



**THE USE OF EHEALTH APPLICATIONS IN STROKE
REHABILITATION.**

A Literature Review

Anna Chiwalala, Vida Obeng-Kwaah & Eta Tabe

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<p>Abstract.</p> <p>The aim of this paper was to explore and discuss the use of ehealth applications in the rehabilitation of stroke patients, to create an understanding of how eHealth assist caregivers in rehabilitating stroke patients, and to discuss how ehealth affect the quality of life of stroke patients. The research questions are:</p> <ul style="list-style-type: none"> How can eHealth be applied in stroke rehabilitation? How can eHealth assist caregivers in the rehabilitation of stroke patients? How can eHealth affect the quality of life of stroke patients? <p>This study was a literature review. An inductive content analysis method was implemented in answering the research questions. Data for this study was retrieved mainly from Google scholar and Arcade's electronic databases. The integrated quality of life theory was used as the theoretical framework for this study.</p> <p>The findings of this study highlight the application of eHealth in the rehabilitation of stroke patients. It also documents significant and meaningful informations on how eHealth assists care givers in the rehabilitation of stroke patients. This is associated with maximizing time and resources, and also minimizing care givers burdens, expenses, and other inconvenience of administering and receiving rehabilitation care such as flexibility, accessibility and effectiveness. High levels of satisfaction demonstrated by stroke patients and their care givers indicated that the use of eHealth applications for stroke patients are a promising potential alternative to standard face-to-face rehabilitative care. This is possible with the development of interpersonal skills specific to the challenge of using such systems by patients and their care givers. More research however, is needed to identify which requirements are most important to optimize in relation to accessibility, usability, and content of comprehensive eHealth interventions from the perspective of patients, and care givers.</p>	
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ABREVIATIONS

TM : Telemedicine: Telemedicine

ASTUTE: Acute Stroke Telemedicine Utility, Training and Evaluation (ASTUTE).

NPT: Normalization process theory

VR: Visual Reality

QOL: Quality of life

IQOL: Integrated quality of life

TAT: Technology-assisted toilets

FOREWORD

We would like to thank our supervisor, Gun-Britt Lejonqvist. We would also like to thank our families and friends for their support. We are very grateful to God for good health and wellbeing throughout this period.

1. INTRODUCTION

Stroke is a lingering clinical condition accountable for expanding healthcare costs in the elderly population. This medical condition is ranked as being the fourth highest cause for fatalities. For those who survive stroke, 40% experience functional impairments that need specialty care, and 10% end up in a nursing facility or other long-term rehabilitation centers (Vtulder et al. 2015). A stroke occurs when the blood supply to part of the brain is interrupted or reduced, preventing brain tissue from getting oxygen and nutrients. It is a form of cardiovascular disease affecting the blood supply to the brain also known as cerebrovascular disease or apoplexy (webmd.com). Stroke is a time-dependent medical emergency in which rapid access to specialist care reduces death and dependency. Up to 26% of patients with acute stroke could potentially be treated with intravenous thrombolysis (Gibson et. al 2016). According to the World Health Organization, 15 million people suffer from stroke worldwide each year, 5 million of these dies and another 5 million are permanently disabled (strokecenter.org 2018).

The rapidly aging population, the diminishing budgets for public healthcare, and the necessity of achieving International Council of Nurses (ICN) 2006 four main ethical responsibilities of nurses including the promotion of health, prevention of illness, restoration of health and alleviation of suffering (Fry et. al 2012) are among the reasons why the demand for and the rise of eHealth solutions in healthcare services are inevitable including rehabilitation of stroke patients. Though eHealth is still a young field seeking a definite definition, it is defined as, “an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broad sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve healthcare locally, regionally, and worldwide by using information and communication technology.”(Dawn et al. 2018).At the same time, demand for alternative rehabilitation resources in motor relearning is highlighted, as traditional forms of rehabilitation are often time-consuming and expensive. (Lohse et al., 2013). This makes eHealth application in rehabilitation of stroke patients a timely research field as most patients of stroke need relearning in one form or the other.

Notwithstanding the available data on eHealth and stroke rehabilitation respectively, researches in the field of eHealth in relation to rehabilitation of stroke patients is in its early

stages. To contribute to the body of knowledge in this field, the authors aim at reviewing empirical studies to provide better understanding of how ehealth is applied in rehabilitations of stroke patients. This study answers the following questions; how can ehealth be applied in stroke rehabilitation? how can eHealth assist caregivers in the rehabilitation of stroke patients? and how can eHealth affect the quality of life of stroke patients? Even though this paper will focus more on eHealth and stroke rehabilitation, imperatively it is worth while to understand that other forms of stroke rehabilitation are significant in the overall well-being of stroke patients, therefore some attention would be provided in this regard in the general literature review.

2. BACKGROUND

2.1 Stroke

A stroke is caused by the interruption of blood supply to the brain, usually because a blood vessel ruptures or is blocked by a clot. This cut off the supply of oxygen and nutrients, causing damage to the brain tissue. Stroke is globally one of the leading causes of mortality, approximately 12% of total death every year, is also one of the leading causes of disability, 40% of people who suffers from stroke do not recover fully. Stroke also results in long-term morbidity and a leading causes of overall disease burden as measured in disability adjusted life years (WHO, 2019)

There are two types of stroke, hemorrhagic and ischemic stroke. Hemorrhagic stroke occurs when an artery of the brain burst, it is further divided into two subtype an intracerebral hemorrhage which happens when the brain blood vessel leaks into the brain, and a subarachnoid occurs when there is bleeding under the outer membrane of the brain and into the thin fluid filled space surrounds the brain. Ischemic stroke occurs when the brain lack oxygen due to the block of the blood vessel, this is usually because of a blood clot in the artery leading to the brain or narrowing of the arteries (carotid stenosis), Ischemic stroke is accountable for 80% of all strokes (World Heart Federation, 2019).

Ischemic stroke can be subdivided into thrombotic and embolic strokes. Narrowing is commonly the result of atherosclerosis, the occurrence of fatty plaques lining the blood vessels. As the plaques grow, the blood vessel becomes narrowed and the blood flow to the area is reduced. Damaged areas of an atherosclerotic plaque can cause a blood clot to form, which blocks the blood vessel. In an embolic stroke, blood clots from elsewhere in the body, travels through the circulatory system and block narrower blood vessels (Gund, 2013).

The common symptom of a stroke is sudden weakness or numbness of the face, arm or leg, mostly on one side of the body. Other symptoms include confusion, difficulty speaking or understanding speech, difficulty seeing with one or both eyes, difficulty walking, dizziness, loss of balance or coordination, fainting or unconsciousness. (WHO, 2019).

The effect of the stroke depends on where the stroke occurs in the brain and how severe the brain is damaged. A person who has a small stroke may experience only minor problems such as weakness of an arm or leg. People who have larger strokes may be paralyzed on one side or lose their ability to speak. Some people recover completely from strokes, but more than 2/3 of survivors will have some type of disability. (Gund, 2013)

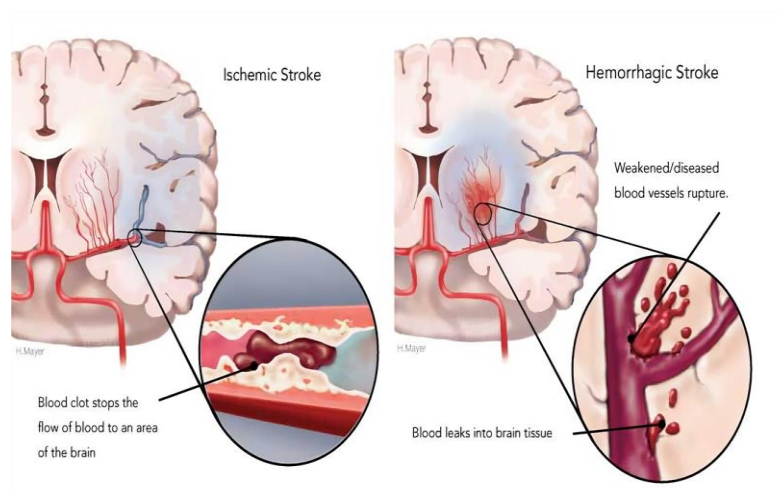


Figure 1. 1. The Two Types of Stroke (Heart and Stroke Foundation, 2004)

2.2 Rehabilitation

Rehabilitation is a process that allows patients to achieve and sustain their optimum levels of physical, psychological, sensory intellectual and social function. This offers the support patient needs to gain freedom and self-determination (WHO ,2017)

2.2.1 Physical rehabilitation

The human body's essential functions are based on physical activity. Physical rehabilitation requires the use of skeletal muscles which, through physical exercises or physical training, improves physical and mental health, result in energy expenditure above resting level. (Brink et al. 2009)

2.2.2 Emotional Rehabilitation

Emotional recovery is about restoring psychological state or emotional state following a loss. An important part of emotional recovery is the regaining of self-esteem, health-related quality of life, self-confidence, functional skills and ability to cope with life circumstances. (Hudson et al. 2001)

2.2.3 Social Rehabilitation

Social recovery ensures that the amount of social support obtained after a loss is possible. Social rehabilitation can be structural, informational, or instrumental assistance obtained through social and social networks. (Kristofferzon et al. 2004)

Rehabilitation is an vital aspect of nursing. Making the patient as functional as possible is the key point for rehabilitation. Rehabilitation is a part of the day-to-day duty of the nurse in the health sector. Rehabilitation includes counseling and other forms of support with the primary purpose of helping the patient do whatever they can by themselves. (Harri-Lehtonen et al. 2014.)

2.3 E-Health

EHealth is an emerging field of medical informatics that involves the organization and delivery of health services and information by means of the internet and other related technologies. EHealth has not only led to technical development but also brought about a new way of working, attitude, global thinking and a commitment for networking with the aim to improve health care locally, regionally and worldwide by using information and communication technology” (Eysenbach 2001).

The use of information and communication technology (ICT) provides new methods for utilizing and improving health services in an efficient way. The rapid developments in ICT during the last decades has led to the rise of new concepts in health and welfare called e-health, or electronic health. Electronic health involves the transfer of health resources and healthcare through electronic medium. It involves the delivery of information, using IT and e-commerce to improve health services and the management of health systems using e-commerce and e-business practices. (WHO, 2012).

The benefits of ehealth technology in the healthcare sector are quite enormous. EHealth is patient empowering. It has made it possible for consumers electronic records to be accessible by consumers over the internet. It has opened new avenues for patient-centered medicine and enables evidence-based patient choices (Eysenback 2001)

It has encouraged a new form of relationship between the patient and health providers whereby decisions are made in a shared manner. Ehealth ensures continuous medical and health education made available via online sources. It has also made easy and possible information exchange and communication between healthcare establishments. It has extended the scope of healthcare beyond its conventional boundaries. It enables consumers to obtain health services and advice from global providers. (Eysenback 2001).

