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ABSTRACT

Telestroke has provided swift, lifesaving treatment and has afforded patients the ability to be treated in an efficient manner in rural areas where neurologists may not always be available. It has been reported that Telestroke in rural areas has increased the ability to treat patients by being able to access a neurologist for assistance in evaluating the patient to determine if administering lifesaving treatments were needed. The utilization of Telestroke has been shown to increase the use of IV Tissue Plasminogen Activator (tPA) which improves outcomes such as better quality of life, lower disability and improved rehabilitation. Employment of Telestroke is discussed as an efficient means of providing 24/7 neurological consultation to stroke patients in rural hospitals. Employment of Telestroke is discussed as an efficient means of providing 24/7 neurological consultation to stroke patients in rural hospitals.

Key Words: Telestroke, Neurologists, Rural Hospitals, Neurologists in rural hospitals, Cost

INTRODUCTION

According to the Centers for Disease Control and Prevention (CDC) in 2015 stroke was the fifth leading cause of death in the United States (U.S.). Those who survive are classified among the highest and most serious long-term disability patients. Stroke is a disease with a high social and economic impact (Wechsler et al., 2013). The incidence of stroke is about 800,000 cases per year (Roger et al., 2012). It has been estimated that the total cost of strokes in the U.S, was 38.6 billion in 2009; taking into consideration the expenses related to healthcare services, medication and lost productivity (Kulscar, Gilchrist & George, 2014).

In recent years, treatments administered within the first few hours by a qualified specialist have shown to reduce mortality and improve prognosis in stroke patients by 30%. The first 60 minutes after the onset of stroke symptoms is crucial to begin treatment in order to minimize long term disability or avert stroke death (Bresnick, 2013). It has been reported that in 2005 that nearly 1.1 million stroke survivors had reportedly struggled with performing basic daily activities (Kulscar et al., 2014).

According to the 2013 Population statistic Census, approximately 19.3% of the U.S. population lives in rural areas, many of which lack permanent presence of an expert neurologist. Telemedicine for stroke, also known as telestroke, helps to bridge the gap between treatment time and shortage of neurologists in rural underserved areas (Nagao, Koschel, Haines, Bolitho & Yan, 2011). Neurologists with stroke care expertise, usually located in urban areas, are not always feasible destinations for Emergency Medical Services (EMS) transporting stroke patients from rural areas. Based on a 2009 national study of EMS response times, it was estimated that only 22% of the U.S. population in a rural area lived within a 30 minute drive to a neurologist staffed medical facility (Albright et al., 2010).

In a broad scope, telemedicine is the practice of medicine at a distance, assisted by the electronic transfer of data through audio and video (Kazley, Wilkerson, Jauch & Adams, 2012). Telestroke is a cost effective delivery method that enables neurologists to provide life-saving treatment to stroke patients in rural areas that lack access to physicians with adequate stroke knowledge and expertise. Under the telestroke model, neurologists are enabled to communicate, using digital technology, with on-site physicians who are treating patients at facilities that do not have adequate stroke expertise. An off-site neurologist can perform neurological assessments of a patient, evaluate brain imaging and aid bedside healthcare providers in diagnosis and treatment, including administering IV tPA which is a clot busting drug that reduces mortality and long term disability (Schwamm et al., 2009).

Physician administered tPA is the only Food and Drug Administration approved treatment for ischemic strokes. By dissolving the clot and increasing blood flow to the brain, tPA that is given between three to four and a half hours from the onset of symptoms can improve the recovery of a stroke (Adeoye et al., 2011).

According to the American Heart Association, telestroke is about developing a network connection through audiovisual systems that allows physical examination of the patient from a distance and evaluation of complementary tests such as a CT or MRI. The neurologist referral center can better identify those patients who will benefit from the transfer and indicate the appropriate treatment, saving crucial time in this pathology (Timpano et al., 2013).

The purpose of this research was to explore the shortage of neurologists in rural areas to determine if telestroke can impact stroke intervention in rural hospitals.

METHODOLOGY

The primary hypothesis of this study was how the use of telestroke in rural health facilities can increase quality outcomes of stroke intervention in hospital emergency rooms if neurologists are not available.

The method for this study was a qualitative study using literature review. The Marshall University Drinko library in Huntington, West Virginia was used for full text articles, utilizing the PubMed, EbscoHost, WorldCat and ProQuest databases. Google Scholar was used when articles could not be located through the above mentioned data bases. Terms included in the search consisted of 'telestroke' AND 'rural hospitals', OR 'hospital reimbursement', OR 'neurologist', OR 'shortage of neurologists in rural areas', OR 'cost', OR 'outcomes'. Reputable websites of CDC, United States Census Bureau, American Heart Association and American Telehealth Association were also used. Articles were limited to the English language. 38 articles were selected for this research. Further, a semi-structured interview with an expert clinician well versed in emergency medical treatment of strokes in a regional ER that utilizes a telestroke hub-model added to the data collection was performed. This clinician will be referred to as Expert in ER telestroke throughout the review. This search was completed by SM, JAP and AS and validated by AC, who acted as a second reader and also double checked if references met research study inclusion and criteria.

