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When referring to this work, full bibliographic details including the author, title, awarding institution and date of the thesis must be given.
Appendix 1 NHS Lothian asthma self-management plan
How to recognise if your asthma is getting worse:

- Have you had difficulty sleeping because of your asthma symptoms (including coughing)?
- Have you had your usual asthma symptoms during the day (cough, wheeze, chest tightness or breathlessness)?
- Has your asthma interfered with your usual activities (e.g. housework, work or school)?

If you have answered ‘yes’ to one or more of the above, then arrange an asthma review with your GP or practice nurse.

See your nurse or GP once a year even when your asthma is well controlled. Take this plan to each visit so it can be updated. Take your symptom or peak flow diary to each visit.

Your local pharmacist is available to give asthma advice.

Get a copy of “Asthma Attacks and Emergency Care” from Asthma UK free of charge by calling the number overleaf.

Do not stop taking your asthma medicines without talking to your doctor first.

For further information contact:

**Asthma UK Scotland**
www.asthma.org.uk
0800 121 6244 (Helpline)
Monday – Friday, 9am – 5pm
(calls free from a BT landline)

**Chest Heart & Stroke Scotland**
www.chss.org.uk
0845 0776000 (Advice Line)
Monday – Friday, 9.30am – 4pm
(calls charged at local rates)
adviceline@chss.org.uk

**My Condition, My Terms, My Life**
www.myconditionmylife.org

**NHS Inform**
www.nhsinform.co.uk

**Smokeline**
www.canstopsmoking.com

With thanks to NHS Lanarkshire for permission to adapt their Asthma Action Plan

June 2012
**Green Zone**

Your asthma is well controlled when:

- Your sleep is not disturbed by asthma symptoms (cough, wheeze, chest tightness or breathlessness)
- Your usual activities are not affected by asthma symptoms
- You have no asthma symptoms during the day
- Your peak flow reading is above ..........

**Action**

Continue to take your usual asthma medicines:

<table>
<thead>
<tr>
<th>Inhaler/tablet name</th>
<th>Preparation/Colour</th>
<th>Dose and frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventer – should be used every day, even when well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliever – should be used if you have symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other asthma medication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Amber Zone**

Your asthma is getting worse if:

- You have difficulty sleeping because of asthma symptoms (cough, wheeze, chest tightness or breathlessness)
- You have difficulty doing normal activities because of asthma symptoms
- You are using your reliever inhaler more or it lasts a shorter time
- Your peak flow is less than 80% of best.

**Action**

Take full dose of inhalers:

- Reliever up to 12 puffs daily
- Maximise dose of any other inhalers. If this does not help, contact your GP or nurse for advice.

If your symptoms do not improve within ____ days see your GP and start steroids as directed.

Take ____ steroid tablets (5mg each) immediately and again each morning for ____ days or as directed.

Always let your GP or nurse know if you have started taking your steroid tablets.

**Red Zone**

Asthma emergency:

- Your symptoms are getting worse (breathless, wheeze, cough or tight chest)
- You are too breathless to speak easily (cannot speak full sentences)
- Your blue reliever inhaler does not help
- Your peak flow reading is below 50% of best.

**Action**

- Get help – call 999 urgently
- Sit up and loosen tight clothing
- Take your reliever inhaler: 4 puffs to start and 1 puff every minute up to 20 puffs until symptoms improve or help arrives.
Appendix 2 Published systematic review in JAMIA
The use of mobile applications to support self-management for people with asthma: a systematic review of controlled studies to identify features associated with clinical effectiveness and adherence

Chi Yan Hui, 1 Robert Walton, 2 Brian McKinstry, 3 Tracy Jackson, 3 Richard Parker, 4 Hilary Pinnock 1

ABSTRACT

Introduction

Asthma is common and associated with significant morbidity. The World Health Organization reports that 235 million people worldwide currently suffer from asthma. 1 Supported self-management, including a personalized asthma action plan (PAAP), reduces morbidity. 2 However, implementation is challenging. Practical, conceptual, and organizational barriers hinder the use of written PAAPs. 3 Practical barriers include lack of time and resources (eg, no immediately available paper-based PAAPs). 2 Conceptual barriers include a mismatch between advice given by professionals and advice patients want on how to live with their asthma. 4 Organizational barriers include a lack of flexible systems for effective communication between professionals and patients. 4

A mobile application (app) has the potential to support self-management, though it needs to engage patients and encourage adherence. This year, it is predicted that 500 million people around the world will use a health care app, and 71% of all UK citizens have a smartphone. 5 Apps have penetrated into people’s daily lives and are increasingly accepted as a tool to monitor health. However, many people stop using a health care app shortly after downloading it. 6 To realize the benefits of self-management, apps need to not only attract potential users, but sustain awareness of and adherence to ongoing use of the system.

Previous research has been focused on clinical outcomes rather than on informing the development of system features that are attractive and adherent, such that patients continue to use the app in routine self-management. We therefore aimed to systematically review the literature to (1) assess clinical effectiveness, (2) characterize the features of the interventions and their association with outcomes, and (3) assess adoption and adherence to usage.

Methods

The systematic review is registered with, and the protocol is available from, the PROSPERO database, registration number CRD42015016414. We followed the procedures described in the Cochrane Handbook for Systematic Reviews of Interventions. 7

Search strategy

The search strategy, inclusion criteria, exclusion criteria, and analysis plan were specified in advance and are documented in the protocol. Table 1 summarizes the PICOS (population, intervention, comparison, outcome, and setting) strategy. We searched 9 databases and 2 trial registries, and undertook manual searches of key relevant journals. Search terms were asthma AND technology terms (3 categories:...
smartphone/tablet app, information and communication technology (ICT) services, devices and platforms) limited to RCTs and quasiexperimental studies with a data limit of 2016 (because this was the year of approval of the global technical specifications for third-generation [3G] cellular systems under the brand IMT-2000 by the International Telecommunication Union, which enable faster ICT application and services, including voice, fax, and Internet).

The detailed search strategy for MEDLINE and EMBASE are provided in Supplementary Appendix A.

Screening and Data Extraction
Titles and abstracts were screened by 1 reviewer (CyH), with 100% random titles checked by a second reviewer (HP) for training and quality control (with 100% agreement). The full text of all potentially eligible studies was retrieved and assessed against the inclusion criteria (see Table 1 PICOS description) by 1 reviewer (CyH), with a random sample of 20 papers reviewed by a second reviewer (TJ) initially with 75% agreement. The disagreement was due to different interpretations of the ICT interventions that would be included in the review. This was

Table 1: Search strategy

<table>
<thead>
<tr>
<th>PICOS search strategy</th>
<th>Inclusion and exclusion criteria, data range, and sources of searches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td>Adults and teenagers with asthma. We excluded young children because (i) the format of effective self-management in preschool children is unclear, and (ii) the dynamics of ICT use are likely to be different if the parent is taking responsibility. We did not set an absolute age threshold, but included any intervention in which the primary target is the person with asthma (as opposed to a parent); we anticipated this would include teenagers 12 years and over. Studies of multiple conditions were included if data specifically about people with asthma could be extracted.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Any ICT intervention with any currently available device, such as smartphone, tablet, smart TV, or computer, to support self-management of asthma. We did not include interventions where the only ICT component was a telephone as an alternative mode of delivery of a consultation or impart information (eg, with an educational video), unless there was ongoing facilitation of self-management.</td>
</tr>
<tr>
<td><strong>Comparator</strong></td>
<td>Patients who were not provided with or did not have access to the ICT system to support their asthma self-management,</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>a. Clinical effectiveness (asthma control, acute exacerbations, intermediate outcomes such as self-efficacy).</td>
</tr>
<tr>
<td></td>
<td>b. Adoption of ICT was assessed by proportion downloading the apps or taking up the intervention, ownership of action plans.</td>
</tr>
<tr>
<td></td>
<td>c. Adherence to ICT intervention was assessed by system usage frequency, withdrawals.</td>
</tr>
<tr>
<td><strong>Settings</strong></td>
<td>Any health care setting.</td>
</tr>
<tr>
<td><strong>Study design</strong></td>
<td>Studies were included if they were randomized controlled trials (RCTs) and quasiexperimental studies.</td>
</tr>
<tr>
<td><strong>Other exclusion criteria</strong></td>
<td>We excluded papers not published in English.</td>
</tr>
<tr>
<td><strong>Date range</strong></td>
<td>The date range for all searches was January 1, 2000, to January 1, 2015, with an updated search in April 2016.</td>
</tr>
<tr>
<td><strong>Databases</strong></td>
<td>MEDLINE, EMBASE, BIOSIS, PsycINFO, AMED, BNI, Cochrane Library (Databases of Abstracts of Reviews of Effects, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, Web of Science Core Collection, and IS Proceedings [ISI-EXPAND, ISS, A1HOL, CKX-S, CKX-SSH, BIKO-S, BIKO-SSH], ScienceDirect.</td>
</tr>
<tr>
<td><strong>Forward citations</strong></td>
<td>A forward citation search was performed on all included papers using International Statistical Institute Proceedings (Web of Science). The bibliographies of all eligible studies were scrutinized to identify additional possible studies.</td>
</tr>
<tr>
<td><strong>Unpublished and in-progress studies</strong></td>
<td>UK Clinical Research Network Study Portfolio (<a href="http://www.clinicaltrials.gov">www.clinicaltrials.gov</a>) and Meta Register of Controlled Trials (<a href="http://www.controlled-trials.com">www.controlled-trials.com</a>).</td>
</tr>
<tr>
<td><strong>Definition</strong></td>
<td>ICT, defined as any information and communication technology consisting of communication devices, software, apps, and Web applications, to allow duplex communication between medical professionals, patients, and carers in order to support asthma self-management.</td>
</tr>
<tr>
<td></td>
<td>Communicative device, defined as any communication hardware such as 3G mobile phone, tablet, computer, smart TV, 2G mobile phone, or landline telephone, to allow duplex communication.</td>
</tr>
</tbody>
</table>
clarified in discussion with a third reviewer (HP), and we subsequently achieved 100% agreement.

Two reviewers (CyH and HP) extracted data using a piloted data extraction sheet under the heading characteristics of the included studies (study method, demographics of participants, asthma severity, sample size, intervention duration, intervention, and control setting); features of the ICT; clinical outcomes (control and exacerbations); and adherence. Disagreements were resolved by discussion.

Risk of bias
Two reviewers (CyH and HP) assessed and documented the methodological quality of included studies using the methods detailed in section 8 of the Cochrane Handbook for Systematic Reviews of Interventions, and used Review Manager 5.3 to record and generate a risk of bias graph. The overarching risk of bias was summarized based on the Cochrane risk of bias tool.

Data synthesis and analysis
Meta-analysis
Heterogeneity of the included studies, such as measures used, intervention setting, and duration, was assessed to judge the appropriateness of performing meta-analysis. For groups of trials where meta-analysis was judged appropriate, mean difference was estimated using a fixed-effect model by R software, and a pooled estimate with 95% confidence intervals reported. We used a fixed-effects method due to the small number of studies and so that the weightings could be dependent on within-study variability and study size rather than influenced by estimates of heterogeneity. If long-term and short-term measures were presented, the long-term measures were taken to determine the treatment effect of the intervention.

Narrative synthesis
We performed narrative synthesis of heterogeneous studies. We plotted the app features and their associations with outcomes, sample size, and intervention duration on a bubble plot. This plot enables identification of a combination of features for effective clinical outcomes and/or adoption and sustainability.

Interpretation
The results of the data synthesis were discussed within the multidisciplinary team, which included expertise in e-health, ICT, and asthma self-management.

RESULTS
Included studies
The identified papers, the screening process, and the final number of studies included are detailed in the PRISMA flowchart (Figure 1). In summary, out of 1919 papers, 14 were finally included, reporting...
<table>
<thead>
<tr>
<th>Author [Year]</th>
<th>Trial</th>
<th>Participant characteristics</th>
<th>Inclusion criteria</th>
<th>Clinical effectiveness outcomes</th>
<th>Self-efficacy, adoption, and adherence outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cingi (2015)</td>
<td>Mobile APP vs Usual care FU 3 months</td>
<td>Secondary care patients: n=68; C: 68; Age: I: 32 yrs (SD: 8.2); C: 34.5 yrs (SD: 8.2)</td>
<td>Mild to severe persistent asthma, owned a smartphone at least 6 months prior to enrollment.</td>
<td>*Asthma control: Compared to control group, more patients achieved a well-controlled asthma score (ACT &gt; 18) than in the control group (I: 49% vs C: 27%, P &lt; .05).</td>
<td>Adherence: App group inputted 90 (70-154) sets of data. 80% of communications were between 06:00 and 18:00. Attrition was greater in the control group (I, 8 vs C, 36).</td>
</tr>
<tr>
<td>Foster (2014)</td>
<td>Personalized adherence discussion (PA2) vs SmartTrack reminder (RF)</td>
<td>Primary and secondary care patients: PAD, n=24; RF, n=35; PAD: I 100; n=41; C: n=43; Age: PAD: 43.3 yrs (SD: 15.8); RF: 40.0 yrs (SD: 13.7); PAD + IRD: 39.7 yrs (SD: 17.7); C: 40.0 yrs (SD: 14.1); % Female: PAD: 63%; RF: 54%; PAD + IRD: 49%; C: 78%</td>
<td>Suboptimal asthma control and prescribed twice-daily ICS/LABA for 1 month or more</td>
<td>*Asthma control: No between-group differences in ACT (P = .14) or between reminder and nonreminder groups. *Medication adherence: Adherence declined in all groups over 6 months (PA2) from 62% to 53% vs RF from 69% to 65%; IF + PA2 from 85% to 69%; UC from 62% to 29%. Exacerbations: No between-group differences in patients with &gt;1 severe exacerbations (P = .26). Quality of life: No between-group differences in mini AQLQ (P = .26).</td>
<td>N/A</td>
</tr>
<tr>
<td>Van Gaalen (2013)</td>
<td>Web monitoring + education vs Usual care</td>
<td>Primary and secondary care patients: n=47; C: 40; Age: I: 38 yrs (SD: 8.2); C: 37 yrs (SD: 8.0); % Female: I: 74%; C: 65%</td>
<td>Patients from Meer agreeing to 30-month FU</td>
<td>Asthma control: Significant but attenuated between group improvement in AQLQ score at 30 months (adj mean diff -0.33 [-0.63, -0.03]). *Quality of life: Significant but attenuated between-group improvement in AQLQ score at 30 months (adj mean diff 0.29 [0.01-0.57]).</td>
<td>N/A</td>
</tr>
<tr>
<td>Meer (2009)</td>
<td>Web monitoring + education vs Usual care</td>
<td>Primary and secondary care patients: n=101; C: 96; Age: I: 35 yrs (range 18-50); C: 37 yrs (range 19-50); % Female: I: 68%; C: 71%</td>
<td>Physician-diagnosed asthma or ICS for ≥3 months, access to internet, Dutch speaking.</td>
<td>Asthma control: Compared to controls, Web group had improved AQLQ at 12 months (I: -0.54 [-0.65 to -0.42] vs C: -0.06 [-0.18 to 0.03]). *Quality of life: Compared to controls, Web group had improved AQLQ at 12 months (I: 0.56 [0.43 -0.68] vs C: 0.18 [0.05-0.31]). Medication adherence: No between-group difference in self-reported medication adherence.</td>
<td>Adherence: Average of 34.8 website log files received from each patient in the Web group at 12 months. No reports on data in the control group.</td>
</tr>
</tbody>
</table>
Table 2: Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Trial</th>
<th>Participant characteristics</th>
<th>Inclusion criteria</th>
<th>Clinical effectiveness outcomes</th>
<th>Self-efficacy, adoption, and adherence outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araujo (2012)</td>
<td>Paper-Web vs Web-paper FU 48 weeks</td>
<td>Secondary care patients: n = 12; C: 9 Age: 1: 26 yrs (SD 6.2); C: 32 yrs (SD 12.2) % Female: 1: 67%; C: 78%</td>
<td>Moderate/severe asthma for ≥ 6 months using ICS/LABA in a single inhaler and FEV1 &gt; 50% predicted.</td>
<td>*Asthma control: No between-group difference in ACOG-6 (mean diff 0.2 [-0.63 to 0.27], P = .42). Quality of life: No between-group difference in mini-AQLQ (mean diff −0.1 [−0.33 to 0.49], P = .68).</td>
<td>N/A</td>
</tr>
<tr>
<td>Cruz-Correia (2007)</td>
<td>Same intervention as Araujo</td>
<td>Refer to Araujo</td>
<td>Refer to Araujo</td>
<td>This publication showed patient’s opinions and adherence to monitoring tool only. Clinical effectiveness reported in Araujo.</td>
<td>Adherence: Paper diary completion was better than Web records (1: 48% vs C: 96%, P &lt; .001), but use of electronic PEF meter was similar in both groups (1: 50% vs C: 50%). 93% of patients were “very interested” in continuing to use the app.</td>
</tr>
<tr>
<td>Lv (2012)</td>
<td>SMS messages vs Verbal education vs Usual care FU 12 weeks</td>
<td>Secondary care patients: n = SMS: 30; Verbal: 14; C: 27; Age: SMS: 36 yrs (SD: 11); Verbal: 41 yrs (SD: 12); C: 37 yrs (SD: 12) % Female: SMS: 33.3%; Verbal: 50.0%; C: 48.1%</td>
<td>Asthma for ≥ 3 months; positive bronchodilator reversibility or bronchodilator provocations test.</td>
<td>Quality of life: compared the traditional (16.32 [SD: 21.30]) and control group (4.21 [SD: 30.40]), SMS group had the highest mean change in AQLQ (31.40 [SD: 34.42], P = .008. Medication adherence: No between-group difference in medication adherence (SM: 86% vs Verbal: 74.1% vs Control: 59%, P = .119).</td>
<td>*Perceived control of asthma: significant different in PACQoL score between SMS group and control group (P = .018).</td>
</tr>
<tr>
<td>Rikkers-Mutsaerts (2012)</td>
<td>Web-based self-management vs Usual care FU 12 months</td>
<td>Primary and secondary patients: n = 46; C: 44 Age: 13.4 yrs (12-17); C: 13.8 yrs (12-17) % Female: 1: 57%; C: 43%</td>
<td>Mild/severe persistent asthma, ICS in previous year, access to Internet, and Dutch speaking...</td>
<td>Asthma control: No between-group difference in change in ACOG at 12 months (−0.05 [-0.35, 0.25]). Quality of life: No between-group difference in change in PACQoL at 12 months (−0.05 [-0.50, 0.41]). Medication adherence: No between-group difference in self-reported medication adherence at 12 months (P = .12).</td>
<td>Adherence: Average of 19.9 website log files received from each patient in the Web group at 12 months. No information on data recording in the control group. Attrition was greater in the Web group (1: 11746 vs C: 4144).</td>
</tr>
</tbody>
</table>
Table 2: Continued

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Trial</th>
<th>Participant characteristics</th>
<th>Inclusion criteria</th>
<th>Clinical effectiveness outcomes</th>
<th>Self-efficacy, adoption, and adherence outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryan (2012) UK RCT (low risk)</td>
<td>Mobile self-management app vs usual care FU 6 months</td>
<td>Primary care patients: n = 145; C: 143; Age: I: 46.6 yrs (SD: 17.7); % Female: I: 66%; C: 59%</td>
<td>Poorly controlled asthma, had or willing to borrow a compatible mobile phone handset.</td>
<td>*Asthma control: No between-group difference in change in ACQ (mean diff: -0.02 [-0.23 to 0.19]). Quality of life: No between-group difference in change in mini AQLQ (mean diff: 0.10 [-0.16, 0.34]). Exacerbation: No between-group difference in A&amp;E attendance (P = 0.32), admissions (P = 0.32), unscheduled GP consultation (P = 0.32), acute exacerbations (P = 0.34).</td>
<td>*Self-efficacy: No between-group difference in change in KOS-A2 self-efficacy mean diff 2.0 (-0.3, 4.2); attitude mean diff -3.2 (-1.6, 1.6). Adherence: Of 27 lost to follow-up, 5 patients because of telemonitoring problems.</td>
</tr>
<tr>
<td>Liu (2011) Taiwan RCT (unclear risk)</td>
<td>Mobile app vs usual care FU 6 months</td>
<td>Secondary care patients: n = 133; C: 116; Age: I: 50.4 yrs (SD: 10.1); % Female: I: 48.8%; C: 52.2%</td>
<td>Moderate to severe persistent asthma.</td>
<td>Asthma control: Compared to control group, mean FEV1 increased at 6 months: I: 65.2 (SEM: 3.2) vs C: 56.5 (SEM: 2.9) (P &lt; 0.05). Quality of life: SF-12 (physical) improved in mobile app group from baseline I: 41.6 (SEM: 1.5) to 45.5 (SEM: 1.4) at 6 months. No significant changes in SF-12 (mental).</td>
<td>Adherence: Percentage of participants recording data decreased over time in both groups (I: 71.7% vs C: 76.7%) at 6 months. Of the 11 patients who withdrew, 4 could not use the app and 2 had problems with the app.</td>
</tr>
<tr>
<td>Prabhakaran et al. (2010) RCT Singapore (high risk)</td>
<td>SMS symptom monitoring vs usual care FU 3 months</td>
<td>Secondary care patients: n = 60; C: 60; Age: I: 37 yrs (SD: 2.4); % Female: I: 48.9%; C: 52.2%</td>
<td>Previous hospital admissions, owned a mobile phone, knew how to use SMS, and understood English.</td>
<td>*Asthma control: No between-group difference in proportion with ACT &gt; 20 at 3 months (I: 36% vs C: 26%, P = 0.13). Exacerbation: No between-group difference in proportion of patients with reduction in FEV1 (I: 65% vs C: 77%, P = 0.13), admissions (I: 1% vs C: 0%, P = 0.5), or hospitalizations (I: 3% vs C: 2%, P = 0.5).</td>
<td>Adherence: Of the 2 patients who withdrew, 1 was dissatisfied with the SMS service.</td>
</tr>
<tr>
<td>Jacobson (2009) US RCT (unclear risk)</td>
<td>Electronic asthma monitoring system (AMS) vs usual care FU 6 months</td>
<td>Primary care patients: n = 29; C: 30; Age: I: 8-15 yrs; C: 8-15 yrs; % Female: I: 51.7%; C: 50.0%</td>
<td>Moderate/severe asthma, &gt; 2 ED visits or ≥ 1 hospitalization.</td>
<td>*Exacerbation: No between-group difference in percentage of patients with emergency department visits (P = 0.8) and hospitalizations (P = 0.6).</td>
<td>Adherence: Compared to control group, data were received on more days in the AMS group (821 days vs C: 136.6 days).</td>
</tr>
</tbody>
</table>
The number of participants for each intervention ranged from 16 to 300, and participants were recruited from primary and secondary care, with mild/moderate, severe persistent, or poorly controlled asthma, or patients admitted to the hospital. Most studies included teenagers and adults, although 1 intervention also included children from 8 years of age. Six interventions additionally required patients to have access to the Internet or own a mobile phone with mobile network capability and/or know how to use short messaging service (SMS).

Characteristics of included studies

The detailed table of characteristics is presented in Supplementary Appendix B and summarized in Table 2. The 12 interventions were conducted from 2005 to 2014 across the world: 2 in the Netherlands, and 1 each in Australia, China, Denmark, Portugal, Singapore, Taiwan, Turkey, the United Kingdom, and the United States. The studies are all RCTs, including a cluster RCT and a crossover RCT. The risk of bias across interventions is summarized in Figure 2.

Participants

The number of participants for each intervention ranged from 16 to 300, and participants were recruited from primary and secondary care, with mild/moderate, severe persistent, or poorly controlled asthma, or patients admitted to the hospital. Most studies included teenagers and adults, although 1 intervention also included children from 8 years of age. Six interventions additionally required patients to have access to the Internet or own a mobile phone with mobile network capability and/or know how to use short messaging service (SMS).

Interventions

Of the 12 RCT interventions, there were 3 mobile apps and 4 Web applications (one of which used peak flow monitoring), 3 SMSs, 1 electronic inhaler reminder system connected with a Web application, and 1 customized asthma monitoring system with 4 keys for data entry and transmission by telephone line.

Comparators

In most studies, the comparator was patients without access to any ICT system to support their asthma self-management, but 1 had 2 comparator groups (usual care and verbal self-management advice).
professional consultation skills training) compared or combined in 4 groups.14

Clinical outcomes
Clinical outcomes are summarized in Table 2, with further details in Supplementary Appendix B.

Meta-analysis for asthma control
Four publications15-18,21,26 reported asthma control using the Asthma Control Questionnaire (ACQ), 2 of which are included in the meta-analysis. One study, Araujo et al.,18 was excluded, because it used a shorter version of the ACQ (ACQ-5), which meant that it was not appropriate to combine this study with the other RCTs that used the full version of the ACQ. There was statistically significantly improved asthma control in the intervention group (mean difference −0.25, [95% CI, −0.37 to −0.12]), but the confidence interval did not include the minimum clinically important difference of 0.528 (see forest plot, Figure 3). In addition, van Gaalen et al.,15 the follow-up study of Meer et al.,21 reported ACQ. The between-group difference was maintained, albeit attenuated...
Narrative synthesis: asthma control

In 6 of 11 studies, researchers reported improved asthma control over time scales of 3–30 months in the intervention groups. The interventions consisted of 2 mobile apps, 2 web applications, and 2 SMSs. A common feature was an electronic diary that could be shared with health care professionals for regular review. Of the 6 interventions, 1 study was at low risk of bias, while 2 studies showed unclear risk of bias.

Quality of life

Although 8 studies reported asthma-related quality of life, heterogeneity of study design and outcome measure precluded meaningful meta-analysis. Four interventions found that quality of life improved over 6–30 months. The interventions were Web applications with common features of an electronic diary, an action plan, and regular supportive reviews by health care professionals. Of the 4 effective interventions, 1 study was at low risk of bias and 3 were at unclear risk of bias.

Exacerbations

Five interventions reported 6 outcomes relevant to exacerbations (hospital admissions, emergency department visits, unscheduled visits to practices, steroid courses, numbers of patients with 1 or more severe exacerbations, and practice visits triggered by an exacerbation alert generated by the ICT system). The interventions were mobile app, smart inhaler, handheld asthma monitoring device, and SMSs. None of the interventions were associated with a significant reduction in exacerbation-related outcomes. Three of the studies presented data on proportion of patients with a hospital admission over 3–6 months, but the rates were very close to zero (0.02%, 0.17%, and 0.25%), so that meta-analysis was unhelpful. Of 6 interventions, 3 studies were at unclear risk of bias, 1 was at low risk of bias, and 1 was at high risk of bias.

Application features in the included interventions

Characteristics of the application features

There were 10 application features in the 12 interventions, details of which are summarized in Table 3. These were categorized into 6 themes: education, asthma diary, action plan, medication adherence, facilitating professional support, raising patients’ awareness of asthma control, and decision support for the health care professional. Eleven of the 12 interventions included more than 1 feature. Four interventions included 5 or more features. Eight included an asthma diary, 8 an action plan, and 11 professional support. Only 1 intervention contained a decision support system for the health care professional.

Application features associated with health-related outcomes of the included interventions

To synthesize the impacts of the application features on health-related outcomes while considering the sample size and duration of each study, we prepared bubble plots (see Figures 4 and 5). The effect on asthma control and quality of life was inconsistent, although there were no examples of harm. There was no significant clinical impact (either positive or negative) on exacerbations.

One study that focused on medication adherence with reminders and treatment logs improved adherence but none of the clinical outcomes. One study that incorporated feedback and decision support for physicians improved asthma control and quality of life.

Adoption and adherence to usage

Action plan ownership

Within the 12 studies, only 1 study reported action plan ownership in the 3 study groups. A significant increase in use of an action plan from baseline to end of study was reported in both intervention groups (Web-based

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**Figure 3: Forest plot for meta-analysis of asthma control and asthma control outcome of long-term follow-up study of Meer.**
<table>
<thead>
<tr>
<th>Table 3. Application features of the included interventions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. Action Plan</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1. Provides</td>
</tr>
<tr>
<td>2. Accurate</td>
</tr>
<tr>
<td>3. Education</td>
</tr>
<tr>
<td>4. Triage</td>
</tr>
<tr>
<td>5. Feedback</td>
</tr>
<tr>
<td>6. Follow-up</td>
</tr>
</tbody>
</table>

**Notes:**
- All interventions were conducted at the hospital level.
- Each intervention was conducted with at least one target group.
- The interventions were evaluated using a combination of qualitative and quantitative methods.
- The interventions were conducted in different settings including hospitals, clinics, and community centers.
- The interventions were conducted with varying levels of resources.

**References:**
Table 3: Application features of the included interventions.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Application</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Communicate with healthcare professionals through text messaging.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Implement self-tracking of medication adherence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Provide reminders for medication adherence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Facilitate professional support through electronic diaries.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Enable patient identification and electronic case management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Schedule regular appointments with healthcare professionals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Support decision-making and treatment adjustment.</td>
</tr>
</tbody>
</table>

Table continued...
monitoring, from 2% to 88%; Web-based specialist support, from 3% to 55%) compared to a smaller increase in the usual care group (from 0% to 6%).

Self-efficacy
Only 1 study reported self-efficacy. The intervention was a mobile app that provided patients with an asthma diary, an action plan, and structured support from health care professionals for 6 months. No significant difference was reported in self-efficacy between the intervention and control group, which had similar professional support (KASE-AQ, self-efficacy score; mean difference 2.8 [95% CI, −0.3 to 4.2]).

Adoption of and adherence to intervention
There were no interventions that explicitly reported adoption of the ICT system, and it is impossible to gauge directly in a trial because, by definition, everyone in the intervention group received the ICT system. However, usage data may give an indication of the general level of interest in the ICT system, and adherence to the system may be inferred by looking at differential attrition rates in the intervention/control groups and reasons for withdrawal. Eight studies reported the data transmitted during the studies and/or reasons for attrition because of problems with the ICT system. Details are summarized in Table 2.

Of the 8 interventions, only 2 (Araujo et al. and Jacobson et al.) reported the data transmitted in the control and intervention groups. Araujo et al. reported there was no significant difference in adherence to electronic peak flow monitoring between the Web application group and paper-based monitoring. At the end of the trial, 12 of the 18 participants in the crossover trial were "very interested" in continuing to monitor their asthma using the Web application. Another study, Jacobson et al., reported 2.85 times more data received from the intervention group than the paper-based group. Araujo et al. used a Web application, while Jacobson et al. used a customized embedded system. They both had the application features of an action plan and facilitated support from health care professionals.

Three interventions explicitly reported the number of patients who were lost to follow-up or withdrew because of problems with the ICT system: Ryan et al. (n = 5, "telemonitoring problem"), Uu et al. (n = 4, "couldn’t use the app"; n = 2, had a "problem with the app"), and Prabhakaran et al. (n = 1, "dissatisfied with the service"). Ryan et al. and Uu et al. were mobile app interventions while Prabhakaran et al. was an SMS application. They both had an asthma diary, an action plan, and support from health care professionals.

DISCUSSION
Summary of findings
Our meta-analysis of 3 trials showed a positive effect on asthma control, and a 30-month follow-up study showed that this effect was sustained, albeit attenuated. Within the 12 studies, 10 common features grouped into 7 themes. Most of the interventions included multiple features of self-monitoring and action plans. The effect of the features on health-related outcomes (asthma control, quality of life, exacerbations) and medication adherence varied, though importantly there were no examples of harm. There was no significant clinical impact (either positive or negative) on exacerbations.

The impact of the different features on adoption of and adherence to the system was not possible to gauge directly, but reasons for attrition highlighted the importance of reliable user-friendly systems.