Ehealth mediums include mobile health, telehealth and telemedicine, internet health, consumer health IT data, electronic health records (HMR), electronic medical records (EMR), health IT systems, big data systems and website (WHO, 2012).

E Health is also essential in order to arrange quality health services with universal access and to create a sustainable financial ground for health care systems. The use of ICT in healthcare has the potential to increase the efficiency of services as well as to improve quality of life and unlock innovation in health markets. This is also emphasized in the strategies of the EU, as noted within the European eHealth action plan, that aim to improve healthcare with a patient-centered approach and reduce costs by developing the use of digital tools and services for health-related matters. (Ahonen et al.2018).

According to the third global survey on ehealth conducted by the WHO Global Observatory for eHealth, eHealth has played a very significant role in promoting universal health coverage in many ways. It has helped in providing services to remote populations and underserved communities through telehealth or mHealth. It has facilitated the training of the health workforce through the use of eLearning.

2.3.1 E-Health Development

EHealth is now a global issue. The topic was discussed at the United Nations World Summit on the Information Society in December 2003 and also at the World Health Assembly in May 2005. Several initiatives have been established by WHO, European Union and Other health bodies toward advancing ehealth. For instance, the WHO Global Observatory for eHealth (GOe) was established in 2005 which aimed at providing member States with strategic information and guidance on effective practices, policies and standards in eHealth

In Europe, eHealth forms a major part of the European commission eEurope action plan. The world Summit of the information Society (WSIS), that was organized with participation of 175 countries (second phase,16-18 November 2005), affirmed its commitment to “improving access to the world`s health knowledge and telemedicine services, in particular in areas such as global cooperation in emergency response, access to and networking among health professionals to help improve quality of life and environmental conditions”

In 2005, the World Health Assembly resolution WHA58.28 was adopted by the WHO. Whereby eHealth was described thus “eHealth is the cost-effective and secure use of

information communication technologies (ICT) in support of health and health related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research” (1). The same Health Assembly adopted another resolution promoting universal health coverage (UHC) (WHA58.33). Since that time the growth in both UHC and eHealth has been accelerating.

The public consultation commissioned by the EU Member states in 2009 was launched on 31 March 2011 and ended on the 30th of May 2011 with the following objectives:- Increase awareness of the benefits and opportunities of eHealth, empower patients and healthcare professionals, address issues currently impeding eHealth interoperability and to improve legal certainty for eHealth. EC should encourage professional associations, scientific societies and, civil society representatives to promote best practices through the development of guidelines and/or codes of conduct for eHealth services; these includes issues of data protection, cross border data transfer, and provider liability and ethics issues (EC Report on eHealth Action Plan 2012-2020).

239 participants contributed to the consultation representing different stakeholders including non-governmental organizations, academia, enterprises, health and social care providers and public authorities from many member states. Regarding specific actions for every objective, most respondents believed that the main instrument to increase patient’s awareness and trust on eHealth is the information campaign.

Another effort by the EU towards eHealth development was the introduction and use of the European Computer Driving License (ECDL), which has been a worldwide resource to provide general knowledge and skills about ICT to all professionals on different educational levels since 1995 The standardized curriculum for biomedical and HI developed by the International Medical Informatics Association (IMIA) is widely known and utilized. Nursing informatics (NI) has been a part of nursing education for many years however, competence in informatics is not limited to the field of nursing but more generally, to the whole field of health and welfare (Ahonen et al.2018).

Advancement in electronic health also brings about demand for specialized skills and competences. It requires a new kind of educational setting for both professionals in working-life and in the education of future professionals in health and welfare. Initiative such as the DeDiWe project is put in place in responding to these challenges and needs. The DeDiWe project, funded by The EU Central Baltic Program 2014-2020 is aimed at enhancing future

health care professionals' abilities to develop digital health care and welfare services. (Ahonen et al.2018).

Regarding legal issues, most of the participants thought encouraging professional associations, scientific societies and civil society representatives to promote the best practices through the development of guidelines and codes of conduct for eHealth services is an important action for the EC. Data protection and liability are the areas to focus on. Some respondents considered that most of the barriers are interconnected, i.e. the lack of patient's awareness would be interconnected to the lack of the user's involvement in the research process (EC Report on E health Action Plan 2012-2020).

It is worth noting that security and safety guarantees will reassure citizens and encourage greater participation in use of eHealth services. Also, providing a legal framework for eHealth is a good way to secure its use and adoption. Health services should meet the needs of patients. Educating policy makers and healthcare managers to become informed decision makers on eHealth problems and solutions and involving healthcare stakeholders in multidisciplinary projects are considered possible ways of addressing barriers.

73.8 percent of the participants thought it important that the EC should encourage professional associations, scientific societies and civil society representatives to promote best practices through development of guidelines for eHealth services, which includes issues of data protection, cross-border data transfer and provider liability and ethical issues (EC Report on eHealth Action Plan 2012-2020).

The significance of introducing ehealth solutions are numerous and quite unprecedented. One importance is that it offered patients that have had stroke with the possibility of rehabilitation.

3. THEORETICAL FRAMEWORK

The integrated quality of life theory was chosen as the theoretical framework for this study. The integrated quality of life theoretical framework emphasises aspects of the quality of life which is an important consideration in this research. The use of the integrated quality of life theory is significant in understanding how the quality of life of both stroke patients and their caregivers is affected using ehealth technology. This theoretical framework serves as a guidance in this research and was used in answering the research questions. Aspects of the quality of life, their measurements are outlined.

3.1 Quality of Life

Health is generally a predisposition to the ability to perform social roles and to respond to changes in the environment. It involves the process of continuously seeking and maintaining balance that is constantly being disturbed by pressures from the internal and external environment.. According to W.H.O (2018), ‘health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’

Upon a study and assessment of 26 facets of people's lives, the World Health Organization described quality of life as multidimensional. Aspects considered included physical wellbeing, psychological health, social and environmental relationships etc. This project was established in 1991. The project's purpose was to establish an international cross-cultural comparable quality of life evaluation tool that assesses the expectations, personal objectives, priorities, and concerns of all people within their background of culture and values (WHO, 2014).

Several conceptual approaches have so far been used to define the quality of life theory. Each of these definitions were made based on the context under consideration. The Integrated Quality of Life approach (IQOL) outlined by Ventegodt, 2003 was used as the theoretical framework in this study.

3.2. The Integrated Quality of Life Concept

The integrated theory of life or IQOL is a meta-theory that covers several QOL theories in a subjective-existential-objective spectrum. According to the IQOL, a human being is an entity composed of subjective and objective factors beginning from the outer layers and moving into the deepest nucleus representing the existential quality of life (Ventegodt, 2003)

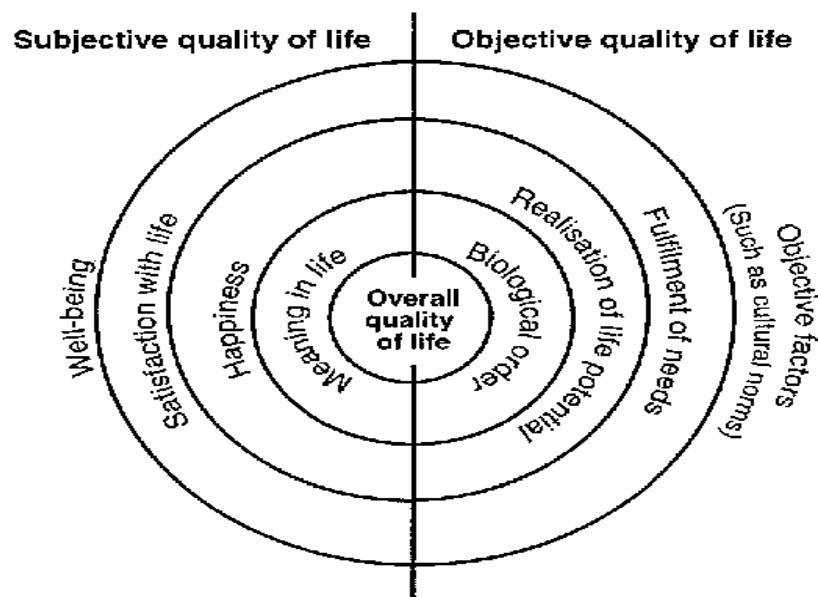


Figure 2. 1. The Integrated Theory of the Quality of Life (Ventegodt et al. 2003)

3.3. Aspects of the Integrated Quality of Life Theory

3.3.1. Well-being

Well-being is the most important aspect of quality of life. It can be determined superficially or in more depth. It's complexity depends on how each individual perceives and determines the definition of well-being (Ventegodt et al. 2003)

When we meet other people, we always say, "How are you?" or "How's life?" We are thus asking that person to give us an evaluation of their quality of life. Such questions do not demand a lengthy explanation of issues of life, merely a random assessment of life in general (Ventegodt, et al. 2003).

3.3.2. Satisfaction with Life

Life satisfaction means we live life in a way that meets our expectations and desires, and we can live the kind of life we want. It is possible to be satisfied, or not unhappy with life, and at the same time feel bad inside, or think life has no meaning (Ventegodt et al. 2003). People are usually less satisfied with life than their state of well-being would suggest. People may seem to feel good, but they're not very happy, only content. In retrospect, there is always something to be disappointed or unhappy about in (Ventegodt, et al.2003).

3.3.3. Happiness

Happiness is also identified with aspects such as love and harmony with nature, and is identified with the entire life of an person. It is rarely correlated with topics such as money or (objective) safety.

“Happiness is an intoxication, a rare sweetness of life, when tiny bubbles sparkle” (Ventegodt et al.2003). Happiness is often associated with aspects such as love and harmony with nature, and is associated with the entire life of an individual. It is rarely associated with concepts such as income, or (objective) health. According to IQOL, happiness is in the depths of an individual and it involves a special symmetry and balance (Ventegodt et al.2003). According to the intergrated quality of life concent, meaning of life is a very personal concept, which is often only shared with the closest friends and relatives.

The search for meaning of life includes the notion that you also need to accept the meaningless of life and that there is “an obligation towards oneself to make amends for what is meaningless” (Ventegodt, et al,2003). Meaning of life is the core of many religions and belief system and the issue with it is that it can also be lost, which leads to confusion and feeling of “becoming lost in ourselves” (Ventegodt, et al,2003).

A Biological View of the Quality of Life: The Biological Information System and the State of Existential Balance.

The biological view of QOL sees the human being as a living organism with cells requiring correct information to function properly and maintain a healthy and balanced bodily system. In this respect, the physical health reveals the biological state of the body and the quality of life lies in between the life that is essentially lived and the formula for being the individual that lies within the depths of the organism (Ventegodt, et al. 2003).

According to the biological view on QOL, the conscious life we are living cannot be maintained if the information system between the cells and organisms does not function properly and thus the individual's health is disrupted (Ventegodt, et al. 2003). The person who lives in such a way that their meaning in life is progressively being lost is also the kind of person who is vulnerable to illnesses that affect the physical appearance and well-being. The relation between the quality of life and illness is thus best explained using a theory of the individual as a biological information system (Ventegodt, et al. 2003).

