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Review Article

Implications of Advances in Remote Patient Monitoring for Nursing Care in Chronicity

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Abstract

The rising burden on healthcare systems, due to ageing and the increasing prevalence of chronic diseases, finds digital health as a potential solution to improve efficient and cost-effective options of service delivery. The rapid development of health technology is driven by the expansion of digital culture in populations, and the inclusion of new opportunities for rapid data transmission and processing. Rapid patient monitoring allows healthcare providers to exchange and interpret reliable health data from individuals living in the community. Chronic patients benefit from the combination of digital health and the internet of things, which facilitates continuous data exchange with providers through wearables or small smart devices. Remote monitoring of people with heart failure, chronic obstructive pulmonary disease and diabetes is widely researched in the application of digital health, obtaining promising results. However, the current demand requires the development of clear regulations to avoid actions on digital health that could negatively impact safety, confidentiality, and equity to services. Artificial intelligence is one of the main areas of concern for developers, providers, citizens, and health systems, due to its enormous potential to generate information autonomously. Data collection and processing by artificial intelligence must be transparent to ensure that health records remain confidential. Nursing care is facing a new paradigm shift and should find different ways to adapt to digital health, starting from including digital skills in training programmes.

Keywords: Telemonitoring; Remote patient monitoring; E-Health; Telehealth; Change management; Nursing practice; Artificial intelligence; Chronicity

Abbreviations: AI: Artificial intelligence; AI-RPM: Integrated Artificial Intelligence-Remote Patient Telemonitoring technology; COPD: Chronic Obstructive Pulmonary Disease; EC: European Commission; HF: Heart Failure; ICT: Information and communication technology; IoT: Internet of things; OECD: Organization for Economic Co-operation and Development; RPM: Remote patient monitoring

Introduction

Chronicity is a major contributor to morbidity and a disability burden for the living in developed countries, led by prevalent conditions such as cancer, diabetes, respiratory and cardiovascular problems [1]. Due to the negative impact of longstanding diseases on quality of life, and their rising incidence worldwide, health systems aim to find cost-effective solutions to care management [2].

In 2010, the World Health Organization included telemedicine and mobile health (m-health) as potential solutions to healthcare demands, among the eight main subjects of its third global survey on e-Health [3]. Accordingly, the European Commission (EC) addressed,

in the action plan on e-Health 2012-2020 [4], the potential benefits that electronic health should provide to all healthcare agents, including the promotion of equity and socioeconomic integration, quality of life, and patient empowerment, due to its characteristics.

Some of the most visible benefits for electronic health are based on the development of the internet of things (IoT), which served as support to person-centeredness by providing people with digital devices that contribute to self-care promotion. This has become feasible, partially due to the fact that almost 66.2% of the global population uses the internet, led by Asia (2.93 billion users), and Europe (750 million). This results in 92% of internet users in developed countries and 26% in low and medium-income countries [5]. In this context, information, and communication technology (ICT) has been included within the EC work document named "A European Care Strategy for caregivers and care receivers", which aims to support the delivery of high-quality social care that is expected to be accessible, affordable, sustainable, and present in any support services at all ages [6].

The pace of technological development, along with digitally driven attitudes in users, allowed to increasingly implement ICT options, such as telehealth, as key elements in several disease management programs [2]. Telehealth is defined as "the delivery of health care services, where patients and providers are separated by distance. Telehealth uses ICT for the exchange of information for the diagnosis and treatment of diseases and injuries, research, and evaluation, and for the continuing education of health professionals" [7]. Telemonitoring or remote patient monitoring (RPM) is an option of telehealth used in inpatient and outpatient settings, that allows healthcare providers to collect, transmit, evaluate, and communicate individuals' health data at a distance [8]. Over the last decade, many healthcare systems have adopted RPM to follow up people with chronic conditions, such as heart failure (HF), chronic obstructive pulmonary disease (COPD), and diabetes, among others.

The development of RPM has been enhanced, due to the emergent use of artificial intelligence (AI) in healthcare and a consolidated digital culture in high-income populations. The integration of AI-RPM expanded its use from simple remote transmission of data to detection of clinically relevant values in combination with track-and-trigger systems, enabling early recognition and rapid interventions in deteriorating individuals [9]. Two main drivers for development of these technologies are a high-volume demand for healthcare systems, and complexity of chronic conditions and comorbidities [10].

