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Telemedicine and homecare: Present and future

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The purpose of this thesis is to describe the current status and the future of telemedicine. The aim of this study is to collect information on how telemedicine is utilized currently in health care, the advantages and disadvantages of it and the future aspects of telemedicine.

The study was conducted as literature review. The data for this study was collected from Cinahl and Medic databases in order to gather information from foreign and domestic sources. The systematic data collection was done during fall 2019 and winter 2020. Twenty articles were selected which passed the selection criteria. These articles were analysed using content analysis. Key points of the articles were gathered and simplified and finally divided into groups according to the subject.

Usefulness of telemedicine varies based on the type of illness the patient has. Telemedicine seems to have great benefits for patients living at home, suffering from skin conditions, those with chronic illnesses, and those with difficulties accessing care. Advantages of telemedicine include communication advantages; enhancement of informal caretakers' and self-care abilities; faster and more accurate data collection, analysis, and response; and an improved ability to modify patient behavior. Studies suggest that telemedicine also effectively reduces hospitalizations thus lowering costs. Concerns and challenges include the loss of physical interpersonal contact and connection, privacy and data protection concerns, cost and accessibility, difficulty of use, low rates of utilization, reduction in quality of care due to time restraints imposed by use of the technology, difficulties in integrating with varying systems, possible detrimental effects on professional ability, difficulty in defining and assigning responsibility and the potential to adversely affect rural physician availability. For telemedicine to be a good alternative to traditional care, it is important that these concerns and challenges be addressed and minimized in future.

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| Keywords | Telemedicine, telehealth, digitalisation |
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1 Introduction

The World Health Organization describes telemedicine as “the delivery of health care, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interest of advancing the health of individuals and their communities” (WHO, 2010).

Telemedicine is a growing and complex area in nursing and health care. Telemedicine has been growing trend, and the need for providing treatment remotely to increase cost-effectiveness has been key part in planning the future of healthcare. (Berkley, Miyong, Radhakrishnan & Xie. 2016). New models for health care need to be developed to answer for the increased demand, provide better access to care and increase cost-effectiveness of care, and telemedicine can be one model to answer these challenges in the future. The ongoing 2020 Covid-19 pandemic has increased the need for telemedicine and remote care dramatically.

The purpose of this thesis is to learn about this emerging and developing field in nursing by doing a systematic literature review, and compile information found using existing literature about the current state and future trends and aspects of telemedicine, as well as its benefits, challenges, and concerns.

2 What is telemedicine

The subject of this thesis is telemedicine and its use in homecare. Telemedicine is a term coined in the 1970s, which according to the World Health Organization (2010) literally means

“healing at a distance” and signifies the use of information and communication technologies to improve patient outcomes by increasing access to care and medical information. The term is not definitively defined, and the exact definition of telemedicine varied across the literature reviewed. Further complicating the analysis of telemedicine, the term “information and communication technologies” can refer to a large variety of devices. For example, in just the article by Cook et al., the following devices were included in the telemedicine service that was being reviewed: sensors to monitor safety (wrist worn fall detectors, epilepsy sensors, sensors that detect when a patient has left their chair or bed, mobile phone trackers, smoke alarms); devices that dispense and/or remind patients to take medications at allocated times; vital signs monitoring equipment (temperature, SP02, and pulse monitors); and communication facilitating devices (pendants and pagers) (2016: 6).

In other studies, smartphone apps (Allaert, Legrand, Abdoul Carime & Quantin, 2020), hearing and vision screening machines (Eksteen, Launer, Kuper, Eikelboom, Bastawrous, & Swanopel. 2019), complex cardiac devices (Fletcher & Meldrum, 2010), communication devices and programs, and even integrated telemedicine systems were classified as telemedicine. and even devices that can diagnose patients. Additional variations in these technologies include the different ways that collected data is transmitted to health care professionals with some devices automatically transmitting data, and others requiring patients to call in or manually enter data (Cook, Randhawa, Sharp, Ali, Guppy, Barton, Bateman & Crawford-White. 2016: 3). While this variation can make precise analysis difficult, for the purposes of this review telemedicine technology indicates technology facilitating communication between patients and health care workers, as well as technology that allows the measurement, analysis, and transmission of data.

2.1 Why telemedicine is relevant

One important reason why telemedicine is relevant and timely is the increasing elderly proportion of the population. According to the World Health Organization (2018), the proportion of the world's population over 60 (now 12%) will nearly double (to 22%), and the amount of people over 80 will grow from 125 million to 434 million by 2050. In addition, as a result of high living standards and unhealthy eating habits in much of the developed world, the amount of those with chronic diseases such as Diabetes type 2 is also rising and putting increasing strain on health systems (Klösch, Klösch, Kundt, van der Zee-Neuen, & Dieplinger. 2020) These and other increases in the demand for care will require more resources and personnel and/or more efficient use of these resources and personnel.

One method of providing care more efficiently is caring for patients at home. Home healthcare is one of the fastest growing healthcare sectors and is becoming an important part of the effort to reduce hospitalizations due to chronic disease (Berkley, Miyong, Radhakrishnan & Xie. 2016: 49). Living longer independently has been found to improve patients' perception of quality of life as well as reducing hospitalization, thus saving money and resources. (De Witte, Everink, Van Der Heide, Spreeuwenberg, Marieke & Willems. 2013). There are, however, some issues with existing homecare practices. For instance, in home hospice care, visits do not happen as often as needed or in a timely manner, especially for patients in remote areas (Phongtankuel, Adelman & Reid. 2018: 138). It was found during one study's review of United States Medicare data that over 30% of patients did not have any contact with the hospice care professionals during their last week of hospice care (Chan, Chiu, Ho, Lam, Lam, Lee, Lee, Lee, Loung & Leung. 2014: 138).

Telemedicine can help to address these shortages of professional visits and personnel by allowing for calls, messaging, or video calls that can facilitate contact between the patient

and/or informal caretaker without requiring transportation of the patient. The technology is less expensive than a nursing visit, can provide a daily coverage of patients, and allows nurses to schedule visits according to patient needs (Bendekovits, 2002). If technology facilitated check-ups occur at a higher frequency than the in-person visits, it can allow for early detection of symptoms and timely care, which could eliminate much of the cost of treating relevant illness at a later date (Long, Babbit & Cohn, 2017). Telemedicine can also be used to care for patients in remote locations or with other mobility handicaps. Previous research has shown that telemedicine helps nurses accomplish tasks quicker, and it also boosts job performance and communication with other professionals as well as with the patient (Barden, Kleinpell, McCarthy, Rincon, Zapatozny & Rufo. 2016).

While there are some great potential benefits to telemedicine, there are also concerns and challenges with telemedicine that need to be considered and addressed before telemedicine can be fully embraced. These concerns include potential inferior diagnosis with telemedicine due to the decrease in visibly accessible information, the inability of telemedicine to replace all face-to-face consultations, the adverse effects of overly independent and self-diagnosing patients, devices that are too complicated and not useable by all types of patients, and a lack of sufficient training on use of these technologies (Berkley et al, 2016). Other challenges include limited availability and high cost (De Witte et al., 2013) These and other challenges will be explored and elaborated on in this review.

3 Aims, purpose and study questions

In doing this research, the researchers aim to do learn from the literature about the current state and future trends of telemedicine, as well as its benefits, challenges, and concerns. As

this is an emerging and developing field, the answers to these questions cannot be definitively found, but this review will describe what current literature shows. The ultimate purpose of this thesis is to explore the practicality and feasibility of using telemedicine in the homecare of patients.

The following study questions will be answered in this review: (1) How cost-effective is this form of medicine as compared to traditional, in-hospital care? (2) What are the advantages and drawbacks of telemedicine as compared to in hospital care? (3) What are the barriers to implementing telemedicine, and how can they be overcome? (4) How will telemedicine change in the future?

4 Methods

4.1 Data collection

For this review, data was collected from reliable sources, primarily using scientific articles from the field of nursing and health care. Data was collected from Finnish and international databases that contain journals concerning nursing and health care. The databases used in this project were CINAHL and Medic. The articles were searched for with the following search phrases: remote nursing, nursing, telemonitoring, telecare, telemedicine, telehealth, homecare, tele homecare, negatives, cons, disadvantages. These search phrases were selected based on their ability to answer the study questions previously mentioned.