3.3.4. Realization of life Potential

According to this view quality of life is closely related to the human roots in nature as life potential is seen as the connection between the human and nature.

This is a general theory of the exchange in living systems of essential information: from cell to organism to society. Human beings are continuously developing starting with a fertilized egg, which contains a huge amount of information. The egg must realize the potential of its information in order to grow and develop throughout life (Ventegodt, et al.2003). According to IQOL, a human's potential is ultimately realized when he or she is living life to the fullest; that is, having meaningful relationships, family and general well-being (Ventegodt, et al.2003).

3.3.5. Fulfilment of Needs

According to this very concrete view the quality of life is high when your needs are fulfilled. The concept of need is more ambiguous and complex than just having what you need. Ventegodt et Al. stated that the need for something is no longer something we need from the outside to be satisfied with (food, shelter, etc.), but something an individual need to accomplish for him or herself (Ventegodt et al. 2003). Are we then to fulfil this urge from the outside world or from within our inner depths? And does this then mean that our needs are fulfilled? Who or what in each of us, is it that needs? The ego? The self? Learned expectations? (Ventegodt, et al.2003).

3.3.6. Objective Factors

According to IQOL objective factors of QOL are easy to determine and they include income, marital status, state of health and the number of daily contacts you have with other people. Despite the seemingly easy categorization, it is necessary to define these factors since they are culturally linked to each other and often falsely confused with the kind of life that we think is "right" (Ventegodt, et al. 2003).

According to IQOL, objective quality of life can be a superficial notion that does not involve any deep reflection on the nature of the culture, even though it does reflect on how well we are adapted to the culture we are living in. The research of QOL has tried to define the quality of life by measuring it objectively. These tests include e.g. counting of social contacts (sociological studies) and questions like “Can you walk?” (medical studies) that tries to create a list of factors that can be measured (yes/no, numerical scales) and are seen as part of a good life. Quality of life in this study has been measured by using such tools in order to gain statistical information on how stroke has affected different dimensions of quality of life.

This thesis works on the integrated quality of life theoretical framework. This theoretical framework is quite beneficial to the scenery of the use of ehealth application in stroke rehabilitation and its impact on stroke patients and caregivers. The integrated quality of life explains different aspects of quality of life such as happiness, well-being, satisfaction, fulfilment of needs, biological factors, and realization of life potential (Ventegodt, et al. 2003). Stroke affects different dimensions of these aspect of quality of life. The chosen theoretical framework gives a better understanding of the dilemma of the stroke victims. It helps as a good guide in the assessment of the improvement on the quality of life of stroke patients brought about by the implementation of ehealth technology in stroke rehabilitation.

4. AIMS AND RESEARCH QUESTIONS

The aim of this paper is to explore the applicability of eHealth technology in the rehabilitation of stroke patients, to create an understanding of how ehealth assist stroke patients and their caregivers in the rehabilitation process and also to look at how eHealth technology affects the quality of life of stroke survivors.

This study answers the following compelling questions:

1. How can eHealth be applied in stroke rehabilitation?
2. How can eHealth assist caregivers in the rehabilitation of stroke patients?
3. How can eHealth affect the quality of life of stroke patients?

5. METHODOLOGY

This thesis is a literature review and a qualitative study. Scientific literature was reviewed using inductive content analysis. The chosen scientific literature was meaningful and subjective to the aim and research questions of the study. The study was done by review of a relevant theory and literature from previous studies.

5.1. Data Collection

The articles used for the study were systematically chosen and care was taken to make sure only the best available material that is relevant to the purpose of the study and answers the research questions were used. Data was retrieved mainly from Google scholar and Arcade's electronic databases such as EBSCO (Academic search elite and CINAHL), Science Direct, SAGE and PUBMED. The key words used were ehealth, stroke, stroke patients, stroke rehabilitation, caregivers. The Boolean operators, AND, OR, NOT were used in combining the search words. Twenty six articles were finally selected to be relevant for this study after inclusion and exclusion criteria were applied to the search. The table 1.1 below shows the data collection process.

Table 1.1 Data collection Process

Database Searched	Keywords	Retrieved Articles	Articles Used
CINAHL, EBSCO	E-health and stroke rehabilitation	6	3
CINAHL, EBSCO	E-health and stroke	5	2
SAGE	E-health and stroke rehabilitation	5	3
GOOGLE SCHOLAR	E-health and stroke	10	8
PUBMED	E-health and stroke rehabilitation	11	7
Science Direct	E-health and stroke rehabilitation	8	3

5.1.2. Inclusion and Exclusion Criteria

The inclusion criteria included articles published between the years 2000 and 2019, peer-reviewed articles in English, all gender and ages, homecare and hospital setting, articles from all countries and full text articles. The exclusion criteria included articles that could not be retrieved without cost and articles not related to eHealth, stroke, stroke patients, stroke rehabilitation and caregivers of stroke patients. The inclusion and exclusion criteria is also shown in Table 2.1 below.

Table 2. 1 Inclusion and Exclusion Criteria

INCLUSION	EXCLUSION
Peer-reviewed articles in English	Articles that could not be retrieved without costs
Article from the year 2000 till date	Articles not related to ehealth, stroke, stroke patients, stroke rehabilitation and caregivers of stroke patients.
All gender and ages	
Homecare and hospital setting	
Articles from all countries	
Full text articles	

5.2. Content Analysis

This study is conducted based on the qualitative content analysis in nursing research approach by Graneheim & Lundma (2004). An inductive content analysis approach was used in order to obtain and widen understanding. Inductive content analysis is a design in which the researcher reads and reviews selective articles to acquire the evident and dormant meanings through the texts in an article. In the content analysis of this study, individual ideas are explained in its own circumstances. The apparent meaning is the manifest content and the latent meaning is acknowledged as the basic or

bottom line for the texts. The unit of analysis is the full text which is read and reviewed. In the twenty-six selective articles, points were sentences, phrases, paragraphs, and words which were related to each other with regard to either their content or context are noted as meaning units. Markers were placed on meaning units to classify them together as codes. Codes with similar content were then included in the categories. A series of categories are then included in themes. Inclusion and exclusion criteria were repeatedly applied when reading the articles. The meaning units were highlighted in terms of the manifest content of the text. The coding process was performed based on the relationship between codes and the applied search words in the research. The search words were marked with colours so that they could be easily identified. Themes and sub-themes were developed in relation to the research questions as illustrated in Figure 3 below.

5.3 Ethical Consideration

Unlike ethical standards, general principles are a set of values and principles used at all stages of the research process to determine suitable and acceptable conduct. Based on the writing instructions and its critical standards in the ethics rules given by Arcada University of Applied Sciences and the book “Understanding nursing research: building an Evidence-based practice” of Grove S & Gray J (2019), the academic thesis is not a direct copy version of any other sources. Accordingly, valuable information from articles were used via a system of referencing with Harvard referencing style. This is of supreme importance as the purpose of each article is not to repeat the information word for word but to give more detailed explanation on existed information of the previous article. In the data analysis process the steps of reading and reviewing papers are conducted one by one to ensure that the duplicated knowledge generalization process is automatically reduced. During the process of thesis writing, it is imperative not to be subjective and biased when presenting methodology. Instead of that, the writer is rational and self-conscious during the processes of the data collection, analysis and interpretation.

6. FINDINGS

After an analysis of the content of the selected articles (see Appendix 1) for this study, themes and sub-themes were formed in relation to the aim of this study as illustrated in figure 3 below.

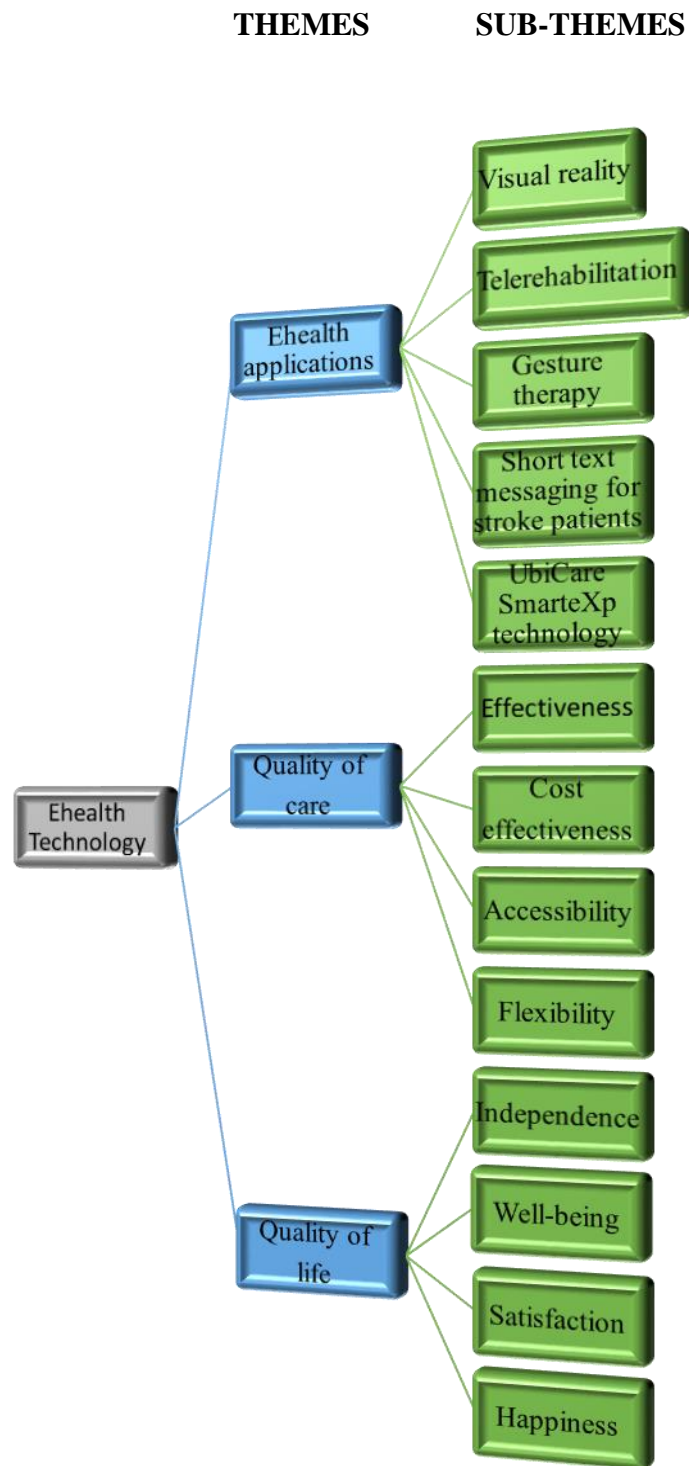


Figure 3. 1. Illustration of Themes and Sub.themes

6.1 E-health Application in Stroke Rehabilitation

Common ehealth solutions used in rehabilitating stroke patients include visual reality (VR), telerehabilitation, gesture therapy, short text messaging for stroke patients and UbiCare SmarteXp technology. Based on the result of the findings of this study, the application of ehealth solutions in the rehabilitation of stroke patients had enormous impact on both caregivers and stroke patients in various ways.

