components of the current technology used in private dental practice. Digital radiographic systems provide immediate results, and this permits the dentist to contact a specialist, discuss treatment options for the patient, and send radiographs to the specialist via email. Another advantage of using electronic dental records with digital radiography is the ability to submit an insurance claim along with the digital radiographs (Muhamedagic & Muhamedagic, 2009).

Implementation of the electronic dental records by the HITECH will require dentists to have a digital radiographic system and a universally accepted standard for exchanging medical images (Burgess, 2015). Digital Imaging and Communications in Medicine (DICOM) is the standard set by the American College of Radiology and the National Electrical Manufacturers'

Association for managing, transferring, printing, storing, and displaying digital images in the medical and dental profession (Burgess, 2015). DICOM transfers the radiograph files in an encrypted format that protects the patient's data. The interoperability format allows dentists to correspond with other medical professionals as long as both providers operate DICOM (Farman, Levato, Gane, & Scarfe, 2008). DICOM was initially introduced to the medical profession in 1985 and has undergone revisions. In 1996, the American Dental Association implemented the use of DICOM in dentistry. DICOM will benefit the patient who has medical issues that are affected by dental problems and the patient who has dental problems that are impacted by medical issues by allowing the primary provider to provide the specialist with digital images before a consultation (Burgess, 2015).

Digital Radiography

Digital radiographic systems in the dental profession produce intraoral, panoramic, and cephalometric images (Wilkins, 2013). The systems are filmless and require specific equipment to record the dental radiographs for transfer to a computer and the computer's imaging software. Conventional film-based dental x-ray units can still be used to supply radiation for digital images. Digital images are a combination of pixels representing approximately 256 shades of gray displayed on a computer monitor (Iannucci & Howerton, 2017; van der Stelt, 2008; Wilkins, 2013). Current digital imaging systems have the capability of storing the images on a hard drive, CD, or a flash drive and can also print images or they can save images for review at a later date and electronically send the images to other professionals (Iannucci & Howerton, 2017; van der Stelt, 2008; Wilkins, 2013).

Background

German physicist Wilhelm Conrad Roentgen discovered x-rays on November 8, 1895. After Roentgen had published documents supporting his discovery of x-rays, other scientists helped to shape dental radiography history by duplicating his discovery and presenting additional information on x-rays. Conventional film-based radiography came into existence two weeks after the x-ray discovery became public when German dentist Otto Walkoff made the first dental radiograph (Iannucci & Howerton, 2017). Walkoff produced the dental radiograph by placing a photographic glass plate covered in black paper and rubber in his mouth. W. J. Morton took the first dental radiograph in the United States (U.S.) (Iannucci & Howerton, 2017). The shaping of the dental radiography history continued with C. Edmund Kells taking the first practical dental radiograph in the U. S. on a patient in 1896 (Iannucci & Howerton, 2017). William H. Rollins evolved the first dental x-ray unit in 1901, and Frank W. Woert was the first to use film intraorally (Iannucci & Howerton, 2017). "From 1896 to 1913, dental x-ray packets consisted of glass photographic plates or film cut into small pieces and hand-wrapped in black paper and rubber" (Iannucci & Howerton, 2017, p. 4). Eastman Kodak Company developed the first manufactured pre-wrapped intraoral film in 1913 followed by the machine-made periapical film packets in 1920 (Iannucci & Howerton, 2017).

Radiographic technique changed from conventional film-based to digital radiography with the invention of computerized transverse axial scanning by G. N. Hounsfield in 1972 (Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009). In the mid-1980s, Francis Mouyen introduced the first digital x-ray sensors. The sensors could acquire a radiographic image; however, the image could only be printed - not stored on a disk (Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009). Digital radiography was first used in dentistry in

1989 and was used to diagnosis temporomandibular joint disease and abnormalities of paranasal sinus (Ajmal & Elshinawy, 2014; Muhamedagic & Muhamedagic, 2009). The introduction of the first digital sensor for the panoramic unit was in 1995 (Iannucci & Howerton, 2017).

Types of Digital Images

In the dental profession, the two methods used to capture digital radiographic images are direct digital imaging and indirect (semi-direct) digital imaging. The direct digital imaging method obtains the images by using a solid-state sensor. Indirect digital imaging method retrieves the image by using a phosphor plate (Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008). Extra-oral and intra-oral imaging are available in both direct and indirect radiographic systems. A dental office should determine the best method according to the individual practice's organization and the software program the practice is using (Muhamedagic & Muhamedagic, 2009).

Direct digital images. Equipment necessary for direct digital images includes a sensor (wired or wireless), conventional dental x-ray unit, and a computer with a software imaging program. Direct digital imaging is a solid-state system which uses a charge-couple device (CCD) or complementary metal oxide semiconductor (CMOS-APS) sensors to capture the image (Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009). An electronic circuit is entrenched in a silicon chip within the CCD which is made up of electrons arranged into blocks or picture elements known as pixels. "A pixel is a small box, or 'well,' into which the electrons produced by the x-ray exposure are deposited" (Iannucci, 2017, p. 291). Each pixel arrangement, or electron potential well, consists of an electronic charge equivalent to the number of electrons that responded within the well (Iannucci, 2017). Each electronic well adapts to a distinct area on the linked computer screen. When the x-ray photons come into

contact with the CCD, the electrons released from the silicon produces an electron charge creating an electronic latent image which is transferred to the computer resulting in a visible image (Iannucci, 2017).

The main difference between the CCD and CMOS systems is the design of the electronic chip (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008; Wilkins, 2013). As stated in the previous paragraph, in the CCD, x-rays are converted into electrons which are stored in electron wells before converting into an image. In the CMOS, electrons are stored in the chip itself, and the individual pixels are smaller (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008; Wilkins, 2013).

Indirect digital images. Indirect digital images are referred to as semi-direct because the image is converted from an analog image to a digital image. The indirect radiographic system uses a photo-stimulable phosphor (PSP), a conventional dental x-ray unit, and an electronic scanner (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008). The photo-stimulable phosphor is referred to as a storage phosphor plate which is covered with phosphor crystals. After the PSP is exposed to x-radiation, the images are collected from the plates by placing the plates in a high-speed scanner (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008). The electronic scanner uses a laser beam consisting of near-red wavelengths to convert the image to a grayscale and transfer to the computer imaging software program (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008). As long as the images are not exposed to bright lights or warm temperatures, the images will remain on the plates for hours (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017;

Muhamedagic & Muhamedagic, 2009; Parks, 2008). Once the plates are exposed to bright lights, the images are erased from the plate; therefore, the plates are reusable (Ajmal & Elshinawy, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Parks, 2008).

Conventional Film-based Radiography

Conventional film-based radiographs first begin to be used in dentistry in 1896. A film-based radiography produces an analog image when the x-ray photons strike the film and record the information on the film (Iannucci & Howerton, 2017). Once the processing of the film begins, the analog image on the conventional x-ray is permanent. Exposure settings and developing procedures determine the brightness and contrast of the image. Conventional radiographic systems generate film-based radiographs that require chemical processing, transporting, storing and an instrument for displaying (Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009). Conventional film-based dental x-ray units can still be used to supply radiation for digital images. Many dental practices continue to use traditional film even though technology advancements have made the transition from traditional film-based radiographs to digital imaging possible. Dental practices that make this transition must purchase a sensor or phosphor plates system (PSP) and a computer with imaging software (Iannucci & Howerton, 2017).

Digital Radiography versus Conventional Radiography

Literature provides evidence of advantages and disadvantages when comparing digital radiography to conventional radiography.

Advantages

Digital radiography is filmless, requires no darkroom or processing chemicals, provides instant viewing of the image, saves time, and decrease in radiation dosage by 50% to 90% (Iannucci & Howerton, 2017). The eradication of chemicals improves the environment due to the elimination of the chemical's odor and waste. Saving time results in increased productivity for dental professionals. After the initial setup, the equipment cost is lower, and film and chemical costs are eliminated (Iannucci & Howerton, 2017). The software program provides an avenue to send the images electronically to other professionals or insurance companies. The grayscale resolution of the digital images aids in diagnosis by allowing the contrast and density of the image to be changed (Greco, 2014; Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Wilkins, 2013). Image enhancement also is available from other features of the software such as colorization, zooming capabilities, and digital subtraction (Iannucci & Howerton, 2017). Digital subtraction is the ability to change the grayscale of an image "so that the radiolucent image (normally black) appear white and the radiopaque images (normally white) appear black" (Iannucci & Howerton, 2017, p. 295).

The software program provides a method for storing the images as well as the capability to email or print duplicates of the images. Using digital radiographic systems with DICOM allows the images to be viewed from different equipment and software (Farman et al., 2008; Iannucci & Howerton, 2017).

