See I told you I was taking it! — Attitudes of adolescents with asthma towards a device monitoring their inhaler use: Implications for future design

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ABSTRACT

Adherence to treatment in asthma is often poor, particularly in adolescents and children where the condition is most prevalent. Electronic monitoring devices have shown potential for improving inhaler use, yet little research has considered the attitudes of patients towards these devices. We gave seven adolescents with asthma an electronic monitoring device to use for one month and collected their views on important issues including monitoring and data sharing. Our results showed that participants felt positively about using the data to demonstrate responsibility for their condition to both their parents and medical professionals, but expressed concern for the attention the device's appearance could draw to them and their asthma. This paper considers the positive and negative perceptions of this novel device and provides new insight into the attitudes of adolescents towards inhaler monitoring, as well as future directions for design and development of monitoring devices for asthma and other chronic medical conditions.

1. Introduction

1.1. Asthma and non-adherence

Asthma is a chronic inflammatory condition of the airways that affects roughly 5.5 million people in the UK (NRAD, 2014). Although highly treatable, asthma poses a significant economic burden, costing the NHS £1 billion every year (NHS Information Centre, 2010).

Asthma inhalers come in two main forms. A 'rescue' inhaler is used to rapidly but temporarily relieve severe symptoms and attacks, whereas a 'preventer' inhaler containing corticosteroids is used daily to suppress airway inflammation and keep symptoms under control (Petrie et al., 2012).

In healthcare, adherence denotes the extent to which a patient follows a treatment plan that has been prescribed to them by a healthcare professional (Bender et al., 1997). A robust finding in asthma literature is that adherence to inhaled corticosteroids is sub-optimal (Bender et al., 1997; Lasmar et al., 2009; Milgrom et al., 1996) with rates ranging from 30 to 70% (Horne, 2006). For effective asthma control and thus reduced emergency room visits and healthcare costs, a patient should adhere to at least 80% of their daily medication (Lasmar et al., 2009).

If a patient does not adhere they may experience severe symptoms and become over-reliant on their rescue medication (Tan et al., 2009). The impact of overuse of rescue medication was demonstrated by a study that found a strong correlation between their increased use and an increased risk of asthma mortality (Suissa et al., 1994). A recent review of asthma deaths in the UK further supported this, showing an association between overuse of short-acting beta agonists (SABA) and asthma deaths (NRAD, 2014). The importance of adherence to inhaled corticosteroids (preventer therapy) has also been highlighted, with a strong correlation found for their proper use and a decreased risk of asthma mortality (Suissa et al., 2000).

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1.2. Adolescents with asthma

Adolescents, or young people between the ages of 10 and 19 (World Health Organisation, 2015), are an age group associated with reduced medical supervision from parents and caregivers as well as poor adherence to medication (Shah et al., 2001). Focusing health research on this age group is particularly important as health behaviours developed here often continue into adulthood and can have long-term effects on health in later life (Holmbeck, 2002; Viner and Macfarlane, 2005).

Asthma is one of the most prevalent conditions in children and young adults worldwide (Michaud et al., 2007). For asthma patients of 18 years and below, it has been demonstrated that median adherence rates to inhaled corticosteroid therapy typically range from 30% to 70% (Klok et al., 2015).

Currently, medical devices with relevance to adolescents are often designed specifically for children, or designed primarily for children but still used by adults (Geljins et al., 2005). It is rarely the case that adolescents are directly considered and involved in the design of devices, although notable examples of where they have do exist (Lang et al., 2012).

1.3. Involving users in the design of medical devices

With the vast number of potential individuals who could interact with any one device such as patients, doctors, nurses and family members, user needs should be taken into account wherever possible, as failure to do so makes the device vulnerable to failure (Grocott et al., 2007).

Whilst involving users may appear unattractive to companies in terms of added time and cost, the benefits are likely to outweigh this through successful design that effectively meets the needs of users, therefore providing an edge over competitors who may not have been as thorough in their development of device requirements (Martin et al., 2008; Privitera and Murray, 2009).

