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A Comparative Analysis of Data Collection Systems Used in Radiography Educational Programs and the Role Mobile Electronic Devices Play

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A Comparative Analysis of Data Collection Systems Used in Radiography Educational Programs and the Role Mobile Electronic Devices Play

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ABSTRACT

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Each radiography program has a system to collect important data from didactic and clinical settings in order to accurately assess the progress and success of students, provide the needed student intervention, and provide accreditation agencies with appropriate documentation that demonstrates student success in reaching program learning outcomes. The purpose of this research study was to determine the method of data collection and documentation used by radiography programs to evaluate student progress and to examine if MEDs play a role in evaluating and documenting student skills at the point of care.

The majority of radiography programs in this study were using paper methods for data collection and program directors reported value in using MEDs in clinical education but revealed that barriers still exist and will need to be addressed in order to increase their usage in clinical education.

DEDICATION

I dedicate this thesis to my family because your value to me is priceless and I know that with you, I can achieve anything. To my husband Richard, thank you for your love, support, and notes and texts of encouragement when I needed it most. You always seemed to know when I needed that boost to motivate me to keep going. Thank you for sharing this journey with me. To my sons, Ryan, Johnathan, Matthew, and Jacob, you bring so much joy and laughter into my life each and every day. Being your mom will always be my proudest achievement and I am so proud of the young men you are all growing into.

To my parents, thank you for believing in me and encouraging me to keep reaching for my dreams. Mom, you are my best friend, always knowing when I need you by my side and when I needed space to grow. I don't know what I would have done without you in my life. You were there when I was sick, happy, sad, and always knew exactly what to say and do. You taught me how to cook, manage a household, and be a great mom while teaching me all the values I needed to grow into the person I am today.

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way to challenge me to write in a professional manner and I have been very thankful for your support during this endeavor. I would not have gotten this far without you.

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CHAPTER 1

INTRODUCTION

Radiography programs consist of both didactic and clinical education with each component designed to complement the other. The clinical education experience is a vital component of a radiography program, giving students the opportunity to put theory and skills learned from didactic and laboratory experiences into practice. Clinical education is a form of experiential learning, as seen in the way students actively learn by doing (Steves, 2005). Kolb's (2015) experiential learning model describes how people learn from their experiences, suggesting that experience plays a central role in the learning process. Learning begins in clinical education as students concentrate on learning the technical skills (Steves, 2005). Students also learn through observation and modeling how other professionals perform (Giordano, 2008). In clinical education, students are exposed to a multitude of unique situations where the student is challenged to think how they will address the situation in order to achieve the desired results. Sometimes, the way the student addresses the situations will have the desired results and other times, it will not. The combination of all these experiences helps develop students' critical thinking skills by challenging them to constantly think outside the norm. Toward the end of their education program, students become more independent and demonstrate more self-directed learning (Steves, 2005). Therefore, evaluation of this learning process is critical to the success of a student's clinical education.

The clinical education experience is uniquely designed by each radiography program while also following the curriculum provided by the American Society of Radiologic Technologists (ASRT) (American Society of Radiologic Technologists [ASRT], 2012). According to the ASRT (2012),

> The content and clinical practice experiences should be designed to sequentially develop, apply, critically analyze, integrate, synthesize and evaluate concepts and theories in the performance of radiologic procedures. Through structured, sequential, competency-based clinical assignments, concepts of team practice, patient-centered clinical practice and professional development are discussed, examined and evaluated (p. 1).

Radiography programs must design clinical experiences to "provide patient care and assessment, competent performance of radiologic imaging and total quality management" (ASRT, 2012, p. 1). The clinical setting provides a unique and real world learning experience so students can incorporate didactic knowledge into professional skills. O'Connor (2015) suggests that

> the clinical setting is both a stimulus environment for the application of learning and an environment rich in its own opportunities for learning. It is the instructor's job to select the most appropriate "stimuli" for students' application of theoretical knowledge and to capitalize on additional learning opportunities (p. 110).

The curriculum provided by the ASRT (2012), serves as a blueprint for educators to follow to ensure that their programs match the profession's standards (p. ii).

In the radiologic sciences, as in most allied health professions, "educators not only must teach the essential clinical skills that employers expect of graduates, but also must ensure that students will be prepared to take certification examinations offered by the [The American Registry of Radiologic Technologists] ARRT" (ASRT, 2012, p. ii). Radiography programs accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT)

adhere to standards that are designed to promote academic excellence, patient safety, and quality healthcare (Joint Review Committee on Education in Radiologic Technology [JRCERT], 2014).

> The Standards require a program to articulate its purposes; to demonstrate that it has adequate human, physical, and financial resources effectively organized for the accomplishment of its purposes; to document its effectiveness in accomplishing these purposes; and to provide assurance that it can continue to meet accreditation standard (JRCERT, 2014, p. 2).

According to Standard Three (2014), "the program's curriculum and academic practices prepare students for professional practice" (p. 35). Within this Standard, programs are required to assess and provide documentation concerning the student's ability to practice in the professional discipline. Determination of students' professional skill level requires evaluation of these skills while in the clinical environment.

Radiography technical skills cannot be measured by objective tests alone because objective tests primarily demonstrate a student's knowledge (Miller, 1990). The radiography profession requires the student to obtain knowledge and also demonstrate how to use the knowledge when faced with a patient or certain clinical situations (Miller, 1990). To promote learning in the clinical environment, assessment should be educational and formative and students should receive feedback on which to build their knowledge and skills (Jones, Shatzer, Van der Vleuten, & Wass, 2001).

Student evaluation is necessary to track and document student clinical performance. Radiography programs use paper-based methods, electronic methods, mobile electronic devices (MED), or a combination of these methods to provide a record of student performance. Program clinical faculty and clinical site instructors observe students and provide documentation of

performance through anecdotal notes, evaluation and competency instruments using rating scales, and skills checklists. Students provide information to program faculty through exam procedure logs, self-evaluation, and journals.

The use of paper-based methods requires faculty to make sure forms are available, there is time to transport paper forms, and there is adequate storage to file data. The use of electronic devices, such as computers, gives faculty the ability to collect, enter, and process data but requires consideration about the proximity of computers to patient care and student evaluation areas. The use of MEDs in the clinical environment enables faculty to perform the same tasks as other electronic devices but the portability of these devices enables faculty to provide quick and accurate feedback on student clinical performance at the point of patient care. With the technological abilities of MEDs versus paper-based student evaluations, MEDs may be acquiring a greater role in clinical education.

Statement of the Problem

The advancements in computer technology have impacted healthcare and education and are opening doors to new opportunities in delivery and service (Carlson, Meyer, Modlin, & Sedlmeyer, 2003). Radiography program faculty use either traditional paper-based systems or electronic systems to evaluate student skills and competence, document student data, and track student performance. With multiple options available to radiography program faculty for data collection and student performance tracking, there may be a preferred method among faculty members that has yet to be identified. Identifying a method that is advantageous for students and also favorable for program directors and clinical instructors has not been researched at this time. In addition, identification of a method that provides radiography faculty and clinical instructors with the resources to document and track student performance and is easily understood could

provide radiography faculty with information needed for their future needs in evaluating students.

Purpose of the Study

The purpose of this research study was to determine the method of data collection and documentation used by radiography programs to evaluate student progress and to examine if MEDs play a role in evaluating and documenting student skills at the point of care.

Research Questions

The following questions guided this study:

1. Are radiography programs using electronic data collecting or traditional paper collecting systems, or a combination of both?
2. Is there a relationship between the data collection method used and the geographic location of the program to clinical sites?
3. Is there a relationship between data collection used and the size of the program?
4. For programs that are using electronic data collecting, are mobile devices used in patient care areas for student evaluation?
5. What are the advantages of using mobile devices for student evaluation?
6. What are the advantages of using paper systems for student evaluation?
7. What are the disadvantages of using mobile devices for student evaluation?
8. What are the disadvantages of using paper systems for student evaluation?

Significance of the Study

Unquestionably, clinical education is a vital component of healthcare education (Neubrander, 2012). During the clinical experience, students observe, interact with, and reflect on patient experiences to reinforce the knowledge learned in the didactic learning experience

(Neubrander, 2012). Evaluation of student clinical performance is a critical aspect in skill growth and future success in the professional field. Radiography programs use a variety of data collection systems and must consider the methods used to evaluate student's skills, document performance, analyze records, and the timeliness information is disseminated to students and faculty. Even with the increasing popularity of MEDs in healthcare education, research concerning whether MEDs are advantageous over other methods of collecting, documenting, and analyzing student's clinical records is needed in order to provide radiography programs with the information that will allow them to use the method that best suits their program needs.

Delimitations and Limitations

The study was delimited to radiography programs in the southeastern states accredited by the JRCERT. To be included in the study, the program had to be a two or four year radiography program located at a community college or university in the following states: Virginia, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana. I located potential participants via a listing on the JRCERT website and contacted them via email to invite them to take part in the study. I collected data in June 2015.

Limitations of the study included the study being sent only to program directors and the responses to the study were limited to just one person in the program. Due to the subjectivity of the study, the attitudes of current faculty may not be reflective of future faculty and yet their responses to the study influence the information collected. In addition, the information collected from radiography program directors was limited to the questions asked on the survey. Other research methods such as interviews could provide much more in depth specific information but would be much more time consuming.

Assumptions

I assumed that programs would participate in the study and that participants would answer all questions honestly.

Operational Definitions

ARRT: The American Registry of Radiologic Technologists is a credentialing organization, seeking high quality patient care in medical imaging, interventional procedures, and radiation therapy. The organization provides testing and certifies technologists, administers continuing education, and ensures ethical requirements are met for annual registration. (ARRT, 2014).

ASRT: The American Society of Radiologic Technologists is an organization that provides educational opportunities for its members, promotes radiologic technology as a career, and monitors state and federal legislation that affects the profession. In addition, the organization is responsible for working with accreditation agencies and establishing standards of practice for the radiologic science profession and developing educational curricula. ("History of the ASRT", 2014).

Electronic data collecting systems: For the purpose of this study, an electronic data collecting system is a computerized system designed for the collection of clinical data in an electronic format and used for educational purposes.

JRCERT: Joint Review Committee on Education in Radiologic Technology is an agency that recognizes the accreditation of traditional and distance delivery educational programs in radiography, radiation therapy, magnetic resonance, and medical dosimetry (JRCERT, 2014).

Mobile electronic devices (MED): Also known as a handheld computer. For the purpose of this study, a mobile electronic device is a small, handheld, computing device that typically has a display screen with touch input or a miniature keyboard. The device has an operating system that can run various application software and allows connections to the internet (Applegate, 2010).

Paper data collecting systems: For the purpose of this study, a paper data collecting system is a completely paper-based system designed to collect clinical data in a paper format and used for educational purposes.

Rural: For the purpose of this study, rural areas are identified as 90 percent or more rural on the Zip Code Area Census 2010 Urban Rural Interactive Table (proximityone.com).

Urban: For the purpose of this study, urban areas are identified as 90 percent or more urban on the Zip Code Area Census 2010 Urban Rural Interactive Table (proximityone.com).

Rural and Urban: For the purpose of this study, rural and urban areas are identified as areas populated with both urban and rural percentages on the Zip Code Area Census 2010 Urban Rural Interactive Table but less than 90 percent in each (proximityone.com).