Although these digital concepts seem clear, it is necessary to highlight that not all the RPM solutions are included in this integrated modality along with AI. Thus, the study conducted Dubey & Tiwari [11], listed the criteria to qualify a solution as AI-RPM, including: "the use of a portable device/sensor for remote use by patient or trained assistant; the automatic and continuous monitoring, data storage and transmission; and an AI algorithm that effectively classifies relevant clinical data and aids clinical decision-making with or without an alert system".

In this new paradigm of care delivery, nurses are still adapting to the use of digital technologies, such telehealth, online education and remote learning, technological aids to technical performance, and decision-making aids [12]. Some of the most significant AI projects are focused on reducing the time spent by nurses in some technical activities, such as collecting and documenting vital signs observations or typing individual care plans, and thus giving them time back to direct patient care [9,13,14]. However, some areas of AI implementation in nursing practice remain unclear and present some challenges, due to the need for standardized digital competencies across the discipline [15]. The purpose of this paper is to provide an overview of some relevant contributions of RPM advances to chronicity care, addressing some benefits and challenges to nursing practice.

Discussion of the Topic

Conducting research on viable integrated healthcare, that acquire clinical vital signs and data on healthy habits to support independent living of older adults with chronic diseases, may be considered key for healthcare systems. Hence, several studies provide related results revealing that integrated care monitoring technologies have the potential to facilitate better standards of care, as they could have a positive impact in older adults' wellbeing, allowing for pertinent interventions [16-18].

The combination of telehealth with remote monitoring of symptoms, body weight, and medication use has demonstrated potential improvements in chronic patients after hospital discharge [19]. Accordingly, one of the most significant contributions of RPM is the control of symptoms and health behaviors, which improve early recognition of undesired outcomes. This remote approach facilitates nursing interventions on improving quality of life, reducing the use of healthcare services, and supporting the management of chronic illnesses in the community [20].

Impact of RPM Advances

A systematic review carried out by Marmol et al. [21], about nursing contribution to chronicity care in Spain, concluded that telemonitoring-based care is one of the nursing interventions with the best impact on the care delivery for persons with chronic diseases. They also revealed some limitations to correctly evaluate efficiency and cost effectiveness, which requires a deeper understanding of the relationship between nursing interventions and healthcare outcomes, to respond to social and healthcare reality.

Overall, non-invasive home telemonitoring demonstrated to be effective in reducing the risk of mortality and hospitalizations, along with improvements in health-related quality of life and satisfaction in heart-failure patients [22]. However, the BEAT-HF study carried out in California [23] found that, in comparison to usual care, the delivery of tele-based care did not reduce hospital readmission nor all-cause mortality over the first 6 months of care transition for heart-failure patients. This project provided a brief understanding of the relationship between RPM, care efficacy and improvement and key outcomes, including transitional care between healthcare levels and hospital readmission [24]. RPM

expansion to other community settings, such as nursing homes, has also shown benefits for patients with heart failure [25].

In COPD patients, the combination of telehealth-RPM is valued to follow up of health data, and to deliver health education. These findings indicate that health education reduces readmission rates, although the focus of these interventions is to improve the care delivery and continuity of care [26].

Although performance indicators are important, we cannot forget about patient experience with RPM and telehealth, and how they perceive replacing clinic visits by remote consultation, as well as the time interval between acute episodes [27]. Therapeutic compliance is pivotal to addressing the control of chronic disease. RPM would be of valuable support for adherence with self-care recommendations, given the collection of ongoing measures and real time information, that allow persons and carers to establish recommended measures and to monitor compliance outcomes. The same outputs were researched in Australia, where an innovative telemonitoring program, named ITEC-CHF, evidenced that telemonitoring improved participant compliance in weight control, along with other significant improvements, such as health maintenance and adherence to medication and diet. Nevertheless, this care model needs a closer definition, especially for heart failure patients, whose age characteristics require keeping their connection with technology [28].