Wei, Rahman, Shaari, Tin Oo, and Alam (2013) compared the image clarity of digital radiographs to conventional radiographs. They took radiographs of an extracted maxillary incisor using different kilovoltage peak (kVp) settings. The conventional radiograph was taken using 70 kVp. The digital radiographs were taken using four different kVp settings. Forty-six

fourth year dental students compared the clarity of images in one of three categories: digital clearer, conventional clearer, or both are equal. Even with the changes in kVp, the image clarity of digital radiographs proved to be better. Additionally, the study results supported that digital radiographs require less radiation than the conventional radiographs. Other advantages of the digital radiographs are the instant view of the image, the necessary storage space is smaller, and the capability to improve the image through enhancement functions in the software (Wei et al., 2013).

Hellen-Halme, Nilsson, and Petersson (2007) found that one of the advantages of using digital radiographs was that the software functions could improve the quality of the images. They determined that illumination and quality of monitor could affect the efficiency of the digital image. The digital software provides functions to help improve digital images; however, dental professionals require training to gain knowledge on how to operate the digital equipment effectively and efficiently (Hellen-Halme et al., 2007).

Disadvantages

The initial setup and software cost is a disadvantage of converting from conventional film-based to digital radiographic systems. Training for the dentist and staff is an additional expense; however, training is essential to learn how to operate the new equipment, interpret the digital images, and accomplish image enhancement (Iannucci & Howerton, 2017; Muhamedagic & Muhamedagic, 2009; Wilkins, 2013). For the patient, the direct imaging sensors may be uncomfortable. The cost of the plastic sleeves for the sensors is an additional cost; however, the sleeves meet infection control requirements (Iannucci & Howerton, 2017; Wilkins, 2013).

Ajmal and Elshinawy (2014) provided evidence that the image quality of a conventional radiograph is better than the image quality of either a direct digital radiograph or an indirect radiograph. X-rays of 25 extracted endodontic treated teeth were generated by a direct digital system, an indirect digital system, and an E-film conventional system. The images were evaluated by two observers for clarity of the enamel, dentin, root canal filling, and dentino-enamel junction as well as the pathology of the apex. They found that the overall quality of the conventional film image was better than both digital systems; however, the quality of the direct digital image was equivalent to the film image. The clarity of the apical image displayed the greatest difference in the quality. Additional studies using more observers and larger samples are needed to justify this evidence (Ajmal & Elshinawy, 2014).

Summary

Implementation of EHRs by the HITECH has led to the implementation of EMRs, EDRs, and PHRs. Collaboration between the medical and dental profession is a "must" for the EHR system to reach its full capabilities. The literature review provided evidence of the implementation of electronic dental records by dental offices as well as the advancement of digital images in the dental profession. Digital radiographs are an important component of the EDR; however, digital radiography has not replaced conventional film-based radiography. Although digital radiographs have been used for over 32 years, studies show that the progression of the conversion from film-based to digital has been slow even though the method of acquiring the images digitally has improved. The purpose of this study was to determine the state of the implementation and usage of digital radiographs and electronic dental records by the private general and pediatric dental practices in Mississippi as well as reasons why the dental practices are not moving forward with the advanced technology.

CHAPTER 3

METHODOLOGY

Overview

The purpose of this study was to determine the state of the implementation and usage of digital radiographs and electronic dental records by the private general and pediatric dental practices in Mississippi as well as reasons why the dental practices are not moving forward with the advanced technology.

Research Questions

The following questions were used to guide this research:

1. Are private dental practices in Mississippi currently using electronic dental records?
2. What factors influence the selection of paper dental records or electronic dental records by private dental practices in Mississippi?
3. Are private dental practices in Mississippi currently using digital radiography?
4. What factors influence the selection of radiography exposure technique, digital or conventional, by private dental practices in Mississippi?
5. What factors influence the selection of the type of digital radiography, direct or indirect, by private dental practices in Mississippi?

Research Design

This study used a non-experimental cross-sectional quantitative design with a locally developed survey instrument. According to Cottrell and McKenzie (2011), "non-experimental research is used to examine the knowledge, attitudes, beliefs, and behaviors of people" (p. 194). In a cross-sectional study, data is collected "at one specific point in time" (Cottrell & McKenzie, 2011, p. 196). In this study, a nonexperimental research design was chosen because

data were collected from established dental offices to determine the current status of implementation and use of digital radiography and electronic dental records in Mississippi as well as the reasons for selecting the type of radiography utilized by the dental practices. Some of the dental offices have made the transition to digital radiography from conventional radiography and from paper records to electronic dental records. Additionally, the cross-sectional design was chosen because data were collected from the private general and pediatric dental practices at one particular point in time. The cross-sectional study was facilitated by a questionnaire that was administered using SurveyMonkey after an invitation to participate with a hyperlink to the survey was emailed to the study's population (See Appendix B). According to Cottrell and McKenzie (2011), the purpose of a survey research design is to administer a questionnaire to a population of the study to collect accurate information.

Strengths and Limitations of the Design

A strength of the survey research design is that data was collected and analyzed anonymously. All respondents were provided the same questions; therefore, the data collected provided the opinions of each respondent regarding the same topic at a set point in time. A limitation of self-reporting data was the time it took for the participant to respond. A strength of the design was the ability to contact the participants more than once. The survey was made available in the invitation email, the reminder email, and the follow-up email. Non-respondents received the reminder email and the follow-up email.

Population

The population of this study included the current private general and pediatric dental practices in the state of Mississippi. The study concentrated on private practice dentists who provided comprehensive oral health care to patients; therefore, periodontists, endodontists,

orthodontists and oral surgeons were not included because they provide specialty services instead of comprehensive oral health care. Private practices with more than one dentist were provided with only one survey since the unit of analysis of the study was a dental practice, not individual dentists. According to the Mississippi Dental Examiners website, as of April 5, 2017, Mississippi had 1128 active general dentists and 66 pediatric dentists (Mississippi State Board Dental Examiners, 2017).

Informed Consent

An informed consent communication was provided to all participants. This communication was delivered by email and provided a description of the study, statement of confidentiality of the responses, and a statement of informed consent (See Appendix C). Informed consent to participate was implied when the participant answered the first question.

Survey Instrument Development

According to Cottrell and McKenzie (2011), the purpose of a survey instrument is "to gather specific information from a targeted group of people" (p. 195). The researcher developed the survey instrument to collect information on the use and implementation of electronic dental records and digital radiography in the current private general and pediatric dental practices in Mississippi. The survey questionnaire (See Appendix B) was standardized and each participant answered the same ten questions. When participants selected "I agree" in the invitation email, informed consent to participate was obtained and the survey opened. The first questions solicited demographic information about the location of the practice and number of years at the current location. The next question asked participants the type of dental records currently being used by the office: electronic, electronic and paper, or paper. The next group of questions referenced the type of records currently being used: what factors influenced the selection of the

type of dental records and plans for conversion to electronic records. The next question asked participants the type of radiographic technique currently being used: digital, conventional, or both (digital and conventional). The last set of questions referenced the type of radiographic technique currently being used: what influenced the selection of the current radiographic technique, what type of digital radiography is currently being used (direct or indirect), what influenced the selection of the current digital radiographic technique and plans for conversion to electronic records.

Instrument Validity

Once approval from the Institutional Review Board (IRB) at East Tennessee State University (ETSU) was obtained, a pilot study established the validity of the survey instrument. According to Cottrell and McKenzie (2011), "validity is concerned with whether the instrument actually does measure" (p. 149) what it is supposed to measure. According to Ary, Jacobs, and Sorensen (2010), "a pilot study is a trial run with a few subjects to assess the appropriateness and practicability of the procedures and data-collecting instruments" (p. 647).

The participants in the pilot study were five members of the dental faculty from the School of Dentistry at the University of Mississippi Medical Center (UMMC). The Dean of the School of Dentistry granted permission to contact the dental faculty via email and to provide them with a link to the survey. The email explained the importance and purpose of the pilot study and requested that the dental faculty answer the survey questions and record the time it took them to complete the survey. The faculty was asked if any questions should be added, if any questions should be deleted and if any questions should be reworded or clarified. They were also asked to provide any comments to assist in validating the survey. Instructions were

provided in the email to use the space provided for Question 10 to submit their recorded time and comments about the survey (See Appendix D).

A suggestion from the pilot study resulted in changing Question 6 from "Does your office plan to convert to electronic records (if you are using paper records)? If yes, why? If no, why?" to "Does your office plan to convert to electronic records (if you are using paper records)? If yes, when? If no, why?" because knowing when the office's plans to convert to electronic records is beneficial in determining the future of electronic records among the private general and pediatric dental offices in MS. Additionally, Question 10 changed from: "If your office is using the conventional radiographic technique, do you plan to convert to digital radiography? If yes, why? If no, why?" to "If your office is using the conventional radiographic technique, do you plan to convert to digital radiography? If yes, when? If no, why?" because knowing when the office's plans to convert to digital radiography is beneficial to determine the future of digital radiography among the private general and pediatric dental offices in MS. Although there was a suggestion to add a question inquiring the brand of software the office was using, I decided not to include because the brand of software is irrelevant to the status of the implementation and usage of electronic dental records and digital radiography by the private general and pediatric dental practices in MS.