Strengths and limitations
Our systematic review provides an evidence-based review explicitly of the ICT features included in recent interventions (since 2000) and their
associations with asthma health-related outcomes. We performed an updated search in early April 2016. Nevertheless, in the fast-moving field of ICT, this may still have missed some contemporary features.

There are some methodological limitations. First, due to resource and time constraints, a single review was performed at the initial screening stage, although we implemented robust training and quality control processes during review to minimize potential inaccuracies. Second, we did not translate papers that were not written in English, though only 1 study (Kokubu et al. in Japanese) was identified. Third, the included trials focused primarily on health outcomes and the interventions included multiple features, so they could not provide evidence on the individual application features associated, though our grouping of the features may be useful for further research.

Interpretations in relation to published literature
Our findings are in line with other reviews, which show that ICT interventions to support asthma self-management have an inconsistent impact on asthma control and quality of life. The core elements of effective self-management recommended by the British asthma guidelines are education, a PAAP, and regular professional review. Two of the 3 interventions incorporating these showed improvement in asthma control. A recent review suggested that providing instruction on better health care management and sharing data with a designated professional were the most valuable features of health care apps for users. Interventions with these features (see the bubble plots, Figures 4 and 5) found that impact on asthma control and quality of life varied, and there was no significant impact on exacerbations.

The inconsistent clinical outcomes from the 11 studies, despite incorporating similar features, highlight the importance of context in determining whether an intervention is effective. This resonates with the findings of a systematic review of studies implementing supported asthma self-management, which concluded that a whole-systems approach (ie, explicitly addressing patient, professional, and organizational factors) showed the most consistent improvement in clinical outcomes. Of the 12 studies in this review, the 11 studies with application features focused solely on patients showed inconsistent impacts on clinical outcomes; the 1 study with features targeted at both patients and health care professionals improved both asthma control and quality of life.

Implications for clinical care and future research
Our findings suggest that mobile apps have the potential to be effective in supporting self-management and are an option that may be preferred by some people and their clinicians. However, these studies of multifaceted interventions did not provide clear evidence on which of the range of ICT features were essential for effectiveness. Furthermore, the lack of

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Figure 4: Clinical outcome: asthma control.

[Figure showing clinical outcomes with interventions and numbers of studies.]
technical specifications of the ICT systems evaluated in the clinically focused publications with health outcomes did not allow understanding of the design factors of the systems, which may have affected how they operated or were used by patients and professionals. Finally, no matter how well designed the ICT is, it will not be effective if patients do not adopt it and continue to use it. The challenge for researchers and technology developers now is to explore the dynamic needs and preferences of people with asthma and evaluate the features associated with improved adoption of and adherence to mobile apps.

CONCLUSION

Mobile apps, incorporating an action plan and other self-monitoring features, are an effective option for supporting self-management, which resonates with the widespread adoption of technology in this digital era. However, there is insufficient evidence to identify the important application features that attract and encourage patients to continue using the app. Further development in this field will require robust studies that not only establish the long-term effectiveness but also evaluate the specific features associated with improved adoption of and adherence to the mobile app.

FUNDING

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COMPETING INTERESTS

None.

CONTRIBUTORS

CyH, RW, BM, and HP designed the systematic review. CyH screened titles and abstracts of references identified in the databases, and HP reviewed the selection. TJ acted as second reviewer. CyH undertook the data extraction and synthesized the data with HP. RP was the statistical advisor. HP reviewed the data. CyH and HP wrote the initial draft of the manuscript. All authors reviewed the content.

ACKNOWLEDGEMENTS

We are grateful to Marshall Dozier for her advice on the search strategy.

SUPPLEMENTARY MATERIAL

Supplementary material is available online at http://jami.oxfordjournals.org/.

REFERENCES


Appendix 3 Search strategy of the nine databases
Medline

1. (smart* adj1 APP$1).ti,ab.
2. (tablet$1 adj1 APP$1).ti,ab.
3. exp "play and playthings"/ or exp video games/
4. exp Geographic Information Systems/
5. exp videoconferencing/ or exp wireless technology/
6. exp Remote Sensing Technology/
7. bluetooth.ti,ab.
8. correspondence as topic/ or electronic mail/ or text messaging/
9. SMS.ti,ab.
10. software/ or database management systems/ or grateful med/ or exp hypermedia/ or exp mobile applications/ or exp programming languages/ or exp software design/ or exp software validation/ or exp speech recognition software/ or exp user-computer interface/ or exp web browser/ or exp word processing/
11. (multi?media adj1 message*).ti,ab.
12. exp internet/ or exp blogging/ or exp social media/
13. facebook.ti,ab.
14. twitter.ti,ab.
15. exp video-audio media/ or exp "instructional films and videos"/ or exp interactive tutorial/ or exp webcasts/
16. wiki*.ti,ab.
17. chatroom.ti,ab.
18. exp Student Health Services/
19. bulletin board.ti,ab.
20. message board.ti,ab.
21. exp Telemedicine/
22. tele*.ti,ab.
23. e?health.ti,ab.
24. m?health.ti,ab.
25. exp Cell Phones/
26. exp microcomputers/ or exp computers, handheld/ or exp minicomputers/
27. (smart adj gadget$1).ti,ab.
28. exp Radio Frequency Identification Device/
29. exp Television/
30. iphone.ti,ab.
31. ipad.ti,ab.
32. android.ti,ab.
33. exp Artificial Intelligence/
34. exp asthma/ or exp asthma, aspirin-induced/ or exp asthma, exercise-induced/ or exp asthma, occupational/ or exp status asthmaticus/
35. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
36. 34 and 35
37. limit 36 to yr="2000 -Current"
38. (quasiexperimental or quasi experimental or pseudo experimental).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
39. 37 and 38
40. limit 37 to randomized controlled trial
41. 39 or 40
Embase

1. (smart* adj1 APP$1).ti,ab.
2. (tablet$1 adj1 APP$1).ti,ab.
3. exp recreation/
4. exp information service/ or exp information/
5. exp geographic information system/
6. exp wireless communication/
7. exp remote sensing/
8. bluetooth.ti,ab.
9. exp text messaging/
10. SMS.ti,ab.
11. exp information processing/
12. exp information processing/
13. exp computer program/
14. exp hypermedia/
15. exp mobile application/
16. exp computer language/
17. exp automatic speech recognition/
18. exp computer interface/
19. exp data processing/ or exp automation/ or exp communication protocol/ or exp computer/ or exp computer assisted diagnosis/ or exp computer assisted therapy/ or exp data base/ or exp data storage device/ or exp documentation/ or exp information processing/ or exp information technology/ or exp recording/ or exp signal processing/
20. exp data processing/ or exp automation/ or exp communication protocol/ or exp computer/ or exp computer assisted diagnosis/ or exp computer assisted therapy/ or exp data base/ or exp data storage device/ or exp documentation/ or exp information processing/ or exp information technology/ or exp recording/ or exp signal processing/
21. general device/ or exp information processing device/ or exp mobile phone/ or exp mp3 player/ or exp tablet machine/ or exp telephone/
22. multimedia/ or exp audiovisual equipment/
23. facebook.ti,ab.
24. twitter.ti,ab.
25. interactive tutorial.ti,ab.
26. mass communication/ or exp e-mail/ or exp fax/ or exp interactive voice response system/ or exp interdisciplinary communication/ or exp internet/ or exp mass medium/ or exp mobile phone/ or exp social media/ or exp telecommunication/ or exp telephone/ or exp television/ or exp text messaging/ or exp videoconferencing/ or exp webcast/ or exp wireless communication/
27. wiki*.ti,ab.
28. chatroom.ti,ab.
29. bulletin board.ti,ab.
30. message board.ti,ab.
31. exp telemedicine/
32. tele*.ti,ab.
33. exp telehealth/
34. m?health.ti,ab.
35. (smart adj gadget$1).ti,ab.
36. iphone.ti,ab.
37. ipad.ti,ab.
38. android.ti,ab.
39. exp asthma/
40. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
   or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or
   32 or 33 or 34 or 35 or 36
41. 37 and 38
42. limit 39 to yr="2000 -Current"
43. limit 40 to randomized controlled trial
44. (quasiexperimental or quasi experimental or pseudo experimental).tw.
45. 40 and 42
46. 41 or 43
PsycINFO

1. (smart* adj1 APP$.1).ti,ab.
2. (tablet$.1 adj1 APP$.1).ti,ab.
3. exp computer games/
5. exp teleconferencing/
6. information technology/ or exp automated information processing/ or exp computer mediated communication/ or exp information science/ or exp information services/ or exp information systems/
7. exp teleconferencing/
8. bluetooth.ti,ab.
9. exp computer software/ or exp decision support systems/ or exp groupware/ or exp word processing/ or exp computer assisted design/ or exp computer assisted therapy/ or exp computer programming/ or exp computers/ or exp data mining/ or exp data processing/ or exp databases/ or exp hypermedia/ or exp hypertext/ or exp intelligent agents/ or exp learning management systems/ or exp multitasking/
10. exp computer applications/ or exp artificial intelligence/ or exp computer assisted design/ or exp computer assisted diagnosis/ or exp computer assisted instruction/ or exp computer assisted testing/ or exp computer assisted therapy/ or exp computer simulation/ or exp groupware/ or exp hypermedia/ or exp hypertext/ or exp automated speech recognition/ or exp computer assisted language learning/ or exp computer mediated communication/ or exp computer peripheral devices/ or exp computer searching/ or exp computers/ or exp data mining/ or exp databases/ or exp decision support systems/ or exp digital divide/ or exp digital video/ or exp electronic communication/ or exp information systems/ or exp intelligent agents/ or exp internet/ or exp learning management systems/ or exp microcomputers/ or exp online therapy/ or exp virtual reality/ or exp word processing/
11. exp messages/ or exp electronic communication/
12. SMS.ti,ab.
13. (multi?media adj1 messag*).ti,ab.
14. exp internet/ or websites/ or exp internet addiction/
15. exp Online Social Networks/
16. exp internet usage/ or exp human computer interaction/
17. exp computer usage/
18. facebook.ti,ab.
19. twitter.ti,ab.
20. audiovisual communications media/ or exp audiotapes/ or exp digital video/ or exp educational audiovisual aids/ or exp films/ or exp photographs/ or exp radio/ or exp television/ or exp television advertising/ or exp videotapes/ or exp animation/
21. webcasts.ti,ab.
22. wiki*.ti,ab.
23. chatroom.ti,ab.
24. bulletin board.ti,ab.
25. message board.ti,ab.
26. exp telemedicine/
27. tele*.ti,ab.
28. e?health.ti,ab.
29. m?health.ti,ab.
30. exp mobile devices/ or exp cellular phones/
31. exp Telephone Systems/
32. exp microcomputers/
33. computers/ or exp digital computers/
34. (smart adj gadget$.1).ti,ab.
35. Radio Frequency Identification Device.ti,ab.
36. exp Television/
37. iphone.ti,ab.
38. ipad.ti,ab.
39. android.ti,ab.
40. exp artificial intelligence/
41. exp multimedia/
42. exp asthma/
43. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
   or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or
   32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41
44. 42 and 43
45. limit 44 to yr="2000 -Current"
Web of Science

2. TS=('/"information communication technology" or "ICT")
4. TS=(Asthma*)
6. TS=('wireless technolog*')
8. TS=('remote sensing technolog*')
10. TS=('remote sensing technolog*')
12. TS=('iphone' or 'ipad')
14. TS=('ehealth' or 'mhealth')
16. #8 OR #7 OR #6 OR #5 OR #4 OR #2 OR #1
18. #9 AND #3
Cochrane library (Database of Abstracts of Reviews of Effects; Cochrane Database of Systematic Reviews, CDSR; Cochrane Central Register of Controlled Trials, CENTRAL)

1. *phone APP*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
2. "tele-advice":ti,ab,kw or "tele-care":ti,ab,kw or "tele-health":ti,ab,kw or "tele-consult":ti,ab,kw or "tele-home":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
3. tele*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
4. mobile *phone*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
5. internet*:ti,ab,kw or web*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
6. "video game":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
7. wireless technology*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
8. "remote patient monitoring":ti,ab,kw or "remote sensing":ti,ab,kw or "remote control":ti,ab,kw or remote sensing technology*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
9. "information system":ti,ab,kw or "information management system":ti,ab,kw or "information technology":ti,ab,kw and "information communication technology":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials
10. "Bluetooth":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
11. "radio frequency identification device":ti,ab,kw or "RFID":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
12. "message passing interface":ti,ab,kw or "message-passing interface":ti,ab,kw or "text message":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
13. "multimedia message":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
14. "social media":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)
15. facebook:ti,ab,kw or "twitter":ti,ab,kw or wiki:ti,ab,kw or wikis:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

16. "iphone":ti,ab,kw or "ipad":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

17. podcast:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

18. chatroom:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

19. "bulletin board system":ti,ab,kw or "message board":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

20. mhealth:ti,ab,kw or ehealth:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

21. "android":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

22. "artificial intelligence":ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

23. asthma*:ti,ab,kw Publication Year from 2000 to 2015, in Cochrane Reviews (Reviews and Protocols), Other Reviews and Trials (Word variations have been searched)

24. #1 or #2 or #3 or #4 or #5 or #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22

25. #25 #24 AND #23
1. asthma* AND (ti(tablet*1 WITHIN/3 APP*1) OR ab(tablet*1 WITHIN/3 APP*1))
2. OR ti(social media) OR ab(social media)
3. OR ti(information communication technology*) OR ab(information communication technology*)
4. OR ti(chatroom*1) OR ab(chatroom*1)
5. OR ti(ICT) OR ab(ICT*1)
6. OR ti(message*) OR ab(message*)
7. OR ti(wireless) OR ab(wireless)
8. OR ti(remote sensing) OR ab(remote sensing)
9. OR ti(phone) OR ab(phone)
10. OR ti(ipad) OR ab(ipad)
11. OR ti(tele*) OR ab(tele*)
12. OR ti(internet) OR ab(internet)
13. OR ti(web) OR ab(web)
14. OR ti(video game*1) OR ab(video game*1)
15. OR ti(smart* WITHIN/3 APP*1) OR ab(smart* WITHIN/3 APP*1)
16. OR ti(mobile phone*1) OR ab(mobile phone*1)
17. OR ti(artificial intelligence) OR ab(artificial intelligence)
AMED

1. (smart* adj1 APP$1).ti,ab.
2. (tablet$1 adj1 APP$1).ti,ab.
3. exp computers/ or exp microcomputers/ or exp expert systems/ or exp internet/ or exp medical informatics/ or exp software/ or exp computer graphics/ or exp virtual reality/ or exp computing/ or exp automatic data processing/ or exp computer assisted instruction/ or exp computer simulation/ or exp information systems/ or exp day care/ or exp disease management/ or exp hospitalization/
5. exp technology medical/
7. bluetooh.ti,ab.
8. SMS.ti,ab.
9. telecommunications/ or exp telemedicine/ or exp telephone/ or exp television/
10. SMS.ti,ab.
11. phone.ti,ab.
12. text messag*.ti,ab.
13. (multi?media adj1 messag*).ti,ab.
14. exp Internet/
15. blog*.ti,ab.
16. social media.ti,ab.
17. facebook.ti,ab.
18. twitter.ti,ab.
19. video game.ti,ab.
20. webcasts.ti,ab.
21. wiki*.ti,ab.
22. chatroom.ti,ab.
23. bulletin board.ti,ab.
24. message board.ti,ab.
25. tele*.ti,ab.
26. e?health.ti,ab.
27. m?health.ti,ab.
28. (smart adj gadget$1).ti,ab.
29. iphone.ti,ab.
30. ipad.ti,ab.
31. android.ti,ab.
32. Artificial Intelligence.ti,ab.
33. exp Asthma/
34. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
35. 33 and 34
36. limit 35 to yr="2000 -Current"
CINAHL

1. TI smart* APP? OR AB smart* APP?
2. TI tablet APP? OR AB tablet APP?
3. (MH "Video Games")
4. (MH "Geographic Information Systems") OR (MH "Health Information Systems") OR (MH "Ambulatory Care Information Systems") OR (MH "Clinical Information Systems") OR (MH "Decision Support Systems, Clinical") OR (MH "Emergency Service Information Systems") OR (MH "Health Information Networks") OR (MH "Home Health Care Information Systems") OR (MH "Hospital Information Systems") OR (MH "Managed Care Information Systems") OR (MH "National Health Information Network") OR (MH "Nursing Information System ..."
5. (MH "Telecommunications") OR (MH "Electronic Mail") OR (MH "Electronic Bulletin Boards") OR (MH "Instant Messaging") OR (MH "Interactive Voice Response Systems") OR (MH "Internet") OR (MH "Social Media") OR (MH "Social Networking") OR (MH "Radio") OR (MH "Telecommuting") OR (MH "Teleconferencing") OR (MH "Telefacsimile") OR (MH "Telehealth") OR (MH "Telemedicine") OR (MH "Telenursing") OR (MH "Telepsychiatry") OR (MH "Telephone") OR (MH "Television") OR (MH "Text Messaging") OR (MH "Videoconference ..."
6. (MH "Remote Consultation")
7. TI remote sensing technology* OR AB remote sensing technology*
8. TI bluetooth OR AB bluetooth
9. TI SMS OR AB SMS
10. TI multimedia message* OR AB multimedia message*
11. (MH "World Wide Web Applications") OR (MH "Blogs")
12. TI facebook OR AB facebook
13. TI twitter OR AB twitter
14. TI wiki* OR AB wiki*
15. TI chatroom OR AB chatroom
16. TI bulletin board OR AB bulletin board
17. TI tele* OR AB tele*
18. TI ehealth OR AB ehealth
19. (MH "Telephone")
21. TI computer OR AB computer
22. (MH "Smart Cards")
23. (MH "Radio Frequency Identification")
24. TI iphone OR AB iphone
25. TI ipad AND AB ipad
26. TI Android OR AB Android
27. (MH "Artificial Intelligence")
28. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27
29. (MH "Asthma")
30. S28 AND S29
31. (MH "Quasi-Experimental Studies")
32. S30 AND S31
33. S30 OR S32
ScienceDirect

1. pub-date > 1999 and ((pub-date > 1999 and (((pub-date > 1999 and TITLE-ABSTR-KEY("ehealth" or "mhealth") or TITLE-ABSTR-KEY(wireless or "remote sensing")))
2. OR (pub-date > 1999 and TITLE-ABSTR-KEY("*phone APP" or "APP" or "Tablet APP" or phone or "ipad" or "iphone") or TITLE-ABSTR-KEY("ICT" or information communication technolog* )))
3. OR (pub-date > 1999 and TITLE-ABSTR-KEY(artificial intelligence) or TITLE-ABSTR-KEY(social media)))
4. OR (pub-date > 1999 and TITLE-ABSTR-KEY(internet or web)) OR (pub-date > 1999 and TITLE-ABSTR-KEY(video game))) OR (pub-date > 1999 and (text messag* and SMS)))
5. OR (pub-date > 1999 and TITLE-ABSTR-KEY/twitter) or TITLE-ABSTR-KEY/twitter) OR (pub-date > 1999 and TITLE-ABSTR-KEY(chatroom) or TITLE-ABSTR-KEY/wiki*)
6. OR (pub-date > 1999 and TITLE-ABSTR-KEY(tele*)) AND (pub-date > 1999 and TITLE-ABSTR-KEY(tele*)))
7. [All Sources(Business, Management and Accounting, Computer Science, Decision Sciences, Engineering, Medicine and Dentistry, Nursing and Health Professions, Psychology, Social Sciences)]
 [All Sources(Business, Management and Accounting, Computer Science, Decision Sciences, Engineering, Medicine and Dentistry, Nursing and Health Professions, Psychology, Social Sciences)]
Appendix 4 Supplementary appendix of the published systematic review in JAMIA
Characteristics of Included Studies and Risk of Bias Outcome

Key: Interventions were ranked by year to cross reference the launching years of the mobile technologies - the first Apple app and Android app were available in the market since 2008[1] and 2009[2] respectively, 3G was available in the market in 2001 (technically approved in 2000[3]); Unless specified, the ACQ, ACT, ACQ-5, PACQ-6, AQLQ AQLQ(S), PAQLQ, mAQLQ and miniAQLQ score are the validated questionnaires; I indicated the intervention group, C indicated control group; * indicated the primary outcome.

**Methods**
Randomised controlled trial

**Participants**
Patients (136, mild to severe persistent): ages 25-41, had been smartphone users for at least 6 months prior to enrollment.

**Interventions**
This was a 3 months study. Patients were randomly assigned to the POPET-mobile app group which enable them to submit their overall health status with an emoticon, share status update, send and receive messages, and ask for immediate assistance with an urgent message option, track their medicine use with a diary that sent automated reminder according to their ACT.

Control: patients receive the application with the ACT only at the beginning and the end of the trial and communicate with the physicians with conventional method.

**Outcomes**
- **Asthma control:** Compared to control group, more patients achieved a well-controlled asthma score (ACT>19) than in the control group [I: 49% VS C: 27, P < 0.05].
- **Adherence:** The data input frequency of the APP group was 90(70-154). 86% of communications were between 8.00AM to 6.00PM. A high attribution number (35% of the total – I: 8 VS C:39) was reported.

**Notes**
N/A

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>The study perform the randomization by an online random number generator program</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Unclear risk</td>
<td>No information/ indication for concealment</td>
</tr>
<tr>
<td>Blinding of participants and personnel</td>
<td>Low risk</td>
<td>In studies of telehealth, blinding of participants is impossible</td>
</tr>
<tr>
<td>(performance bias)</td>
<td>Patient self-reported the outcomes (study and control participants reported their ACT at the beginning and the end of the study in the system.) It means that there was no risk of researcher influence and reduces the risk of bias. It overcomes the problems of lack of blinding.</td>
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</tr>
<tr>
<td>Blinding of outcome assessment</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td>(detection bias)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete outcome data (attrition</td>
<td>Attrition number was not reported separately in control and study group. 47 of the 136 asthma patients were lost during the study because the patients requested to be removed from the study, or they moved to Turkish cities. However, the drop out patients did not included in the measurement of outcome, the attrition bias is low.</td>
<td></td>
</tr>
<tr>
<td>bias)</td>
<td></td>
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<tr>
<td>Selective reporting (reporting bias)</td>
<td>Unclear risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>It is ‘unclear’ because there is no published protocol and the authors don’t state that they made no changes to the protocol.</td>
<td></td>
</tr>
<tr>
<td>Other bias</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The study appears to be free of other sources of bias.</td>
<td></td>
</tr>
</tbody>
</table>
**Methods**
Cluster Randomised 2 x 2 factorial controlled trial

**Participants**
Patient (143, moderate-severe): ages 14 to 65, with suboptimal asthma control (Asthma Control Test [ACT] score <19), and prescribed twice-daily ICS/LABA for 1 month or more

GP (43): GPs were recruited through 4 Sydney general practice organizational divisions. They were able to access to computer and e-mail, and not currently participating in another adherence-promoting study.

**Interventions**
This was a 6 months study. Patients were randomly assigned to four clusters trials (UC, PAD, IRF and PAD&IRF).

**Personalized adherence discussion (PAD):** GPs asked patients to complete a short questionnaire about barriers to controller inhaler use; carry out discussion on the medication adherence and help them to set goal and strategies

**Inhaler reminder (IRF):** patients received twice-daily SmartTrack reminders for missed ICS/LABA doses.

**Inhaler reminder plus adherence feedback (IRF+PAD):** patient received reminder from SmartTarck twice daily AND each month, GPs received an automated email to view a Web site graph of their patients' daily ICS/LABA use; GP use the ICS/LABA to discuss follow-up visit or any subsequent appointments with patients

**Control (UC):** All GPs received brief training on the delivery of active UC, including the provision of a written asthma action plan, inhaler technique review/education, and a follow-up appointment. Patients received the usual care from the trained GP

<table>
<thead>
<tr>
<th>Outcomes</th>
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<tbody>
<tr>
<td><em>Asthma control:</em> No significant differences in ACT score among the 4 intervention groups (p=0.14) nor between reminder or non-reminder group.</td>
<td></td>
</tr>
<tr>
<td><em>Medication adherence:</em> The adherence declined in all groups during the 6 months study [PAD:from =62% to 35% VS IRF:from =80% to 60%; IRF+PAD:from=85% to 68%; UC:from</td>
<td></td>
</tr>
</tbody>
</table>
- Exacerbations: No significant differences among the 4 groups [patients with >1 severe exacerbation \( P=0.06 \)]
- Quality of life: There were no significant differences in mini-AQLQ among the 4 groups \( P=0.26 \)

<table>
<thead>
<tr>
<th>Notes</th>
<th>Before allocation revealed and study training received, 5 GPs withdrew the intervention</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>‘Randomization of GPs was by computer-generated random code, with a minimization algorithm to ensure balance of GP locations by socioeconomic Area’</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Low risk</td>
<td>‘After randomization, GP allocation concealment was maintained until during the training workshop. As with any behavioral intervention, blinding of GPs and patients to their own intervention(s) was not possible, but the other interventions were not described, and to aid blinding, GPs in each group received UC training. To avoid bias, and with ethics approval, GPs in the UC and PAD-only groups, and their patients, were not advised about the SmartTrack recording function until study end, when all patients received a debriefing statement and were offered a confidential copy of their adherence record.’</td>
</tr>
<tr>
<td>Blinding of participants and personnel (performance bias)</td>
<td>Low risk</td>
<td>In studies of telehealth, blinding of participants is impossible</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Low risk</td>
<td>‘The primary outcome measure (assessed at the patient level) was the ACT score, collected by telephone by a researcher blinded to the patient’s intervention group.’</td>
</tr>
<tr>
<td>Bias</td>
<td>Risk</td>
<td>Description</td>
</tr>
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<td>---------------------------------------------------</td>
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<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low</td>
<td>Attrition was similar in both groups</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Unclear</td>
<td>It is 'unclear' because there is no published protocol and the authors don't state that they made no changes to the protocol</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low</td>
<td>The study appears to be free of other sources of bias</td>
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</tbody>
</table>
Van Galen 2013

<table>
<thead>
<tr>
<th>Methods</th>
<th>Randomised controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>107 participants, who replied for the follow up from the study of Meer, Bakker (2009)</td>
</tr>
<tr>
<td>Interventions</td>
<td>This was an addition 1.5 years follow up study of Meer, Bakker (2009).</td>
</tr>
</tbody>
</table>
| Outcomes         | - **Asthma control**: There was a significant and slightly attenuated improvement in ACQ score between groups at 30th month [adjusted between group difference -0.33 (-0.61 to -0.05)]  
- **Quality of life**: There was a significant and slightly attenuated improvement in AQLQ score between groups at 30 month [adjusted between group difference 0.29 (0.01 to 0.57)] |
| Notes            | N/A |

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
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<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>Same as Meer 2009</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Low risk</td>
<td>Same as Meer 2009</td>
</tr>
<tr>
<td>Blinding of participants and personnel (performance bias)</td>
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</tr>
<tr>
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<td>Same as Meer 2009</td>
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<tr>
<td>Selective reporting (reporting bias)</td>
<td>Low risk</td>
<td>Same as Meer 2009</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low risk</td>
<td>Same as Meer 2009</td>
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</table>
Meer 2009

<table>
<thead>
<tr>
<th>Methods</th>
<th>Randomised controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>200 adult ages 18 to 50 who were physician-diagnosed as asthma coded according to the International Classification of Primary Care in the electronic medical record and were treated with inhaled corticosteroids for 3 months or more during the previous year, had access to the Internet and mastery of the Dutch language.</td>
</tr>
<tr>
<td>Interventions</td>
<td>This was a 12 months study with outcome measured at the 3th and 12th month. Patients were randomly assigned to internet-based self-management program including electronic diary, action plan with treatment advice, online and group education, and remote web communication. Control: patient received usual care according to Dutch general practice guideline, a medical review and treatment adjustment every 2-4 weeks in unstable asthma and medical review once/twice yearly for patients whose asthma is under control.</td>
</tr>
</tbody>
</table>
| Outcomes         | • **Asthma control**: Compared to control group, web group had a significant improvement in the ACQ score at the 12th month [I: -0.54 (-0.65 to -0.42) VS C: -0.06 (-0.18 to 0.05)].  
• **Quality of life**: Compared to control group, web group had a significant improvement in AQLQ score at the 12th month [I: 0.56 (0.43 to 0.68) VS C: 0.18 (0.05 to 0.31)].  
• **Medication adherence**: No between-group difference in self-reported medication adherence.  
• **Adherence**: An average of 34.8 website log files received from each patient in the web group at the 12th month. No reports on the numbers of received data in the control group. |
| Notes            | N/A |

### Bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
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<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>We randomly assigned patients to the 2 groups (1:1 ratio) by using a computer-generated, permuted-block scheme. Allocation took place by computer after collection.</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Low risk</td>
<td>‘We randomly assigned patients to the 2 groups (1:1 ratio) by using a computer-generated, permuted-block scheme. Allocation took place by computer after collection of the baseline data, ensuring concealment of allocation.’</td>
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<tr>
<td>Blinding of participants and personnel (performance bias)</td>
<td>Low risk</td>
<td>In studies of telehealth, blinding of participants is impossible.</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Low risk</td>
<td>Patient self-reported the outcomes, it means that there was no risk of researcher influence and reduces the risk of bias. It overcomes the problems of lack of blinding. ‘We collected all outcome data similarly in both groups. Participants provided the Asthma Control Questionnaires, symptom-free days, and prebronchodilator FEV1 through the Internet (the usual care group had limited access to the Web site for 2 weeks at baseline, 3 months, and 12 months). We collected the other outcomes by written questionnaires.’ [long term follow up] ‘Patients who previously participated were invited, by a letter containing information on the follow-up measurements, to attend the LUMC for follow-up measurements at 30 months after baseline. Patients were asked to report on their daily dose of inhaled corticosteroids (ICS) and to complete 2 paper-based questionnaires, namely an ACQ (including FEV1) and an AQLQ, a validated 21-item questionnaire for assessment of asthma-related quality of life....Questionnaires were sent in the mail to patients who were unable or unwilling to...’</td>
</tr>
</tbody>
</table>
Inhaled corticosteroid doses were reported as fluticasone equivalents’

<table>
<thead>
<tr>
<th>Bias</th>
<th>Risk</th>
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<tbody>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Low</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low</td>
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</table>

Attrition was similar in both groups. The protocol is published and there are no important change between the registered protocol and the published paper.

**Incomplete outcome data (attrition bias)**

Attrition was similar in both groups.

**Selective reporting (reporting bias)**

The protocol is published and there are no important change between the registered protocol and the published paper.

**ISRCTN registry:**

ISRCTN79864465(09/01/2006)


The study appears to be free of other sources of bias.
### Methods
Randomised crossover controlled trial

### Participants
21 adult mean (SD) ages 29±10, consecutive adults attending an outpatient allergy clinic with moderate to severe asthma (at least 6 months since diagnosis), treated with inhaled budesonide (320-1280 µg/day) and formoterol (9-36 µg/day) in a single inhaler during the previous month, and a prebronchodilator predicted forced expiratory volume in the first second of expiration (FEV1) above 50%

### Interventions
This was a 48 weeks study with outcome measured at the 4th and 48th week. Patients were randomly assigned to use web-based or paper based diary and action plan in sequence, each for 4 weeks.

**Web based:** patient used Piko-1 to monitor PEF/FEV1 once daily, log PEF, FEV1, symptoms and exacerbation in web, the data are plotted on the 3 colour zone. Patients received immediate treatment adjustment advised by doctor.

