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Attitudes and Utilization of Tissue Plasminogen Activator Involving Telemedicine

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ABSTRACT

Tissue plasminogen activator (tPA) is used to treat acute ischemic stroke and is widely accepted as standard practice in the medical community. Literature shows that providers are hesitant to use this therapy due to the associated risks. Supporting literature shows that tPA is highly effective if administered within a three hour window, when adhering to strict protocols and guidelines for patient qualification. Telestroke programs have been shown to improve the time from stroke onset to administration of tPA by allowing a neurologist to be present during the decision making process. The aim of the study was to examine attitudes of physician assistants in both rural and urban Minnesota in regard to telemedicine use, specifically telestroke, and whether there is a difference regarding utilization, administration of tPA, as well as attitudes toward it. An electronic survey was sent to member physician assistants of the Minnesota Academy of Physician Assistants (MAPA). Review of survey results revealed that rural physician assistants believe that telemedicine in general would be helpful in their practice; whereas, urban physician assistants disagree in their attitude regarding the helpfulness of telemedicine in providing care for patients. Additionally, positive aspects and barriers to telemedicine use were examined and determined to be consistent with prior research.

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CHAPTER 1: INTRODUCTION

Background

Technology is the way of the future and is currently being implemented in various aspects of medical care. Trends toward innovation have placed healthcare to be in a position of prime opportunity for exploitation in the midst of new and existing technologies. Telemedicine has evolved out of a need to provide healthcare to populations with a variety of unique needs, whom otherwise would be unable to receive adequate healthcare. Several modes including electronic health records (EHR), email and text messaging, and telehealth have become opportunities to streamline, communicate with patients, collaborate and gain access to specialty medical consultations for patients and healthcare professionals. Delivery of telehealth services has been successfully executed across the country utilizing a variety of platforms.

As advances in technology have changed, so too have patient demographics. According to the Department of Health and Human Services (2013), by the year 2030 there will be 72.1 million older Americans age 65 or older, which is greater than twice the amount as in 2000. The implementation of the Affordable Healthcare Act is expected to substantially increase demand for healthcare. Nationally, there is an estimated additional 30.4 million that will be insured, with an increase of 298,000 individuals in Minnesota, alone (Gruber, 2013; Society of Actuaries, 2013). As resources stand, sufficient numbers of clinicians are at a current and projected shortage, leading to ineffective means to provide adequate care (AAMC, 2012). Against this backdrop, ensuring sufficient providers to rural healthcare shortage areas becomes an impending concern.

To cause further difficulty, analysis of rural populations present more challenges. Rural populations are generally less health literate and have increased healthcare needs due to low socioeconomic and educational levels (Halverson, et al., 2013). Additionally, transportation barriers including distance and weather related conditions contribute to inaccessibility to timely and appropriate care (Family Caregiver Alliance, 2006). Another problem facing rural communities is a misdistribution of primary and specialty care providers; only 10% of physicians practice in rural areas even though 20% of the population lives there (Bodenheimer & Pham, 2010). It is estimated that there are approximately 95,583 certified PAs practicing nationwide, with than 1,896 PAs practicing in Minnesota. According to AAPA 6.5% of practicing PAs in MN are working in Emergency Medicine (AAPA, 2013; NCCPA, 2014). Clinicians practicing in rural locations may lack specialized education and training needed to thoroughly treat patients with specialty needs (Haozous et al., 2012). Telemedicine has the potential to alleviate some of these adversities, but in rural communities the adoption of new technology is dependent on provider and patient attitudes regarding ease of utility, associated costs and real time benefits (Cameron, Bashshur, Halbritter, Johnson, & Cameron, 1998).

Telemedicine is currently used in a variety of settings such as in radiology in which imaging can be stored and accessed from remote locations, remote physiological monitoring of cardiac patients; and also in primary care with such successfully implemented web based platforms as Virtuwell and Zipnosis that are staffed by physician assistants and nurse practitioners to remotely diagnosis and treat patients (Mettner, 2011). Virtual healthcare is an option in extending quality and specialized health care to rural communities (Singh, Mathiassen, Stachura, & Astapova, 2010). Meyers, Gibbs, Thacker

and Lafile (2012) discuss a shining example of an expansive telehealth network that has successfully provided improved access to care in rural underserved communities throughout the state of Nebraska. Another prime example is Essentia Health; a Minnesota based healthcare organization that currently utilizes telemedicine to provide care to underserved populations in rural Minnesota in specific fields including stroke, dermatology, mental health, cardiology, and emergency medicine (J. Lyon, personal communication, November 20, 2013). Telemedicine is increasingly being utilized throughout the nation as it has shown to be an exceptional method for effectively providing patient health services to numerous patient populations.

One such population that telemedicine is being use to provide care for are stroke patients. Worldwide, stroke is the second leading cause of death, with ischemic stroke the most common type (Xu et al., 2013). Greater than two-thirds of patients admitted to the hospital for strokes between the years of 1999 to 2009 were over the age of 65, with the average age being 70 to 71 years old (Hall, Levant, & DeFrances, 2012). There are protocols and algorithms to follow during the presentation of an acute ischemic stroke patient including the use of thrombolytic therapy. However, the use of thrombolytics may be restricted to institutions that have specialized knowledge of its utilization in stroke patients (Lazaridis, Desantis, Jauch, & Adams, 2013). Therefore, it can be challenging for mid-level providers in rural hospitals to effectively treat stroke patients where specialists are scarce, thus transportation to tertiary hospitals is needed for definitive care (J. Lyon, personal communication, November 20, 2013). Telestroke is being implemented across the United States and has proved be an invaluable tool in improving accessibility to

specialists and providing services to stroke patients that would otherwise be unavailable in remote areas (Parra, et al., 2012; Esterle & Mathieu-Fritz, 2013).

Problem Statement

Sufficient healthcare is a concern for the impending increase in the aging population, especially for those who experience a stroke in a rural setting. Beginning in 1989 to the present, patients admitted to the hospital with a diagnosis of stroke have been steadily increasing (Hall, Levant, & DeFrances, 2012). There are not enough neurologists specializing in stroke care in rural hospitals to combat the growing number of stroke cases (Esterle & Mathieu-Fritz, 2013). With increasing numbers of physician assistants locating to rural areas, a need for available consults when time is of the essence is essential. Telemedical innovation may be a cost-effective and efficacious means of caring for these patients.

Purpose

The purpose of the study was to determine the extent in which telemedicine is being utilized for the treatment of acute stroke presentations in obtaining timely specialist consults and how treatment differs between rural and urban providers. Change and adoption of new methods of healthcare delivery is needed due to decreased availability of neurologists specializing in stroke in rural hospitals (Esterle & Mathieu-Fritz, 2013). Telemedicine can provide consultations with specialists from a distance and allow access to care that would otherwise be unavailable to patients who live in rural areas (Esterle & Mathieu-Fritz, 2013). This will become even more of a necessity as the baby boomer population ages with ever demanding needs for specialty care, as well as the desire to remain in one's hometown (J. Lyon, personal communication, November 20, 2013).

Within the past few years, telestroke programs have been implemented around Minnesota to help stroke victims. The newness of the programs has left gaps in areas of research regarding the effectiveness of patient treatment and outcomes. This study aims to help fill this gap as the knowledge gained from the research will become increasingly important with the reliance on midlevel practitioners to care for the severely ill in rural hospitals.

Significance of the Study

Telemedicine allows for specialists to be involved in critical decision making when time is of the essence, specifically with acute stroke presentations. This mode of extending care lends itself toward a collaborative team approach by involving the provider, nurse and family within the consultation process and allows care to be provided in a rural setting that otherwise would have not been possible (Esterle & Mathieu-Fritz, 2013). It is important to determine how telemedicine contributes to the utilization and attitudes toward tissue plasminogen activator (tPA), as it is the first line treatment for an ischemic stroke. Additional information regarding its value may encourage telemedical expansion to other rural hospitals, increase reimbursement by insurance and federal agencies, and extend primary care along with specialist services to rural shortage areas.

The physician assistant plays an important role in reaching rural communities because of the generalized training, as well as the ability to practice in remote areas where physicians are in limited supply. Before the advent of telemedicine, it could take several hours for a physician capable of authorizing the use of thrombolytics to become available, thus compromising the wellbeing of the patient (Hall, Levant, & DeFrances, 2012). Through the use of this technology, the physician assistant practicing in remote hospitals can now gain access to the neurologist and expedite care to stroke patients.

Currently, research is lacking in regard to physician assistants utilizing a telestroke system. Aside from extending care to the rural population, a physician assistant's ability to practice is rooted in effective communication with a supervising physician. This very aspect lends toward the ability of physician assistants to work effectively in a team approach with specialty medical doctors in providing quality patient centered care (Ballweg, Sullivan, Brown & Vetrosky, 2013).

Research Questions

After reviewing current research some questions have been left unanswered about telemedicine and telestroke specifically. This study attempted to answer the following research questions:

1. How do attitudes toward the utilization of telemedicine differ between rural and urban practicing physician assistants?
2. When an onsite neurology consultation is not available within the three hour window, to what extent is telemedicine being utilized by physician assistants in rural hospitals for stroke presentations?
3. How has telestroke neurology consultation in rural Minnesota impacted the confidence level of rural physician assistants toward the use of thrombolytic therapy as compared to urban physician assistants?

Definitions

The following definitions for important terms are provided below and should be considered throughout this article and for the purpose of this study.

Critical Access Hospital: A rurally located hospital certified to receive reimbursement to improve financial stability (Rural Assistance Center, 2014).

Large Rural/Urban Cluster: Considered an open settlement of 10,001 to 49,999 people (CDC National Center for Health Statistics, 2014).

Small Rural Area: Considered an open settlement of less than or equal to 10,000 people (CDC National Center for Health Statistics, 2014).