CHAPTER 2

REVIEW OF LITERATURE

Radiography programs use various methods to evaluate and track students' skills and progress in clinical education. Through this literature review I examined the types of clinical data collection and tracking systems that radiography programs use and the role that mobile electronic devices (MED) have in evaluating student skills at the point of patient care. I used the East Tennessee State University (ETSU) Charles C. Sherrod Online Library database to conduct research of the literature and limited sources to full text, peer-reviewed articles, published between the years of 2002 and 2015. I used the following terms in my search: PDA, mobile electronic devices, evaluation, learning, clinical practice, clinical education, and student evaluation.

Purpose of Student Evaluation

Evaluation is defined as "the process of collecting and analyzing data gathered through one or more measurements in order to render a judgment about the subject of the evaluation" (O'Connor, 2015, p. 299). Direct observation of student performance during clinical rotations "can assess things such as patient interaction, efficiency, motivation, decision making skills, procedural skills, data synthesis, and clinical plan formation" (Manthey, Magilner, Ozumba, & Neiberg, 2008, p. 779). Evaluation helps to "determine student's progress toward and achievement of program outcomes, the effectiveness of the educational process in fostering student learning, and the success of the program in accomplishing its mission" (O'Connor, 2015, p. 299) of preparing students for entry into practice.

In the clinical setting, clinical instructors "make and collect observations and anecdotes relating to student performance and other types of data, then compare this information to a set of

standards and grade the students accordingly" (Zafrir & Nissim, 2011, p. 168). Clinical evaluations can be formative or summative. Formative evaluation provides students with feedback on their performance in order to encourage improvement, whereas summative evaluation provides faculty with a formal opinion or grading of student performance and competence (Zafrir & Nissim, 2011).

However, student evaluations in radiography programs cannot be determined by grades alone. Graduates of radiography programs are required to demonstrate competency in general patient care and radiographic procedures as well as successfully completing the following coursework:

- digital image acquisition and display,
- ethics and law in Radiologic Sciences,
- human structure and function,
- image analysis,
- imaging equipment,
- introduction to computed tomography (CT),
- introduction to Radiologic Science and health care,
- medical terminology,
- patient care in Radiologic Sciences,
- pharmacology and venipuncture,
- principles of imaging,
- radiation biology,
- radiation production and characteristics,
- radiation protection,

- radiographic pathology,
- radiographic procedures (The American Registry of Radiologic Technologists [ARRT], 2014).

Development of clinical skills begins in the didactic setting, although students practice and master these skills in the clinical environment. O'Connor (2015) suggested that the clinical education setting "provides students with opportunities to develop the knowledge, skills, and attitudes" (p. 164) needed "within the realistic work settings in which they will practice" (p. 164). O'Connor (2015) also suggested that the "clinical education setting presents students with experimental, practical learning opportunities" that are "dynamic, with much of the content out of the direct control of the instructor" (p. 182). Content learned in the clinical setting is more "embedded within the patient's situation" (O'Connor, 2015, p. 182) and "unless the student interacts with this content, she will have no means of developing a working knowledge of the rules she has learned in the classroom" (O'Connor, 2015, p. 182).

Zafrir (2011) suggested that evaluation of student clinical skills necessitates collecting and

> analyzing knowledge regarding students' varying abilities, and transforming this knowledge into an evaluation that is objective and yet meaningful to students in accordance with both learning goals and standards of practice. To perform successful evaluations, teachers must be able to translate and interpret the multitude of situations experienced by students throughout the clinical placement. (p. 167).

Instructor assessment and evaluation of student progress while students are practicing in the clinical environment is important to determine the rate at which students progress towards

graduation requirements. According to Jeffreys (2007), knowledge of individual student strengths and weaknesses can help faculty initiate the appropriate intervention for at-risk students. Evaluation methods used to determine strengths and weaknesses of students in clinical education include competency examinations, skills checklists, student self-evaluations, and clinical journals (O'Connor, 2015). Information on student evaluations enables faculty to provide feedback that is essential for students' professional growth. Feedback provides students with "direction and helps to boost their confidence as well as their motivation and self-esteem" (Matua, Seshan, Akintola, & Thanka, 2014, p. 25). Fair and honest feedback on student clinical evaluation is especially important for students having difficulties. This "feedback is often sought by the students as a way of measuring their improvements and gaining insights into which areas they still need to work on" (Nusbaum, Plakht, Raizer, & Shiyovich, 2013, p. 1264).

Importance of Data Collection

In order to accurately assess the progress of students, provide needed intervention, and provide accreditation agencies with appropriate documentation demonstrating program success, faculty must have a system to collect important data from didactic and clinical settings. Faculty use data collected from student evaluations, competencies, and academic grades to determine if students are meeting course objectives and to provide feedback, suggest remediation, and evaluate the needs of students in the clinical learning experience (O'Connor, 2015). Carlson et al. (2003) concluded that "this comprehensive and detailed information could be used to enhance student assignments, learning, and evaluation" (p. 194). Faculty can also use data collection to evaluate the "effectiveness of clinical agencies in providing a variety of student experiences as well as support curriculum decisions and program evaluations" (Carlson et al., 2003, p. 194).

Even though accreditation by the Joint Review Committee on Education in Radiologic Technology (JRCERT) is voluntary, it is considered the gold standard among radiography programs (JRCERT, 2014). The JRCERT requires radiography programs to maintain record keeping and provide documentation from data collected in order to demonstrate program performance measures. The JRCERT will, in turn, monitor and provide program information to the public in order to assure students, employers, and the general public that the radiography program is effective in educating students within the professional scope of practice (JRCERT, 2014).

In addition to the JRCERT, the American Registry of Radiologic Technologists (ARRT) requires that students must demonstrate competency in didactic coursework and an ARRT-specified list of clinical procedures in order to be considered a candidate for the ARRT primary certification and registration (*2015 Radiography Handbook*, 2015). The purpose of demonstrating competency in didactic coursework is to verify that students had the "opportunity to develop fundamental knowledge, integrate theory into practice and hone affective and critical thinking skills required to demonstrate professional competency" (*2015 Radiography Handbook*, 2015, p. 29). Satisfaction of these requirements is indicated through the program director and, if required, an authorized faculty member's signature on the student's application for certification and registration (*2015 Radiography Handbook*, 2015). The ARRT contacts the educational program director to complete verification of the student's successful completion of "both the clinical and didactic phases of the program as it was accredited, as well as the ARRT-specified competency requirements" (*2015 Radiography Handbook*, 2015, p. 14).

Methods used for Data Collection

According to the Standards outlined by the JRCERT, "the program develops and implements a system of planning and evaluation of student learning and program effectiveness outcomes in support of its missions" (JRCERT, 2014, p. 57). To meet this standard, radiography programs develop an "assessment plan that, at a minimum, measures the program's student learning outcomes in relation to the following goals: clinical competence, critical thinking, professionalism, and communication skills" (JRCERT, 2014, p. 58). While each radiography program has a unique system for collecting and recording the various documents needed to meet these requirements, the two methods that are used to collect and record data are paper-based or computer-based methods.

The traditional paper-based method to collect and record documentation requires stacks of paper and program faculty have some "difficulty in tracking the progression of students throughout the students' clinical experience" (Sander & Morrison, 2011, p. 21). Another method program faculty use to document and track student data requires the use of computer technology. Computer-based methods could be a more efficient means to collect and record data and has the potential to also "provide direct access to reports for program faculty and students alike" (Sander & Morrison, 2011, p. 21). Salyers, Carter, Antoniazzi, and Johnson (2013) found that an online clinical tracking system permitted monitoring of student progress by students and faculty while also tracking the breadth and depth of student clinical experiences.

Paper-Based Data Collection

Paper-based methods have been used for many years to evaluate, test, and document student progress. In this method, students and faculty are required to collect, maintain, and submit paper-based documentation for clinical education experiences such as clinical hours,

competency and evaluation of student performance, reflective journals, and anecdotal notes. Johansson, Nilsson, and Petersson (2013) found that nursing students perceived documenting notes on scraps of paper, in notebooks, or in diaries unreliable. Transferring notes taken during clinical education on multiple pieces of paper to notebooks can be time consuming, requires organization of material, and there is a risk the notes could be lost or misplaced before submission to program faculty.

Cullen, Stiffler, Settles, and Pesut (2010) described the Indiana University School of Nursing's (IUSON) experience with a paper-based method of data collection as becoming "increasingly outmoded, cumbersome, and painful to store, maintain, and monitor" (p. 22). Radiography faculty may find it cumbersome and time consuming to supply the needed paper-based forms to clinical instructors and to document submission to the program faculty. Cullen et al. (2010) also noted that IUSON's program faculty found it "difficult to see patterns in patient care volume, cases, types of cases, and caregiving activities and learning experiences by analyzing written documentation logs" (p. 22). Another issue is that paper-based data collection requires radiography educators to find space to store all the hard copy documentation.

Program faculty use clinical documentation for program reporting to their accreditation agencies. At one time, radiography programs accredited by the JRCERT were required to submit a substantial amount of paper documentation in order to support their efforts in meeting necessary accreditation standards. Recently, the JRCERT has implemented changes which have reduced the amount of paper-based documentation radiography programs are required to submit. In April 2013, the JRCERT required that all radiography programs submit annual and interim reports through the Accreditation Management System (AMS) and no longer accepted paper-based documentation (Winter, 2013). Consequently, in 2013, to aid program directors the

JRCERT provided a web-based portal for each program to submit documentation into the AMS (Winter, 2013).

Electronic Data Collection

With the explosion of technology in healthcare, electronic methods are available to test, evaluate, document, and track student progress in clinical education. Cullen et al. (2010) suggested that "databases are common management tools used by healthcare, colleges, and universities" (p. 21). Faculty members can use collected data to "coordinate and evaluate students as well as clinical environments" (Cullen et al., 2010, p. 21). Meyer (2002) suggested that "current technology can optimize use of the information collected from students' experiences with efficient categorization, synthesis, and analysis" (p. 115). Hass (2006) reported that conversion from paper to electronic documentation improved accuracy and timeliness of tracking students' clinical experiences and also improved data analysis. Despite the group instruction on using the device, the variety of computer products used made instruction more cumbersome and troubleshooting a challenge (Hass, 2006). Hass (2006) concluded that the change to computer-based clinical tracking was a "great investment of time and resources" and "offers many advantages" (Hass, 2006, p. 68). Advantages noted in the study included "more extensive curriculum evaluation than was possible using a paper-based system" and "the accuracy and timeliness of tracking students' clinical experiences" (Hass, 2006, p. 69). Electronic-based devices can potentially provide faculty the resources to efficiently observe clinical skills and provide students timely feedback. Torre, Treat, Durning, and Elnicki (2011) "indicated a difference in observation and feedback time" (p. 12) between the use of paper-based methods and PDAs in clinical education. The authors found that the use of an electronic-based

device may result in a gain of clinical skills observation time and feedback delivery (Torre et al., 2011).

George, Davidson, Serapiglia, Barla, and Thotakura (2010) suggested challenges surrounding "the introduction of new technology to students and faculty included the need for faculty development, resistance to change, fear of technology failure, and lack of support" (p. 372). Educators must be aware of these challenges or barriers and incorporate support services when introducing new technology (George et al., 2010).