**Paper based:**
patient used the paper-based self-management action plan to perform self-management. The paper based format is the same as the one of the web form

### Outcomes
- **Asthma control:** no significant difference in ACQ-5 score between groups [-0.2(-0.63 to 0.27), P=0.417]
- **Quality of life:** no significant difference in mini-AQLQ score between groups [-0.1(-0.33 to 0.49), P=0.683]

### Notes
N/A

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
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</thead>
<tbody>
<tr>
<td>Random sequence generation</td>
<td>Low risk</td>
<td>The study had a crossover design, with patients randomly allocated using a computer-generated algorithm to a web-based or paper-based asthma diary and action plan, each for a period of 4 weeks</td>
</tr>
<tr>
<td>(selection bias)</td>
<td></td>
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<tr>
<td>Allocation concealment</td>
<td>Unclear risk</td>
<td>The study had a crossover design, with patients randomly allocated using a computer-generated algorithm to a web-based or paper-based asthma diary and action plan, each for a period of 4 weeks</td>
</tr>
<tr>
<td>(selection bias)</td>
<td>Based or paper-based asthma diary and action plan, each for a period of 4 weeks (It is central allocation but the concealment detail is 'unclear')</td>
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<tr>
<td>Blinding of participants and personnel (performance bias)</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td>In studies of telehealth, blinding of participants is impossible</td>
<td></td>
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</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Unclear risk</td>
<td></td>
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<tr>
<td>Unclear if the researchers has been blinded to collect data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td>Only 2 attrition - 1 lost internet connection and 1 moved to another city</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td>It is 'unclear' because there is no published protocol and the authors don't state that they made no changes to the protocol</td>
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<tr>
<td>Other considerations for cross over study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was use of a cross-over design appropriate?</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td>Asthma is a reasonably stable condition and where long term follow up is not required, so the cross-over design is suitable for asthma being studied</td>
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</tr>
<tr>
<td>Is it clear that the order of receiving treatments was randomized?</td>
<td>Low risk</td>
<td></td>
</tr>
<tr>
<td>Yes, the participants were randomised by using computer generated algorithm</td>
<td></td>
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<tr>
<td>Can it be assumed that the trial was not biased from carry-</td>
<td>Unclear risk</td>
<td></td>
</tr>
<tr>
<td>There may have potential psychological carry over effect by the order of intervention received but the effect on the (primary outcome) asthma control is minimal</td>
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<tr>
<td>Question</td>
<td>Risk</td>
<td>Answer</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
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<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Are unbiased data available? That is, whether only first period data are available</td>
<td>Low</td>
<td>Data were not only available for first-period, post-internet and post-paper data were both available in the report</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low</td>
<td>The study appears to be free of other sources of bias</td>
</tr>
</tbody>
</table>
Cruz-Correia 2007

<table>
<thead>
<tr>
<th>Methods</th>
<th>Randomised crossover controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Interventions</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Outcomes</td>
<td>This publication showed the patient’s opinions and adherence to monitoring tool only. Clinical effectiveness please refers to Araújo. Adherence: Compare to the web group, the control group was significantly received a higher % of data received [I: =48% VS C: =95%, P&lt;0.001]. However, the % of the use of Piko-1 to actually measure and was similar in both groups [I:50% VS C:50%]. 12, 63% of patients showed ‘very interested’ in continuous to use the web application.</td>
</tr>
</tbody>
</table>

- **Notes**: N/A

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors’ judgement</th>
<th>Support for judgement</th>
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<tr>
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<td>Low risk</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Unclear risk</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
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<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Unclear risk</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low risk</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Unclear risk</td>
<td>Same as Araújo (2012)</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low risk</td>
<td>Same as Araújo (2012)</td>
</tr>
</tbody>
</table>
Lv 2012

<table>
<thead>
<tr>
<th>Methods</th>
<th>Randomised controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>150 adult older than 18 years old who were diagnosed of asthma according to GINA at least 3 months before recruitment, were positive in bronchodilator reversibility test or bronchodilator provocation test in the past year</td>
</tr>
</tbody>
</table>
| Interventions | This was a 12 weeks study. Patients were randomly assigned to three groups (control, traditional and SMS).  

**Tradition:** patients received the same education as the control group and use paper based action plan for self-management.  

**SMS:** patients received the same education as the control group and SMS reminder twice everyday on how to manage asthma, send question and received answer to clinic investigator by SMS.  

**Control:** patients received verbal asthma education from outpatient clinic physicians |
| Outcomes | • *Asthma control:* there was a significant difference in the PACQ-6 score between SMS group and the control group \( [P=0.018] \)  
• **Quality of life:** compare to the traditional \([16.52\pm21.10]\)and control group\([4.21\pm30.98]\), SMS group had the highest mean AQLQ(S) changes \([31.40\pm30.42]\)  
• **Medication adherence:** SMS group had the highest percentage of medication compliance [SMS:80% VS traditional:74.1% VS control:50%]  
• *Perceived control of asthma:* there was a significant different in the PACQ-6 score between SMS group and the control group \( [P=0.018] \) |
| Notes | N/A |

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
</table>
| Random sequence generation | Unclear risk | Insufficient description of the randomization assignment so it is
This trial was a prospective, randomized, controlled study. One hundred fifty eligible asthma outpatients from March 2009 to April 2010 were enrolled and randomly assigned to three groups: control, traditional, and SMS groups.

### Allocation concealment (selection bias)
- **Unclear risk**
- **Risk**
- **No information on any concealment**

### Blinding of participants and personnel (performance bias)
- **Low risk**
- **In studies of telehealth, blinding of participants is impossible**

### Blinding of outcome assessment (detection bias)
- **Unclear risk**
- **Unclear if the researchers has been blinded to collect data**

### Incomplete outcome data (attrition bias)
- **Unclear risk**
- **There are no description on a high rate of attrition in the traditional group (23/50), SMS group (20/50) and control group (36/50) so it is 'unclear' how does it bias the outcomes**

### Selective reporting (reporting bias)
- **Unclear risk**
- **It is 'unclear' because there is no published protocol and the authors don't state that they made no changes to the protocol**

### Other bias
- **Low risk**
- **Insufficient information to assess whether an important risk of bias exists**
## Methods
Randomised controlled trial

## Participants
90 adolescents ages 12–18 years who were diagnosed of mild to severe persistent asthma characterized by a prescription of ICS more than 3 months in the previous year, had access to internet, and understanding of the Dutch language.

## Interventions
This was a 12 months study with outcome measured at the 3th and 12th month. Patients were randomly assigned to internet-based self-management program including electronic diary, action plan with treatment advice, online and group education, and regular medical reviews.

Control: patient received usual care according to Dutch guideline on asthma management in children in general practice and in hospitals

## Outcomes
- **Asthma control:** No significant difference in ACQ score between groups at 12th month [-0.05(-0.35-0.25)]
- **Quality of life:** No significant difference in the PAQLQ score between group at 12 month [-0.05(-0.50 to 0.41)]
- **Medication adherence:** No significant difference between groups at the 3th and 6th month [14(-79 to 108), 14(-75 to 102)]
- **Adherence:** An average of 19.9 website log files received from each patient in the web group at the 12th month. No reports on the numbers of received data in the control group. Compare to control group, attrition is greater in the web group (I:11/46 VS C:4/44).

## Notes
Attrition is greater than in the intervention group (11/46) compared to control (4/44)

## Bias

<table>
<thead>
<tr>
<th>Authors’ judgement</th>
<th>Support for judgement</th>
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<tbody>
<tr>
<td><strong>Random sequence generation</strong> (selection bias)</td>
<td><strong>Unclear risk</strong></td>
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This trial was a prospective, randomized, controlled study. One hundred fifty eligible asthma outpatients from March 2009 to April 2010 were
enrolled and randomly assigned to three groups: control, traditional, and SMS groups’

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<th>Study Assumption</th>
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<th>Explanation</th>
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<td>Blinding of participants and personnel</td>
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<td>In studies of telehealth, blinding of participants is impossible</td>
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<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Unclear</td>
<td>Unclear if the researchers has been blinded to collect data</td>
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<td>Incomplete outcome data (attrition bias)</td>
<td>High</td>
<td>The differential loss in the intervention group is something of a concern in the intervention group (11/46), especially as the baseline characteristics of the control and intervention group were different</td>
</tr>
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<td>Selective reporting (reporting bias)</td>
<td>Unclear</td>
<td>It is ‘unclear’ because there is no published protocol and the authors don't state that they made no changes to the protocol</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low</td>
<td>The study appears to be free of other sources of bias.</td>
</tr>
</tbody>
</table>
### Methods
Randomised controlled trial

### Participants
Adolescents and adult ages 12 and over who were registered with participating practices, had poorly controlled asthma (defined as score ≥1.5 on asthma control questionnaire (ACQ))19, and had, or were willing to borrow, a compatible mobile phone handset and a contract with a compatible network.

### Interventions
This was a 6 months study. Patients were randomized to mobile phone self-management intervention including electronic diary, action plan with treatment advice.

Control: Patient received paper based action plan for self-management.

### Outcomes
- **Asthma control**: no significant difference in the change of ACQ score between groups [-0.02(-0.23 to 0.19)]
- **Quality of life**: no significant difference in mini-AQLQ between groups in changes [0.10(-0.16 to 0.34)]
- **Exacerbation**: no significant difference between group in changes [median 0 for both groups in A&E attendances (P=0.08), A&E admission (P=0.32), unscheduled practices consultation(P=0.07), steroid course(P=0.79), acute exacerbation(P=0.84)]
- **Self-efficacy**: no significant difference between groups in change [self-efficacy 2.0(-0.3 to 4.2); attitude -0.2(-1.6 to 1.6)]
- **Adherence**: Of 27 lost to follow up, 5 patients because of the telemonitoring problems.

### Notes
N/A

### Bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
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<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>&quot;All consenting participants were stratified by practice and centrally randomised (Health Services Research Unit, University of Aberdeen) to mobile phone or paper based monitoring with a 1:1 allocation with random block sizes of two or four...telephone&quot;</td>
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</table>
randomisation ensured concealment until the treatment was assigned. The practice nurse informed the patient of allocation to ensure the researchers were blinded to allocation throughout data collection and analysis.’

<table>
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<tr>
<th>Allocation concealment (selection bias)</th>
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<tr>
<td>‘All consenting participants were stratified by practice and centrally randomised (Health Services Research Unit, University of Aberdeen) to mobile phone or paper based monitoring with a 1:1 allocation with random block sizes of two or four; telephone randomisation ensured concealment until the treatment was assigned. The practice nurse informed the patient of allocation to ensure the researchers were blinded to allocation throughout data collection and analysis.’</td>
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<tr>
<td>In studies of telehealth, blinding of participants is impossible</td>
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<tr>
<th>Blinding of outcome assessment (detection bias)</th>
<th>Low risk</th>
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<tr>
<td>‘A researcher blinded to allocation collected primary outcome data at the final trial visit’</td>
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<tr>
<td>The attrition was similar in both group</td>
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<th>Selective reporting (reporting bias)</th>
<th>Low risk</th>
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<tr>
<td>The protocol is published, and there is a clear statement at the beginning of the methods that there were no important changes. ClinicalTrials.gov Identifier: NCT00512837 (submitted: August 7, 2007) Primary outcome: change in asthma control between baseline and six months as measured by ACQ. The ACQ measures clinical goals of asthma management on a scale: 0 (good control) to 6, is responsive to change, with a intra-individual minimum important difference</td>
<td></td>
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</tbody>
</table>
Secondary outcome: Morbidity

- Mean difference in ACQ at 3 and 6 months.
- Proportion of patients with an ACQ<0.75 at three and six months.
- Mean difference in mini-AQLQ which measures the physical/emotional impact of asthma on a scale

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<th>Other bias</th>
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<td></td>
<td>Insufficient information to assess whether an important risk of bias exists</td>
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</table>
Liu 2011

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<thead>
<tr>
<th>Methods</th>
<th>Randomised controlled trial</th>
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</thead>
<tbody>
<tr>
<td>Participants</td>
<td>120 adult (SD) mean ages 54.0±2.4 and 50.4±1.9 in control and intervention group respectively, were diagnosed with moderate to severe persistent asthma from the outpatient clinics of Chang Gung Memorial Hospital.</td>
</tr>
<tr>
<td>Interventions</td>
<td>This was a 6 months study with outcome measured at the 3th and 6th month. Patients were randomly assigned to use mobile phone app including electronic diary, action plan with treatment advice and regular medical reviews. Control: patient received usual care according to GINA guideline, using paper based diary and 3 colour action plan to perform self-management.</td>
</tr>
</tbody>
</table>
| Outcomes | • Asthma control: the FEV1%predicted significantly increased at 6 months (65.2±3.2%, P<0.05) compared to the control group and baseline.  
• Quality of life: SF-12 (physical) improved in the mobile app group improvement in from baseline 41.6 (SEM1.5) to 45.5 (SEM 1.4) at 6 months. No significant changes in SF-12(mental).  
• Adherence: Adherence decreased over time in both groups, % patients sending data (I:81.7% at 3thmonth, 71.7% at 6thmonths; C: 85% at 3thmonth , 76.7% at 6thmonths. 6 of the 11 patients who withdrew because they couldn’t use the APP(n=4) and had problems with the APP(n=2) |
| Notes | 6 of the 11 who withdrew, they did so because of problems with the technology (4 couldn't use it, and 2 had problems with the 'app') |

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<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
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<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Unclear risk</td>
<td>No descriptions on the randomisation process</td>
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<tr>
<td>(performance bias)</td>
<td>of participants is impossible</td>
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<tr>
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<td>Unclear risk</td>
<td>Unclear if the researchers has been blinded to collect data</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Unclear risk</td>
<td>There are no description on a high rate of attrition in the intervention group (17/60) and control (14/60), so it is 'unclear' how does it bias the outcome</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
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<td>It is 'unclear' because there is no published protocol and the authors don't state that they made no changes to the protocol</td>
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Prabhakaran 2010

<table>
<thead>
<tr>
<th>Methods</th>
<th>Randomised controlled trial</th>
</tr>
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<tbody>
<tr>
<td>Participants</td>
<td>120 adult ages 21 years or above, was admitted for an acute exacerbation of asthma, owned a mobile phone, knew how to use SMS system and understood English.</td>
</tr>
<tr>
<td>Interventions</td>
<td>This was a 3 months study. Patient was randomised to SMS self-management system including answering asthma symptoms question and received advice from build in algorithm/asthma nurse via SMS. Control: patient received conventional inpatient asthma management.</td>
</tr>
</tbody>
</table>
| Outcomes        | • *Asthma control*: no significant improvement in ACT (improvement score to ≥20) between groups [I:36 VS C:28, P=0.113]  
• *Exacerbation*: no significant reduction in emergency department visit between groups [I:51 VS C:57, P=0.063], admissions [I: 55 VS C:56, P=0.50] and in nebulisations [I:50 VS C:54, P=0.053]  
• *Adherence*: of the 2 withdrew patients, 1 because of dissatisfied with the services |
| Notes           | compliance with the SMS was 82% over 3 months (no data for the compliance of control group) |

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<tr>
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<tr>
<td>Random sequence generation (selection bias)</td>
<td>Low risk</td>
<td>‘Allocation was from an envelope with slips of paper. Subjects had to draw from the envelope to discover their allocated group.’</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Unclear risk</td>
<td>It did not state whether the envelope was opaque/sequentially numbered. If it was possible to detect the allocation without opening the envelope, then it is possible to influence allocation. ‘Allocation was from an envelope with slips of paper. Subjects had to draw from the envelope to discover their allocated group.’</td>
</tr>
<tr>
<td>Blinding of participants and personnel</td>
<td>Low risk</td>
<td>In studies of telehealth, blinding of participants is impossible</td>
</tr>
<tr>
<td><strong>Blinding of outcome assessment (detection bias)</strong></td>
<td><strong>High risk</strong></td>
<td>Asthma nurse knew who are the patients in the SMS group from the 3 extra questions, so they were not blinded. At the end of the third month, all study subjects received a follow-up telephone call from the asthma nurse. Subjects were assessed on asthma control using the Asthma Control Test (ACT), use of nebulization, emergency department (ED) visits and hospital admissions for asthma since the last admission 12 weeks previously. Patients in the intervention group had three additional questions about the SMS service.</td>
</tr>
<tr>
<td><strong>Incomplete outcome data (attrition bias)</strong></td>
<td><strong>Low risk</strong></td>
<td>The attrition was similar in both group.</td>
</tr>
<tr>
<td><strong>Selective reporting (reporting bias)</strong></td>
<td><strong>Unclear risk</strong></td>
<td>It is ‘unclear’ because there is no published protocol and the authors don’t state that they made no changes to the protocol.</td>
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<td><strong>Other bias</strong></td>
<td><strong>Low risk</strong></td>
<td>Insufficient information to assess whether an important risk of bias exists.</td>
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</tbody>
</table>
### Methods

| Randomised controlled trial |

### Participants

| 59 children ages 8 to 15 who were diagnosed with moderate-to-severe asthma, had 2 or more ED visits or 1 hospitalization with a primary diagnosis of asthma at 1 of 6 participating HHC medical centers in the year before recruitment |

### Interventions

| This was a 6 months study. Patients were randomly assigned to Asthma monitoring system (AMS) including answering a short list of questions about his or her asthma symptoms and use of medications with a 4-keys, telephone line hand-sized electronic device. Clinician or case manager review and telephone patient to advice clinic visit or treatment adjustment if needed. Control: patients received paper-based diary for self-management. |

### Outcomes

| Exacerbation: No significant difference in the percentage of patients visited to the emergency department \[P=0.8\] and hospitalisation \[P=0.6\]. Adherence: Compare to control group, more data were received in the AMS group \[1:211 \text{ VS } 1:36.6\]. |

### Notes

| N/A |

### Bias

<table>
<thead>
<tr>
<th><strong>Random sequence generation</strong> (selection bias)</th>
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<th><strong>Support for judgement</strong></th>
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<tbody>
<tr>
<td>Unclear risk</td>
<td>Insufficient description of the randomization code and assignment so it is hard to define Yes or No for this randomization. ‘Upon enrolling a child, the case manager sent the child’s contact information to MetroPlus Health Plan, which held the randomization codes and forwarded the information to AMAC staff or the diary health educators, depending on the randomization assignment.’</td>
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</table>

| **Allocation concealment** (selection bias) | Unclear risk | Insufficient description of the randomization code and assignment so it is hard to define |
Upon enrolling a child, the case manager sent the child’s contact information to MetroPlus Health Plan, which held the randomization codes and forwarded the information to AMAC staff or the diary health educators, depending on the randomization assignment.

<table>
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<th>Bias Type</th>
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<td>In studies of telehealth, blinding of participants is impossible.</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Low risk</td>
<td>Patient self-reported the outcome. The researchers were blinded. ‘Upon enrolment, all study participants completed a demographic and behavioural questionnaire. The primary outcomes of interest were ED visits for asthma, hospitalizations for asthma, and their costs. These data were obtained from the MetroPlus Health Plan member utilization database.’</td>
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<td>Insufficient information to assess whether an important risk of bias exists.</td>
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</table>
### Methods
Randomised controlled trial

### Participants
300 adults, ages 18 to 45, who were diagnosed with asthma and living in the catchment area of H:S Bispebjerg University Hospital of Copenhagen, Denmark

### Interventions
This was a 6 months study. Patients were randomly assigned to 3 groups (Internet, Specialist and GP)

- **Internet**: patients received internet-based asthma management tool comprised of 3 coloured electronic diary accompanied by a written treatment plan. Physician received a decision support system to keep track on patient’s condition and instruct treatment adjustment to patients if needed.

- **Specialist**: patients received paper based diary with 3 colour action plan and they were taught to adjust their medication.

- **GP**: GP received patient’s symptoms and test report and advice patient’s need for pharmaceutical treatment.

### Outcomes
The odds for asthma symptoms (improved one or more severity steps) and AQLQ score significantly in favour of the web group.

- **Asthma control**: [Web VS Specialist 2.64(1.43-4.88), Web VS GP 3.26(1.71-6.19), Specialist VS GP 1.23(0.66-2.30)]

- **Quality of life**: [Web vs Specialist 2.21(1.09-4.47), Web VS GP 2.10(102-4.31), Specialist VS GP 0.95(0.43-2.07)]

- **Adoption**: Compare to the specialist and usual care group, web group showed a largest improvement on the use of action plan (I: from 2% to 88%; S: from 3% to 55%; U: from 0% to 6%)

### Notes
A narrow age range of younger adult (ages 18 to 45)

### Bias

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<tr>
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<th>Support for judgement</th>
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<td>Low Risk of Bias ‘The patients were randomized consecutively by using the sealed envelope technique’</td>
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<td>It did not state whether the envelope was opaque/sequentially numbered. If it was possible to detect the allocation without opening the envelope, then it is possible to influence allocation. ‘The patients were randomized consecutively by using the sealed envelope technique’</td>
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<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Low risk</td>
<td>Outcome assessment by self-reporting questionnaire, therefore single-blinded. Not possible to blind participants to intervention ‘All asthmatic subjects filled in questionnaires on asthma quality of life (AQLQ) asthma self-care, smoking habits, education, salary, sick leave, and hospitalization. In addition, the study physician conducted a questionnaire-based interview on respiratory symptoms, current medication, compliance (good/poor), and adverse reactions.’</td>
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<tr>
<td>Other bias</td>
<td>Low risk</td>
<td>The study appears to be free of other sources of bias</td>
</tr>
</tbody>
</table>
## Methods

Randomised controlled trial

## Participants

116 adult with (SD) mean ages 24.6±6.5, who were diagnosed with persistent asthma for at least 6 months and were being treated with ICS and LABA

## Interventions

This was a 6 months study. Patients were randomized to SMS group comprised of usual care and an Ericsson SH888 GSM mobile telephone to send PEF to asthma specialist via SMS, results were mapped on a 3 colour graph and asthma specialist instructed treatment adjustment and follow up plans weekly via SMS.

Control: patients received usual care comprised of asthma education, self-management plan and standard treatment.

## Outcomes

- **Asthma control:** Compare to control group, SMS group had better symptom control in coughing and night symptom - cough symptom score [I:1.42±0.28 VS C:1.85±0.43, P<.05], night symptom score [I:0.85±0.32 VS C:1.22±0.23, P<0.05]
- **Exacerbation:** the total number of office visit requests sent to patients because of exacerbation detected were similar between the two groups [I:21 VS C:15]. The hospital admission was [I:2 VS C:7].
- **Adherence:** 1769 data were received by SMS. No reports on the numbers of received data in the control group

## Notes

N/A

## Bias

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<td>Bias</td>
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<td>PEF are collected via SMS in intervention group but there is no information on how the other data are collected. Also, there are no descriptions for data measurement for control group. So, it is unclear if the research was blinded to collect data.</td>
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<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low risk</td>
<td>No patient withdrew from the study after enrolment.</td>
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Appendix 5 Short paper (in press) in BCS HIS conference proceedings
What do people with asthma want to see in an asthma self-management app? A review of views expressed in online social discussion forums

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Robert Walton
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Brian McKinstry
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Hilary Pinnock
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Queen Mary University of London
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Self-management improves asthma outcomes. Mobile apps are an option for self-management though engaging users is challenging. The features that patients want in an app are unclear. We aimed to identify ‘wanted’ app features from online forums. We systematically searched (November 2013-January 2017) Google for ‘asthma’ ‘forums’, retrieved posts in which patients discussed app features, and synthesised the perceptions thematically using a framework approach. We included 29 threads from nine forums. 59 patients commented on 33 different features in four categories: self-monitoring, feedback/advice, professional/carer support, reminders. Most patients ‘wanted’ self-monitoring features (logging peak flow, medication and symptoms, personal indoor/outdoor monitoring for triggers) but did not explicitly mention action plans. Fitness tracking, smart device provoked a wide range of responses. The lack of discussion about action plans, suggests today’s apps are limited to self-monitoring rather than self-management. Further research is needed to understand this limitation as well as the adoptive and adherent features which encourage self-management.

Keywords: Asthma self-management, Mobile Phone App, Online social forum

1. Introduction

Asthma is common and associated with significant morbidity (Mukherjee 2016). Self-management (as opposed to passive self-monitoring), incorporating a personalised asthma action plan, reinforced by education and supported by regular professional review, reduces morbidity (BTS/SIGN 2016; Pinnock 2016). Using a mobile application (app) to support self-management is an option which is at least as effective as traditional care (Hui 2017).

Apps are widely used for health management (Imison 2016, Deloitte 2015); in 2013, there were 191 apps for people with asthma in English (Huckvale 2015). However, encouraging on-going engagement with apps is challenging (Paul 2015). Users frequently typically stop using a healthcare app within 30 days of downloading, (Localitytics 2014; Appboy 2016), reducing the potential benefits of using an app to support self-management. Making the app something people want to use should increase engagement. In general, healthcare apps with features that save time and provide an efficient way of managing care are valued by users (Mendiola 2015) and likely to promote usage. However, in the specific context of asthma self-management, the features that users’ value remains unknown.

Clinical research typically focuses on the health-related effectiveness and safety of technology, rather than providing evidence on the valued features of apps (Harrison 2013). In contrast, online discussion forums provide a real time communication platform from which to collect people’s experiences and opinions (Moorhead 2013). We therefore reviewed the conversations in forums to identify the mobile technology features discussed and valued by people with asthma.

2. Method

We used the Google search guide (Googel 2015) to perform forum searches on 17 November 2015 (updated 8 January 2017) using the key terms ‘asthma’ AND ‘forum’. The first 20 results were reviewed from each search and the name of and links to the forums were extracted. Local searches were performed within each of the included forums. If a local search facility was not provided in the site, the Google search engine was used to perform the local forum search by using the recommended universal syntax (site:[url] [search term]). ‘Asthma’ AND (‘app’ AND/OR ‘gadget’ AND/OR ‘smartphone’) were used as the key search terms for the threads which were assessed by the inclusion/exclusion criteria:

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What do people with asthma want to see in an asthma self-management app? A review of views expressed in online social discussion forums

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Inclusion criteria: Threads (query or comment) mentioning any feature a) to support asthma self-management or b) made by someone with asthma, related to smartphone or tablet app features including standalone or web-based apps, apps connected with smart devices (smart inhalers, peak expiratory flow (PEF) meters, indoor air monitors, pedometers).

Exclusion criteria: a) Discussions which did not mention features of asthma apps and/or asthma; b) No replies to the thread (‘simplex communications’); c) App features directed at children; d) New app announcements by developers e) Information without a view on the app features f) Forums not in English.

Data range: The last post on the thread was less than two years before our search date.

Threads were screened and assessed against the inclusion criteria by one reviewer (CyH), with 30% checked by a second reviewer (VE) (100% agreement achieved). Both reviewers extracted data using a piloted data extraction table under the headings of ‘app features’ and ‘feelings about features’. Comments about a specific mobile product were extracted to a separated table. Disagreements were resolved by discussion.

The two reviewers (CyH and VE) coded the threads iteratively in NVivo. Application features were categorised with reference to previously described features (Hui 2017) and strategies for supporting self-management (Pearce 2016). Emerging themes were developed iteratively and discussed within the multidisciplinary study team. Mentions of specific products (app, smart device gadget or website) were extracted into a separate table and comments mapped to the features to gain an understanding of which product features were considered important.

Results

2.1. Characteristics of the included social discussion forums, threads and people

Nine social discussion forums were identified as having threads on asthma apps/ smart devices. The threads identified, the screening process and the final numbers of threads included, are detailed in the flowchart (Figure 1). In total, 29 threads with opinions from 59 people, were included for analysis. Only eight people were from a forum specifically for asthma; the majority from Reddit (http://www.reddit.com/search?q=%22asthma+app%22&restrict_sr=&sort=relevance&t=all). More than half of the people (58%) stated that they had experience with digital tools, such as smartphone, app and excel spreadsheet. Fewer than 5% of the people stated that they used paper-based diaries for self-management (n=2) or had not used an app before (n=2).

![Flow chart for the included threads](image)

Key: * the 29 threads were extracted from nine social forums, they were Reddit(n=14), Patient.co(n=4), DailyStrength(n=3), Asthma UK(n=3), Running bug(n=2), Patientlikeme(n=1), Healthboard(n=1), eHealth(n=1) and Cerentiv268(n=1)
2.2. Application features

We identified 33 different features that we grouped into four categories. Figure 2 illustrates the categories and features, the frequency of comments and perceptions of respondents. Four themes emerged: self-monitoring, fitness/health, self-management, emerging technology.

2.3. Application features associated with self-monitoring

Features in the self-monitoring category were the most frequently discussed (79/106 comments: 74.5%). Of all the monitoring features, logging PEF rate (n=18), logging medication usage (n=11), monitoring for indoor or outdoor triggers and pollutants (n=8) were the top four features about which respondents felt positive.

"I was looking for something to track my PEF-meter readings and other info like wheezing." [This person started the thread asking for recommendations about good asthma management apps].

"I'd like something simple. A counter app I can set to start with how many doses my inhaler is supposed to have, and then a way I can count down doses until I need to get a new inhaler."

Specific comments about self-monitoring included concerns about data privacy when logging, storing and collecting health data with an app; logging several aspects of health data in one place (features that made life easier were regarded as 'useful').

2.4. Application features associated with fitness and health

15 people with asthma mentioned fitness and health features which were not usually included in asthma apps. These features were running coaching (n=6), weight watching (n=6), tracking activity (n=1), quitting smoking (n=1), logging health data such as exercise, hours slept and food (n=1). Two thirds (10/150) thought it would be useful to combine these features with other asthma monitoring features or were looking for an app with these features. One person doubted if an asthma app with running coaching would be helpful for all people because asthma was unique to the individual. People who mentioned running coaching were all frequent runners with asthma; they all thought exercise was good for their asthma, including two who described themselves as having exercise-induced asthma.
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"haven't found any app that really helps an asthmatic track & improve their endurance training... So I was wondering if others with asthma have used any specific resources (online sites, mobile apps, magazines etc etc) to help them train for their running goals?"

"What affects one person and works and doesn't work for one person often has nothing to do with another person's circumstances. For that reason, I wonder how an app could possibly be useful to all asthmatics."

Of the six people who mentioned weight watching, three people were positive about combining logging their weight and their asthma in a single app while three others mentioned specific weight watching apps that they had used. One person with asthma, was looking for the best app to help quit smoking.

2.5. Application features related to self-management

None of the respondents discussed features about education or explicitly mentioned action plans or using self-monitoring data to adjust medication by themselves, though people frequently discussed the features of 'self-monitoring' and receiving 'support from healthcare professionals'.

"if you have an [a] smart phone there is an app called [the app's name] that I use. You can log symptoms, triggers, when you use your pro-air, Peak Flow Reading, etc. You can also send yourself a weekly report which I love."

"Can you also make it iOS compatible? I'd pay good money to have a more convenient way to track meds than my little snoopy notebook" [A developer mentioned plans for an asthma medication diary and the person with asthma posted this response].

"I've never used an asthma app...But if I had to imagine I was using one, it would do the following... Sends information in an eMail to my pulmonologist..."

There was one person who recommended an app endorsed by Asthma New Zealand, which incorporated an action plan and other monitoring features; other respondents indicated that they were 'very interested' in using this app.

"What is the app called please would be very interested in this please reply asap [as soon as possible]" [An enquiry to the previous respondent who mentioned an app by Asthma New Zealand which combined several records in one place].

"I use it and find it very helpful, can also show to your Dr or even email a report to their office, very clever little app." [Response to the enquiry].

There were another seven people who discussed an app prototype with an action plan. They discussed the monitoring features such as logging PEF and two mentioned another app which also incorporated an action plan with monitoring features. However, none of them explicitly discussed the action plan feature in the app.

"Has anyone signed up the [name] app. Loving it simple features. To find the link go to Asthma UK Facebook page and click on it. They want people with asthma to try out the app. Especially love the place for recording peak flow and diary entry." [This person starting the discussion in the forum].