Specialty Medicine Consultations: Includes but is not limited to medical doctors in the areas of cardiology, oncology, endocrinology, neurology, and many more.

Stroke: When blood flow to brain tissue is limited or obstructed (Hall, Levant, & DeFrances, 2012).

Telemedicine: The use of electronic information and communication technologies to provide and support healthcare (Ballweg, Sullivan, Brown & Vetrosky, 2013).

Telestroke: A subset of telemedicine that is designed specifically to care for patients suffering from an acute stroke (Genentech, 2014).

Underserved Population: Defined as persons residing in a rural area.

Urban Area: Considered a settlement of greater than or equal to 50,000 people (CDC National Center for Health Statistics, 2014).

CHAPTER 2: LITERATURE REVIEW

Introduction

If a large-vessel stroke is left untreated for even a minute, up to 1.9 million neurons may be lost and 14 billion synapses destroyed (Fassbender, Balucani, Walter, Levine, Haass, & Grotta, 2013). Advancements in research and technology have allowed medicine to intervene in this disease process, enabling for more efficient care and improvement of patient outcomes. Assessment and diagnosis of acute stroke must be conducted early on, and the decision-making process must be conducted without delay to enable prudent and prompt intervention. Telestroke empowers health care providers, who lack confidence and sufficient clinical experience, to competently treat acute stroke patients through neurologist consultation, therefore expediting treatment. This chapter will synthesize and critically review the literature regarding current practice in utilizing telemedicine for stroke assessment and determination of tPA use in the rural emergency department. Articles included in this review were based on the relevance and scope of contribution to the current understanding of telestroke, its effectiveness, and impending concerns of use. Through further analysis, this chapter will discuss the types of clinicians that are seeing patients in rural hospitals and how this affects patient care.

Background

Beginning in the 1990's, there was an explosion of technological advances including the internet and mobile devices, which has lead to the inevitable creation of telemedicine. In 2012, an estimated 245.3 million internet users existed in the United States (IWS, 2012). Technology has progressed at such a fast rate that it often leaves individuals unable to keep up with advances. In many ways medicine and

telecommunications have paralleled in innovation and in discovering new methods of healthcare delivery. Connecting the general population to technological resources available to improve healthcare is not always an easy or straightforward task. Many challenges can be found in implementation of telemedicine, which include stakeholders, competing interests, and barriers to utilization. Even though the use of telemedicine is rising, its growth is limited due to accessibility to broadband connection, costs involved in set up and necessary support (WHO, 2010). These issues may deter smaller facilities and patients from accepting telemedicine (WHO, 2010).

Although healthcare reform is a topic in the news daily, the constant advances in telehealth are not as well covered; though plenty of change and innovation has occurred. These changes are very important, as they will influence how healthcare is delivered in the future. Initially, telemedicine has consisted of a store-and-forward method, in which information such as radiological images are transmitted to another provider for viewing at a later date. Real time virtual telecommunication is now at the forefront, allowing both parties to communicate using video technology from remote locations (Kelly, Schwaam, & Bianchi, 2012). This form of healthcare delivery has been used for some time with many piloted projects funded by the government to evaluate its effectiveness and cost-savings (Davidson, & Santorelli, 2009).

Telemedicine is a strategic and cost effective way to deliver healthcare, bringing expertise to small communities with limited resources and is progressively becoming a more accepted model of healthcare (ATA, 2013). The Centers for Medicare and Medicaid Services recently approved expansion of geographic coverage for telemedicine in rural health shortage areas, allowing for increased provider coverage, expanded reimbursement

for virtual communication and added coverage for chronic conditions (ATA, 2013). These actions indicate movement toward further acceptance of telemedicine and illustrate the changing landscape of healthcare delivery.

Extensive time and money has been invested in research on how to best manage acute instances of stroke in order to improve patient outcomes. Levine and Gorman (1999) made a call for increased use of technology to expand care to ischemic stroke patients, devising the term "telestroke" to illustrate the connection between technology and the care of acute stroke patients. The two neurologists were able to see the value in using evolving technology to support and expand care in the assessment and evaluation of acute stroke treatment. Telestroke has the ability to connect rural hospitals to larger facilities with stroke units in place to provide responsive and effective care for these patients (Levine & Gorman, 1999). As a result, telemedicine has been growing rapidly with acute stroke care and has increased nine-fold in some rural areas (Fisher, 2013).

Though little difference exists in the management of an acute stroke patient presenting to any hospital, a difference can be found in how a patient's case is handled in an urban versus a rural facility (Johansson & Wild, 2010). These differences are related to the level of provider expertise present at the facility, as they must be qualified to assess and treat acute stroke patients. Therefore, it is important to know what types of providers are seeing patients in the hospital and how this could affect care. With more physician assistants locating to rural areas, there is a need for available consults when time is of the essence. Since a general shortage of specialty physicians practicing in rural hospitals exists, services to treat patients presenting with an acute stroke must be available to eliminate lost time or unnecessary transfer to a larger tertiary hospital. Providing access

to specialty physicians can be accomplished with a system such as telestroke, which can connect the consulting specialist to both the provider and the patient via video conferencing. That being said, telestroke has been developed as a subsection of telemedicine, which is specifically designed for acquiring neurology consultation when a specialist physician is not available locally in a timely manner (Johansson & Wild, 2010).

General Stroke Management

In 1976 the Federal Drug Association (FDA) approved tissue plasminogen activator (tPA) as a thrombolytic agent for the treatment of ischemic stroke (Adams et al., 2007). This decision was based on the National Institute of Neurological Disorders and Stroke (NINDS) study. The study compared ischemic stroke patients treated with tPA to those treated with a placebo. Those treated with tPA had improvements in neurological function based on the National Institute of Health stroke scale (NIHSS), with a complete recovery three months after stroke. The study also pointed to increased outcomes for individuals who were treated early with tPA, specifically within the first 90 to 180 minutes (Adams et al., 2007). Intracranial hemorrhage is a possible complication of tPA therapy; therefore, prudent selection of qualified patients is important in avoiding potentially fatal outcomes. Further research is necessary to delineate factors leading to hemorrhagic transformation. It is important to note that all thrombolytic, anticoagulant or antiplatelet therapies have this risk; therefore, close monitoring for hemodynamic change is pivotal to successful treatment (Adams et al., 2007).

In the management of stroke, the time of symptom onset is the most critical information. Family members or bystanders can provide additional clues that are helpful in diagnosing and ferreting out other potential causes. Health conditions, such as

arteriosclerosis and traumatic brain injury, would preclude the patient from thrombolytic treatment (Adams et al., 2007). Telestroke is instrumental for interaction with family members in decision-making, since it allows specialists to gather this information and enables opportunity to provide consent for treatment.

In the hospital setting strict guidelines and protocols are followed when caring for the acute stroke patient. Adams et al. (2007) outlined the initial treatment for stroke work up to include a general assessment of the airway, breathing, and circulation (ABC), oxygen saturation, body temperature and examination of head and neck for signs of trauma, seizure, or carotid artery blockage. Examination of skin and extremities may give clues to alternate conditions such as coagulopathy. Due to the critical nature and time constraints, protocols regarding particular tests are followed and a thorough, but brief, neurological exam is performed and evaluated by a scoring system such as NIHSS (Adams et al., 2007). The scale quantifies the degree of symptoms, enabling decision-making and allowing for standardized communication between healthcare providers. Additionally, brain imaging, including CT or MRI, is often employed to determine the location, size, and the extent of cerebral infarct, as well as any active bleeding (Adams et al., 2007). Although various healthcare providers are able to utilize stroke scales, it is suggested that providers be skilled in reading CT brain scans to make definitive judgments (Adams et al., 2007). Once the patient is found to have a confirmed ischemic stroke, treatment with intravenous alteplase (tPA) is considered. This treatment is only available if the patient arrives within the appropriate treatment window, which may be three or four and one half hours depending on facility treatment protocol (Fassbender et al., 2013; del Zoppo, Saver, Jauch, & Adams Jr., 2009).

Many acute ischemic stroke patients are unable to receive tPA as they arrive outside of the treatment window. Fassbender et al. (2013) discuss a study that sought to identify where the delay between onset of symptoms and treatment occurs. The authors found that most of the delay occurred between time of onset of stroke symptoms and presentation to the hospital. They identified several ways to decrease the delay, thus effectively increasing the window of opportunity for the use of tPA (Fassbender et al., 2013). In this study, the use of patient and emergency medical service (EMS) education was found to be the most effective way to increase stroke outcomes. EMS personnel can assist with decreasing the delay through proper stroke education, which improves ability of the dispatcher and EMS to identify stroke symptoms sooner, resulting in expedited care (Fassbender et al., 2013).

Preferentially transporting acute stroke patients to hospitals which specialize in stroke care and alerting the accepting physician about the case prior to arrival can result in accelerated care (Fassbender et al., 2013). The authors found that most prescreening for tPA usage can be completed en route to the hospital when portable CT scanners and point-of-care lab tests are made available to EMS. Also, telemedicine can be utilized by EMS personnel while en route with a stroke patient, by contacting the receiving hospital and stroke centers. The extent of telemedicine's role in earlier administration of tPA has yet to be fully examined (Fassbender et al., 2013).

Benefits Seen in Rural Hospitals Utilizing a Telestroke System

Although the use of thrombolytics has proven to be an effective treatment leading to improved outcomes in stroke patients, most individuals who suffer from a stroke in a remote area have limited access to thrombolytics due to the scarcity of neurologists

practicing within these rural hospitals (Nagao, Koschel, Haines, & Bolitho, 2011). It has been found that acute stroke patients receiving care from a neurologist as opposed to a general medicine provider have a better chance of survival, better outcomes, and better recovery (Johansson & Wild, 2010). In order for eligible stroke patients to receive thrombolytic treatment, they must be transferred to an urban hospital to gain access to a neurologist who can administer this treatment. Unfortunately for some patients, the additional transportation time puts stroke patients outside the time window necessary to administer tPA. In order to reduce unnecessary transport and enable acute stroke patients to receive effective treatment in a timely manner, many rural facilities have adapted the use of telestroke (Nagao et al., 2011).