All the data for the review was collected with a systematic data collection method. Data collection was precisely defined, limited, systematic and repeatable. The criteria for exclusion and inclusion were objective. For the Thesis to be based on reliable and recent information, search results were limited to publications between the years of 2009 to 2020. Further selection criteria were that full text was available, results were written in English or Finnish,

related words apply, that they were from academic journals, and that the articles were peer reviewed. If there were over 50 results for a given search, the amount of results that were analysed was limited to the first 50 results. The articles were filtered for use in 4 phases. First the articles with titles relating to the study questions were selected. Then from those, the abstracts were read, and if the articles still seemed to be useful and relevant based on the selected criteria they would not be filtered out. Finally, the text of each was read, and if it was found to be relevant and useful, the article was selected for analysis. 20 articles were selected with this process for further data collection.

The articles were read through carefully, and relevant points relating to the study questions were extracted from the articles. The points were either paraphrased or quoted directly, with attention paid to correctly citing the extracts to ensure that proper credit was given to the authors of the articles.

4.2 Data analysis

The content analysis in this literature review was done systematically and objectively. The objective was to produce compressed information from the collected data based on the study questions. In a literature review, different research material is combined, and synthesis is produced from previous research data. (Kyngäs & Vanhanen, 1999) In order to accomplish this, after all the relevant data was collected, a thematic analysis of all the extractions was done, and the data was sorted into the different themes. From there further subthemes were found, and with these subthemes, the content of the results, discussion, and conclusion were created.

5 Results

Table 1. Data collection methods:

| Database | Search words | Selection criteria | Results | Selected according to headline | Selected according to abstract | Selected according to full text |
|----------|---|--|-----------------------|--------------------------------|--------------------------------|---------------------------------|
| CINAHL | Patient education AND Digi* | 2009-2019 Full text, English, Academic Journals | 93 | 8 | 4 | 3 |
| CINAHL | Telemedicine AND nursing | Full text, 2009-2019, Academic Journals | 340 | 7 | 5 | 2 |
| CINAHL | Telemed* AND home* | Full text. 2009-2019, English, Academic Journals | 7 | 3 | 3 | 2 |
| CINAHL | Telemedicine OR telehealth AND nursing AND Homecare | Full text, 2009-2020, English, Academic Journals | 1997 (first 50) | 17 | 10 | 4 |
| CINAHL | Negatives OR cons OR | Full text, English, | 94 (first 50) | 18 | 9 | 6 |

| | | | | | | |
|-------|---|---|----|---|---|---|
| | disadvantages OR bad AND Telemedicine OR telehealth OR Telecare | 2009-2020, Academic Journals | | | | |
| Medic | Nurs* AND Tele* | Full text, English or Finnish, 2010-2020 | 46 | 5 | 3 | 3 |

6 Discussion

There were certain themes for the results that reoccurred throughout the articles reviewed which will be discussed in this section. These themes, as well as the answers to the study questions are divided into the following categories: the beneficiaries of telemedicine, the benefits, and the challenges and concerns.

To avoid biased reporting on the data, the selection of the articles was done on a basis established before the research had begun. The search terms used follow logically from the study questions, and the process of elimination of non-relevant literature was made clear and is repeatable. Chosen search terms gave researchers all the essential information and material needed for the literature review. Reporting on the articles was done as objectively as possible, the method of analysis being explained above to ensure validity. These research

methods were presented to and approved by a supervising teacher and two peers. No data will be used without proper accreditation and citation to respect intellectual property.

6.1 Beneficiaries

The usefulness of telemedicine varies also based on the type of illness the patient has. Generally, telemedicine seems to have great benefits for patients living at home, and the general benefits for patients at home will be discussed in the later benefits section. However, there are also different specific populations of those needing healthcare that seem to benefit significantly from telemedicine. Those populations include those with skin conditions, those with chronic illnesses, and those with difficulties accessing care due to physical or economic limitations.

6.1.1 Skin Conditions

Telemedicine can be very useful as part of the care of skin conditions since they are usually visible on the surface of the skin. According to Tronier and Harrison, pictures and recording the progression of these conditions provides useful data for clinicians. Doing so allows them to see how the disease and or treatment is progressing, and to respond in real time to these changes. In addition, self-examination by patients is an important part of diagnosing disease, such as melanoma, early enough to improve outcomes, and the monitoring prompted by using such programs can help patients to detect diseases earlier. There are also some companies trying to provide apps that will give an instant diagnosis of skin conditions, but there are many challenges and much potential for mistakes to be made if not properly supervised. It will likely be first used for clinical support by specialists before it is polished enough for consumer use. Because of this, dermatology apps are now focused on collecting

transmitting data, such as images, medications that are used, depression and anxiety levels which can empower patients to make behavioural changes. The data collected can then be discussed during the next doctor-patient communication. It may be in the future that the technology will progress enough that apps can diagnose diseases without doctor input, and the doctor would only be needed to give prescriptions if needed. As of now though, this is a very promising advancement for telemedicine and an area where it seems to be well suited for use. (2019: 42-43).

6.1.2 Chronic diseases

Chronic COPD and heart failure impose a significant burden on individuals and health care systems worldwide (Hunting, Shadid, Sahakyan, Fan, Money Penny, Stanimirovic, North, Petrosyan, Krahn & Rac 2015). These and other chronic diseases generate a high amount of hospitalizations and health care costs, many of which can be avoided by proactive treatment and monitoring (Hunting et al, 2015). Telemedicine can be an important part of the solution to those issues. Heart failure, hypertension, diabetes, and COPD in people 65 above were common diagnoses for tele-homecare services in one study (Berkley et al., 2016, p. 51). In the Ontario tele homecare program that Hunting et al. studied, patients were given pulse oximeters, blood pressure cuffs, floor scale and touch screen tablet. They were instructed on how to use these devices and how to report the results with the touch screen tablet. Results were monitored by health care professionals and this daily transmission of patient data was used to individualize a care plan based on the needs of the patient. This and other telemedicine interventions and have shown promise in reducing hospitalization, improving quality of life, self-management, and access to care for people suffering from chronic diseases (Hunting et al, 2015).

Another example of how telemedicine can help to treat chronic diseases is shown with diabetes type 2. With approximately 422 million people affected (World Health Organization, 2020), type 2 diabetes mellitus is one of the most common diseases worldwide. The associated healthcare costs for this disease alone globally amount to \$827 billion each year. The condition is linked with an unhealthy lifestyle and inadequate health literacy. Type 2 diabetes forms the basis for the development of other serious diseases, such as strokes, polyneuropathies, and heart attacks (World Health Organization, 2020). According to Klösch et al., the demands on health services are rising as more people are diagnosed with this condition, and eHealth services (e.g. Mobile phone applications, email consultations, calling, and webcams) are increasingly being integrated into nursing care to meet this demand. Studies on the effects of electronic patient centered systems have found a positive impact on the course of treatment. Computer-assisted decision making, access to symptoms for nurses in real time, and digital prescription of medications can sustainably improve care for these patients. Integrating eHealth systems into diabetes treatment was recognized as helpful by both affected patients and health personnel in the studies reviewed. The use of digital systems generally had a positive effect on the health-related outcomes of the patients. Patients had the opportunity to view their symptoms in graph format and could add questions in their own words as comments (2020).

There is also great potential for telemedicine interventions to help with chronic diseases in the developing world, where 80% of all Non-communicable disease deaths occur (Saleh, 2018, p. 53). The use of a relatively low-cost interventions in the form of SMS reminders and information sent to diabetic and hypertensive patients in rural and refugee camp settings in Lebanon proved to be very successful in prompting and supporting behavioral changes and other treatment strategies. 81% of the 1000 participants surveyed perceived improvement in self-management, lifestyle medications, or overall life quality improvement, and there was generally high satisfaction with the program (Saleh et al., 2018). This is an example of how not all telemedicine is high cost or requires high levels of training from participants. With the

lack of access to treatment that affects many people around the world, even simple Telemedicine interventions like this can have great effects.

