Realising the potential of mHealth to improve asthma and allergy care: how to shape the future

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Introduction

mHealth (mobile health) refers to the use of mobile and wireless devices in the support of healthcare delivery and improvement of health outcomes. mHealth has evolved from eHealth (electronic health), the use of information and communication technology (ICT) for health services and information transfer. According to the World Health Organization [1], mHealth "has the potential to transform the face of health service delivery across the globe. A powerful combination of factors is driving this change. These include rapid advances in mobile technologies and applications, a rise in new opportunities for the integration of mobile health into existing mHealth services, and the continued growth in coverage of mobile cellular networks." The potential applications and benefits of mHealth are extensive and expanding [2] (table 1). Many of these tools can be applied to asthma and allergies.

The application of mHealth solutions can support the provision of high-quality care to patients with chronic respiratory diseases such as asthma. It can provide satisfaction for both patients and healthcare professionals, and reduce healthcare consumption and costs [3]. However, it is increasingly being recognised that implementing ICT innovations may also have adverse consequences. It is therefore important to test applicability in each individual situation [4].

Two papers published in this issue of the *European Respiratory Journal* (*ERJ*) refer to the potential use of mHealth in asthma. One paper focusses on the patient and the healthcare professional's experience [5], and the second proposes a non-ICT developed algorithm to manage asthma [6]. This algorithm will be difficult to implement without an ICT solution.

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TABLE 1 Potential applications of mobile health technologies [1]

Emergency toll-free telephone services
Treatment compliance
Appointment reminders
Community mobilisation and health promotion
Raising of awareness
Mobile telemedicine
Public health surveys and surveillance
Patient monitoring
Information initiatives
Decision support systems
Patient records

Impact of mHealth in asthma and allergic diseases

There is need for a more comprehensive and tailored approach to personalise current management and to improve adherence to treatment in asthma [7, 8] and upper-airway diseases [9].

Digital self-management interventions for adults with asthma are promising. Most studies using mHealth, telemedicine, electronic health records and digital app interventions, in both adults and children, appear to be only of moderate quality and show high heterogeneity in the study end-points and designs [10]. There is some evidence of small beneficial effects on asthma control in adults and children [11, 12] and of some effect on treatment adherence [13, 14]. The primary focus of most of the Android (Google, Mountain View, CA, USA) operating system asthma applications has been on patient self-monitoring and self-assessment, but there are low levels of health information quality across all applications [15]. Self-management facilitated by a healthcare professional is important for the control of symptoms and prevention of exacerbations [16]. Existing standards for conducting trials and reporting results in mHealth should be reported. They should include an assessment of the minimal clinically important difference as well as the prevention of potential pitfalls such as threats to patient privacy protection, data fishing, and lack of compliance of interventions with evidence-based medicine, guideline recommendations and regulatory board statements [17].

Smart devices and Internet-based applications are already used in rhinitis and may help to fulfil some of the unmet needs [18–21]. MASK-rhinitis (MACVIA-ARIA Sentinel Network for Allergic Rhinitis), an ICT system centred around the patient [20, 21], is one of the implementation tools of the Action Plan of the European Innovation Partnership on Active and Healthy Ageing [22].

Human factors applied to the design, development and evaluation of mHealth

Appropriately identifying and representing stakeholders' interests and viewpoints in evaluations of mHealth is a critical part of ensuring continued progress and innovation [23]. Patient, caregiver and clinician evaluations and recommendations play an important role in the development of asthma mHealth tools by supporting the provision of asthma management [24].

Few studies have been performed in asthma to assess human factors. Patients/consumers must perceive the need for assistance with a task and assign priority to the task supported by the mHealth intervention. Additionally, the cost of adopting the intervention (*e.g.* additional effort or time spent learning the new system) must be lower than the benefit. Otherwise, there is a high risk that consumers will not adopt the mHealth intervention [25].

A systematic review was carried out on studies published in 2013 and 2014. It examined whether human factor methods were applied in the design, development and evaluation of mobile applications developed to facilitate aspects of patient-centred care coordination [26]. 12 of the 15 papers describing the design or development of an app reported the use of a human factors approach. The most frequently used methods were interviews and surveys, which often included an exploration of the participants' current use of information technology (IT). 16 papers described the evaluation of a patient application in practice. All of them adopted a human factors approach, typically an examination of the use of app features and/or surveys or interviews which enquired about patients' views of the effects of using the app on their behaviour (*e.g.* medication adherence), knowledge and relationships with healthcare providers. However, none of the studies in the review assessed the impact of mobile applications on health outcomes. The review showed that human factors approaches are nearly always adopted to some extent in the design, development and evaluation of mobile applications. Moreover, an effective implementation strategy for Internet-based self-management support in asthma care should focus on human factor barriers [27].

Overall, clinicians view asthma mHealth technology as supporting the aims of the patient-centred medical home. In one study in children, primary care physicians and pulmonologists wanted different information from a mobile app [28].