Data Collection Procedure

Representatives from the Mississippi State Dental Examiners Office were contacted by telephone to inquire how to obtain email addresses for the population. The staff gave two methods for obtaining the list of addresses: 1) purchase the list from the office or 2) collect the list from the organization's website. The individual at the office strongly suggested collecting the email addresses from the website and assisted the researcher in locating the addresses. The

link on the website provided specific information on each licensed dentist in Mississippi. The information included specialty title if applicable, email addresses, and the name and address of the dental practice where each dentist practiced as well any satellite office(s). The list of email addresses was created by searching the website for the general and pediatric dental offices by county while eliminating other specialty offices such as periodontal, endodontic, and oral surgery offices. The collected list consisted of 712 general dental practices and pediatric dental practices (Mississippi State Board Dental Examiners, 2017).

Anonymity was maintained by using email addresses to provide the survey link. Names and addresses of the population were not associated with the email addresses. No personal information was collected from the survey. The respondents' Internet Protocol (IP) Addresses were not disclosed from the responses making the results anonymous. Informed consent to participate was gained when the participant answered the first question of the survey. Confidentiality was maintained by using SurveyMonkey's security technology. Transport Layer Security (TLS) encrypted the respondent traffic which protected communications by using both server authentication and data encryption. This ensured that the user data in transit was safe, secure, and available only to intended recipients.

The collection of data began on the third Monday in September 2017. An email with a link to the survey was sent inviting the population to participate. The email provided a description of the study, statement of confidentiality of the survey, and a statement of informed consent (See Appendix C). East Tennessee State University was the sponsor of the research; therefore, the email contained the University's logo. The respondents were asked to respond within ten business days of receiving the email.

Two weeks after the initial emailing, a reminder email including the survey link was sent to all non-respondents (See Appendix E). Non-respondents were determined from a non-respondent list provided by the survey software. Four weeks after the initial emailing, a follow-up communication via an email containing the survey link was sent to all non-respondents. The email requested participation within ten business days of receiving the email and emphasized the importance of the study.

Eleven business days after the emailing of the follow-up communication email, the final data was collected from the submitted surveys. The data was exported from SurveyMonkey into Microsoft Excel to determine the use of digital radiography and electronic records by the specific population.

Data Analysis

A response rate (r) was determined by dividing the number of completed surveys (c) by the population number (s) and multiplying the quotient by 100 ($r = c/s \times 100$). The refusal rate (f) was determined by dividing the number of non-respondents (n) by the population number (s) and multiplying the quotient by 100 ($f = n/s \times 100$) (Cottrell & McKenzie, 2011).

The data collected were exported from the survey software and analyzed using Microsoft Excel. Descriptive statistics were computed.

Summary

The study was conducted to determine the implementation and usage of digital radiography by the current private general and pediatric dental practices in Mississippi as well as the usage of electronic records by the dental practices. Chapter 3 explained the chosen research design, the population surveyed, data collection, and data analysis. Also, the chapter discussed the pilot study and the validation of the survey instrument.

CHAPTER 4

RESULTS

Introduction

Implementation of electronic health records by the Health Information Technology for Economic and Clinical Health (HITECH) has led to the implementation of electronic dental records at dental offices as well as the advancement of digital images in the dental profession. The purpose of this study was to determine the state of the implementation and usage of digital radiographs and electronic dental records by the private general and pediatric dental practices in Mississippi as well as reasons why the dental practices have not moved forward with the advanced technology.

The researcher surveyed the private general and pediatric dental practices in MS. The following research questions guided this study:

1. Are private dental practices in Mississippi currently using electronic dental records?
2. What factors influence the selection of paper dental records or electronic dental records by private dental practices in Mississippi?
3. Are private dental practices in Mississippi currently using digital radiography?
4. What factors influence the selection of radiography exposure technique, digital or conventional, by private dental practices in Mississippi?
5. What factors influence the selection of the type of digital radiography, direct or indirect, by private dental practices in Mississippi?

Respondents

The data collection process followed the outline presented in Chapter 3 and transpired over a six-week period (September 18 – October 29, 2017). A total of 712 invitation emails

with a link to the survey were sent to private practice dental offices which provides comprehensive oral health care to patients. Four hundred forty-four emails were opened, 204 emails were unopened, 52 opted out of the study, and 12 were undeliverable. Of the study's population of 712, 116 responded to the invitation to participate resulting in a 16% response rate. Of the 116 respondents, 104 consented to participate (89.66%), 12 respondents did not participate (Figure 1).

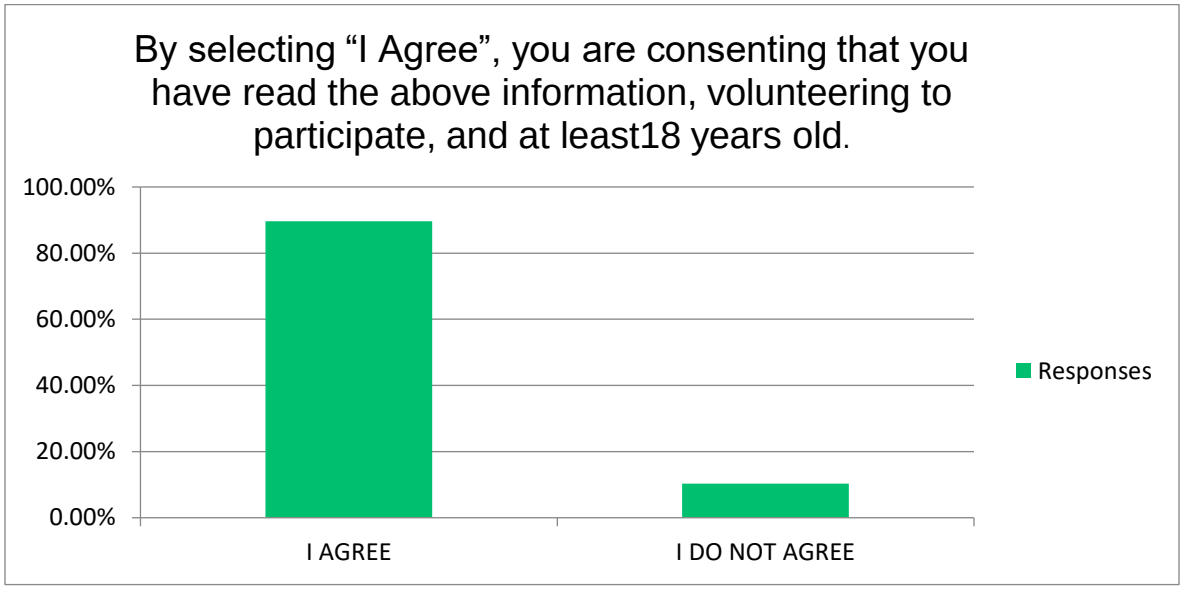

Figure 1. Percentage of Informed Consent Agreements Received

Practices' Demographics

A total 104 respondents agreed to participate. Eighty-four participants (81%) answered Survey Question 2: "How many years has your office been at the current location?" Fifteen (18%) practices reported being established for less than five years. Fourteen (17%) practices reported being established in the six to ten years range. Twenty-one (25%) practices reported being established in the 11 to 20 years range. Fourteen (17%) practices reported being established in the 21 to 30 years range. Twenty (24%) practices reported being established 31 plus years (Figure 2).