With the utilization of telestroke, neurologists can be accessed, patient health information can be exchanged, and patients can be treated with thrombolytics in remote areas. Telestroke enables the neurologist to review patient data, perform audiovisual physical examination, review imaging, and provide the best recommendations for the patient in regards to thrombolytic administration (Nagao et al., 2011). Telestroke is not only used to administer thrombolytics, but also for stroke rehabilitation and further stroke prevention (Chopard, Hubert, Moulin, & Medeiros de Bustos, 2012). Nagao et al. (2011) discuss a project that sought to develop a viable telestroke system in a remote hospital in Victoria, Australia. The goal of the project was to enable safe administration of tPA to patients presenting with acute ischemic stroke. This system involved videoconferencing between the top stroke care unit at Royal Melbourne Hospital and the Northeast Health Wangaratta (Nagao et al., 2011). In order for ischemic stroke patients to be eligible to participate in the study, risk factors and intracranial hemorrhage had to be absent and

presentation to the hospital needed to be within 4.5 hours of symptomatic onset. Based on the neurologist's expertise, tPA treatment was or was not recommended (Nagao et al., 2011). Data was collected by auditing medical files of 145 acute stroke patients during the control year from October 2008 to September 2009, with further retrospective analysis performed on medical files of 130 additional acute stroke patients from October 2009 to September 2010 of the intervention year. Although, data analysis revealed that only 36 patients in the control year compared to 54 patients in the intervention year qualified for thrombolysis, none of the patients during the control year received tPA treatment. Of the 54 patients in the intervention year, 24 were involved in the telestroke system with 8 receiving thrombolytic therapy (Nagao et al., 2011). The results of this study showed that there was no association between tPA administration and death in the patients who were involved in this telestroke system. Based on these findings, Nagao et al. (2011) was able to conclude that a telestroke system was a viable option for safely extending thrombolytic treatment to acute ischemic stroke patients who presented in rural Victoria. This study confirms the life saving measure a telestroke system provides to increase access to neurologists in a timely fashion. Furthermore, the authors express that research should focus on the barriers of implementing telestroke including reimbursement and funding, and questions regarding neurologist liability. They also purport that standardized training for physicians using this technology should be considered (Nagao et al., 2011).

In the United States there have been other types of telestroke systems launched. A group of researchers from the department of neurology and emergency medicine at the Medical College of Georgia (MCG) report on the first 50 patients treated using a Remote

Evaluation of Acute IsChemic Stroke (REACH) system (Switzer et al., 2007). REACH is a telestroke network composed of nine rural hospitals in East Central Georgia which are associated in a "hub and spoke" model with MCG as the main "hub" hospital. The aim of the REACH system is to extend care to predominantly underserved minority populated counties (Switzer et al., 2007). The system assists rural emergency physicians in decision-making regarding tPA use in patients presenting with symptoms of ischemic stroke. Five neurologists and a specialty-trained physician divide responsibility for around the clock scheduling (Switzer et al., 2007).

When a provider from one of the rural hospitals identifies a patient with a potential ischemic stroke who might benefit from tPA therapy, a call is placed to the main "hub" hospital emergency communications center (Switzer et al., 2007). At that point, an operator pages one of six on-call REACH specialists (Switzer et al., 2007). The on-call provider is then connected by telephone with the emergency physician, while at the same time accessing the online REACH system from his or her home. The specialist is able to visually communicate through an internet connection with the "spoke" health center referring physician, patient, and family members via a cart located in the patient's room with a mounted camera. The REACH specialist remotely proceeds to take a history and directly evaluates the patient while accessing vital sign data and CT imaging available on the REACH computerized system (Switzer et al., 2007). At this point, the REACH specialist is able to determine whether the patient qualifies for tPA therapy based on recognized guidelines and then recommends whether or not treatment should be initiated. Once this decision has been agreed upon, tPA treatment is provided by the referring

provider and the patient is subsequently transferred to the main "hub" hospital for further evaluation and treatment (Switzer et al., 2007).

Switzer et al. (2013) compared the onset to treatment time (OTT) of patients that were assessed using the REACH system with patients who were initially treated at the "hub" MCG hospital emergency department. Patient data was gathered from 2003 to 2006 with at least one patient treated from each of the nine "spoke" hospitals (Switzer et al., 2007). The onset to treatment time was 127.6 minutes for the REACH patients of which half were treated within two hours and the other half within 90 minutes (Switzer et al., 2007). During the same time period, 26 patients were treated at the "hub" MCG hospital with an average of 146 minutes, of which 35% were treated within two hours and 19% within 90 minute of onset (Switzer et al., 2007). Although the results did not show statistically significant differences between the REACH patients and the "hub" MCG hospital, the researchers were able to show that the REACH system was effective with decreased time to treatment in comparison with the "hub" MCG hospital. This study exemplifies that tPA can be administered quickly and effectively in rural hospitals that utilize a telestroke system. The system eliminates delays by allowing the stroke specialist to consult from a remote location. Additionally, the ability to see the patient in real time provides confidence for the stroke specialist in making the diagnosis and also validates that the appropriate therapy is executed (Switzer et al., 2007).

Many benefits have been reported by numerous studies in regard to the utilization of telemedicine. The primary benefit of telestroke, discussed above, is that acute stroke patients can gain access to neurologists and effective treatment, which would otherwise be unavailable. Telestroke interventions increase the use of tPA and have demonstrated

an increase in the quality and process of treating these patients. Cost reduction has been reported due to the fact that transportation to urban hospitals is reduced (Johansson & Wild, 2010). Furthermore, the utilization of telestroke leads to improved stroke education for rural providers and patients and a more effective execution of rehabilitation services (Johansson & Wild, 2010).

In order to evaluate these proposed benefits of telestroke on a large scale, Johansson and Wild (2010) performed a systematic review of 18 studies to assess viability, efficacy, acceptability, quality and dependability of treatment delivery in acute stroke. The authors selected these studies based on incorporation of the following measures: stroke patients, assessment of services provided in telestroke, inclusion of health data outcomes, care procedures, resource consumption, and patient and provider acceptance/satisfaction. After thorough analysis of these studies, Johansson and Wild (2010) found that telestroke is a viable and accepted option in connecting neurologists in distant stroke units to rural community hospitals by telephone or visual consult. Specifically, telestroke led to improved health results as there was a reduction in dependency and death at the three-month follow up (Johansson & Wild, 2010). In regard to patient/provider satisfaction and acceptance, they were able to conclude that telestroke is associated with high levels of satisfaction and acceptance (Johansson & Wild, 2010). The researchers found that telestroke sped up the administration of tPA and prevented unnecessary transfers to stroke centers. Although the implementation of telemedicine warrants a significant initial cost investment, increased use of tPA was shown to be cost effective and in the end to actually decrease overall costs (Johansson & Wild, 2010).

Many factors contribute to a successful telestroke system. Johansson and Wild (2010) discuss the factor of highest importance is collaboration between rural hospitals and the stroke centers. Another important aspect is the utilization of standardized stroke protocols and guidelines that easily distinguish the urgency of care needed (Johansson & Wild, 2010). Ongoing training for health professionals in regard to stroke and utilization of telestroke, along with 24-hour access to telestroke services have all shown to contribute to a quality telestroke practice (Johansson & Wild, 2010). Of further importance is educating the community about stroke symptoms, presentation and treatment, which not only improves public awareness, but also leads to better patient outcomes by decreasing the time it takes for patients to present to local hospitals (Johansson & Wild, 2010).

Concerns Surrounding Telemedicine

In all avenues of healthcare, medical ethics must always be made a top priority. Technology has advanced at a rapid pace that brings complexities which many physicians are not able to keep pace with (Chopard et al., 2012). Bioethical concerns have been raised regarding biotechnologies such as telemedicine. It is important that concerns of the patient are acknowledged, to ensure that the patient is completely informed about the telemedical service so they can give full consent. Patients are advised to sign a consent form before engaging in the telemedical system. If the patient is incapable of signing a consent form for medical reasons, the utilization of telemedicine is simply determined by its therapeutic potential (Chopard et al., 2012).

Concerns with telemedicine have also been raised in regard to the effects on the patient-provider relationship (Chopard et al., 2012). For obvious reasons the relationship

is much different through a technological device when compared with face-to-face consultation. Another important aspect of the patient-provider relationship is the importance of patient confidentiality. The provider is fully responsible for ensuring this privacy, yet must rely on technology in which the provider does not have complete control of when utilizing telemedicine. One of the larger challenges in ensuring patient confidentiality through the use of telemedicine is limiting information to what is relevant for that particular consultation, as well as allowing the patient to have input on relative information (Chopard et al., 2012). These encounters tend to be complex situations as personal information may be relevant to the presenting case and may influence the treatment plan. Concerns present as to whether patients may be too involved in the interaction and what is shared, leading to a negative impact on patient outcomes; on the other hand, if patient input is limited, the patient and this information may be gradually dismissed from the process (Chopard et al., 2012).

Still other concerns have been raised about how telemedicine affects roles and responsibilities of providers, as well as deficiencies in the legal aspects surrounding its use. The general rule regarding provider responsibility is that each provider is responsible for his or her own actions; therefore, effective communication between the attending physician and the virtual doctor is essential. The attending physician must communicate all necessary patient information, enabling the virtual doctor to make a proper and sufficient recommendation. During the telemedical conference, all written documentation and verbal communication is governed by rules and is traceable, and is stored for later access as necessary (Chopard et al., 2012).