Use of Mobile Electronic Devices in Clinical Education

The use of MEDs in healthcare and education has expanded over the past few years (Farrell & Rose, 2008). These devices are small, portable, provide mobile computing tools, are "convenient to use for quick data management, and enable users to accomplish tasks anywhere and at any time" (Johansson, Petersson, Saveman, & Nilsson, 2012, p. 50); however, most of the research on the use of MEDs in clinical education has focused on nursing and medical students. Personal digital assistants (PDA) can potentially serve as useful tools in clinical practice to retrieve immediate information, save time and make a more efficient use of time, improve access to relevant clinical information, and build student confidence in their work practices (Johansson et al., 2013). PDAs create efficiency in time management skills in clinical education by allowing

> evaluators to document and record direct observation of students' clinical skills in a timely and efficient manner, saving the time and effort typically associated with data gathering and data entry, an important consideration in the venue of a multi-site clerkship. (Torre et al., 2011, p. 12)

With mobile devices, health care students have no need to carry numerous reference books since many of these can be accessed with an app. This allows students to "carry all the

information found in standard medical textbooks and other references in one small device that fits in a lab-coat pocket" (Ventola, 2014, p. 362). Radiography students may benefit from using mobile devices to access reference tools such as positioning protocols and notes taken from the didactic setting. Students stated that "medical-surgical clinical guidelines would be useful on the PDA because they were expected to look up the procedure before performing the skill" (Farrell & Rose, 2008, p. 18). Instead of carrying heavy textbooks, one radiography program used PDAs to provide positioning manuals and 30 second videos of radiographic examinations to cover positioning, radiation safety, and image critique as a referencing tool for student use in clinical education (Marino & Odle, 2008). Radiography students may also save time by using MEDs to manage patient logs, clinical competencies, and evaluations.

In a 2013 study, Johansson et al. found that participants thought that mobile devices added the benefit of recording information immediately, as one participant expressed that "we like to think that we remember very much but we do not and we also distort information" (p. 1249). Not only do MEDs have the potential to assist clinical instructors and students in accurately recording information as it happens but they can also serve as tools to assist with other duties in clinical education. A new nursing program at Robert Morris University (RMU) integrated the use of PDA technology and even though students were initially unsure how these devices would help with learning, they eventually learned how these could be used (Davidson & George, 2005). Faculty required these students to create a database to track an aspect of their own clinical practice with their PDAs. The students used this assignment to demonstrate how they used their PDAs to track clinical experiences, hours, and the number of patients with a particular pathology (Davidson & George, 2005). During this assignment, many students expressed their frustration with learning something new but as time in the program and clinical

requirements increased, the students found the technology easier to use and learned how useful the PDAs had become to them in clinical education (Davidson & George, 2005).

Students in clinical education are "increasingly relying on mobile devices as a 'pocket brain' for quick, easy access to information they need in order to succeed in their programs and careers" (Ventola, 2014, p. 361). Ventola (2014) reported that resources frequently used included: online textbooks and lectures, medical podcasts, medical calculators, and search engines to look up unfamiliar terms. In addition to the availability of these resources, "mobile apps for health care students can be used for knowledge assessment, such as case study quizzes or tests to help prepare for board examinations" (Ventola, 2014, p. 361). The ability to access these "resources has been shown to enhance student learning in the clinical environment and to increase student knowledge scores" (Ventola, 2014, p. 361).

Mobile Electronic Devices in Student Evaluation

The portability of mobile devices may provide a benefit for student evaluations at the point of care by allowing clinical instructors the ease of documenting student performance anytime and anywhere. Some radiography programs are using PDAs to track students' clinical activities and performance in the clinical setting (Marino & Odle, 2008). The size and portability of MEDs allows clinical instructors to easily evaluate students while they are performing patient care duties, reducing the likelihood that specific student performance will be forgotten or distorted at a later time. The ultimate goal in evaluating students is to provide students with feedback on their clinical performance in order to advance learning in the clinical environment (Hauer & Kogan, 2012). Since accurate instructor evaluation and feedback of student performance is essential for effective student learning in clinical practice, MEDs may provide

clinical instructors with the tools needed to effectively and efficiently perform these duties (Clynes & Raftery, 2008).

Students found PDAs to be useful to quickly access assessment forms, streamlined data collection, enhanced time management, and provided the learner with immediate information (Fisher & Koren, 2007). If wireless technology is available, this feature may allow clinical instructors to share student evaluation information with educational faculty immediately following completion of the student's evaluation.

Types of Mobile Devices Used in Clinical Education

There are several different types of mobile devices used in clinical education including PDAs, smartphones, laptops, and tablet PCs. These mobile devices are increasingly used by students in medical education and training in order to "log their experiences, to access information about medical conditions and drug treatment, to perform calculations, and to make basic notes" (Ventola, 2014, p. 361). All these devices can be loaded with software applications and most can access wireless networks for web-based references.

PDAs were introduced in 1993 by Apple Computers and have evolved into wireless devices that have a wide range of capabilities including data entry, internet referencing, downloading and sharing files, and can be synchronized with a desktop computer (Zurmehly, 2010). PDAs operate much like a computer but can easily fit into the hand or pocket and use touch screen technology with either a stylus or keyboard for user comfort (Zurmehly, 2010). PDAs have been in use for some time but the "introduction of the iPhone, iPad, and other smartphones and tablets has changed the type of information that can be easily accessed on mobile devices" (Boruff & Storie, 2014, p. 22). Ventola (2014) reported that

> health care professionals now use smartphone or tablet computers for functions they used to need a pager, cellphone, and PDA to accomplish. Smartphones and tablets combine both computing and communication features in a single device that can be held in a hand or stored in a pocket, allowing easy access and use at the point of care (p. 356).

Boulos, Wheeler, Tavares, and Jones (2011) agreed that

> the latest generation of smartphones are increasingly viewed as handheld computers rather than as phones, due to their powerful on-board computing capability, capacious memories, large screens and open operating systems that encourage application development. The potential for the creation of simple and easy to download apps for smartphones has created a vibrant new industry. There is now an app for just about every social, entertainment, and educational requirement. (p. 3)

Laptops are available in a variety of sizes but can be cumbersome to carry from room to room, depending on the size of the laptop. The pharmacy department at the University of Wisconsin Hospital and Clinic (UWHC) pilot tested the use of laptops on mobile carts in decentralized patient care areas, however, Krough, Rough, and Thomley's (2008) "pilot project was of limited success because of the large size and awkwardness of the cart" (p. 155).

Tablet PCs are available in slate form or a convertible form which converts the tablet into a notebook when desired. These devices are typically lighter weight and are also thinner than a laptop making them easier to carry around (Krough et al., 2008).

Software Packages for Use on Mobile Devices in Clinical Education

Ventola (2014) suggested that

> the use of mobile devices by health care professionals (HCPs) has transformed many aspects of clinical practice and has led to the rapid growth in the development of medical software applications (apps) for these platforms. Numerous apps are now available to assist HCPs with important tasks, such as: information and time management; health record maintenance and access; communication and consulting; reference and information gathering; patient management and monitoring; clinical decision-making; and medical education and training. (p. 356)

HandDBase is a HIPAA-compliant relational database software program that can be used on mobile devices in order to organize, track, and manage information (Ventola, 2014). With HanDBase, program faculty can create their own database, enter data, search, sort, and filter data to create reports (DDH Software, 2014).

To save limited data space on mobile devices, web-based or cloud based clinical tracking systems can be used to house information and be accessible from any device that is internet accessible. Examples of these clinical tracking systems include the Typhon Group Healthcare Solutions and Trajecsys. Typhon Group's Allied Health Student Tracking System is an electronic web database that is customizable for any type of allied health educational program (Typhon Group Healthcare Solutions, 2014). The system

> functions as a complete and secure electronic student tracking system, including comprehensive clinical skill logs and reports, a fully featured evaluation and survey component for assessments, management of student rotation scheduling, student electronic portfolios, student and supervisor biographic databases, clinical

site database, curriculum mapping, secure management… (Typhon Group Healthcare Solutions, 2014).

Trajecsys is a cloud based record keeping system for online time record, evaluations, skill check-offs, and activity logs for educational programs (Trajecsys, 2013). The system can be accessed anywhere or from any device that has internet capability (Trajecsys, 2013). The Trajecsys system allows program faculty to quickly generate reports from various data collected such as time records, evaluations, competency examinations, skill level, and clinical site activity (Trajecsys, 2013).

Summary

After reviewing the literature related to student evaluation, data collection methods, and the use of MEDs in clinical education and student evaluation, I believe important information can be gained by furthering research in this subject area. Healthcare and education are increasingly using electronic methods for documentation and many are finding MEDs useful due to their portability and convenience for quick data management. Future information for radiography clinical education can be gained from researching radiography programs' chosen methods for data collection and the advantages and disadvantages related to these methods.

CHAPTER 3

DESIGN AND METHOLOGY

Overview

Radiography programs use either traditional paper-based systems or electronic systems to evaluate, document, and track student performance and learning outcomes. The technology revolution has resulted in an increased use of computers in many healthcare facilities and computers become essential tools in hospitals, educational settings, and community health settings. With the growing presence of mobile electronic devices (MED) in education and healthcare, there has been a new wave of technology applications, web-based data collection, and organizing sites (Morgan, 2013).

The purpose of this research study was to determine the method of data collection and documentation used by radiography programs to evaluate student progress and to examine if MEDs play a role in evaluating and documenting student skills at the point of care.
Studies have shown the value of the use of MEDs in nursing and other medical programs but there is limited research in radiography (Applegate, 2010).

Research Questions

The following questions guided this study:

1. Are radiography programs using electronic data collecting or traditional paper collecting systems, or a combination of both?
2. Is there a relationship between the data collection method used and the geographic location of the program to clinical sites?
3. Is there a relationship between data collection used and the size of the program?

4. For programs that are using electronic data collecting, are mobile devices used in patient care areas for student evaluation?
5. What are the advantages of using mobile devices for student evaluation?
6. What are the advantages of using paper systems for student evaluation?
7. What are the disadvantages of using mobile devices for student evaluation?
8. What are the disadvantages of using paper systems for student evaluation?

Research Design

This study was a cross-sectional quantitative research study. I used a survey to collect information regarding radiography program directors' preferred method for collecting data to document and track student performance. Cross-sectional studies are conducted by collecting data at "one specific point in time" (Cottrell & McKenzie, 2011, p. 196). Cottrell and McKenzie (2011) stated that the purpose of survey research is to gather specific information in order to determine the attitudes, opinions, beliefs, values, behaviors, or characteristics of a targeted group of people.

This research is designed to be used by radiography programs decision makers in order to gain information that may be useful in their clinical education program; it may also be helpful to other allied health education programs.

Population

In order to provide sufficient data, the population for this study was drawn from radiography programs that are accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT) in the following southeastern states: Virginia, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana. Programs accredited by the JRCERT adhere to the same standards in documenting and tracking

student progress (JRCERT, 2014). The use of JRCERT accredited programs provided consistency in clinical data collection and student procedure tracking. Delimitating a study by specific parameters and rationale makes a study more "feasible and not just for the convenience or interest of the researcher" (Cottrell & McKenzie, 2011, p. 87).

I referenced the JRCERT for a listing of all two and four year radiography programs in these states that were both accredited by the JRCERT and regionally accredited (Joint Review Committee on Education in Radiologic Technology [JRCERT], 2014). The information from the JRCERT included a listing of radiography programs, filtered by state, and each institution's name, mailing address, website address, and program directors name and email address. Program directors were selected to participate in the survey.

Clinical coordinators and clinical instructors have more direct involvement in clinical education so I considered using them for my population first. Radiography programs use clinical faculty, full-time and part-time, who are paid employees of the college but also use technologists who are paid employees of the clinical sites as clinical instructors for students. Each program structures their clinical faculty differently making it difficult to use clinical instructors for the population. Programs that are accredited by the JRCERT have full-time program directors and clinical coordinators who are paid by the college but clinical coordinator information was not listed on the JRCERT listing. I researched each program and attempted locating clinical coordinator information but found this information difficult to find for some programs so I decided to use program directors for my population even though they may not have been the best candidates to answer some of the questions in the survey.