There are a number of case studies where use of human factors methods has led to the design of usable medical devices. For example, interviewing physicians and other end-users and observing their short-comings led to the successful design of automated external defibrillators (AEDs) that could be used by people with no previous experience in emergency situations (Kroll et al., 1991). Focus groups and usability tests helped to inform a redesign of infusion pumps, to reduce handling issues as well as error resistance (Garmer et al., 2002; Liljegren et al., 2000). In mental health, multiple methods including usability questionnaires, follow-up interviews and a user-trial were implemented in the development of a personal monitoring system for patients with bi-polar (Bardram et al., 2013).

The value in considering the design of medical devices is highlighted further in Sharples et al., where five case studies are used to demonstrate the relationship between medical device design and resultant user behaviour within a systems context (Sharples et al., 2012).

1.4. Electronic monitoring devices for asthma

Inhaler use can be monitored through methods including patient self-report, dose-counting, canister weighing and pharmacy records, however all of these techniques suffer from inaccuracy (Howard et al., 2014).

Electronic monitoring devices (EMDs) form a growing area of asthma research, where it has been demonstrated that they offer the most accurate solution for monitoring adherence to asthma therapy (Bender et al., 2000; Burgess et al., 2008; Ingerski et al., 2011). There is also evidence that these devices can actually improve adherence when they include a reminder function to alert a patient when their next dose is due (Chan et al., 2015; Charles et al., 2007).

EMDs usually attach to a patient's normal inhaler and record a date and time log whenever the patient actuates a new dose (Chan et al., 2013). These data have potential to be shared, allowing stakeholders such as parents, carers, asthma nurses, prescribing consultants or the patient themself to view data and track inhaler use over time. Despite robust evidence for their effectiveness in clinical research for accurately monitoring inhaler use, little to no research has considered patient attitudes towards these devices (Howard et al., 2014).

1.5. The 'Internet of Things' and the trend towards data-driven healthcare

EMDs for asthma are part of an emerging field of devices and technologies that sit within the 'Internet of Things'. The Internet of Things refers to 'smart objects' that have at least basic computing capabilities as well as a connection to other Internet enabled entities (Miorandi et al., 2012). A key feature of these 'objects' is their functionality to sense physical phenomena such as light or temperature, and this is what separates them from normal parts in typical networked systems (Miorandi et al., 2012).

EMDs are part of the 'Internet of Things' as they collect data about a patient's inhaler use and transfer this information to an online database where it can be viewed on a device such as a smartphone, tablet or computer.

The Internet of Things has great potential for healthcare as it helps create a shift from cure to prevention (Walport, 2014). Connected devices capable of monitoring a patient's vital signs such as heart rate, blood flow and blood sugar can create a wealth of data collected outside of a patient's clinical check-ups, allowing for a much greater understanding of that patient's health on a day-to-day basis (Topol, 2012).

For common chronic conditions such as asthma or diabetes, these smart devices could also potentially allow a clinician to remotely monitor a patient in near to real time and provide rapid interventions when signs point to potentially health-threatening situations such as an oncoming asthma attack. Previous research has indicated that remote monitoring of patients with asthma could help to improve treatment outcomes (Steel et al., 2002).

1.6. Goals of the study

With adolescence associated with a high asthma prevalence, poor adherence and a tendency to be overlooked in medical device design (Geljins et al., 2005; Lang et al., 2012), this study aimed to investigate the potential impact of an exemplar EMD called the 'SmartTrack' on a sample of adolescents with asthma. The SmartTrack device monitors and records the exact date and time of every inhaler actuation and can upload this information to an online database where it can be viewed by anyone with granted access. Audible tones can also be played to remind the patient when their next dose is due.

This paper provides new insight into the attitudes of adolescent users towards the concept of a 'smart inhaler', with particular focus on feelings about having their medication-taking behaviour recorded, and the extent to which they would be comfortable with this recorded behaviour being shared. This research determines future directions for the design and implementation of smart inhalers specifically, and technology-enhanced medical devices more generally.