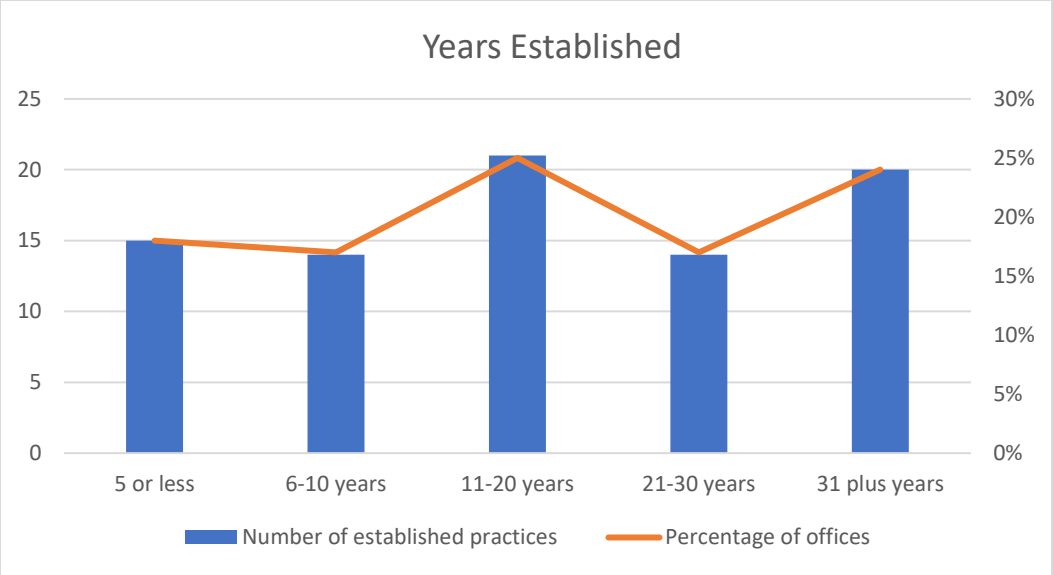

Figure 2. Number of Years Current Practice Established

Eighty-nine of the 104 respondents answered Survey Question 3: "Where is your practice located?" Three choices of location resulted in 44.94% in rural areas, 32.58% in suburban areas, and 22.47% in urban areas (Figure 3).

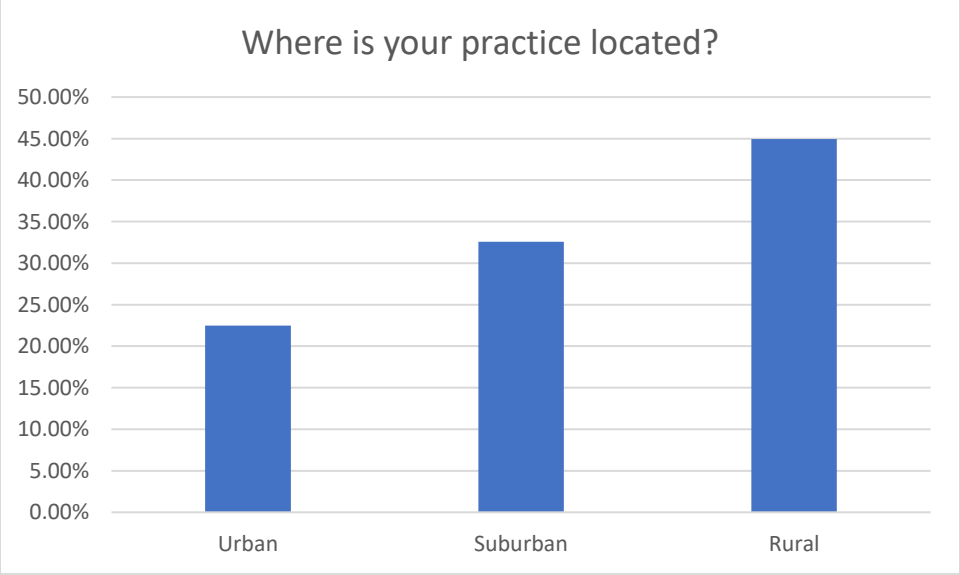

Figure 3. Location of Respondents' Practices

Analysis of Data

The data was analyzed using Microsoft Excel. Descriptive statistics were computed to answer the research questions.

Research Question 1: Are private dental practices in Mississippi currently using electronic dental records?

Eighty-nine of the 104 respondents answered Survey Question 4: "What type of dental records is your office using?" which provided data related to Research Question 1. Electronic, electronic and paper, and paper were the available answers. Of the respondents, 46.07% are using electronic dental records. 42.70% are using electronic and paper dental records, and 11.24% are using paper dental records (Figure 4).

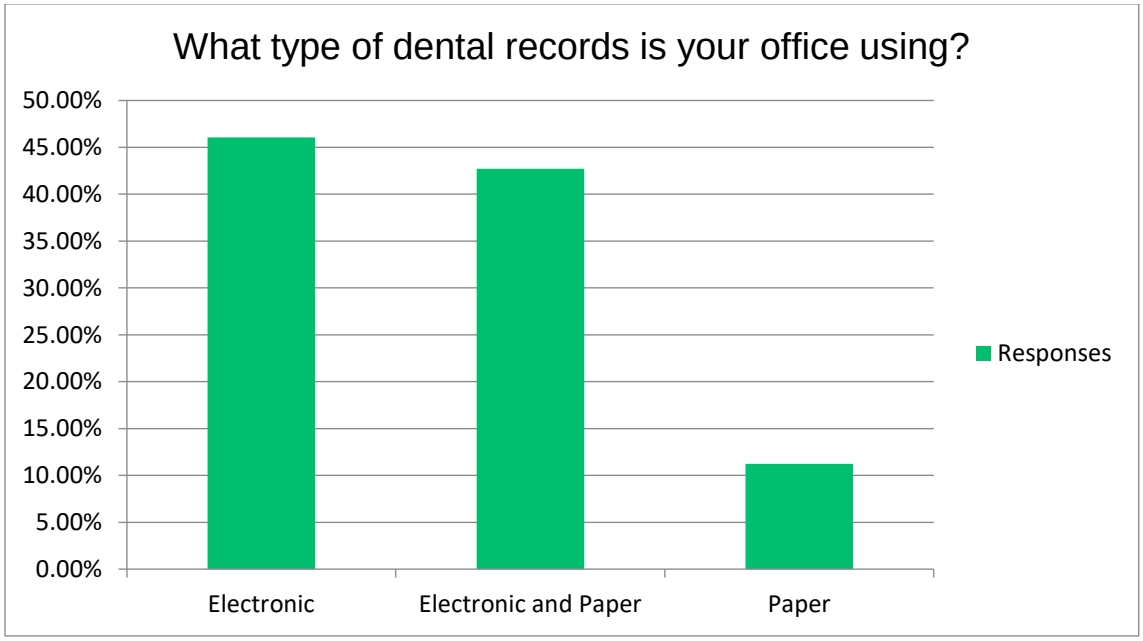

Figure 4. Type of Dental Records

Research Question 2: What factors influence the selection of paper dental records or electronic dental records by private dental practices in Mississippi?

Eighty-four of the 104 respondents answered Survey Question 5: "What influenced the selection of your current type of dental records?" The respondents answered the question according to the type of dental record being used by the offices. Common factors among users of EDRs and EDRs with paper dental records were: keeping up with technology (10 offices), efficient (10 offices), ease of use (10 offices), time saver (4 offices), storage (8 offices), insurance processing (5 offices), and EHR mandate per government (4 offices). Common Factors among users of EDRs with paper records and paper records only were: cost of conversion (9 offices), computer issues (5 offices using EDRs with paper and 4 offices using paper only), and "old habits" or too old to change (15 offices).

Other factors provided by the respondents using electronic dental records were: convenient, standard of care, electronic health records mandated by government, and dental electronic software pre-existing in practice. Two mobile dental units use electronic dental records for easy access to dental records between the two mobile units when operating at different locations. One dental practice accepted grant funding from Medicaid that required the practice to convert to electronic dental records.

Several practices using EDRs with paper records were using EDRs only to send electronic insurance claims and to store digital radiographs. They were still using paper dental records to record patient notes and as a backup if computers failed. Additional factors for using paper dental records along with EDRs were time-consuming to scan old documents into the computer and paper dental records pre-existed in the practice.

Only 11.24% reported using only paper dental records. Other factors influencing use of paper dental records were familiarity, lack of knowledge of electronic records, and no desire to change.

Research Question 3: Are private dental practices in Mississippi currently using digital radiography?

Survey questions 7 and 8 provided data related to Research Question 3. Eighty-nine of the 104 respondents answered Survey Question 7: "What type of radiography technique is your office currently using?" Digital, conventional (film-based), and both (digital and conventional) were the available answers. Of the respondents, 76.40% are using digital, 13.48% are using conventional, and 10.11% are using both conventional and digital (Figure 5).