6.1.1 Virtual Reality

Virtual reality, or VR, is a form of technology which allows the person to experience moving in a virtual environment and receive feedback on their performance (Veerbeek et al. 2017; Lennon et al. 2018). Weiss et al. (2006) defines VR as “the use of interactive simulations created with computer hardware and software to present users with opportunities to engage in environments that appear and feel similar to real world objects and events”. The immersion rate is usually higher when head-mounted displays or video capturing in which the user is represented within the virtual environment is used. VR can be either immersive or non-immersive depending on the way the environment is projected. Immersive method requires that the patient wears a special pair of glasses while the non-immersive method is perceived through e.g. a computer screen or a projection screen. (Veerbeek et al. 2017; Lennon et al. 2018).

According to studies done by lohse et al. (2013), VR allow the patients to have access to health care while staying at home. This is seconded by the study done by Faria et al. (2016). The use of VR has emerged as a valuable approach in stroke rehabilitation, providing the opportunity to practice cognitive and motor activities that are normally not possible to be practiced in the clinical setting. VR also provides real-time feedback on the present level and movement quality of the individual (Zimmerli et al., 2013; Keshner,2004)

6.1.2 Telerehabilitation

Telerehabilitation is the ehealth technology whereby medical rehabilitation care can be provided from a distance. It is one of the most suitable rehabilitation cares in poststroke patients, especially in remote areas (Tchero et al., 2018). Due to inconvenient transportation and cost for rehabilitation programs, most stroke survivors are living in denial from receiving professional supervised rehabilitation which consequently delays rehabilitation time. There is the need for new outpatient rehabilitation and recovery training strategies that meet the

specific needs of patients and their caregivers and thus e-health has come with a solution. Telerehabilitation has improved cognitive function, health-related quality of life, low cost and satisfaction in stroke survivor

6.1.3 Gesture Therapy

In stroke, motor and cognitive disabilities are disabilities that affect the person on a great level. The rehabilitation is intense, and it requires a lot of commitment from all parties involved, patient with family and the field of therapists. Therefore, it is important to develop technologies that allow the patient to practice intensive movement without an always-present therapist. With a computer vision-based system a stroke patient can practice arm movement exercises at home or at the clinic, with interactions with the therapist. The system provides a virtual environment for facilitating movement training, with computer vision algorithms that track the hand of the patient. Within the system comes a gripper with a pressure sensor to include hand and finger rehabilitation and the program can track the patient's head as well, to detect trunk compensation. (Sucar et al, 2008)

To track the movement of the hand a colored ball is attached to a gripper, via webcam the movement can be recorded or monitored. The vision algorithm locates and track the ball using color information, and by estimating the apparent diameter of the ball the 3-D position in space can then be calculated. The pressure sensor in the gripper can be used to simultaneously track some specific movement in the hand. In simulation the patient can experience using the hand in real time by interacting in a virtual environment. The program can be used to mimic real life situations and perform different tasks and by this provide effective rehabilitation for the patient. The physical system has 3 main elements; a) a computer to run the software, b) a webcam to track the movement and c) a hand grip to follow the motion of the hand. The software itself has 3 components; therapy activities that guide movements, progress charts that track rehabilitation and informs the patient of their progress and a therapist page that allows monitoring and prescription of the therapy. The therapy is presented in the software as games. The simulated activities are designed with the patient's everyday life in mind and thus the games present task- specific practice with functional relevance, the tasks include stove cleaning, window mopping, fruit shopping, driving etc.(Sucar et al, 2008)

Through the system configuration the therapist can customize the rehabilitation to each patient which provides excellent therapeutic benefits for the patient. The patient can train at home and

this cuts the costs of excessive visits at the rehabilitation clinic. The system gives objective visual feedback of the task at hand, which has the effect of enhancing motivation and endurance in the rehabilitation progress. The games also provide some entertainment value which adds to the therapeutic effect of the rehabilitation, by doing the rehabilitation “in a fun way” the patients concentration and motivation stays high. In the software configuration the patient can follow up his/her own rehabilitation progress and set own goals in the progress. This is of great value to the rehabilitation progress; motivation is a big deal when it comes to rehabilitation success. .(Sucar et al, 2008)

6.1.4 Short Text Messaging for Stroke Patients

For a stroke patient, it is very important to remember to take the medicines on time. Almost 1 of 6 stroke patients have problems with taking the medicines. The main reasons for this are complicated treatment instructions and lack of the patient's motivation to take the medicines. Also, one big reason for this is that the stroke patient does not remember to take the medicines on time. Earlier methods to remind the stroke patient of taking the medicines on time are phone calls and more clear instructions for the patient. These are however things that need huge resources to make them work as they should.

Since technology has now a days developed, new ways to keep the stroke patient remembering the medicines has been created. Almost everyone in today’s world has a telephone, so it seems natural to create eHealth solutions that function in the telephone. In a study “Improving medication adherence in stroke patients through Short Text Messages (SMS4Stroke)-study protocol for a randomized, controlled trial” they have found a new easier and a more low-cost way to remind the stroke patient about taking the medicines.

The idea is that the stroke patient gets an automatic text message to her or his telephone every time when it is time to take the medicines. The system is called the “Short text message system”. The patient is required to answer the text message when they have taken the medicine. If the patient does not answer the reminder text message for five days, the patient will get a phone call to clarify the reason why she or he has not taken the medicines. If the patient gets changes in recipes or doses of the drugs the patient is given instructions to call a helpline that is available 24/7 with trained staff.(Kamal et al.2015)

According to Gurol-Urganci et al (2012) the benefits of mobile phone messaging is convenient for both patients and healthcare providers. It shortens waiting times for healthcare services

and the cost of healthcare. Some researchers have analysed the use of mobile phones in healthcare and illustrated the broad application and ability of eHealth applications such as mobile phones to increase access to healthcare and improve service delivery efficiency (Gurol-Urganci et al.2012). Studies done by Kamal et al (2015) also recorded that ehealth solutions make the care of stroke patients easier and safer. The short text messaging for stroke patients is a good solution in keeping stroke patients reminded of taking their medicines such automatic short message reminders have been used earlier in HIV and diabetes patient's treatment, and it is great that the short message reminders are also useful nowadays with stroke patients. However, the important that every text message that is sent to remind the patient of taking the medicines is personalized and tailored exactly to fill the patient's needs is recommended. This eHealth solution surely makes the care of a stroke patient easier and safer. This short text message system seems to be quite effective and practicable, so with little effort a high impact for improving the quality of life of its users is achieved. (Kamal et al 2015).

6.1.5 UbiCare SmarteXp Technology

This is a stroke recovery engagement solution (technology) that connects hospitals and other care providers to the stroke patient and caregivers through an interactive platform. This technology helps improve the quality of care and helps prevent a second stroke. With this technology, patients receive targeted educational and health messages 24/7 via a mobile device. Some of these educational health content may include videos and surveys relating to patients' condition. This technology allows patients and caregivers to get access to their healthcare provider in case of any health concern. The UbiCare SmarteXp`s technology helps improve patient self-management. This technology is very suitable, and the interface is very easy to use and implement by the patient. It is well compatible with most health systems. The (Pharmaceutical Journal, 2018)

Healthcare organizations using this technology in supporting and caring for their patients find out that 90 percent of their patients feel more connected and 86 percent are better able to manage their care by themselves. With automatic delivered content and real-time analytics, SmarteXp`s technology empowers both stroke patients and healthcare providers throughout.

The articles that were selected for this literature review met the inclusion and exclusion criteria mentioned above. Each selected article addressed either of the research questions in a different way. The main issues addressed were the impact of eHealth technology on the quality of life of stroke patients, the impact of ehealth technology on caregivers of stroke

patients and how it assists them in delivering care. This section therefore outline how ehealth technology assists in improving the quality of life of stroke survivors and also how it affects the caregivers of stroke patients during stroke rehabilitation.

6.2 The Impact of ehealth on Caregivers in Stroke Rehabilitation in Relation to Quality of Care

Aspects relating to the quality of care (service) such as effectiveness, accessibility, flexibility and cost effectiveness are highlighted here as well as ehealth contributions to issues relating to caregiver's well-being such as on caregiver's burden, caregiver's health Status, social support, problem solving abilities, are also outlined. Studies show that the application of ehealth in the rehabilitation of patients has been both significant and non-significant pertaining to the caregivers. E-health impact on caregivers in the rehabilitation of stroke patients is measures by using Burden Interview tools, Pearlin Mastery Scale, Center for Epidemiological Studies Depression (CES-D) scale, which is a Likert-type scale tool that assesses caregivers' feeling regarding each item during 'a last week' and other scales (Aldehaim et al. 2016). Items measured were under the categories of Caregiver's burden, problem-solving abilities, caregiver's health status, social support, preparedness, and healthcare utilization (Aldehaim et al. 2016; Vtulder et al. 2015). The results of the study reports on Caregiver's Burden, Problem-Solving Abilities, Caregiver's Health Status, and Social Support shows statistically no significant differences. Meanwhile measurement under Preparedness average scores reveal improved preparedness on the parts of stroke rehabilitation care givers.

6.2.1 Effectiveness

Under quality of care, the combination of CME and supported self-management by using eHealth technology is affirmed to be a novel way to improve self-efficacy, empower stroke patients and their families, and reduce caregiver burden (van Vliet, Pomeroy, Wolf, & Kwakkel, 2015 in Vloothuis et.al 2016). Ehealth is also confirmed to have significantly not only increase the level of self-efficacy but also essentially good for follow-ups, and patients reported a significant improvement of their extended activities of daily living (Vloothuis 2016). Ortiz-Fernández et al (2019) study addressing how quality of life can be improved by self-management interventions, proposes that ehealth applications such as the use of mobile phones can be used to provide relevant lifestyle recommendations to the patient and the caregiver in relation to the risk of a new stroke. Another study conducted by Liu S et al (2017) also concluded that mobile health is a viable strategy to improve and control the risk factors of strokes, improve glycaemic control and abstinence from smoking. According to Teriö et. el

2019 the new knowledge of application of e-health in stroke rehabilitation led to a change of approach to clients in a positive direction. Also, it promotes collaboration and contributes to unifying the team and teamwork. A subject in Teriö et. al. 2019 testifies how ehealth has promoted totally sharing and discussing at almost equal levels for staff’, meaning the different professionals could share their views openly despite different educational levels and or professional background. Good communication channels are also noted and appreciated by the participants. They believed that the new knowledge acquired made a difference in their clinical work. (Teriö et.al 2019). Gibson et.al 2016 findings also support previously reported issues, such as the need for staff to have excellent technical skills, the importance of staff interpersonal skills and a sense of alienation arising from the use of TM to maxima’s the accessibility benefits ehealth technology bring forward.