"I also use [name] app. That graphs it [the PEF]."

2.6. Application features related to emerging technology

Comments about using environmental surveillance to detect and display the concentration of triggers, enabling people to cross reference to their asthma control were all positive.

"I would want the ability to graph my peak flows with a decent level of detail. Track medication taken and the ability to print out and cross reference data points. Ideally to weather conditions like temperature, humidity and air quality."

Responses related to smart devices such as electronic metered dose inhalers, pedals and indoor air monitors connected with smartphone apps varied. Of 14 responses in which a smart device was mentioned, eight were positive about using the device to auto log PEF, running, steps, indoor triggers, and medication use.

"The only feature that would really benefit me would be a way to track when I took it, maybe interaced with smart phones." [suggesting a smart inhaler – this was a response to a list of inhaler features, including app, ergonomic and aesthetic, suggested by a designer at the beginning of the thread].

"I'm after an app where I can track my peak flow readings, my medication intake and hopefully have a pedometer incorporated. Does such a thing exist?"

"I had a respiration problem because of the dust particles. I started using a product named [the smart indoor monitor] and it works great... It just update the information in my smartphone as well as my tablet and I feel that am protected. It is just amazing"

One person felt the smart metered dose inhaler with features of dose-taking log, peak flow log, air quality sensor and reminder was nothing unique from a common metered dose inhaler. Four responses emphasised that they just "want it (the inhaler) to work". Two responders who appreciated using a smart device were also worried about the high cost and data privacy issues.

"None of those things [a list of features suggested by designer] seem important to me, I just want it to work. Remaining puffs has already been implemented
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3. Discussion

Our online social forum review captured perspectives on mobile app features that people valued. Four categories (self-monitoring, feedback/advice, professional/carer support, reminders) were discussed by people with asthma in eight social forums during the period (November 2013-January 2017). Self-monitoring features (logging PEF, medication and symptoms, monitoring for triggers and pollutants) were widely discussed and valued by people with asthma. General health and interest forums reach a wide population and attracted the majority of people in our included threads. Including fitness and health features (running coaching, weight loss and quitting smoking) in an asthma app would avoid multiple apps and be convenient. Smart devices provoked a wide range of responses.

No-one explicitly commented on features related to education, action plans or using logged data to self-manage their medication. However, seven people discussed apps known to incorporate an action plan, though the feature people highlighted and recommended to others was being able to send information to their doctor.

4. Strengths and limitations

The strength of this review is that it provides an evidence-based review of application features that people with asthma discuss in forums and captures their views on emerging technologies. However, the review has some limitations.

Compared to qualitative interviews, body language, facial expression and tone, could not be captured from questions and responses in online social discussion forums. We did not post follow up questions to clarify peoples’ opinions as that would have affected the discussions. On the other hand, the data we collected were freely expressed in an ‘open’ environment uninfluenced by a specific research agenda.

The opinions we collected were from ‘posters’ (people who communicate their experience to others) and omitted the ‘lurker’ (those who read the content but do not post their opinions). The results may not include all the features that would be valuable to all people with asthma. The features discussed were generally components of existing apps; further research will be needed to identify novel features that may motivate people to adopt asthma self-management in an app. Our list of valued features, however, is a useful starting point for discussing and developing a prototype app.

Due to resource/time constraints, the initial selection was undertaken by a single reviewer, though a proportion was checked by a second reviewer as a quality check.

5. Interpretation of findings in relation to previously published work

The PRISMS taxonomy (Pearce 2016) summarises 14 strategies for supporting self-management. The 33 different features discussed (typically positively) by people with asthma in our study reflected 12 of the taxonomy items. The two taxonomy items not discussed were ‘information about available resources’ and the ‘action plan’. Some people, however, were using a national patient charity’s support group forum to share experience and information so were implicitly using resources.

No respondents explicitly discussed action plans, though one person mentioned other features of an app known to contain an action plan. Action plans are uncommon features of asthma apps in the market (Huckvale 2015), so people may not have tried one, or may not know what an ‘action plan’ was; or not be aware that it could be implemented in an app. In contrast, a number of features of mobile apps associated with supported self-management (such as monitoring peak flows, symptoms, medication use, monitoring indoor or outdoor triggers and pollutants, receiving feedback or advice for further actions on their asthma) were accepted by people with asthma.

6. Conclusion

Currently available apps and the majority of comments posted on social forums by people with asthma focus on self-monitoring rather than self-management. Specific features such as running coaching, weight loss and quitting smoke were welcomed by a few people, and could be integrated in asthma apps. Further research is needed to understand the barriers to moving apps from self-monitoring to self-management, and to evaluate app’s features associated with effective adoption and adherence to self-management.

7. Funding

CyH is funded by a PhD studentship from the Chief Scientist Office (Scotland) (AUKCAR/14/01). The
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work was supported by the Asthma UK Centre for Applied Research (AUK-AC-2012-01).

8. Acknowledgments

We are grateful to Maria Wolters for her advice on the review design, search strategy and analysis design.

References


Mukherjee M, Stoddart A, Gupta RP et al. (2016) The epidemiology, healthcare and societal burden and costs of asthma in the UK and its member nations: analyses of standalone and linked national databases. BMC Medicine, 14:113

Appendix 6 MARS scoring questions
### Mobile Application Rating Scale (MARS)

#### App Classification

The Classification section is used to collect descriptive and technical information about the app. Please review the app description in iTunes / Google Play to access this information.

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>App Name</td>
<td></td>
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<tr>
<td>Rating this version</td>
<td></td>
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<tr>
<td>Developer</td>
<td></td>
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<td>N ratings this version</td>
<td></td>
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<tr>
<td>Version</td>
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<td>Last update</td>
<td></td>
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<tr>
<td>Cost - basic version</td>
<td></td>
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<tr>
<td>Cost - upgrade version</td>
<td></td>
</tr>
<tr>
<td>Platform</td>
<td>□ iPhone □ iPad □ Android</td>
</tr>
<tr>
<td>Brief description</td>
<td></td>
</tr>
</tbody>
</table>

#### Focus: what the app targets

*select all that apply*

- □ Increase Happiness/Well-being
- □ Mindfulness/Meditation/Relaxation
- □ Reduce negative emotions
- □ Depression
- □ Anxiety/Stress
- □ Anger
- □ Behaviour Change
- □ Alcohol /Substance Use
- □ Goal Setting
- □ Entertainment
- □ Relationships
- □ Physical health
- □ Other __________________________

#### Theoretical background/Strategies

*select all that apply*

- □ Assessment
- □ Feedback
- □ Information/Education
- □ Monitoring/Tracking
- □ Goal setting
- □ Advice /Tips /Strategies /Skills training
- □ CBT - Behavioural (positive events)
- □ CBT – Cognitive (thought challenging)
- □ ACT - Acceptance commitment therapy
- □ Mindfulness/Meditation
- □ Relaxation
- □ Gratitude
- □ Strengths based
- □ Other __________________________

#### Affiliations:

- □ Unknown □ Commercial □ Government □ NGO □ University

#### Age group (all that apply)

- □ Children (under 12)
- □ Adolescents (13-17)
- □ Young Adults (18-25)
- □ Adults
- □ General

#### Technical aspects of app (all that apply)

- □ Allows sharing (Facebook, Twitter, etc.)
- □ Has an app community
- □ Allows password-protection
- □ Requires login
- □ Sends reminders
- □ Needs web access to function
App Quality Ratings
The Rating scale assesses app quality on four dimensions. All items are rated on a 5-point scale from "1.Inadequate" to "5.Excellent". Circle the number that most accurately represents the quality of the app component you are rating. Please use the descriptors provided for each response category.

SECTION A
Engagement – fun, interesting, customisable, interactive (e.g. sends alerts, messages, reminders, feedback, enables sharing), well-targeted to audience

1. Entertainment: Is the app fun/entertaining to use? Does it use any strategies to increase engagement through entertainment (e.g. through gamification)?
   1 Dull, not fun or entertaining at all
   2 Mostly boring
   3 OK, fun enough to entertain user for a brief time (< 5 minutes)
   4 Moderately fun and entertaining, would entertain user for some time (5-10 minutes total)
   5 Highly entertaining and fun, would stimulate repeat use

2. Interest: Is the app interesting to use? Does it use any strategies to increase engagement by presenting its content in an interesting way?
   1 Not interesting at all
   2 Mostly uninteresting
   3 OK, neither interesting nor uninteresting; would engage user for a brief time (< 5 minutes)
   4 Moderately interesting; would engage user for some time (5-10 minutes total)
   5 Very interesting, would engage user in repeat use

3. Customisation: Does it provide/retain all necessary settings/preferences for apps features (e.g. sound, content, notifications, etc.)?
   1 Does not allow any customisation or requires setting to be input every time
   2 Allows insufficient customisation limiting functions
   3 Allows basic customisation to function adequately
   4 Allows numerous options for customisation
   5 Allows complete tailoring to the individual’s characteristics/preferences, retains all settings

4. Interactivity: Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)? Note: these functions need to be customisable and not overwhelming in order to be perfect.
   1 No interactive features and/or no response to user interaction
   2 Insufficient interactivity, or feedback, or user input options, limiting functions
   3 Basic interactive features to function adequately
   4 Offers a variety of interactive features/feedback/user input options
   5 Very high level of responsiveness through interactive features/feedback/user input options

5. Target group: Is the app content (visual information, language, design) appropriate for your target audience?
   1 Completely inappropriate/unclear/confusing
   2 Mostly inappropriate/unclear/confusing
   3 Acceptable but not targeted. May be inappropriate/unclear/confusing
   4 Well-targeted, with negligible issues
   5 Perfectly targeted, no issues found

A. Engagement mean score = ____________
SECTION B

Functionality – app functioning, easy to learn, navigation, flow logic, and gestural design of app

6. Performance: How accurately/fast do the app features (functions) and components (buttons/menus) work?
   1. App is broken; no/insufficient/inaccurate response (e.g. crashes/bugs/broken features, etc.)
   2. Some functions work, but lagging or contains major technical problems
   3. App works overall. Some technical problems need fixing/Slow at times
   4. Mostly functional with minor/negligible problems
   5. Perfect/timely response; no technical bugs found/contains a ‘loading time left’ indicator

7. Ease of use: How easy is it to learn how to use the app; how clear are the menu labels/icons and instructions?
   1. No/limited instructions; menu labels/icons are confusing; complicated
   2. Useable after a lot of time/effort
   3. Useable after some time/effort
   4. Easy to learn how to use the app (or has clear instructions)
   5. Able to use app immediately; intuitive; simple

8. Navigation: Is moving between screens logical/accurate/appropriate/ uninterrupted; are all necessary screen links present?
   1. Different sections within the app seem logically disconnected and random/confusing/navigation is difficult
   2. Useable after a lot of time/effort
   3. Useable after some time/effort
   4. Easy to use or missing a negligible link
   5. Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts

9. Gestural design: Are interactions (taps/swipes/pinches/scrolls) consistent and intuitive across all components/screens?
   1. Completely inconsistent/confusing
   2. Often inconsistent/confusing
   3. OK with some inconsistencies/confusing elements
   4. Mostly consistent/intuitive with negligible problems
   5. Perfectly consistent and intuitive

B. Functionality mean score = __________

SECTION C

Aesthetics – graphic design, overall visual appeal, colour scheme, and stylistic consistency

10. Layout: Is arrangement and size of buttons/icons/menus/content on the screen appropriate or zoomable if needed?
    1. Very bad design, cluttered, some options impossible to select/locate/see/read device display not optimised
    2. Bad design, random, unclear, some options difficult to select/locate/see/read
    3. Satisfactory, few problems with selecting/locating/seeing/reading items or with minor screen-size problems
    4. Mostly clear, able to select/locate/see/read items
    5. Professional, simple, clear, orderly, logically organised, device display optimised. Every design component has a purpose
11. Graphics: How high is the quality/resolution of graphics used for buttons/icons/menus/content?

1. Graphics appear amateur, very poor visual design - disproportionate, completely stylistically inconsistent
2. Low quality/low resolution graphics; low quality visual design – disproportionate, stylistically inconsistent
3. Moderate quality graphics and visual design (generally consistent in style)
4. High quality/resolution graphics and visual design – mostly proportionate, stylistically consistent
5. Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout

12. Visual appeal: How good does the app look?

1. No visual appeal, unpleasant to look at, poorly designed, clashing/mismatched colours
2. Little visual appeal – poorly designed, bad use of colour, visually boring
3. Some visual appeal – average, neither pleasant, nor unpleasant
4. High level of visual appeal – seamless graphics – consistent and professionally designed
5. As above + very attractive, memorable, stands out; use of colour enhances app features/menus

C. Aesthetics mean score = ____________

SECTION D

Information – Contains high quality information (e.g. text, feedback, measures, references) from a credible source. Select N/A if the app component is irrelevant.

13. Accuracy of app description (in app store): Does app contain what is described?

1. Misleading. App does not contain the described components/functions. Or has no description
2. Inaccurate. App contains very few of the described components/functions
3. OK. App contains some of the described components/functions
4. Accurate. App contains most of the described components/functions
5. Highly accurate description of the app components/functions

14. Goals: Does app have specific, measurable and achievable goals (specified in app store description or within the app itself)?

N/A Description does not list goals, or app goals are irrelevant to research goal (e.g. using a game for educational purposes)
1. App has no chance of achieving its stated goals
2. Description lists some goals, but app has very little chance of achieving them
3. OK. App has clear goals, which may be achievable.
4. App has clearly specified goals, which are measurable and achievable
5. App has specific and measurable goals, which are highly likely to be achieved

15. Quality of information: Is app content correct, well written, and relevant to the goal/topic of the app?

N/A There is no information within the app
1. Irrelevant/inappropriate/incoherent/incorrect
2. Poor. Barely relevant/appropriate/coherent/may be incorrect
3. Moderately relevant/appropriate/coherent/and appears correct
4. Relevant/appropriate/coherent/correct
5. Highly relevant, appropriate, coherent, and correct
16. Quantity of information: Is the extent coverage within the scope of the app; and comprehensive but concise?

N/A  There is no information within the app
1  Minimal or overwhelming
2  Insufficient or possibly overwhelming
3  OK but not comprehensive or concise
4  Offers a broad range of information, has some gaps or unnecessary detail; or has no links to more information and resources
5  Comprehensive and concise; contains links to more information and resources

17. Visual information: Is visual explanation of concepts – through charts/graphs/images/videos, etc. – clear, logical, correct?

N/A  There is no visual information within the app (e.g. it only contains audio, or text)
1  Completely unclear/confusing/wrong or necessary but missing
2  Mostly unclear/confusing/wrong
3  OK but often unclear/confusing/wrong
4  Mostly clear/logical/correct with negligible issues
5  Perfectly clear/logical/correct

18. Credibility: Does the app come from a legitimate source (specified in app store description or within the app itself)?

1  Source identified but legitimacy/trustworthiness of source is questionable (e.g. commercial business with vested interest)
2  Appears to come from a legitimate source, but it cannot be verified (e.g. has no webpage)
3  Developed by small NGO/institution (hospital/centre, etc.) /specialised commercial business, funding body
4  Developed by government, university or as above but larger in scale
5  Developed using nationally competitive government or research funding (e.g. Australian Research Council, NHMRC)

19. Evidence base: Has the app been trialled/tested; must be verified by evidence (in published scientific literature)?

N/A  The app has not been trialled/tested
1  The evidence suggests the app does not work
2  App has been trialled (e.g., acceptability, usability, satisfaction ratings) and has partially positive outcomes in studies that are not randomised controlled trials (RCTs), or there is little or no contradictory evidence.
3  App has been trialled (e.g., acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence.
4  App has been trialled and outcome tested in 1-2 RCTs indicating positive results
5  App has been trialled and outcome tested in ≥ 3 high quality RCTs indicating positive results

D. Information mean score = ____________ *

* Exclude questions rated as “N/A” from the mean score calculation.
App subjective quality

SECTION E

20. Would you recommend this app to people who might benefit from it?

1  Not at all  I would not recommend this app to anyone
2  There are very few people I would recommend this app to
3  Maybe  There are several people whom I would recommend it to
4  There are many people I would recommend this app to
5  Definitely  I would recommend this app to everyone

21. How many times do you think you would use this app in the next 12 months if it was relevant to you?

1  None
2  1-2
3  3-10
4  10-50
5  >50

22. Would you pay for this app?

1  No
3  Maybe
5  Yes

23. What is your overall star rating of the app?

1  ★  One of the worst apps I've used
2  ★★  Average
3  ★★★  One of the best apps I've used

Scoring

App quality scores for

SECTION
A: Engagement Mean Score = _______________________
B: Functionality Mean Score = _______________________
C: Aesthetics  Mean Score = _______________________
D: Information Mean Score = _______________________
App quality mean Score  = _______________________
App subjective quality Score = _______________________

Queensland University of Technology
YOUNG AND WELL
App-specific

These added items can be adjusted and used to assess the perceived impact of the app on the user’s knowledge, attitudes, intentions to change as well as the likelihood of actual change in the target health behaviour.

SECTION F

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<tbody>
<tr>
<td>1.</td>
<td>Awareness: This app is likely to increase awareness of the importance of addressing [insert target health behaviour]</td>
<td>Strongly disagree</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly Agree</td>
<td></td>
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<tr>
<td>2.</td>
<td>Knowledge: This app is likely to increase knowledge/understanding of [insert target health behaviour]</td>
<td>Strongly disagree</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly Agree</td>
<td></td>
<td></td>
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<tr>
<td>3.</td>
<td>Attitudes: This app is likely to change attitudes toward improving [insert target health behaviour]</td>
<td>Strongly disagree</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td></td>
<td></td>
<td>Strongly Agree</td>
<td></td>
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<tr>
<td>4.</td>
<td>Intention to change: This app is likely to increase intentions/motivation to address [insert target health behaviour]</td>
<td>Strongly disagree</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly Agree</td>
<td></td>
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<tr>
<td>5.</td>
<td>Help seeking: Use of this app is likely to encourage further help seeking for [insert target health behaviour] (if it’s required)</td>
<td>Strongly disagree</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td></td>
<td></td>
<td>Strongly Agree</td>
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<td>6.</td>
<td>Behaviour change: Use of this app is likely increase/decrease [insert target health behaviour]</td>
<td>Strongly disagree</td>
<td>1</td>
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<td>Strongly Agree</td>
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Appendix 7 MARS score
### Score 1 (First reviewer)

#### CareTRx

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Mean score (section A), MA: 3.8
Mean score (section B), MB: 4.4
Mean score (section C), MC: 5.3
Mean score (section D), MD: 3.6

Total score (MA+MB+MC+MD): 4.4

#### AsthmaMD

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<th>Section A</th>
<th>Mark</th>
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<th>Mark</th>
<th>Section C</th>
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Mean score (section A), MA: 3.4
Mean score (section B), MB: 3.3
Mean score (section C), MC: 3
Mean score (section D), MD: 4.3

Total score (MA+MB+MC+MD): 3.3

#### My Asthma UK

<table>
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<tr>
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<th>Mark</th>
<th>Section B</th>
<th>Mark</th>
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Mean score (section A), MA: 3
Mean score (section B), MB: 3
Mean score (section C), MC: 2
Mean score (section D), MD: 3.9

Total score (MA+MB+MC+MD): 3.2

#### Myasthma

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Mean score (section A), MA: 2.4
Mean score (section B), MB: 3.3
Mean score (section C), MC: 1.3
Mean score (section D), MD: 2.2

Total score (MA+MB+MC+MD): 2.2

#### AsthmaPit

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Mean score (section A), MA: 2.4
Mean score (section B), MB: 3.3
Mean score (section C), MC: 2.3
Mean score (section D), MD: 3.0

Total score (MA+MB+MC+MD): 3.0
### Score 2 (Second reviewer)

#### CareTRx

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Mean score (section A), MA 4.2  
Mean score (section B), MB 5  
Mean score (section C), MC 5  
Mean score (section D), MD 3.5  
Total score (MA+MB+MC+MD)/4 4.4

#### AsthmaMD

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Mean score (section A), MA 4.2  
Mean score (section B), MB 3.8  
Mean score (section C), MC 3.3  
Mean score (section D), MD 3.5  
Total score (MA+MB+MC+MD)/4 3.4

#### Asthma UK

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Mean score (section A), MA 3.2  
Mean score (section B), MB 3.8  
Mean score (section C), MC 3.0  
Mean score (section D), MD 2.8  
Total score (MA+MB+MC+MD)/4 3.4

#### Myopodium

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Mean score (section A), MA 3.2  
Mean score (section B), MB 2.3  
Mean score (section C), MC 1.3  
Mean score (section D), MD 2.3  
Total score (MA+MB+MC+MD)/4 2.4

#### AsthmaPiD

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Mean score (section A), MA 3.2  
Mean score (section B), MB 2.3  
Mean score (section C), MC 3  
Mean score (section D), MD 2.3  
Total score (MA+MB+MC+MD)/4 2.4

---

### Notes:

- Mark values range from 1 to 19, with higher scores indicating better performance.
- The mean scores for each section are calculated by averaging the scores for each attendee.
- Total scores are calculated by averaging the mean scores across all sections.
- N/A indicates a value not applicable or not available.
Appendix 8 Ten motif questions and thresholds
<table>
<thead>
<tr>
<th>Question number</th>
<th>10 questions segments</th>
<th>Patients to fill in</th>
<th>[Note: highlighted were the thresholds to remind patient to look at their action plan]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Night symptom score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asthma has not woken me in the last week.</td>
<td>Asthma has woken me on one night in the last week. Check action plan.</td>
</tr>
<tr>
<td>2</td>
<td>Day symptom score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I have had no symptoms in the last week.</td>
<td>I had symptoms on one day in the last week.</td>
</tr>
<tr>
<td>3</td>
<td>Activity score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asthma did not limit my activities in the last week.</td>
<td>Asthma limited my activities on one day in the last week.</td>
</tr>
<tr>
<td>4</td>
<td>Daily peak flow score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My peak flow is better than my best today.</td>
<td>My peak flow is the same as my best today.</td>
</tr>
<tr>
<td>5</td>
<td>Daily reliever (blue) inhaler score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I haven't used blue inhalers today.</td>
<td>I have taken one puff of my blue inhaler today.</td>
</tr>
<tr>
<td>6</td>
<td>Preventer inhaler used</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I haven't used my preventer inhaler today.</td>
<td>I have used less than my usual dose of preventer today.</td>
</tr>
<tr>
<td>7</td>
<td>Steroid tablets taken</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
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<td></td>
<td>I haven't taken any steroid tablets today.</td>
<td>I have taken more than 10mg of steroid today.</td>
</tr>
<tr>
<td>8</td>
<td>Nose and eyes: allergy score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I haven't had any sneezing/running nose or itchy eyes today.</td>
<td>I have had a little sneezing/running nose or itchy eyes today.</td>
</tr>
<tr>
<td>9</td>
<td>Smoking score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
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<td></td>
<td>I haven't smoked today.</td>
<td>I have smoked less than 5 cigarettes today.</td>
</tr>
<tr>
<td>10</td>
<td>Exercise score</td>
<td>1 (Good)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I have done 30-60 minutes moderate or 30+ minutes of vigorous exercise</td>
<td>I have done 30-60 minutes moderate or 30+ minutes of vigorous exercise</td>
</tr>
</tbody>
</table>
Appendix 9 The system architecture of our app prototype
Date we collected for analysis:
- Participant's adoption, download, retention rate
- Participant's usage pattern (data logging frequency)
- Feedback on online questionnaires (before and after)
- Interview with patient and practices participants (before and after)

**Research level**

Data Input by users

**Management level**

- Weather, pollen and pollution information
- Internet
- Update information and discussion about asthma, inhaler and peak flow meter technique video
- Asthma UK website, forum and youtube channel

**Pathway no.** | **Features** | **Description** | **Input** | **Output** |
---|---|---|---|---|
1 | 10 questions related to asthma and health | Patient monitored 10 aspects of their asthma status by completing the segments of the u-Motif "flower". This includes the standard morbidity questions of the Royal College of Physicians three questions (RCP3Qs), peak flow, use of reliever inhaler, other medication use and lifestyle status. | Answers to the questions [5 segment score] | Score saved by the patient were mapped in the health report |
2 | Action plan | UK paper action plan ([https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/](https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/)) which is freely available for anyone to download – and indeed may be accessed via the electronic health record used in many UK practices. The APP version of the Asthma UK action plan is a template and personalised information about recognising deterioration and the actions to be taken have to be completed by the patients' own clinical advisor. | The medical advice by the practices | A completed action plan |
3 | Diary | Diary to record daily items (e.g. the meal they took, the event they joined and the place they travelled) | Pictures and notes on items | The record displayed by date and time |
4 | Lung function | Patient recorded their daily or weekly peak flow values | Peak flow values | The peak flow values displayed by date and time |
5 | Medication reminder | An alarm to remind patient to take medication. | The alarm frequency, date, time, the numbers of puff to be taken, name and picture of the medication | The phone vibrated / sound. A reminder pop up on phone |
6 | Task reminder | An alarm to remind important activities (e.g. meeting, exercise and events). | The alarm frequency, date, time, a picture of the activities. | The phone vibrated / sound. A reminder pop up on phone |
Appendix 10 GRAMMS checklist
Good reporting of a mixed methods study (GRAMMS)

| (1) Describe the justification for using a mixed methods approach to the research question | Yes, it is reported in chapter 7.  
To develop a more comprehensive understanding of how patients would adopt and use of an app to support their self-management was the reason to choose the mixed method. |
| --- | --- |
| (2) Describe the design in terms of the purpose, priority and sequence of methods | Yes, it is reported in chapter 7 and chapter 8.  
The purpose of the design was to explore if the smartphone app, or in a broader sense, if technology was a worthwhile option to support asthma self-management from the three perspectives: i) clinical, ii) a patient’s and iii) a technological perspective. There were no priorities to the qualitative and quantitative approaches. They were equally emphasised, and used to supplement and validate each other. The sequence is described in chapter 8 and further illustrated in figure 32. |
| (3) Describe each method in terms of sampling, data collection and analysis | Yes, it is reported in chapter 7 and chapter 8. |
| (4) Describe where integration has occurred, how it has occurred and who has participated in it | Yes, it is reported in chapter 7 and chapter 8.  
The ‘point of interface’ or ‘mixing of data’ thus occurred iteratively throughout data collection. Details are reported in section 8.1.10. 8.1.11.  
Participants are reported in 7.4.2, 8.1.6 and 8.1.7. |
| (5) Describe any limitation of one method associated with the present of the other method | Yes, it is reported in section 10.2. |
| (6) Describe any insights gained from mixing or integrating methods | Yes, it is reported in chapter 10. |
Appendix 11 REC and HRA approvals
19th May 2016

Miss Chi Yan Hui
PhD student
The University of Edinburgh
Asthma UK Centre for Applied Research, Usher Institute of Population Health Sciences and Informatics
Medical School
Teviot Place, Edinburgh
EH8 9AG

Dear Miss Hui

Study title: Adoptive and adherent smart phone app’s features to support self-management for people with asthma

REC reference: 16/SS/0101
Protocol number: AC16041
IRAS project ID: 178664

The Research Ethics Committee reviewed the above application at the meeting held on 18 May 2016. Thank you for attending to discuss the application.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this favourable opinion letter. The expectation is that this information will be published for all studies that receive an ethical opinion but should you wish to provide a substitute contact point, wish to make a request to defer, or require further information, please contact the REC Manager Ms Joyce Clearie, joyce.clearie@nhslothian.scot.nhs.uk. Under very limited circumstances (e.g. for student research which has received an unfavourable opinion), it may be possible to grant an exemption to the publication of the study.

Ethical opinion

The members of the Committee present gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.
Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

- Please do final typographical and grammatical check of all participant information and make sure expressed in lay terms.
- PIS guidelines for consent make clear that UMotif will be getting just the participants email address.
- Results/study summary should be posted on Asthma group website.
- Streams A and B – Selection will be done sequentially not randomly? please confirm

You should notify the REC once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. Revised documents should be submitted to the REC electronically from IRAS. The REC will acknowledge receipt and provide a final list of the approved documentation for the study, which you can make available to host organisations to facilitate their permission for the study. Failure to provide the final versions to the REC may cause delay in obtaining permissions.

[All studies]
Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise).


Where a NHS organisation’s role in the study is limited to identifying and referring potential participants to research sites (“participant identification centre”), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of management permissions from host organisations.

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database. This should be before the first participant is recruited but no later than 6 weeks after recruitment of the first participant.
There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.

If a sponsor wishes to request a deferral for study registration within the required timeframe, they should contact hra.studyregistration@nhs.net. The expectation is that all clinical trials will be registered, however, in exceptional circumstances non registration may be permissible with prior agreement from the HRA. Guidance on where to register is provided on the HRA website.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

NHS Sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see “Conditions of the favourable opinion” below).

Summary of discussion at the meeting

Ethical issues, noted and resolved in preliminary discussion

- **Suitability of the applicant and supporting staff**
  This was considered acceptable

- **Independent review**
  This was considered acceptable

- **Other general comments**
  No other general comments

- **Suitability of the summary of the research**
  This was considered acceptable

- **Suitability of supporting information**
  This was considered acceptable

- **Social or scientific value; scientific design and conduct of the study**
  Overall the study’s scientific value, scientific design and the conduct was considered to be acceptable. They had few significant ethical concerns over the project

Ethical issues raised by the Committee in private discussion, together with responses given by the researcher when invited into the meeting. The Chair welcomed Miss Chi Yan Hui and Brian McKinstry to the meeting.
• **Recruitment arrangements and access to health information, and fair participant selection**

The Chair asked the researchers to confirm the recruitment for streams A and B. She confirmed that these would be practice recruitment – up to 5 general practices from diverse demographic areas. Eligible practices will have an asthma-trained nurse willing to participate in the research. Practices will search their electronic health record and identify people on the asthma register who meet eligibility criteria. Stream A patients will have expressed interest in response to the invitation from their GP. They will be contacted by the CI who will answer any questions about the study and if they are still interested in participating they will download the APP. Stream B patients will be handed an information pack about the APP by their practice nurse during a consultation. If they are interested in participating they will download the APP.

• **Favourable risk benefit ratio; anticipated benefit/risks for research participants (present and future)**

In response to a query by the Chair the CI and supervisor confirmed and gave an assurance that the APP would be updated in accordance with the latest clinical guidelines. The Committee was reassured by this.

• **Care and protection of research participants; respect for potential and enrolled participants’ welfare and dignity**

The Committee had some concerns over Group C, those not identified by a health care professional and asked the researchers about this. They confirmed that when downloading the APP it would be confirmed that the APP makes it clear that it does not replace normal healthcare/emergency procedures. The Committee was reassured by this.

The Committee wished it made clear that a commercial company will be getting details of participants’ email.

• **Informed consent process and the adequacy and completeness of participant information**

The researchers were asked to clarify who uMotif were? The CI confirmed uMotif was a private company and their technology partner. She confirmed that by using the uMotif software platform, the APP will be available for use on both Apple and Android mobile operating systems.

It was noted that uMotif would retain details of informed consent on the Cloud.

**Approved documents**

The documents reviewed and approved at the meeting were:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
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<tr>
<td>Summary CV for supervisor (student research) [HP IRAS CV]</td>
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<td>08 March 2016</td>
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**Membership of the Committee**

The members of the Ethics Committee who were present at the meeting are listed on the attached sheet.

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

**After ethical review**

**Reporting requirements**

The attached document “After ethical review – guidance for researchers” gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study
The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website: http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/

HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at http://www.hra.nhs.uk/hra-training/

16/SS/0101 Please quote this number on all correspondence

With the Committee’s best wishes for the success of this project.

