

Impact of Telemedicine in Management of Chronic Diseases

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Abstract

Diagnosis of chronic diseases has an impact on the patient's quality of life and the healthcare system. Telemedicine facilitates the delivery of medical intervention at home to improve health outcomes and reduce cost to the NHS. Adoption of telemedicine for routine management of chronic diseases positively impacts on the healthcare of patients and healthcare professionals. However, there are several challenges affecting the adoption of telemedicine into routine healthcare delivery. Lack of universal regulations and quality assurance protocols can impact the wide scale implementation of telemedicine into routine healthcare. Therefore, further research, support and training is required for successful adoption for routine management of chronic diseases.

Keywords

Telemedicine, Chronic Diseases, Heart Disease, COPD, Diabetes, Quality Assurance

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Introduction

The rising population of people affected with chronic conditions is one of the major challenges affecting the health and social care system in the United Kingdom (UK) as observed by Salisbury et al. (2015) and accounts for 7 out of 10 deaths each year in the United States of America (USA) (Center for Disease Control and Prevention (CDC) 2017). Chronic diseases such as chronic obstructive pulmonary disease (COPD), heart disease and diabetes affect over 15 million people in both the UK and USA, with almost a third of the population affected with multiple chronic conditions (NICE 2016, CDC 2017). Salisbury et al. (2015) reported that 30% of the population worldwide suffers from at least one chronic condition, accounting for 70% of the total health service costs in the UK, and 86% of the USA's health care cost (CDC 2017). According to NICE (2016), COPD accounts for over 1 million hospital bed use and 1.4 million GP consultations annually, costing the health service over £982 million per year while coronary heart disease affects 2.3 million people with over 500,000 cases of heart failure (SIGN 2016). In addition to the rising cost of healthcare due to these chronic conditions, quality of life is reduced in addition to life expectancy of patients affected (Vestbo et al. 2013). Chronic diseases are major contributors to sickness and disability worldwide, with Vestbo et al. (2013) estimating that COPD would be the third leading cause of death worldwide by 2020. It is therefore important to address the risk factors for these diseases and implement strategies for diagnosis, management and prevention (NICE 2016).

There are several global resources dedicated to applying different forms of telemedicine to manage chronic conditions worldwide. This article will discuss the international initiatives of implementing telemedicine for chronic diseases across the USA and the

United Kingdom. The benefits and challenges surrounding effective implementation of telemedicine will be discussed before rounding up with recommendations followed by a conclusion.

Policies and Directives

Currently, the use of information technology for delivering care at home, and remotely through telemedicine interventions appears to be one of the internationally recognised innovations in managing health challenges associated with chronic diseases (Salisbury et al. 2015). There are several international initiatives based on telemedicine to facilitate better diagnosis and management of chronic diseases, thereby ensuring positive patient outcomes (Zamarrón, Morete and González 2014).

According to the CDC (2017) management and prevention of diseases is based on governmental policy to improve disease awareness, global health promotion initiatives, and improving health care interventions. The World Health Organization (WHO) (2015) estimates that over 200 million people in Europe and America suffering from one or more of these chronic diseases could benefit from home treatment, thereby decreasing the costs and burden on health care. Home management of diseases also provides efficient health care delivery and improves the sustainability of the healthcare system (Campion, Dorsey and Topol 2016).

The Department of Health (2011) undertook the largest randomised control trial of telehealth and telecare in the world (The Whole System Demonstrator (WSD)) to evaluate their effectiveness and benefits in managing diabetes, heart disease and COPD. The outcome of the WSD forms the basis of the '3 million lives' campaign and the mandate to

the NHS Commissioning Board to empower and support the increasing number of people living with long-term conditions in the UK to self-manage their conditions at home (Department of Health 2013, Bond and Worswick 2015).