6.1.3 Patients with physical barriers to accessing care

Another common theme of the literature was that the one of the most sizable groups of telemedicine beneficiaries, and an important reason for the development of these technologies, are remote patients and others with physical barriers to care access. These patients can be those that are physically distant from health centers or relevant specialists, or those that have transportation difficulties due to health conditions or handicaps. For instance, in Germany there is a lack of rural physicians. This lack causes a decrease in speed of access and quality of care for rural patients, which has prompted Germany to give a lot of consideration to telemedicine to deal with this issue. (Nerlich, Herbst, Ernstberger & Blaetzinger, 2019: 72-73.)

Finland is an example of another country with similar issues. With nearly 70% Finland being sparsely populated rural area, and approximately 400 000 people living in rural and remote locations (Stat.fi) far away from health care providers, using telemedicine to address and improve the access to care for this population is highly important and cost effective. Another example is Brazil. In Brazil “large territorial extension, thousands of isolated and difficult access places, extremely unequal distribution of good quality medical resources, among other aspects that are challenging the realization of the right to health, allow us to predict the existence of a great potential for the expansion of telemedicine in the country” (Santana, Dantas, Soares, Hercules & Leite 2018: 4.) It is important that these patients are not abandoned, and these countries and many others should consider telemedicine to mitigate this issue.

For other patients, even if they do not live far away from health centers, it is still difficult to physically access them. Dementia patients, for example, are difficult to transport, and telemedicine may offer a much easier alternative to caretakers, allowing them to be treated at home instead (Santana et al., 2018: 1). At-home hospice patients are also a population that could benefit greatly from telemedicine, both due to the fact that due to their commonly fragile state it is often preferable not to move them, and also that telemedicine could help to address the lack of timely and consistent care for them (Phongtankuel et al., 2018: 137-138). To illustrate this lack of timely care issue, it was found during research using Medicare data that over 30% of patients did not have any contact with the hospice care professionals during their last week of hospice care (Phongtankuel et al., 2018: 138). Other patients that have difficulty in being transported to the hospital would likely also benefit from telemedicine and the fact that it allows patients to be treated at home.

6.1.4 Patients with economic barriers to care access

Physical barriers to access are not the only reason why some populations have difficulty accessing healthcare, another important barrier to care is poverty. As already mentioned previously about the study from Lebanon, telemedicine can be a way to improve access to lower income populations of the chronically diseased (Saleh et al., 2018). In another study out of South Africa (Eksteen, Launer, Kuper, Eikelboom, Bastawrous & Swanoepel 2019), which looked at the effect of mobile health technology supported community-based hearing and vision screening program, it was found that its use allowed community health workers to provide a low cost and accessible service, which also relieved some of the strain on resource constrained public health institutions. Hearing and visual impairments are the most common disabilities in children under 5, and services to treat this problem like these are often unavailable in low to middle income countries due to lack of funding and trained personnel. It was stated in the study that “mHealth has been recognized as increasingly important in

supporting the achievement of the sustainable development goals and addressing access and affordability concerns in underserved populations” (2019: 672).

6.2 Benefits

Telemedicine has been shown to have many benefits in its current state, and it may prove itself to be even more beneficial if further developed. The benefits found in the literature include communication advantages; enhancement of informal caretakers' and self-care abilities; faster and more accurate data collection, analysis, and response; improving behavioral modification; reducing hospitalization; lowering costs; and increasing patient confidence in the healthcare process.

6.2.1 Communication Advantages

Communication is very important in healthcare, and it is something that telemedicine can improve. With normal oral communication, both the sender and receiver are affected by information and perception biases. Telemedicine has the potential to deliver structured, focused, and thorough information between the sender and the receiver. Especially in life-threatening situations, quick accurate exchange of info is vital (Nerlich et al., 2019: 72-73), and more clear, precise communication can help doctors to make better decisions, and could reduce the errors caused by unclear transmission. It can also reduce the distortion of information that could result if information is relayed second-hand, which depends on the memory and communication of both the first and the second communicators. The clearer the information that health care professionals receive, the easier it will be to make precise decisions about the patient's care.

Besides direct clarity advantages, telehealth can also improve communication by lessening the amount of time used in an interaction and reducing the potential impact of non-verbal communication distortions as found in the study by Quieroz de Souza and his colleagues (2018: 934). Telemedicine can also make communication easier. For example, the Ontario Telemedicine Network now “allows a secure platform that bridges patients and their healthcare providers through personal devices such as smartphones that allow for interactions from any provider location to any patient location at any time of day” (Law, McKenzie, & Law, 2019: 156). In a separate study by Barden and his colleagues (2016), which assessed the impact of telemedicine on nursing care in intensive units, the majority of nurses felt that the telemedicine made collaboration and their job easier. As quoted in the study: “Respondents reported that communication (60.4%) and collaboration (65.9%) were improved with tele-ICU, and skilled communication and mutual respect ranked high in both phases of the study” (2016: 18). While this study was done in an intensive care unit, clearer communication is helpful in any nursing field. Precise communication between patients, informal caregivers, nurses, physicians and whoever else is involved in the care of these patients at home can help to ensure that the right care is given at the right time and for the right reasons.

6.2.2 Enhancement of informal caretakers' and self-care abilities

Oftentimes much of patient care, for instance in chronic disease patients, is done independently at home or by an informal caretaker. 60-70% of hospice patients that live at home, for example, are often are cared for by both health care providers and informal caregivers, with most of the work being done by informal caregivers (Phongtankuel et al.,

2018). Helping these patients and informal caretakers to best care for themselves requires good patient education and adequate cooperation with professional health care works. Telemedicine can be useful in accomplishing these things. In a qualitative study of British telehealth adopters, people who used the tech generally agreed on the equipment's usefulness in allowing them to monitor their own condition (Cook et al., 2016: 12) It was found in a separate study (Hunting et al., 2015) that Telehealth gave patients and informal caretakers a sense of security and confidence in managing their own care at home, and its use reduced reliance on traditional health care for their health concerns when they did arise. The study also found that all participants found great potential in the program to help them manage and be aware of their condition and the best ways to treat it. Additionally, Lempiäinen (2019) found in her qualitative study that telemedicine was well-suited to client groups in need of guidance and counseling, and brought many benefits to said clients (Lempiäinen 2019). The right guidance and counseling are important parts of enhancing the informal caretaker's and patient's abilities to best care for their condition.

Educating and giving the proper resources for informal caretakers can mean better quality care for patients. Oftentimes in the care of dementia patients, the caretaker is a relative, who may not have sufficient knowledge of how to communicate and how to best care for the patient, meaning they are in need of support from health professionals (Santana et al., 2018: 1). Telemedicine can allow for synergistic care connecting professionals and informal caregivers. It can enable mutual tracking of vital signs and important data by both the professionals and the informal caretakers and allow professionals to easily give instructions for the best care to informal caretakers, without needing to physically come to the residence. As another example, telemedicine can allow patients/caretakers to request medications or supplies when needed for care (Phongtankuel et al., 2018: 139). Telemedicine can also be used to track caretaker wellbeing, allowing for adjustments to care to fit their needs, likely in the form of more visits or support from professionals (Phongtankuel et al., 2018: 138)

An example of a well-made system that enhances these care abilities is QuietCare, which monitors the activities of homecare patients. Data collected by the sensors, without patient input, can be used by caregiver to adjust care plans. Due to the design of the product, the study found that the Quietcare system did not have a significant impact on clients' perceptions of independence or quality of life. The use of this system also resulted in 75.9% of informal caregivers reporting that the system allowed the client to be cared for without interruptions to his/her daily activities and it had a significant impact on their subjective burden (De Witte et al., 2013).

6.2.3 Better data collection and response

One of the advantages of telemedicine is that it can allow for more frequent and regular data collection and transmission, which can help health care professionals make better decisions for the care of their patients. While the data collection and transmission methods of telemedicine care differ, real time automatic transmission of data is a form that can be especially useful. As an example, Velardo et al., in their study on the use of telemedicine to help treat COPD patients, found that one of telemedicine's main advantages was that it allowed for remote and direct collection of health-related data from patients at home, as well as facilitating the systematic administration of questionnaires. In another study, a qualitative analysis of Tele homecare in Ontario, nurses and administrators in the program told that a big part of their work consisted of monitoring and managing patient data along with providing regular care for the patients and communicating with all the other members of the care team (Hunting et al., 2015). While this data is also collected in traditional care, telemedicine can help to increase the frequency of the data collection, by making it more convenient or even automatic.