RESULTS

Impact of Telestroke Technology

The unavailability of neurological consultation and recommendation is accentuated if studies are considered that show thrombolytic treatment. It is effective in specialized centers, but ceases to be if administered in hospitals with little experience and few patients (Biglan et al., 2012). Usually patients arriving at a local hospital with a suspected acute stroke are urgently transferred to a large regional medical center (Ickenstein et al., 2005). This move typically takes 30 to 90 minutes, the patient is re-evaluated by the neurologist on-call. Under these conditions, in most cases, the therapeutic window of four and a half hours for thrombolytic therapy has been consumed, thus depriving virtually all strokes that start in rural areas of the most effective treatments for the acute phase (Hyland, 2013). In cases where it is possible, safely administered intravenous tPA, transfer loss is very important in time as it is well known to have a negative impact on subsequent functional recovery (Hoody, Hanson, Carter & Zink, 2008). Initiatives to reduce latency to medical helicopters have managed to moderately increase the number of patients treated with tPA, although at a high cost benefit due mainly to 80% of patients transferred are ultimately not candidates for thrombolytic therapy (Müller-Barna et al., 2014).

Despite its limitations a healthcare model based on urgent road transport of stroke patients have a positive impact on evolution, since a seemingly simple measure as urgent evaluation by a neurologist clearly improves prognosis because it allows the immediate adoption of the most appropriate therapeutic measures and early identification of complications (Agarwal & Warburton, 2011; Cho et al., 2008). In order to save time, new protocols have been developed where suspected stroke patients bypass the nearest downtown hospital thus shortening treatment and increasing the percentage of candidates for thrombolytic treatment (Ganapathy, 2004). Strategies are included in the 2012 recommendations from the Brain Attack Coalition however there is a widespread view that the new Information Technology and Communication has to play a key role in the future (Schneck & Morales-Vidal, 2012; Storm, Gunzel & Theiss 2011).

There are different types of technology able to transmit the necessary information between centers, although the technology chosen can vary in medical centers, the criteria requires a fast, reliable and quality communication method. The adoption of telestroke should be individualized in each case according to the characteristics and pre-existing technology in each medical center. A study published by LaMonte et al. (2008) evaluated the effectiveness of telestroke services compared to in-person services and found patients were diagnosed and treated more quickly when receiving telestroke assessments than those relying on in-person assessments, 17 minutes versus 33 minutes. The telestroke systems have evolved to the point that they are readily available which allow the consulting neurologist to remain in one place while waiting for the patients results (Choi & Urban, 2002).

According to the Expert in ER Telestroke, small rural facilities lack neurologists' onsite to evaluate and treat stroke patients. The shortage of neurologists in rural areas is a multifactorial problem. First, the rationale of staffing a full-time neurologist may not be justified in a small rural facility. Cost to recruit and retain such specialist could be difficult to fund thereby limiting the compensation a rural facility could support. Additionally, smaller facilities may lack of technology to provide the necessary services to a treat a stroke patient. The Expert noted a solution to neurology shortages in rural facilities; it has been the utilization of telestroke that can be used to treat patients at the bedside using telestroke technology. Using this technology the patient is evaluated by a neurological specialist who can treat the patient instantaneous. Telestroke is directed to the patient's bedside where the neurologist on the other end, controls the camera to have access to view the patient. The process is efficient and allows for the timely treatment to reduce the cells from being deprived of oxygen. The Expert works at St. Mary's Medical Center, which provides services to rural facilities and noted the process works well and allows for a direct link to a specialist. The Expert noted that while hospitals are gaining access to these services there are others who have not implemented due to existing technology and cost (Expert in ER Telestroke, 2015). Depending on the vendor, prices and maintenance cost per month will vary, however one high-end estimate in 2011, was between \$5,000-\$6,000 per month for telestroke with 24/7/365 network on-call coverage, with integrated security socket platform (Freeman, Barrett, Vatz & Damerschalk, 2012).

Impact of Telestroke on Quality

Telestroke is a safe and feasible tool for stroke diagnosis to enhance tPA utilization and improve long term outcomes. The tPA administration rate, during a recent study, was shown to have increased to 55% and in some cases used in hospitals for the first time. When tPA is managed, stroke patients can experience significantly improved outcomes, such as better quality of life, decreased rates of disability and improved rehabilitation (Fang, Cutler & Rosen, 2010). The cost efficiency of telestroke is realized through reduction in disability and associated long-term care (Zanaty et al., 2014).