The study published this month in the *ERJ* [5] is of importance since it attempts to determine the perspectives of people with asthma and healthcare professionals on the use of mHealth for asthma self-management. The authors used a sequential exploratory mixed-methods design. The focus group participants (18 asthmatic subjects and five healthcare professionals) allowed the development of questionnaires, which were subsequently disseminated to people with asthma and to healthcare professionals. 12 potential uses of mHealth were identified. In the second step, the 186 asthmatic subjects requested an mHealth system to monitor asthma control over time (72%) and to collect data to share with healthcare professionals (70%). However, an alert system to identify loss of asthma control (86%) and to advise patients on when to seek medical attention (87%) was most often selected by the 63 healthcare professionals. Asthmatic subjects thought less often than healthcare professionals that assessing medication adherence and inhaler technique could improve asthma control. These data provide strong support for mHealth in asthma self-management, but highlight the importance of understanding the perspectives of end-users and factoring these into the design of the intervention if this has any chance of being successful.

Clinical decision support systems in the management of complex diseases

Asthma action plans can improve outcomes for around two decades but their implementation in routine practice remains poor. The reasons for this are complex but include the fact that patients' and professionals' understanding perspectives of their utility are misaligned, and that the processes used have been largely paper-based and hence inconvenient. mHealth-based tools, and particularly smartphones, can support the delivery of asthma action plans. However, detailed formative work is essential to ensure that these are carefully developed in order to meet the needs of both patients and providers. IT system users must be allowed to decide on the future direction of major national IT initiatives. But the task of redistributing power equally amongst stakeholders is challenging [29]. Short cuts are unlikely to be successful.

Clinical decision support systems (CDSS) are software algorithms that advise healthcare providers on the diagnosis and management of patients, based on the interaction of patient data and medical information, such as prescribed drugs. CDSS should be based on the best evidence and algorithms to aid patients and healthcare professionals to jointly determine the treatment and its step-up or step-down strategy for an optimal disease control.

However, a systematic review in asthma, carried out in 2014, indicated that the current generation of CDSS was unlikely to improve outcomes for patients with asthma because they are rarely used and their advice is not followed. Future CDSS for the management of asthma need to align better with professional workflows so that pertinent and timely advice is easily accessible within the consultation [30]. Newer studies have been carried out. My Asthma Portal enhances asthma quality of life but not asthma control [31]. Another study was able to predict asthma exacerbations using remotely monitored adherence [32].

In allergic rhinitis, the MASK CDSS is incorporated into an app and an interoperable tablet [21] for healthcare professionals (ARIA Allergy Diary Companion) [20, 33]. This is based on an algorithm to aid clinicians to select pharmacotherapy for patients with allergic rhinitis (AR) and to stratify their disease severity [33]. It uses a simple step-up/step-down individualised approach to AR pharmacotherapy and may hold the potential for optimal control of symptoms, while minimising side-effects and costs. However, its use varies depending on the availability of medications in the different countries and on resources.

Kouri *et al.* [6] did not use ICT tools but should benefit from them. Although the authors overestimate the prevalence of uncontrolled asthma, their paper is of great clinical relevance. An asthma action plan (AAP) is an individualised written plan produced by a healthcare professional for a patient with asthma. It provides education and guidelines for self-management of worsening symptoms in a "traffic light" configuration [34]. Joint production is necessary [35, 36]. Asthma action plans improve quality of life, reduce healthcare utilisation and are cost-effective [37, 38]. However, few patients receive an AAP, partly due to the prescribers' inability to complete "yellow zone" instructions (how to intensify therapy for acute loss of control). Furthermore, primary care practices are not yet ready to support AAP implementation [39]. mHealth may be of importance although patients may not be very interested in identifying loss of control, as found by Simpson *et al.* [5] in this issue. Kouri *et al.* [6] reviewed the best evidence from recent asthma guidelines [40–42] and adult studies addressing acute loss of asthma control (January 2010 to March 2016). Recommendations were comparable across guidelines but some areas lacked guidance. Based on this review, practical evidence-based algorithms were developed for therapeutic intensification in the yellow zone. The authors also developed operational guidelines to maximise adherence and minimise errors. 87 regimens were identified. Operational guidance included several stepping-up procedures in the

"yellow zone". An implementation tool was developed to facilitate AAP delivery at the point-of-care, addressing existing gaps and uncertainties. The authors established basic principles for formulating yellow zone prescriptions and proposed that the tool should be implemented as part of a multifaceted approach to augment AAP usage.

This study paves the way for predictive medicine in asthma. However, before its conclusions are implemented globally: 1) the rules established need to be reviewed by a large group of experts including patients, primary care physicians, health economists and policy makers to investigate its potential application in developed and developing countries; 2) the resulting AAP should then be tested in real-life trials assessing the cost-effectiveness of the approach in different health systems; 3) care pathways should be developed at a country/region level taking into account available and affordable medications; and 4) it is unlikely that primary care physicians who see most of the asthmatic patients will be able to easily use this AAP since it is, in essence, relatively complex. Furthermore, many drugs are now in generic forms that differ between countries and whose number is rapidly evolving. An ICT solution is therefore highly favoured if the authors wish to have their guidance applied in real life. In this latter case, we tend to disagree with the authors who indicate that printable, paper-based algorithms can be used in clinical settings in the vast majority of practices.

Conclusion

mHealth is still a highly promising concept for the management of chronic diseases and precision medicine. However, even in diseases such as diabetes, its real value is not yet fully realised [43, 44] and cost-effectiveness studies are needed. The two papers published in this issue of the *ERJ* are of great importance for the development of mHealth in asthma.

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