This increase in the amount of data can then be utilized to increase the quality of patient care. One thing that this continuous collection and transmission of data relating to patient conditions can enable is prompt contact with nurses and other health professionals in cases of health deterioration. This form of real time data collection and tracking can also improve hospice care by helping professionals to make more rapid adjustments to care and medications to minimize suffering of the patient (Phongtankuel, Adelman & Reid, 2018: 138). This tracking can also be very useful in cardiological care, where early detection of warning signs and symptoms is very important, since a delay of care for cardiac disorders is one of the main causes of death (Quieroz de Souza, Goncalo de Oliviera, Silva Santana, Mulatinho, Cardoso, Ferreira, Batista & Jael 2018: 937) In the study by Berkley et al. (2016: 49), it was found that “daily monitoring of patients via tele-homecare can enable home health care nurses to detect early warning signs, prevent expensive emergency department visits, and reduce the frequency of hospitalizations, allowing patients to feel secure at home and improving their quality of life” Another study on cancer patients, self-reporting symptoms with an online platform was associated with an increase in median overall survival (Phongtankuel et al., 2018: 138). Having enough data can also allow resources to be optimized and distributed in a sensible way (Klösch et al. 2020).

A more specific example of this kind of use is described by Fletcher (2010) in the rise in implantation rates of complex cardiac devices such as implantable cardioverter defibrillators, cardiac resynchronization therapy pacemakers, and defibrillators. This rise has occurred in response to several large randomized clinical trials confirming that the use of these devices reduces mortality and improves heart failure symptoms. The escalating number of patients implanted with these complex cardiac devices has led to increasing pressure on technical device follow-up clinics, therefore new, innovative follow-up methods have had to be explored. The devices are able to transmit data stored in the patient’s device which is retrieved by the home monitored and transmitted via a telephone network. This kind of remote monitoring can prevent inappropriate therapy and can deactivate or reactivate shock therapy

before and following surgical procedures. This data can also give the ability to intervene early in an arrhythmic event and result in the patient needing less severe treatment. This system has been found to be a reliable early warning system to indicate worsening heart failure. This is an important development, as the number of implantations of these devices are growing. This is not intended to replace in-person follow up completely, but it may mean they are seen just when they need to be seen, instead of on a recurring schedule. (Fletcher, 2010)

6.2.4 Behavioural modification

Telemedicine can also be an important tool in helping patients to modify health related behaviour. It was found in a systematic review by Santana and colleagues that telemedicine use improved elderly behavioral management skills and perceptions of caregiver's care load. The same study also found an improvement in adherence to treatment, improvement in quality of care, and better understanding of caretakers of pathology and comorbidities (2018: 4).

Mobile phones are great ways to transmit data and information, and since many people have and use their phones all the time, they don't require any additional technology to be bought, saving money and time for the patient and health care provider. Phones are useful for many different applications of telemedicine. For instance, mobile phone apps are often used to modify behaviour. Typical uses for such health apps are monitoring weight, promoting fitness, and reducing calorie and alcohol consumption (Tronier & Harrison, 2019: 42). The use of SMS messages in rural areas and refugee camps to help treat disadvantaged patients with chronic diseases is also an example of how telemedicine can help with behavioural modification. (Saleh et al., 2018). Saleh et al. stated in their study "There is evidence from various countries regarding the potential of mHealth in addressing NCDs through health education and self-management, improving prevention and treatment strategies, and

providing appointment reminders to improve compliance and attendance in PHC” (2018: 53-54).

6.2.5 Less hospitalization

Without a telemedicine system, patients must go to hospitals to obtain healthcare service. Since telemedicine facilitates remote treatment of simple ailments and quick treatment responses to data collected and transmitted, it can reduce the amount of these hospitalizations needed. Unnecessary hospitalizations cost money, put strain on health care systems and take time and resources away from for whom physical care is the only option. Santana et al. (2018) found in their study that telemedicine can reduce the need for primary care, help avoid unnecessary hospital admission, and allow the elderly to live at home longer. It has also been shown, as explained in the above “Behavioral Modification” section that Telemedicine can help treat and promote lifestyle changes for sufferers of Chronic diseases, which can reduce the need for treatment later.

6.2.6 Reducing costs

One of the main benefits of telemedicine is that it reduces the costs of healthcare for health care systems as well as individual patients. An example of this comes from the Lebanon study (Saleh et al., 2018), where SMS messages proved to be very effective in promoting behavioral changes in chronic disease patients, thereby saving the health care system the capacity and resources needed to treat them if the behavioral changes were not done. The community health mobile health screening project in South Africa (Eksteen et al., 2019) also shows how technology has helped to provide low cost and accessible services to low income communities, taking a load off resource constrained public health institutions in the process.

As stated in the article: ““The program had a low cost of screening per child, high participation numbers, high attendance of those who failed initial screening and immediate rescreening at the community-based second screening and overall low proportion of children receiving a diagnostic referral to a public health institution” (Eksteen et al., 2019: 676). In another study, it was also found by Fletch and Meldrum (2010) that remote monitoring reduced number of routine follow-up visits by at least half without compromising the safety of the patient, saving the costs associated with the follow-ups.

Telemedicine can also potentially save costs in other areas, such as homecare. Homecare is becoming an increasingly popular way to treat patients, as portrayed by the fact it is one of the fastest growing sectors of healthcare (Berkley et al., 2016: 49). There are significant challenges with homecare, such as decreasing payments for the services and increases in accountability for patient outcomes. This means there is need for innovations to provide more care, as well as more effective care for these home care patients, which tele-medicine may be able to help with (Berkley et al., 2016: 49). Other areas where telemedicine can reduce the costs of healthcare is through the reduction in travel and parking costs, and the costs of lost working hours or days if the patient needs to be hospitalized for longer periods of time.

The Tele-doctor service is another example of a promising telemedicine concept that could help to reduce costs. In this service the doctor chooses their patients and designates tasks for specifically trained telemedicine assistants. The assistant then goes to the patient’s home and takes data (vital signs or others) and doctor gets data and can respond and video chat if deemed necessary. Neither the doctor nor the patient needs to be physically present, saving both time and resources. This concept won Telematik-Award (2017) for concept with promising future (Nerlich et al., 2019: 76). This concept would require specialized and thorough training of the telemedicine assistants and clinicians but given those conditions it has a lot of potential.

6.2.7 More confidence in care process

Part of optimized healthcare is helping to reduce the stress and uncertainty associated with healthcare by educating patients and encouraging questions. Telemedicine can also be useful to increase patient confidence in their healthcare. When patients know they are being monitored and that health care workers can respond quickly to any situation calling for response, it can help them feel more secure in their safety. Cook et al (2016) found in their qualitative study of telemedicine users and non-users that in general, patients got increased sense of security and assurance along with improved access to clinicians as benefits. The study also found that patients reported feeling cared about and that more capable of self-monitoring their condition.

Patient reported more positive experience than clinicians (felt cared about, promoted self-monitoring) (Cook et al., 2016)

6.3 Challenges and Concerns

While there is a lot to be excited about with telemedicine, and many potential benefits, there are also significant and numerous concerns and challenges to be considered and addressed. The challenges that were found in the literature include: the loss of physical interpersonal contact and connection; privacy and data protection concerns; cost and accessibility; difficulty of use; low rates of utilization; reduction in quality due to insufficient time to care; difficulties in integrating with varying systems; possible detrimental effects on professional ability; difficulty in defining and assigning responsibility; potential to adversely affect rural physician availability; and that more development and research needs to be funded and done . In order for telemedicine to be a good alternative to traditional care and to be worth investment in by governments and businesses, it is important that these concerns and challenges be addressed and minimized. In this section we will discuss these

challenges and concerns, and also discuss any potential solutions to them found in the literature.

6.3.1 Loss of physical interpersonal contact and connection

A significant part of healthcare is the interpersonal contact and connection that emerges between patients and their health care providers. There are concerns that if telemedicine becomes more widely used, it may replace this in person care, during which a good relationship can be established and which may allow for closer inspection of things that may not be noticed through the telemedicine program (Phongtankuel et al., 2018: 139). It was found by Nerlich et al. in their analysis of the usefulness of telemedicine in orthopaedics and trauma surgery, that “online chats or video calls with the responsible physician are currently less appealing for patients”(2017: 73) There is concern that this could lead to a dehumanization of medicine, which would be unacceptable because telemedicine should only be used if it provides a better quality of patient care (Allaert et al., 2020). There is also concern from Allaert and his colleagues that if telemedicine does prove to be much cheaper and more efficient, and as a result becomes more popular, that it may be used as a replacement for traditional care without careful consideration of patient’s symptoms.