Although telestroke exposes fundamental problems with privacy, it can be used to combat other legal issues. Chopard et al. (2012) confer that complications such as intracranial hemorrhage after administration of intravenous tPA are more common with physicians who are inexperienced in its administration as compared to experienced physicians. The authors found that 40% of emergency physicians do not use tPA because of possible complications and for trepidation of litigation. Providers who refuse to use tPA can still be held accountable for not treating with tPA when deemed appropriate (Chopard, et al., 2012). Surprisingly, this fear is so strong that in review of lawsuits surrounding tPA awarding for the patient, 83% of providers failed to treat, while only 17% of the patients actually resulted in treatment complications (Chopard, et al., 2012). Telestroke can be used to decrease the risk of litigation and enable the attending physician to consult with a neurologist who can provide patient assessment, expertise and supervision, dispersing the medical liability between both parties. Although the benefits of telestroke are endless, telestroke is still not being used to its full potential (Chopard et al., 2012).

Physician Assistants in Rural Hospitals

On a national level, staffing rural emergency departments is difficult due lack of interest by board certified emergency physicians to practice in rural areas because of low patient flow (Casey, Wholey, & Masocovice, 2008). Before the study done by Casey, Wholey, and Moscovice (2008), the last national survey of rural hospitals was completed in 1990. Casey, Wholey, and Moscovice (2008) mailed out a survey, which contacted 440 national rural hospitals with 408 responding. The researchers gathered information on the types of clinicians that are running the emergency departments as well as patient

flow (Casey, Wholey, & Masocovice, 2008). Out of the hospitals which responded, one third used contracted physician coverage with only 14% of the emergency department staff covered solely by a physician assistant (PA) or nurse practitioner (NP) (Casey, Wholey, & Masocovice, 2008). The hospitals with the lowest patient volumes, less than 10,000 annual visits, were more likely to have a higher percentage of PA/NP coverage (Casey, Wholey, & Masocovice, 2008). Overall, about one third of the hospitals used PAs for at least some coverage during the week (Casey, Wholey, & Masocovice, 2008). Furthermore, the researchers also looked at the training provided to the emergency department staff and discovered that only 75% had been trained in Advanced Cardiac Life Support in greater than 95% of the hospitals; and, only 15% had completed a specific rural trauma team development course (Casey, Wholey, & Masocovice, 2008).

Low patient volume coupled with most providers working only part-time in an emergency department leads to little incentive for providers to participate in specialized training programs. In the state of Minnesota, as well as in several other states in the Upper Midwest, state specific training for emergency staff is required (Casey, Wholey, & Masocovice, 2008). This training includes residency programs for PAs and NPs, as well as staying updated in advanced cardiac life support training and trauma nursing core courses, which are provided through individual state certification protocols (Casey, Wholey, & Masocovice, 2008). Assistance is offered to offset costs associated with this training (Casey, Wholey, & Masocovice, 2008). The Medicare Rural Hospital Flex Program is an example of an assistance program for rural emergency department staff (Casey, Wholey, & Masocovice, 2008). With the assistance of such programs, the response rate for additional training was higher than those states that did not offer

assistance (Casey, Wholey, & Masocovice, 2008). Ultimately this leads to better care for patients with improved outcomes.

In a more recent study, completed in 2012, the staffing differences in Iowa's rural hospitals were examined. Emergency departments in rural hospitals are most frequently staffed by family practice physicians rather than board certified emergency physicians, especially in rural communities (Groth, House, Overton, & DeRoo, 2013). At the same time, both NPs and PAs have been increasingly utilized in rural emergency departments where physicians are in even fewer numbers. Often the PA is the only provider in the emergency department for a majority of the week, with access to an on call physician (Groth et al., 2013). The study analyzed Iowa's emergency departments by utilization of telephone surveys, revealing that 60.5% of emergency departments were staffed by a sole PA or NP for at least part of the week (Groth, House, Overton, & DeRoo, 2013). This rate has increased from their initial survey in 2008, in which there was only 38.7% coverage of emergency departments by PAs (Casey, Wholey, & Masocovice, 2008). The increase in PAs and NPs being hired is due to an overall decreased cost as well as a lean pool of emergency and family practice physicians available (Groth et al., 2013). This trend of PA and NP coverage is also seen in the rural hospitals across the state of Minnesota.

The reality is that with fewer physicians available to staff rurally located emergency departments, newer staffing models must be used. Garland and Gershengorn (2013) suggest the use of both physician assistants and nurse practitioners, as well as telemedicine technologies to allow struggling facilities the ability to cope with the decline of physician availability. In a review looking at PAs and NPs as physician extenders,

along with telemedicine use in intensive care units (ICUs), there has been an overall improvement in care provided (Garland & Gershengron, 2013). Despite the fact that this study focuses on ICU's, it is important to note that the use of physician extenders will assist with physician shortages in other medical settings, including rural emergency departments. The use of telemedicine, as described by Garland and Gershengorn (2013), showed an overall decrease in mortality rate and length of stay. Currently, there is little research completed about how PAs and NPs participate in telemedicine to care for complicated patients along with limited research on how their participation in a telemedical system affects patient outcomes (Garland & Gershangorn, 2013).

Conclusion

With the advances in technology as well as improvements in healthcare, the merging of the two has naturally created telemedicine. Since granting approval for the use of tPA as a thrombolytic agent, there have been many protocols and guidelines set in place for the safe administration of the drug (Adams et al., 2007). The administration of tissue plasminogen activator is time sensitive, and if a patient presents outside the 3 hour window it cannot be administered. In a rural community where a neurologist is not readily available, the critical factor for patients presenting with stroke symptoms is time, and an agreed upon parameter is that "time is brain", therefore telemedicine, specifically telestroke, is a critical life saving measure. With the use of telemedicine, tPA can be administered with the stroke specialist on board for immediate consult, providing confidence in the provider decision. The successful utilization of tPA through the use of telestroke has been a profound advancement. Although it brings to light new issues regarding privacy, liability, and decreased human interaction concerns; the research

shows that providers are held responsible for their actions, and telestroke has the potential to actually decrease the rate of lawsuits surrounding utilization of tPA in acute stroke situations.

In addition, the shortage of stroke specialists and overall decrease in board certified emergency physicians and those who are willing to practice rurally is also problematic. In their place are family practice physicians, physician assistants and nurse practitioners. This being the case, it is even more essential to provide a way to easily involve stroke specialists and create a team approach in the care of stroke patients. A need for further research is key in promoting the advancement and progression for future development of telestroke, as well as a need to assess the knowledge, comfort level and how midlevel providers are being involved with telemedicine and tPA use in acute stroke care.

CHAPTER 3: METHODOLOGY

Introduction

The purpose of this study was to examine the attitudes of physician assistants in Minnesota in regard to the use of telemedicine, specifically telestroke, and how utilization and attitudes differ between rural and urban providers. The study population was practicing physician assistants who were members of the Minnesota Academy of Physician Assistants (MAPA). The research questions addressed in this study were:

1. How do attitudes toward the utilization of telemedicine differ between rural and urban practicing physician assistants?
2. When an onsite neurology consultation is not available within the three hour window, to what extent is telemedicine being utilized by physician assistants in rural hospitals for stroke presentations?
3. How has telestroke neurology consultation in rural Minnesota impacted the confidence level of rural physician assistants toward the use of thrombolytic therapy as compared to urban physician assistants?

This chapter discusses the study population, materials used, validity and reliability, study design, as well as procedure, statistical methods, and limitations to the study.

Population

The Minnesota Academy of Physician Assistants is the official organization concerning regional and national affairs of physician assistants in Minnesota, and is a constituent chapter of the American Academy of Physician Assistants (MAPA, 2010). Current MAPA members were chosen as a convenience sample in an attempt to assess the multitude of physician assistants practicing in Minnesota as a method to gain the

largest sample size possible. MAPA is made up of both physician assistants and physician assistant students in Minnesota; therefore, important to note, only certified practicing physician assistants were contacted for this study. Consent was obtained from MAPA's administrator after MAPA executive board approval (See Appendix C). MAPA members who replied to the survey serve to represent physician assistant providers in Minnesota.

Materials Used

The survey was sent in electronic form by email from MAPA's administrator via hyperlink, which directed them to the Qualtrics survey software website. The hyperlink included a cover letter followed by the questionnaire. The survey contained 30 questions that included both originally developed questions about demographics, as well as adopted questions which were modified from existing surveys about the utilization and attitudes toward telemedicine and telestroke. The questionnaire had two sections: demographics and questions regarding telemedicine including telestroke.

The first question involved consent to take the survey and if the respondent answered "no," they were directed away from the survey. Questions 2 through 6 involved general demographic information including area of practice or specialty, and general questions about telemedicine. Based on the answer to question six in the initial part of the survey regarding telemedicine utilization, the respondent may or may not have continued with the remainder of the survey or jumped to the final four questions. The remainder of the survey contained a multiple-choice and fill-in-the-blank format.

Section two consisted of specific questions regarding telemedicine, as well as specific questions about the use of telestroke. The questions were adapted from the

Department of Neurology and Center for Health Services survey at the University of Colorado School of Medicine (University of Colorado, 2014; Center for Health Services, n.d.). This survey was specifically directed towards physicians providing care in rural emergency rooms. The questions were reviewed and several of the Likert scale questions were adapted to be answered by physician assistants. Additional demographic questions were modified from a survey in the Interactive Journal of Medical Research in a similar fashion (Parra et al., 2012). The questionnaire was also originally directed towards physicians and was then modified for physician assistants. The survey contained multiple-choice, fill-in-the-blank and Likert scale formats. Should the respondent answer "no" to having treated ischemic stroke, they were also directed to the last four questions of the survey to increase reliability. The cover letter and a list of the questions asked can be referenced in the questionnaire (see Appendix A and Appendix B, respectively).