Informed Consent Consideration

All participants in this study received information regarding the purpose of the study and gave their voluntary consent to participate. In survey research, participants are often presented with a statement that implies consent by completing the survey; in survey research, this type of consent is "acceptable in place of an actual consent form" (Cottrell & McKenzie, 2011, p. 109). I invited each participant in this study to participate in the study by email and gave them information about the purpose of the study, clear directions for completing the survey, my contact information, and directions concerning consent. The Institutional Review Board (IRB) of East Tennessee State University (ETSU) reviewed and approved the study on June 1, 2015 (see Appendix A).

Survey Instrument Development

I designed a survey (see Appendix B) to obtain information to answer the study's research questions regarding the specific methods each radiography program uses to collect data for student performance, their satisfaction of chosen methods, and the barriers in the way of change. I included specific radiography program demographic attributes, such as size and geographic location, in order to determine if relationships exist between these attributes and the data collection methods chosen. In order to determine the receptiveness of radiography program faculty concerning the use of MEDs for clinical student evaluation, I included questions about attitudes and opinions regarding the use of these devices in clinical education.

Instrument Validity

I determined the validity of the study instrument by establishing face validity and conducting a pilot study. Validity of an instrument is established when the instrument "actually does measure the underlying attribute or not" (Cottrell & McKenzie, 2011, p. 149). According to

Cottrell and McKenzie (2011), a study instrument has face validity if "the instrument appears to measure what it purports to measure" (p. 151). This is easily established by having one or more individuals familiar with the subject area review the instrument and determine if the instrument appears to measure the subject area (Cottrell & McKenzie, 2011). Face validity is considered a first step in determining validity but should not be the only step (Cottrell & McKenzie, 2011). A professional educator familiar with the subject area reviewed the study instrument and provided feedback before the pilot study was conducted.

Pilot studies are designed on a small scale to provide trial run of the survey instrument to addresses weaknesses in the survey before the study is conducted (Cottrell and McKenzie, 2011). I conducted a pilot study in April 2015 by inviting program faculty from one JRCERT accredited radiography program in my geographical area to participate in the study. I provided pilot study participants with a cover letter (Appendix C) and a paper copy of the survey (Appendix B). After completing the survey, participants met with me to provide feedback on the survey questions.

Recommendation of the Pilot Study

After reviewing the suggestions written by participants, I discussed them with the participants to make sure I had a clear understanding of their questions and feedback. After discussion, I changed the wording in some questions in order to enhance the clarity. One suggestion was to add a question to the survey to gain knowledge about the participant's general experience using MEDs. Even though I thought the suggestion to add a question about program director's interest in a web-based method for accreditation data and analysis was important, it was not relevant to this particular study. This may be an area that could benefit from further research in the future.

Data Collection Procedures

With advancements in modern technology, the strategies, options, and techniques available to conduct surveys have changed over time (Cottrell & McKenzie, 2011). Cottrell and McKenzie (2011) stated that "with the increased use of the Internet and e-mail, it is a natural extension to consider sending survey questionnaires by means of this technology" (p. 201). I used email to solicit participation from two and four year radiography programs, located in Virginia, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana and accredited by the JRCERT. I sent all study participants a cover letter (Appendix D) by email and a link to the study's survey (Appendix E) via Google forms on June 3, 2015. Study participants had until June 17, 2015 to complete the survey. Participant responses were automatically formatted into an Excel spreadsheet which included the name of school and responses to survey questions.

According to Cottrell and McKenzie (2011), response rates can increase by twenty percent with one follow up mailing. On June 18, 2015, after referencing the master listing, I sent study participants who did not complete the electronic survey by June 17, 2015, an email containing a reminder cover letter (Appendix F) and a link to the survey (Appendix E) via Google forms. These study participants had until June 30, 2015 to complete the survey. In an effort to increase response rates, I used the incentive of entering participants in a drawing for a Wal-Mart gift card. Since participant names hold no value to the study other than obtaining names for the contest, I destroyed these after the closing of the study.

Data Analysis

I used descriptive statistics to conduct data analysis. Descriptive statistics are used to "summarize data about a population or variable so they can be easily comprehended" (Cottrell &

McKenzie, 2011, p. 256). I used Cramer's V to determine the strength of an association between two variables (planetmath.org, 2015).

Strengths and Limitations

Strengths of this study include the use of a follow up email for data collection, allowing for the maximum return rate of surveys and the timing of the data collection. This study is designed to collect information to help programs make decisions about selecting data collection systems but does not determine the best method to select. Limitations of the study include self-reported responses from the participants and the responsiveness of the participants included in the study. Due to the subjectivity of the study, the attitudes of current faculty could influence the responses and information collected from the study. Information collected by the researcher is also limited to the questions asked in the survey which may or may not elicit additional information that could be better obtained by other research methods.

Summary

I used a cross-sectional quantitative research study to collect information regarding radiography programs' preferred method for collecting data to document and track student performance and the use of MEDs in student evaluation. I sent participants a link to the survey via email and used Google forms to collect the data from the questionnaire. I used descriptive statistics to organize, summarize, and explain the data collected.

CHAPTER 4

DATA ANALYSIS

The purpose of this study was to determine the methods of data collection and documentation used by the staff of radiography programs to evaluate student progress and to examine whether mobile electronic devices (MED) played a role in evaluating and documenting student skills at the point of care. The results of this study may provide educators working in radiography programs useful information that can be used to improve the clinical education in their respective programs.

Respondents

The population for this study included radiography program directors currently employed in radiography programs accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT) and regionally accredited in the following southeastern states: Virginia, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana. Out of 120 radiography program directors contacted to complete the survey, 42 program directors responded, yielding a 35 percent survey response rate.

Specifically, I initially contacted potential study participants on June 3, 2015 via email requesting that they complete the survey. By June 17, 2015, 34 program directors had responded to the study and on June 18, 2015, I sent a reminder email to all program directors who had not responded to the study and gave them until June 30, 2015 to complete the survey. During this period, eight additional program directors responded to the study. I closed the data collection on June 30, 2015.

Results

The participating radiography program directors' responses to the survey answered the research questions as noted in the following sections. I used descriptive statistics to report the collected responses.

Research Question Number 1: Data Collection System

Research question number one was stated as follows: Are radiography programs using electronic data collecting or traditional paper collecting systems, or a combination of both?

The majority of respondents indicated that they use paper methods to collect data for student evaluation (58.5%) and competency (63.4%). Less than half use electronic (24.4% evaluation, 19.5% competency) or a combination of paper and electronic methods (17.1% evaluation, 17.1% competency) to collect data for student evaluation and competency. One did not answer each of these questions. The results can be found in Tables 1 and 2.

Table 1.

Collection Methods for Student Evaluation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electronic method	10	23.8	24.4	17.1
	Paper method	24	57.1	58.5	41.5
	Paper and electronic method	7	16.7	17.1	100.0
	Total	41	97.6	100.0	
Missing	NR	1	2.4		
Total		42	100.0		

Table 2.

Collection Methods for Student Competency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electronic Method	8	19.0	19.5	17.1
	Paper Method	26	61.9	63.4	36.6
	Paper and Electronic Method	7	16.7	17.1	100.0
	Total	41	97.6	100.0	
Missing	NR	1	2.4		
Total		42	100.0		

Half (50%) of the respondents use paper methods for recording student evaluation and 47.6 % use paper methods when recording student competencies. The remaining respondents use electronic (28.6% evaluation, 28.6% competency) or a combination of paper and electronic methods (21.4% evaluation, 23.8% competency) to record student evaluation and competency. The results can be found in Tables 3 and 4.

Table 3.

Recording Methods for Student Evaluation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electronic method	12	28.6	28.6	21.4
	Paper method	21	50.0	50.0	50.0
	Paper and electronic method	9	21.4	21.4	100.0
	Total	42	100.0	100.0	

Table 4.

Recording Methods for Student Competency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electronic method	12	28.6	28.6	23.8
	Paper method	20	47.6	47.6	52.4
	Paper and electronic method	10	23.8	23.8	100.0
	Total	42	100.0	100.0	

Research Question Number 2: Data Collection Method vs. Geographic Location

Research question number two was stated as follows: Is there a relationship between the data collection method used and the geographic location of the program's clinical sites? I used college city zip codes to determine whether the locations were urban, rural, or a combination of urban and rural. I used descriptive statistics to describe this data and included frequencies and percentages. Of the 42 respondents, 76.2% were located in urban areas and the remaining 23.8% were located in a combination of urban and rural areas. The results are found in Table 5.

Table 5.

Geographic Locations of Radiography Programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	32	76.2	76.2	23.8
	Urban and Rural	10	23.8	23.8	100.0
	Total	42	100.0	100.0	

In order to determine whether there was a relationship between the geographic location of the school and the method used for data collection, I used Crammer's V since the data collected was nominal in scale. Using a 95% confidence interval (alpha<.05), I concluded that there was

no relationship between the data collection method used and the geographic location of the school (p=.339). The results are found in Table 6.

Table 6.

Relationship Between the Data Collection Method and Geographic Location

		Value	Approx. Sig.
Nominal by Nominal	Phi	.230	.339
	Cramer's V	.230	.339
N of Valid Cases		41	

Research Question Number 3: Data Collection Method vs. Program Size

Research question number three was stated as follows: Is there a relationship between data collection used and the size of the program? For the purpose of this study, I used radiography program student enrollment to determine the size of radiography programs.

Student enrollment ranged in categories from 0-10 students to 41 or more students each year. Of the 42 respondents, 50% indicated that their radiography programs enroll 11-20 students, 26.2% indicated that they enroll 21-30 students, 11.9% indicated that they enroll 31-40 students, 7.1% indicated that they enroll more than 41 students, and 4.8% indicated that they enroll 0-10 students each year. The results are found in Table 7.

Table 7.

Number of Students Enrolled Each Year in Radiography Programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-10	2	4.8	4.8	4.8
	11-20	21	50.0	50.0	11.9
	21-30	11	26.2	26.2	61.9
	31-40	5	11.9	11.9	88.1
	41 or more	3	7.1	7.1	100.0
	Total	42	100.0	100.0	

In order to determine if there was a relationship between the data collection method used by the school and the size of the radiography program, I used Crammer's V since the data collected was nominal in scale. Using a 95% confidence interval (alpha<.05), I concluded that there was no relationship between the data collection method used and the size of the radiography program (p=.201). The results are found in Table 8.

Table 8.

Relationship Between the Data Collection Method and Program Size

		Value	Approx. Sig.
Nominal by Nominal	Phi	.518	.201
	Cramer's V	.366	.201
N of Valid Cases		41	

Research Question Number 4: Mobile Devices and Student Evaluation

Research question number four was stated as follows: For programs that are using electronic data collecting, are mobile devices used in patient care areas for student evaluation? I used descriptive statistics, including frequencies and percentages, to describe data collected.

While 26.2% of respondents indicated that they use mobile devices to evaluate students at the point of care, 73.8% indicated that they did not. The results are found in Table 9.

Table 9.

MEDs in Clinical Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	31	73.8	73.8	73.8
	Yes	11	26.2	26.2	100.0
	Total	42	100.0	100.0	

Only those respondents who used a method other than paper for collecting and recording student data answered questions 15-20. Question 15 was stated as follows: If an electronic method is used to collect and record data, what device are you using? Respondents selected all devices their radiography program used in clinical education for these purposes. A total of 37 devices were listed by the 23 respondents who answered this question. Of the devices being used, 51.4% were desk top computers and the remaining 48.6% of the devices consisted of a variety of MEDs. Multiple respondents recorded the use of more than one type of device in clinical education. The tablet (21.6%) was the most frequently recorded mobile device. The remaining mobile devices recorded were the laptop (10.8%), smart phone (10.8%), iPad (2.7%), and PDA (2.7%). The results are found in Table 10.