A potential solution to the dehumanization and loss of connection concern is that, as much of the material has suggested, telemedicine should not replace in person care, but rather complement and add to it. The amount of interpersonal contact could also be ideally flexibly adjusted based on patient needs and wants. It was found in a study about personal telemedicine device for cancer care that telemedicine synergized with in person care, instead of just replacing it (Law et al., 2019: 157). It was also found in a study on telemedicine use for the care of elderly Alzheimer patients, that the primary use of telemedicine for these patients was to complement face-to-face care, assist caregivers, and to follow up on previous

care (Santana et al., 2018: 4). As of now, the technology is not good enough to replace in person care and should not try to do so. Health care professionals should see telemedicine as a tool they can use to optimize the care of their patients and their own wellbeing.

6.3.2 Privacy and data protection

As more and more documents, resources, and data have been moved online in recent years, privacy and data protection are becoming increasingly important issues across many sectors. Privacy and data protection are also very important and relevant issues in the adoption of telemedicine technology (Phongtankuel et al., 2018: 139). There is potential that the information could be intercepted by malicious actors, or that databases housing such information could be hacked into and compromised. Hackers could use this data to take advantage of people and financially damage them.

There are some ways that these concerns can be addressed. With smartphones, the protection of medical confidentiality on networks can benefit from cryptographic techniques, and patient records can be exchanged on electronic platforms placed at approved health data hosts in order to constitute electronic evidence, duly authenticated and time-stamped in the event of a medicolegal challenge, which is not currently the case on most current telemedicine systems (Allaert et al., 2020) Some countries have worked to address this issue. In Germany, the concern of remote data transmission being interceptable and exploitable is addressed with mandatory end-to-end transmission (Nerlich et al., 2019: 76). Manufacturers and developers should address these issues before telemedicine systems are released, and regulators should create a system to assure that these systems are secure, and that patient information is kept private.

6.3.3 Cost and accessibility

Many of the devices that are being used and are being developed for use in telemedicine may be too costly or inaccessible for some patients and/or health systems. Patients may be unable to afford devices, or the internet services required for them to function (Phongtankuel et al., 2018: 139). Phongtankuel et al. found, as an example, that according to 2017 Pew Research Center data, only 42% of US adults 65 and older owned a smartphone. This is an issue because smartphones are commonly used in telemedicine to transmit and measure relevant data and are a cheaper alternative to other devices that may be used. As another example, although remote monitoring reduces the time spent and cost for the patient, this requires an initial time investment in setting up remote monitoring clinics. This often requires lengthy legal processes as well as thorough training for patients and health care professionals. (Fletcher & Meldrum, 2010).

The fact that the technology is often developed and improved upon so quickly also makes this more of an issue. Is it worth buying an expensive telemedicine device when it may be improved upon and obsolete in 2 years? These are issues that needs to be considered and addressed by telemedicine development plans. It may still be worth the investment in the long term, but the costs of these set ups and training should be considered

6.3.4 Difficulty in using

Many of the new technologies being developed are complex and require the training of patients and health care workers in order to be fully utilized. Certain patient populations such as the elderly have difficulty using more complex assistive technologies, and that may be why they are often hesitant to use them. More basic technologies are often more acceptable to the elderly (Cook et al., 2016: 2). It was found by Klösch et al. that an important factor in the acceptance of telemedicine is the ease of use of the system (2020). One method of

training patients to use these devices is through the distribution of written instructions, such as leaflets. However, if the devices are complex these written instructions may be long and complex as well. It was found in a study of UK telehealth service users and non-users that patients often felt overwhelmed with leaflets and written information about the technology and found it difficult to read and comprehend it all (Cook et al., 2016: 9). It should be a goal of telemedicine developers to develop simple to use technology as well as simple instructions. If health care workers are adept at using the technology, they could ideally educate the patient on how to use it at the time of referral.

Difficulty using the technology can also lower the amount and quality of its use by healthcare workers. According to Klösch et al. in their study of telemedicine systems used for the care of type 2 diabetes patients that most of the problems during the implementation were due to a lack of relevant computer skills among nurses or patients (2020). Koivunen and Saranto had similar conclusions in their study, in which they found that some nurses lacked even basic keyboard skills and that inadequate support and training were barriers to telemedicine use (2017). In a Finnish study done by Riina-Malla Kosonen, nearly half of the participating health care professionals reported that due to lack of resources there is not enough time to familiarize oneself with new technology needed in tele healthcare. (Kosonen, 2018). Informal caretakers should be trained as well. In a study by Hunting et al., it was observed that informal caregivers oftentimes helped patients use the technology by physically helping in use and reminding patients to take the readings (Hunting et al. 2015). Time and resources should be invested in training these workers to effectively use the technology.

Those in charge of technical support should be knowledgeable as well. Technical issues are bound to occur with these technologies, which may discourage use, especially if they are not dealt with quickly, or if the people in charge of fixing the issues are not sufficiently knowledgeable to fix it (Cook et al., 2016: 17). Ensuring that IT professionals working with the technology have adequate training can also make it easier for healthcare workers to deal

with technical issues (Klösch et al. 2020). In order to maximize patient usage of these technologies, it is important that timely individual technical support is available so that patients are able to get answers to questions they have. If patients, as well as healthcare workers, feel supported and are confident in the ability of these technicians to use the technology and help them in a timely manner to deal with any issues, they will be more likely to persevere in learning how to use the systems.

There are also some more niche concerns that effect some potential beneficiaries of telemedicine. One concern is that much of this would be unusable by those that are illiterate. In the Lebanon SMS intervention study, it was found that one of the limitations of the program was that it required people to be literate, which not all were. Those in charge of the program were considering adding voice messages to the program to address this (Saleh et al., 2018: 61). In homecare, adoption of more accessible technology is needed to allow patients with disabilities and complex conditions to participate in tele-homecare programs (Hunting et al, 2015). If telemedicine does become widely used, it will likely need to develop programs and devices usable by blind, deaf, and otherwise physically or mentally handicapped patients as well. These issues should be considered and addressed by those creating long-term plans for the use of telemedicine.

6.3.5 Low rates of utilization

Telemedicine will only be effective and useful if people are willing to use it. Despite the seeming abundance of reasons for use and potential, utilization remains low in many areas. Utilizations in homecare of these technologies was found to be still low in one study, with for instance only an 11% increase in tele-homecare use from 2007-2013 (Berkley et al., 2016: 50). Velardo et al. found in their study that there was a lack of compliance with recommendations for use of telemedicine technology, and that a significant factor effecting

adoption was difficulties encountered in engaging participants and clinicians. They also found in their review of the literature that many studies reported that patients had difficulties using the technology, which led to low compliance rates (2017). This point just underlines the importance of developing easy to use technology, with proficient technical support available and easy to understand instructions.

The attitudes of health care workers towards the technology was also an important factor in adoption rates. Koivunen and Saranto (2017) found that despite the benefits, some nurses still had mixed feelings regarding the use of the technology. In the study done by Barden et al. (2016) about the use of telemedicine in intensive care units, they identified the attitudes of ICU and tele-ICU staff as the most significant barrier to use of the technology. Cook et al. in their excellent and comprehensive study of the factors influencing the decision to adopt and engage with telemedicine, found that for nurses there was a lack of training and uncertainty about the actual effectiveness which were made them unconvinced of the effectiveness of the technology. Some nurses also felt that this technology was simply being implemented to drive down costs, that the program just meant more work for them, and felt that adoption was a threat to their nurse identity. They also were unhappy that their input was rarely sought, and they felt the change was being forced upon them (2016: 65-68). To avoid these issues nurses should feel that they are part of the decision to implement this technology, their concerns should be respected and addressed, and the benefits for them and the patients they are treating should be made clear.