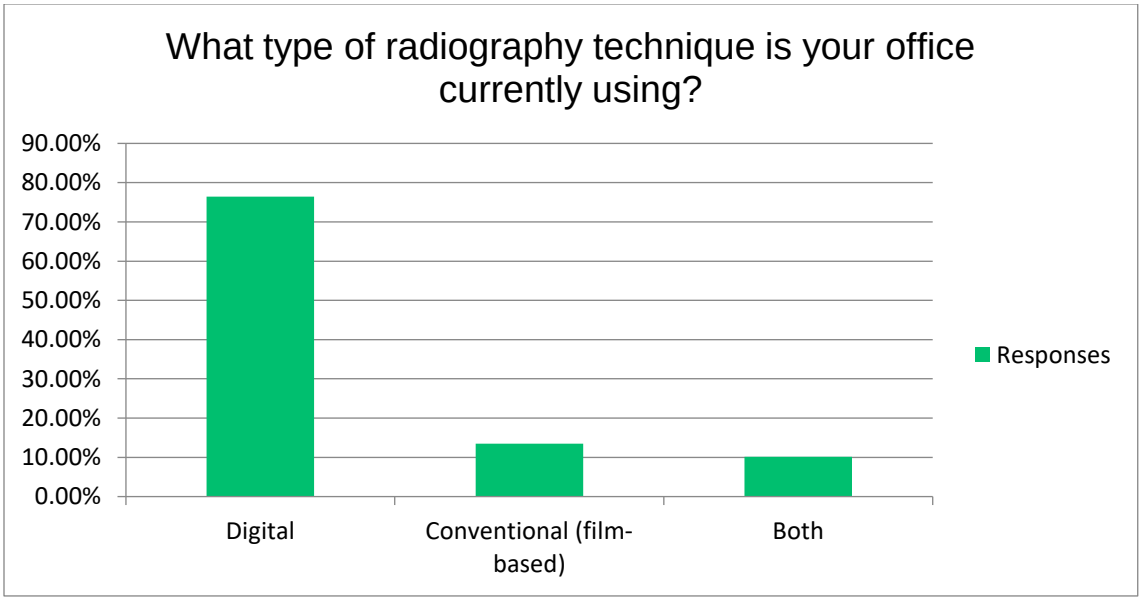

Figure 5. Type of Radiography Technique

Seventy-seven of the 104 respondents answered Survey Question 8: "If you are using digital radiography, what type of digital radiography technique is your office currently using?" Direct (sensor) and Indirect (phosphor plate) were the available answers. Of the respondents, 85.71% use direct (sensor) and 14.29% use indirect (phosphor plate) (Figure 6).

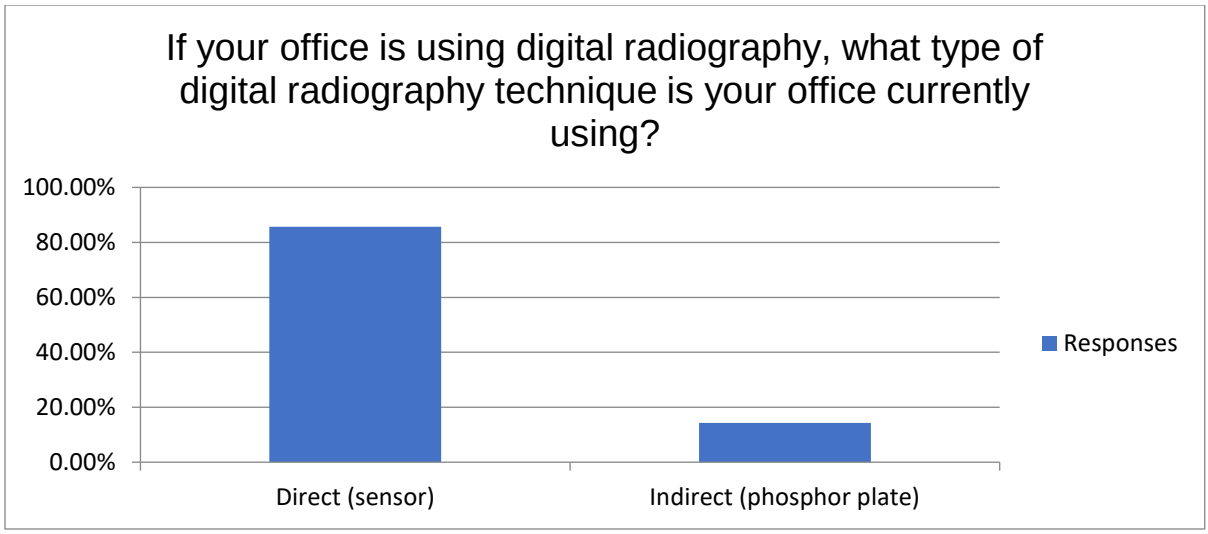

Figure 6. Type of Digital Radiography Technique

Research Question 4: What factors influence the selection of radiography exposure technique, digital or conventional, by private dental practices in Mississippi?

The data to answer this research question came from Survey Question 9: "What influenced the selection of your current type of radiography technique?" The respondents' answers to this question were analyzed according to the type of radiography exposure technique the practices are currently using. Common factors which influenced the use of digital technologies were quality and clarity of images (9 offices), near instant results (6 offices), environmental concerns, convenience (6 offices), ease of use (9 offices), storage (five offices), efficiency (10 offices), less radiation (3 offices), and the speed of use (9 offices). Specific factors were reduced hassle and need for materials, no chemicals for developing, improve patient education, and better for diagnosing. The expense of a failing processor necessary for conventional film-based technique influenced a practice to select digital method.

Common factors that influenced use of conventional techniques were the cost of digital (6 offices), quality of images (3 offices), and reluctance to commit to digital due to computer/software issues (3 offices). Several offices use the film-based technology because it

was pre-existing in the business, there was no desire to change or it is less expensive when establishing a new practice. Some practices used both conventional and digital radiography techniques. The sensor is large and bulky; therefore, some keeps the film-based method available for patients who are unable to tolerate the sensor.

Research Question 5: What factors influence the selection of the type of digital radiography, direct or indirect, by private dental practices in Mississippi?

The data to answer this research question came from Survey Question 9: "What influenced the selection of your current type of radiography technique?" The respondents' answers to this question were analyzed according to the type of digital radiography exposure technique the practices are currently using. Common factors that influenced the offices use of direct (sensor) radiography methods were quality and clarity of images (13 offices), near instant results (13 offices), efficiency (5 offices), and convenience (11 offices). Common factors that influenced the offices use of indirect (phosphor plates) methods were affordability (5 offices), efficiency (2 offices), longevity (2 offices), patient's comfort (3 offices), and use of precision instruments (3 offices). A single pediatric dental practice used the indirect radiography technique because the plates are similar to film and more flexible than the sensors. The sensors are too bulky, and the plates are easier to place.

Electronic Dental Records Conversion Plans Data

Data from Survey Questions 6 provided information on the dental office's plans to convert from paper to electronic dental records. Fifty-four of the 104 respondents answered Survey Question 6: "Does your office plan to convert to electronic records (if you are using paper records)? If yes, when? If no, why?" Of the 54 respondents, 64.81% respondents selected "If yes, when?" and 38.89% respondents selected "If no, why?" (Figure 7). Several of those

selecting yes reported that they are already in the process of converting to electronic records (5 offices). Some practices (7 offices) provided a time frame such as within six months, two years, and three years for their conversion. Two offices were using electronic records that are cloud-based. Other answers were: uncertain, when mandated, and when I can afford it.

Answers to "If no, why" were: cost (6 offices), no desire to change (6 offices), lack of trust in digital records (7 offices), computer problems (7 offices), no training available for employees (5 offices), and reticence for a major overhaul at this point in my practice. Some respondents referenced the years the dentist had been in practice. The dentist will retire soon; therefore, it would not be beneficial to change at this time due to cost and knowledge. Another respondent's answer referred to using electronic records; however, the office keeps a hard copy of the patient's protected health information (PHI) and current treatment plan. The respondent believed these two items are too important to lose because of technology failing.

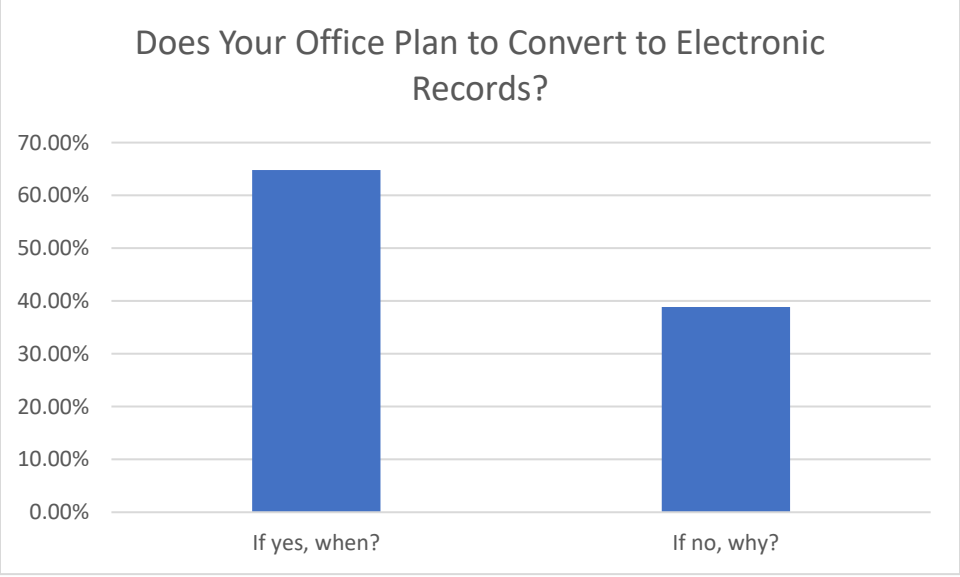

Figure 7. Converting to Electronic Records: Yes or No

Digital Radiography Conversion Plans Data

Data from Survey Questions 10 provided information on the dental office's plans to convert from conventional radiographic technique to digital radiography. Twenty-nine of the 104 respondents answered Question 10: "If your office is using the conventional radiographic technique, do you plan to convert to digital radiography? If yes, when? If no, why?" Of the 29 respondents, 65.52% respondents selected "If yes, when?" and 34.48% respondents selected "If no, why?" (Figure 8). Several of those selecting yes reported that they are already in the process of converting to digital radiography (4 offices). Some practices provided a time frame (5 offices) such as by the end of the year, within three years and three years in which they will convert to digital radiography. Other answers were: soon, interested getting a smaller sensor to eliminate film, and when I can afford it.