Table 10.

Devices Used in Clinical Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Desk top	19	51.4	51.4	51.4
	iPad	1	2.7	2.7	54.1
	Laptop	4	10.8	10.8	64.9
	PDA	1	2.7	2.7	67.6
	Smart phone	4	10.8	10.8	78.4
	Tablet	8	21.6	21.6	100.0
	Total	37	100.0	100.0	

Along with a variety of electronic devices that are used in clinical education, radiography faculty also use a variety of applications to collect and record data. Survey question 16 was stated as follows: If an electronic method is used to collect and record data, what application are you using? Of the 20 respondents who answered the question, Trajecsys (30%) and eValue (15%) were the two most frequently recorded applications. Other applications included Blackboard (10%), onlineradschool.com (10%), Desire2Learn (5%), desktop (5%), Excel (5%), Google Chrome (5%), HanDBase (5%), Moodle (5%), and self-written (5%).The results are found in Table 11.

Table 11.

Applications Used with Electronic Devices in Clinical Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Blackboard	2	10.0	10.0	10.0
	Desire2Learn	1	5.0	5.0	15.0
	Desk top	1	5.0	5.0	20.0
	eValue	3	15.0	15.0	35.0
	Excel	1	5.0	5.0	40.0
	Google Chrome	1	5.0	5.0	45.0
	HanDBase	1	5.0	5.0	50.0
	Moodle	1	5.0	5.0	55.0
	onlineradschool.com	2	10.0	10.0	65.0
	self-written	1	5.0	5.0	70.0
	Trajecsys	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

Survey question 17 was stated as follows: Are you satisfied with the method your program is currently using to collect and record data for student performance? Again, this question was restricted to those who are using methods other than paper for collecting and recording data for student evaluation. Of the 23 respondents who answered this question, 13 were satisfied, six strongly satisfied, three dissatisfied, and one was strongly dissatisfied. The results can be found in Table 12.

Table 12.

Satisfaction Levels

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly satisfied	6	14.3	26.1	13.0
	Satisfied	13	31.0	56.5	69.6
	Dissatisfied	3	7.1	13.0	73.0
	Strongly dissatisfied	1	2.4	4.3	100.0
	Total	23	54.8	100.0	
Missing	NR	19	45.2		
Total		42	100.0		

The four respondents who were dissatisfied or strongly dissatisfied provided information about why they were dissatisfied, whether they planned to change their current method, and the barriers to change their current methods. The results can be found in Table 13.

Table 13.

Reasons for Dissatisfaction and Barriers to Change

Satisfaction Level	Reason for Dissatisfaction	Plans to Change	Barriers to Change
Dissatisfied	The clinical coordinator wants to do electronic, but the purchase cost is too high in a downward budget time. We were a hospital based program that ran on a very low budget. The program was transferred in 2011. Money was spent on phantoms, computers & programs etc.	Yes	Cost
Dissatisfied	Using paper and electronic	No	Cost
Strongly Dissatisfied	Blackboard platform is not user friendly and unpredictable	Yes	College preference
Dissatisfied	Not feasible for compiling data and reports	No	Cost

Respondents currently using electronic methods for student clinical evaluation answered survey questions 21-23. Question 21 was stated as follows: If your program is currently using an electronic method for student clinical evaluation, do program faculty or clinical staff use mobile

electronic devices to evaluate student skills at the point of patient care? Of the 22 respondents who answered this question, 27.3% use mobile devises for student clinical evaluation at the point of care at all clinical sites, 4.5% use mobile devices for student clinical evaluation at the point of care only at select clinical sites, and 68.2% do not use mobile devices for student clinical evaluation at the point of care at any clinical site. The results can be found in Table 14.

Table 14.

Faculty Use of MEDs for Student Evaluation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, at all clinical sites	6	14.3	27.3	68.2
	Yes, but only at select clinical sites	1	2.4	4.5	95.5
	No not at any clinical sites	15	35.7	68.2	100.0
	Total	22	52.4	100.0	
Missing	NR	20	47.6		
Total		42	100.0		

Question 22 was stated as follows: If your program is currently using an electronic method for competency examinations, do program faculty or clinical staff use mobile electronic devices to evaluate student performance at the point of patient care? Of the 20 respondents who answered this question, 30% use mobile devices for competency examinations at the point of care at all clinical sites, 5% use mobile devices for competency examinations at the point of care only at select clinical sites, and 65% do not use mobile devices for competency examinations at the point of care at any clinical sites. The results can be found in Table 15.

Table 15.

Faculty Use of MEDs for Student Competency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, at all clinical sites	6	14.3	30.0	65.0
	Yes, but only at select clinical sites	1	2.4	5.0	95.0
	No, not at any clinical sites	13	31.0	65.0	100.0
	Total	20	47.6	100.0	
Missing	NR	22	52.4		
Total		42	100.0		

Question 23 was stated as follows: If your program is currently using an electronic method for collecting and recording data, do students use mobile electronic devices for clinical examination logs during patient downtime? Of the 22 respondents who answered this question, 22.7% allow students to use mobile devices for clinical examination logs during downtime at all clinical sites, 9.1% allow students to use mobile devices for clinical examination logs during downtime only at select clinical sites, and 68.2% do not allow students to use mobile devices for clinical examination logs at any clinical site. The results can be found in Table 16.

Table 16.

Student Use of MEDs for Examination Logs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, at all clinical sites	5	11.9	22.7	68.2
	Yes, but only at select clinical sites	2	4.8	9.1	90.9
	No, not at any clinical sites	15	35.7	68.2	100.0
	Total	22	52.4	100.0	
Missing	NR	20	47.6		
Total		42	100.0		

The last five questions were about how MEDs can be used in clinical education. By answering the questions with strongly agree, agree, disagree, and strongly disagree, respondents expressed their opinions about whether MEDs can improve student's clinical education, accuracy and timeliness of student reporting, and whether they believed MEDs are a distraction to students and faculty. Only those participants who use MEDs in clinical education responded to those questions. I used descriptive statistics, including frequencies and percentages, to describe the data.

Question 28 asked participants if MEDs can improve radiography students' clinical education experience by having didactic and positioning references available in one device. Of the 21 respondents who answered this question, over half agreed (42.9%) and strongly agreed (33.3%) that these devices could improve student's clinical education experience while the remaining participants disagreed (19%) and strongly disagreed (4.8%). The results are found in Table 17.

Table 17.

MEDs Improve Radiography Students' Clinical Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	9	21.4	42.9	42.9
	Disagree	4	9.5	19.0	61.9
	Strongly agree	7	16.7	33.3	95.2
	Strongly disagree	1	2.4	4.8	100.0
	Total	21	50.0	100.0	
Missing	NR	21	50.0		
Total		42	100.0		

Question 29 asked if MEDs used by clinical faculty and staff can improve accuracy of student clinical performance. Of the 20 respondents who answered this question, 40% agreed and

25% strongly agreed that these devices could improve accuracy of recording student clinical performance while 20% disagreed and 15% strongly disagreed. The results are found in Table 18.

Table 18.

MEDs Improve Accuracy of Student Clinical Performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	8	19.0	40.0	40.0
	Disagree	4	9.5	20.0	60.0
	Strongly agree	5	11.9	25.0	85.0
	Strongly disagree	3	7.1	15.0	100.0
	Total	20	47.6	100.0	
Missing	NR	22	52.4		
Total		42	100.0		

Question 30 asked if MEDs used by clinical faculty and staff can improve timeliness of student clinical performance. Over half of the 22 respondents who answered this question agreed (50%) and strongly agreed (27.3%) that these devices could improve the timeliness in recording of student clinical performance while 22.7% disagreed. The results are found in Table 19.

Table 19.

MEDs Improve Timeliness of Student Clinical Performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	11	26.2	50.0	50.0
	Disagree	5	11.9	22.7	72.7
	Strongly agree	6	14.3	27.3	100.0
	Total	22	52.4	100.0	
Missing	NR	20	47.6		
Total		42	100.0		

Question 31 asked if MEDs were a distraction for clinical faculty. Over half of the 21 respondents who answered this question disagreed (57.1%) and strongly disagreed (9.5%) that these devices are a distraction for clinical faculty when using them in clinical education but 23.8% agreed and 9.5% strongly agreed that they were a distraction. The results are found in Table 20.

Table 20

MEDs as a Distraction for Faculty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	5	11.9	23.8	23.8
	Disagree	12	28.6	57.1	81.0
	Strongly agree	2	4.8	9.5	90.5
	Strongly disagree	2	4.8	9.5	100.0
	Total	21	50.0	100.0	
Missing	NR	21	50.0		
Total		42	100.0		

Question 32 asked if MEDs were a distraction for students. Of the 22 respondents who answered this question, 22.7% agreed and 31.8 % strongly agreed that MEDs were a distraction for students and 31.8 % disagreed and 13.6% strongly disagreed that these devices were a distraction. The results are found in Table 21.

Table 21.

MEDs as a Distraction for Students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	5	11.9	22.7	22.7
	Disagree	7	16.7	31.8	54.5
	Strongly agree	7	16.7	31.8	86.4
	Strongly disagree	3	7.1	13.6	100.0
	Total	22	52.4	100.0	
Missing	NR	20	47.6		
Total		42	100.0		

The respondents who answered research questions 5-8, were asked to select all answers that applied to their program. Respondents provided a variety of advantages and disadvantages for using paper systems and mobile devices for student evaluation.

Research Question Number 5: Advantages of Using Mobile Devices

Research question number five was stated as follows: What are the advantages of using mobile devices for student evaluation? Of the respondents who answered this question, seven thought that ease of use was an advantage to using mobile devices in clinical education for student evaluation, five thought that timely feedback was an advantage, three thought that ease of data analysis was an advantage, and two thought that faculty acceptance was an advantage. Other advantages were that MEDs were required by the college to use, student tracking, saving of time and travel, providing student feedback on grades, and grade tracking and calculating. The results are found in Table 22.

Research Question Number 6: Advantages of Using Paper Systems

Research question number six was stated as follows: What are the advantages of using paper systems for student evaluation? Of the respondents who answered this question, six

thought that ease of use was an advantage of using a paper system for student evaluation and four thought that clinical acceptance was an advantage. Other advantages were duplicate documentation, faculty acceptance, familiarity, hard copy, low cost, and not all students have access to a computer or electronic devices. The results are found in Table 22.

Research Question Number 7: Disadvantages of Using Mobile Devices

Research question number seven was stated as follows: What are the disadvantages of using mobile devices for student evaluation? Of the respondents who answered this question, five thought that clinical acceptance was a disadvantage of using mobile devices for clinical evaluation, four thought that software or technical problems was a disadvantage, and three respondents indicated that there were not any disadvantages. Other disadvantages were cost, ease of data analysis, and ease of use. The results are found in Table 22.

Research Question Number 8: Disadvantages of Using Paper Systems

Research question number eight was stated as follows: What are the disadvantages of using paper systems for student evaluation? Of the respondents who answered this question, four thought that supplying multiple forms, three thought timely feedback, and two thought that storage was a disadvantage. Other disadvantages were that clinical instructors are resistant, ease of data analysis, manual grading, it is easier to lose documents, and their system works. The results are found in Table 22.

Table 22.