6.2.2 Cost Effectiveness

Healthcare Utilization measurements results show significant difference with significant decrease in emergency department visits and hospital readmission related to stroke survivors (Vloothuis 2016). In exploring patients’ and carers’ perceptions of TM in the assessment of acute stroke, NPT which is a valuable framework to analyse people's illness experiences and has been used recently in a large systematic review of qualitative studies of the treatment burden of stroke was applied and the findings from this study suggest that patients and carers can engage well with telemedicine programmes in acute stroke, and find their use acceptable and less costly. (Gibson et.al 2016, Aldehaim et al. 2016, Vtulder et al. 201 Ögren et.al 2018,). Per protocol analysis showed a reduced length of inpatient stay and fewer readmissions, whereas patients reported a significant improvement of their extended activities of daily living (Vloothuis 2016, Yachnin, et al. (2017). The independence on parts of patients makes the discharge of patients to their homes feasible (Yachnin et.al 2017). Study done by Kamal et al (2015) also found out that e-Health solutions make the care of stroke patients easier, faster and safer. Short text messaging system is among the applied applications to reduce cost and for easy implementation. So, with small efforts, a high impact can be realized. Kamal et al (2015)

6.2.3 Accessibility and Flexibility

Result from Wentink et.al 2018, and Ross et al., 2016 testify the application of e-health in stroke rehabilitation by caregivers as suitable to the constant modification of the environment

of health care systems and the general environment. This corresponds to its flexibility to be integrated in familiar, existing tools and applications. (Matthew-Maich et al., 2016). In addition, a mechanism of impact to matching the implementers' earlier professional education, their working experience and scientific knowledge of the new intervention (Teriö et.al 2019), This corresponds to its flexibility to be integrated in familiar and existing tools and applications. (Matthew-Maich et al., 2016). The use of eHealth makes the services available and time saving. Rehabilitation after stroke requires several skilled health professionals, including physiatrists, physiotherapists, nurses, speech therapists, and occupational therapists. Sometimes, these human resources are limited which hampers the recovery process among stroke survivors. Supervised rehabilitation is often challenged by transportation restriction to hospitals and inconvenience, this challenge is being resolving by the application of ehealth in the rehabilitation process of a client (Sarfo et al., 2018).

6.3 The Impact of ehealth Technology on the Quality of Life of Stroke Patients

Quality of life can be improved by self-management interventions. However, self-management intervention can be time-consuming, difficult, and labour intensive. This is why the application of ehealth in the rehabilitation of stroke patients comes into the scene.(Ortiz-Fernández et al (2019) In this section, aspects pertaining to the quality of life of stroke patients such as independence, wellbeing, happiness, convenience, and satisfaction in relation to ehealth and stroke rehabilitation is highlighted. Studies show that ehealth technology could be used to remedy the difficulties associated with self-management intervention for stroke patients. (Ortiz-Fernández et al (2019). Other studies proposes that ehealth applications such as the use of mobile phones can be used to provide relevant lifestyle recommendations to the patient and the caregiver in relation to not only an existing stroke, but also the risk of a new stroke (Gurol-Urganci et al (2012), Lui S et al (2017). Mobile health is another viable strategy to improve and control the risk factors of strokes, improve glycaemic control and abstinence from smoking which are indirectly precautions against stroke. (Lui S et al (2017).

6.3.1 Independence

Results of TAT shows how eHealth applications in rehabilitation to stroke patients can increase stroke patient independence and r

reduce burden of care, for instance physical and psychological burden on both the caregiver and the recipient of care. (Yachnin et.al 2017, Aldehaim et al. 2016; Vtulder et al. 2015,). Independence have also been shown in use of virtual reality in that it allows the patients to work out in their own home independently, according to study done by lohse et al (2013). Yachnin et.al 2017 studies on the independence on parts of patients of patients records how this removes burdens on already scarce hospital resources and in addition on the part of the patients promoting affordable budget management, contentment, and satisfaction

6.3.2 Wellbeing, Satisfaction and Happiness

One of the most cited advantages of VR in rehabilitation is the ability to motivate the user to persist in practicing the required movements and occupations. Increasing the time spent in rehabilitation is the best way to improve the results of therapy. The motivating effect of VR has been documented by e.g., Matijevic et al. (2013), Anderson et al. (2010), and Keshner and Fung (2017). EHealth is confirmed to have significantly reduced the level of caregiver fatigue with increased feelings of self-efficacy (Vloothuis 2016). EHealth contributions relating to caregiver's and patient's well-being such as burden, health Status, social support, problem solving abilities in the rehabilitation process of a patient has been significant pertaining to the caregivers and patients (Aldehaim et al. 2016; Vtulder et al. 2015).

7. DISCUSSION

This chapter discusses and reflect on the findings of the study in relations to the questions for this study. The application of eHealth technology and practices in the rehabilitation of stroke patients is complex and can be challenging for caregivers. This is exacerbated for patients and caregivers, who lack familiarity with the health-care setting and who have to engage with health-care systems and technology whilst also experiencing a serious and potentially life-changing illness episode, particularly in emergency care (Gibson et al 2016).

The high incidence of stroke in older people and in socio-economically deprived groups means that many patients with stroke and their care-givers are likely to be unfamiliar with e-health applications and technology. Despite internet access reaching more households and individuals, about 64% of older adults (>65 years) living alone do not have internet access, 89% of people over 65 years have never made a video call, and 43% of families in the lowest income decile do not have a home computer (Gibson et al 2016).

Similar to all forms of rehabilitation process, it is recommended that people with stroke, and their caregivers, be actively involved in the planning, development, delivery and monitoring of services. The effects and the success of the application of eHealth on caregivers of stroke rehabilitation patients directly and indirectly reflects on the success of stroke patients themselves. Only a few articles selected for this study reported on how eHealth assists caregivers in the rehabilitation of stroke patients, most of the articles rather focuses on how e-health affects the stroke patients themselves and not their caregivers.

7.1 The Significant of ehealth Technology to Caregivers

For the purpose of this discussion, the effect of eHealth applications on caregivers in the rehabilitation of stroke patients is discussed in relation to health care professionals as formal caregivers and other caregivers as informal caregivers. Application of eHealth in rehabilitation of stroke patients have been experienced by formal caregivers as a common means where all professional teams caring for stroke patients can share information and care partnering to clients. It is deemed as a removal of geographical, language and time boundaries, providing efficiency in rendering care to stroke clients who otherwise might have been impossible to reach. Also, it is testified as common grounds for team unification and the teamwork. The results also testify to its flexibility to be integrated in familiar and existing

educational platforms, working experiences, scientific knowledge, new environments, tools and applications.

Formal caregivers also benefit from its suitability to constant modification of new knowledge environments and clinical approaches to clients in a positive direction. The findings also propose that in order for formal caregivers to benefit totally from the applications of eHealth in the rehabilitation of stroke patients, health professionals need to have excellent technical skills, good interpersonal skills and a sense of alienation arising from the use of eHealth applications. In relation to informal caregivers, the findings for home-health assist caregivers in the rehabilitation of stroke patients identified some effects such as how these applications affect the burdens of caregivers of stroke rehabilitation patients, their problem-solving abilities, their health status and social support systems. Their results suggest that there are levels of some positive effects in these areas, but the effects were not that significantly affected by the applications of eHealth technologies. Van Vliet et. al (2016) in Vloothuis et. el (2016), among others, findings confirm a significant reduction of care-givers burden and the level of caregivers fatigue in relation to their health status. Again, caregiver's average preparedness to help and handle their stroke clients or family for rehabilitation purposes has improved.

Almost all the articles selected for this part agreed to the significant enhancement of caregivers' ability to care for clients, reducing stroke patient's emergency department visits and hospital re-admission (Aldehaim et al. 2016; Vtulder et al. 2015). The findings also suggest that the usage of eHealth applications have improved self-efficacy, supported self-management, empowered stroke patients and their families (van Vliet, Pomeroy, Wolf, & Kwakkel, 2015 in Vloothuis et. el 2016). The results show that eHealth applications in the rehabilitations of stroke patients can increase stroke patients' independence thereby reducing burden of care on the parts of caregivers. Stroke patient's independence in addition is a prerequisite for their hospital stay discharges. The findings from this study also suggest that, to maximize the benefits both informal caregivers and stroke rehabilitation patients derive from the applications of eHealth, there are several aspects which need attention from clinical staff in order for the success of such systems. Some of the articles brought to light the availability of literature on technology-based interventions developed and tested for stroke patients, and the fact that an overall, diverse technology-based interventions have been identified for strokecaregivers, but the literature are insufficient to conclusively determine the effects of these interventions on caregivers. There is also a critic of articles not providing

cost–benefit analysis of how the introduction of technology-based intervention into the routine rehabilitation process has affected the patients and their caregivers financially. There are mentions of the reductions in hospitals re-admissions but not the cost–benefit associated with this. There is also an emphasis on the need of early timing for intervention, as soon as caregivers start new responsibilities and the timing of the intervention should be on preparing caregivers for a new role before their loved one gets transferred from a medical or rehabilitation centers to the home or other types of settings. Timing interventions that incorporate a theoretical for caregivers as early as possible is seen as a promising strategy. In addition, is the suggestions for the involvements of stroke clients and their caregivers goal-setting within their cultural context plus the availability of adequate needed and supported information from the IT technicians, since lack of knowledge of the technical parts of the intervention makes some tasks difficult to handle. As the use of technologies becomes more widespread it is vital that assumptions are not made about patients' and care-givers' familiarity with such systems and the acceptance of their use in a health-care context. Stroke patients and their caregiver's active participation, preferences and expectations must be safeguarded considering other practical realities.

7.2 The Significance of ehealth Technology to Stroke Patients

Based on how can e-health affect the quality of life of stroke patients, VR is rated as an independent control of practice and stimuli, it is versatile, secure and easy to record and offers input to the user. (Lohse et al.,2013) This provides the patient with a healthy and relaxed atmosphere that can increase motivation and dedication in itself. That, at the same time, reduces the recovery costs. Its Flexibility means that the difficulty level can be adjusted depending on the success of the user (Faria et al., 2016), and the attention of the user can be diverted or decreased (Keshner, 2004). Additionally, advances can be easily graded and documented (Matijevic et al., 2013; Lewis and Rosie, 2012). VR also provides real-time feedback on the present level and movement quality of the individual (Zimmerli et al., 2013; Keshner,2004). The utilisation of visual reality in the rehabilitation of stroke patients have some merits and demerits. One of the most cited advantages of Visual reality in stroke rehabilitation is the potential to inspire the patient to engage in exercising the necessary movements and occupations. The best way to enhance the treatment quality is to increase the time spent in recovery. For example, Matijevic et al. (2013), Anderson et al. (2010), and Kushner and Fung (2017) have reported the motivating effect of VR. The motivational impact

of visual reality in stroke rehabilitation is due to the fact that VR games are well-designed (Lohse et al., 2013).