Process of Telemedicine

According to Merrell (2015) telemedicine (also referred to as telehealth) facilitates the improvement of the patient's health status through a two-way interactive audio-visual communication technology, between patient and healthcare practitioner at a distance to support healthcare. The variety of telecommunication tools used include telephones, smartphones, tablets, laptops and mobile wireless devices such as connected blood glucose meters and blood pressure monitors (Zamarrón, Morete and González 2014). These telecommunication tools facilitate independent monitoring of a patient's weight, blood pressure and oxygen saturation over a period and allow clinicians to evaluate clinical information provided by patients and medical data captured to diagnose and treat patients remotely (Wallace et al. 2012, Bond and Worswick 2015). Medical data transmitted could be shared appropriately with specialists around the world to facilitate diagnosis, management of complex cases, maintain follow-up appointments, report health concerns and detect early signs of health deterioration through a wide range of healthcare apps (Campion, Dorsey and Topol 2016, Schneider and Biglan 2017). It offers convenient and easy access to quality person-centred care according to the Department of Health (2015), thereby reducing health inequalities for housebound patients (Beck 2016).

Impact of Policy Directives on Healthcare

Telemedicine is a rapidly growing component of healthcare in both the USA and the UK, due to the continual growth of technology (Standing and Hampson 2015). According to the American Telemedicine Association (2015), over 200 telemedicine networks with 3,500 service sites were available in the USA as of 2015 with over 1 million Americans accessing different forms of the innovation to monitor their chronic conditions. Approximately 4.9 million people use a form of integrated cellular connectivity for home monitoring devices in USA and Europe as at the end of 2016 as reported by Gupta et al. (2017). Telemedicine in healthcare is estimated to increase by 38.7 percent over the next five years worldwide, with an estimated increase to 25.2 million people using it by 2021 due to government initiatives to move healthcare delivery from hospital to the patient's home (Gupta et al. 2017). Worldwide, millions of diabetic, heart disease and COPD patients monitor and maintain their health and control their disease using telemedicine, reducing the burden on the emergency services, cutting hospital admissions and length of stay in the hospital thereby decreasing healthcare costs as compared to traditional care (O'Connell 2015).

Comparing the uptake of telemedicine in the management of chronic diseases between UK healthcare and USA healthcare, the USA appear to have a higher uptake according to Standing and Hampson (2015), despite the UK being the first country to adopt telemedicine and having larger government funded programs for telemedicine (Sanders et al. 2012). Over half of all USA hospitals use some form of telemedicine to maintain patients' chronic conditions and they are rapidly moving towards larger scale implementation in all healthcare for all diseases, as observed by Buquet (2016). However,

Standing and Hampson (2015) observed that larger scale implementation of telemedicine in the UK healthcare was currently restricted by lack of infrastructure to drive the growth in the sector.

The implementation of telemedicine in the management of chronic diseases is not without its challenges such as the search for more supportive evidence as observed by Gorst et al. (2014), which affects the large-scale implementation and adoption of telemedicine within routine healthcare in both the UK and USA.

Cost Implication to Healthcare Providers

The basic telemedicine equipment required for the self-management of heart disease, COPD and diabetes includes a visual base unit (a television set, laptop or desktop) with attachments such as spirometer, weigh scales, glucometers, blood pressure cuff and pulse oximeters (Henderson et al. 2013). One of the challenges as observed by Clark and Goodwin (2010) is the lack of evidence for capital return on investment and the potential to increase costs due to the need for more diagnosis and assessment of patients using the technology. Telemedicine is also considered to be too costly, particularly the equipment needed, to implement on a larger scale within the NHS infrastructure as observed by the Department of Health (2015). Clark and Goodwin (2010), however, suggested that the price of equipment could be reduced with new procurement models and significant take-up through the consumer market. Henderson et al. (2013) further highlight the additional costs of telemedicine which include, cost of monitoring staffing, supervisors, project managers, direct and indirect administrative costs, technology support and staff training.

Patient Acceptance and Adherence to Technology

Achieving cost effective management of chronic diseases and better health outcome is directly influenced by patient compliance and adherence to the use of telemedicine tools provided, as observed by Hamine et al. (2015). Patients' acceptance has been acknowledged as the major influence on the future implementation of telemedicine according to Gorst et al. (2014) but there is a perception that most patients often refuse or abandon telemedicine. Factors affecting patient's acceptance and adherence are discussed below.