In most cases, it is reported that the motivation and positive attitude to implement new things among health care professionals was a key facilitator. If health care professionals can see the potential of telemedicine in improving and optimizing their own workload, implementing these solutions was highly successful. Another solution could be that, as Quieroz de Souza et al. suggested, training for the use of this technology should be started at undergraduate level to follow current technological era (Quieroz de Souza et al., 2018: 936) The use of

Telemedicine requires a lot of competence, and if telemedicine is to prosper, education of its use for both professionals and patients should be a top priority (Lempiäinen, 2019). Cook et al. concluded that much of nurses' concerns could be addressed by improved training and orientation, improved guidelines, and improved telemedicine systems (2016: 69). It is also very important that the reasons for use, and the advantages that said use can have, should be repeatedly mentioned, and made clear to patients and professionals so that it does not seem like a meaningless burden.

6.3.6 Reduction in quality due to insufficient time to care

Telemedicine reduces the amount of time needed to care for a patient, as explained in the benefits section. There are however concerns this may result in a lower quality of care. In a qualitative study looking at the challenges and opportunities of the telemedicine program in Ontario, Canada, researchers found that there was often an insufficient amount of time allotted to care for the patients (Law et al., 2019). In another study, all Tele homecare nurses interviewed stated their caseloads were too high, due to a set quotient of 80-100 patients (Hunting et al., 2015). Since this is a relatively new method of care, it will probably take some time for those in charge of setting caseloads to adjust to an optimum number where the nurses are not overwhelmed, and patients are receiving quality care. More research should be done into what these optimum numbers are, and if quality is decreased even if those optimum numbers are found.

6.3.7 Difficulties in integrating with varying systems

There is a wide variety of different systems for storing and analyzing health data that are used in healthcare. For instance, there are thousands of Electronic Medical Record systems

in the US alone (Phongtankuel et al., 2018: 140). The variability of these systems is already an issue for care, as it makes integrating care across time, different systems, professions, and care facilities difficult. This issue should be addressed, and a good telemedicine system should be able to integrate with whatever existing and future health data collection and analysis systems it may be part of (Phongtankuel et al., 2018: 140).

6.3.8 Possible detrimental effects on professional ability

Telemedicine also has potential to be used as a decision aid for nurses and clinicians. There is concerns that this kind of use would reduce autonomy, promote passivity, and may inhibit professional conduct. It should be used, if used, as a complement to their capacity to think, not as a replacement (Quiroz de Souza et al., 2018: 937). It is important that health care professionals remain able to make important decisions without the aid of these technologies, should they come into use, due to the fact that the system may fail, and that ultimately, they are responsible for the outcome of those decisions.

6.3.9 Difficulty in defining and assigning responsibility

According to Allaert et al., it may be difficult for the purpose of justifying its use and cost to insurers, to define a recognized act of telemedicine with consistency, which could make its use an issue in the United States. Another obstacle is the issue of responsibility if something goes wrong or a patient is injured (2020). Is the health care professional responsible for recommending the technology, or should the technology manufacturers be held responsible? These things need to be defined and laid out before telemedicine can be fully embraced.

6.3.10 Potential to adversely affect rural physician availability

Though the limited availability of quality care in rural and isolated areas is often cited as a reason to consider and develop telemedicine, there is concern that it could cause the opposite to happen. Allaert et al. state: “that the intensive use of telemedicine, paradoxically, could ultimately contribute to a decline in medical demographics. If specialists located in rural areas are deprived of a portion of their consultations, the economic profitability of their practice could be jeopardized, leading them to settle elsewhere” (2020). This possibility should be considered, and watched for, as this could potentially result in a lower quality of care for these patients, instead of increasing the quality as it should.

6.3.11 More resources for development and studies needed

This field has great potential for a lot of benefits for health care and society as a whole, and politicians and other broader decision-making bodies should be aware of these benefits, if they are not already. This potential cannot be realized without further development and studies, which will require more support and funding. In Germany, there is support for this development from politics, medical societies, and advisory telemedicine alliances which is a good basis for further research in this field. (Nerlich et al., 2019: 77). These technologies need to be developed to address the concerns mentioned in this section, and to create better and cheaper technologies that will make adoption easier.

It is also important that more research is done in order to maximize the benefits and ensure that the benefits of telemedicine outweigh the negatives before more broad adoption of the technology into healthcare. There was found to be scarcity of publications on this subject by Santana et al., and they suggested that more studies are called for and more investment in telemedicine development (2018: 4-5). There is also uncertainty about the roles of different professions in this care. It was found by Quieroz de Souza and his colleagues that the role

of the nurse in telemedicine is not clearly defined and theoretically justified, and that more research needs to be done in this area (2018: 936). Cook et al. found in their study that the criteria for which patients should use the technology, and what the roles of the healthcare workers involved were uncertain (2016: 71). These uncertainties and issues need to be addressed in order to best utilize telemedicine, and studies to answer them should be funded.

7 Conclusion

During this thematic review of the literature, much information was found that answered the study questions and portrayed the current state of telemedicine. Findings of this paper indicate that the beneficiaries of telemedicine were patients living at home, people with skin conditions, chronic diseases, and those with difficulties accessing care due to physical or economic limitations. The benefits to care discovered included the following: communication advantages; enhancement of informal caretakers' and patients' care abilities; faster and more accurate data collection, analysis, and response; improving behavioral modification; reducing hospitalization; and lowering costs. There were also significant and numerous challenges found in the literature including the loss of physical interpersonal contact and connection, privacy and data protection concerns, cost and accessibility of the technology, difficulty of use, low rates of utilization, reduction in quality of care due to time restraints imposed by use of the technology, difficulties in integrating with varying systems, possible detrimental effects on professional ability, difficulty in defining and assigning responsibility, potential to adversely affect rural physician availability, and that more development and research needs to be funded and done. Potential solutions to some of these challenges were discovered in the literature and were explained in the discussion section.

7.1 The future of telemedicine

Due to telemedicine's continuously evolving and changing nature, it is difficult to predict its future. There are, however, technologies that are currently being developed in the field of telemedicine, and the research reviewed discussed some of these future developments and their potential impacts on the healthcare field. One area of improvement will likely be the production of easier to use and cheaper technologies, as the technologies continue to improve due to continuing research and competition among companies. Examples of other potential improvements and future technologies include the following: the potential of increased utilization of smart phones, the use of smart wearable technology to monitor patients, better patient education through e-resources, and the potential use of telemedicine technologies as decision aids.

7.1.1 Smartphones

The use of smartphones has the potential to make telemedicine more easily accessible and cheaper for consumers. If much of telemedicine utilizes mobile phones, it could save a lot of money by replacing the need to buy more expensive machines to do the same tasks. According to Allaet et al. (2020), in their essay on smartphone apps ability to generalize telemedicine, "Compared to acquisition structures, smartphones are cheap and almost the whole population already has one, including healthcare providers - even if they do not necessarily wish to use their personal phones for professional purposes. Having a smartphone for the purpose of telemedicine is not an excessive expense and could even fall within the scope of the telemedicine packages provided by the health insurance system for its development." Some examples of how smartphones can be utilized in telemedicine include their ability to improve communication between patients and health care providers,

provide quality patient education, and also allow patients to record and share data about their health with these providers.

7.1.2 Smartwatch and other wearable self-monitoring technologies

An area of development and interest in recent years has been the use of smartwatches and other self-monitoring technologies such as methods of monitoring patient health. One promising study is looking at using smartwatch tech to monitor symptoms in patients (Phongtankuel et al., 2018: 138). Devices such as smartwatches or other wearable monitoring tech can allow for continuous monitoring and recording of different relevant information relating to patient health, even outside of hospital settings. The increased amount of data about the patient's health can help doctors to make better and more personalized decisions regarding the treatment of the patient. Improvements to these devices in the future will likely mean more precise measurements as well as the capacity to monitor more bodily conditions than possible now.

7.1.3 Patient Education

Educating patients allows them to take part in their own care, empowers them to make decisions regarding their care, and good education helps patients see the necessity for behavioral changes or medication usage that can help with their condition (Phongtankuel et al., 2018: 138). There is potential for new applications and websites to help educate patients, perhaps more efficiently and with better results than traditional education methods. Finland, for example, has developed the website Terveyskylä to give quality and easily accessible information to patients and others. Websites like this can make finding quality information easy, which is important because the internet is full of less accurate sources or even

misinformation. Apps and websites could be further developed to adjust the information given based on the patient's learning abilities and prior knowledge. Visual aids and interactive learning can help patients to better learn and remember the information taught, as well as give more suitable options for patients with different styles of learning. Patients could also be tested throughout their learning process to ensure proper understanding, and the systems could be updated continuously based on data about the results to optimize the process.

