Asthma and Chronic Obstructive Pulmonary Diseases

Subjects: Health Care Sciences & Services

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Asthma and chronic obstructive pulmonary disease (COPD) are prevalent chronic pulmonary diseases requiring ongoing self-management. According to the World Health Organization, approximately 339 million people worldwide have asthma, and over 65 million suffer from moderate-to-severe COPD, making it the third leading cause of death worldwide. Asthma typically starts early in life and is related to an allergy, whereas COPD is typically caused by air pollutants such as cigarette smoke or biomass fuel.

telemonitoring telehealth telemedicine asthma COPD respiratory symptoms monitoring eHealth disease management

1. Introduction

Assessments by healthcare providers typically only offer a relatively static status of a patient at a given point in time and may not reflect their full range of symptoms and fluctuations. For example, in patients with asthma, it is not uncommon to have a normal lung function and no symptoms during the assessment, while being symptomatic at home [1]. Furthermore, patients may fail to recognize early signs of an exacerbation, leading to delays in consultation, diagnosis and treatment [2][3]. The early detection and intervention of an exacerbation can reduce recovery times and the need for hospitalization, while also improving quality of life (QoL) [3][4][5]. Frequent evaluations of symptoms and clinical parameters also facilitate personalized care, helping to enhance diagnostic accuracy, improve disease management and prevent exacerbations. However, healthcare providers already have a high workload [6], and increasing the number of clinical visits and assessments is undesirable.

Technological advancements have produced convenient and affordable tools for monitoring symptoms, including Bluetooth ® blood pressure devices, oximeters and mini spirometers. In addition, patients are increasingly able to access the internet, and healthcare providers and organizations are increasingly able to exchange medical data safely within specific digital environments. These developments have led to innovative possibilities for diagnosing, monitoring and treating patients with asthma or COPD. An example of this is telemonitoring. It allows patients to monitor their symptoms and physical parameters at home, share the data with healthcare providers and receive tailored treatment strategies based on that information. In this way, technology can support healthcare providers to deliver personalized disease management and more frequent symptom monitoring without the need for clinical visits or physical on-site assessments [7][8].

Telemonitoring can empower patients to become more actively involved in managing their asthma or COPD [9][10]. Numerous studies have shown that self-management is difficult and often poor in these groups, with an estimated 22–78% of patients having poor adherence to medical therapies [11]. Furthermore, incorrect inhaler technique is common [12], and 30–50% of symptomatic patients continue to smoke despite moderate-to-severe COPD [13]. Education can improve self-management skills and enhance disease control [14][15]. Thus, telemonitoring enables patients to be actively involved in their disease management and provides time-efficient education and feedback.

International asthma and COPD guidelines, such as the Global Initiative for Asthma (GINA) and the Global Initiative for Chronic Obstructive Lung Disease (GOLD) [16][17], acknowledge the potential of telemonitoring in disease management. Telemonitoring may offer benefits to disease status [18], health-related QoL (HR-QoL) [18][19], exacerbations [19], hospital admissions [19], exercise capacity [18][20] and healthcare utilization (including emergency room visits) [21]. To date, the considerable heterogeneity in the research methodology, monitoring devices, outcome variables and patient populations in studies of telemonitoring make it difficult to draw firm conclusions regarding its effectiveness [7][22][23] and feasibility [24] for these diseases. Implementing telemonitoring in healthcare can also be complicated by organizational limitations, technical matters and resistance from potential users [25]. Acceptance by stakeholders, integration in electronic health records and cost-effectiveness in comparison to current treatment are key to successful implementation. Many promising eHealth technologies have failed to realize their potential to improve outcomes due to resistance from healthcare providers or patients [25][26].

2. Current Insights

2.1. Main Results

This narrative review summarized the findings of thirteen RCTs of telemonitoring interventions for asthma (n = 2) and COPD (n = 11). Eight showed clinical improvements, mainly regarding (time to) exacerbations, hospitalizations or death, and three of these demonstrated symptom improvement. Approximately one-third of the studies also evaluated safety and feasibility, and these all showed that the interventions were feasible and free of adverse events. When the monitored symptoms exceeded a certain threshold, healthcare providers in all the studies received automated warnings, and if needed, patients were called for further intervention. Despite the strict inclusion criteria, there was still large variation in the number of patients, the interventions, the follow-up times and the outcome measurements among the studies. However, the main difference between effective and ineffective interventions seemed to be the inclusion of some form of patient education in all the effective interventions compared to one-fifth of the ineffective interventions. Whether the improvements were caused by the educational intervention alone or the combination of telemonitoring and education (and possibly other factors) remains to be elucidated.