Validity and Reliability

Content validity was ensured by asking questions relevant to the utilization and attitudes of telemedicine and telestroke. In some capacity several of the survey questions had been previously administered, however the original questionnaire was directed toward physicians rather than physician assistants specifically. This has added to the validity and reliability of the survey nonetheless. Additionally, the questionnaire was designed to redirect the surveyed physician assistant to pertinent portions of the survey with qualifying questions if they did not have experience in telemedicine or experience treating ischemic stroke; thereby assuring reliability and validity of the responses as well. Both committee chair members Wallace Boeve and Donald Hopper read through the survey watching for validity and reliability with the specific suggestion of using a Likert

scale. Our survey was also reviewed by Tracy Vacca, an emergency physician assistant working in south central Minnesota, for understandability and reliability.

Study Design

This was a qualitative pilot study whose primary analysis was to compare the responses to the questionnaire between two groups, specifically urban versus rural practicing physician assistants in regard to their attitudes and utilization of telemedicine and telestroke. A secondary analysis within groups of rural and urban physician assistants was planned to be done, comparing attitudes in relationship to the utilization telestroke. The independent variables were telemedicine and telestroke, and dependent variables were the responses to the questions asked in the questionnaire in regard to the utilization and attitudes toward telemedicine/telestroke. Survey responses, which were less than 95% complete, were excluded from the analysis.

Procedure

Upon receiving permission from the Minnesota Academy of Physician Assistants (MAPA) to conduct research using their member database, Bethel University IRB approval was obtained (see appendices C and D for approval letters). A total of 645 questionnaires were distributed to the designated sample of MAPA members via email by MAPA's administrator with a hyperlink to the online survey hosted on the Qualtrics survey software website. The survey was presented in a web-based questionnaire composed of 30 questions, containing Likert-scale, multiple-choice and fill-in-the-blank formats. Along with the questionnaire, the email included a cover letter with an introduction to the study and instructional information on completing the survey. The survey also contained the cover letter and statement of informed consent. The statement

advised the survey participant that informed consent was granted by the respondent's decision to continue on and complete the survey. An email contact to the research study faculty advisor was provided for questions or concerns regarding the study and/or confidentiality. Each MAPA member was supposed to receive a reminder e-mail 7 days before the survey closed with the intent to increase the response rate. The subject responses were accepted for up to three weeks in order to achieve the largest sample size possible.

To reduce the margin of error and for a statistically significant response rate, researchers predicted that at least 129 questionnaires needed to be completed. Since there are 645 practicing MAPA members, it was predicted that at least 20% would participate in the study, which is equivalent to 129 questionnaires. The responses to the questionnaire contained de-identified data, which are held in a secure database within the Qualtrics website. Data was compiled into a Microsoft Excel spread sheet and once statistical analysis was completed, it was stored on a jump drive and secured in a filing cabinet within the office of the Bethel University Physician Assistant program.

Statistical Methods

The primary analyses of the responses were compared between two groups, specifically rural versus urban physician assistants, in regard to the utilization and attitudes of telemedicine and telestroke. The means of the groups were compared between one another using ANOVA. Based upon the purpose of the study, the question for primary analysis was: how do the attitudes toward telemedicine differ between rural and urban practicing physician assistants. Correlation and regression statistical analysis was used to analyze utilization and attitudes of telemedicine and telestroke within these

individual groups. The questions for secondary analysis were: what barriers are encountered by rural physician assistants who are not using telemedicine; and, what do rural physician assistants find to be the positive aspects regarding the use of telemedicine. The data was compiled into graphs, tables, and charts in Microsoft Excel and transferred to MedCalc utilizing mean and correlational statistical analysis.

Limitations

The limitations of the study include the limited number of questions that were asked, the limited number of useful responses, the limited sample population, as well as the lack of personal contact with the survey population. Due to the possibility that some physician assistants do not utilize telemedicine or telestroke, it was expected that there might be a reduced number of usable responses from MAPA members. Additionally, the only point of contact was MAPA's administrator; therefore, the expected response rate may have been inadvertently lowered as opposed to direct contact with respondents. The web-based questionnaire contained a limited amount of questions in an effort to promote a higher response rate. Furthermore, the survey had not been reviewed by an expert panel for readability and credibility. The most important recognizable limitation was that our questionnaire was administered to only practicing physician assistant MAPA members, and did not encompass all practicing Minnesota physician assistants.

CHAPTER 4: RESULTS

Introduction

This section discusses the data results and research technique of data analysis used to present the characteristics of respondents, use of telemedicine, barriers encountered toward utilization, and the attitudes of physician assistants regarding telemedicine.

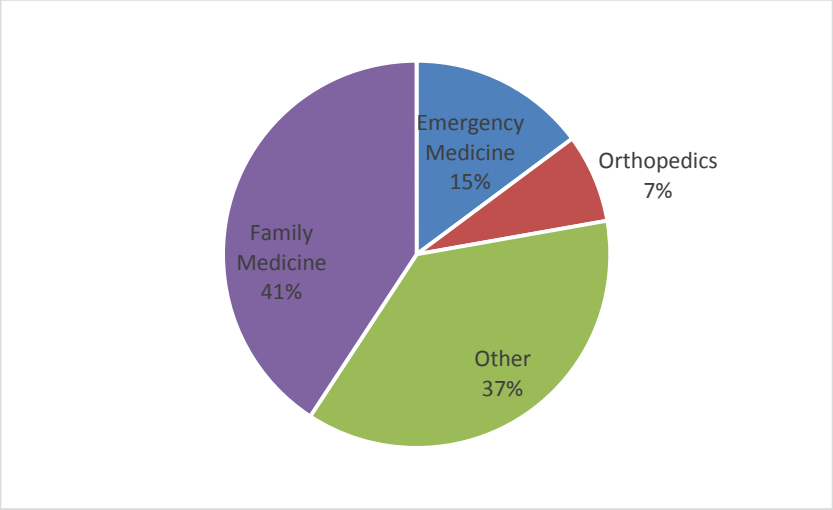
Characteristics of Respondents

A total of 645 surveys were sent out via an e-mail link to MAPA physician assistant contacts as described in chapter 3. The number of physician assistants who responded was 27, with 25 surveys that were complete, with an overall response rate of 4.19%, within the three week time period. The two incomplete surveys were greater than 95% complete; therefore, all survey responses were included in the data analysis. Of the twenty-seven respondents, thirteen worked in a clinic setting, eleven worked in a hospital, four reported working in a critical access hospital, three worked in a physician private practice, three worked in a walk-in clinic, one worked in urgent care, one worked in corporate and one worked at a university. Eleven of the respondents worked in family medicine, four in emergency medicine, two in orthopedics, and the remaining eleven worked in other specialties including diabetes, endocrinology, general surgery, cardiovascular surgery, nephrology, urgent care and education. Six of the respondents had practiced for more than twenty-one years, five had been practicing between sixteen to twenty years, five had practiced from eleven to fifteen years, one had been practicing from six to ten years and ten had practiced from zero to five years. Sixteen of the respondents were practicing in urbanized areas, eight reported practicing in a large rural

area and only three were practicing in a small rural area. Of the 27 questionnaires, only three respondents had utilized telemedicine in their current or past practice as a physician assistant.

After the data was analyzed, it was organized into pie charts, bar graphs, and whisker plots using both Microsoft Excel and Medcalc. Of the survey respondents, 41% practice in a rural setting and 59% reported practicing in an urban setting. The most common area of practice for both rural and urban physician assistants in Minnesota was family practice (see Figure 1). Out of the physician assistant responses, 41% worked in family medicine, 15% worked in an emergency department, 7% worked in orthopedics, and 37% reported "other" and filled in the specialty (see Appendix F).

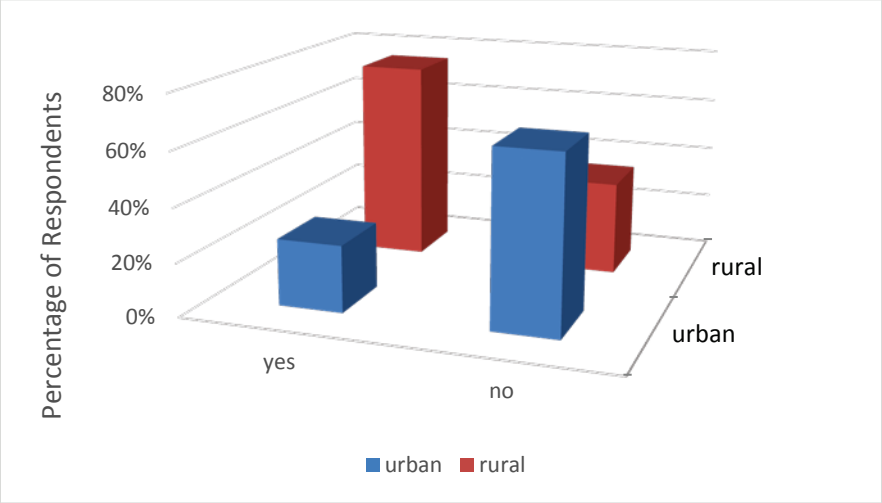
Figure 1. Survey Respondents by Practice Areas



Of the rural practicing providers, seventy-five percent believed that telemedicine would be of benefit to their practice (see Figure 2). However, a majority of urban

physician assistants did not agree that telemedicine would be helpful in their current practice.