Answers to "If no, why?" were: too expensive for small office, quality of images, no desire to change after using paper and film-based radiographs for years, and no interest in converting because of cost and knowledge. The dentist is near retirement; therefore, not interested in changing due to the expense. Two practices use the conventional technique as a backup.

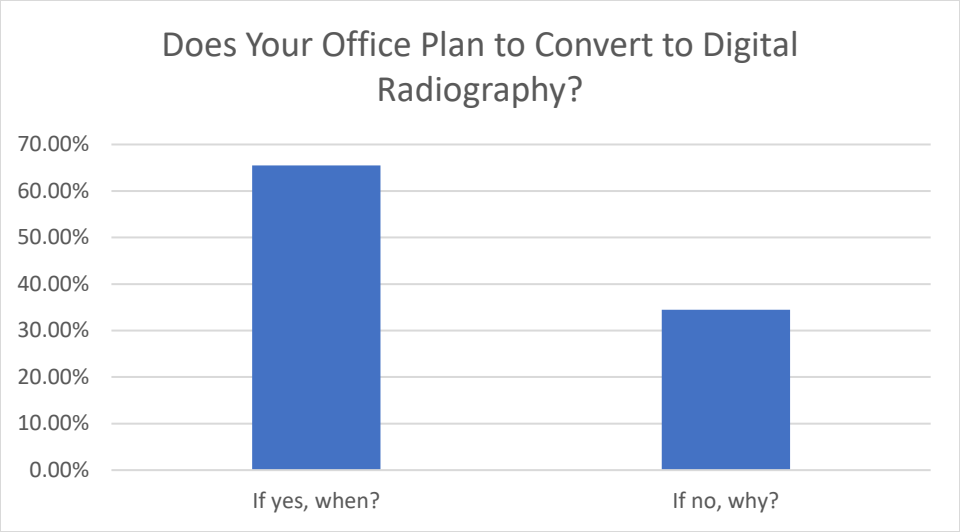

Figure 8. Converting to Digital Radiography: Yes or No

Summary

Chapter 4 presented the data collected from the survey emailed to the private general and pediatric dental practices in MS. The purpose of the study was to determine the state of the implementation and usage of digital radiographs and electronic dental records as well as reasons why the dental practices are not moving forward with the advanced technology. Chapter 5 furnishes the conclusions of the study.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Overview

The Health Information Technology for Economic and Clinical Health (HITECH) was signed into law on February 17, 2009, as part of the American Recovery and Reinvestment Act (ARRA). A primary objective of the HITECH was the nationwide implementation and usage of electronic health records (EHRs) (Jamoom et al., 2016; Kempfert & Reed, 2011; Thurston, 2014). On June 15, 2010, the Government and Public Affairs Division of the American Dental Association (ADA) posted a summary of the HITECH provisions providing information of interest to dentists. The summary acknowledged that the implementation and use of electronic dental records (EDRs) by the HITECH pertained to private practice dentists, the dental profession, and dental schools (American Dental Association, 2010). The literature demonstrated that the implementation of HITECH incorporated the usage of EHRs by physicians and hospitals. Additionally, the implementation of HITECH has led to the implementation of EDRs at dental offices as well as the advancement of digital images in the dental profession. The purpose of this study was to determine the state of the implementation and use of digital radiographs and EDRs by the private general and pediatric dental practices in Mississippi as well as reasons why the dental practices are not moving forward with this advanced technology.

Summary of Findings

The open-ended questions in the survey provided feedback to determine the reasons why some dental offices in Mississippi had not moved forward in technology. The following summary focuses on these reasons provided by the private general or pediatric dental practices

using EDRs and paper records or only paper records as well as the offices use digital radiography, conventional radiography, or both.

Dental Records

The most common factors that influenced offices to use paper records along with EDRs or paper records only were cost, distrust in computer technology, and lack of training. Of these, cost is not surprising; however, distrust in computer technology and lack of training were unexpected. Dentists are reluctant to accept any change that is costly. From my experience, the cost of the improvement is the main item discussed when implementing improvements. To transition from paper records to EDRs as well as to digital radiographs requires the purchase of computers in every operatory, EDR software, digital radiography software, digital radiography equipment, and dental team training. Staying current with technology, I believe, assists in providing patients optimum oral health care. Electronic dental records provide an avenue to discuss care with the patients. Periodontal charting in the software and digital radiographs are effective educational tools.

With technology advancing, computers are part of everyday life. Having a "computer person" available to assist with issues as well as offsite backup storage are answers to computer issues. In the office where I worked, the "computer person" would come to the office when issues occurred or remotely determine any computer issues from his office. Results from the data indicated that some offices were using paper records to record patient notes and as a backup if the computer failed. One office kept a copy of the patient's treatment plan and health history to avoid losing the information due to computer failure. In the office I worked in, the backup system created a backup of the data every night and transferred it to a secure offsite location through the internet. The backup system is more reliable than paper records which can

be destroyed by fire, flooding (due to plumbing issues or sprinkler systems), or natural weather disasters.

As for training, the majority of the dental staff are required to complete continuing education (CE) courses every year. The dentist and staff could receive training through CEs. When the office purchases the dental software program for the EDRs, training is part of the package. Lack of knowledge of electronic records was another factor collected from the data; however, every respondent answered the survey through an email which suggests that they are computer knowledgeable enough to use emails. Change and improvement require learning; therefore, the knowledge of electronic records could be obtained through CEs or training from the software company.

The factors which influenced offices to use EDRs with papers were: keeping up with technology, efficient, ease of use, time saver, storage, insurance processing, and electronic health record mandate per government. These factors promote several benefits of using EDRs. Electronic dental records are efficient, a time saver, and easy to use. Every patient requires a chart, and after years of being established the number of charts increases as well as the space needed to store the charts. The implementation of EDRs eliminates the need for paper charts as well as the storage space needed to maintain the patient's paper charts.

The data indicated that several practices were using EDRs only to send electronic insurance claims and to store digital radiographs. I recently worked in a dental office that used EDRs to file private insurance claims and Medicaid claims in addition to storing digital radiographs. The office used paper charts to record treatment, treatment plan, and patient's health history. In recent years, many of the insurance companies established a policy to accept only electronic claims; therefore, dental offices that filed patients' insurance had to implement

the use of dental software and obtain internet access. The EDR software enables the office to document the patient health history and includes a clinical chart which records the patient's treatment and treatment plan. In addition, the software includes patient scheduling and billing applications.

Another reason for not advancing with technology could be the number of years the practice had been established. The average number of years the offices responding have been established is 25 years. The offices who gave the answer "no desire to change" have been established the longest. Statements provided by several offices indicated that these dentists were trained using paper records; however, the offices established for ten or less years indicated that the dentists were trained using EDRs and digital radiograph. As stated previously, training received by the current dental students include EDRs and digital radiography. Training is available through CE courses.

Being "too old to change" is not a reason I support. First and foremost, patient care should be the primary focus of every office. As I stated previously, advancement in technology can help to provide patients the optimum oral health care. Additionally, lack of implementing the technology advancements in the practice can lower the value of the practice. At retirement time, the value of the practice will be lower than it would be if the current technology was already implemented. New graduates looking to purchase dental offices will be more interested in offices that are up-to-date.

Radiography

Survey results indicated that many of the private general and pediatric dental practices are using digital radiography. Even some dental practices using paper records were using digital radiography. Several reasons that prompt dental offices to transition to digital radiography were:

1. More insurance companies are accepting only electronic claims including radiographs.
2. Insurance companies who accept claims via the mail will not return radiographs.
3. Dental offices who are Medicaid providers are required to send claims electronically. Radiographs mailed to Medicaid are not returned.
4. The increased cost of the automatic processor and chemicals required for processing conventional radiographs.
5. Repair parts for the automatic processor are difficult to obtain and are costly.

