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The Quest for Managing Stroke through A Mobile Device Application: A Review Study of Innovative Technologies Related to Cerebrovascular Accident

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ABSTRACT

Stroke, also known as a cerebrovascular accident (CVA), is the fifth leading cause of death for Americans, accounting for 140,000 lives each year ("Stroke facts," 2017). CVA marks 1 out of every 20 deaths and nearly 75% of all strokes occur in people aged 65 years and above (Centers for disease control," 2017). As a leading cause of long-term disability, stroke can have devastating effects on patients and their caregivers. Despite a number of emerging technologies that could potentially be helpful in the prevention, evaluation, and rehabilitation of strokes, typically, such technologies are limited and only considered for millennials. Similarly, at the present time, there is not a single platform designed specifically for stroke management. This makes access to relevant CVA information for baby boomers and the elderly challenging and the potential edification process rather inefficient. The key objective of this review is to identify and discuss effective technologies that can assist baby boomers, born between 1946 and 1964 in the United States, to manage CVA and further explore possible concerns of baby boomers associated with awareness and accessibility of the aforementioned technologies.

Introduction

According to the Centers for Disease Control and Prevention ("Stroke facts," 2017), stroke, also known as Cerebrovascular Accident (CVA), is the fifth leading cause of death for Americans. Further, it is the leading cause of long-term disability and nearly 75% of all strokes occur in people 65 years of age or older. Currently, there are a number of ongoing debates about the elderly and baby boomers in relation to their access to emerging technologies that have the potential to help manage stroke rehabilitation. Thus, edification within the context of new digital platforms related to this specific cause is needed. In a recent study targeting primary care physicians (PCPs) in the New York City area, 69% of physicians responded that they do not discuss any options for primary stroke prevention through the aid of mobile applications with patients (Halket, Singer, Balucani, Stefanov, & Levine, 2017). At the present time, there are multiple mobile applications that manage each controllable factor of a stroke, such as weight, hypertension and cholesterol, and yet, there is not a single platform specifically designed for managing a stroke. With a goal of identifying and discussing effective technologies relevant to managing stroke in the United States, this fundamental review study explores possible baby boomers' concerns associated with awareness and accessibility of the aforementioned technologies.

Cerebrovascular Accident

CVA occurs when blood flow to an area of the brain is cut off; therefore, resulting in brain cells being deprived of oxygen. This lack of oxygen equates to the death of the cells coupled with a consequential loss of that area of the brain's ability to control its specific functions ("Stroke facts," 2017). Strokes are either labeled as hemorrhagic or ischemic. Ischemic stroke, the most common type of stroke, occurs when a blood vessel carrying blood to the brain is blocked by a blood clot ("What is stroke," 2019). According to a recent survey ("National center for health statistics," 2019), age-adjusted percentages of having a stroke for ages 18-44 is 0.6 with a standard error of 0.09. This percentage increases for ages 45-64 to 3.2 with a standard error of 0.23 and increases further for ages 65-74 to 6.6 with a standard error of 0.23. The largest age-adjusted percentage of stroke is recorded at 11.1 with a standard error of 0.66 for ages 75 and over. Therefore, it is crucial for the aging population, which essentially encompasses society as a whole, to learn about the symptoms of CVA and to utilize the technology available to manage the rehabilitation process in the wake of a stroke. Since 2013, overall induced deaths by stroke fatality rates have declined in the United States ("Stroke facts," 2017). Nonetheless, the decline in stroke fatality rates has stalled in 3 out of every 4 states and has even reversed in 22 states ("Preventing stroke deaths," 2017). The baby boomer generation is one of the age groups that are affected by CVA.