Figure 2. Urban vs. Rural Attitude Regarding Helpfulness of Telemedicine



Use of Telemedicine Comparing Rural versus Urban Physician Assistants

The majority of survey respondents (85%) had never used telemedicine. Of those providers, MedCalc ANOVA was used to determine if telemedicine would be helpful in providing care to their patients. As shown below in Table 1 the F-ratio of 3.6 and a P-value of 0.073 are within a 90% (0.1 alpha) confidence interval. This means that there was a statistically significant difference between the means of providers working in a rural versus an urban setting in regard to their attitudes toward telemedicine at a 0.1 confidence interval (see Table 1). Essentially this reaffirms that an ANOVA, which is a test comparing means, is an accurate statistical analysis for this survey response. Likert-scale associated with survey question 18 was assigned a score from one to four for analysis, with one representing strongly agree to four meaning strongly disagree with the

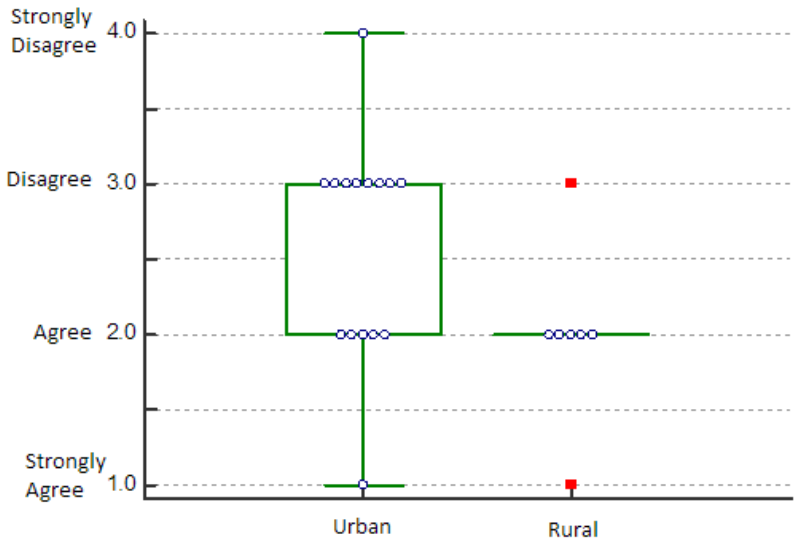
statement "would telemedicine be helpful with your job in providing care to patients." On average, the urban providers tend to disagree with the statement that telemedicine would be beneficial for their practice with a mean of 2.6 and standard deviation of 0.74. Whereas, rural physician assistants are in agreement that telemedicine would be beneficial to their practice with a mean of 2.0 and standard deviation of 0.58.

Table 1. MedCalc ANOVA Output of Urban vs. Rural Non-telemedicine Providers Response to "helpfulness of telemedicine in their practice."

F-ratio			3.6
Significance Level			P=0.073
Factor	n	Mean	SD
Urban (1)	15	2.6	0.74
Rural (2)	7	2	0.58

The box-and-whisker plot in Figure 3 shows the Likert distribution of provider attitudes toward the helpfulness of telemedicine. Of the rural providers surveyed, all agree that telemedicine would be helpful in their practice. However, more urban

Figure 3. Provider Attitudes toward the Helpfulness of Telemedicine

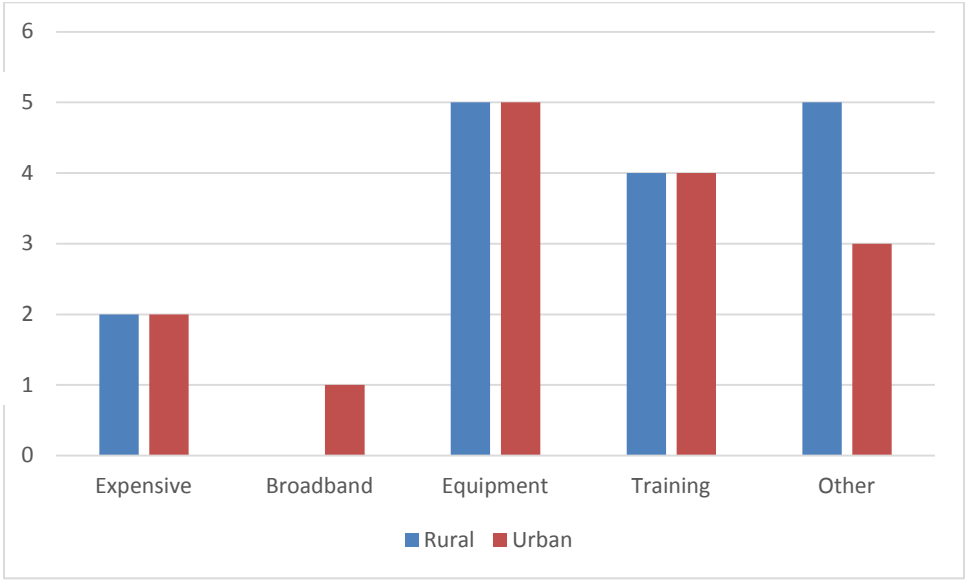


practicing physician assistants disagree with the helpfulness of telemedicine and in fact one strongly disagrees that telemedicine would be helpful. Therefore the distribution of the urban responses is more variable as compared to the rural responses.

Barriers Encountered Toward Telemedicine Use

Furthermore, providers responded by stating that some of the barriers to the use of telemedicine include cost factors, broadband access, equipment availability, training and other barriers obtained through an open-ended question (see Figure 4). Both rural and urban providers felt that lack of equipment was the most encountered barrier. Responses to the open-ended question included issues with licensing across states, dislike for the mode of delivery, not equivocal to face-to-face interaction, patient ability to participate using newer technology, corporate barriers, telemedicine simply not being offered, and feelings of telemedicine not being necessary due to the ability to access to specialists.

Figure 4. Barriers Encountered by PAs in Telemedicine Use



PA Attitudes toward the Utilization of Telemedicine

Of the three providers who use telemedicine and treat ischemic stroke patients, one stated that they were very comfortable, one was comfortable, and one was not comfortable in diagnosing ischemic stroke. Two of the three surveyed providers strongly agreed that they were comfortable administering tPA, while the third strongly disagreed with being comfortable administering this medication. One of the rural PAs were concerned with liability, while the remaining two felt liability was not a concern in regard to the utilization of tPA for treatment of ischemic stroke. All three rural PAs who responded yes to the use of telemedicine felt that in an ideal situation they would want tPA administered to themselves or a family member.

Summary

Analysis of the data revealed that a statistically significant difference exists between rural and urban providers. Telemedicine was viewed more positively by rural providers than those practicing in an urban setting. The following chapter includes a discussion of the findings, implications of research, limitations of research, as well as suggested future research.

CHAPTER 5: DISCUSSION/CONCLUSION

Introduction

The main aim of this research project was to examine how the utilization and attitudes of telemedicine differ between rural and urban practicing physician assistants. The purpose of the study was to determine the extent in which telemedicine is being utilized for the treatment of acute stroke presentations in obtaining timely specialist consults and how treatment differs between rural and urban providers. Additionally, the study focused on the extent to which telemedicine was being utilized by rural physician assistants when an onsite neurology consultation is not available, and whether a telestroke consultation improves the confidence level of physician assistants administering tPA. The following research questions were addressed in this study:

1. How do attitudes toward utilization of telemedicine differ between rural and urban practicing physician assistants?
2. When an onsite neurology consultation is not available within the three hour window, to what extent is telemedicine being utilized by physician assistants in rural hospitals for stroke presentations?
3. How has telestroke neurology consultation in rural Minnesota impacted the confidence level of rural physician assistants toward the use of thrombolytic therapy as compared to urban physician assistants?

In this chapter, a discussion of findings, implications of research, limitations of the research as well as suggested future research are discussed.

Discussion of Findings

This study was designed to determine utilization and attitudes towards telemedicine, specifically telestroke use in physician assistants. Twenty-seven surveys, of the 645 e-mail surveys sent out, were received and considered for analysis. Statistical analysis was performed using ANOVA examining differences between group means regarding attitudes between urban and rural physician assistants.

Research Question 1. The first research question, *how do attitudes toward the utilization of telemedicine differ between rural and urban practicing physician assistants?* Based on the ANOVA test with a p-value of 0.07 there was a significant difference between the attitudes of rural and urban providers. A greater percentage of rural physician assistants as compared to urban physician assistants agreed that telemedicine would be helpful in providing care for their patients. It is widely known that rural healthcare providers work in areas that are less populated and have fewer specialists available for a face-to-face consult. The fact that rural healthcare providers have fewer access to specialists was revealed by Bodenheimer and Pham (2010) who discussed that there is a misdistribution of primary and specialty care providers in rural communities, specifically that only 10% of physicians practice in rural areas even though 20% of the population lives there. The shortage of specialists in rural communities instills the idea that telemedicine could assist with this issue and was supported by the data results of this study.

Research Question 2. The second research question, *when an onsite neurology consultation is not available within the three hour window, to what extent is telemedicine being utilized by physician assistants in rural hospitals for stroke presentation?* This

question was difficult to answer based on the low response rate in this study. However, all the physician assistants surveyed who are involved with telestroke agree that telemedicine has medical relevance in the utilization of tPA in acute stroke presentation. However, an unexpected result was that of the three rural physician assistant respondents, two providers felt that the liability of administering tPA was not an issue. As presented in the literature review, Chopard et al. (2012) found that 40% of emergency physicians do not use tPA because of possible complications and for trepidation of litigation and thus a significant barrier toward the overall utilization of tPA. Therefore, the results of the study contradict what was found in the literature review. It is important to note that since there were only three respondents who fit the inclusion criteria of working in a rural setting and treating stroke patients while utilizing telestroke, it is difficult to obtain an accurate portrayal of Minnesota physician assistant attitudes as they are not fully represented.