Telestroke Cost Benefit and Reimbursement

Prior to telestroke, possible stroke patients were transferred to larger medical centers. Later was the introduction of Telephone Advice that was used to reduce the amount of transfers out though non-visual physician consultation (Handschu et al., 2014). In both cases, patients were unnecessarily transferred out, which not only reduced reimbursement for the rural hospital, but also increased the expenses to the rural hospital for the actual transportation cost of the patient if not covered by insurance (Demaerschalk, 2011).

There are financial barriers to implement telestroke. Costs are broken down into four categories, equipment, installation and maintenance, training and clinical resources. While costs vary, the average cost to implement telestroke is \$46,000 (Miley, 2009). Either the hub or spoke hospital can pay the expenses related to costs of telestroke (Hess & Audebert, 2013). According to the researcher these expenses could be fees for the neurologist in the form of on-call pay, costs for hardware infrastructure, and fees to a third party vendor for consulting. Additionally, most programs rely on public sector financing which are usually associated with academic medical systems, however these programs are typically restricted to rural areas.

A summary of reimbursement by the American Telehealth Association in 2013, has noted that while Medicare has lagged behind other payors, currently, the reimbursement has been the same for telestroke, from January 2007 to January 2013, as it is for face-to-face with three restrictions: location, qualifying facility and approved procedure.

DISCUSSION

The purpose of this research was to explore the shortage of neurologists in rural areas to determine if telestroke can impact stroke intervention in rural hospitals. The results of the literature review and interview with an expert in the field have suggested telestroke has had a positive effect on treatment of stroke patients by allowing a more timely assessment which enables earlier use of IV tPA. The literature review supports telestroke an alternative to neurologists on-site in rural area hospitals (Avitzur, 2010).

Telestroke has permitted hospitals without access to neurologists to provide management of thrombolytic therapy in stroke patients. Patients displaying symptoms of stroke can be observed by a neurologist, who can also see the patient's brain scans for damage caused by a hemorrhage or a blocked artery. A significant part of the population living in geographically remote areas of large hospitals and the permanent presence of an expert neurologist at each of the district hospitals is unfeasible. There have been several strategies to address these problems and one of them is telestroke (Wechsler et al., 2013). This system consists of the development of hospitals networked together using audio visual technology that allows remote physical examination of the patient and evaluation of tests. The neurologist can better identify those patients who will benefit from the transfer and indicate the appropriate treatment.

The process of medical decision making is guided by the neurologist who uses telestroke to evaluate the patient in a rural setting. A decision must be made to transfer the patient, start IV tPA and transfer to a referral hospital or utilize telestroke to treat the patient at the rural hospital. This was confirmed with the semi-structured interview with an Expert in the field of ER telestroke. The Expert confirmed that when rural facilities implemented telestroke, it improves access to stroke care however it has been noted that implementation costs, which are estimated at \$46,000, prohibits implementation at some facilities.

The literature review was limited in the area of reimbursement due to the frequently changing policies within various governmental and commercial payors. It has been observed that telemedicine network; either urban or rural, both need a significant capital investment for equipment and technical support. Hence, the components of the total cost of development and maintenance of telestroke network includes the equipment, support of information technology, the essential administrative and clinical personnel along with personnel training and education. The successes of telestroke programs are dependent upon having the financial means to sustain the program (Silva, Farrell, Shandra, Viswanathan & Schwamm, 2012).

CONCLUSION

The application of technologies of communication and information improve the efficacy and efficiency of treatment of acute stroke in patients presenting to the emergency department of a rural hospital. Telestroke is suggested to be effective in stroke pathology when a neurologist is unavailable. Telestroke provides enhancement of utilization of tPA and when tPA is managed, stroke patients experience a better quality of life, decreased rates of disability and improved rehabilitation.

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APPENDIX A

Questions for Semi-Structured Interview with an Expert in ER Telestroke on March 15, 2015

- Why is the timing of stroke treatment important?
- Why is there a need for telestroke in the treatment of stroke?
- Why is it important for patients to see a stroke specialist as opposed to general doctor?
- How have you used telestroke to solve the problem of diagnosing and treating stroke patients? How fast is it?
- How does the process work?
- How is telestroke in the ER working?
- What are the main barriers in implementing telestroke?
- Will patients still need to see a specialist in person?
- Is your facility supporting any other hospitals via telestroke (i.e., acting as a hub to another hospital)?
- If so, how is that working?
- Do the rural hospitals you support experience a shortage of neurologists? Is that why they opted for telestroke?
- What is the driving factor or most common reason rural hospitals experience a shortage of neurologists?
- In your experience, is the process efficient?