Yours sincerely

Ms Joanne Mair
Chair

E-mail: joyce.clearie@nhslothian.scot.nhs.uk

Enclosures: List of names and professions of members who were present at the meeting and those who submitted written comments

"After ethical review – guidance for researchers" [SL-AR2 for other studies]

Copy to: , NHS Lothian Research & Development Office
South East Scotland REC 02

Attendance at Committee meeting on 18 May 2016

Committee Members:

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<thead>
<tr>
<th>Name</th>
<th>Profession</th>
<th>Present</th>
<th>Notes</th>
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<tr>
<td>Dr Balkishan Agrawal</td>
<td>General Practitioner</td>
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<tr>
<td>Mr William Farquhar</td>
<td>Retired</td>
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<td></td>
</tr>
<tr>
<td>Rev Denise Herbert</td>
<td>Priest</td>
<td>Yes</td>
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<tr>
<td>Mrs Alanah Kirby</td>
<td>Senior Lecturer</td>
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<tr>
<td>Dr Yann Maidment</td>
<td>General Dental Practitioner</td>
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</tr>
<tr>
<td>Ms Joanne Mair</td>
<td>Research Facilitator</td>
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<td></td>
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<tr>
<td>Mr Lindsay Murray</td>
<td>Health &amp; Safety Manager</td>
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<tr>
<td>Mr Hugh Olson</td>
<td>Lawyer</td>
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<tr>
<td>Dr Lynne Philip</td>
<td>General Practitioner</td>
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<tr>
<td>Mr Alec Richard</td>
<td>Researcher</td>
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<tr>
<td>Professor Lindsay Sawyer</td>
<td>Professor Emeritus</td>
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<tr>
<td>Dr Hester Ward</td>
<td>Public Health Consultant</td>
<td>Yes</td>
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<tr>
<td>Mrs Louisa Wilson</td>
<td>Clinical Research Manager</td>
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Also in attendance:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position (or reason for attending)</th>
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<tr>
<td>Dr Alex Bailey</td>
<td>Scientific Officer</td>
</tr>
<tr>
<td>Ms Joyce Clearie</td>
<td>REC Manager</td>
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</tbody>
</table>
08 June 2016

Miss Chi Yan Hui
PhD student
The University of Edinburgh
Asthma UK Centre for Applied Research, Usher Institute of Population Health Sciences and Informatics
Medical School
Teviot Place, Edinburgh
EH8 9AG

Dear Miss Hui,

**Study title:** Adoptive and adherent smart phone app’s features to support self-management for people with asthma

**REC reference:** 16/SS/0101

**Protocol number:** AC16041

**IRAS project ID:** 178664

Thank you for your letter of 1 June 2016. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 23 May 2016.

**Documents received**

The documents received were as follows:

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**Approved documents**

The final list of approved documentation for the study is therefore as follows:

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INVESTORS IN PEOPLE
Working Lives
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</table>

You should ensure that the sponsor has a copy of the final documentation for the study. It is the sponsor's responsibility to ensure that the documentation is made available to R&D offices at all participating sites.

16/SS/0101 Please quote this number on all correspondence

Yours sincerely

Joyce Clearie
SESREC 2 Manager

E-mail: joyce.clearie@nhslothian.scot.nhs.uk

Copy to: NHS Lothian Research & Development Office
Dear Miss Hui

Study title: Adoptive and adherent smart phone app’s features to support self-management for people with asthma
IRAS project ID: 178664
Protocol number: AC16041
REC reference: 16/SS/0101
Sponsor University of Edinburgh

I am pleased to confirm that HRA Approval has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications noted in this letter.

Participation of NHS Organisations in England

The sponsor should now provide a copy of this letter to all participating NHS organisations in England.

Appendix B provides important information for sponsors and participating NHS organisations in England for arranging and confirming capacity and capability. Please read Appendix B carefully, in particular the following sections:

- Participating NHS organisations in England – this clarifies the types of participating organisations in the study and whether or not all organisations will be undertaking the same activities
- Confirmation of capacity and capability - this confirms whether or not each type of participating NHS organisation in England is expected to give formal confirmation of capacity and capability. Where formal confirmation is not expected, the section also provides details on the time limit given to participating organisations to opt out of the study, or request additional time, before their participation is assumed.
- Allocation of responsibilities and rights are agreed and documented (4.1 of HRA assessment criteria) - this provides detail on the form of agreement to be used in the study to confirm capacity and capability, where applicable.
Further information on funding, HR processes, and compliance with HRA criteria and standards is also provided.

It is critical that you involve both the research management function (e.g. R&D office) supporting each organisation and the local research team (where there is one) in setting up your study. Contact details and further information about working with the research management function for each organisation can be accessed from www.hra.nhs.uk/hra-approval.

Appendices
The HRA Approval letter contains the following appendices:
- A – List of documents reviewed during HRA assessment
- B – Summary of HRA assessment

After HRA Approval
The document "After Ethical Review – guidance for sponsors and investigators", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:
- Registration of research
- Notifying amendments
- Notifying the end of the study
The HRA website also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

In addition to the guidance in the above, please note the following:
- HRA Approval applies for the duration of your REC favourable opinion, unless otherwise notified in writing by the HRA.
- Substantial amendments should be submitted directly to the Research Ethics Committee, as detailed in the After Ethical Review document. Non-substantial amendments should be submitted for review by the HRA using the form provided on the HRA website, and emailed to hra.amendments@nhs.net.
- The HRA will categorise amendments (substantial and non-substantial) and issue confirmation of continued HRA Approval. Further details can be found on the HRA website.

Scope
HRA Approval provides an approval for research involving patients or staff in NHS organisations in England.

If your study involves NHS organisations in other countries in the UK, please contact the relevant national coordinating functions for support and advice. Further information can be found at http://www.hra.nhs.uk/resources/applying-for-reviews/nhs-hsc-rd-review/.

If there are participating non-NHS organisations, local agreement should be obtained in accordance with the procedures of the local participating non-NHS organisation.
User Feedback
The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please email the HRA at hra.approval@nhs.net. Additionally, one of our staff would be happy to call and discuss your experience of HRA Approval.

HRA Training
We are pleased to welcome researchers and research management staff at our training days – see details at http://www.hra.nhs.uk/hra-training/

Your IRAS project ID is 178664. Please quote this on all correspondence.

Yours sincerely

Gemma Oakes
Assessor

Email: hra.approval@nhs.net

Copy to:
Mr Chris Coner, University of Edinburgh [Sponsor Contact]
resgov@accord.scot
Ms Susan Shepherd, NHS Lothian (ACCORD) [Lead NHS R&D Contact]
susan.shepherd@nhslothian.scot.nhs.uk
NIHR CRN Portfolio Applications Team
portfolio.applications@nihr.ac.uk
## Appendix A - List of Documents

The final document set assessed and approved by HRA Approval is listed below.

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<td>Summary CV for supervisor (student research) [HP IRAS CV]</td>
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Appendix B - Summary of HRA Assessment

This appendix provides assurance to you, the sponsor and the NHS in England that the study, as reviewed for HRA Approval, is compliant with relevant standards. It also provides information and clarification, where appropriate, to participating NHS organisations in England to assist in assessing and arranging capacity and capability.

For information on how the sponsor should be working with participating NHS organisations in England, please refer to the, participating NHS organisations, capacity and capability and Allocation of responsibilities and rights are agreed and documented (4.1 of HRA assessment criteria) sections in this appendix.

The following person is the sponsor contact for the purpose of addressing participating organisation questions relating to the study:

Mrs Chris Coner (0131 242 9448, resgov@accord.scot)

HRA assessment criteria

<table>
<thead>
<tr>
<th>Section</th>
<th>HRA Assessment Criteria</th>
<th>Compliant with Standards</th>
<th>Comments</th>
</tr>
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</table>
| 1.1     | IRAS application completed correctly | Yes | The applicant has confirmed that the study does not involve a device and the IRAS filter question should reflect that the study is a questionnaire/interview study. The applicant has confirmed that Part C should list the following research sites:  
- Firrhill Medical Centre  
- Hermitage Medical Practice  
Submission of an amendment will be required to add any new sites to the study. |
<p>| 2.1     | Participant information/consent documents and consent process | Yes | No Comments. |
| 3.1     | Protocol assessment | Yes | No Comments. |</p>
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<th>HRA Assessment Criteria</th>
<th>Compliant with Standards</th>
<th>Comments</th>
</tr>
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<td>4.1</td>
<td>Allocation of responsibilities and rights are agreed and documented</td>
<td>Yes</td>
<td>There is one site type participating in this study. Study activity is the same at all participating NHS organisations. The statement of activities and schedule of events has been provided. A simple contract letter will be used as the agreement between the sponsor and the participating NHS organisations. The template agreement has been provided.</td>
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<td>4.2</td>
<td>Insurance/indemnity arrangements assessed</td>
<td>Yes</td>
<td>Where applicable, independent contractors (e.g. General Practitioners) should ensure that the professional indemnity provided by their medical defence organisation covers the activities expected of them for this research study.</td>
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<tr>
<td>4.3</td>
<td>Financial arrangements assessed</td>
<td>Yes</td>
<td>The study is funded by the Chief Scientist’s Office (Scottish Government). The sponsor has confirmed that no funding will be provided to participating NHS organisations.</td>
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<td>5.1</td>
<td>Compliance with the Data Protection Act and data security issues assessed</td>
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<td>5.2</td>
<td>CTIMPS – Arrangements for compliance with the Clinical Trials Regulations assessed</td>
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<td>No Comments.</td>
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<td>5.3</td>
<td>Compliance with any applicable laws or regulations</td>
<td>Yes</td>
<td>No Comments.</td>
</tr>
<tr>
<td>6.1</td>
<td>NHS Research Ethics Committee favourable opinion</td>
<td>Yes</td>
<td>No Comments.</td>
</tr>
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</table>
### Participating NHS Organisations in England

This provides detail on the types of participating NHS organisations in the study and a statement as to whether the activities at all organisations are the same or different.

There is one site type participating in this study. Study activity is the same at all participating NHS organisations. A Statement of Activities and Schedule of Events have been provided.

A simple form letter contract will act as the agreement between the sponsor and participating NHS organisations in England.

The template has been provided.

Not all sites have been listed at Part C of the application. An amendment should be submitted when the sites are known.

The Chief Investigator or sponsor should share relevant study documents with participating NHS organisations in England in order to put arrangements in place to deliver the study. The documents should be sent to both the local study team, where applicable, and the office providing the research management function at the participating organisation. For NIHR CRN Portfolio studies, the Local LCRN contact should also be copied into this correspondence. For further guidance on working with participating NHS organisations please see the HRA website.

If chief investigators, sponsors or principal investigators are asked to complete site level forms for participating NHS organisations in England which are not provided in IRAS or on the HRA website, the chief investigator, sponsor or principal investigator should notify the HRA immediately at hra.approval@nhs.net. The HRA will work with these organisations to achieve a consistent approach to information provision.
Confirmation of Capacity and Capability

This describes whether formal confirmation of capacity and capability is expected from participating NHS organisations in England.

**Participating NHS organisations in England will be expected to formally confirm their capacity and capability to host this research.**

- Following issue of this letter, participating NHS organisations in England may now confirm to the sponsor their capacity and capability to host this research, when ready to do so. How capacity and capacity will be confirmed is detailed in the *Allocation of responsibilities and rights are agreed and documented (4.1 of HRA assessment criteria)* section of this appendix.
- The *Assessing, Arranging, and Confirming* document on the HRA website provides further information for the sponsor and NHS organisations on assessing, arranging and confirming capacity and capability.

Principal Investigator Suitability

This confirms whether the sponsor position on whether a PI, LC or neither should be in place is correct for each type of participating NHS organisation in England and the minimum expectations for education, training and experience that Pis should meet (where applicable).

The sponsor has confirmed that a Local Collaborator would be required at each participating NHS organisation and these have already been identified.

**Training** – All necessary training will be provided by the Central Research Team.

GCP training is not a generic training expectation, in line with the *HRA statement on training expectations*.

HR Good Practice Resource Pack Expectations

This confirms the HR Good Practice Resource Pack expectations for the study and the pre-engagement checks that should and should not be undertaken.

A letter of access is expected for researchers that do not have contractual arrangements in place with the participating NHS organisation. No disclosure and barring service or occupational health checks will be needed where a letter of access is required.

Other Information to Aid Study Set-up

This details any other information that may be helpful to sponsors and participating NHS organisations in England to aid study set-up.

The applicant has indicated that they intend to apply for inclusion on the NIHR CRN Portfolio.
Appendix 12 Nurse recruitment pack
A4A study: 3 mins guide to practices nurse

1 Inclusion criteria:
   • Adults (≥ 16yrs) on the ‘active’ asthma register of their practices. ‘Active’ asthma is defined as having a coded diagnosis of asthma and having been prescribed an asthma medication in the previous 6 months.

Exclusion criteria:
   • People with very severe asthma, e.g. under a hospital clinic, or who have had an admission within the previous 3 months (who may be expected to have been provided with a PAAP by the hospital clinic or prior to discharge tailored to their specific clinical needs)
   • People unable to provide informed consent (e.g. dementia, learning disabilities)
   • People unable to self-manage their own asthma (e.g. in nursing/residential care, cognitive impairment)
   • At the GP/nurse’s discretion for other severe or more significant conditions (including other lung conditions such as chronic obstructive pulmonary disease, and people on the palliative care register)

2 What to do in the consultation?
   1) Give the information pack to all eligible patients until all the packs have gone.
   2) Introduce the study, invite patient to join this study
   3) Tell them how they may get further information.

Example: “This is a research study to explore the features of an asthma self-management app which attract patients to download it, and encourage them to continue to use it. You are invited to use this app to manage your asthma. You can store your asthma action plan, monitor your peak flow, use of reliever inhaler, other medication use and lifestyle status, as well as setting reminder, make a picture diary and generate reports in this app. If you wish to join this study, you can follow the download process and use it for 3 months. The information sheet tells you what to do. I will be happy to help you to fill in the action plan. If you have any questions about the download or the study, you can contact the research team, they are happy to help. The enquiry contacts are at the back of the information sheet [please show the patients].”

3 The app contains a personalised asthma action plan, so some patients may arrange an extra consultation to fill in the plan if they haven’t already got a plan they can copy. The practice will be paid for any extra consultation(s), so please note them carefully on the log sheet. This will help us to calculate the correct reimbursement for your practice.

4 Any question, please contact Io Hui, email: io.hui@ed.ac.uk or phone: 01316503209.
Thank you!

Note:
A4A study log sheet

Practice’s name: ____________ Nurse’s name: ____________

1) The age and gender of people to whom you give a pack

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<th>No.</th>
<th>Age</th>
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2) The number of extra consultations required by the patients as a result of completing the action plan

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<th>Month</th>
<th>Date of extra consultations</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. October</td>
<td>e.g. 3rd, 3rd, 3rd; 6th; 8th; 8th</td>
</tr>
<tr>
<td></td>
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</table>
3) Making notes: At the end of the study, we will ask you to tell us your experience of introducing this app to patients. You may want to keep a note of the things that you would like to tell us.
Appendix 13 Study protocol, IRAS form, recruitment packs and A4A webpage
Adoptive and adherent smart phone app’s features to support self-management for people with asthma (APP for Asthma)

Study protocol

Protocol authors: Hui CY, Walton R, McKinstry B, Pinnock H.

This work is funded by the Chief Scientist Office (Scotland) [AUKCAR/14/01]. This work is carried out with the support of the Asthma UK Centre for Applied Research [AUK-AC-2012-01].

[APP for asthma] study protocol version 1.0 (08/03/2016)
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[APP for asthma] study protocol version 1.0 (08/03/2016)
Summary

Combining the inter-related pathways of the APP Development Roadmap in the Oxford Academic Health Science Network Report\(^1\), and the Medical Research Council (MRC) Framework of Developing and Evaluating Complex Interventions\(^2\), this study will refine and test the feasibility of an "APP" for a smart phone with the potential to integrate with cloud-based health records to enable supported self-management for people with asthma. The project overview and the study summary are shown in figure 1.

Context of this work

This is a qualitative and quantitative study that aims to understand the attractive and adherent features of an APP with a cloud-based health record to support asthma self-management through the process of planning, designing and conducting a feasibility study on a prototype APP. By using the uMotif software platform, the APP will be available for use on both Apple and Android mobile operating systems. uMotif is our technology partner and will prepare their software platform to provide a mobile app for this study. The PhD is part of Programme 1 of the Asthma UK Centre for Applied Research, which has the overarching aim of embedding supported self-management into routine asthma care using a whole-system approach. As such, it is a collaborative research project between the University of Edinburgh and Queen Mary, University of London.

[APP for asthma] study protocol version 1.0 (08/03/2016)
Introduction

Asthma is one of the commonest long term conditions. The World Health Organization (WHO) estimates that 235 million people currently suffer from asthma worldwide\(^1\) while almost 4.3 million adults suffer from asthma in UK\(^4\).

**Supported self-management, including a personalised asthma action plan (PAAP) improves asthma outcomes**

There is robust evidence that supported self-management improves asthma control, reduces exacerbations and decreases the social and economic burden of asthma\(^5,6\). The British Guideline on the Management of Asthma recommends that supported self-management reinforced by a PAAP should be offered to all people with asthma\(^7\). The recent UK National Review of Asthma Deaths observed that only a quarter of the people who died had a record of being given a PAAP, and highlighted self-management education as an important modifiable factor that might have prevented the death\(^8\). Research also shows that patients without a written PAAP are four times more likely to be admitted to hospital\(^9\).

Combined with regular professional review, PAAPs are a crucial component of effective support for self-management\(^6\). A PAAP is a set of tailor-made self-management instructions or actions for a patient to take in the event of deteriorating asthma. It informs the patient how to recognise that their asthma is deteriorating, when and how to modify medications, and when and how to access medical advice\(^10,11\). An effective, individualised PAAP can be based on symptoms or personal best PEF and uses two to three action points to trigger self-management decisions\(^7\).

**Implementation of asthma self-management remains poor**

However, PAAP ownership remains low. According to Asthma UK’s ‘Time to take action on asthma’ report, in 2014 70% of asthma patients did not have an action plan\(^4\). Previous researchers have identified barriers that hinder the usage of written PAAPs; these are practical, conceptual and organisational. Practical barriers include lack of time and resources, no immediately available paper-based PAAPs\(^12\). Conceptual barriers include a mismatch between the advice from professionals and the advice patients want for living with their asthma\(^13\). Organisational barriers include the lack of flexible systems for effective communication between professionals and patients\(^5,14\).

**The potential of information technology to promote asthma self-management**

As information communication technologies (ICTs) become more accessible and wearable in daily life and are widely accepted by patients for healthcare purposes\(^15\), researchers have become interested in ICTs incorporating PAAPs for asthma self-management. Improved clinical outcomes have been shown in systematic reviews of telehealthcare for asthma\(^16\), though less clearly for mobile ‘apps’\(^17\). However, as yet there are no recommendations on the format or context in which the latest digital application should be delivered in order to overcome the barriers to widespread use. To realise benefits from ICT-supported asthma self-management, systems will need to attract stakeholders (patients, professionals and organisations) to try them out, adopt and then adhere to sustained use of the digital self-management strategies. Previous research has been focussed on the clinical outcomes rather than seeking to inform the development of system features that are attractive and adherent, so that patients want and continue to use the APP in their routine self-management.
Potential attractive and adherent features for an APP for further study
From our systematic review, the evidence on clinical outcomes from the use of telemedicine intervention for adult with asthma is inconsistent; sometimes improving outcomes and sometimes having no effect, but there are no examples of harm. A list of potential attractive and adherent features to support self-management have been extracted from our systematic review, mobile phone assessment rating system analysis (MARS)¹⁹ and the social forum analysis.

The attractive features are the in-APP and out-APP features that attract patients to download and try out a new APP for their self-management. Examples of the potential attractive features are recommendation of the APP by their friends/family members, a clear description of the APP in the Google play/Apple APP market that can project a good health outcome for the patients. In contrast, the adherent features are the in-APP features that encourage people to come back to the APP after download and first log in to the APP. Examples of potential adherent features are functionality such as an asthma diary/log, advice from an action plan, reminders to aid compliance, and environmental alerts about pollen count and temperature etc. Further study is needed to refine this list of attractive and adherent features by obtaining the views of patients and healthcare professionals.

A prototype APP is a useful tool for triggering ideas from patients and healthcare professionals as hands-on experience can stimulate their thinking and help them to evaluate which attractive and adherent features work for them (or not). We therefore, collected advice from professional experts and lay advisory groups, and in discussion with our technology partner to prepare an alpha version APP for this feasibility study.

Description of the prototype APP
The core function of the APP is as a self-monitoring tool. Users can monitor 10 aspects of their asthma status by completing the segments of the u-Motif ‘flower’ (see Figure 2 screenshot of the uMotif flower). This includes the standard morbidity questions of the Royal College of Physicians three questions (RCP3Qs)¹⁹, peak flow, use of reliever inhaler, other medication use and lifestyle status.

The segments are:
1. In the last week how many nights have you woken because of your asthma?
2. In the last week, on how many days have you had your asthma symptoms?
3. In the last week on how many days has your asthma limited your activities?
4. What is your peak flow?
5. In the last day, how many doses of your reliever (blue) inhaler have you used?
6. Have you used the preventer inhaler today?
7. Have you taken any steroid tablet (mg) this today?
8. Do you have sneezing/running nose/itchy eyes in the past 24 hours?
9. Have you smoked today?
10. Have you done any exercise today?
Figure 2 screenshot of the uMotif flower

The APP provides links to useful information (Asthma UK website, Asthma UK updates, latest publication about asthma, inhaler demo video, social forum of Asthma UK, weather, pollen count and air quality information). There is an option for completing a daily diary, setting medication and task reminders. In addition the APP includes a template for a PAAP. This is an electronic form of the Asthma UK paper action plan (https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/) which is freely available for anyone to download – and indeed may be accessed via the electronic health record used in many UK practices. The APP version of the Asthma UK action plan is a template and personalised information about recognising deterioration and the actions to be taken have to be completed by the patients’ own clinical advisor. (Figure 3 screenshot of the plan (everyday care), Figure 4 screenshot of the plan (worse))
My personal best peak flow is:

My preventer inhaler:
insert name/colour

I need to take my preventer inhaler every day even when I feel well

I take

0 puff(s) in the morning and

0 puff(s) at night.

My reliever inhaler:

This is what I can do straight away to get on top of my asthma:

1.

If I haven’t been using my preventer inhaler, start using it regularly again or:
Increase my preventer inhaler dose to

puff(s)

times a day until my symptoms have gone and my peak flow is back to normal

Take my reliever inhaler as needed (up to

puff(s) every four hours)

If I don’t improve within 48 hours make an urgent...

The Asthma UK Action plan also includes advice for dealing with emergency attacks which follows guideline recommendations. This emphasises the means of contacting medical advice as well as how to provide emergency relief whilst awaiting assistance. (see Figure 5 screenshot of the plan (emergency flow chart))
I find it difficult to walk or talk.
I find it difficult to breathe.
I'm wheezing a lot or I have a very tight chest or I'm coughing a lot.
My peak flow is below:

 THIS IS AN EMERGENCY TAKE ACTION NOW

- Sit up straight – don’t lie down. Try to keep calm
- Take one puff of my reliever inhaler every 30 to 60 seconds up to a maximum of 10 puffs.
- If I feel worse at any point or if I’m using my inhaler
- If I still don’t feel any better after 10 puffs, I’ll call 999 for an urgent hospital appointment with my GP or asthma nurse to get advice.

Rapid commercially and academically appropriate framework to refine the APP
There are some key outstanding questions which require to be addressed as the APP is refined from the alpha to the beta-version. We need to explore and refine usability, and understand attractive and adherent features both when the decision to choose an APP is made in the commercial market (APP stores) as well as when it is advised in a clinical context. In addition we need to discover if attractive and adherent features vary in patients who are a) familiar with self-management vs. not used to performing self-management; b) novice smartphone users vs experienced users; and c) different gender or age groups. In a process that follows the stages of the APP Development Roadmap20 merged with aspects of the Medical Research Council (MRC) Framework for Developing and Evaluating Complex Interventions21 we plan a feasibility study to refine the APP and capture patients and healthcare professionals’ opinions on the potential of emerging technologies in the market to support their self-management. Commercial timescales mean that this needs to be a rapid process (it typically takes about 6 months for the launch of a group of emerging technologies) and the three streams will proceed in parallel. In this parallel process, any changes to features and/or the interface of the APP identified during feedback interviews (approximately monthly with the patients in stream A) will be implemented (if feasible within the timeframe) as updates to the APP and made available to patients in streams B and C. (see figure 1 for diagram of the streams and detailed explanation in the methodology). Patients in streams B and C will be asked if the updates were easy to implement and whether (or not) they improved the usability/attractiveness of the APP. The following figure illustrates where our project fits in the APP development roadmap and MRC framework.

Figure 5 screenshot of the plan (emergency flow chart)

APP for asthma study protocol version 1.0 (08/03/2016)
Figure 6 Our project bridges the gap between the APP development roadmap and the MRC framework
**Aim**

To refine usability of the prototype APP, assess feasibility in a healthcare context and explore attractive and adherent features both in clinical and commercial settings.

**Objectives**

A. In an iterative process, to build on the uMotif platform to refine the interface and application features of the APP (from alpha version to beta version) and explore the attractive and adherent features identified in the previous literature and social forum review.

B. To assess the attractiveness of an APP to patients if it is introduced by their healthcare professional and the patient's adherence to using the APP and application features after 30, 60 and 90 days.

C. To assess the attractiveness of an APP to patients who discover it because of advertisements on the web/APP market or recommendation of friends and the degree of patient's adherence (retention rate) to the APP and application features after 30, 60 and 90 days.
Method

Design: A six months feasibility study in three streams (A, B and C)

A. In an iterative process, to build on the uMotif platform to refine the interface and application features of the APP (from alpha version to beta version) and explore the attractive and adherent features identified in the previous literature and social forum review

Study design: In a sequential, iterative process, three cohorts of approximately five people with asthma will use the APP for one month and provide interviews before (to observe initial usability and explore ‘attractive’ features) and after the 1-month trial (to explore practical experience and ‘adherent’ features). Healthcare professionals from the five participating practices will be interviewed for their views on the practicalities of using the APP and explore any impact this has had on consultations and delivery of self-management support.

![Image of method diagram]

**Healthcare professional level outcomes**
Quantitative data: Number of information sheet delivered to patients
Qualitative data: Interview

**Patient level outcomes**
Quantitative data: Number of patients who express their interest; APP’s weekly usage; usage pattern; retention rate at 30, 60 and 90 days
Qualitative data
Interview; Usability observation; Questionnaires; Online forum; Enquires to uMotif’s support

Figure 7 design for stream A which recruit via practices

Practice recruitment: We will recruit up to 5 general practices from diverse demographic areas (e.g. high/low areas of deprivation; predominantly younger/older populations; routinely

|APP for asthma| study protocol version 1.0 (08/03/2016) |
providing asthma self-management (or not)) to participate in stream A and B (see below). Eligible practices will have an asthma-trained nurse willing to participate in the research.

**Patient recruitment:** Practices will search their electronic health record (EHR) and identify people on the asthma register who meet the following eligibility criteria:

**Inclusion criteria:**
- Adults (≥ 16yrs) on the ‘active’ asthma register of their practices. ‘Active’ asthma is defined as having a coded diagnosis of asthma and having been prescribed an asthma medication in the previous 6 months.

**Exclusion criteria:**
- People with very severe asthma, e.g. under a hospital clinic, or who have had an admission within the previous 3 months (who may be expected to have been provided with a PAAP by the hospital clinic or prior to discharge tailored to their specific clinical needs)
- People unable to provide informed consent (e.g. dementia, learning disabilities)
- People unable to self-manage their own asthma (e.g. in nursing/residential care, cognitive impairment)
- At the GP’s discretion for other severe or more significant conditions (including other lung conditions such as chronic obstructive pulmonary disease, and people on the palliative care register)

Each practice will write, enclosing an information pack to a random sample of 100 eligible patients. People who are interested in the study, will complete and return an expression of interest form (including some basic demographic details and information about their experience of asthma self-management and their use, or not, of healthcare APPs; and confirming that they have a compatible smartphone/tablet with Android 4.3.3 or iOS 7.0 or later, and are able to use an APP written in English) to the research team. On the basis of this information we will purposively sample up to 5 people for each of three cycles. This will be based on:
- Age: a range of ages including young adults (16-25), adults (26-60), and older adults (61+)
- Action plan: with/without an action plan
- Technology: is/is not a frequent healthcare APP user

Any patients expressing interest, but not selected for the qualitative research (stream A), will be invited to try the APP for 3 months (as part of stream B).

**Activation of the APP, ‘Use of APP’ on-line eligibility check and consent process**

i. The researcher will send the patient by e-mail a link to download the APP and provide a stream code to activate the APP.
ii. Patients will use their smartphone to download the uMotif APP from the APP store
iii. When the patient first opens the APP they will be prompted to enter the stream code in the APP.
iv. The patient will be asked to confirm that they are living in the UK. Patients answering ‘yes’ will proceed to the next page.
v. The patient will be asked to confirm their eligibility by responding to eligibility questions (Are you 16 years or over? Do you have asthma diagnosed by your doctor? Are you under the care of a hospital clinic or have been admitted to hospital in the last 3 months for your asthma? (Put your answers in the box below.)

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asthma. Patients answering ‘yes’ to the first 2 questions and ‘no’ to the last will progress to the next page.

vi. The patient will be invited to read the on-line version of the information sheet and check the box confirming that ‘I have read and understood the content of the information sheet’. This will allow them to progress to next page.

vii. The patients will be asked to complete the on-line consent form which gives their consent for the research team to extract data about their use of the APP over the three months of the study, collect and analyse any monitoring data that they submit during the three months, collect and analyse any comments they make on the APP forum, agree to us sending a link to an on-line questionnaire at the beginning and at the end of the three months. If they check all the boxes they will progress to the next page.

viii. The patients will be asked to register a personal account for the APP. They will be asked to register a user name, password and email and agree to the uMotif terms and conditions to use the APP. If they fill in the information and check the box they will progress to the next page.

ix. The patient will be asked for some background information for the data analysis: year of birth, gender, do they use regular preventer medication for their asthma, do they have a written PAAP, have they tried any healthcare APPs before.

x. The participant will be asked to fill in the short initial questionnaire (see page 15).

xi. The APP provides a short tutorial on how to use the APP, after which the patient can begin to use the APP.

Arrangements for interviews and obtaining informed consent for interviews
We will arrange interviews at the sites where are convenient to the patients. If patient cannot come to the sites, we will ask if we can go to their home to conduct the interview. Written informed consent for the interviews will be obtained prior to commencing the initial interview and confirmed verbally prior to the follow-up interview (after the 1-month trial of using the APP).

Overview of topics for discussion in the interviews with patients
We adopted the basic elements (trigger, motivation and ability) of the BJ Fogg behaviour change model to design the topic guide questions and have refined the questions with our lay advisory group. An outline of the interview topics is given below.

We will conduct two interviews (one before and one after the 1-month trial) for each cycle of 5 patients

- Initial interview (Before 1-month trial) The interview will be in two parts and will last approximately one hour:
  - Explore initial usability: We will ask the patient about their practical experience of downloading and using the APP for the first time (if they have downloaded) or assist them to do so if they require support. We will then observe whether they have worked out how to use the APP (e.g. to perform their usual monitoring tasks, look up information, check their action plan) and gain their initial impression of usability.
  - Explore attractive features: We will ask about the features that attracted them to try out an APP to support their self-management. Finally we will ask about any features that will encourage them to keep using the APP for their self-management.