2.2. Comparison with Current Literature

Recent systematic reviews and meta-analyses on telemonitoring in asthma or COPD have shown that negative effects on clinical outcomes are rare [27], consistent with our finding of either positive outcomes or similar effects in

comparison to usual care. Furthermore, feasibility and safety were also assessed in some of the included studies, revealing no adverse effects. Studies have also shown that telemonitoring can be feasible and acceptable for older people with COPD. Thus, we conclude that telemonitoring seems to be a safe and promising approach to support disease management in patients with asthma and COPD.

2.2.1. Telemonitoring and Patient Education

Most telemonitoring interventions with at least one positive outcome had integrated an interactive educational component. Hong and Lee [19] previously found a similar effect in a meta-analysis of telemonitoring for patients with COPD. Active patient involvement through education or skills delivery to support coping with the disease seems to improve the outcomes. A reason for this mediating effect might be that telemonitoring is dependent on behavioral change in the patient and healthcare provider. It is important for patients to follow the monitoring instruction and for healthcare providers to use the results of the monitoring in their management, and using telehealth to deliver education can empower patients by giving them greater insight and the tools to manage their disease [7]. Bonnevie et al. [18] showed that interventions with automated feedback, representing a form of patient education, improved long-term adherence to home-based exercise therapy. Enhanced self-management can improve physical activity, avoidance and medication adherence. This could explain the greater effectiveness of telemonitoring programs with an educational component.

2.2.2. Accetability, Feasibility and Adherence

The effectiveness of telemonitoring applications on disease outcomes was evaluated in the studies evaluated in this review, with positive effects only found in some. It may be that there is no direct link between the telemonitoring intervention and disease outcomes. For example, if the application is not used (correctly) by the patient or if the healthcare provider is not using the collected data, health status will not be affected by telemonitoring alone. Instead, behavioral and implementation factors likely moderate the effectiveness of any intervention, which makes it remarkable that these are rarely measured in telemonitoring effectiveness studies. Some papers only described the feasibility of the intervention or the satisfaction with the program, failing to mention the behavioral and implementation factors that will also affect the results of telemonitoring. If the patient does not use an intervention, or if it is not correctly implemented in the healthcare process, it cannot be effective. To improve telemonitoring adherence and implementation for asthma or COPD management, greater attention should be given to patient behavior and user-friendliness. Furthermore, it remains unclear if and how healthcare providers used the telemonitoring results in clinical decisions, and indeed if patients' self-management improved due to symptom monitoring. These uncertainties limit our ability to pinpoint which moderating or mediating factors led to the observed clinical effects in the included studies.

Interventions with similar clinical effects to CAU may still be relevant if they improve other parameters, such as indirect costs, e.g., workload, work satisfaction or time and travel burdens. Michael Porter proposed the concept of value-based healthcare [28] to support decision making in healthcare by weighing the following three integrated concepts: patients value, health outcomes and costs. This suggests that implementing a telemonitoring innovation can be of value if health outcomes remain stable and patient satisfaction and/or costs improve. Unfortunately, the

included studies merely focused on clinical outcomes, which may have led to the unnecessary rejection of interventions that improve value-based healthcare. There is an urgent need for studies that assess all the concepts related to healthcare improvement, not merely clinical effects, for telemonitoring interventions.

3. Conclusions

Telemonitoring is effective, feasible and safe compared to care as usual for patients with COPD. There was an insufficient number of studies to draw conclusions regarding asthma telemonitoring. Telemonitoring can improve several clinical outcomes in COPD patients, including the need for hospitalization, length of hospitalization, number of clinical visits, QoL and number of exacerbations. Adding an educational element to a telemonitoring intervention seems to increase the prospect of a positive effect. However, there is a lack of research on the behavioral and process factors related to telemonitoring. Future research should focus on the effects of telemonitoring in patients with asthma, the full telemonitoring process for the patient and the healthcare provider and its implementation in the healthcare organization, as well as the impact of patient and healthcare provider characteristics.

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