7.1.4 Potential use as a decision aid

There is potential for an AI (artificial intelligence) system, or even a simpler expertly programmed system, to help physicians as well as other health professionals make decisions regarding patient care. If enough information is given to a self-learning artificial intelligence system as well as information on the results, self-learning AI could foreseeably be able to make precise decisions about patient care: even potentially better than physicians or other trained experts, who may make decisions based on faulty memory and limited knowledge. It is even possible that these kinds of systems may eventually replace some portion of health care professional work entirely.

While these kinds of systems may not be developed or used in the near future, there are decision support systems that can and are already being used. According to Quieroz de Souza and his colleagues (2018: 927): "In the context of diagnosis support, the incorporation of technology into nursing practice, such as the use of computerized decision support systems, for example, helps the work for many reasons: it facilitates and makes the decision-making process more agile, subsidizes knowledge in areas where clinical experience is limited, increases safety in problem-solving and ensures quality of care." These kinds of decision support systems could reduce adverse results due to professional error and could ultimately provide better quality and more consistent care to patients. There are concerns that

this kind of technology would reduce autonomy, promote passivity, and may inhibit professional conduct. In order to avoid these effects, these systems should be used as a complement to their thinking capacity not as a replacement (Quiroz de Souza et al., 2018: 937).

7.2 Corona virus's effect on telemedicine

The unfortunate occurrence of the corona virus pandemic this year has had many effects on different sectors, as industries have been forced to adapt to the necessary restrictions of interpersonal contact, meaning that more people are working from and spending more time at home. Due to its ability to provide care and counselling remotely without requiring patients to come to a physical location and risk spreading of or exposure to the virus, telemedicine has been playing an important role in healthcare during this crisis. In the US, telemedicine has been put into use to replace in-person family meetings, consultations, and has even been mandated by the University of California to be used in the care of palliative and nonpalliative patients for ambulatory patients whenever possible. Regulations on telemedicine have also been eased, and patients can now receive telemedicine across state lines and even get prescribed controlled substances via telemedicine (Calton, Abedini & Fratkin, 2020: e12). This increased use of these technologies as well as the need for development and improvement of telemedicine could increase funding for research and development and accelerate the adaptation of these technologies: indicating that this topic and the considerations made here will be increasingly important. The future of telemedicine has great potential to change healthcare as we know it, and it is important that these decisions and changes be made carefully while considering all relevant information.

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Table 1. Data collection methods:

| Database | Search words | Selection criteria | Results | Selected according to headline | Selected according to abstract | Selected according to full text |
|----------|-----------------------------|--|---------|--------------------------------|--------------------------------|---------------------------------|
| CINAHL | Patient education AND Digi* | 2009-2019 Full text, English, Academic Journals | 93 | 8 | 4 | 3 |
| CINAHL | Telemedicine AND nursing | Full text, 2009-2019, Academic Journals | 340 | 7 | 5 | 2 |
| CINAHL | Telemed* AND home* | Full text. 2009-2019, English, Academic | 7 | 3 | 3 | 2 |

| | | Journals | | | | |
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| CINAHL | Telemedicine OR telehealth AND nursing AND Homecare | Full text, 1997- 2009- 2020, English, Academic Journals | 1997 (first 50) | 17 | 10 | 4 |
| CINAHL | Negatives OR cons OR disadvantages OR bad AND Telemedicine OR telehealth OR Telecare | Full text, English, 2009- 2020, Academic Journals | 94 (first 50) | 18 | 9 | 6 |
| Medic | Nurs* AND Tele* | Full text, English or Finnish, 2010- 2020 | 46 | 5 | 3 | 3 |

Table 2. Summary of selected articles:

| Writers, year, country | Name of the research article | Purpose | Research methods | Results |
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| Albahri, O - Albahri, A - Mohammed, K - Zaidan, A - Zaidan, B - Hashim, M - | Systematic Review of Real- time Remote Health Monitoring System in Triage and Priority- | Examine real- time remote monitoring in triage and priority-based sensor | Literature review | Telemedicine is an emerging topic that warrants further |

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| <p>Salman, O. Malaysia. 2018</p> | <p>Based Sensor Technology: Taxonomy, Open Challenges, Motivation and Recommendation s.</p> | <p>technology used in telemedicine</p> | | <p>investigation . The main contribution of this article is a comprehens ive survey and classificatio n of works related to the topic.</p> |
| <p>Allaert, F – Legrand, L – Abdoul Carime, N – Quantin, C France 2020</p> | <p>Will applications on smartphones allow a generalization of telemedicine?</p> | <p>Will use of smartphone applications allow health care professionals to overcome some limitations that telemedicine has, and could it allow the generalization of telemedicine</p> | <p>Journal article</p> | <p>Smartphone based telemedicine should be anticipated as the main force behind the reorganizati on of our health system. Smartphone s bear the promise of fully transformed and dematerializ ed healthcare systems. After overcoming</p> |

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| | | | | the need for a non-site doctor, the coupling of telemedicine and artificial intelligence techniques may even call into question the very need for a doctor in many situations |
| Barden, Connie – Kleinpell, Ruth – McCarthy, Mary – Rincon, Teresa – Zapatochny R ufo, Rebecca. United States of America. 2016 | Assessing the impact of telemedicine on nursing care in intensive care units | Conduct a national benchmarking survey of nurses working in intensive care telemedicine facilities in the United States | Quantitative research, n=1213 | Using tele-intensive care enables nurses to accomplish tasks quicker. It improves job performance, collaboration, and communication. Barriers include technical problems and |

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| | | | | interruptions in care. |
| Berkley, Amy - Kim, Miyong - Radhakrishnan, Kavita - Xie, Bo. United States. 2016 | Barriers and facilitators for sustainability of tele-homecare programs: A systematic review | Identify the barriers and facilitators for sustainability in tele-homecare programmes implemented by home health nursing agencies | Systematic literature review | Findings implicate that the patient satisfaction with tele-homecare programs were far more positive than clinicians. Nursing staff were worried about lack of training and orientation. |
| Cook, Eric J. – Randhawa, Gurch – Sharp, Chloe, Ali, Nasreen – Guppy, Andy – Barton, Garry – Bateman, Andrew – Crawford-White, Jane. United | Exploring the factors that influence decision to adopt and engage with an integrated assistive telehealth and telecare service in Cambridgeshire, UK: A nested qualitative study of patient ‘users’ and ‘non-users’ | To examine the barriers and facilitators that influence people into using or not using telehealth technology | Qualitative semi-structured interviews with users (n= 28) and non-users (n=12) | Barriers: threat to identity and independence Facilitators: Positive attitude, perceived need, usability, usefulness of equipment, |

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| Kingdom. 2016 | | | | continued engagement , and reassurance of referrer with patient |
| Eksteen, Susan – Launer, Stefan – Kuper, Hannah – Eikelboom, Robert – Bastawrous, Andrew – Swanepoel, De Wet. 2019. South Africa | Hearing and Vision Screening for preschool children using mobile technology, South Africa | “To implement and evaluate a community-based hearing and vision screening programme for preschool children in the Western Cape, South Africa, supported by mobile health technology (mHealth) and delivered by community health workers (CHWs).” (672) | Community health workers screened 8023 children, evaluated results | Mobile health supported community health work provided low-cost, accessible service, taking load off resource constrained public health institutions |
| Fletcher, L – Meldrum, N. United Kingdom. 2010. | Remote monitoring of patients with cardiac devices | Remote monitoring offers a safe, practical, and cost-effective alternative to hospital follow up visits for patients with implantable cardioverter | Journal article | Remote monitoring of implantable cardiac devices offers an alternative approach to patient management |