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• **One-month trial.** The participant will then use the APP for one month by themselves. The APP encourages them to see their asthma nurse to arrange completion of the personalised asthma action plan. They can send enquiries and instant comments to uMotif technical support or to our forum. We will have access to this open feedback to inform the follow-up interview.

• **Follow-up interview (After 1-month trial)** The interview will be in two parts and last approximately one hour:
  o We will ask for their usage feedback; specifically any practical problems with navigating the software, recording monitoring data, or accessing their action plan. We will ask whether they discussed the action plan with their asthma nurse and for feedback on how that worked.
  o We will explore the reason why they keep using (or not using) the APP after a month and any adherent features that motivated them to keep using it (or discouraged them from using it). Do they have any suggestions for additional attractive or adherent features?

In an iterative process, we will undertake three rounds of interviews/trial of the technology/feedback interviews each with up to five participants over approximately three months.

**Professional recruitment**
We will invite healthcare professionals from participating practices to participate in interviews (face-to-face or by telephone according to the interviewee’s preference) before and towards the end of the study. In most practices the key professionals providing routine care for people with asthma (including asthma self-management) are asthma-trained nurses, but we will extend interviews to any healthcare professionals and/or practice staff who have a role in providing asthma care.

**Arrangements for interviews and informed consent**
We will arrange interviews at convenient times and offer face-to-face or telephone interviews according to preference. Participants will be asked for informed consent prior to the interview (arranged by post if the interview is by telephone)

**Overview of topics for discussion in the interviews for healthcare professionals**
We adopted the basic elements (trigger, motivation and ability) of the BJ Fogg behaviour change model to design the topic guide questions and refined the questions with our lay advisory group. An outline of the interview is given below.

We plan two interviews (at the beginning and towards the end of the study) with key professionals (typically the practice nurses) and one interview (towards end of the study) with any other members of the practice team involved in asthma care and/or provision of asthma self-management.

• **Initial interview (as patient recruitment starts).** The first interview will focus on the process of inputting personalised data into the action plan for the patient and will explore initial perceptions of the system and the perceived impact of using the APP in the consultation.

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Follow-up interview (Towards the end of the practice involvement with the project):
We will ask for feedback on the practicalities of using the APP and explore any impact this has had on consultations and delivery of self-management support. We will ask about perceptions of attractive and adherent features.

Data handling and data analysis (observation and interview)
The interviews will be digitally-recorded, transcribed and entered into NVivo for analysis. Notes from observation of how the APP is used (initial interviews) will be coded using NVivo. Contemporaneous comprehensive field notes will aid contextualisation. We will use framework analysis to answer our specific questions relating to usability and exploration of attractive and adherent features. Analysis will be iterative, so that insights from the early cycles will inform both the refinement of the APP and also the topic guide for later interviews.
B. To assess the attractiveness of an APP to patients if it is introduced by their healthcare professional and the patient's adherence to using the APP and application features after 30, 60 and 90 days

**Study design:** Patients will be introduced to the APP by their asthma nurse in a routine review and invited to download and use the APP for three months. The APP will encourage them to see the asthma nurse for completion of the personalised asthma action plan. During these three months, they can send enquiries and instant comments to uMotif technical supports or our forum. They will be asked to fill in short questionnaires before and after using the APP. We aim to recruit 100 patients for this stream, though some may be respondents to the written invitation from the practice (Stream A).

**Healthcare professional level outcomes**

**Quantitative data:** Number of information sheet delivered to patients

**Qualitative data:** Interview

**Patient level outcomes**

**Quantitative data:** Number of patients who express their interest; APP's weekly usage; usage pattern; retention rate at 30, 60 and 90 days

**Qualitative data**

Questionnaires; Online forum; Enquires to uMotif's support

**Figure 8 design for stream B which recruit via asthma nurse**

**Patient recruitment:** The asthma nurse from participating practices will be asked to give information packs about the APP and the research to all potentially eligible patients seen over the 3 month recruitment phase.
‘Use of APP’ on-line eligibility check and consent process: Patients will receive an information pack from their asthma nurse during a routine asthma review, or will have responded to a mailed invitation from the practice to participate in Stream A. The pack will contain information about the APP, an information leaflet about the research, instructions for downloading the APP, and a stream code to activate the APP.

- Patients wishing to participate will follow the link in the information pack and use their smartphone to download the uMotif APP from the APP store in the usual way.
- When the patient first opens the APP they will be prompted to enter the stream code to activate the APP.
- The patient will be asked to confirm that they are living in the UK. Patients answering ‘yes’ will proceed to the next page.
- The patient will be asked to confirm their eligibility by responding to eligibility questions (Are you 16 years or over? Do you have asthma diagnosed by your doctor? Are you under the care of a hospital clinic or have been admitted to hospital in the last 3 months for your asthma). Patients answering ‘yes’ to the first 2 questions and ‘no’ to the last will progress to the next page.
- The patient will be invited to read the on-line version of the information sheet and check the box confirming that ‘I have read and understood the content of the information sheet’. This will allow them to progress to next page.
- The patients will be asked to complete the on-line consent form which gives their consent for the research team to extract data about their use of the APP over the three months of the study, collect and analyse any monitoring data that they submit during the three months, collect and analyse any comments they make on the APP forum, agree to us sending a link to an on-line questionnaire at the beginning and at the end of the three months. If they check all the boxes they will progress to the next page.
- The patients will be asked to register a personal account for the APP. They will be asked to register a user name, password and email, and agree to the uMotif terms and conditions to use the APP. If they fill in the information and check the box they will progress to the next page.
- The patient will be asked for some background information for the data analysis: year of birth, gender, do they use regular preventer medication for their asthma, do they have a written PAAP, have they tried any healthcare APPs before.
- The participant will be asked to fill in the short initial questionnaire (see page 15).
- The APP provides a short tutorial on how to use the APP, after which the patient can begin to use the APP.
Data collection

- ‘Attractiveness’ The asthma nurses will maintain a list of the number of information packs they hand out. Download rates will be extracted from the uMotif database sorted by the study ID in a password protected excel file.
- ‘Adherence’. We will collect the user’s routine APP data such as weekly usage, user pattern and retention rate at 30, 60 and 90 days, and monitoring data from the database maintained by uMotif.
- Online forum & enquires: we will provide an online forum for people to post their thoughts when they are using the APP, we will collect these posts as well as all the inquiries sent to uMotif technical supports.
- Questionnaires: Patients will be asked to fill in the ‘initial’, questionnaire in the APP immediately after downloading and registering the APP and we will send a questionnaire link to the patient after they have been using the APP for 3 months. An outline of the questionnaires is given below.
  o Initial (Before using the APP): The questionnaire will address a) which features attracted them and made them decide to try out an APP for self-management, and b) which features do they think will encourage them to keep using the APP for their self-management. The list will include features extracted from our previous systematic review and other reviews. In addition we have discussed attractive and adherent features with our patient advisory group to refine the wording so that it is understandable for lay people. c) do they have any special needs on reading or use of smartphone? Patient can choose if they want to tell us or not. There will have three choices for them – No, Yes, Prefer not to say.
  o After 3 months. The questionnaire will ask the patient whether they are still using the APP, and if so which features have motivated them to keep using the APP. If they are not still using the APP what did they not like about the APP and what might have encouraged them to continue. If we have implemented an update, did this improve the APP’s features and attractiveness. The format of the follow-up questionnaire will be similar to the initial questionnaire but the list of features may differ as we will adapt the final questionnaire in the light of the findings of the qualitative interviews (stream A) In addition we will ask about usability of the APP (listing issues raised by the qualitative interviews) We will also ask if they went to their healthcare professional to assist them to fill in the PAAP. If so, have they used the PAAP and was it useful?

Sample size: Our primary outcome is the retention rate at 30 days after download in order to determine adherence. With statistical advice, we calculated the sample size for the assessment of retention rate based on a 50% retention rate after 30 days. A sample of 97 patients will give us 80% power with 95% confidence interval to detect a difference with a maximum half-width of 10% (i.e. 40-60%). This offers an acceptable precision and is feasible within the recruitment timescale of three months.
Data Analysis

- **Attractiveness and adherence (Download and usage rates)**
  - *Attractiveness:* We will calculate the proportion of patients who download the APP compared to the number of packs handed out by the nurses, and the proportion having responded to the written invitation from the practice.
  - *Adherence:* We will calculate the APP’s retention rate as the proportion of users who are still using the APP after 30, 60 and 90 days. Weekly usage patterns will be plotted graphically.

- **Questionnaires:** Responses to questionnaires will be extracted to a table and analysed using descriptive statistics. The ranking and priorities of the application features will be analysed for the group as a whole and then for the key sub-groups identified by the demographic questions during the registration process (e.g. age, gender, previous ownership of a PAAP, novice smartphone user vs experienced user)

- **Online forum & enquires.** Feedback from the online forum, enquiries and questionnaires will be entered into NVivo for analysis in order to answer our questions about usability, attractive and adherent features.
C. To assess the attractiveness of an APP to patients who discover it because of advertisements on the web/APP market or recommendation of friends and the degree of patient’s adherence (retention rate) to the APP and application features after 30, 60 and 90 days

**Study design:** This group of participants are people, living in the UK, who come across our APP’s information in the market (e.g. on our research website, via friends from our participants in streams A&B, in Google play store or Apple app store). They will be able to download and apply to be registered to use the APP for three months. During those three months, they can send enquiries and instant comments to uMotif technical supports or our forum. With consent, we will track their usage data and request completion of questionnaires before and after using the APP.

![Diagram](image)

**Patient level outcomes**

**Quantitative data:** Number of patients who express their interest; APP’s weekly usage; usage pattern; retention rate at 30, 60 and 90 days

**Qualitative data:** Questionnaires, Online forum; Enquires to uMotif’s support

**For GP/asthma nurse**

**Interview** - For those patients who tell us (in the final questionnaire) that they did ask their nurse/GP to complete the PAAP, we will ask for their permission and send a (very short) questionnaire to the nurse/GP asking what they thought about being asked to complete an APP.

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**Participant recruitment:** The APP will be available on Google Play and the Apple APP store and information will be available on the research website.

- Patients wishing to participate will download the uMotif APP from the APP store.
- When the patient first opens the APP they will be prompted to enter the stream code to activate the APP.
- The patient will be asked to confirm that they are living in the UK. Patients answering ‘yes’ will proceed to the next page.
- The patient will be asked to confirm their eligibility by responding to eligibility questions (Are you 16 years or over? Do you have asthma diagnosed by your doctor? Are you under the care of a hospital clinic or have been admitted to hospital in the last 3 months for your asthma). Patients answering ‘yes’ to the first 2 questions and ‘no’ to the last will progress to the next page.
- The patient will be invited to read the on-line version of the information sheet and check the box confirming that ‘I have read and understood the content of the information sheet’. This will allow them to progress to next page.
- The patients will be asked to complete the on-line consent form which gives their consent for the research team to extract data about their use of the APP over the three months of the study, collect and analyse any monitoring data that they submit during the three months, collect and analyse any comments they make on the APP forum, agree to us sending a link to an on-line questionnaire at the beginning and at the end of the three months. If they check all the boxes they will progress to the next page.
- The patients will be asked to register a personal account for the APP. They will be asked to register a user name, password and email and agree to the uMotif terms and conditions to use the APP. If they fill in the information and check the box they will progress to the next page.
- The patient will be asked for some background information for the data analysis: year of birth, gender, do they use regular preventer medication for their asthma, do they have a written PAAP, have they tried any healthcare APPs before.
- The participant will be asked to fill in the short initial questionnaire (see page 15).
- The APP provides a short tutorial on how to use the APP, after which the patient can begin to use the APP.

**Data collection**

- ‘Attractiveness’: Download rates will be extracted from the uMotif database sorted by the unique APP’s user ID in a password protected excel file.
- ‘Adherence’: We will collect the user’s routine APP’s data such as weekly usage, user pattern and retention rate at 30, 60 and 90 days, and monitoring data from the database maintained by uMotif.
- **Online forum & enquiries:** we will provide an online forum for people to post their thinking when they are using the APP, we will collect these posts as well as all the inquiries send to uMotif technical supports.
- **Questionnaires:** Patients will be asked to fill in the ‘initial’, questionnaire in the APP immediately after downloading and registering the APP and we will send a questionnaire link to the patient after they have been using the APP for 3 months. An outline of the questionnaires is given below.
o 'Initial' Before using the APP: The questionnaire will address a) which features attracted them and made them decide to try out an APP for self-management, and b) which features do they think will encourage them to keep using the APP for their self-management. The list will include features extracted from our previous systematic review and other reviews. In addition we have discussed attractive and adherent features with our patient advisory group to refine the wording so that it is understandable for lay people. c) do they have any special needs on reading or use of smartphone? Patient can choose if they want to tell us or not. There will have three choices for them – No, Yes, Prefer not to say.

o After 3 months. The questionnaire will ask patients whether they are still using the APP, and if so which features have motivated them to keep using the APP. If they are not still using the APP what did they not like about the APP and what might have encouraged them to continue. If we have implemented an update, did this improve the APP’s features and attractiveness? The format of the follow-up questionnaire will be similar to the initial questionnaire but the list of features may differ as we will adapt the final questionnaire in the light of the findings of the qualitative interviews (stream A). In addition we will ask about usability of the APP (listing issues raised by the qualitative interviews). We will also ask if they went to their healthcare professional to assist them to fill in the PAAP. If so, have they used the PAAP and was it useful?

Sample size: uMotif have agreed to handle the first 200 people who apply.

Data Analysis

- **Attractiveness and adherence (Download and usage rates)** The APP’s retention rate will be calculated as the percentage of users who are still using the APP after 30, 60 and 90 days. Weekly usage patterns will be plotted graphically.

- **Questionnaires:** Responses to questionnaires will be extracted to a table and analysed using descriptive statistics. The ranking and priorities of the application features will be analysed for the group as a whole and then for the key sub-groups identified by the demographic questions during the registration process (e.g. age, gender, previous ownership of a PAAP, novice smartphone user vs experienced user)

- **Online forum & enquires.** Feedbacks from online forum, enquires and questionnaires will be entered into NVivo for analysis in order to answer our questions about usability, attractive and adherent features.
Over-arching synthesis and interpretation

The findings of the three streams of work (A, B and C) will be synthesised in order to answer our three over-arching questions:

- Usability of the APP. Key issues identified from the qualitative refining interviews (Stream A) will be validated and quantified by incorporating specific questions in the questionnaires (Streams B and C).
- Attractive features. Attractive features identified in the qualitative interviews (Stream A) will be listed in the questionnaires (Streams B and C). Attractiveness will be assessed by calculating the proportion of people invited to use the APP by the nurse who actually download and register to use the system.
- Adherent features. Adherent features identified in the qualitative interviews (Stream A) will be listed in the questionnaires (Streams B and C). Adherence will be assessed using the usage data from uMotif (Streams B and C). Our outcome of interest is usage at 30, 60 and 90 days. We will be able to compare adherence in people invited to use the APP by their asthma nurse, compared to those people who found the APP on the web/APP store.

The emerging findings will be presented to a multidisciplinary group (including the steering group, colleagues from the Asthma UK Centre for Applied Research, the patient and public involvement group) in order to aid interpretation and obtain a wider perspective on the implications for development of an implementation intervention.

Exit strategy

The smartphone APP is intended to be delivered for research purpose in this 3-month research. There is no anticipation that the intervention will continue to be provided to patients after the study. If our feasibility study proves promising, we will seek funding to offer the APP as an option in a UK wide randomised control trial of implementation of self-management.

Publication strategy

The evidence based reviews and the feasibility study will be published in peer-reviewed journals and Asthma UK for Applied Research webpage, presented as abstracts at national and international conferences and disseminated via the co-applicants’ contacts with professional and policy bodies and lay groups and organisations.

Potential risks and burden

- There is a potential risk that the patients will presume there is a clinician to monitor their health data which this is not the case for this APP. Therefore, we have clearly written down what the APP doesn’t do in the information sheet and added an item in the consent form to make sure that they understand there is no clinician monitoring their asthma readings and they are responsible for accessing advice if their asthma is deteriorating.

- Patients will be asked to complete two short questionnaires at the beginning and end of using the APP. To reduce the associated burden, we will construct on-line questionnaires with pick-lists plus optional space for free-text comments.

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Stream A: Patients in Stream A will be asked to provide 2 interviews at the beginning and end of the 1-month trial of using the APP. To reduce the associated burden, we will conduct the interview at an accessible venue for our participants. If travel is needed, we will pay participants travel expenses. Professional time will be reimbursed at the rates recommended by Clinical Research Networks and telephone interviews will be offered.

- People will be expected to have and maintain their own smartphone device and provide their own data connectivity.
- The quantity of data used by the APP is very small and is unlikely to have a significant effect on participants' data plans. This will be clearly communicated to participants prior to registration.

**Data security**

- The data captured on the patient’s mobile phone or home computer and software will be independent of the operating system.
- Participants’ data such as their logged health data and app’s usage pattern are automatically sent from their smartphone / tablet device via secure SSL encryption to the EU-based uMotif cloud servers, when their device has internet connectivity (3G / 4G / Wifi). All data sent to the servers is backed-up in real-time and the database is encrypted for security.
- Participant study data on the servers will only be accessible by approved study staff and partners. Participants are able to see their own data only – not data from other participants.
- All data will be held in accordance with the UK Data Protection Act (uMotif Limited is a notified Data Controller and Processor) and the Health and Social Care Information Centre’s (HSCIC) Information Governance toolkit (uMotif Limited is certified to Level 2 of the Information Governance (IG) Toolkit).
- Each participant will agree to the uMotif standard Terms and Conditions ([https://www.umotif.com/termsAndConditions](https://www.umotif.com/termsAndConditions)) and Privacy Policy ([https://umotif.com/privacyPolicy](https://umotif.com/privacyPolicy)). These state that participants own their own data and can request a copy of it at any time.
- After the research, paper based data and digital data will be archived in the university for 5 years.

**Project management and quality assurance**

- The research team will meet monthly via tele-conference/ in person
- Supervisory meetings between Dr Pinnock and Miss Hui are held in between the monthly meeting as required
- The study will follow the Good Clinical Practice Standard within the Research Governance framework.
- Ethical approval will be sought via the National Research Ethics Services, University and management approval from NHS Lothian
- Research governance approval will be sought from NHS Lothian Research Governance Committee
Finance

This study is funded by a PhD studentship from the Chief Scientist Office (Scotland) [AUKCAR/14/01]. This work is carried out with the support of the Asthma UK Centre for Applied Research [AUK-AC-2012-01]

Timetable

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References


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[APP for asthma] study protocol version 1.0 (08/03/2016)
This is an invitation to take part in a research study. Before you make a decision please read the following information carefully.

First we will explain the background to the study and how the study will be conducted. Then we will explain what will happen if you decide to take part. Take time to consider if you would like to take part. It may be helpful to discuss with friends or family, or your GP, and if anything remains unclear please contact us directly (details on the back page)

Do you have (Android 4.3.3+) smartphone/tablet or (iOS 7+) iPhone/ iPad ? If so, our asthma APP will work on your phone or tablet.
Why are we doing the study?

Understanding about your asthma and triggers, knowing how to manage day to day, and how to respond to worsening symptoms are important parts of living with asthma. It is known that being given an personalised action plan by your asthma nurse or GP leads to better day to day control of asthma symptoms, less time off work or school and also reduces the risk of an asthma attack. You can learn more about asthma action plans at:

https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/

In the past, asthma action plans have been written on paper, but nowadays many people have smart phones that they have with them most of the time. We want to develop an action plan in an APP which can be personalised by an asthma nurse or GP in the same way as paper plans, but will also enable users to record their symptoms in the 'cloud' so that it can be shared with a healthcare professional during a review. Our technology partner is uMotif.

We want to find out what features of an APP would make people with asthma want to download the APP and to use it regularly.

What is involved if I decide to take part? We will ask you to use our APP for a month and to tell us whether you think it is easy to use, what you like about it and what you think could be better. If you decide to take part:

- We will send you the link to the APP and an activation code so that you can download it to your phone (or we can help you do this if you prefer). We will invite you to fill in a short questionnaire before you start to use the APP. In the questionnaire, we will ask you about the features of the APP that made you decide to try it out, and which features you think will be useful so that you will go on using it.
- A few days later we will arrange an interview with you when we will ask you to tell us, and show us, how you are learning to use the APP. We will ask you to tell us about the features of the APP that made you decide to try it out, and which features you think will be useful so that you will go on using it.
- You can then use the APP for a month and (if you wish) leave any comments on our forum. We will collect information from the APP database about how often you use the APP.
- After a month, we will send you another short questionnaire and we will also arrange another interview when we will ask you what you think about the APP, which features you used, and what you didn’t find useful. The interviews will be arranged at a time and place that is convenient to you.
Who will be leading this study? Miss Chi Yan Hui, Io will lead the study as part of her PhD research, supervised by Professor Hilary Pinnock, Professor Robert Walton and Professor Brian McKinstry.

How have we chosen who to invite? You have been sent this invitation because you have regular treatment for asthma. The expression of interest form has a few questions about your asthma, whether you have an action plan, and whether you often use health APPs. We will look at the information on the expression of interest form and choose a range of people with different viewpoints and experience for our study. We will then contact selected people, answer any questions and make arrangements for the interview. If we don’t invite you for an interview, we will ask if you would like to use the APP for 3 months, followed up with a short questionnaire.

Can I be sure that what I say will be kept confidential? Yes. Any information about you, and everything that you say will be kept strictly confidential. Your name and contact details will be kept securely at the University of Edinburgh. The interviews will be audio recorded and everything that you tell us will be written out and anonymised before we review and analyse our findings.

What does the APP do? Using this app can help you track and understand your asthma and capture useful data to help you manage your asthma. It can store information about your asthma that you can share with your doctor or nurse. It includes an action plan which your doctor or nurse can help you fill in. Other features include quick links to the pollen count and pollution index, a medication reminder and links to the latest news about asthma research.

What doesn’t the APP do? The app does not recommend or advise you to do or change anything. If you have asthma symptoms it will suggest that you look at your action plan and follow instructions from your clinicians. The app does not provide you with a constant communications channel with your clinicians. Do not rely on the app in case of emergency or if your asthma is getting worse. If you have any concerns or issues with your health, you must contact your health professionals.

Will this app use up my data plan? The quantity of data used by the APP is very small and is unlikely to have a significant effect on your data plan.

There are no clinicians monitoring your asthma readings. You are responsible for getting advice or help if your asthma deteriorates.
What personally identifiable data will be sent/stored in the APP’s (uMotif) server? The only personally identifiable data that will be sent/stored in the server are your email address and user name you provide.

What will happen to the results of the study? We will send you a summary of our findings at the end of the study. Findings will be posted on the AUKCAR website, presented at conferences and published in a journal.

Will taking part affect the treatment I receive for my asthma? No. Taking part, or deciding not to take part, in the study will not affect the care you receive from your practice, or the hospital.

Can I change my mind about taking part? Yes. You may change your mind at any time and don’t have to give a reason.

What are the benefits of taking part? Using the APP will help you to monitor your asthma, though taking part in this research may not benefit you personally. However, being involved in the study will help us to develop a better APP for asthma self-management.

Are there any risks if I decide to take part? No. Your treatment will not be affected: we are only asking for your opinions.

About funding and organisation? The study is part of a research programme for the Asthma UK Centre for Applied Research. The study is being funded by the Chief Scientist Office (Scotland) and has ethical approval from the South East Scotland REC 02 Ethics Committee.

I have some questions about the study: Io Hui will be pleased to answer any questions. phone: 0131 650 3209 or email: io.hui@ed.ac.uk

To speak with an independent researcher you can contact Dr Nicola McCleary, a researcher who is not part of the study team by: phone: 0131 650 2682 or email: nico-la.mccleary@ed.ac.uk

If you wish to make a complaint about the study please contact NHS Lothian: NHS Lothian Complaints Team, 2nd Floor, Waverley Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG phone: 0131 536 3370 or email: feedback@nhslothian.scot.nhs.uk

“I want to take part!”

Please complete the enclosed expression of interest form and return it in the stamped addressed envelope to Io Hui.

Thank you for taking the time to read this information sheet.
APP for Asthma – Invitation to help with asthma research

Dear xx,

We are writing to ask if you would be willing to take part in the above study that is being carried out by a PhD student at the Asthma UK Centre for Applied Research, University of Edinburgh. The [insert practice name] is helping with the research by writing to some people with asthma on their practice list.

The aim of this study is to develop an APP that will help people to look after their asthma. To do this, the researchers need people to try out the prototype APP and tell them what they think about it. They want to ask people about how they look after their asthma, and what features of an APP would make them want to download the APP and to use it regularly.

Please find enclosed:
- An information sheet that tells you about the study.
- A form that you can return to the research team if you think you might be interested to help with the study.
- A reply paid envelope for returning the form.

If you require any further information on the study or require help with filling in the form, please do not hesitate to contact Io Hui, the PhD student who is leading the study: Telephone: 01316503209 or email: io.hui@ed.ac.uk. Io can only answer questions about the study. If you have any concerns about your asthma, please contact the practice in the usual way.

Thank you very much for reading this letter.

Yours sincerely,
[Insert GP name(s)]
EXPRESSION OF INTEREST FORM [A4A—APP for asthma]

**About you**

Name: ___________________________________________

Age: ☐ 16-25  ☐ 26-45  ☐ 46-65  ☐ 65 or over

Gender: ☐ Female   ☐ Male

Contact telephone number: ______________________ (Best time to contact you: ____________)

Email address: __________________________

Preferred contact: ☐ Phone   ☐ email

**Eligibility check**

To be eligible to this study, you must have (Android 4.3.3+) smartphone/tablet or (iOS 7+) iPhone/ iPad

Are you a smartphone/ tablet/iPad user ?

☐ Yes (Please state: ☐ Android  ☐ Apple iOS)

☐ No

**About your asthma and past experience on APP, smartphone**

*Please tick the appropriate box below*

1. Have you been given written information ?
   ☐ Yes   ☐ No   ☐ No written information but I have been told what to do

2. Have you tried any healthcare APPs before?
   ☐ Yes, I am still using at least one of the healthcare APPs  ☐ Yes, but I am not using any of them
   ☐ No, I have never used any healthcare APPs

**Your preference**

*Please tick the appropriate box below*

☐ I am interested in using the APP and take part in two interviews

☐ I am interested in using the APP but do not want to take part in the interview

**Signature:** ___________________________  **Date:** ___________________________

Please complete the enclosed expression of interest form and return it in the stamped addressed envelope to Io Hui.
If you have any further questions about the study please contact

- Miss Io Hui (0131 650 3209; io.bui.ed.ac.uk)
- Dr. Hilary Pinnock (0131 650 8102; Hilary.Pinnock@ed.ac.uk).

Usher Institute of Population Health Sciences and Informatics,
The University of Edinburgh,
Medical School, Teviot Place,
Edinburgh EH8 9AG
United Kingdom

CONSENT FORM [A4A—APP for asthma]

Participant’s preferred contact (phone/email) ____________________________

1. I confirm I have read and understood the information sheet dated XXXXXX (version XX), for the above study and have had the opportunity to ask questions.

2. I consent to take part in interviews for the above study.

3. I understand that my participation is voluntary and I am free to withdraw at any time without giving any reason.

4. I understand that the interviews will be audio recorded.

5. I understand that all of the information about me recorded for this project will be anonymised (that is, my name will be removed) and will not affect my confidentiality in any way. If the results of the study are published it will not be possible to identify information about me.

6. I am willing for my anonymised data to be archived and made available for further research.

7. I understand that relevant sections of my data collected during the study may be looked at by individuals from the regulatory authorities and from the Sponsor(s) (NHS Lothian and the University of Edinburgh) or from the/other NHS Board(s) where it is relevant to my taking part in this research. I give permission for those individuals to have access to my records.

8. I give permission for my age and gender to be used in the analysis of the results.

9. I agree to take part in this study.

Name of Participant ____________________________ Date __/____/____ Signature ____________________________

Name of Person taking consent ____________________________ Date __/____/____ Signature ____________________________

[APP for asthma] Consent form version 1.0 — group A (08/03/2016)
This is an invitation to take part in a research study. Before you make a decision please read the following information carefully.

First we will explain the background to the study and how the study will be conducted. Then we will explain what will happen if you decide to take part.

Take time to consider if you would like to take part. It may be helpful to discuss with friends or family, or your GP, and if anything remains unclear please contact us directly (details on the back page).

Do you have (Android 4.3.3+) smartphone/tablet or (iOS 7+) iPhone/ iPad? If so, our asthma APP will work on your phone or tablet.
Why are we doing the study?

Understanding about your asthma and triggers, knowing how to manage day to day, and how to respond to worsening symptoms are important parts of living with asthma. It is known that being given a personalised action plan by your asthma nurse or GP leads to better day to day control of asthma symptoms, less time off work or school and also reduces the risk of an asthma attack. You can learn more about asthma action plans at:

https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/

In the past, asthma action plans have been written on paper, but nowadays many people have smart phones that they have with them most of the time. We want to develop an action plan in an APP which can be personalised by an asthma nurse or GP in the same way as paper plans, but will also enable users to record their symptoms in the ‘cloud’ so that it can be shared with a healthcare professional during a review. Our technology partner is uMotif.

We want to find out what features of an APP would make people with asthma want to download the APP and to use it regularly.

What is involved if I decide to take part? In this study, you will have a chance to use our APP and to tell us whether you think it is easy to use, what you like about it and what you think could be better. If you decide to take part:

• You will download the APP and use the activation code on the last page of this information sheet to get into the APP. We will ask you to fill in a short questionnaire before you start to use the APP. In the questionnaire, we will ask you about the features of the APP that made you decide to try it out, and which features you think will be useful so that you will go on using it.

• You can then use the APP for three months and (if you wish) leave any comments on our forum. We will collect information from the APP database about how often you use the APP.

• After three months, we will send you another short questionnaire, which will ask you what you think about the APP, which features you used, and what you didn’t find useful. We will ask whether your asthma nurse or GP helped you complete your action plan and whether you have found the plan useful.
Who will be leading this study? Miss Chi Yan Hui, Io will lead the study as part of her PhD research, supervised by Professor Hilary Pinnock, Professor Robert Walton and Professor Brian McKinstry.

Can I be sure that what I say will be kept confidential? Yes. Any information about you, and everything that you say will be kept strictly confidential. Your name and contact details will be kept securely at the University of Edinburgh.

What personally identifiable data will be sent/stored in the APP's (uMotif) server? The only personally identifiable data that will be sent/stored in the server are your email address and user name you provide.

What will happen to the results of the study? We will send you a summary of our findings at the end of the study. Findings will be posted on the AUKCAR website, presented at conferences and published in a journal.

Will taking part affect the treatment I receive for my asthma? No. Taking part, or deciding not to take part, in the study will not affect the care you receive from your practice, or the hospital.

What does the APP do? Using this app can help you track and understand your asthma and capture useful data to help you manage your asthma. It can store information about your asthma that you can share with your doctor or nurse. It includes an action plan which your doctor or nurse can help you fill in. Other features include quick links to the pollen count and pollution index, a medication reminder and links to the latest news about asthma research.

What doesn’t the APP do? The app does not recommend or advise you to do or change anything. If you have asthma symptoms it will suggest that you look at your action plan and follow instructions from your clinicians. The app does not provide you with a constant communications channel with your clinicians. Do not rely on the app in case of emergency or if your asthma is getting worse. If you have any concerns or issues with your health, you must contact your health professionals.

Will this app use up my data plan? The quantity of data used by the APP is very small and is unlikely to have a significant effect on your data plan.