Baby Boomers

In the United States, baby boomers refer to those born between 1946 and 1964, or post-World War II (Colby & Ortman, 2014). As of 2019, baby boomers range from 55 to 73 years old. Baby boomers represent a population size and a specific market segment for a risk group associated with stroke. Nonetheless, Generation Y or Millennials are larger in population size, and therefore, specific factors influencing Millennials and their purchasing attitudes and patterns have become much more of an important focus for consumer research than the other age groups (Belleau, Summers, Xu, & Pinel, 2007; Martin & Bush, 2000, as cited in Ordun, 2015). Moreover, even if inequities in internet availability and accessibility have gradually diminished due to technological advances, compared to younger counterparts, baby boomers are more likely to have lower health literacy, which in turn, negatively impacts their understanding of health care access and chronic disease management (Tennant, 2015). Even if baby boomers are able to access the internet, searching through and understanding the state-of-the-art technologies

could be a rather arduous and complex process. Consequently, the lingering question is whether or not baby boomers, a large population affected by CVA, should be the ones managing their health-related conditions or simply remain unaware of the benefits of having access to emerging technologies such as virtual reality and telehealth as rehabilitation possibilities.

Selected Health Care Technologies

Health care technologies are instrumental in enhancing healthcare services. Many of these advances are brought to life through innovation (Schilling, 2020). By improving outcomes and reducing costs, innovative technologies pave the path for addressing health care issues both in terms of stroke prevention or rehabilitation and enable new opportunities for reaching a larger number of stroke patients (Barbash & Glied, 2010; Chandra & Skinner, 2012; Drummond, et al., 2008; Miller, 2011; Safi, 2018). A number of relevant technologies currently available for assisting stroke rehabilitation and other methods of increasing the accessibility of baby boomers to reach web portals and mobile internet platforms are presented in the subsequent sections.

Mobile Applications

Mobile applications are increasingly becoming a gateway for a number of services and products on the internet. These applications refer to software installed on most cell phones, tablets, and hand-held electronic devices. Throughout this section, a number of technologies linked to mobile applications that could have potential impacts on stroke prevention or rehabilitation are explored.

According to a case-controlled study with 6,000 individuals within the United States, 90% of strokes can be attributed to just 9 modifiable risk factors (Halket, Singer, Balucani, Stefanov, & Levine, 2017). Halket et al. (2017) also studied targeted interventions to reduce blood pressure and cigarette smoking as well as to promote physical activity and a healthy diet which could substantially reduce the risk of stroke. There are multiple health-related mobile applications curated specifically to manage such vascular risk factors (Boateng, Batsis, Halter, & Kotz, 2017). One of these is *ActivityAware* that monitors a person's daily activity level for providing deeper insight into hypertension and obesity. Thus far, there is not a single platform specifically designed for stroke rehabilitation and most platforms are limited in stroke prevention. This could be an underlying reason for why physicians hesitate to discuss such applications.

In a recent study, 69% of primary care physicians (PCPs) responded that they do not discuss any mobile applications for any kind for primary stroke prevention with patients (Halket et al., 2017). In the same study, however, 77% of PCPs, expressed interest in a mobile application that targeted primary stroke prevention. According to Cleveland Clinic (2018), there are nine controllable risk factors for stroke. One of these factors is weight management. In an exemplary case of utilizing technology as a means of risk reduction, the use of a mobile application for weight management has proven to be efficient in terms of aiding significant changes in body weight (Mateo, Granado-Font, Ferré-Grau, & Montaña-Carreras, 2015). Specifically, for each MET-h/week, a common method of expressing exercise dose is the calculation of metabolic equivalents (METs) per week, was associated with a 0.13 kg/m^2 and 0.33 kg decrease in Body Mass Index and body weight, respectively (Stoner, Beets, Brazendale, & Moore, 2018). As of March 2019, the iOS Application Store (IOS, 2019), hosts a range of mobile applications for CVA awareness, pocket cards, and puzzle games all targeted at bringing different levels of information. In spite of these applications, a comprehensive and reliable mobile application that would assist a user in managing all the controllable factors associated with stroke, as well as an ability to evaluate and recognize stroke symptoms and offer tools for rehabilitation purposes is non-existent.