Technology Usability and Costs

Digital innovative tools could unintentionally promote health disparities as observed by Hamine et al. (2015), especially among the elderly due to lack of knowledge, inability to use and access to technology. However, Bond and Worswick (2015) reported that most patients found the telemedicine system easy to use, even without prior experience with computers. Berkel et al. (2016), however, highlight the link between a patient's literacy level and their ability to use the technology. Although, Reider-Demer et al. (2017) suggested that patients often declined participation in telemedicine due to lack of access to the technology's supporting equipment, as purchase of these technologies could incur extra costs for patients (Beck 2016). Hamine et al. (2015) also reported issues with the cost of the technology applications (apps) as a barrier to patient's adherence, as patients with low income are less likely to purchase apps updates for the telemedicine systems.

Internet Access

Schneider and Biglan (2017) identify inadequate internet access as a barrier to patients' acceptance and adherence to telemedicine. Global distribution of the internet is uneven, as observed by Brake (2017), with only 85% of households worldwide having access to the internet. Within the UK, approximately 14% of individuals have never had any access to the internet with only 12% in the USA (Schneider and Biglan 2017). To reduce disparities due to lack of internet access, especially within the ageing population, internet facilities need to be made widely available and training opportunities are required to facilitate easier access to the internet, increase familiarity with necessary technology and improve experiences with telemedicine (Gorst et al. 2014).

Currently in both the USA and the UK, there are several government incentives such as, the UK government's £400 million Digital Infrastructure Investment Fund (DIIF) and the US Federal Communication Commission's Connect America Fund (CAF) to improve broadband infrastructure, internet access to the remote areas of the country and subsidise the cost of internet access (Brake 2017, HM Treasury 2017). This helps facilitate better adherence to telemedicine, as patients are more likely to be able to afford the cost of internet access, consequently facilitating their participation in telemedicine systems to better manage their conditions (Berkel et al. 2016).

System Failure

Real-time exchange of patient data is important to facilitate the timely diagnosis of a patient's situation and provide interventions before the condition escalates (Vestbo et al. 2013). However, data transmission delay is one of the issues experienced with

telemedicine, which could lead to patient dissatisfaction with the service, re-hospitalisation and relapse of condition especially with COPD and heart disease, which could have been prevented (Steinman et al. 2015). O'Connell (2015), however, suggested that delay in data interpretation could also be due to unavailability of healthcare workers to pick up the trend and attend to patients in a timely manner.

Patient Capacity

Sanders et al. (2012) identified the length of time it took for some elderly patients to gain confidence in using the system as one of the barriers. They further suggested that it took some patients several months to be competent, this is supported by Kolltveit et al. (2017) who suggest that patient's noncompliance with telemedicine might be due to their inability to use the equipment provided competently, thereby increasing their negative perception. Issues surrounding failed readings of telemedicine equipment have also been identified especially among the elderly, as observed by Gorst et al. (2014), which could be due to lack of capacity and lack of healthcare workers to help with readings on a regular basis (Kolltveit et al. 2017). Reider-Demer et al. (2017) also highlight other co-morbidities like a patient's physical, neurological and cognitive impairment, as a barrier to use of telemedicine, which might affect their participation and suitability to use the system. Therefore, Beck (2016) identified that healthcare professionals need to recognise that telemedicine is not appropriate for all patients as some patients might benefit more from home visits.

Psychosocial Factor

The patient's discomfort with the concept of telemedicine is another challenge to widescale implementation of telemedicine into routine healthcare delivery (Merrell 2015). Office Practicum (2015) reported that less than 75% patients were comfortable communicating with their healthcare providers using telemedicine systems. They also reported that 16% of patients who had access to telemedicine services choose to present in the emergency department for minor complaints (Campion, Dorsey and Topol 2016). Gorst et al. (2014) reported 32% of participants refused telemedicine outright due to lack of interest, or a belief that monitoring was unnecessary. Clark and Goodwin (2016) also report some patients' perception of telemedicine as unnatural and restrained compared to personal interaction.