Advantages and Disadvantages of Using MEDs and Paper Methods for Student Evaluation

Advantage/Disadvantage	Reason	Frequency
Advantages of MEDs	Ease of Use	7
	Timely Feedback	5
	Ease of Data Analysis	3
	Faculty Acceptance	2
	Required by College	1
	Student Tracking	1
	Saves time and travel	1
	Provides student feedback on grades	1
	Grade tracking and calculating	1
Advantages of Paper Method	Ease of Use	6
	Clinical Acceptance	4
	Duplicate Documentation	1
	Ease of Use	1
	Faculty Acceptance	1
	Familiarity	1
	Hard Copy	1
	Low Cost	1
	All students do not have access to computer	1
	All students do not have electronic devices	1
Disadvantages of MEDs	Clinical Acceptance	5
	Software or Technical Problems	4
	None	3
	Cost	1
	Ease of Data Analysis	1
	Ease of Use	1
Disadvantages of Paper Method	Supply of Multiple Forms	4
	Timely Feedback	3
	Storage	2
	Easier to lose documents	1
	Clinical Instructors are resistant	1
	Ease of Data Analysis	1
	Our system works	1
	Manual grading	1

Comments

The pilot study was completed via paper method to allow respondents to write comments under each question. After the pilot study was completed, the study survey was typed into Google forms and tested. The survey was designed so that question 15 and 16 would allow study participants the option of selecting multiple answers. When I typed these questions into Google forms, I failed to select the option to allow multiple answers. This survey was tested but this flaw

was not evident during the pilot. Multiple participants typed their answers for these questions in the comments at the end of the survey.

Respondents provided several comments to further explain their views on using MEDs in clinical education.

- We created our own online survey tool and housed it on our college server with password protection. It dumps data into an excel spreadsheet that only faculty of the program can access from the college. We did not want to incur costs to our students or the college for expensive devices or apps. Our paid program CI uses an iPad in the clinical setting for notations and record keeping as well as application such as Essential Skeleton, to support student remediation. We also video students practicing in the clinical setting with it and show the student to self-evaluate errors or strengths.
- Electronic devices are the new, fast and modern way for this younger generation use. Therefore incorporating it in system to record and collecting information is the way we should go.

  For us the older generation who are used to paperwork we still find it easier and tend to use the paper method because change is difficult and learning a the new language of electronic is scary.
- Prior to merging with another college we were using electronic records for student evaluations. I do miss it!
- The biggest barrier to electronic devices at the point of care is the perception that these devices (phones, tablets etc) should never be visible to a patient. I happen to think that this is correct from the patient's POV.

- We do not use hand held devices, or tablets because of the poor reception in Radiology Department that are lead lined; our clinical sites do not approve of these devices and we do not allow students to use these devices in clinical areas due to HIPAA. We do record our grades on the computer using spreadsheets for data collection.
- Mobile electronic devices have the potential to make data collection and student grading easier for instructors however it has been my experience that students tend to try to abuse the access to the internet when in possession of mobile electronic devices.

Summary

This chapter is the summary of the data collected from 42 full time radiography program directors working at two or four year community colleges or universities in the southeastern states from June 3, 2015 to June 30, 2015. All data collected was nominal and I used descriptive statistics for reporting the responses. Where appropriate, I used Crammer's V to test for differences.

Most of the respondents indicated that they still use a paper method for collecting and recording student performance. Those who use electronic devices in clinical education provided a list of the devices and applications they use for student data collection and recording in clinical education. They indicated that paper and MEDs have both advantages and disadvantages when used for data collection and recording in clinical education. The responses to the open ended questions regarding the use of MEDs in clinical education provided another layer of information that could be used by program directors in determining whether to use MEDs in clinical education.

CHAPTER 5

CONCLUSIONS, DISCUSSIONS, AND RECOMMENDATIONS

The purpose of this research study was to determine the method of data collection and documentation used by radiography programs to evaluate student progress and to examine if MEDs play a role in evaluating and documenting student skills at the point of care.

The clinical setting should be an environment rich in professional learning opportunities in which students develop the knowledge and skills they need for the radiography profession. Observation, evaluation, and tracking of student learning in clinical education is vital to student success. Accurate and timely feedback from clinical instructors is necessary to provide students with information needed to grow and develop their skills.

Clinical instructors use a variety of tools such as anecdotal notes, checklists, evaluation, and competency to track student performance. Documentation of this performance is important to demonstrate student progress as well as demonstrate the program's ability to meet their learning outcomes. While each program has a unique system for collecting and recording information needed to track student performance and program assessment, the methods used are paper-based, computer-based, or a combination of both.

The traditional paper-based method has been used for many years to collect and record student data but requires stacks of paper that only one person can view at a time and creates an additional time burden for clinical instructors and faculty in grading, transporting student evaluations and competency, and sorting data needed to track student performance (Sander & Morrison, 2011). The computer-based method to collect and record student data does have some challenges with the introduction of new technology but has the advantage of "accuracy and timeliness of tracking students' clinical experiences" (Hass, 2006, p. 69). Mobile electronic

devices (MED) are small, portable devices with powerful operating systems which provide clinical instructors with the ability to evaluate and document student performance anywhere and at any time (Johansson et al., 2012). The size and portability of MEDs provide clinical instructors with the ability to record student performance while observing the student and if wireless technology is available, clinical instructors can easily share this information with students and program faculty immediately.

The advancements in computer technology have opened doors to technology that may be useful for radiography program faculty and clinical instructors evaluating student performance in clinical education. This research was not designed to find a superior method for data collection but rather to seek information that will be helpful to radiography program directors in their future needs to document student clinical performance.

Conclusions

In drawing conclusions for this research study, one must remember that the data collected was limited to the 42 program directors who responded to the survey. The population was limited to radiography program directors working for two or four year radiography programs that were accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT) and also regionally accredited by the Southern Association of Colleges and Schools (SACS). The study was also limited to a four week time period beginning on June 3, 2015 and ending June 30, 2015.

After considering these limitations, I drew the following conclusions regarding the method of data collection and documentation that is being used by radiography programs to evaluate student progress and whether MEDs play a role in evaluating and documenting student skills at the point of care:

Although the majority of program directors indicated their programs were using a paper method for collecting data for student evaluation and competency, this does not indicate that computers are not being used. Computers are used once the data is collected to record and store data for student grading and clinical performance tracking. Student grades are often stored electronically in computer programs such as Excel and may even be posted for student review and storage through the college's computer platform such as Blackboard, D2L, or Moodle.

More program directors indicated their programs were using an electronic or a combination of paper and electronic method to record data than to collect data for student evaluation and competency, most likely because student clinical tracking information is needed electronically in order to supply program assessment information for accreditation. Programs accredited by the JRCERT are required to place assessment information on the program's website as well as submit information to the JRCERT through a web-based portal. Even though a radiography program uses a paper method to collect data, this data will have to be saved in an electronic format in order to provide this information.

Desk top computers were the most commonly used electronic devices indicated by program directors. This is not surprising since desk top computers are readily available in most healthcare facilities. Healthcare facilities use electronic methods to store patient records, including imaging studies, and to manage patient billing accounts. Desk top computers can be used in the clinical environment to record student attendance, student evaluation, and student competency. Radiography program directors who wish to use software or cloud based solutions for student tracking, but also experience barriers to using MEDs in clinical education sites, may find a compromise using desk top computers. Since they are readily used for most daily work

activities in the clinical education site, they are often accepted with IT monitoring internet activity.

Even though program directors indicated that MEDs could improve student clinical experiences, the accuracy of recording student clinical performance, and the timeliness in recording of student clinical performance, the majority of program directors indicated that they did not use MEDs at the point of care but this does not indicate that mobile devices are not being used by clinical instructors. Tablets were the most frequently used MEDs used by program directors. Clinical instructors use mobile devices such as tablets to document and record anecdotal notes and grades since they are portable, come in easy viewing sizes, have internet capability, and act like a computer. Even if internet services are not available, these notes and grades can be recorded on the tablet and later transferred via internet to college faculty. This creates efficiency in recording and relaying student clinical information used for student performance tracking from the clinical environment to the college.

Trajecsys and eValue were the most frequently used applications because they are currently the two that are available for purchase at an institutional rate with IT support to manage and store data that is needed for student tracking and accreditation. Both of these programs are cloud based solutions that can be accessed from any web browser or mobile application and are relatively inexpensive solutions for student clinical tracking and data storage. All clinical faculty can grade competencies, evaluate students, or verify student attendance at any time and students have immediate grading and feedback on competencies and evaluations. Stored student data can later be used to demonstrate student clinical performance for accreditation. All data is owned by the radiography program but is managed and stored by Trajecsys or eValue. As with most

clinical educators, finding an effective and efficient solution to manage, store, and track student performance is important in time management practices.

Even though MEDs do have a role in clinical education, there are still barriers and radiography programs are slow to accept their use at the point of care for student evaluation and competency.

Discussion

Although faculty and students use MEDs in everyday life, there were still barriers to their use in clinical education. Some of the comments provided by program directors helped to explain.

One program director thought that electronic devices were a new, fast, and modern way to collect and record information but may be easier and more accepted with the younger generation. The older generation is more familiar with paper methods and believes this method is much easier than learning something new. Learning something new can be difficult and if the paper method has worked well for many years, it may be a challenge for faculty and clinical instructors to change. Regardless of the options available, unless program faculty are dissatisfied with their current method, they may see changing data collection systems as an unneeded waste of time.

Another concern is how we view others using MEDs in our presence. Today, MEDs are our connection to others through text and social media. Our patients may feel that if we use MEDs while caring for them that we are being rude and not giving them our full attention. They may not understand that we are using these devices to document their care and to reference pertinent information. One program director said that MEDs should not be used where the devices are visible to patients. Clinical instructors using MEDs to document student performance

can use these devices from behind the control panel where it would not be visible to the patient and still evaluate students at the point of care.

Another concern when working with patients in a clinical setting is adhering to HIPAA and making sure patient privacy is not violated. MEDs have the ability to video, photograph, and record information that would violate patient's privacy and present a barrier to using them in clinical education. One program director commented that students were not allowed to use these devices in clinical areas due to HIPAA.

Faculty, clinical instructors, and students have access to patient records while in clinical education sites. Most clinical education sites require these individuals to sign documentation that they understand what HIPPAA is and that they will comply with patient privacy procedures. Employees who violate HIPAA laws can be penalized with employment termination just as faculty and students can be penalized with academic dismissal or termination of clinical site affiliation with the radiography program. The use of MEDs in clinical education does increase the ways patient privacy can be violated but the possibility of violation already exists whether MEDs are being used or not. MEDs may make some tasks much easier but current penalties for violation of HIPAA laws are still relevant with their use and strict accountability should still be held as standard practice.

Slow acceptance of the use of MEDs in clinical education could be due to worry of HIPAA violation, clinical staff acceptance of learning new technology, or patient satisfaction to name a few. Radiography equipment and many radiology and hospital information systems are constantly updating in order to keep up with current technology in the profession. These changes come with staff training on the new technology. Radiography program directors who make the decision to change the method their program uses to collect and track student performance in

clinical education will need to train all those who are affected by these changes. This may require time and patience in order to accommodate clinical staff work schedules, their experience level with technology, and work load within the clinical site. When introducing MEDs for use of student evaluation, training should include where these devices are accepted within patient care. Patient satisfaction surveys weigh heavily in how hospitals are reimbursed for their services making patients experiences very important. It is important to work with clinical education site administrators when planning where it is acceptable to use MEDs in patient care and for program faculty to provide clear policies and penalties for misuse to clinical instructors and students.