Research Question 3. The third research question, *how has telestroke neurology consultation in rural Minnesota impacted the confidence level of rural physician assistants toward the use of thrombolytic therapy as compared to urban physician assistants?* This question was also difficult to answer due to the low response rate. When survey participants were asked about their comfort level in using tPA for treatment of ischemic stroke, a majority of those using telestroke stated that they were comfortable in administering tPA. As stated in the literature review, Switzer et al. (2007) discussed that the ability to see the patient in real time provides confidence for the stroke specialist in making the diagnosis and also validates that the appropriate therapy is executed. The results of this study builds upon the Switzer et al. (2007) findings, as it was found that utilizing telestroke also increases the confidence level of the physician assistant

administering the tPA. It is possible to speculate that those who are more comfortable using tPA have better access to a neurologist, whether it is via telemedicine or other onsite sources.

Open-Ended Questions. In order to gain further insight into the positive aspects of telemedicine which may have not been addressed in the survey; an open-ended question was included asking about positive aspects of telemedicine and telestroke. Responses from urban physician assistants include comments that a program like telestroke provide "greater patient access", that it "offers care to those that have transportation issues or those that travel far distances", that it "would be very great for underserved areas or when a PA needs to consult with [a] mentor who is not onsite or available," and lastly, that telestroke "reassures the PA before giving tPA by bringing the stroke neurologist to the bedside." These are both positive remarks about telemedicine and telestroke, in general, which align with the positive aspects of telemedicine and telestroke that was found in the literature review (Family Caregiver Alliance, 2006; Nagao et al., 2011; Switzer et al., 2007). Rural physician assistants also reported that access to specialty care, not just in the case of neurologist, but additional specialties such as cardiology is challenging in rural hospitals and expressed how telemedicine would be helpful in alleviating those needs.

In order to gain further insight into the barriers of telemedicine which may have not been addressed in the survey; an open-ended question was included asking about the barriers of telemedicine and telestroke. The responses from physician assistants include cost and "nothing is equal as face to face" interaction. Other comments include "I don't like it" and that "I work at a large enough institution that specialists are available without

telemedicine." The barriers suggested by the survey participants are also in alignment with the barriers to telemedicine that were found in the literature review (Cameron, Bashshur, Halbritter, Johnson, & Cameron, 1998; Nagao et al., 2011).

Implications of Research

Telemedicine, specifically telestroke, can be a valuable asset to rural practices in the care of acute ischemic stroke patients. As mentioned in the first chapter, a lack of studies exists regarding telemedicine use specifically in Minnesota; and in particular, the use of telestroke and how it impacts physician assistant practice. Having this research available will hopefully have an impact on how rural hospitals view telemedical systems. As previously noted, a difference in attitudes and utilization of telemedicine has been identified; specifically, those practicing in rural communities agree that the availability of this technology would be helpful in their practice. These findings will hopefully encourage rural practices to initiate future telemedicine and telestroke programs in their hospitals and clinics.

Limitations of the Research

As with any research project there are always limitations. Some of the limitations were anticipated prior to the distribution of the survey, but were out of the control of the researchers. One limitation was the low survey response rate. A response rate of 20% (129 surveys) had been predicted and would have been ideal for obtaining statistically significant data; however, the number actually received was significantly less. The researchers only received a 4.19% response rate and out of the 27 surveys received, only three rural respondents had utilized telemedicine in their current or past practice.

Reasons for the low response rate may involve a combination of factors. Possible factors may include a lack of personal contact with the survey population, or loss of control in regard to survey distribution as the only point of contact the researchers had with the survey population was electronically, through MAPA's administrator. The researchers had planned to have the reminder email sent to MAPA members one week prior to the survey close date; however, it is unclear if the email was sent out by the MAPA administrator at the one week time period before the survey close date. The short duration of time from the reminder email to the survey close date may have contributed to the low response rate, although there was no further response after the reminder email was sent out. Additionally, the survey was only available for three weeks and some physician assistants may not have checked their email dedicated to receiving MAPA correspondence during that time period. The survey response rate may have also been inadvertently lowered due to the daily workload of practicing physician assistants and the high volume of emails and surveys they receive daily. Research shows that surveying healthcare providers, particularly physicians, is associated with a low response rate and is highly related to lack of time or survey burden (Cunningham et al., 2015). Furthermore, after analyzing the data it was found that this study was underpowered due to the low response rate. In order to be powered at 0.80 with a 0.10 alpha, it would be necessary to have 16 respondents in each group; or, 21 in each group to achieve a 95% (0.05 alpha) confidence level.

Another limitation was that a majority of the research questions could not be adequately analyzed to show any significance, as there were only three participants who actually utilized telemedicine in their current or past practice, therefore qualifying to

answer these questions in the survey. Two of the research study questions, specifically question two about telemedicine utilization and question three about how telestroke has impacted the confidence level of rural physician assistants toward tPA use could not be statistically analyzed. Therefore, the data cannot be generalized to either urban or rural practicing physician assistants and can only be presented as descriptive data.

Overall, the research study was limited by the number of survey participants and by the fact that the survey was only sent to the 645 practicing physician assistant MAPA members, which does not encompass all 1,896 practicing PAs in Minnesota. (NCCPA, 2014). In effect, the results are not representative of the population of interest, specifically the practicing physician assistant MAPA members, nor can the results be representative of all physician assistants that practice in Minnesota. To increase response rate physician assistants could have been approached directly, a paper copy via postal service could have been sent out, or an incentive for completing the survey could have been offered.

Suggested Future Research

This study was designed to add to the available research regarding the use of telestroke involving physician assistants. The results of this study prompt further research targeting physician assistants working in an emergency department setting since a majority of respondents were family practice PAs. It may also be interesting to research how comfort levels involving the utilization of tPA differ between physician assistants who work primarily in the emergency department versus those who work in family practice and only work occasional shifts in the emergency room.

Repeating this study with modifications in survey distribution or acquisition of data may provide a larger representative sample in order to adequately analyze attitudes and utilization of telemedicine. Additionally, expanding the sample to include all practicing physician assistants in the state of Minnesota, rather than only MAPA members may provide a more representative population and an increased level of response in order to obtain significant data.

Another potential area of research might encompass whether telemedicine improves outcomes of individuals suffering from ischemic stroke when compared to those treated at facilities that do not have a telemedicine assisted system in place. Survey respondents commented that telemedicine would increase access for patients; therefore, it may be enlightening to seek experiences from patients and families that have been impacted by the use of telemedicine in ischemic stroke presentation, or simply patient openness to the use of telemedicine in general.

Conclusion

The use of tissue plasminogen activator has been an important advancement in the treatment of stroke patients. With the surrounding risks and benefits, precision is needed when administering this thrombolytic agent. This can be accomplished through access to a neurologist during an acute stroke presentation. Since there is a lack of neurology specialists in rural Minnesota, telemedicine and telestroke has a significant role in that it enables providers at rural facilities to gain access to a neurologist, permitting the neurologist to consult with both the provider and patient. Consultation with a neurologist via a telestroke system facilitates an assessment of the patient, allows for CT or MRI interpretation and ultimately provides an individualized treatment plan. After performing

an extensive literature review, it was clear that there were areas that were deficient of adequate research. Specifically research was limited regarding physician assistant attitudes toward telemedicine, telestroke and tPA utilization; therefore, this was the focus of the study. The researchers of this study aimed to answer the research questions, which include how attitudes toward telemedicine differ between rural and urban practicing physician assistants, to what extent telemedicine is being utilized by rural physician assistants, and how has telestroke affected confidence levels toward the use of thrombolytic therapy. In an effort to answer these questions, the survey was sent out to MAPA members via an email from MAPA's administrator.

Though the response rate was low, most respondents felt that telemedicine would be useful in rural healthcare, not just ischemic stroke cases alone. The physician assistants that were utilizing telemedicine and telestroke were confident in administering tPA. Of the three rural physician assistants that were utilizing telemedicine to treat ischemic stroke patients, only one had access to a neurologist through telestroke. Survey respondents stated many other positive aspects to utilizing a telemedical system included providing care to those with transportation barriers, that it provides for greater patient access including underserved areas, that it allows for the physician assistant to consult with a mentor, along with providing reassurance for tPA administration as it brings the neurologist to the bedside. Survey respondents stated that barriers to using a telemedicine system include cost and that the system could never be equivocal to a face to face interaction with the patient. Overall, what was found in the literature review was validated by the data obtained from this study.

If the research were repeated, it would be prudent to use a method that would ensure a greater response rate. However, despite the low response rate, enough data was obtained to show a statistically significant difference between urban and rural PAs in regards to their attitude toward the helpfulness of telemedicine in their practice. Furthermore, with the addition of the open-ended response questions enough descriptive data was obtained to perform secondary analysis describing attitudes, as well as positive aspects and barriers to telemedicine and telestroke. Both rural and urban providers see the value of telemedicine in rural hospitals and clinics where specialist consultation is not readily available. This research study showed that rural physician assistants utilize telemedicine more frequently and find it to be more useful than urban physician assistants. With more physician assistants being utilized in rural healthcare settings and practicing in remote hospitals, they can be instrumental in expediting care to stroke patients through telemedicine. This information reinforces the expansion of telemedical systems such as telestroke, specifically in rural communities where resources and specialty support in ischemic stroke care is limited. We recognize that costs associated with implementing telemedical systems and adopting new systems of health care can be a significant barrier in rural hospitals. However, if rural healthcare in Minnesota is to provide quality and equitable health care to its aging rural population, telemedical technology needs to be embraced and promoted in order to adequately and appropriately treat ischemic stroke patients.

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Appendix A

Cover Letter

Cover Letter

Informed Consent Form
Physician Assistant Telemedicine Survey

March 31, 2015

Dear Participant:

You are invited to participate in a research study being conducted by graduate students from the Bethel University Physician Assistant Program. The study is designed to collect information to assess factors which may contribute to the use of telemedicine in ischemic stroke care.