However, VR may not be more effective than conventional therapy, but may be useful to improve outcomes in the absence of other therapy interventions after stroke or as an add-on therapy. It can be important to remember that there's still need for further investigation into the subject before any definitive conclusions can be drawn. Study done by Laver et al. (2017) found that there was insufficient evidence to reach conclusions about the impact of virtual reality and interactive video games on gait speed, balance, engagement or quality of life. It does, however, not seem to show any major significant results when compared to conventional therapy.

Another cited advantage of VR in rehabilitation is the ability to motivate the user to persist in practicing the required movements and occupations. Increasing the time spent in rehabilitation is the best way to improve the results of therapy. The motivating effect of VR has been documented by e.g., Matijevic et al. (2013), Anderson et al. (2010), and Keshner and Fung (2017). The motivational effect of VR is of course dependent on the fact that the VR games are well-designed (Lohse et al., 2013). Other key advantages of VR from the user perspective is that it allows independent practice and stimulus control, it is flexible, safe and easily documented and it provides the user feedback. VR allows the patient to practice in his/her own home. (Lohse et al., 2013) This provides the patient a safe and comfortable environment, which in itself can improve motivation and engagement. At the same time, this decreases the costs of rehabilitation.

From the user's point of view, one of the key drawbacks of VR is that VR approaches are often too general and not tailored for the individual user and their particular needs. Sometimes, the strategies are not adequately evaluated with respect to their motor learning efficacy during therapy. (Zimmerli et al. 2013). Anderson et al. (2010) indicated that Wii apps were not developed with the rehabilitative emphasis in mind, and this presents a number of problems: games are too complicated for patients, they primarily target upper-body gross motor functions and lack support for task adjustment, grading and quantitative measurements. Activities used in therapy need to be meaningful for the client to involve and inspire the patient (Kielhofner, 2008). Likewise, it is also important for the VR experience to be carried out in a reliable manner in order to be beneficial to the patient (Glännfjord et al., 2016). Common consensus is that interventions in the virtual environment are likely beneficial if they

are used as an adjunct to conventional therapy. Using VR without a therapist's proper orientation and guidance is actually a risk to rehabilitation success.

Many clinicians use it to motivate clients without identifying or controlling the actual cognitive and neuromuscular parameters that could be modified by these activities, according to Keshner and Fung (2017).

According to Ortiz-Fernández et al(2019) Several reviews have shown the potential of the new eHealth technologies can reduce the risk of suffering a stroke episode, improving the control of risk factors, however all of them conclude that new and well-designed studies are needed, the study has mention also that there is no study about the caregivers and health professionals' point of view of the new technology-based medicine in the reviewed literature related to selfmanagement intervention. Gurol-Urganci et al (2012), Kamal et al (2015). On the use of mobile phones in healthcare shows the broad application of mobile phones and their ability in expanding access to healthcare, in improving the efficiency of service delivery, in the enhancement of diagnosis, in treatment and rehabilitation and also in the promotion of public health programs.

Study done by Lui S et al (2017) found out that mobile Health is a potentially effective tool in the management of key stroke risk factors such as diabetes and smoking. However, it could not find appropriately eligible studies of mobile Health focusing on stroke related ailments such as hypertension or hyperlipidaemia control. There have not been published mobile health studies with stroke as an endpoint, major reasons for the lack of interventions for stroke because stroke largely affects elderly individuals, who may not have much ability and interest in using mobile phone applications or Internet, and the cognitive and physical deficits from stroke may also limit participation in mobile Health related activities. Also, the potential risks associated with using mobile phone messaging include the possibility of incorrect data input, lack of understanding or misinterpretation of knowledge, reading difficulties for those with poor vision or literacy issues. In addition, mobile phone messaging is intended to support or enhance the care delivery process, rather than replacing it. In addition, text messaging is unable to detect verbal and non-verbal signals that can also affect the message's interpretation. Physicians submitting abnormal test results may fail to meet patient needs immediately in terms of explaining the findings, prognosis, and treatment options implications. Patient safety may also be compromised once information has been obtained on abnormal results if immediately action is not taken.

According to studies done by Chen et al (2015) on the delivery of rehabilitation interventions to stroke survivors via telerehabilitation, more research is still required to investigate if telerehabilitation can be used as an alternative or as a supplement to conventional therapy that is delivered face to face, The studies continued to argue that although telerehabilitation is reported to reduce the cost of administering an intervention, studies do not include reports on cost-effectiveness, there is currently insufficient evidence upon which to conclude.

Furthermore, studies in reviews provided little information regarding usability of information and communication technologies that are used to deliver telerehabilitation. Most studies used simple telephone or video conferencing equipment, and few examples were provided of more complex technologies such as wearable sensors or remote monitoring or combinations of technology. It is widely acknowledged that mixed-methods studies are essential in this field in order to evaluate acceptability for health professionals and healthcare recipients well as usability.

In the theory of integrated quality of life, different aspect of quality of life such as happiness, well-being, satisfaction, fulfilment of needs, biological factors, and realizing of potential has been explained by Ventegodt, et al. 2003 .Stroke has affected different dimensions of these aspect of quality of life to stroke survivors in resulting to long-term morbidity and a leading causes of overall disease burden as measured in disability adjusted life years .In relation to this study, the use of eHealth in rehabilitation of stroke patient has shown to improves the well-being of stroke survivors.

According to the biological view on QOL, the conscious life we are living cannot be maintained if the information system between the cells and organisms does not function properly and thus the individual's health is disrupted (Ventegodt, et al. 2003). The person who lives in such a way that their meaning in life is progressively being lost is also the kind of person who is vulnerable to illnesses that affect the physical appearance and well-being. Mostly stroke saviours suffer from disability which came along with it, this makes then to feel vulnerable and burden to their family since they cannot live independently in their daily normal life activities, but ehealth applications such as Virtual reality, telerehabilitation, Short text messaging for stroke patients, and UbiCare SmarteXp Technology applied in the rehabilitation of stroke patients has impacts on their quality of life's in different ways. These has been assessed by studies by Kamal et al (2015) Gurol-Urganci et al (2012), lohse et al (2013), Faria et al. (2016) and (Zimmerli et al., 2013; Keshner,2004, Patients have gained their independency, became happy and satisfied despite of the disability.

According to this very concrete view, the quality of life is high when your needs are fulfilled. The concept of need is more ambiguous and complex than just having what you need. Ventegodt et al. stated that the need for something is no longer something we need from the outside to be satisfied with (food, shelter, etc.), but something an individual need to accomplish for him or herself (Ventegodt et al. 2003). The use of eHealth seems to have the potential of motivating stroke patients, Matijevic et al. (2013), Anderson et al. (2010), and Kushner and Fung (2017) have reported the motivating effect of VR. The motivational impact of visual reality in stroke rehabilitation is to the fact that VR games are well-designed (Lohse et al., 2013).

8. CONCLUSION AND RECOMMENDATION

The use of ehealth in rehabilitation is more challenge when dealing with a neurological condition such as stroke. Many brain injuries resulting in distraction on individual's ability to plan, cordinate,concentrate and remember information. Rehabilitation through electronic devices can be impossible and challenge to some patients depending to their condition and age. Defaults or interruptions in software services can affect the patient concetration who already experiences difficulties with sudden changes. EHealth applications in rehabilitation of stroke patients are rapidly developing worldwide because of their importance. The rapid development and increasing speed of e-health applications in the rehabilitation of stroke patients requires continuous study in order to establish the efficacy of such applications. Despite the limitations, our findings document significant and meaningful informations on how e-health assist care givers in the rehabilitation of stroke patients. This is associated with maximizing the time and resources, whiles minimizing care givers burdens, expenses, and other inconvenience of administering and receiving rehabilitation care for stroke patients. High levels of satisfaction demonstrated by stroke patients and their care givers indicate eHealth rehabilitation applications for stroke patients are a promising potential alternative to standard face-to-face rehabilitative care. This is possible with the development of interpersonal skills specific to the challenge of using such systems by patients and their care givers. More research however, is needed to identify which requirements are most important to optimize in relation to accessibility, usability, and content of comprehensive eHealth interventions from the perspective of patients, and care givers.

8.1 Limitations and Strengths

Using an inductive methodological approach in this study helped to ensure that content analysis was objective and exhaustive. Carrying out this research in a group provided a better understanding of the articles being analysed and therefore added more insights into the study. A wide range of skills were applied during this study thus increases productivity and performance. Collaborating with one another help us in identifying our weaknesses and strengths and help us develop our interpersonal skills. The authors used twenty-six peer-review articles which strengthens the findings. Another strength of this study is that there were three authors, and each author was resigned with a question to research and to focus on, but still having the possibility to work on the other research questions. This helps give focus on and explore as much as possible following the inclusion and exclusion criteria. There was no

age restriction implemented in this study, which means that the findings can be broadly applicable to all people of all ages

Even though the authors tried to cover all the main points of the selected articles, this study does not provide a complete picture of these assessments. There is a great possibility that the selected articles do not contain all the relevant information regarding the aim of this thesis. Only articles in English language were utilised. Relevant resources relation to the aim of this study might have been written in other languages other than English. The authors did not have access to all the relevant scientific literature required for this research since some of the articles needed to be purchased and purchased articles were not included in the search for articles criteria. Another limitation of this study is that there was not enough research done on this topic previously. This made this study a little challenging. There were also limitations in figuring out strong search keywords. Even though there are merits of working in a group as mentioned above, there were also setbacks. It was sometimes challenging to put plenty of ideas in a cohesive manner.

Notwithstanding the setbacks of this study, the expected purpose and aim of this research were achieved without any contradiction or conflict among the content of cited literature.

REFERENCES

- Aldehaim, A., Alotaibi, F., Uphold, C. and Dang, S. (2016). The Impact of Technology Based Interventions on Informal Caregivers of Stroke Survivors: A Systematic Review. *Telemedicine and e-Health*, 22(3), pp.223-231. Google scholar
- Ahonen O., Rajalahti E., Tana J., Lejonqvist G., Kinnunen U., Saranto K., (2018). Digital Health and Welfare Service Development in an International Multidisciplinary Student Team. In: *Studies in Health Technology and Informatics*, IOS Press. [doi:10.3233/978-1-61499-830-3-679](https://doi.org/10.3233/978-1-61499-830-3-679)
- Anderson, F., Annett, M. and Bischof, W.F., 2010. Lean on Wii: physical rehabilitation with virtual reality Wii peripherals. *Stud Health Technol Inform*, 154(154), pp.229-34.
- Berelson, B. ,1952, *Content Analysis in Communication Research*, Glencoe III: Free Press. p. 18.
- Brahnam, S. and Jain, L.C., 2011. Virtual Reality in Psychotherapy, Rehabilitation, and Neurological Assessment. In *Advanced Computational Intelligence Paradigms in Healthcare 6. Virtual Reality in Psychotherapy, Rehabilitation, and Assessment* (pp. 1-9). Springer Berlin Heidelberg.
- Brink E., Brändrström y., Grankvist G., Alsen P., Herlitz J., Karlson B.W. 2009. Physical activity six months after a myocardial infarction. *International Journal of Nursing Practice* 15, 191-197.
- Chen, J., Jin, W., Zhang, X., Xu, W., Liu, X. and Ren, C. (2015). Telerehabilitation approaches for Stroke Patients: Systematic Review and Meta-analysis of Randomized Controlled Trials. *Journal of Stroke and Cerebrovascular Diseases*, 24(12), pp.2660-2668.
- Cho, K.H. and Lee, W.H., 2013. Virtual walking training program using a real-world video recording for patients with chronic stroke: a pilot study. *American journal of physical medicine & rehabilitation*, 92(5), pp.371-384.
- Dawn M Heisey-Grove. Henry J Carretta. *Journal of Medical Internet Research* 2018, <https://innovatemedtec.com/digital-health/ehealth> accessed 4.4.2020..
- Eysenbach, G., 2001. What is e-health?. *Journal of medical Internet research*, 3(2).