There are no clinicians monitoring your asthma readings. You are responsible for getting advice or help if your asthma deteriorates.
Can I change my mind about taking part? Yes. You may change your mind at any time and don’t have to give a reason.

What are the benefits of taking part? Using the APP will help you to monitor your asthma, though taking part in this research may not benefit you personally. However, being involved in the study will help us to develop a better APP for asthma self-management.

Are there any risks if I decide to take part? No. Your treatment will not be affected: we are only asking for your opinions.

About funding and organisation? The study is part of a research programme for the Asthma UK Centre for Applied Research. The study is being funded by the Chief Scientist Office (Scotland) and has ethical approval from the South East Scotland REC 02 Ethics Committee.

I have some questions about the study: lo hui will be pleased to answer any questions. phone: 01316503209 or email: io.hui@ed.ac.uk

To speak with an independent researcher you can contact Dr Nicola McCleary, a researcher not part of the study team by: phone: 0131 650 2682 or email: nicola.mccleary@ed.ac.uk

If you wish to make a complaint about the study please contact NHS Lothian: NHS Lothian Complaints Team, 2nd Floor, Waverley Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG phone: 0131 536 3370 or email: feedback@nhslothian.scot.nhs.uk

“If you decide to take part, please follow the steps below ~

Step 1: Download the APP. Enter ‘uMotif’ in google play or apple app store.
Step 2: When you open the APP, click ‘Register using a code’ and then select ‘Europe’ for the region. Enter the activation code below.
Step 3: Follow the instructions in the APP to give us consent to monitor your APP’s usage data and to send you the short questionnaires.
Step 4: Sit back and enjoy !

Activation code: A4A-B

Thank you for taking the time to read this information sheet.
Do you have (Android 4.3.3+) smartphone/tablet or (iOS 7+) iPhone/ iPad? If so, our asthma APP will work on your phone or tablet.

This is an invitation to take part in a research study. Before you make a decision please read the following information carefully.

First we will explain the background to the study and how the study will be conducted. Then we will explain what will happen if you decide to take part.

Take time to consider if you would like to take part. It may be helpful to discuss with friends or family, or your GP, and if anything remains unclear please contact us directly (details on the back page).

To be eligible for this study, you must be living in the UK.

Queen Mary University of London

[APP for asthma] patient information sheet version 1.1—group C (01/06/2016)
Why are we doing the study?

Understanding about your asthma and triggers, knowing how to manage day to day, and how to respond to worsening symptoms are important parts of living with asthma. It is known that being given a personalized action plan by your asthma nurse or GP leads to better day to day control of asthma symptoms, less time off work or school and also reduces the risk of an asthma attack. You can learn more about asthma action plans at:

https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/

In the past, asthma action plans have been written on paper, but nowadays many people have smart phones that they have with them most of the time. We want to develop an action plan in an APP which can be personalized by an asthma nurse or GP in the same way as paper plans, but will also enable users to record their symptoms in the ‘cloud’ so that it can be shared with a healthcare professional during a review. Our technology partner is uMotif.

We want to find out what features of an APP would make people with asthma want to download the APP and to use it regularly.

What is involved if I decide to take part? In this study, you will have a chance to use our APP and to tell us whether you think it is easy to use, what you like about it and what you think could be better. If you decide to take part:

- You will download the APP and use the activation code in the last page of this information sheet to get into the APP. We will ask you to fill in a short questionnaire before you start to use the APP. In the questionnaire, we will ask you about the features of the APP that made you decide to try it out, and which features you think will be useful so that you will go on using it.

- You can then use the APP for three months, and (if you wish) leave any comments on our forum. We will collect information from the APP database about how often you use the APP.

- After three months, we will send you another short questionnaire, which will ask you what you think about the APP, which features you used, and what you didn’t find useful. If your asthma nurse or GP helped you complete the action plan, we will ask you if we can write to them to find out what they thought about the APP.
Who will be leading this study? Miss Chi Yan Hui, lo will lead the study as part of her PhD research, supervised by Professor Hilary Pinnock, Professor Robert Walton and Professor Brian McKinstry.

Can I be sure that what I say will be kept confidential? Yes. Any information about you, and everything that you say will be kept strictly confidential. Your name and contact details will be kept securely at the University of Edinburgh.

What personally identifiable data will be sent/stored in the APP’s (uMotif) server? The only personally identifiable data that will be sent/stored in the server are your email address and the username you provide.

What will happen to the results of the study? We will send you a summary of our findings at the end of the study. Findings will be posted on the AUKCAR website, presented at conferences and published in a journal.

Will taking part affect the treatment I receive for my asthma? No. Taking part, or deciding not to take part, in the study will not affect the care you receive from your practice, or the hospital.

What does the APP do? Using this app can help you track and understand your asthma and capture useful data to help you manage your asthma. It can store information about your asthma that you can share with your doctor or nurse. It includes an action plan which your doctor or nurse can help you fill in. Other features include quick links to the pollen count and pollution index, a medication reminder and links to the latest news about asthma research.

What doesn’t the APP do? The app does not recommend or advise you to do or change anything. If you have asthma symptoms it will suggest that you look at your action plan and follow the instructions from your clinicians. The app does not provide you with a constant communications channel with your clinicians. Do not rely on the app in case of emergency or if your asthma get worse. If you have any concerns or issues with your health, you must contact your health professionals.

Will this app use up my data plan? The quantity of data used by the APP is very small and is unlikely to have a significant effect on your data plan.

There are no clinicians monitoring your asthma reading. You are responsible for getting advice or help if your asthma deteriorates.
Can I change my mind about taking part? Yes. You may change your mind at any time and don’t have to give a reason.

What are the benefits of taking part? Using the APP will help you to monitor your asthma, though taking part in this research may not benefit you personally. However, being involved in the study will help us to develop a better APP for asthma self-management.

Are there any risks if I decide to take part? No. Your treatment will not be affected: we are only asking for your opinions.

About funding and organisation? The study is part of the research programme for the Asthma UK Centre for Applied Research. The study is being funded by the Chief Scientist Office (Scotland) and has ethical approval from the South East Scotland REC 02 Ethics Committee.

I have some questions about the study: Io hui will be pleased to answer any questions. phone: 01316503209 or email: io.hui@ed.ac.uk

To speak with an independent researcher you can contact Dr Nicola McCleary, a researcher not part of the study team by: phone: 0131 650 2682 or email: nicola.mccleary@ed.ac.uk

If you wish to make a complaint about the study please contact NHS Lothian: NHS Lothian Complaints Team, 2nd Floor, Waverley Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG phone: 0131 536 3370 or email: feedback@nhslothian.scot.nhs.uk

“"I want to take part!“

If you decide to take part, please follow the steps below:

Step 1: Download the APP. Enter ‘uMotif’ in google play or apple app store.

Step 2: When you open the APP, click ‘Register using a code‘ and then select ‘Europe‘ for the region. Enter the activation code below.

Step 3: Follow the instructions in the APP to give us consent to monitor your APPs usage data and to send you short questionnaires.

Step 4: Sit back and enjoy!

Activation code: A4A-C

Thank you for taking the time to read this information sheet.
This is an invitation for doctors, asthma nurses and administrative staff working in general practices to take part in an asthma research study.

Before you decide it is important for you to understand why the research is being done and what it will involve.

First we will explain the background to the study and how the study will be conducted. Then we will explain what will happen if you decide to take part. Please take your time to read the following information carefully and discuss it with others if you wish. If anything remains unclear please contact us directly.

Background to the study

We know that supported self-management is effective, yet it hasn’t been widely provided: less than 1 in 4 people who replied to an Asthma UK web survey owned an asthma action plan (For more information about this survey see http://www.asthma.org.uk/campaign-survey). The APP 4 asthma study is developing an APP with an asthma action plan and we want to find out what healthcare professionals and GP practices think about the APP and using it with their patients.

We know that general practice is very busy and any new initiative must fit in with the routines of practice and not make more work for busy professionals. Your opinions about what will make an APP useful in practice will help us to develop a practical and useful self-management APP for patient in the UK.

What is involved if I decide to take part? We would like to hear your views on how the APP influences (or not) the consultation and the organisational facilitators and barriers of introducing a new self-management APP to asthma patients in daily routine care.

You can participate in the study by giving us an short interview (face-to-face or by telephone). In the interview we will ask about the most useful features of the APP and how it helps (or hinders) the care you provide. Did any of the patients use or discuss the APP in a consultation? Generally we will only ask people for one interview, but it would be very helpful if we could interview the person most involved with asthma care (usually the asthma nurse) at the beginning and at the end of the project.

Who will be leading the discussion? Miss Chi Yan Hui, Io will lead the discussion, supervised by Professor Hilary Pinnock, Professor Robert Walton and Professor Brian McKinstry.
APP 4 Asthma—Invitation

Can I be sure that what I say will be kept confidential? Yes. Any information about you, and everything that you say will be kept strictly confidential. Your name and contact details will be kept securely at the University of Edinburgh. The interviews will be audio recorded and everything that you tell us will be written out and anonymised before we review and analyse our findings.

What will happen to the results of the study? We will send you a summary of our findings at the end of the study. Findings will be presented at conferences and published in a journal.

Can I change my mind about taking part? Yes. You may change your mind at anytime and don’t have to give a reason.

What are the benefits of taking part? Participation may be used as evidence of engagement in active clinical improvement programme, research and as part of practice development plans and educational activities. We will provide certificates for your continuing professional development portfolios.

Will our costs be covered? Yes. We will provide reimbursement in line with the Clinical Research Network reimbursement rate.

Will taking part effect my status at work? Taking part in this research is entirely voluntary and will not affect your professional standing within the practice. The interview will take about 30 mins.

About funding and organisation? The study is part of the research programme for the Asthma UK Centre for Applied Research. The study is being funded by the Chief Scientist Office (Scotland) and has ethical approval from the South East Scotland REC 02 Ethics Committee.

I have some questions about the study:

Io hui will be pleased to answer any questions. phone: 01316503209 or email: io.hui@ed.ac.uk

To speak with an independent researcher you can contact Dr Nicola McCleary, a researcher not part of the study team by phone: 0131 650 2682 or email: Nicola.mccleary@ed.ac.uk

If you wish to make a complaint about the study please contact NHS Lothian: NHS Lothian Complaints Team, 2nd Floor, Waverley Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG phone: 0131 536 3370 or email: feedback@nhslothian.scot.nhs.uk

“I want to take part!”

Please complete the enclosed expression of interest form and return it in the stamped addressed envelope to Io Hui.

Thank you for taking the time to read this information sheet.
EXPRESSION OF INTEREST FORM [A4A—APP for asthma]

If after reading the enclosed leaflet you decide that you are interested in helping with our study please complete this form which asks for some background information about you and your role in asthma care. We will use this information to ensure that we recruit people with different experiences of the healthcare services.

Contact information

Name ________________________________________________________________
Practice Name Address _______________________________________________
Contact telephone number: ___________________ (Best time to contact you: ________)
Email address: _______________________________________________________
Preferred contact: ☐ Phone ☐ Email ☐ Post

About your professional role

Which of these best describes your role within the practice?

☐ GP ☐ Asthma nurse ☐ Administrative ☐ Other: Please specify _______________

About your professional role

Please tick the box below if you want to take part

☐ I am interested in taking part in the interview

Signature: ___________________________________ Date: _________________

Please complete the enclosed expression of interest form and return it in the stamped addressed envelope to Io Hui.
If you have any further questions about the study please contact

- Miss Io Hui (0131 650 3209; io.hui.ed.ac.uk)
- Prof. Hilary Pinnock (0131 650 8102; Hilary.Pinnock@ed.ac.uk)
Usher Institute of Population Health Sciences and Informatics,
The University of Edinburgh,
Medical School, Teviot Place,
Edinburgh EH8 9AG
United Kingdom

CONSENT FORM [A4A—APP for asthma]

Participant’s preferred contact (phone/email) _________________________

1. I confirm I have read and understood the information sheet dated 08/03/2016 (version 1.0), for the above study and have had the opportunity to ask questions.

2. I consent to take part in interview(s) for the above study.

3. I understand that my participation is voluntary and I am free to withdraw at any time without giving any reason.

4. I understand that the interview(s) will be audio recorded.

5. I agree to take part in this study.

Name of Participant ____________________________________________ Date __/__/____ Signature ______________________

Name of Person taking consent ____________________________________________________________________________ Date __/__/____ Signature ______________________
A4A – APP for Asthma

What features do you want to see in a smartphone/tablet APP to support your self-management?
An observational study asking for patients’ opinions.

Would you like to help us develop an APP for people with asthma?

Try out the APP now!
DOWNLOAD

We are looking for people to try out a new APP and tell us what they think.

Are you eligible?
You are eligible to take part if you are:
• living in the UK
• 16 years or over
• diagnosed with asthma by your doctor
• are not under the care of a hospital clinic or have been admitted to hospital in the last 3 months for your asthma.

What we will ask for in the research?
We will send you two short questionnaires before and after you use the APP; it’s totally up to you to decide if you want to fill it in or not. We will also use your APP’s usage patterns to answer our research questions.

Are you ready to get started?
You’ll want to check the study details again before you decide.

Instructions

This work is funded by the Chief Scientist Office (Scotland) (AUKCAR/14/11).
This work is carried out with the support of the Asthma UK Centre for Applied Research (AUK-AC-2012-01).
A4A – APP for Asthma

What features do you want to see in a smartphone/tablet APP to support your self-management?
An observational study asking for patients' opinions.

Would you like to help us develop an APP for people with asthma?

Try out the APP now!

DOWNLOAD

I want to know more

We are looking for people to try out a new APP and tell us what they think.

Instructions for installing the APP

1. Want to have a try on this APP?
   - Go to the APP store, type 'uMotif' in the search box, Press 'Install'. (More details below)

2. Open the APP. Select 'Europe'.
   - Click 'Register an account'. Enter the Activation Code 'A4A-C'.

3. Fill in the eligibility questionnaires and give your consent in your data usage to our research.

4. That's it! Relax and use our APP!

Instructions for installing the APP on Android smartphone or tablet

- Please follow the following steps on your smartphone or tablet:
  1. If you haven't had a google account, add one on your device
  2. Touch the Google Play Store app icon (see the icon on the right screen)
  3. Type 'uMotif' in the search box
  4. Touch the 'uMotif' icon
  5. Touch 'Install'.
  6. Follow the onscreen instruction (press 'skip' for the account setup if don't want to)

Instructions for installing the APP on iPhone or iPad

- Please follow the following steps on your iPhone or iPad:
  1. Touch the App Store app icon (see the icon on the right screen)
  2. Type 'uMotif' in the search box
  3. If you are searching in iPad, make sure you have checked the 'iPhone only' option in the toolbar (at the top of the page)
  4. Touch the 'uMotif' icon
  5. Touch 'Install'.
  6. Follow the onscreen instruction

The app will be installed in your phone.

If you cannot install the app, please email A4A@umotif.com
A4A – APP for Asthma

What features do you want to see in a smartphone/tablet APP to support your self-management?
An observational study asking for patients’ opinions.

Would you like to help us develop an APP for people with asthma?

Try out the APP now!

DOWNLOAD

I want to know more

We are looking for people to try out a new APP and tell us what they think.

The people behind this research:

Miss Hui C. PhD student
Prof. Pincock H. Main Supervisor
Prof. Walton R. Second Supervisor
Prof. McKinstry B. Third Supervisor

*This work is funded by the Chief Scientist Office (Scotland) [AUKCAR/14/01].
This work is carried out with the support of the Asthma UK Centre for Applied Research [AUKCAR-2302-40].

http://www.aukcar.ac.uk/a4a-app-for-asthma/
A4A – APP for Asthma

What features do you want to see in a smartphone/tablet APP to support your self-management? An observational study asking for patients’ opinions.

Would you like to help us develop an APP for people with asthma?

Try out the APP now!

DOWNLOAD

I want to know more

We are looking for people to try out a new APP and tell us what they think.

The study Taking part Instructions People Contact Forum

We are happy to answer your questions about this study!

You can email us. We will get back to you as soon as possible. Thanks.

For technical questions about the APP: A4A@umotif.com

For questions about the research: hui.hui@ed.ac.uk / hilitary.pinnock@ed.ac.uk

(+44) 0131 650 3209/ (+44) 0131 650 8102

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Edinburgh, EH8 9AG

Usher Institute

This work is funded by the Chief Scientist Office (Scotland) (AUKCAR/11/1).
This work is carried out with the support of the Asthma UK Centre for Applied Research (AUKCAR/2012-01).
A4A – APP for Asthma

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We are looking for people to try out a new APP and tell us what they think.

The study  Taking part  Instructions  People  Contact  Forum

Anyone who is using the A4A app is welcome to post in this forum.
The forum is hosted on a separate site, ProBoards. You will need to register to post.

Visit the forum.

This work is funded by the Chief Scientist Office (Scotland) [AUKCAR/14/01].
This work is carried out with the support of the Asthma UK Centre for Applied Research [AUKAC2012-01].
Appendix 14 Online consent process
‘Use of APP’ on-line eligibility check and consent process for three different streams (A, B & C)

STREAM A:
Patients express interest in response to the invitation from their GP. Those purposively sampled for the interview study (stream A), will be contacted by the researcher (Io Hui), who will answer any questions about the study. If they are still interested in participating they will download the APP and enter the ‘Use of APP’ on-line eligibility check and consent process below. [Consent for the interviews will be taken on paper prior to the interview]

STREAM B:
Patients will be handed an information pack about the APP by their practice nurse during a consultation. If they are interested in participating they will download the APP and enter the ‘Use of APP” on-line eligibility check and consent process below.

STREAM C:
Patients finding the APP in the APP store, or on the Asthma UK Centre website, or told about the APP by friends or family may decide that they wish to participate. The website and description of the APP in the APP store will make it clear that the APP is only for use by people living in the UK. If they are interested in participating they will download the APP and enter the ‘Use of APP” on-line eligibility check and consent process below.

Online consent process:

- Patients will use their smartphone/tablet to download the uMotif APP from the APP store
- They will be prompted to enter the stream code to activate the APP. The stream code is a code to identify which stream they are in – for STREAM A participants, they will receive the code in our confirmation email; for STREAMS B, it is clearly printed on the last page of the patient information sheet; for STREAMS C, it is clearly shown online (project webpage, online patient information sheet and social forum).

Eligibility check
- The patient will be asked to confirm that they are living in the UK. Patients answering ‘yes’ will proceed to the next page.
- The patient will be asked to confirm their eligibility by responding to eligibility questions (Are you 16 years or over? Do you have asthma diagnosed by your doctor? Are you under the care of a hospital clinic or have been admitted to hospital in the last 3 months for your asthma). Patients answering ‘yes’ to the first 2 questions and ‘no’ to the last will progress to the next page.

Information check
- The patient will be invited to read the on-line version of the information sheet and check the box confirming that ‘I have read and understood the content of the information sheet’. This will allow them to progress to next page.
On-line consent

- The patients will be asked to complete the on-line consent form which gives their consent for the research team to extract data about their use of the APP over the three months of the study, collect and analyse any monitoring data that they submit during the three months, collect and analyse any comments they make on the APP forum, agree to us sending a link to an on-line questionnaire at the beginning and at the end of the three months. If they check all the boxes they will progress to the next page.

The following are the consent statements each of which the patient has to check:

1. I confirm that I have read and understand the information sheet (dated XX/XX/XX, version XXX) for the above study and have had the opportunity to consider the information and ask questions.
2. I understand that my participation is voluntary and I’m free to withdraw at any time without giving any reason.
3. I agree that my email address, user name and monitoring data may be sent/stored on the uMotif servers.
4. I give permission for the researchers to use my APP’s download & usage data, any feedback that I place on the forum, or questions I send to u-Motif, and to use my age and gender in the analysis of the results.
5. I agree to being sent a short questionnaire before and after I have used this APP for 3 months.
6. I understand that all of the information about me collected for this project will be anonymised (that is, my name will be removed) and will not affect my confidentiality in any way. If the results of the study are published it will not be possible to identify information about me.
7. I am willing for my anonymised data to be archived and made available for further research.
8. I give permission for my age and gender to be used in the analysis of the results.
9. I understand that no clinician is monitoring my asthma readings and that I am responsible for accessing healthcare advice if my asthma deteriorates.
10. I agree to take part in the above study

Registration and background information

- The patients will be asked to register a personal account for the APP. They will be asked to provide a user name, password and email, and agree to the uMotif terms and conditions to use the APP. If they fill in the information and check the box they will progress to the next page.

- The patient will be asked for some background information for data analysis: year of birth, gender, do they use regular preventer medication for their asthma, do they have a written PAAP, have they tried any healthcare APPs before.
The following is the background information which patient will be asked for.

‘Please may we have a contact e-mail address so that we can send you the results of our research?’

Email address: __________________

‘To help us to understand how the APP can help different people, it will be helpful if we learn a little bit about you!’

Age: 16-25 26-45 46-65 65 or over
Gender: Female Male

1. Have you been given written information by your GP or practice nurse about what to do if your breathing gets worse? (Yes/No/no written information but I have been told what to do)
2. Do you use regular preventer medication for your asthma? (Yes/No)
3. Have you tried any healthcare APPs before? (Yes, I am still using at least one of the healthcare APPs/Yes, but I am not using any of them/ No, I have never used any healthcare APPs); If yes, which are your favourite APPs?
4. Are you an Android smartphone/Android tablet/Apple iPhone/Apple iPad user? (Yes, Android smartphone/Yes, Android tablet/Yes, Apple iPhone/Yes, Apple iPad/No)
5. Do you have special needs on reading or using a smartphone? (Yes/No) If yes, yes, please state ______.
6. Where did you hear about our APP? (friend/webpage/social media/invitation letter from practices, please state the name of the practice: ____; asthma nurse during consultation, please state the name of the asthma nurse: ______/others, please state: ______)

Initial questionnaire
- The participant will be asked to fill in the initial questionnaire asking a) which features attracted them and made them decide to try out an APP for self-management, and b) which features do they think will encourage them to keep using the APP for their self-management. c) do they have any special needs on reading or use of smartphone?
Tutorial and start to use the APP

- The participants will receive a short tutorial to learn how to use the APP. After the tutorial, they will begin to use the APP.
Appendix 15 Topic guide for patients and practices in stream A
Details topic guide

- **Initial interview (within a few days of the patient downloading the APP).** The first interview will focus on the process of inputting personalised data into the action plan for the patient and will explore initial perceptions of the system and the perceived impact of using the APP in the consultation.

### Patient participant initial interview

**Open question**

- How was the download process? Were there any technical problems?
- Why did you decide to download the APP before the meeting?
- Why did you decide not to download the APP before the meeting?
- What triggered your interest in the APP?
- What made you decide to try out the APP?
- What would make you keep using the APP in the coming month?

### For asthma nurse (before)

**Open question**

- What do you think are the pros and cons of encouraging patients to use an APP?

### Follow-up interview (After using the APP for a month (patients) or towards the end of the practice involvement with the project (professionals)):** We will ask for feedback on the practicalities of using the APP and explore any impact this has had on consultations and delivery of self-management support. We will ask about perceptions of attractive and adherent features.

*Caveat: the topic guide will evolve iteratively as themes emerge with the initial interviews with asthma nurse and patients.*

### For patient participant (after)

**Open question**

- Are you still using the APP?
- What made you keep using it/stop using it?
- Do you use the APP regularly – how do you remember? What reminders do you use (or not)?
- Are there any technical problems that you experienced with the APP?

### For asthma nurse and other professionals (after)

**Open question**

- What do you think are the pros and cons of encouraging patients to use an APP?
- Which features would encourage you to introduce an APP into your routine practice?
Appendix 16 Pre study questionnaire
**Initial questionnaire (before use the APP)**

**A. There are many reasons why we might decide to try out an APP. Here are some reasons for deciding to try an APP. Please indicate whether you agree or disagree with them.**

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<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
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<td>1</td>
<td>I would download the APP if I had asthma symptoms and needed help to manage my asthma</td>
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<td>2</td>
<td>I would download the APP if it was recommended by my GP or asthma nurse during a consultation</td>
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<td>3</td>
<td>I would download the APP if it was recommended by my GP or asthma nurse in a letter</td>
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<td>4</td>
<td>I would download the APP if it was advertised by the NHS</td>
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<td>5</td>
<td>I would download the APP if it was recommended by friend or family member</td>
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<td>I would download the APP if it was recommended by people in a magazine, digital media such as YouTube or twitter or Facebook etc.</td>
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<td>7) I would download the APP if it was introduced for a research study and I want to help the research</td>
<td>Strongly disagree</td>
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<td>8) I would download the APP if it was free</td>
<td>Strongly disagree</td>
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<td>9) I would download the APP if it was recommended by the review or have a high star ranking in the apple app store or google play store</td>
<td>Strongly disagree</td>
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<td>10) I would download the APP if it had the functions that I need</td>
<td>Strongly disagree</td>
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<td>11) Other: please state ____________</td>
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**B. Please tell us what would you like to see in an APP to support your asthma management?**

There are lots of features that might be included in an asthma APP. Here are some features that have been used in asthma APPs. **Please indicate whether you agree or disagree with them.**

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<tbody>
<tr>
<td>1) I would like the APP to tell me about how to manage my asthma (e.g. how to use my inhaler, use of action plan, tips on managing my asthma etc.)</td>
<td>Strongly disagree</td>
<td>Disagree</td>
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<td>2) I would like the APP to have an electronic diary that allowed me to log my asthma symptoms or peak flow, medication use and when I had seen my doctor or nurse.</td>
<td>Strongly disagree</td>
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<td>3) I would like the APP to remind me to log my symptoms in the diary</td>
<td>Strongly disagree</td>
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<td>4) I would like the APP to warn me if my asthma was getting worse or if I was having an attack</td>
<td>Strongly disagree</td>
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<td>5) I would like the APP to show my symptoms scores and daily peak flow on a 3 colour graph (green, amber and red)</td>
<td>Strongly disagree</td>
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<td>Neutral</td>
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<td>6) I would like the APP to have an action plan that could tell me what to do if my asthma was getting worse.</td>
<td>Strongly disagree</td>
<td>Disagree</td>
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[APP for asthma] initial questionnaires version 1.0 (08/03/2016)
<table>
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<tr>
<th>Question</th>
<th>Strongly disagree</th>
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<td>7) I would like the APP to remind me to take my regular medication</td>
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<td>8) I would like to be able to order my repeat prescriptions using the APP</td>
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<td>9) I would like to share my APP dairy with my GP/asthma nurse</td>
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<td>10) I would like the APP to remind me when I am due to see my asthma nurse or GP for a routine review.</td>
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<td>11) I would like the APP to have a panic button to alert friend or healthcare expert who can get emergency help</td>
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<td>12) I would like the APP to show me the daily pollen count in my area</td>
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<td>13</td>
<td>I would like the APP to alert me when the pollen count in my area is high</td>
<td>Strongly disagree</td>
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<td>14</td>
<td>I would like the APP to remember when I had symptoms, cross reference with environmental factors and tell me about possible triggers for asthma</td>
<td>Strongly disagree</td>
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<td>15</td>
<td>I would like the APP to help me to relax such as providing stress free exercises or playing music</td>
<td>Strongly disagree</td>
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<td>16</td>
<td>I would like the APP to have some games about asthma (avatar or virtual pet or simple shooting game etc.)</td>
<td>Strongly disagree</td>
<td>Disagree</td>
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<td>17</td>
<td>I would like the APP to connect with my inhaler to log the number of dose I have taken and remind me when the medication is running out</td>
<td>Strongly disagree</td>
<td>Disagree</td>
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<td>18</td>
<td>I would like the APP to help me to achieve my activity goals as well as watching my asthma condition during sport</td>
<td>Strongly disagree</td>
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<td>19)</td>
<td>I would like the APP to help me watch my weight as well as my asthma condition</td>
<td>Strongly disagree</td>
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<td>20)</td>
<td>I would like the APP to help me to quit smoking as well as watching my asthma condition</td>
<td>Strongly disagree</td>
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C. Do you have any special needs on reading or use of smartphone?

- ○ No
- ○ Yes, please state: ____________________
- ○ Prefer not to say
Appendix 17 Post study questionnaire
After questionnaire (after use the APP for 3 months)

<table>
<thead>
<tr>
<th>Part A</th>
<th>There are many features in our app. We would like to know which ones you have used…</th>
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<tbody>
<tr>
<td>1)</td>
<td>Can you tell us how often do you use these features (s)?</td>
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<tr>
<td>a) Motif flower log (the 10 questions)</td>
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<td></td>
<td>Not regular, used it when needed</td>
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<td>b) Diary</td>
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<td>Not regular, used it when needed</td>
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<td>c) Health report</td>
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<td>d) Task reminder</td>
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<td>Not regular, used it when needed</td>
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</tr>
<tr>
<td>e) Mediation reminder</td>
<td>Never</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>f) Asthma action plan</td>
<td>Never</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>g) Information on asthma</td>
<td>Never</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>h) Lung function log</td>
<td>Never</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2) Are you still continuous to use this app?</td>
<td>Yes</td>
</tr>
<tr>
<td>2.1) (If yes) Please tell us what prompted you to this app. a) My asthma symptoms were troublesome and I needed help to manage my asthma</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>b)</strong> My GP or asthma nurse told me about this app during a consultation</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td><strong>c)</strong> I received a letter from my GP or asthma nurse which told me about this app</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td><strong>d)</strong> My friend or family member told me about this app</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td><strong>e)</strong> I read some information about this app on twitter or facebook</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td><strong>f)</strong> I want to help the research</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td><strong>g)</strong> The task reminder prompt me to use this app</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td><strong>h)</strong> The medication reminder prompt me to use this app</td>
<td>Strongly disagree</td>
</tr>
</tbody>
</table>
i) Anything else prompted you to use this app?  
Yes, please state ____________________  
No

2.1) (If yes, cont.) Please tell us what has motivated you to continue to use this app.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I think I can manage my asthma better by using the app</td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
</tr>
<tr>
<td>b) The health report and/or the lung function log helps me to show how well my asthma is controlled to the GP or nurse</td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
</tr>
<tr>
<td>c) I <strong>like</strong> some of the feature(s) of this app</td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
<td><img src="image" alt="Circle" /></td>
</tr>
</tbody>
</table>

(for all) Can you tell us which feature(s) you **like**? (tick all those apply)

- a) Motif flower log (the 10 questions)
- b) Diary
- c) Health report
- d) Task reminder
- e) Medication reminder
- f) Asthma action plan
- g) Information on asthma
- h) Lung function log
- i) None of these
d) I **need** some of the feature(s) of this app

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(For all) Can you tell us which feature(s) you **need** (tick all those apply)

- a) Motif flower log (the 10 questions)
- b) Diary
- c) Health report
- d) Task reminder
- e) Mediation reminder
- f) Asthma action plan
- g) Information on asthma
- h) Lung function log
- i) None of these

e) Anything else has motivated you to continuous use this app?

- Yes, please state ____________
- No

2.1) (If no) Please tell us why you have stopped using this app.

a) The app does not help me to manage my asthma

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) I **dislike** some of the feature(s) of this app

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(For all) Can you tell us which feature(s) you **dislike**? (tick all those apply)

- a) Motif flower log (the 10 questions)
- b) Diary
c) I **don’t need** some of the feature(s) of this app

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>〇</td>
<td>〇</td>
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<td>〇</td>
<td>〇</td>
</tr>
</tbody>
</table>

(If all) Can you tell us which feature(s) you **don’t need**? (tick all those apply)

- a) Motif flower log (the 10 questions)
- b) Diary
- c) Health report
- d) Task reminder
- e) Mediation reminder
- f) Asthma action plan
- g) Information on asthma
- h) Lung function log
- i) None of these

d) Anything else have stopped you using this app?