Wang et al. (2017) suggested early referral to a telemedicine service was essential, to reduce a patient's attachment and expectation of in-person visits from healthcare professionals and to reduce their discomfort of telemedicine service. Bond and Worswick (2015), reported issues surrounding patients stepping-down from telemedicine programs when they can effectively self-manage. Bond and Worswick (2015) reported that most patients are dependent on the system after 12 weeks of the telemedicine program, and are reluctant to have the equipment removed after the program, which has the potential to create further issues regarding the cost for new equipment for other patients and patient dependency. Therefore, Henderson et al. (2013) suggested further governmental intervention to the issue surrounding stepping-down as the tools are integral to a patient's continual self-management (O'Connell, 2015). NICE (2016) emphasise the need for structured educational programmes to empower patients to improve self-care and

management of chronic diseases, reduce technology anxiety, and improve perception of telemedicine.

Impact on Healthcare Professionals

Healthcare professionals, according to Gorst et al. (2014) have an important role to play in patient recruitment and successful implementation of the interventions (Kolltveit et al. 2017). Bond and Worswick (2015), evaluate the benefits of using telemedicine in managing chronic disease for healthcare professionals, which include better understanding of a patient's health status, less demand on healthcare professionals, and more flexibility to meet acute patients' medical needs (Brewster et al. 2014). Office Practicum (2015), however, suggests that only 84% of healthcare executives feel that telemedicine services are important to their organisation, which can affect wider scale implementation.

Healthcare Staff's Attitude and Acceptance

Brewster et al. (2014) in their study highlight the preference of staff, especially nurses, for face-to-face autonomous interaction with patients rather than remote interactions, which are perceived to affect negatively the nurse-patient relationship and job satisfaction (Sanders et al. 2012). Brewster et al. (2014) also concluded that some nurses feel telemedicine shifts the focus away from direct contact with patients and creates a trust issue which could be avoided with direct contact.

One of the issues reported by Steinman et al. (2015) was the lack of awareness of telemedicine services amongst healthcare professionals. A study carried out by Bond and

Worswick (2015) suggested that while healthcare professionals believed they had a role to play in promoting patients' self-management, their role in educating through telemedicine was unclear. The adoption of telemedicine systems into routine healthcare requires the acceptance of all users, it is therefore important to improve awareness of the technology amongst staff to facilitate better understanding and up-take of the intervention (Gorst et al. 2014).

Organisational Culture and Beliefs

Clark and Goodwin (2010) argued that replacing direct contact with remote technology could be an issue for healthcare professionals, as it challenged their perception of the norm in the health and social care services. A study of healthcare professionals' views on telemedicine carried out by Brewster et al. (2014), highlighted staff's scepticism towards telemedicine and the belief that the technology may leave them redundant, with some healthcare professionals especially nurses stating that it was not real nursing. Their studies also discussed the staff's low expectation of the positive outcomes, therefore making telemedicine highly unlikely for the management of COPD, diabetes and heart disease (Sanders et al. 2012).

Gorst et al. (2014) reported organisational culture of not sharing knowledge and skills among professionals and patients as one of the barriers to telemedicine. This also challenges the organisational change management process, which according to Steinman et al. (2015) was not dependent on resource availability or regional need for telemedicine solutions. There is a need for policymakers to support healthcare professionals to overcome the barriers associated with existing professional and organisational cultures through self-directed support, personal budgets and resource

allocation systems to facilitate effective change management (Clark and Goodwin 2010, Gorst et al. 2014).

Lack of Technology Expertise

Kuria (2017) found in their study that the level of knowledge and practice of nurses in telemedicine varied and were

dependent on individual technical expertise. Studies carried out by Brewster et al. (2014), noted that some staff felt the technology was not user-friendly, and 25% of staff involved in the study named technical issues and lack of technical skills in installing and using the technology as a barrier when recommending it to a patient.