EC Report on eHealth Action Plan 2012-2020 <https://ec.europa.eu/digital-single-market/en/news/ehealth-action-plan-2012-2020-innovative-healthcare-21st-century>

Faria, A.L., Andrade, A., Soares, L. and i Badia, S.B., 2016. Benefits of virtual reality based cognitive rehabilitation through simulated activities of daily living: a randomized controlled trial with stroke patients. *Journal of neuroengineering and rehabilitation*, 13(1), pp.96.

Fry, ST & Johnston, MJ (3th Ed) (2012), Ethics in Nursing Practice. Oxford, Blackwell publishing

García-Lizana, F. and Giorgo, F., 2012. The future of e-health, including telemedicine and telecare, in the European Union: from stakeholders' views to evidence based decisions. *Journal of Telemedicine and Telecare*, 18(6), pp.365-366.(PUBMED)

https://raijmronlineresearch.files.wordpress.com/2017/07/2_8-15-dr-nilesh-b-gajjar1.pdf

(Accessed 2.1.2020)

Gibson, j., lightbody, e., mcloughlin, a., mcadam, j., gibson, a., day, e., fitzgerald, j., may, c., price, c., emsley, h., ford, g.a. And watkins, c., 2016. 'It was like he was in the room with us': patients' and carers' perspectives of telemedicine in acute stroke (from pubmed)

Girone, M., Burdea, G., Bouzit, M., Popescu, V., Deutsch, J.L. 2001. A stewart platform-based system for ankle telerehabilitation, *Autonomous Robots*, 10(2), pp. 203-212.

Glännfjord, F., Hemmingsson, H. and Larsson Ranada, Å., 2016. Elderly people's perceptions of using Wii sports bowling—A qualitative study. *Scandinavian journal of occupational therapy*, 24(5), pp.329-338.

Graneheim & Lundman , 2004, Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness, *Nurse Educ Today*, 24, 2, 105-12.

Grove S & Gray J, 2019, “Understanding nursing research: building an Evidence-based practice”, *College of Nursing and Health innovation, Texas*, volume 4, p98-106.

Gund Miss B.M, G., 2013. Stroke: A Brain Attack. *IOSR Journal of Pharmacy (IOSRPHR)*, 03(08), pp.01-23.

Guroi-Urganci, I., de Jongh, T., Vodopivec-Jamsek, V., Car, J. and Atun, R. (2012). Mobile phone messaging for communicating results of medical investigations. Cochrane Database of Systematic Reviews. (EBSCO) <https://www.ubicare.com/stroke-recovery>
<https://www.heartandstroke.ca/stroke/what-is-stroke>

Harri-Lehtonen, O. Numminen, H. Vesala, H. 2014. Toimintakykyä ylläpitävä työote. Kehitysvamma-alan verkkopalvelu Vernerit. <http://verneri.net/yleis/toimintakyky-yllapitava-tyoote> read 10.2.2016 (read 11.12.2015 <https://www.iwh.on.ca/newsletters/at-work/88/new-world-health-organization-guidelines-on-rehabilitation-tap-into-institute-synthesis>)

Hudson, J., Board, E.M. & Lavalley, D. 2001. The role of cardiac rehabilitation in dealing with psychological loss among survivors of a cardiac event. *Journal of Loss and Trauma* 6, 301-312.

Kamal A. et al, 2015, *BMC Neurology*, “Improving medication adherence in stroke patients through Short Text Messages (SMS4Stroke) -study protocol for a randomized, controlled trial”, p.2-9.
<http://web.b.ebscohost.com.ezproxy.arcada.fi:2048/ehost/pdfviewer/pdfviewer?vid=4&sid=7cfe685e-2104-4716-a75d-0e4e5bf326d2%40pdc-v-sessmgr01>

Keshner, E.A., 2004. Virtual reality and physical rehabilitation: a new toy or a new research and rehabilitation tool?. *Journal of NeuroEngineering and Rehabilitation*, 1(1), pp.8.

Keshner, E.A. and Fung, J., 2017. The quest to apply VR technology to rehabilitation: tribulations and treasures. *Journal of Vestibular Research*, 27(1), pp.1-5.

Kielhofner, G., 2008. *A model of human occupation: Theory and application*. Lippincott Williams & Wilkins.

Kimberly A. N, 2016, *Content analysis guide book*, Sage publication INC, Cleveland State University, 438p.

Kondracki N, Wellman N, Amundson D, 2002, *Content analysis: review of methods and their applications in nutrition education*, *J Nutr Educ Behav*, 34, 4, 224-30.

Kristofferzon, M.L., Löfmark, R. & Carlsson, M. 2004. Coping, social support and quality of life time after myocardial infarction. *Journal of Advanced Nursing* 52(2), 113-124.

Laver, K., Lange, B., Gorge, S., Deutsch, J., Saposnik, G. & Crotty, M., 2017, Virtual reality for stroke rehabilitation, Cochrane Database of Systematic Reviews.

<https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD008349.pub4/full>
(22.6.2019).

Lennon, S., Ramdharry, G. & Verheyden, G., 2018, *Physical Management for Neurological Conditions*, fourth edition, Elsevier, United Kingdom. **Sciencedirect**

Lewis, G.N. and Rosie, J.A., 2012. Virtual reality games for movement rehabilitation in neurological conditions: how do we meet the needs and expectations of the users?. *Disability and rehabilitation*, 34(22), pp.1880-1886.

Lohse, K., Shirzad, N., Verster, A., Hodges, N. and Van der Loos, H.M., 2013. Video games and rehabilitation: using design principles to enhance engagement in physical therapy. *Journal of Neurologic Physical Therapy*, 37(4), pp.166-175.

Liu, S., Feng, W., Chhatbar, P., Liu, Y., Ji, X. and Ovbiagele, B., 2017. Mobile health as a viable strategy to enhance stroke risk factor control: A systematic review and meta-analysis. *Journal of the Neurological Sciences*, 378, pp.140-145. **Sciencedirect**

Matijevic V., Secic A., Masic V., Sunic M., Kolak Z., Znika M., 2013. Virtual Reality in Rehabilitation and Therapy. *Acta clinica Croatica*, 52(4), pp. 453-457.

Matthew-Maich N1, Harris L, Ploeg J, Markle-Reid M, Valaitis R, Ibrahim S, Gafni A, Isaacs S. (2016) Designing, Implementing, and Evaluating Mobile Health Technologies for Managing Chronic Conditions in Older Adults: A Scoping Review. [JMIR Mhealth Uhealth](#). 2016 Jun 9;4(2):e29. doi: 10.2196/mhealth.5127. (PubMed)

Ortiz-Fernández, L., Sagastagoya Zabala, J., Gutiérrez-Ruiz, A., Imaz-Ayo, N., Alava-Menica, A. and Arana-Arri, E., 2019. Efficacy and Usability of eHealth Technologies in Stroke Survivors for Prevention of a New Stroke and Improvement of Self-Management: Phase III Randomized Control Trial. *Methods and Protocols*, 2(2), p.50. (**google scholar**)

Ross Jamie, Fiona Stevenson, Rosa Lau & Elizabeth Murray (2016) Factors that influence the implementation of e-health: a systematic review of systematic reviews (PubMed)

Sarfo, F., Ulasavets, U., Opare-Sem, O. and Ovbiagele, B. (2018). Tele-Rehabilitation after Stroke: An Updated Systematic Review of the Literature. *Journal of Stroke and Cerebrovascular Diseases*, 27(9), pp.2306-2318. Google scholar

Strokecenter.org 2018, <https://www.webmd.com/heart-disease/stroke>, accessed 6.4.2020

Sucar L. Enricque, Roger Luis, Leder Ron, Hernandez Jorge and Israel Sanchez. 2008, *Gesture Therapy: A vision-Based System for Upper Extremity Rehabilitation*. (google scholar) https://www.researchgate.net/profile/Ron_Leder/publication/49628051_Gesture_Therapy_A_VisionBased_System_for_Upper_Extremity_Stroke_Rehabilitation/links/00b49514ae5eb30bc8000000.pdf

Teriö, M., Eriksson, G., Kamwesiga, J.T. and Guidetti S, 2019. What's in it for me? A process evaluation of the implementation of a mobile phone-supported intervention after stroke in Uganda. BioMed Central.(EBSCO)

Tchero, H., Tabue Teguo, M., Lannuzel, A. and Rusch, E. (2018). Telerehabilitation for Stroke Survivors: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research*, 20(10), p.e10867. (PUBMED)

The Pharmaceutical Journal, 2018. Stroke survivors need more support with taking medicines, survey finds.

Van Gemert-Pijnen, J., Peters, O. & Ossebaard, H., 2013. Improving eHealth. The Netherlands: Eleven international publishing.

Veerbeek, J., van Wegen, E., van Peppen, R., Hendriks, H., Rietberg, M., van der Wees, Ph.J., Heijblom, K., Goos, A., Hanssen, W., Harmeling-van-der We, B., de Jong, L., Kamphuis, J., Noom, M., van der Schaft, R., Smeets, C., Vluggen T., Vijsma, D., Vollmar, C. & Kwakkel G., 2014, *KNGF Clinical Practice Guideline for Physical Therapy in patients with stroke*, Royal Dutch Society for Physical Therapy (google scholar) https://www.kngf.nl/binaries/content/assets/kennisplatform/onbeveiligd/guidelines/stroke_practice_guidelines_2014.pdf (22.3.2020) .

Ventegodt, S., Merrick, J. and Andersen, N., 2003. Quality of Life Theory I. The IQOL Theory: An Integrative Theory of the Global Quality of Life Concept. *The Scientific World JOURNAL*, 3, pp.1030-1040.