Another consideration is whether the clinical sites have a mobile device policy. If the clinical site has a policy, this information would provide guidance for radiography programs in determining the parameters in which they can be used while evaluating students in clinical education. If the clinical site does not have a policy, radiography program faculty should consider discussing the terms under which they want to use mobile devices in order to determine whether it would be permissible at the clinical site.

Program directors also mentioned the cost of MEDs, budget cuts, and student costs as other concerns with using MEDs in clinical education. While there are costs associated with the use of tablets and apps, program directors may need to weigh those against the amount of faculty time involved in documentation using a paper-based method. Paper methods of collecting, recording, and tracking student performance requires manual analyzing which will take considerable more time than electronic methods. The time this takes faculty could be saved and used in other areas within the program since many programs may be experiencing budget cuts through a decreased staff. The annual cost of ink and paper a radiography program uses to supply forms and copy information for record keeping should also be considered. There is no

information in this study that supports whether these considerations would equal the cost of programs using MEDs in clinical education but validation of these costs can help support the programs decision to use MEDs or not.

Another barrier is whether internet access is required for applications being used on MEDs. Faculty and clinical instructors should investigate the clinical facility's internet access before incurring any cost for the devices. A program director commented that his or her program did not use hand held devices or tablet because of the poor reception in the lead lined Radiography department.

Data from this study supports that program directors thought MEDs have value in clinical education but barriers still exist and will need to be addressed in order to increase their usage in clinical education.

Recommendations for Future Research

I collected data that could aid program directors in determining methods to collect and record student progress in the best manner for their program. Further research could address the following:

1. This study was conducted in radiography programs in a limited geographic area and may not be indicative of responses from program directors in other areas of the country. I would suggest future study to collect data from a wider range of programs.
2. This study was conducted during a limited time in the summer semester and may not have been the most advantageous time for program directors to be available for research studies. I would suggest data collection of future research to be collected mid fall or spring semesters.

3. This study's population included only program directors, however, I did not get input from clinical coordinators and clinical instructors who have more direct involvement in documenting and recording student performance. I would suggest future research to include clinical coordinators and clinical instructors.
4. Program directors in this study reported value to using MEDs in clinical education but also commented these devices were not used in clinical sites due to HIPAA. I would suggest future research to include clinical site administrators and whether they view MEDs as too much risk for HIPAA violation to allow their use for student evaluation.
5. Costs and faculty time are associated with both paper methods and MEDs in clinical education and while this study did not collect information about these factors, it could validate cost effective reasons for MED use or not. I suggest future research to include costs of MEDs and paper methods against the amount of faculty time involved in documentation for each method.
6. Program directors reported that MEDs would be a valuable reference tool for students but were split about whether MEDs were a distraction to students. Since student views were not collected in this study, I suggest further research to obtain student views about the use of MEDs in clinical education.
7. Program directors in this study reported value in using MEDs in clinical education but also listed barriers as to why their programs did not use MEDs in clinical education. Although this study did not collect information about mobile device policies, I suggest further research to include whether clinical sites have mobile device policies in place.

The advancements in technology have given us different options for radiography programs to use for data collection and even though each program has a preferred method to use, sharing

information is helpful to all. Learning about options that are being used by programs, the success the programs have seen in using these options, and the barriers that programs have encountered will provide information to move forward in how we collect the data needed to track student performance.

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APPENDICES

Appendix A

IRB Approval

IRB APPROVAL – Initial Exempt
June 2, 2015
Robin Garner
RE: A Comparative Analysis of Data Collection Systems Used in Radiography Educational Programs and the Role Mobile Electronic Devices Play
IRB#: 0515.19e
ORSPA#: ,
On **June 1, 2015**, an exempt approval was granted in accordance with 45 CFR 46. 101(b)(2). It is understood this project will be conducted in full accordance with all applicable sections of the IRB Policies. No continuing review is required. The exempt approval will be reported to the convened board on the next agenda.
・new protocol submission xform, CV of PI, cover letter, reminder letter, Radiography Programs: Methods of Data Collection Survey

Projects involving Mountain States Health Alliance must also be approved by MSHA following IRB approval prior to initiating the study.
Unanticipated Problems Involving Risks to Subjects or Others must be reported to the IRB (and VA R&D if applicable) within 10 working days.
Proposed changes in approved research cannot be initiated without IRB review and approval. The only exception to this rule is that a change can be made prior to IRB approval when necessary to eliminate apparent immediate hazards to the research subjects [21 CFR 56.108 (a)(4)]. In such a case, the IRB must be promptly informed of the change following its implementation (within 10 working days) on Form 109 (www.etsu.edu/irb). The IRB will review the change to determine that it is consistent with ensuring the subject's continued welfare.

Sincerely,
George Youngberg, M.D., Chair
ETSU/VA Medical IRB
Cc: Ester Verhovsek

Appendix B

Radiography Programs: Methods of Data Collection Pilot Study Survey

Please select one answer for each question unless instructed otherwise.

1. Please provide the name of the school.

   _____

2. What is the school's zip code? _____

3. How many students do you enroll each year in your radiography program?

   A. 0-10

   B. 11-20

   C. 21-30

   D. 31-40

   E. 41 or more

4. How many approved JRCERT clinical education sites are affiliated with your radiography program?

   A. 0-5

   B. 6-10

   C. 11-15

   D. 16-20

   E. 21-25

   F. 25 or more

5. How many full time faculty clinical instructors are involved in evaluating (grading) students?

   A. 0-5

   B. 6-10

   C. 11-15

   D. 16-20

   E. 25 or more

6. How many part time faculty clinical instructors are involved in evaluating (grading) students?

   A. 0-5

   B. 6-10

   C. 11-15

   D. 16-20

   E. 25 or more

7. What is the approximate size of the smallest hospital affiliated with your radiography program?

   A. 0-50 beds

   B. 51-99 beds

   C. 100-200 beds

   D. 201-300 beds

   E. 301-400 beds

   F. 401 or more beds

8. What is the approximate size of the largest hospital affiliated with your radiography program?

   A. 0-50 beds

   B. 51-99 beds

   C. 100-200 beds

   D. 201-300 beds

   E. 301-400 beds

   F. 401 or more beds

   When answering the following questions, mobile electronic devices are defined as handheld computing devices such as: iPad, iPhone, android phones and tablets, and any other smartphones.

9. What method does your radiography program use to collect and record data for student clinical evaluation?

   A. Paper method and paper filing

   B. Paper method and electronic filing

   C. Paper method and paper/electronic filing

   D. Electronic method, not web-based

   E. Electronic method, web-based

   F. Other, please describe:

10. What method does your radiography program use to collect and record data for competency examinations?

    A. Paper method and paper filing

    B. Paper method and electronic filing

    C. Paper method and paper/electronic filing

    D. Electronic method, not web-based

    E. Electronic method, web-based method

    F. Other, please describe:

11. If electronic method is used to collect and record data, what device are you using? **(Choose all that apply).**

    A. Desk top computer

    B. Tablet

    C. PDA

    D. Laptop

    E. Smart phone

12. If electronic method is used to collect and record data, what application are you using?

    _____

13. Are you satisfied with the method your program is currently using to collect and record data for student performance?

    A. Strongly satisfied

    B. Satisfied

    C. Dissatisfied

    D. Strongly dissatisfied

14. If you are dissatisfied with the method your program is currently using to collect and record data for student performance, what is the main reason for your dissatisfaction?

    _____

15. If you are dissatisfied with the method your program is currently using to collect and record data for student performance, do you have plans to change the method?

    A. Yes

    B. No

16. If you are dissatisfied with the method your program is currently using to collect and record data for student performance, what are the barriers to change (select all that apply)

    A. Cost

    B. Resistance to change

    C. Ease of use

    D. Lack of knowledge about what is available

    E. Other, please describe:

17. If your program is currently using an electronic method for student clinical evaluation, do program faculty or clinical staff use mobile electronic devices to evaluate student skills at the point of patient care?

    A. Yes, at all clinical sites

    B. Yes, but only at select clinical sites

    C. No, not at any clinical sites

18. If your program is currently using an electronic method for competency examinations, do program faculty or clinical staff use mobile electronic devices to evaluate student performance at the point of patient care?
    A. Yes, at all clinical sites
    B. Yes, but only select clinical sites
    C. No, not at any clinical sites
19. If your program is currently using an electronic method for collecting and recording data, do students use mobile electronic devices for clinical examination logs during patient downtime?
    A. Yes, at all clinical sites
    B. Yes, but only select clinical sites
    C. No, not at any clinical sites
20. If your program is currently using mobile electronic devices for student clinical evaluation, at the point of care, what are the **advantages**? (select any that apply)
    A. Ease of use
    B. Faculty acceptance
    C. Clinical acceptance
    D. Ease of data analysis
    E. Timely feedback
    F. Other, please describe:

21. If your program is currently using mobile electronic devices for student clinical evaluation at the point of care, what are the **disadvantages**? (select any that apply)

    A. Cost

    B. Faculty acceptance

    C. Clinical acceptance

    D. Ease of use

    E. Software or technical problems

    F. Other, please describe

22. If your program is currently using a paper method for student clinical evaluation at the point of care, what are the **advantages**? (select any that apply)

    A. Ease of use

    B. Faculty acceptance

    C. Clinical acceptance

    D. Other, please describe:

23. If your program is currently using a paper method for student clinical evaluation at the point of care, what are the **disadvantages**? (select any that apply)

    A. Cost

    B. Timely feedback

    C. Supply of multiple forms

    D. Ease of data analysis

    E. Faculty are resistant

    F. Clinical Instructors are resistant

    G. Other, please describe:

24. Mobile electronic devices can improve radiography student's clinical education by having didactic and positioning references available in one device.
    A. Strongly agree
    B. Agree
    C. Disagree
    D. Strongly disagree
25. Mobile electronic devices used by clinical faculty and staff can improve accuracy of student clinical performance.
    A. Strongly agree
    B. Agree
    C. Disagree
    D. Strongly disagree
26. Mobile electronic devices used by clinical faculty and staff can improve timeliness of student clinical performance.
    A. Strongly agree
    B. Agree
    C. Disagree
    D. Strongly disagree
27. Mobile electronic devices are a distraction for clinical faculty.
    A. Strongly agree
    B. Agree
    C. Disagree
    D. Strongly disagree

28. Mobile electronic devices are a distraction for students.

A. Strongly agree

B. Agree

C. Disagree

D. Strongly disagree

29. If you have additional comments, please provide them here.

If you would like to see the results of this study, please provide your contract information and preferred method of communication (hard copy or email).

Thank you for your time in completing this survey.

Appendix C

Pilot Study Cover Letter

My name is Robin Garner and I am a graduate student in the Allied Health Sciences program at East Tennessee State University, a doctoral research university located in Johnson City, Tennessee. As part of my degree requirements for the Master of Science in Allied Health degree, I am conducting research to determine methods of data collection used by radiography programs and whether mobile electronic devices have a place in student evaluation.

I am inviting you to participate in this research. Your decision to participate is voluntary and there is minimal risk of participation in this study. All responses in this study will be kept confidential. Information collected in this study may benefit educational programs in the radiologic sciences. This study is not designed to determine a superior method of data collection and student evaluation, but rather to gain information that may be useful for radiography program directors and clinical coordinators.

In this study, you will be asked to complete a survey and answer a series of questions in order to establish validity of the survey for the research study. Your completion and submission of this survey is your consent to participate in the pilot study.

