



Telemanagement in asthma: an innovative and effective approach

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Purpose of review

Information and communication technology (ICT) could potentially help to reduce the considerable burden of asthma that still exists despite wide availability of effective therapies. Telemanagement is an interactive and proactive management approach consisting of an ongoing partnership of patients and professionals supported by ICT and focused on clinical outcomes and patient goals in the individual. This review highlights recent developments in telemanagement in the ongoing management of patients with asthma focused on the effectiveness, cost-effectiveness and implementation of telemanagement in asthma care.

Recent findings

An increasing number of studies address the effectiveness of components or a comprehensive telemanagement intervention in children and adults with mild to severe asthma. Telemanagement of asthma in the individual patient includes key components of asthma management, such as education, self-monitoring, goal setting, written action plans and regular medical review. Such a comprehensive telemanagement approach is effective in improving quality of life and clinical outcomes, especially in adult patients with moderate to severe asthma.

Conclusion

Telemanagement of asthma can be an effective and cost-effective approach tailored to the individual patient needs. More research is needed on the long-term effectiveness and cost-effectiveness of telemanagement of patients with asthma under real-world conditions and on effective implementation strategies.

Keywords

asthma, e-health, internet, self-management, telemedicine

INTRODUCTION

Information and communication technology (ICT) plays an essential role in supporting daily life in today's digital society [1,2]. In healthcare, ICT has the potential to enhance the quality of care in the management of patients with chronic diseases, to improve adherence to therapy and to allow early detection of exacerbations by continuously monitoring and providing feedback to the patient [3]. Internet-based strategies have been shown to be beneficial in the management of a variety of chronic diseases such as hypertension [4], HIV [5] and chronic heart failure [6] by enabling patient empowerment and behavior change [7,8]. Moreover, there is an increasing demand from patients for using internet applications in the management of their diseases [9]. Because many of these aspects are also relevant for patients with a chronic respiratory disease, there might be a role for ICT support in the management of patients with asthma.

According to the current asthma guidelines, treatment strategies should target minimization of symptoms, optimization of lung function and prevention of exacerbations with few medication related side effects [10]. However, despite wide availability of effective therapies for asthma, a considerable number of patients do not manage to achieve these proposed targets and experience a profound burden of disease [11,12] with a significant impact on their quality of life and on society as a whole [13]. The use of ICT in the management of patients with

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KEY POINTS

- The use of information and communication technology (ICT) in the management of patients with asthma could potentially help to reduce the considerable burden of disease that still exists despite wide availability of effective therapies and given demographic challenges.
- Telemanagement is an interactive and proactive management approach consisting of an ongoing partnership of patients and professionals supported by ICT and focused on clinical outcomes and patient goals in the individual.
- A comprehensive telemanagement approach is effective in improving quality of life and clinical outcomes, especially in adult patients with moderate to severe asthma and supports informed and educated patient autonomy.
- More research is needed on the long-term effectiveness and cost-effectiveness of telemanagement of patients with asthma under real-world conditions and on effective implementation strategies.

asthma could potentially help to overcome some of the barriers at the patient, professional and organizational level, which hamper the effectiveness of conventional asthma therapies.

First, ICT might empower patients with the tools and skills to become adequate self-managers and thereby gain control over their disease. For patients with asthma, this includes self-monitoring (e.g. lung function), being able to detect and respond to symptom worsening, possibilities to tailor medication to their individual needs and the ability to easily contact a professional. Second, health professionals may find ICT useful in order to interactively support patients' self-management, establishing a patient–professional partnership. Third, at an organizational level of healthcare, ICT might enable proactive care, for example by providing easy-to-use and personalized asthma action plans [14], and identifying patients who are at risk of symptom worsening [15].

Although many variants of ICT applications have been developed for management of individual patients in the respiratory field [2], there are only sparse data on their effectiveness and, therefore, the role of these applications in asthma (self)-management is still unclear. This article provides an overview of recent developments of management strategies for the individual patient with asthma that incorporate ICT applications.

TELEMANAGEMENT APPROACH

In the medical scientific literature, there is a wide variability in terms to describe the usage of ICT

applications in the management of chronic diseases. Some of the commonly used terms are e-health, telemedicine, telehealth, telemonitoring and telemanagement.

Whereas e-health refers to the complete field of health services which are delivered or enhanced by ICT [16,17], the definition of telemedicine and telehealth refers to the delivery of healthcare services to remote areas by using ICT for information transmission from the patient to a healthcare professional and back to the patient in order to save consultations and avoid journeys [18,19]. Another related term, telemanagement, is more focused on the ongoing management of the individual patient by employing ICT applications [20]. In this review, telemanagement will be defined as an interactive and proactive management approach consisting of an ongoing partnership of patients and professionals supported by ICT and focused on clinical outcomes and patient goals in the individual.

The cornerstone of telemanagement is tailoring treatment to the individual patient needs. Therefore, a telemanagement approach consists of the following components: electronic case management (individualized treatment plan), medication management (including reminders), case-specific education and instruction and integration with the electronic medical record of the healthcare provider [20].