The offices using conventional radiography were concerned about computer/software issues. These offices need to compare their concern for computer/software issues with the benefits of transitioning to digital radiographs represented in the reasons listed above. The repair cost and supplies to continue using conventional radiography will soon outweigh the computer/software issues. The dentist I worked for made the transition to digital radiographs because of a failing automatic processor. The data collected from the survey indicated several offices had transitioned due to the processor failing. The cost of the repair and replacement parts as well as the difficulty in getting the replacement parts led the dentist to transition to digital radiographs.

Additionally, these offices need to compare the radiation dose a patient receives from conventional with the dose received from digital radiography. Radiation dosage from digital radiographs is 50% to 90% lower than conventional radiography (Iannucci & Howerton, 2017).

There are limitations of this study that should be considered in the analysis of the data. First, the response rate was 16%. The response rate was affected by the number of dental practices that chose not to participate or did not open the survey email as well as the number of emails that were undeliverable. Some of the survey emails were possibly marked as spam. A

second limitation was the lack of certainty of collecting all email addresses through the collection method. The method involved searching for the general dental offices per county on the Mississippi State Board of Dental Examiners' website as well as the pediatric dental offices while eliminating other specialty practices such as periodontal, endodontic, and oral surgery offices. Third, there was no certainty that the person who responded knew the correct answers. Even though a survey was emailed to the email address provided on the MS State dental website for each general and pediatric dental office, the person answering the email might not have known the factors that influenced the current type of records, the factors that influenced the current type of radiography, the number of years the practice had been established, and/or the difference in urban, rural, or suburban.

Conclusions

As stated previously, the number of dental practices in Mississippi using EDRs (46.07%) was not remarkably higher than the number using EDRS with paper records (42.70%). Additionally, the number of dental practices using digital radiography (76.40%) was substantially higher than those using conventional radiography (13.48%) as well as those using both digital and conventional radiography (10.11%).

Advancement in computer technology is evident in every profession. The implementation of EHRs by the signing of the HITECH in 2009 is a prime example of progress in computer technology in the medical field. According to a study in 2015, 84% of the hospitals in the U.S. had implemented EHRs (Henry et al., 2016). In 2013, 78% of the office-based physicians had implemented EHRs (Hsiao & Hing, 2014). In hospitals, electronic health records have become an effective and efficient avenue for communication and provide health information such as clinical findings, clinical manifestations, diagnostic, assessments, diagnosis,

and etiology (Ghazisaeedi et al., 2014). Even though the ADA encouraged the implementation of HITECH through the use of EDRs by dental practices in 2010, the data from the survey shows that many dental offices in Mississippi have not accepted the change in technology (American Dental Association, 2010). Even though the majority of the offices using EDRs with paper records have started the process of upgrading or have plans shortly to upgrade, 32% of the offices have no intentions of discontinuing paper records. The offices using only paper records don't have any intentions to upgrade. As stated previously, the reasons provided for not transitioning to only EDRs were distrust in computer technology, cost, lack of training, and past computer/software issues.

How accurate are these results? Is this the true picture of the implementation and use of EDRs and digital radiographs among the dental offices in MS? Only 116 of the 712 emails responded sent making the respondent rate 16%. The results don't represent the majority of the dental offices in MS. However, the results do provide insight into why offices haven't transitioned. From the offices using EDRs and digital radiographs, the results render the benefits of EDRs and digital radiographs.

The benefits of electronic dental records are the same for dental offices as EHRs are for hospitals and office-based physicians. Growth and improvement in a dental practice require accepting the increased cost, training of dentist and staff, and implementing computer technology. Hospitals have a more substantial number of patients than dental offices; however, the benefits of using EHRs out ways the risk of the technology failing.

Electronic health records in the medical field provide communication between physician and patient, physician and physician, and hospital and physician's offices. The proven relationships between systemic diseases and oral health conditions support incorporating EDRs

in dental practices. The future technology could be the collaboration of the medical and dental professionals through EHR systems to provide patients with the optimum health care. Advancements in technology is a given; therefore, to provide optimum oral health care, the "old school" dental professionals must accept change.

Recommendations for Change to Electronic Dental Records

Listed below are recommendations to encourage dental offices to make the transition to EDRs. Recommendations are:

1. Training: Software companies should include training with the purchase of the software program.
2. Cost: Dental offices need to accept that improvement and keeping up with technology is costly. An increase in the demand and use of electronic records software can help to reduce the cost.
3. State mandates or incentives: With the implementation of HITECH, states should mandate the implementation of electronic dental records. Financial incentives similar to the incentives offered to medical providers enrolled in the Medicare Program should be offered to dental offices using electronic dental records.

Future Research

Future research can be done to further the understanding of the status of the implementation and usage of EDRs and digital radiography in private dental practices in Mississippi. I would suggest conducting this study in another state to determine the status of the implementation and use of EDRs and digital radiographs and compare the results with the ones from this study. The results will show if the state has implemented the use of EDRs and digital

radiographs more than Mississippi has. If the state has been more successful, the study can show what methods were used to be more successful.

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APPENDICES

Appendix A

Core Objectives and Menu Objectives of the Meaningful Use Incentive Plan

Eligible Professionals – 15 Core Objectives

1) Computerized provider order entry (CPOE)
2) E-Prescribing (eRx)
3) Report ambulatory clinical quality measures to CMS/States
4) Implement one clinical decision support rule
5) Provide patients with an electronic copy of their health information, upon request
6) Provide clinical summaries for patients for each office visit
7) Drug-drug and drug-allergy interaction checks
8) Record demographics
9) Maintain an up-to-date problem list of current and active diagnoses
10) Maintain active medication list
11) Maintain active medication allergy list
12) Record and chart changes in vital signs
13) Record smoking status for patients 13 years or older
14) Capability to exchange key clinical information among providers of care and patient-authorized entities electronically
15) Protect electronic health information

Eligible Professional Menu Objectives

1) Implement drug formulary checks.
2) Incorporate clinical lab-test results into EHR as structured data.

3) Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach.
4) Send patient reminders per patient preference for preventive/follow-up care.
5) Provide patients with timely electronic access to their health information (including lab results, problem list, medication lists, and allergies) within 4 business days of the information being available to the EP.
6) Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate.
7) The EP who receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation.
8) The EP who transitions their patient to another setting of care or provider of care or refers their patient to another provider of care should provide summary care record for each transition of care or referral.
9) Capability to submit electronic data to immunization registries or immunization information systems and actual submission according to applicable law and practice.
10) Capability to submit electronic syndromic surveillance data to public health agencies and actual submission according to applicable law and practice.

Appendix B

Survey Instrument

1. By selecting “I Agree”, you are consenting that you have read the above information, volunteering to participate, and at least 18 years old.

- I AGREE
- I DO NOT AGREE

2. How many years has your office been at the current location?
3. Where is your practice located?

- Urban
- Suburban
- Rural

4. What type of dental records is your office using?
    - Electronic
    - Electronic and Paper
    - Paper
5. What influenced the selection of your current type of dental records?
6. Does your office plan to convert to electronic records?

    If yes, when?

    If no, why?
7. What type of radiography technique is your office currently using?
    - Digital
    - Conventional (film-based)
    - Both

8. If your office is using digital radiography, what type of digital radiography technique is your office currently using?
    - Direct (sensor)
    - Indirect (phosphor plate)
9. What influenced the selection of your current type of radiography technique?
10. If your office is using conventional radiographic technique, do you plan to convert to digital radiography?

    If yes, when?

    If no, why?

Appendix C

Invitation Email

East Tennessee State University

Department of Allied Health Sciences

PO Box 70690

Johnson City, TN 37614

Dear Participant:

My name is Barbara Brent and I am a graduate student at East Tennessee State University. I am working on the Master of Science Degree in Allied Health. In order to finish my studies, I need to complete a research project. The name of my research study is "A Survey of the Implementation and Usage of Electronic Dental Records and Digital Radiographs in Private Dental Practices in Mississippi.

The purpose of this study is to determine the state of the implementation and usage of digital radiographs and electronic dental records by the private general and pediatric dental practices in Mississippi as well as the reasons why the dental practices are not moving forward with the advanced technology. I would like to give a brief online survey to private general and pediatric dental practices using SurveyMonkey. It should only take about five minutes to finish. You will be asked questions about the implementation and usage of electronic records and digital radiographs in your dental practice. Since this study deals with dental practices, there are no foreseeable risks to participate in the study. However, you may also feel better after you have had the chance to review the survey questions. This study will not directly benefit you or others; however, the study may benefit society by raising awareness and thus encouraging more dentists to embrace digital radiography and electronic patient records. Results will also provide information to assist dental practices in understanding the importance of implementing and using digital radiography as part of electronic dental records.