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| | | defibrillators (ICDs) or cardiac resynchronization therapy (CRT) devices | | t. It allows more patients to be reviewed at a time when growing numbers of ICD and CRT implantations are occurring. New technology can transmit data without any patient intervention and this approach may mean patients are seen when they need to be seen |
| Hunting, Gemma – Shadid, Nida – Sahakyan, Yeva – Fan, Iris – Moneypenny, Crystal – Stanimirovic, Aleksandra – | A multi-level qualitative analysis of Telehomecare in Ontario: challenges and opportunities | Determine effectiveness of Telehomecare for patients with COPD or heart failure. | Qualitative research, n=89 | Telehomecare has potential in impacting patients' lives, but there are still key challenges facing it. |

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| <p>North, Taylor – Petrosyan, Yelena – Krahn, Murray – Rac, Valeria. Canada. 2015</p> | | | | <p>Further implementat ion and continuous assessment are needed.</p> |
| <p>Klösch, M - Klösch, C - Kundt, F - van der Zee- Neuen, A - Dieplinger, A. Austria. 2020</p> | <p>eHealth systems for the optimised care of patients with type 2 diabetes.</p> | <p>Investigate the effects of eHealth systems on the health status of patients and the communication between patients and nurses</p> | <p>Literature review</p> | <p>eHealth systems have had a proven positive influence on patients' state of health and understandi ng of therapy. Subjectively perceived communicati on with the nursing staff also improved with eHealth systems. Problems can arise in the implementat ion phase</p> |
| <p>Koivunen, M – Saranto, K· Finland, 2020</p> | <p>Nursing professionals' experiences of</p> | <p>Synthesise the best available research</p> | <p>Qualitative research n=33</p> | <p>Variety of application in use</p> |

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| | <p>the facilitators and barriers to the use of telehealth applications: a systematic review of qualitative studies.</p> | <p>evidence on nursing professionals' experiences of the facilitators and barriers to the use of online telehealth services in nursing practice</p> | <p>causes new learning needs and it seems that the allocation of resources for the implementation is a constant problem. The change from traditional face-to-face nursing practice to telehealth use calls for local agreements among health professionals and ICT experts. Despite the everyday use of ICT in personal life, nurses' attitudes towards telehealth use in</p> |
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| | | | | nursing still remain somewhat negative |
| Kosonen, Riina-Malla. Finland. 2018 | Perusterveydenhuollon työntekijöiden näkemyksiä sähköisten etäsovellusten ja videoteknologian käyttöönotosta pohjois-Savossa | Describe the factors that affect the implementation of the electronic applications and video technology in health care. To produce information about attitudes, readiness and need for education among basic health care professionals | Quantitative study. N= 139 | Education, availability of technology and technological support and positive attitude towards new technology are promotive factors. The barriers for the implementation of the electronic applications were changes in the organizations and lack of needed technology and resources |
| Law, Ethan – McKenzie, Eric – Law, | Personal Device Telemedicine in a Highly | To examine the present and future viability of | Mixed method. Quantitative from admin data, | 22% of clinical visits moved to |

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| Calvin. Canada. 2019 | Specialized Cancer Care Delivery Model: A Pilot study to assess feasibility and identification of future potential. | telemedicine and remote care in the treatment of cancer patients by reviewing 6- month pilot of advanced telemedicine development in the field | qualitative from healthcare provider interviews | personal device telemedicine . Interviews themes: “synergy rather than replacement of in person visits, better integration of family and caregivers in clinical decision making, that personal device telemedicine may become an important method to address equity in health system.” (155) This telemedicine is feasible + offers novel advantages |
| De Witte, Luc - | Activity monitoring technology to support homecare | Examine potential effects of activity | Qualitative research, n=39 | Activity monitoring can be |

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| <p>Lexis, Monique - Everink, Irma - Van der Heide, Loek - Spreeuwenberg, Marieke – Willems, Charles. 2013. Netherlands</p> | <p>delivery to frail and psychogeriatric elderly persons living at home alone</p> | <p>monitoring system on clients, formal and informal caregivers</p> | | <p>effective in supporting elderly people to continue living at home alone. It is a promising assistive technology for elderly people to live longer independently.</p> |
| <p>Nerlich, Michael – Herbst, Tanja – Ernstberger, Antonio – Blaetzinger, Markus. 2019. Germany</p> | <p>Opportunities of Telemedicine for Orthopaedics and Trauma Surgery</p> | <p>To discuss the potential of telemedicine in particular for Orthopedic and Trauma surgery, before and after surgery</p> | <p>Literature review</p> | <p>There is a lot of potential in telemedicine for pre-treatment, clinical, and post-treatment use. It allows for more efficient communication and is especially use in saving time and money in the</p> |

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| | | | | <p>treatment of remote patients with no easy access to care. Challenges include data privacy and training of professionals using it, along with perfecting systems (need financial support and interest).</p> |
| <p>Phongtankuel, Veerawat – Adelman, Ronald D. – Reid, M. C. United States of America, 2018</p> | <p>Mobile health Technology and home hospice care: promise and pitfalls</p> | <p>To discuss potential benefits and pitfalls of using mHealth applications in hospice care and show some relevant telemedicine work</p> | <p>Literature review</p> | <p>Benefits: allow for more frequent check-ups with patients and informal caretakers, collection and tracking of data in real time, good method of patient education</p> |

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| | | | | Pitfalls: difficult to design a program that works for patient and provider needs while being simple, |
| Queiroz de Souza, Claudinalle Farias – Goncalo de Oliveria, Dulcineide, Silva Santana, Alef Diogo da, Mulatinho, Leticia Moura – Cardoso, Mirian Domingos – Ferreira e Pereira, Emanuela Batista – Maria de Aquino, Jael. 2018. Brazil. | Evaluation of Nurse's Performance in Telemedicine | To learn and describe what nurses do in telecardiology in order to improve and create qualification for the tele-healthcare. | Qualitative study of nurses + analysis. N = 19 | Nurses knowledge about the telemedicine program found out, and actions developed by nurses discovered. Flow chart for program was built. |
| Santana, Rosimere Ferreira – Dantas, | Telecare to Elderly People with Alzheimer and Their | Analyse literature on use of telemedicine as nursing | Systematic Review. N = 2 | Telephone monitoring, cameras to film care |

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| <p>Raquel Vaqueiro – Soares, Thais da Silva – Hercules, Ana Beatriz Serra – Leite Junior, Homero Marinho Teixeira. 2018. Brazil</p> | <p>Caregivers: Systematic Review</p> | <p>intervention for Alzheimer’s patients and caregivers, also to identify main tech and instruments of evaluation used</p> | | <p>were used, teleconferences via video call were used. Telemedicine can be considered an advanced practice and accessible alternative</p> |
| <p>Shadi – Farah, Angie – El Arnaout, Nour – Dimassi, Hani – El Morr, Christo – Muntaner, Carles – Ammar, Walid – Hamadeh, Randa – Alameddine, Mohamad. 2018. Lebanon</p> | <p>mHealth use for non-communicable diseases care in primary health: patients’ perspective from rural settings and refugee camps</p> | <p>Assess perspective of Diabetic and hypertension users of the mHealth intervention eSanha in rural areas and Palestinian refugee camps</p> | <p>Mixed method. Quantitative data via phone surveys (n=1000) + qualitative data through focus groups</p> | <p>The use of messaging was very useful for behavioral change needed for health improvement, difficulties arose with people who are older or illiterate.</p> |
| <p>Tronier, Daniel – Harrison, Julian. 2019. United Kingdom</p> | <p>Promoting the Use of Health Apps to Monitor signs of Skin Cancer</p> | <p>To describe how dermatology self-care managing apps are changing the tele dermatology field, and to improve lives of</p> | <p>Literature Review</p> | <p>Just described app use, negatives and positives, and the potential for</p> |

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| | | patients and supporting professionals in the practice | | future use in treating dermatological conditions. |
| Velardo, C – Shah, S - Gibson, O - Clifford, G - Heneghan, C - Rutter, H - Farmer, A – Tarassenko, L., United Kingdom, 2017 | Digital health system for personalised COPD long-term management | Study use of complex mobile health solutions for the remote monitoring and management of patients suffering from chronic obstructive pulmonary disease in self-managing their condition | Journal article | Strategies and tools aimed at refining a digital health intervention require iterative use to enable convergence on an optimal, usable design. ‘Continuous improvement’ allowed feedback from users to have an immediate impact on the design of the system, resulting in high compliance with self-monitoring over a |

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