For asthma, no single recipe for a telemanagement approach exists. However, known key components of management of asthma in the individual patient, such as education, self-monitoring, goal setting, written action plans and regular medical review [21], can easily be translated into a telemanagement approach including several modules with functionality corresponding to each of the key components of asthma management (see Fig. 1).

By providing self-monitoring tools such as easy-to-use handheld electronic monitoring devices or symptom questionnaires, patients can gain insight into their level of asthma control which gives them suggestions for subsequent treatment adjustment. Furthermore, telemanagement could incorporate a treatment algorithm which provides patients with instant treatment advice to maintain step-down, step-up (and/or contact a healthcare professional) their medication based on their history and current level of asthma control.

Preferably, telemanagement is integrated into an electronic medical registry that is used by the healthcare provider and a personal electronic health record used by the patient. Finally, telemanagement could include educational modules, that is interactive information on inhalation technique and a module for electronic consultations.

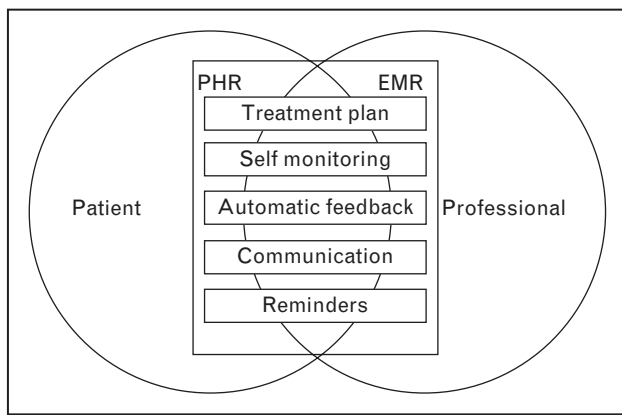


FIGURE 1. Schematic depiction of telemanagement in asthma. This figure represents key components of a telemanagement approach in asthma, a continuous process that is jointly shaped by the patient and professional. Patient and professional set goals, which are translated into a predefined treatment plan. Depending on self-monitoring goals, patients receive medical and motivational feedback that might also include self-treatment advice. The information and communication technology (ICT) system can be integrated with the personal health record (PHR) and the electronic medical record (EMR) of the professional. Communication is facilitated by e-consult or traditional methods. Automated reminders will alert patients to conduct self-monitoring activities or to schedule a consultation with their professional.

There are a number of ethical issues to consider in telemanagement related to the empowerment of the patient: privacy of information, informed consent, the accessibility and usability of the technology and the danger of making patients too dependent on technological support instead of making them more autonomous. However, in our view, telemanagement might help to shape patient autonomy based on considerations of relationality, care and responsibility which may better serve patients [22].

EFFECTIVENESS OF TELEMAGEMENT IN ASTHMA

A recent meta-analysis conducted by McLean *et al.* [23²²] included 21 randomized controlled clinical trials on telehealthcare interventions in both children and adults with asthma. These studies embodied a broad range of different interventions varying from follow-up of medication adherence by telephone to internet-based self-monitoring and feedback. The authors conclude that telehealthcare was not associated with a clinically relevant improvement in asthma-related quality of life or risk of visits to the emergency department. However, in this meta-analysis, there were only few examples of a

comprehensive telemanagement approach in asthma. Furthermore, patients in the control strategies often received an enhanced form of usual care, which makes it difficult to draw final conclusions on the effectiveness of telemanagement in asthma. In the study by Van der Meer *et al.* [24] in patients with mild-to-moderate persistent asthma, it was demonstrated that a comprehensive telemanagement approach consisting of a treatment plan, self-monitoring of lung function by Forced expiratory volume in the first second and asthma control with feedback and e-communication with a professional to support the patients' self-management can lead to significant improvements in quality of life, symptom-free days, asthma control and lung function as compared with usual care. More recently, a posthoc analysis of the study demonstrated that patients with partly controlled or uncontrolled asthma benefited the most from the telemanagement strategy [25²³]. In addition, this study showed that about 60% of the patients were still using the telemanagement service on their individual indication, after 1 year. There was a wide variability in the intensity of the usage of the telemanagement service, based on patient preferences, which was most intensive during the first 3 months. This illustrates that telemanagement does not seem to make patients too dependent on technological support but rather supports informed and educated patient autonomy.

In addition, with the benefits shown in patients with mild-to-moderate asthma, telemanagement might be particularly advantageous for children and adults with severe persistent asthma who are at higher risk of hospital admission due to asthma exacerbations or patients who have prednisone-dependent asthma [26,27]. In a study performed in Taiwan [28²⁴], it was demonstrated that patients with severe asthma who were managed via a mobile telephone based interactive system had a significant improvement in lung function and reduced number of exacerbations as compared with patients included in the usual care strategy (paper self-management tools only). The patients in the mobile phone group received a software package for their mobile phone, which consisted of an electronic diary (peak expiratory flow rate, daily asthma symptom score, need for reliever use) and a treatment decision support tool which gave feedback based on the level of asthma control from the previous 7 days.