Lack of confidence about the safety and reliability of the equipment was also one of the issues discussed by Gorst et al. (2014). Bond and Worswick (2015) suggested the need to make telemedicine a requirement for all healthcare professionals to promote confidence and reduce discomfort experienced with the use of the system. This was further supported by the study carried out by Bradford and Penny (2016) suggesting that policy makers and nursing organisations need to empower nurses to incorporate telemedicine into their practice. The Royal College of Nurses recommended integrating telemedicine modules for nurses in the UK to equip them with skills required for telemedicine healthcare delivery (Wright 2014), whereas the National Organisation of Nurse Practitioners has already incorporated telemedicine curriculum into their core competencies for nurse practitioners in the USA (Bradford and Penny 2016).

Quality Assurance for Telemedicine

Quality assurance, as described by Wootton et al. (2015), is essential for good medical decision making and can be defined as the systematic process of ensuring a quality standard of care. Considering the increasing drive for the adoption of telemedicine in the self-management of chronic diseases within the two countries, Wootton et al. (2015) and Buquet (2016) suggested that limited quality assurance has been incorporated into telemedicine. Currently, according to Clark and Goodwin (2010), there are no mandatory minimum clinical standards for telemedicine services in the UK; however, there is a trade association Code of Practice. Whereas the American Telemedicine Association (2015), responsible for telemedicine quality assurance, has released several practice guidelines and technical guidance for healthcare practitioner in the USA.

According to the American Telemedicine Association (2015), the standards for the protection and privacy of patients' information are governed by the *Health Insurance Portability and Accountability Act* (HIPAA) (1996) under the USA federal law. However, in the UK, European law sets the standard for patient safety. According to Raposo (2016), telemedicine in the UK is regarded as two processes: a health service and an information service. Consequently, regulation occurs through two different directives. The health service aspect of telemedicine, according to Kelly (2011), is regulated by *E-Commerce Directive 2011/24/EU* and *Medical Device Directive 93/42/EEC* while the *Data Protection Act (1998)* and *E-Privacy Directive 2002/58/EC* govern the processing of personal information. The Department of Health also set a regulation for all telemedicine operators working within the NHS to comply with their Confidentiality Code of Practice and Guidelines on information security (NHS England 2016; Raposo 2016). The major

challenge with the quality assurance of telemedicine in both countries according to Buquet (2016) and Raposo (2016) is the fact that there are no uniform regulations for telemedicine services potentially causing confusion for health professionals using the equipment with patients.

Recommendation

To address the inequalities associated with the use of telemedicine, it is important for the government to design and develop systems targeting user groups with limited or no knowledge of the technology and diverse patient groups, thereby reducing the disparities and ensuring a better global uptake of telemedicine. To improve the acceptance of telemedicine amongst staff and its use within the care pathway, it is necessary for policy makers to invest in implementing strategies to encourage use of telemedicine such as training, support and universal guidelines as to when it is appropriate to refer patient to the service and universal regulations. To improve future uptake, telemedicine modules could also be included in the university curriculum to facilitate the sensitisation of future nurses and clinicians, thereby improving their knowledge to promote the use of the service.

Conclusion

The impact of telemedicine in self-management of chronic disease appears to be mainly positive. Implementation of telemedicine into routine healthcare is a governmental priority both in the UK and the USA due to its potential to increase efficiency in healthcare. However, more policies and directives involving education, support and research into

long-term use of the technology are required to promote adoption within both countries. Limited independent research has been carried out to analyse the role of nursing staff in supporting a patient to self-manage their chronic disease. Research on the impact of telemedicine on a patient's cultural beliefs, disease management and ease of use is also limited. Therefore, further research on the impact of telemedicine in improving the outcome of chronic diseases is required. Despite the challenges to telemedicine especially the lack of legal framework, privacy protection, rules and regulations, it appears to be a positive and rapidly expanding concept.

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