Different associations of chronic patients demand the provision of better standards of care through healthcare digitalization, that lead to better health outcomes. For this purpose, they prioritize the use of telemonitoring, as an element within telemedicine [29]. Some elements that may positively influence patient experience are the ongoing expansion of digital culture and the use of IoT, including wearables, which facilitate new nursing approaches to manage chronic pain [30]. Benefits from m-health and telemonitoring have been observed in diabetes control, thanks to the inclusion of wearables in the service portfolio of the National Health Service of Spain. In comparison to other countries that use this tool, some studies showed its effectiveness to solve problems of vigilance, compliance with hygienic-dietary, educational measures, and access to healthcare providers. There exists evidence supporting that glycemic control can be improved by adapting therapeutic measures of glycemia and transferring live results to healthcare providers [31].

Challenges of RPM Advances

Some systematic reviews, conducted to explore how telemonitoring has been used for persons with COPD, highlight the importance of following this research line, based on results that indicate the existence of contradicted information about program efficacy for these care recipients. However, these results identify a smaller number of visits, better disease management and reinforced relationships between patients and healthcare providers. Some barriers detected were related to low quality data, bigger workload for healthcare providers and higher costs [32].

The disruptive availability of AI solutions in different scenarios has caused controversy about data protection and ethical use of technology. In this regard, the WHO highlighted the importance of transparency and documentation, avoiding opaque processes of data transmission and transformation [33]. Consequently, the release of a common regulatory framework for AI, known as the AI Act, is underway in Europe, listed among the top priorities in public protection [34]. The social gap between high and middle-low-income countries seems to widen, due to AI implementation in healthcare, despite the current agenda to reduce inequity. Another concern related to AI is the view of technology as a threat to job opportunities in healthcare [35,36]. This concern and other concerns were expressed in different nursing forums and institutions, where also people-centeredness integration of digital health was addressed [37].

Current Insights

RPM and other modalities of e-Health offer a wide range of services to chronic people, with an ongoing development of synergies with other digital AI solutions. Digital health promotes individual empowerment to make health decisions and adopt patient-centered measures in all areas of healthcare. Remote patient monitoring provides valuable options for healthcare interaction and its continuous support can be facilitated using m-health and wearables [38]. Nonetheless, data transformation should occur in safe and regulated environments that guarantee data protection and controlled processes, to guarantee people's safety. There is a concern in healthcare providers about how AI could serve as a tool or assistant to care activities, while it may be seen as a threat to employment and patient centeredness [36]. However, nursing activities are susceptible to changes as new technologies evolve, therefore training programmes may consider including a set of competencies in digital health, as part of the nursing core curricula [37].

Conclusions

Digital health technologies applied in different modalities, such as m-health or teleassistance, open a new field of possibilities to health promotion, especially to people with chronic diseases, disability or with situations of functional dependence, contributing to personal autonomy and permanence within the usual environment. Knowledge about telemonitoring impact and benefits in care delivery for persons with chronic diseases is widely extended, although it is important to solve some key issues, to guarantee accessible and equitable healthcare services for the existent variety of chronic patients, especially those more vulnerable, taking account of social and digital health determinants. These interventions should be organized in conjunction with social services, to ensure an integrated approach to chronicity. Another aspect to consider is the upcoming challenge for healthcare systems, due to population ageing. Consequently, it is important to prioritize those interventions that could counteract the loss of self-care capacity in ageing, chronically ill or cognitively impaired populations. Thus, these interventions should be conducted towards the maintenance of minimum dependency levels and long-lasting functional capacity.

The need for investment in digital innovation to guarantee social interaction is key to social services, as they serve to

support social innovation. Despite of this, RPM implementation, in conjunction with other healthcare models focused on digital technologies, represent a challenge due to its regulatory gap, the lack of person-centered technology and training inadequacy for all the parties involved: patients, carers, and providers. In addition, there exists certain variability between sources and about different ways to provide RPM, which generated contradictory results in the literature review. Future research should focus on the standardization of RPM services and the predictability of acute episodes. It also may be pertinent to describe how certified prescription tools could have an impact on self-care management for chronic patients. Policy implementation towards the reduction of digital gap, promotion of telemonitoring use and innovation in safe digital tools for chronicity, is a priority for equitable access to healthcare.

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Conflict of Interest

No conflict of interest.

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