Another study [29²⁵] focused on tapering of oral corticosteroid dose in patients with prednisone-dependent asthma. In this randomized controlled trial, a strategy combining an internet-based tool and daily monitoring of symptoms, lung function and fraction of exhaled nitric oxide (FE_{NO}) was

superior to usual care in tapering the dose of oral corticosteroid in patients with prednisone-dependent asthma, without decreasing lung function or asthma-related quality of life. Patients in the internet group had access to a website consisting of an electronic diary (lung function, FE_{NO} , daily asthma symptom score and assessment of asthma control), on which patients received direct treatment advice. Compliance with the monitoring measurements and entering the data into the website was very high and patients were satisfied overall with the telemanagement strategy.

Two recent studies investigated aspects of telemanagement in the care of children with asthma. Deschildre *et al.* [30[■]] compared a telemonitoring strategy consisting of home spirometry and medical feedback by a professional with a conventional treatment strategy (usual care and a paper diary for symptom, rescue treatment and healthcare use registration) in children with severe uncontrolled asthma. The authors were unable to find a difference in severe exacerbations (primary outcome), healthcare usage, inhaled corticosteroids maintenance treatment, lung function and quality of life. However, this relatively small study might have been underpowered, as it required 26 patients per group to detect a difference between groups on the primary outcome, but the end-point analysis could be determined in only 44 patients after 3 months of study and in only 35 patients after 1 year. In another recent study, Van der Valk and coworkers [31[■],32] conducted a post-hoc analysis on daily FE_{NO} measurements in 77 children with allergic asthma. The authors concluded that daily telemonitoring of FE_{NO} can detect changes prior to a moderate asthma exacerbation. Whether this information is a valuable basis for subsequent treatment adjustments and whether that might result in a reduction in the exacerbation rate and the number of hospital admissions needs further study. Therefore, the practical implications of daily telemonitoring of FE_{NO} in these patients are not yet clear.

Summarizing, the most recent available studies in children and adults show that telemanagement applications, whether involving mobile telephone based interactive systems or internet-based systems, are promising tools for supporting the management of patients with asthma. There is increasing evidence that a comprehensive telemanagement approach leads to an important gain in quality of life and clinical outcomes, especially in adult patients with moderate to severe asthma, and supports informed and educated patient autonomy [28[■],29[■]]. The application of telemanagement in the care of children with asthma has been shown to be feasible and well accepted by patients [30[■]]. However, well

designed and sufficiently powered studies are required to evaluate the long-term effects of telemanagement in children with asthma.

COST-EFFECTIVENESS OF TELEMANAGEMENT IN ASTHMA

Given current demographic challenges and costs of healthcare, novel cost-effective management strategies for asthma are required to face up to the global burden of asthma. To date, the cost-effectiveness of telemanagement interventions, including the cost of the technology and the user time is rarely reported. A cost-utility analysis of the study from Van der Meer *et al.* [24] showed that telemanagement can be as effective as current asthma care with regard to quality of life in terms of patient utilities and costs are similar over a 1-year period [33[■]]. However, the long-term cost-effectiveness may be more favourable, as the major intervention costs for equipment and cost of education sessions apply to the first year; costs in later years may be reduced, whereas the long-term effects observed during the first year may sustain. In addition, costs per patient will decrease if maintenance costs can be spread over an increasing number of users, thereby further improving the cost-effectiveness. Future long-term studies should include the costs for the ubiquitous technology upgrades and should focus on criteria such as which patients should have the telemanagement service and over what period in order to optimize outcomes.

IMPLEMENTATION OF TELEMANAGEMENT IN ASTHMA CARE

Given the accumulating evidence on the effectiveness of telemanagement in asthma, we advocate the implementation of comprehensive telemanagement services in routine practice. This will also allow us to collect further information on costs and effects under real-world circumstances. During the development and the implementation process itself, a focus should be kept on the end users [34]; therefore potential barriers and facilitators perceived by the end users should be identified prior to implementation. A structured implementation strategy is needed to incorporate telemanagement in current clinical practice and into a patient's daily life. Tailoring an implementation strategy to barriers and facilitators experienced by the target group (patients with asthma, nurses and physicians) is recommended [35]. Such barriers can be identified at different levels of the healthcare system: innovation, individual patient, professional level, societal context (i.e. opinion of colleagues),

organizational context (organization of care process), economic context and political context [36,37]. For instance, a telemanagement application should not only address the daily routine of patients and professionals, but should also become embedded in the organizational context (i.e. availability of a professional who can check e-consultations, good interoperability between different healthcare systems). Additionally, the digital infrastructure (i.e. mobile phone connectivity) should be available to reach those in rural areas [38]. Therefore, current and future studies should focus on barriers and facilitators for implementation of telemanagement in asthma and an implementation strategy should specifically address these barriers and facilitators.

CONCLUSION

Given current demographic challenges and costs of healthcare, ICT has a promising role in providing proactive and patient-centered care. Telemanagement of asthma can be an effective and cost-effective approach tailored to the individual patient needs, particularly for those at higher risk of worsening of asthma. Further research is needed on the long-term effectiveness and cost-effectiveness of telemanagement of patients with asthma under real-world conditions and on effective implementation strategies.

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Conflicts of interest

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Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 332).

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