Your confidentiality will be protected as best we can. Since we are using technology no guarantees can be made about the interception of data sent over the Internet by any third parties, just like with emails. We will make every effort to make sure that your name is not linked with your answers. SurveyMonkey has security features that will be used: IP addresses will not be collected by making the results anonymous and Transport Layer Security (TLS) encrypts respondent traffic which protects communications by using both server authentication and data encryption. This ensures that user data in transit is safe, secure, and available only to intended recipients. Although your rights and privacy will be protected, the East Tennessee State University (ETSU) Institutional Review Board (IRB) and research study staff can view the study records.

Taking part in this study is voluntary. You may decide not to take part in this study. You can quit at any time. You may skip any questions you do not want to answer or you can exit the online survey form if you want to stop completely.

If you have any research-related questions or problems, you may contact me, Barbara Brent at 601-955-5206 I am working on this project together with my teacher Dr. Ester Verhovsek. You may reach her at 423-547-4902. Also, you may call the chairperson of the IRB at ETSU at (423) 439-6054 if you have questions about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone who is not with the research team or if you cannot reach the research team, you may call an IRB Coordinator at 423/439-6055 or 423/439-6002.

Thank you so much for taking the time to complete my survey. If possible, please submit your completed survey within the next ten business days.

Sincerely,

Barbara Brent, RDH, BS

115 Arrow Dr.

Clinton, MS 39056

babrent@etsu.edu

By selecting "I Agree," you are consenting that you have read the above information, volunteering to participate, and at least 18 years old.

- o I AGREE
- o I DO NOT AGREE

Appendix D

Email for Pilot Study

East Tennessee State University

Department of Allied Health Sciences

PO Box 70690

Johnson City, TN 37614

Dear Dental Faculty,

My name is Barbara Brent, and I am a graduate student at East Tennessee State University. I am working on the Master of Science Degree in Allied Health. In order to finish my studies, I need to complete a research project. The name of my research study is "A Survey of the Implementation and Usage of Electronic Dental Records and Digital Radiographs in Private Dental Practices in Mississippi." The purpose of this study is to determine the state of the implementation and usage of digital radiographs and electronic dental records by the private general and pediatric dental practices in Mississippi as well as the reasons why the dental practices are not moving forward with the advanced technology.

I obtained permission from the Dean of the School of Dentistry to contact you for participation in a pilot study for my research project. A link to the research survey which was developed for the private general and pediatric dental offices in Mississippi will become available after responding to the question to below. Once the survey has been validated through the pilot study, the link to the survey will be emailed to general and pediatric dental offices in MS. The data from the survey will determine the current status of the implementation and use of digital radiography along with electronic records in the dental offices in Mississippi as well as the reasons why the dental practices are not moving forward with the advanced technology.

I am requesting your assistance by answering the survey questions and recording the time it takes to complete the survey. Please acknowledge if any question should be added, if any question should be deleted, and if any question should be reworded or clarified. I am also requesting you to provide any comments to assist in validating the survey. Recorded time and comments can be submitted by using the space provided for Question 10.

Since this study deals with dental practices, there are no foreseeable risks to participate in the study. However, you may also feel better after you have had the chance to review the survey questions. This study will not directly benefit you or others; however, the study may benefit society by raising awareness and thus encouraging more dentists to embrace digital radiography and electronic patient records. Results will also provide information to assist dental practices in

understanding the importance of implementing and using digital radiography as part of electronic dental records.

Your confidentiality will be protected as best I can. Since I am using technology, no guarantees can be made about the interception of data sent over the Internet by any third parties, just like with emails. I will make every effort to ensure that your name is not linked to your answers. SurveyMonkey software will be used to collect the data. Only email addresses will be entered into the software. SurveyMonkey has security features that will be used: IP addresses will not be obtained by making the results anonymous, and Transport Layer Security (TLS) encrypts respondent traffic which protects communications by using both server authentication and data encryption. This ensures that user data in transit is safe, secure, and available only to intended recipients. Although your rights and privacy will be protected, the East Tennessee State University (ETSU) Institutional Review Board (IRB) and research study staff can view the study records.

I appreciate your contribution to my research by completing the survey along with your recorded time and any comments within five business days of receiving this email. Thank you for taking time out of your busy schedule to help me with my research.

Regards,

Barbara Brent, RDH, BS

115 Arrow Dr.

Clinton, MS 39056

brentbk@etsu.edu

(601)955-5206

By selecting “I Agree,” you are consenting that you have read the above information, volunteering to participate, and at least 18 years old.

- o I AGREE
- o I DO NOT AGREE

Appendix E

Email Reminder

Subject Line: Friendly Reminder

You recently received an email inviting you to participate in my research project by completing a brief survey about the implementation and use of electronic dental records and digital radiography by current private general and pediatric dental practices in Mississippi as well as the reasons why the dental practices are not moving forward with the advanced technology. I hope you will be able to participate. If you completed the survey, thank you for your participation. If you haven't completed the survey, respond below to start or continue the survey. It should only take about five minutes to finish.

You will be asked questions about the implementation and usage of electronic records and digital radiographs in your dental practice. Since this study deals with dental practices, there are no foreseeable risks to participate in the study. However, you may also feel better after you have had the chance to review the survey questions. This study will not directly benefit you or others; however, the study may benefit society by raising awareness and thus encouraging more dentists to embrace digital radiography and electronic patient records. Results will also provide information to assist dental practices in understanding the importance of implementing and using digital radiography as part of electronic dental records.

Your confidentiality will be protected as best we can. Since we are using technology no guarantees can be made about the interception of data sent over the Internet by any third parties, just like with emails. We will make every effort to make sure that your name is not linked with your answers. SurveyMonkey has security features that will be used: IP addresses will not be collected by making the results anonymous and Transport Layer Security (TLS) encrypts respondent traffic which protects communications by using both server authentication and data encryption. This ensures that user data in transit is safe, secure, and available only to intended recipients. Although your rights and privacy will be protected, the East Tennessee State University (ETSU) Institutional Review Board (IRB) and research study staff can view the study records.

Taking part in this study is voluntary. You may decide not to take part in this study. You can quit at any time. You may skip any questions you do not want to answer or you can exit the online survey form if you want to stop completely.

If you have any research-related questions or problems, you may contact me, Barbara Brent at 601-955-5206 I am working on this project together with my teacher Dr. Ester Verhovsek. You may reach her at 423-547-4902. Also, you may call the chairperson of the IRB at ETSU at (423) 439-6054 if you have questions about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone who is not with the research team or if you cannot reach the research team, you may call an IRB Coordinator at 423/439-6055 or 423/439-6002.

Your contribution is essential to the success of this research. Thank you so much for taking the time to complete my survey. If possible, please submit your completed survey within the next ten business days.

Barbara Brent, RDH, BS

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By selecting "I Agree," you are consenting that you have read the above information, volunteering to participate, and at least 18 years old.

- o I AGREE
- o I DO NOT AGREE

VITA

BARBARA K BRENT

Education:	M. S. Allied Health, East Tennessee State University, Johnson City, Tennessee, 2018 B. S. Dental Hygiene, University of Mississippi Medical Center, School of Health Related Professions, Jackson, Mississippi, 2014 Pre-B. S. Dental Hygiene May, Hinds Community College, Raymond, Mississippi Certificate in Dental Hygiene, University of Mississippi Medical Center, School of Health Related Professions, 1981 Associate of Applied Science, Hinds Community College, Raymond, Mississippi, 1978
Professional Experience:	Dental Hygienist, Jackson Medical Mall Dental Clinic, School of Dentistry, University of Mississippi, Jackson, Mississippi, 2017-present Clinical Instructor, Dental Hygiene Program, School of Dentistry, University of Mississippi, Jackson, Mississippi, 2014-present Dental Hygienist, Kimberly Tolbert, DMD, Clinton, Mississippi, 1998-2017 Dental Hygienist, C. Owens Palmertree, DDS, Clinton, Mississippi, 1998-2000 Dental Hygienist, Robert Sadler, DDS, Vicksburg, Mississippi, 1991-1997 Dental Hygienist, C. Brent Thomas, DMD, Vicksburg, Mississippi, 1990-1991 Dental Hygienist, Kirby P. Walker, Jr., DDS, Jackson, Mississippi, 1988-1990 Dental Hygienist, Michael K. Hardy, DMD, Jackson, Mississippi, 1988-1988 Dental Hygienist, Daniel F. Boone, DDS, Clinton, Mississippi, 1987-1988 Dental Hygienist, Robert M. Abraham, DDS, Vicksburg, Mississippi, 1981-1987
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