Vloothuis, J., De Bruin, J. Mulder, M., Nijland, R., Kwakkelk, G. and Van Wegen, Erwin E. H., 2018. Description of the CARE4STROKE programme: A caregiver-mediated exercises intervention with e-health support for stroke patients. Hoboken, New Jersey: John Wiley & Sons, Inc. (EBSCO)

Vtulder, M., Kwakkel, G. and van Wegen, E. (2015). Caregiver-mediated exercises with e-health support for early supported discharge after stroke (CARE4STROKE): (SAGE)

WebMeb: <https://www.webmd.com/stroke/default.htm> (20.1.2020)

Weiss, P., Kizony, R., Feintuch, U. & Katz, N., 2006, Virtual reality in neurorehabilitation, In: Selzer, M., Cohen, L., Gage, F., Clarke, S. & Duncan, P. (eds.), *Textbook of Neural Repair and Rehabilitation*. Cambridge University Press, Cambridge (UK). (EBSCO)

Wentink, M., Bodegom-Vos, L., Brouns, B., Arwert, H., Vliet Vlieland, T., De Kloet, A. and Meesters, J. (2018). What is Important in E-health Interventions for Stroke Rehabilitation? A Survey Study among Patients, Informal Caregivers, and Health Professionals. *International Journal of Telerehabilitation*, 10(1), pp.15-2 science direct

W.H.O,2012 <https://www.who.int/ehealth/en/> Global Observatory for eHealth, W.H.O, (2012)

WHO ,2017 <https://www.iwh.on.ca/newsletters/at-work/88/new-world-health-organization-guidelines-on-rehabilitation-tap-into-institute-synthesis><https://www.stroke.org/en/about-stroke/types-of-stroke>

WHO, 2014).<https://www.who.int/healthinfo/survey/whoqol-qualityoflife/en/>

WHO | Stroke, Cerebrovascular accident. [online] Available at: https://www.who.int/topics/cerebrovascular_accident/en/ [Accessed 30 Sep. 2019].21.World Heart Federation. (2019).

Stroke -World Heart Federation. [online] Available at: <https://www.world-heart-federation.org/resources/stroke/> [Accessed 30 Sep. 2019].

Yachnin D., Gharib G., and Jutai J., (2017) ‘Technology-assisted toilets: Improving independence and hygiene in stroke rehabilitation’, *Journal of Rehabilitation and Assistive Technologies Engineering*. doi: 10.1177/2055668317725686.(SAGE)

Zimmerli, L., Jacky, M., Lünenburger, L., Riener, R. and Bolliger, M., 2013. Increasing patient engagement during virtual reality-based motor rehabilitation. Archives of physical medicine and rehabilitation, 94(9), pp.1737-1746. (PUBMED)

ÖGREN J., IREWALL, A., SÖDERSTRÖM, L. and MOOE, T., 2018. Long-term, telephone-based follow-up after stroke and TIA improves risk factors: 36-month results from the randomized controlled NAILED stroke risk factor trial. BioMed Central. (EBSCO)

APPENDIX

List of Selected Articles

Aldehaim, A., Alotaibi, F., Uphold, C. and Dang, S. (2016). The Impact of Technology-Based Interventions on Informal Caregivers of Stroke Survivors: A Systematic Review. *Telemedicine and e-Health*, 22(3), pp.223-231. Google scholar

Faria, A., Andrade, A., Soares, L. and i Badia, S., 2016. Benefits of virtual reality based cognitive rehabilitation through simulated activities of daily living: a randomized controlled trial with stroke patients. *Journal of NeuroEngineering and Rehabilitation*, 13(1), pp96. (google scholar)

GIBSON, J., LIGHTBODY, E., MCLOUGHLIN, A., MCADAM, J., GIBSON, A., DAY, E., FITZGERALD, J., MAY, C., PRICE, C., EMSLEY, H., FORD, G.A. and WATKINS, C., 2016. 'It was like he was in the room with us': patients' and carers' perspectives of telemedicine in acute stroke (from pubmed)

GuroI-Urganci, I., de Jongh, T., Vodopivec-Jamsek, V., Car, J. and Atun, R. (2012). Mobile phone messaging for communicating results of medical investigations. *Cochrane Database of Systematic Reviews*. (EBSCO)

<https://www.ubicare.com/stroke-recovery>

Kamal A. et al, 2015, *BMC Neurology*, “Improving medication adherence in stroke patients through Short Text Messages (SMS4Stroke) -study protocol for a randomized, controlled trial”,p.2-9.(PUBMED)

<http://web.b.ebscohost.com.ezproxy.acada.fi:2048/ehost/pdfviewer/pdfviewer?vid=4&sid=7cfe685e-2104-4716-a75d-0e4e5bf326d2%40pdc-v-sessmgr01>

Keshner, E.A. and Fung, J., 2017. The quest to apply VR technology to rehabilitation: tribulations and treasures. *Journal of Vestibular Research*, 27(1), pp.1-5. Pubmed

Keshner, E.A., 2004. Virtual reality and physical rehabilitation: a new toy or a new research and rehabilitation tool?. *Journal of NeuroEngineering and Rehabilitation*, 1(1), pp.8. (SAGE)

Lennon, S., Ramdharry, G. & Verheyden, G., 2018, *Physical Management for Neurological Conditions*, fourth edition, Elsevier, United Kingdom. **Sciencedirect**

Lohse, K., Shirzad, N., Verster, A., Hodges, N. and Van der Loos, H., 2013. Video Games and Rehabilitation. *Journal of Neurologic Physical Therapy*, 37(4), pp.166-175. **(google scholar)**

Liu, S., Feng, W., Chhatbar, P., Liu, Y., Ji, X. and Ovbiagele, B., 2017. Mobile health as a viable strategy to enhance stroke risk factor control: A systematic review and meta-analysis. *Journal of the Neurological Sciences*, 378, pp.140-145. **Sciencedirect**

Matthew-Maich N1, Harris L, Ploeg J, Markle-Reid M, Valaitis R, Ibrahim S, Gafni A, Isaacs S. (2016) Designing, Implementing, and Evaluating Mobile Health Technologies for Managing Chronic Conditions in Older Adults: A Scoping Review. *JMIR Mhealth Uhealth*. 2016 Jun 9;4(2): e29. doi: 10.2196/mhealth.5127. From PubMed

Matijevic V., Secic A., Masic V., Sunic M., Kolak Z., Znika M., 2013. Virtual Reality in Rehabilitation and Therapy. *Acta clinica Croatica*, 52(4), pp. 453-457. Google scholar

Ortiz-Fernández, L., Sagastagoya Zabala, J., Gutiérrez-Ruiz, A., Imaz-Ayo, N., Alava-Menica, A. and Arana-Arri, E., 2019. Efficacy and Usability of eHealth Technologies in Stroke Survivors for Prevention of a New Stroke and Improvement of Self-Management: Phase III Randomized Control Trial. *Methods and Protocols*, 2(2), p.50. **(google scholar)**

Ross Jamie, Fiona Stevenson, Rosa Lau & Elizabeth Murray (2016) Factors that influence the implementation of e-health: a systematic review of systematic reviews from PubMed

Sarfo, F., Ulasavets, U., Opare-Sem, O. and Ovbiagele, B. (2018). Tele-Rehabilitation after Stroke: An Updated Systematic Review of the Literature. *Journal of Stroke and Cerebrovascular Diseases*, 27(9), pp.2306-2318. Google scholar

Sucar L. Enricque, Roger Luis, Leder Ron, Hernandez Jorge and Israel Sanchez. 2008, *Gesture Therapy: A vision-Based System for Upper Extremity Rehabilitation*. **(google scholar)**
https://www.researchgate.net/profile/Ron_Leder/publication/49628051_Gesture_Therapy_A_VisionBased_System_for_Upper_Extremity_Stroke_Rehabilitation/links/00b49514ae5eb30bc8000000.pdf

TERIÖ, M., ERIKSSON, G., KAMWESIGA, J.T. and GUIDETTI, S., 2019. What's in it for me? A process evaluation of the implementation of a mobile phone-supported intervention after stroke in Uganda. *BioMed Central*.(EBSCO)

Tchero, H., Tabue Teguo, M., Lannuzel, A. and Rusch, E. (2018). Telerehabilitation for Stroke Survivors: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research*, 20(10), p.e10867. (PUBMED)

Veerbeek, J., van Wegen, E, van Peppen, R., Hendriks, H., Rietberg, M., van der Wees, Ph.J., Heijblom, K., Goos, A., Hanssen, W., Harmeling-van-der We, B., de Jong, L., Kamphuis, J., Noom, M., van der Schaft, R., Smeets, C., Vluggen T., Vijsma, D., Vollmar, C. & Kwakkel G., 2014, *KNGF Clinical Practice Guideline for Physical Therapy in patients with stroke*, Royal Dutch Society for Physical Therapy ([google scholar](https://www.kngf.nl/binaries/content/assets/kennisplatform/onbeveiligd/guidelines/stroke_practice_guidelines_2014.pdf))
https://www.kngf.nl/binaries/content/assets/kennisplatform/onbeveiligd/guidelines/stroke_practice_guidelines_2014.pdf (22.3.2020) .

VLOOTHUIS, J., DE BRUIN, J., MULDER, M., NIJLAND, R., KWAKKEL, G. and VAN WEGEN, ERWIN E. H., 2018. Description of the CARE4STROKE programme: A caregiver-mediated exercises intervention with e-health support for stroke patients. Hoboken, New Jersey: John Wiley & Sons, Inc. (EBSCO)

Vtulder, M., Kwakkel, G. and van Wegen, E. (2015). Caregiver-mediated exercises with e-health support for early supported discharge after stroke (CARE4STROKE):SAGE

Weiss, P., Kizony, R., Feintuch, U. & Katz, N., 2006, Virtual reality in neurorehabilitation, In: Selzer, M., Cohen, L., Gage, F., Clarke, S. & Duncan, P. (eds.), *Textbook of Neural Repair and Rehabilitation*. Cambridge University Press, Cambridge (UK). .(EBSCO)

Wentink, M., Bodegom-Vos, L., Brouns, B., Arwert, H., Vliet Vlieland, T., De Kloet, A. and Meesters, J. (2018). What is Important in E-health Interventions for Stroke Rehabilitation? A Survey Study among Patients, Informal Caregivers, and Health Professionals. *International Journal of Telerehabilitation*, 10(1), pp.15-2 science direct

Yachnin D., Gharib G., and Jutai J., (2017) ‘Technology-assisted toilets: Improving independence and hygiene in stroke rehabilitation’, *Journal of Rehabilitation and Assistive Technologies Engineering*. doi: 10.1177/2055668317725686.(SAGE)

Zimmerli, L., Jacky, M., Lünenburger, L., Riener, R. and Bolliger, M., 2013. Increasing patient engagement during virtual reality-based motor rehabilitation. *Archives of physical medicine and rehabilitation*, 94(9), pp.1737-1746. (PUBMED)

ÖGREN, J., IREWALL, A., SÖDERSTRÖM, L. and MOOE, T., 2018. Long-term, telephone-based follow-up after stroke and TIA improves risk factors: 36-month results from the randomized controlled NAILED stroke risk factor trial. *BioMed Central*. (EBSCO)