If you have any questions concerning the research or survey, please contact Robin Garner (garnerr@goldmail.etsu.edu) or Dr. Ester L. Verhovsek (verhovse@etsu.edu). If you have any questions concerning your rights as a participant, please contact the IRB at East Tennessee State University at 423-439-6053.

I appreciate your time in participating in this survey.

Please complete the survey by May 8, 2015.

Robin Garner, RT (R) (M), BAOM
Masters Candidate
East Tennessee State University

Appendix D

Study Cover Letter

My name is Robin Garner and I am a graduate student in the Allied Health Sciences program at East Tennessee State University, a doctoral research university located in Johnson City, Tennessee. As part of my degree requirements for the Master of Science in Allied Health degree, I am conducting research to determine methods of data collection used by radiography programs and whether mobile electronic devices have a place in student evaluation.

I am inviting you to participate in this research. Your decision to participate is voluntary and there is no foreseeable risk of participation in this study. All responses in this study will be kept confidential. Information collected in this study may benefit educational programs in the radiologic sciences. This study is not designed to determine a superior method of data collection and student evaluation, but rather to gain information that may be useful for radiography program directors and clinical coordinators.

In this study, you will be asked to complete an electronic survey. Please click on the link below to begin the survey. You must be at least 18 years of age to participate in this study and your completion and submission of this survey is your consent to participate in this research. All participants in this study will be entered into a drawing to win a fifty dollar Wal-Mart gift card.

If you have any questions concerning the research or survey, please contact Robin Garner (garnerr@goldmail.etsu.edu) or Dr. Ester L. Verhovsek (verhovse@etsu.edu). If you have any questions concerning your rights as a participant, please contact the IRB at East Tennessee State University at 423-439-6053.

I appreciate your time in participating in this survey.

Please complete the survey by June 17, 2015.

Robin Garner, RT (R) (M), BAOM
Masters Candidate
East Tennessee State University

Appendix E

Radiography Programs: Methods of Data Collection Survey

Please select one answer for each question unless instructed otherwise.

1. Please provide the name of the school.

   _____

2. What is the school's zip code? _____

3. How many students do you enroll each year in your radiography program?

   F. 0-10

   G. 11-20

   H. 21-30

   I. 31-40

   J. 41 or more

4. How many approved JRCERT clinical education sites are affiliated with your radiography program?

   G. 0-5

   H. 6-10

   I. 11-15

   J. 16-20

   K. 21-25

   L. 26 or more

5. How many full time faculty and clinical preceptors are involved in evaluating (grading) students?

   F. 0-5

   G. 6-10

   H. 11-15

   I. 16-20

   J. 21-25

   K. 26 or more

6. How many part time faculty and clinical preceptors are involved in evaluating (grading) students?

   F. 0-5

   G. 6-10

   H. 11-15

   I. 16-20

   J. 21-25

   K. 26 or more

7. What is the approximate size of the smallest hospital affiliated with your radiography program?

   G. 0-50 beds

   H. 51-100 beds

   I. 101-200 beds

   J. 201-300 beds

   K. 301-400 beds

L. 401 or more beds

8. What is the approximate size of the largest hospital affiliated with your radiography program?

   G. 0-50 beds

   H. 51-100 beds

   I. 101-200 beds

   J. 201-300 beds

   K. 301-400 beds

   L. 401 or more beds

For this study, mobile electronic devices are defined as handheld computing devices such as: iPad, iPhone, android phones and tablets, and any other smartphones.

9. How much general experience do you have using mobile electronic devices in your everyday work or home activities?

   A. Very experienced

   B. Experienced

   C. No experience

10. Does your program currently use mobile electronic devices in clinical education?

    A. Yes

    B. No

11. What method does your radiography program use to collect data for student clinical evaluation?
    A. Paper method
    B. Electronic method
    C. Paper and electronic method
    D. Other, please describe
12. What method does your radiography program use to record data for student clinical evaluation?
    A. Paper method
    B. Electronic method
    C. Paper and electronic method
    D. Other, please describe
13. What method does your radiography program use to collect data for competency examinations?
    A. Paper method
    B. Electronic method
    C. Paper and electronic method
    D. Other, please describe
14. What method does your radiography program use to record data for competency examinations?
    A. Paper method
    B. Electronic method
    C. Paper and electronic method
    D. Other, please describe

If you answered "Paper method" for questions 11-14 (you only use a paper method for collecting and recording student data), please stop here and you may skip to the optional survey questions 33-36. If you answered any of the other options, please continue with questions 15-36.

15. If an electronic method is used to collect and record data, what device are you using? **(Select all that apply).**

    F. Desk top computer

    G. Tablet

    H. PDA

    I. Laptop

    J. Smart phone

16. If an electronic method is used to collect and record data, what application are you using?

    _____

17. Are you **satisfied** with the method your program is currently using to collect and record data for student performance?

    E. Strongly satisfied

    F. Satisfied

    G. Dissatisfied

    H. Strongly dissatisfied

18. If you are **dissatisfied** with the method your program is currently using to collect and record data for student performance, what is the main reason for your dissatisfaction?

    _____

19. If you are **dissatisfied** with the method your program is currently using to collect and record data for student performance, do you have plans to change the method?

    C. Yes

    D. No

20. If you are **dissatisfied** with the method your program is currently using to collect and record data for student performance, what are the barriers to change (select all that apply)

    F. Cost

    G. Resistance to change

    H. Ease of use

    I. Lack of knowledge about what is available

    J. Other, please describe:

21. If your program is currently using an electronic method for student clinical evaluation, do program faculty or clinical staff use mobile electronic devices to evaluate student skills at the point of patient care?

    D. Yes, at all clinical sites

    E. Yes, but only at select clinical sites

    F. No, not at any clinical sites

22. If your program is currently using an electronic method for competency examinations, do program faculty or clinical staff use mobile electronic devices to evaluate student performance at the point of patient care?

    D. Yes, at all clinical sites

    E. Yes, but only select clinical sites

    F. No, not at any clinical sites

23. If your program is currently using an electronic method for collecting and recording data, do students use mobile electronic devices for clinical examination logs during patient downtime?

    D. Yes, at all clinical sites

    E. Yes, but only select clinical sites

    F. No, not at any clinical sites

24. If your program is currently using mobile electronic devices for student clinical evaluation, at the point of care, what are the **advantages**? (select all that apply)

    G. Ease of use

    H. Faculty acceptance

    I. Clinical acceptance

    J. Ease of data analysis

    K. Timely feedback

    L. Other, please describe:

25. If your program is currently using mobile electronic devices for student clinical evaluation at the point of care, what are the **disadvantages**? (select all that apply)

    A. Cost

    B. Faculty acceptance

    C. Clinical acceptance

    D. Ease of use

    E. Software or technical problems

    F. Other, please describe

26. If your program is currently using a paper method for student clinical evaluation at the point of care, what are the **advantages**? (select all that apply)

    E. Ease of use

    F. Faculty acceptance

    G. Clinical acceptance

    H. Other, please describe:

27. If your program is currently using a paper method for student clinical evaluation at the point of care, what are the **disadvantages**? (select all that apply)

    H. Cost

    I. Timely feedback

    J. Supply of multiple forms

    K. Ease of data analysis

    L. Faculty are resistant

    M. Clinical Instructors are resistant

    N. Other, please describe:

28. I believe mobile electronic devices can improve radiography student's clinical education by having didactic and positioning references available in one device.

    E. Strongly agree

    F. Agree

    G. Disagree

    H. Strongly disagree

29. I believe mobile electronic devices used by clinical faculty and staff can improve accuracy of student clinical performance.

    E. Strongly agree

    F. Agree

    G. Disagree

    H. Strongly disagree

30. I believe mobile electronic devices used by clinical faculty and staff can improve timeliness of student clinical performance.

    E. Strongly agree

    F. Agree

    G. Disagree

    H. Strongly disagree

31. I believe mobile electronic devices are a distraction for clinical faculty.

    E. Strongly agree

    F. Agree

    G. Disagree

    H. Strongly disagree

32. I believe mobile electronic devices are a distraction for students.

    E. Strongly agree

    F. Agree

    G. Disagree

    H. Strongly disagree

The following questions are optional and will be used as demographic data.

33. What is your work position?

    A. Full time Program Director

    B. Full time Clinical Coordinator

    C. Other, please describe:

34. How long have you worked as a radiography educator?

    A. 1-5 years

    B. 6-10 years

    C. 11-15 years

    D. 16-20 years

    E. 21-25 years

    F. 26 or more years

35. How many years have you worked in the radiography profession?

    A. 1-5 years

    B. 6-10 years

    C. 11-15 years

    D. 16-20 years

    E. 21-25 years

    F. 26 or more years

36. If you have additional comments, please provide them here.

If you would like to see the results of this study, please provide your contact information and preferred method of communication (hard copy or email).

Thank you for your time in completing this survey.

Robin Garner, RT (R) (M), BAOM
Masters Candidate
East Tennessee State University

Appendix F

Reminder Cover Letter

My name is Robin Garner and I am a graduate student in the Allied Health Sciences program at East Tennessee State University, a doctoral research university located in Johnson City, Tennessee. As part of my degree requirements for the Master of Science in Allied Health degree, I am conducting research to determine methods of data collection used by radiography programs and whether mobile electronic devices have a place in student evaluation.

This is a reminder email that it is not too late to participate in this research. Your decision to participate is voluntary and there is no foreseeable risk of participation in this study. All responses in this study will be kept confidential. Information collected in this study may benefit educational programs in the radiologic sciences. This study is not designed to determine a superior method of data collection and student evaluation, but rather to gain information that may be useful for radiography program directors and clinical coordinators.

In this study, you will be asked to complete an electronic survey. Please click on the link below to begin the survey. You must be at least 18 years of age to participate in this study and your completion and submission of this survey is your consent to participate in this research. All participants in this study will be entered into a drawing to win a fifty dollar Wal-Mart gift card.

If you have any questions concerning the research or survey, please contact Robin Garner (garnerr@goldmail.etsu.edu) or Dr. Ester L. Verhovsek (verhovse@etsu.edu). If you have any questions concerning your rights as a participant, please contact the IRB at East Tennessee State University at 423-439-6053.

I appreciate your time in participating in this survey.

Please complete the survey by June 30, 2015.

Robin Garner, RT (R) (M), BAOM
Masters Candidate
East Tennessee State University

VITA

ROBIN S GARNER

Personal Data:	Date of Birth: December 13, 1970
	Place of Birth: Pinehurst, North Carolina
Education:	East Tennessee State University, Johnson City, TN
	Master of Science in Allied Health 2015
	Ashford University, Clinton, IA
	Bachelor of Arts in Organizational Management, 2008
	Sandhills Community College, Pinehurst, NC
	Associate in Applied Science in Radiography, 1992
Professional Experience:	Clinical Coordinator, Radiography Program
	Sandhills Community College, Pinehurst, NC
	2008-present
	Clinical Instructor, Radiography Program
	Sandhills Community College, Pinehurst, NC
	2006-2008
	Staff Technologist & Mammography
	First Health Moore Regional Hospital, Pinehurst, NC
	2004-2010
	Staff Technologist & Mammography
	Pinehurst Radiology Associates, Pinehurst, NC
	1999-2004
	Staff Technologist
	First Health Moore Regional Hospital, Pinehurst, NC
	1992-1999

Professional Affiliations:	American Society of Radiologic Technologists (ASRT) Education, Radiography, & Mammography Chapters 2005-present North Carolina Society of Radiologic Technologist (NCSRT) 1992-present
Honors Awards:	Ashford University Presidential List, 2007 Sandhills Community College, Clinical Excellence Award, 1992