Virtual Reality (VR)

Virtual reality (VR) provides users with a three-dimensional interaction experience with the virtual world, engaging the mirror-neuron system (Saposnik, Teasell, Mamdani, Hall, Mcllroy, Cheung, Thorpe, Cohen, & Bayley,

2010). EVREST is an illustrative example of the first randomized clinical trial whose results attested to the fact that VRWii is a feasible, safe, and potentially effective intervention method to enhance motor function recovery in stroke patients (Sinclair & Saposnik, 2010).

The gaming industry has developed a variety of VR systems for home use, making this technology both affordable and accessible with potential to be applied within community settings (Saposnik et al., 2010). Furthermore, VR is already being used for a variety of medical applications including acute inpatient medical settings, investigations of Alzheimer's disease, and surgery (Dascal, Reid, IsHak, Spiegel, Recacho, Rosen, & Danovitch, 2017; García-Betances, Arredondo-Waldmeyer, Fico, & Cabrera-Umpiérrez, 2015; Vávra, Roman, Zonča, Ihnát, Němec, Kumar, Habib, & El-Gendi, 2017).

While proven to be effective, the use of VR systems or gaming devices is a hurdle for many organizations due to legal aspects (Karl, Soderquist, Farhi, Grant, Krohn, Murphy, & Straughan, 2018). It is debatable if stroke patients who rarely fall into a millennial generation, or their caregivers are aware of such technologies and could use them effectively. Further research into these areas are needed. Despite these deliberations, there is an increasing interest amongst researchers to focus on stroke prevention and rehabilitation through use of VR methods that highlight fitness and exercise programs (Proffitt et al., 2015; Proffitt & Lange, 2015; Proffitt & Lange, 2013).

Telehealth

According to the World Health Organization (WHO), telehealth involves the use of telecommunications and virtual technology to deliver healthcare advice outside traditional health facilities ("Health and sustainable development," 2016). Guidance and advice by health professionals is not the only challenge for patients. According to a study performed by the Helsinki University Central Hospital, CVA not only emotionally distresses a patient but equally leads to depression in 30% to 33% of all caregivers during the acute phase and during subsequent periods of 6 months and 18 months' following the acute phase (Berg et al., 2005). As caregivers experience physical and emotional distress, any means of assistance or clarification regarding stroke management and the perceived tangible and effective support mechanisms available are crucial in preventing caregiver burnout (Buckley et al., 2004). Telehealth provides access to guidance remotely and provides a robust mode of caring for patients and caregivers in a dynamic and flexible manner. This service could possibly increase a survivor rate amongst victims of stroke.

Conclusions

Through this literature review, the effectiveness of a selected number of technologies such as mobile applications, virtual reality, and telehealth have been explored for the prevention and rehabilitation of CVA. In effect, the need for reaching patients through robust and remote ways have been exhibited for their well-being. Conversely, despite the displayed efficiencies of these technologies, awareness and accessibility of baby boomers and caregivers to such technologies still, remain rather unexplored. Throughout the course of this literature study, a number of challenges have been unveiled.

When it comes to mobile applications, millennials are typically prioritized as potential customers in comparison to baby boomers. Hence, such strategic efforts could possibly result in fewer companies targeting baby boomers for marketing campaigns of emerging technologies useful for CVA management. Consequentially, these measures would result in a limited awareness amongst baby boomers about the technologies available even if technologies such as telehealth and VR have their own limitations. Furthermore, a lack of a single, all-inclusive mobile platform that addresses patient concerns for stroke management prevents physicians from discussing mobile applications of any kind with patients. Thus, chances of patients utilizing affordable technologies for prevention of another stroke and rehabilitation is reduced.

Conclusively, in the wake of these findings, a future study that clearly identifies baby

boomers' awareness of the discussed technologies, in addition to their interest in accessing technological means useful for CVA management is hereby suggested. In the wake of this study, follow-up research study among baby boomers that equally identify the best learning practices for familiarization with the aforementioned technologies can be initiated to fill a potential unawareness gap. Moreover, discussions that shed light on technical and business challenges associated with the integration of different technologies into one platform for stroke patients is of particular interest. Such an integrated platform could potentially facilitate the edification process regarding recent technologies and the engagement of baby boomers in seeking potential solutions and information regarding their current health situations.

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