You will be asked to complete an electronic survey. Your participation in this study is voluntary and you may refuse to participate at any time. At a maximum, the survey should take only five minutes to complete.

This survey has been approved by the Institutional Review Board of Bethel University. There are no risks associated with participating in this study beyond those encountered in everyday life. The survey collects no identifying information of any respondent. All responses will be anonymous and reported only as a collective combined total.

If you have any questions regarding the survey or this research project in general, please contact the research faculty chair, Professor Wallace Boeve at (w-boeve@bethel.edu). If you have any questions concerning your rights as a research participant, please contact the IRB of Bethel University at Bethel University Institutional Review Board, P.O. Box 2322, 3900 Bethel Drive, St. Paul, MN 55112.

By continuing with the survey, you are indicating your consent to participate in the study. While you will not experience any direct benefits from participation, information collected in this study may benefit the profession of physician assistants in the future by better understanding their role in stroke care. Your participation is appreciated.

Please click on the survey link below and provide us with your feedback no later than April 21, 2015.

https://bethel.qualtrics.com/SE/?SID=SV_3sniJPsJixsfTdr

Thank you,

Brittany Kelly, Karin Filip, & Stacy Underhill

This invitation does not imply any endorsement of the survey research and/or its findings by MAPA. The survey contents and findings are the sole responsibility of the individuals conducting the survey.

Appendix B

Survey

Questionnaire

1. I have read, understood, and printed a copy of the above consent form and it is the desire of my own free will to participate in this study.
    - Yes
    - No
2. Type of site(s) where you practice? Choose all that apply.
    - Hospital
    - Critical Access Hospital
    - Clinic
    - Physician Private Practice
    - Community Health Center
    - Walk-in Clinic
    - Urgent Care
    - Other (Fill in the blank)
3. What is your specialty
    - Cardiology
    - Dermatology
    - Emergency Medicine
    - Family Medicine
    - Neurology
    - OB/GYN
    - Oncology

- Orthopedics
- Pediatrics
- Psychology
- Other (fill in the blank)

4. How many total years have you been in practice?
    - 0-5 years
    - 6-10 years
    - 11-15 years
    - 16-20 years
    - 21+ years
5. The area in which you practice primarily serves:
    - Small Rural (2,500 or less people)
    - Large Rural (2,500 to 50,000 people)
    - Urbanized Areas (50,000 or more people)
6. Do you currently use or have you ever used telemedicine?
    - Yes, I currently use telemedicine
    - Yes, I have used telemedicine in the past
    - No, I have never used telemedicine

If No, I have never used…is selected then skip to Would telemedicine be helpful…

7. How have you used telemedicine? Choose all that apply.
    - Diagnosis
    - Second opinion

- Telestroke
- Follow-up
- Other (fill in the blank)
- I do not use telemedicine

8. Have you received formalized education to utilize telemedicine and/or telestroke? Pick one. (Training refers to on-the-job training or training workshops)

- Training on telemedicine only
- Training on telestroke only
- Training on telemedicine and telestroke
- No training

9. Has telemedicine enhanced the effectiveness of your job?

- Strongly disagree
- Disagree
- Agree
- Strongly agree

10. Does telemedicine increase your confidence level in patient care and treatment?

- Strongly disagree
- Disagree
- Agree
- Strongly agree

11. Do you currently treat or have you treated ischemic stroke patients?

- Yes, I treat ischemic stroke patients in my current practice

- Yes, I have treated ischemic stroke patients in the past
- No, I have not treated ischemic stroke patients

If No, I have not treated ischemic…is selected then skip to Would telemedicine be helpful with your…

12. My involvement during the acute management of ischemic stroke is:

- With direct input of supervision physician
- Without direct input of supervising physician
- Telestroke utilization

13. Who is available to you for consultation utilizing telemedicine? Pick all that apply.

- ED Physician
- On-call radiologist
- Neurologist
- Neuroradiologist
- Other (fill in the blank)

14. Is there a dedicated stroke team at your institution? Pick all that apply.

- Yes, onsite services are available at all times
- No, but phone consultation is available
- No, but telestroke consult is available
- No dedicated services available

15. Have you received formal NIH stroke scale education?

- Yes

- No

16. How comfortable are you with the diagnosis and treatment of patients with ischemic stroke?

- Very comfortable
- Comfortable
- Non comfortable
- Not comfortable at all

17. Telestroke is critical in my practice to diagnosis and treat patients with ischemic stroke.

- Strongly disagree
- Disagree
- Agree
- Strongly agree

18. Telestroke has helped me to accomplish the diagnosis and treatment of a stroke patient more quickly.

- Strongly disagree
- Disagree
- Agree
- Strongly agree

19. I have personally been involved in the acute management of a patient who was given tissue plasminogen activator (tPA) for ischemic stroke.

- Yes

- No

If No is selected, then skip to I am comfortable administering tPA.

20. I have personally been involved in the acute management of a patient who was given tissue plasminogen activator (tPA) for ischemic stroke.

- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 25+

21. I am comfortable administering tPA.

- Strongly disagree
- Disagree
- Agree
- Strongly agree

22. Under what circumstances would you feel comfortable administering tPA in a patient with acute ischemic stroke? Choose all that apply.

- Without a neurology consultation
- After phone consultation with a neurologist
- Real time video consultation with a neurologist
- Face to face consultation with a neurologist
- Would not give tPA under any circumstances

23. Based upon the consult available to you and their analysis of the non-contrast CT image, I am comfortable administering tPA.

- Strongly disagree
- Disagree
- Agree
- Strongly agree

24. For the ideal ischemic stroke patient who presents within 3 hours of symptom onset, I am likely to administer tPA?

- Strongly disagree
- Disagree
- Agree
- Strongly agree

25. Liability of using tPA to treat a patient with an acute ischemic stroke is a major concern.

- Strongly disagree
- Disagree
- Agree
- Strongly agree

26. If you or a family member presented with an acute ischemic stroke within the tPA window, would you want tPA administered?

- Strongly disagree
- Disagree

- Agree
- Strongly agree

After this question was answered, respondents were directed to the question What barriers do you encounter…

27. Would telemedicine be helpful with your job in providing care for patients?
    - Strongly disagree
    - Disagree
    - Agree
    - Strongly agree
28. What barriers do you encounter to the use of telemedicine? Choose all that apply.
    - Too expensive
    - Lack of broadband access
    - Lack of telemedical equipment
    - Lack of education
    - Lack of training
    - Other (Fill in the blank)
29. Please provide any comments regarding barriers to telemedicine/telestroke.
30. Please provide any comments regarding the positive aspects of telemedicine/telestroke.

Appendix C

MAPA Letter of Approval

MAPA Letter of Approval

MAPA MINNESOTA ACADEMY OF PHYSICIAN ASSISTANTS
PARTNERS IN HEALTHCARE
600 South Hwy 169, Suite 1680, St. Louis Park, MN 55426
www.minnesotapa.org office@mnacadpa.org
Phone: 952-562-8700 Fax: 952-542-0135

July 30, 2014

Bethel University Institutional Review Board
P.O. Box 2322
3900 Bethel Drive
St. Paul, MN 55112.

Dear IRB Committee:

Please note that Karin Filip, Brittany Kelly, and Stacy Underhill, Bethel graduate students, have the permission of the Minnesota Academy of Physician Assistants (MAPA) to conduct research using our member database for their study, "Attitudes and Utilization of Tissue Plasminogen Activator Involving Telemedicine." The Bethel Graduate students have informed me of the design of the study as well as the targeted population.

The students will contact MAPA members to recruit them by email, to complete a survey which will be submitted via Qualtrics software. The students plan is to distribute the email as soon as possible once the students have Bethel IRB approval. MAPA will distribute the survey letter /email which will include the link to the survey to ensure confidentiality of our members. The student's research activities will be finished by August 2015.

The students have agreed to abide by MAPA's confidentiality policy. The students have also agreed to provide to my office a copy of the Bethel University IRB-approved, stamped consent document before contacting participants for the survey.

I support this effort and will provide any assistance necessary for the successful implementation of this study. If you have any questions, please do not hesitate to call. I can be reached at 952-562-8700.

Sincerely,

Arlene Lensing

Arlene Lensing
Executive Director

Appendix D

Bethel University IRB Approval Letter

Bethel University IRB Approval letter

Feb 10, 2015

Karin, Stacy, and Brittany;

I write this letter to you in approval of Level 3 Bethel IRB of your project entitled: "Attitudes and Utilization of Tissue Plasminogen Activator Involving Telemedicine." This approval is good for one year from today's date. You may proceed with data collection and analysis. Please let me know if you have any questions."

Sincerely;

Wallace Boeve, EdD, PA-C
Program Director
Physician Assistant Program
Bethel University
w-boeve@bethel.edu
651 308-1398 cell
651 635-1013 office
651 635-8039 fax
http://gs.bethel.edu/academics/masters/physician-assistant

Appendix E

Reminder Letter

Reminder Letter

Dear MAPA members,

You were sent an invitation to participate in our research project regarding telemedicine utilization. The survey will be closing after April 21st, 2015. If you have not already done so, please take a moment to fill out the survey by clicking on link below.

https://bethel.qualtrics.com/SE/?SID=SV_3sniJPsJixsfTdr

Thank you for your time,

Karin Filip, Brittany Kelly & Stacy Underhill

Bethel University Graduate Students

Appendix F

Additional Data

Additional Data

Table 2. Open-ended Responses to PA Specialty of Practice: What is your Specialty?

General practice (adults only)
Educator
Diabetes
Endocrinology
Cardiac Surgery
Cardiovascular Surgery
General Surgery
Surgery
Nephrology
Urgent Care