- Yes, please state ________________
- No

**Part B. Next, we would like to know if you used our app in your asthma reviews…**

1) Do you usually go to your annual review?

| a) Yes, every year on time |
| b) No, I never go to the annual consultation |
| c) Not regularly. Sometimes attend but sometimes not. |

1.1) (If ‘no’ or ‘not regularly’) Can you tell us why you don’t

<p>| a) The clinic/appointment times are not convenient |</p>
<table>
<thead>
<tr>
<th>2) Did you make an extra appointment with your practice because of this app?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>
| 2.1) (if ‘yes’) What were the reason(s) for the extra appointment? (Please check all appropriate) | a) I wanted to fill in the asthma action plan with the nurse.  
b) I wanted to discuss my asthma with nurse because filling in the app made me realise that my asthma control was not as good as it could be.  
c) Other: (Please state: ) |
| 3) Did you use or discuss this app in your annual review or extra appointment? | Yes | No |
| 3.1) (if ‘yes’) How did you use this app in the consultation? | a) I asked the nurse to complete the asthma action plan for me  
b) I used the health report to discuss about my asthma with the nurse  
c) I used the lung function log to discuss my asthma with the nurse  
d) Other: (Please state: ) |

**Part C. This is the last part; we would you know, overall, what do you think about this app after using it for 3 months...**

<table>
<thead>
<tr>
<th>1. Has the app made you think more about your asthma?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>
| 2. How well controlled is your asthma? | a) controlled  
b) mostly controlled |
3. Do you think this app can help you improve your asthma control?

<table>
<thead>
<tr>
<th>Option</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>c) poorly controlled</td>
<td>Yes (Please state why: ____________)</td>
</tr>
<tr>
<td>b) Poorly controlled</td>
<td>No (Please state why: ____________)</td>
</tr>
</tbody>
</table>

4. How long, do you think, you will go on using this app?

<table>
<thead>
<tr>
<th>Option</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have already stopped</td>
<td>Yes</td>
</tr>
<tr>
<td>Maybe a few weeks</td>
<td></td>
</tr>
<tr>
<td>Maybe a few months</td>
<td></td>
</tr>
<tr>
<td>Maybe a year or more</td>
<td></td>
</tr>
</tbody>
</table>

5. Are there other features that you would like us to add into this app?

<table>
<thead>
<tr>
<th>Option</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Please tell us what you would like included:</td>
</tr>
<tr>
<td></td>
<td>____________</td>
</tr>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

11. Do you have anything else that would like to tell us about this app?

<table>
<thead>
<tr>
<th>Option</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Please state: ____________</td>
</tr>
<tr>
<td>No</td>
<td></td>
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</tbody>
</table>
Appendix 18 Enquires or feedback from the app enquiry box/emails
#6126 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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</thead>
<tbody>
<tr>
<td>19 October 2016, 10:08 am</td>
<td>Web Service</td>
<td></td>
</tr>
</tbody>
</table>

**Status** | **Type** | **Priority** | **Group** | **Assignee**  
Closed | - | - | Support | uMotif Customer Service Agent

19 October 2016, 10:08 am  
It needs a peak flow diary so you can record morning and night so it does have to be done on paper!! You need to be able to enter personal best and then record morning and night with symptoms!! This would make this app fab!! It would just be a case of changing the petal for peak flow so you put an amount and it compares to your best!!

uMotif Customer Service Agent  19 October 2016, 5:52 pm

Hi

Thanks for using the uMotif app! There is the ability to record your peak flow using the "Lung Function" module in the side menu of the app (press the three white lines in the top left-hand corner of the app to access the menu).

If you don't think we've labelled it correctly as "Lung Function", please let us know what it should be called to let you find it more easily!

Thanks for tracking

Alistair  
Team uMotif

20 October 2016, 11:07 am

Thank you I've found it! Is it possible to export it to the iOS health app to see it graphed!! Or is that possible in the app! The only one I can find is the petal but that's not an actual reading. I need to able to see it graphed to see patterns in the reading!!

Thanks

Sent from my iPhone

uMotif Customer Service Agent  25 October 2016, 2:50 pm

Hi

Thanks for the clarification - we are working on the feature to link the data you're generating to Apple Health Kit - it's not available yet, but please watch this space as we hope to have it available in the next couple of months

Hope that this helps

Alistair  
Team uMotif
#6238 APP for Asthma feedback

Submitted: 28 October 2016, 10:00 am
Received via: Web Service
Requester: [Redacted]

<table>
<thead>
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<th>Status</th>
<th>Type</th>
<th>Priority</th>
<th>Group</th>
<th>Assignee</th>
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<tbody>
<tr>
<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

I don't smoke so can I remove the smoking icon it do I just ignore it?

uMotif Customer Service Agent 28 October 2016, 4:30 pm

Hi,

Thanks for getting in touch, the icon is fixed so please ignore it each time.

Many thanks

Team uMotif

Support Software by Zendesk
#6312 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 November 2016, 11:35 pm</td>
<td>Web Service</td>
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</table>

<table>
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<tr>
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<th>Assignee</th>
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<tbody>
<tr>
<td>Closed</td>
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<td>Support</td>
<td>uMotif Customer Service Agent</td>
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</tbody>
</table>

Submitted
2 November 2016, 11:35 pm

I like the concept of this app. It would be great to be able to share my asthma plan from this app with my husband in case of emergency. Is that possible please? At The moment he carries a tatty piece of paper!!

uMotif Customer Service Agent 3 November 2016, 11:02 am

Hi

Glad you're liking the app. There's no way to send the data from your asthma action plan directly to your husband (for data security issues with have to be ultra careful about how people can access their data).

If you wanted to, you can take a screenshot of the screen showing your data and send it to your husband though and he can keep it alongside this link to the Asthma UK website

https://www.asthma.org.uk/advice/manage-your-asthma/action-plan/

Hope that this helps and thank you for using uMotif!

Alistair
Team uMotif
#6340 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 November 2016</td>
<td>Web Service</td>
<td>[Redacted]</td>
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<th>Status</th>
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<tbody>
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<td>Closed</td>
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<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

4 November 2016, 10:26 am

The peak flow graph isn’t working. I am getting a blank screen.

**uMotif Customer Service Agent**  4 November 2016, 2:52 pm

Hi,

Thanks for getting in touch.

We’re fixing the issue, please give us a few hours and graphs should be back.

Regards

Team uMotif

**elanaoali**  4 November 2016, 4:24 pm

Thank you

Sent from Samsung tablet

-------- Original message --------

Support Software by Zendesk
#6343 APP for Asthma feedback

Submitted: 4 November 2016, 12:51 pm
Received via: Web Service
Requester: [Redacted]

Status: Closed
Type: Support
Priority: -
Group: Support
Assignee: uMotif Customer Service Agent

4 November 2016, 12:51 pm

I found it complicated to begin with. I didn't realise the motif info could all be submitted together so I found it time consuming. Now I understand how to use it, it's simple. I can't get the graphs in the health report bit to work as when I rotate my screen it just shows a blank, black screen.

uMotif Customer Service Agent 4 November 2016, 2:50 pm

Hi,

Thanks for the feedback, we're glad you've got used to it now.

Can I ask what would have made it clearer?

Also how did you discover that you could complete it in one go?

Regarding the graphs, which phone or tablet are you using?

Many thanks

Team uMotif 4 November 2016, 3:17 pm

Hi,

A note to say you can complete each section in one go would be helpful. I found out you could do that by playing around and accidentally discovered it.

I'm using a mini iPad 2. I've just checked again though and it's now working.

Thanks

Sara x

uMotif Customer Service Agent 4 November 2016, 4:22 pm

Great thanks, let us know if you need anything else.

Regards

Team uMotif

Support Software by Zendesk
#6358 APP for Asthma feedback

<table>
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<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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<tr>
<td>6 November 2016, 7:12 pm</td>
<td>Web Service</td>
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<table>
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<th>Status</th>
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<tr>
<td>Closed</td>
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<td>Support</td>
<td>uMotif Customer Service Agent</td>
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</tbody>
</table>

6 November 2016, 7:12 pm
The graph for the peak flow hasn't updated it since I started it. Please can you look thank you

uMotif Customer Service Agent 7 November 2016, 1:23 pm
Hi,
Thanks for getting in touch. Can you ensure you have refreshed the Health Report. Let me know how you get on?

Team uMotif

Support Software by Zendesk
#6411 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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</thead>
<tbody>
<tr>
<td>10 November 2016, 10:28 pm</td>
<td>Web Service</td>
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<tr>
<td>Closed</td>
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<td>Support</td>
<td>uMotif Customer Service Agent</td>
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</tbody>
</table>

I like the app, however the graphs don't really make sense as I don't understand what the numbers on the y-axis mean. I can see a trend, which is useful, but the data doesn't really mean anything. My asthmamd app graph has peak flow reading along the y-axis to make sense of the graph. I can't understand the other graphs either, for example on steroid use, it plots on the 5 line when I've had 0 steroids. I asked my Mathematician husband to have a look and he didn't think they made sense either.

**uMotif Customer Service Agent** 15 November 2016, 10:35 am

Hi

Many thanks for using the app and the feedback on the graphs.

The 1 - 5 numbers relate to the scores you entered on the motif Track Symptoms interface. 1 is the innermost setting on each petal, while a 5 is the outermost setting - this is often the positive expression of the symptom or score.

Does that help make more sense of the graphs?

Thanks

Bruce
Team uMotif

**Quirky** 16 November 2016, 10:31 am

Hi,

That makes sense now. Thank you. I do, however, prefer the graph on my asthmamd app which shows me my actual peak flow readings along the y-axis. Your graph is useful, but not as helpful as the asthmamd one for peak flow. I'd like to see the readings on the graph as well.

Thanks
Sara

**uMotif Customer Service Agent** 17 November 2016, 5:41 pm

Hi

Thanks for the feedback - it's noted about the peak flow graph and we'll work on this in the next version - thanks for using the app and again for the feedback!

Alistair
Team uMotif

**Quirky** 17 November 2016, 6:23 pm

Thank you. I'll keep using it.

Love
#6416 APP for Asthma feedback

Submitted | Received via | Requester
----------|--------------|-------------
11 November 2016, 1:01 am | Web Service | [Redacted]

<table>
<thead>
<tr>
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<th>Type</th>
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<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

11 November 2016, 1:01 am
Hi. Is it possible to correct a motif rather than just do another one please? If not, that would be a wonderful feature to add. Thanks

uMotif Customer Service Agent 11 November 2016, 11:52 am
Hi

Thanks for getting in touch.

You can review which days you have already entered data for by using the timeline at the bottom of the motif screen.

1) From the homescreen, press Track Symptoms
2) Press on the timeline at the bottom of the screen
3) Scroll down to see a list of days that data has been entered for
4) Press on a specific day to see a list of the motif segments scored
5) Press on a specific entry to either edit the score or delete it
6) Press close at the top of the screen to return to the motif

You can also watch a video on how to do this here: [https://vimeo.com/169733152/227fe5d8ff](https://vimeo.com/169733152/227fe5d8ff)

Hope that this helps

Team uMotif
### #6440 APP for Asthma feedback

<table>
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<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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<tbody>
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<td>14 November 2016, 10:49 pm</td>
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<tr>
<td>Closed</td>
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<td>Support</td>
<td>uMotif Customer Service Agent</td>
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</tbody>
</table>

When looking on the 'health report' tab, the scale of the y-axis on all of the graphs are incorrect. Also I can't find an option to scroll through the graph to look at different dates. It would also be useful to be able to plot actual peak flow as entered in the lung function tab, to see if there are any trends.

**uMotif Customer Service Agent** 17 November 2016, 4:59 pm

Hi

Thank you for the feedback! You can change the time period for the graph you're viewing using the dropdown menu.

Can you clarify when you say that the scale is incorrect, what is it that doesn't display correctly?

Thank you for the feedback on peak flow - we'll pass this onto the developers for consideration in our next version.

Keep tracking!

Alistair

Team uMotif

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**uMotif Customer Service Agent** 21 November 2016, 1:14 pm

Hi,

Thanks for getting back in touch.

You are correct that the values described on the Motif are being tracked as 1-5 on the graphs. The issues arises due to the questions asked via the Motif in this study which contain numerical values. We are showing all symptoms simply as 1-5 on the graphs which doesn't allow for specific answers to be shown. I appreciate this isn't very clear in this case.

We are working on ways to better show the information on the graphs.
Feedback from user really helps us shape the product going forward so thanks for getting in touch and being so clear.

If there is anything further we can help you with please let us know.

Regards

Team uMmoti

Support Software by Zendesk
#6583 APP for Asthma feedback

<table>
<thead>
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<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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</thead>
<tbody>
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<td>Web Service</td>
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<td>Closed</td>
<td></td>
<td></td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

The app assumes I own a peak flow meter. I do not!

**uMotif Customer Service Agent** 24 November 2016, 11:52 am

Hi

Thanks for taking part in the App for Asthma project and thank you for the feedback - please use all of the areas of the app that you're able to

Alistair
Team uMotif

Support Software by Zendesk
**#6871 APP for Asthma feedback**

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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</thead>
<tbody>
<tr>
<td>28 December 2016, 7:41 pm</td>
<td>Web Service</td>
<td></td>
</tr>
</tbody>
</table>

**Status**    **Type**    **Priority**    **Group**    **Assignee**
Closed        -          -          Support    uMotif Customer Service Agent

28 December 2016, 7:41 pm
Very good as you concentrate more on symptoms and lifestyle.

uMotif Customer Service Agent    31 December 2016, 9:02 am
Thanks, we really appreciate the positive feedback.
We'd appreciate a good review in Google Play Store or Apple Store please if you have time!
Keep Tracking!
Team uMotif

Support Software by Zendesk
After recording one motif how do I return to the Motif to do the next?

Hi,

Thanks for getting in touch.

You can complete all the segments and then save the Motif. You can then go back to the home screen and select 'Track Symptoms'.

There is more information on the Motif here: https://vimeo.com/169688857

I hope that helps.

Regards

Team uMotif

Thank you. I'll try that next time.

Sent from my iPad
#6910 APP for Asthma feedback

Submitted: 4 January 2017, 10:51 pm
Received via: Web Service
Requester: [Redacted]

Status | Type | Priority | Group | Assignee
--- | --- | --- | --- | ---
Closed | - | - | Support | uMotif Customer Service Agent

4 Jan, 10:51 pm

The obvious thing I found was your only going to get out of it, what you put in to it. So the more data you input the more helpful it will become. Would like the option to remove the smoking motif as I don't smoke, never have and never will.

uMotif Customer Service Agent 6 Jan, 10:41 am

Hi,

Thanks, we really appreciate the positive feedback.

The Asthma study team wanted to collect the same segments for each person hence smoking is fixed.

We'd appreciate a good review in Google Play Store or Apple Store please if you have time!

Keep Tracking!
Team uMotif

Support Software by Zendesk
#6914 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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<tbody>
<tr>
<td>5 January 2017, 6:29 pm</td>
<td>Web Service</td>
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<table>
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<tr>
<th>Status</th>
<th>Type</th>
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<tr>
<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

5 Jan, 6:29 pm
I like the app as it reminds me of the symptoms I take for granted.

uMotif Customer Service Agent 6 Jan, 10:47 am
Thanks, we really appreciate the positive feedback.
We'd appreciate a good review in Google Play Store or Apple Store please if you have time!

Keep Tracking!
Team uMotif

Support Software by Zendesk
#6917 APP for Asthma feedback

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<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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<tbody>
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<td>6 January 2017, 9:34 pm</td>
<td>Web Service</td>
<td>uMotif Customer Service Agent</td>
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<th>Type</th>
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<th>Group</th>
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<tr>
<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

6 Jan, 9:34 pm

Nothing to add.
#6982 APP for Asthma feedback

Submitted 12 January 2017, 9:35 pm  
Received via Web Service  
Requester [Redacted]

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<thead>
<tr>
<th>Status</th>
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<th>Priority</th>
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<tr>
<td>Closed</td>
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<td>Support</td>
<td>uMotif Customer Service Agent</td>
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</table>

It has and continues a great way of keeping an eye on my symptoms. This is the second year and winter of having moderate asthma after 10 years of mild asthma. Winter months are the worst time for my asthma.

uMotif Customer Service Agent 13 Jan, 11:52 am

Thanks, we really appreciate the positive feedback.

We'd appreciate a good review in Google Play Store or Apple Store please if you have time!

Keep Tracking!
Team uMotif

Support Software by Zendesk
#6997 APP for Asthma feedback

<table>
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<th>Submitted</th>
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<th>Requester</th>
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<tbody>
<tr>
<td>13 January 2017, 10:35 pm</td>
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<td>Closed</td>
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<td>Support</td>
<td>uMotif Customer Service Agent</td>
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</tbody>
</table>

Today is 13th Jan but the health report graphs only show up to the 8th. How can I see the rest?

**uMotif Customer Service Agent** 15 Jan, 3:09 pm

Hi,

Thanks for getting in touch.

Please press refresh to get the latest data.

Regards

Team uMotif
#7101 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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<tbody>
<tr>
<td>23 January 2017, 11:06 am</td>
<td>Web Service</td>
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</table>

**Status**  | **Type** | **Priority** | **Group** | **Assignee** |
---|---|---|---|---|
Closed | - | - | Support | uMotif Customer Service Agent |

The app is very good at pinpointing symptoms previously ignored as the norm.

**uMotif Customer Service Agent** 23 Jan, 4:03 pm

Thanks, we really appreciate the positive feedback.

We'd appreciate a good review in Google Play Store or Apple Store please if you have time!

Keep Tracking!

Team uMotif
#7151 APP for Asthma feedback

<table>
<thead>
<tr>
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<th>Received via</th>
<th>Requester</th>
</tr>
</thead>
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<th>Priority</th>
<th>Group</th>
<th>Assignee</th>
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<tbody>
<tr>
<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

**Submitted 26 Jan, 10:29 pm**

Hello Is there a way to show more than a week's results on the graphs?

**uMotif Customer Service Agent 27 Jan, 11:21 am**

Hi,

You can change the date range at the top of the report and press refresh.

Many thanks

Team uMotif

**27 Jan, 11:31 am**

Thanks for your help.

Sent from my iPad

Support Software by Zendesk
# #7250 APP for Asthma feedback

**Submitted** | **Received via** | **Requester**
--- | --- | ---
3 February 2017, 2:10 pm | Web Service | 

**Status** | **Type** | **Priority** | **Group** | **Assignee**
--- | --- | --- | --- | ---
Closed | - | - | Support | uMotif Customer Service Agent

3 Feb, 2:10 pm

I love the app. It helps me to record & stay on top of my symptoms. It allows me to set a reminder to take my inhaler. I can diarise my symptoms when I’m having a poor day with my asthma, which is useful to follow & track. I think it will be a fantastic resource for young (teenage) patients as it’s a “cool” way to manage asthma or other types of long-term ‘unseen’ conditions like diabetes, epilepsy, etc.

**uMotif Customer Service Agent** 5 Feb, 9:08 pm

Thanks, we really appreciate the positive feedback.

We’d appreciate a good review in Google Play Store or Apple Store please if you have time!

Keep Tracking!
Team uMotif

Support Software by Zendesk
#7266 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
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<tbody>
<tr>
<td>5 February 2017</td>
<td>Web Service</td>
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</tbody>
</table>

<table>
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<th>Priority</th>
<th>Group</th>
<th>Assignee</th>
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<tbody>
<tr>
<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

Hi,

Please get in touch with the study team at: io.hui@ed.ac.uk for more information.

Regards
Team uMotif

Support Software by Zendesk
#7675 APP for Asthma feedback

<table>
<thead>
<tr>
<th>Submitted</th>
<th>Received via</th>
<th>Requester</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 March 2017, 9:38 pm</td>
<td>Web Service</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status</th>
<th>Type</th>
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<th>Group</th>
<th>Assignee</th>
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</thead>
<tbody>
<tr>
<td>Closed</td>
<td>-</td>
<td>-</td>
<td>Support</td>
<td>uMotif Customer Service Agent</td>
</tr>
</tbody>
</table>

31 Mar, 9:38 pm
The graph would be more helpful if it showed actual values

uMotif Customer Service Agent  3 Apr, 9:09 am

Hi [Name],
Thanks for the feedback, we'll pass that onto our development team and they'll factor it in for future work.
Let me know if there is anything else we can do to help.

Thanks again,
Team uMotif
Team uMotif
#8209 APP for Asthma feedback

Submitted: 30 July 2017, 6:43 pm
Received via: Web Service
Requester: [Redacted]

CCs:
Io Hui <io.hui@ed.ac.uk>

Status: Solved
Type: -
Priority: -
Group: Support
Assignee: uMotif Customer Service Agent

30 Jul, 6:43 pm
I have been trying the app for several months now and am entering almost the same data each day. I don't refer to it at any other time so am considering stopping. I would welcome Io's comments as I will continue if it is helpful to her.
Joy Dunn

uMotif Customer Service Agent 31 Jul, 11:20 am

Hi
Thank you for getting in touch.
We have passed your query on to the study team.

Many thanks
Team uMotif

Io Hui 31 Jul, 12:07 pm
Thank you for forwarding the enquiry to me. I have made a reply to the patient.

Best wishes,
C.Y. HUI, Io
Usher Institute of Population Health Sciences and Informatics
Asthma UK Centre for Applied Research
The University of Edinburgh
Rm 815, Doorway 1
Old Medical School
Teviot Place
Edinburgh
United Kingdom
EH8 9AG
Email: io.hui@ed.ac.uk
Cc: HUI Chi yan <lo.Hui@ed.ac.uk>
Subject: [uMotif] Update: APP for Asthma feedback
Some patient participants provided feedback or asked questions via email. The emails were recorded below.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Additional comment from stream A, patient A7</th>
</tr>
</thead>
<tbody>
<tr>
<td>A7</td>
<td>My last comments on the Motif - if you are interested. I decided to fill in the Motif weekly rather than daily. There are parts of the wheel which ask question for the week and some ask questions for each day. I think the wheel needs to be consistent or be more flexible. Not sure how I would go about this - perhaps there should be two wheels?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th>Follow up question to stream A, patient A12 (this is a follow up question in the reply email to patient A12. Patient A12 emailed me to explain she did not want to attend the post study interview.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A12</td>
<td>Hi, Option a and I've not seen any ad by NHS for an app.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th>Additional comment from stream C participant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C9</td>
<td>Have just completed the questionnaire for the A4A app. Just one quick follow up, the questions regarding using the app at my annual asthma review of course I would be doing this at my next review in December. Would like the option to be able to print it off though as a .pdf perhaps to show, rather then have to show from my smartphone. If there was a way for the app to send the health report as an email with an attachment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th>Additional comment from stream C participant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C9</td>
<td>Will carry on using the app until no longer able. If you could send me the logged data once the app stops that would be awesome. As I sure it would be useful for reference. I am sure I logged symptoms of chest tightness, coughs, sneezing and a reduced peak flow reading for the start of the year. In .pdf format would be great. If your planning on launching a second version of the app I would indeed be very interested in trying it out.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th>Additional comment from stream C participant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C9</td>
<td>(No) thank you for coming up with the asthma app as a way of logging data in a simple but informative way. Then to have the data conveniently on mobile phone in a pocket, so never far from our asthma action plans, medication reminders etc. Receiving the data via email is fine. Look forward to hearing more about version two of the app in the future.</td>
</tr>
<tr>
<td>Participants</td>
<td>Enquiry emails about setup</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>A4</td>
<td>I'm using my iPad mini 4 and clicked on &quot;App Store&quot; I entered [name] in the search bar and got a message saying &quot;No results for [name] so I don't know what to do next or what I have done wrongly.</td>
</tr>
</tbody>
</table>
| A7           | Problem with App -  
Wants me to buy the APP initially - not sure this is correct.  
Phone is an Android - v6, Motorola G - 3rd Generation  
(after reply with step by step answer)  
It now tells me I do not have enough space. But will keep trying.  
Success!!!!!! Had to delete an App or 2. At least it is installed but not sure whether registration is complete or not. |
| B1 (swapped to B) | I was just wondering if it was possible to turn off the notifications on my phone for the app? It makes my phone bleep at least once or twice a day and its driving me mad! If it can't be changed I might have to ask to come off the study as I don't like my phone making noise for each reminder, I don't have any other apps I use set up to make noise for notifications so it's a bit frustrating. |
Some patient participants provided free text feedback in the final questionnaires. Their comments were recorded below.

**Initial questionnaire:**

<table>
<thead>
<tr>
<th>Participants</th>
<th>Other reason(s) to download the prototype app, please type here.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Good way of tracking asthma over longer period of time - see history</td>
</tr>
<tr>
<td>C2</td>
<td>To help monitor my asthma and the asthma my 4 year old son has</td>
</tr>
<tr>
<td>C3</td>
<td>To see if it helps manage my asthma</td>
</tr>
<tr>
<td>C4</td>
<td>I would download it if asthma uk charity promoted it-in fact, I heard sboutcitcin their forum.</td>
</tr>
<tr>
<td>C5</td>
<td>To help record my symptoms which might help me see a pattern to any exacerbations. This would help me manage my condition. Having accurate records which are easy to complete would also help me make the most of consultations with my asthma nurse and GP.</td>
</tr>
<tr>
<td>C6</td>
<td>Handy</td>
</tr>
<tr>
<td>C7</td>
<td>If it would help me to monitor my symptoms.</td>
</tr>
<tr>
<td>C8</td>
<td>To measure my asthma for my own benefit, I like the data</td>
</tr>
<tr>
<td>A7</td>
<td>A: Curiosity</td>
</tr>
<tr>
<td>A12</td>
<td>A: Mainly to help with research into asthma.</td>
</tr>
<tr>
<td>A15</td>
<td>A: if it guaranteed to reduce severity of symptoms</td>
</tr>
<tr>
<td>Participants</td>
<td>Do you think this app can help you improve your asthma control? (1: Yes; 0: No)</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>C10</td>
<td>1 Makes me make an effort to keep checking what my peak flow is doing</td>
</tr>
<tr>
<td>C11</td>
<td>1 Really good for monitoring day to day symptoms and keeping an eye on how much reliever inhaler I'm taking</td>
</tr>
<tr>
<td>C9</td>
<td>1 It can help me track change</td>
</tr>
<tr>
<td>C12</td>
<td>1 Made me more aware of symptoms and identifying when I was going downhill</td>
</tr>
<tr>
<td>C13</td>
<td>1 Recognise quicker when I need to seek medical help</td>
</tr>
<tr>
<td>C14</td>
<td>0 I manage my asthma and symptoms well</td>
</tr>
<tr>
<td>A8</td>
<td>1 Medicine reminder, keeping records</td>
</tr>
<tr>
<td>A4</td>
<td>0 My asthma is generally mild and well controlled. I think I know the triggers - exercise and being out in the wind</td>
</tr>
<tr>
<td>C14</td>
<td>1 Medication reminder</td>
</tr>
<tr>
<td>C15</td>
<td>0 It doesn't actually help me keep track of my asthma any more than I already do</td>
</tr>
<tr>
<td>C16</td>
<td>0 I have a good understanding of it and know what to do and when</td>
</tr>
<tr>
<td>C17</td>
<td>0 I am good at managing it anyway but the app is useful tool in recording information</td>
</tr>
<tr>
<td>C18</td>
<td>1 It is a good reminder when things are not controlled to think about all aspects of my daily life</td>
</tr>
<tr>
<td>C19</td>
<td>0 Already well controlled</td>
</tr>
<tr>
<td>C20</td>
<td>1 It is very clear from the motif when you are having issues, easy to identify and deal with triggers. Able to use the health review to look at patterns as well.</td>
</tr>
<tr>
<td>C21</td>
<td>1 It's a handy way to record symptoms and note triggers so you can spot patterns and take</td>
</tr>
<tr>
<td>User</td>
<td>Interaction</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>C22</td>
<td>1</td>
</tr>
<tr>
<td>C23</td>
<td>1</td>
</tr>
<tr>
<td>C24</td>
<td>0</td>
</tr>
<tr>
<td>C25</td>
<td>1</td>
</tr>
<tr>
<td>C26</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix 19 A4A discussion forum
Hi A4A participants,

A warm welcome to our discussion forum especially for all the users of our App for Asthma (A4A). I apologise for all the inconvenience caused by the move of our forum from the AUKCAR website in the week of 18Nov 2016. This move was due to the spam attack that we experienced in the first month after launch. We hope this forum, with login registration, could prevent the spam attack from happening again and we hope you to post your thoughts about using an app for asthma self-management or something you would like to see improve about our app. We will take your views into our research data but you will not be identified in any of our reports or publications. Your username will be anonymous. If you have any concerns, please contact me (Io Hui) at io.hui@ed.ac.uk.

Thanks.

Io Hui (admin of this forum and the PhD student of the A4A study)

---

Thoughts76, New Member

Jan 23, 2017 at 02:39pm via

Saw this and it's brilliant! I can record my medicines and create my asthma action plan there, as well as diarise my symptoms.

What an absolutely fantastic idea to have an app for asthma management! I am so impressed I had to sign up to participate in the study. Brilliant for asthma patients like me, but more importantly I do not say the app is brilliant just lightly. My background is as a Connexions Personal Adviser & Careers Adviser working mostly with 13-19 year olds & my sister (now 29) was diagnosed type 1 diabetic aged 5 an app for health management is a fantastic way to reach young people on their own level & an equal footing as they understand this technology better than we did. I now work as Postgraduate Admissions staff at a university, so I also understand the benefit of research & the work that goes in. Just a brilliant research topic & proud to participate.

---

Administrator

Jan 12, 2017 at 7:24pm

Thanks for leaving your thoughts here.

Well A4A users in this forum.
We welcome any thoughts from you about our app and/or this study - positive, neutral, negative are all welcome!

Thanks,

Io Hui (admin of this forum and the PhD student of the A4A study)
Appendix 20 Advertisements/feedback from Facebook and Twitter
1. **Advertisements on the AUKCAR twitter (6th, 7th and 10th October, 2016):** By clicking the links on those advertisements, patients were redirected to my project webpage for download information.

   ![AUKCAR tweet 1](image1)

   ![AUKCAR tweet 2](image2)

   ![AUKCAR tweet 3](image3)

2. **Advertisement on the Asthma UK twitters (28th October, 2016):** By clicking the links on the advertisements, patients were redirected to the Asthma UK webpage for further information.

   ![Asthma UK tweet](image4)
3. Advertisement and comments on the Asthma UK facebook (28th October, 2016): By clicking the links on the advertisements, patients were redirected to the Asthma UK webpage for further information.
4. Advertisement on the Asthma UK website (28th October, 2016): By clicking the links on the advertisements, patients were redirected to my project website for download information.

**Asthma UK website**

**Lay study title:** A4A – APP for Asthma: an observational study asking for patients opinions on the features that they want to see in a smartphone/tablet APP to support their self-management

**Institution:** The study is part of a research programme for the Asthma UK Centre for Applied Research. The work is being carried out as the collaboration between the University of Edinburgh and the Queen Mary University of London and is funded by the Chief Scientist Office (Scotland).

**About the study:** Supported self-management incorporating a Personal Asthma Action Plan (PAAP) helps people control their asthma themselves. They can adjust their treatment when their symptoms change, so they have fewer attacks. However, few people have a PAAP because for many reasons, routine asthma self-management isn’t always offered during routine care. Also, the traditional paper-based PAAPs in use just now have limitations – people may not have a paper plan with them when they need it and they are too clinically-focussed so cannot address the wider challenges of living with asthma. We think modern smart technology can help. We aim to develop an app for smartphones/tablets/laptops as part of an integrated system of care. This will give people a PAAP which will also offer wider non-clinical help too. Producing an app that is attractive, that people to continue to use and meets the needs of patients are central to the design of our APP.

**When will this study be recruiting?** 03 October, 2016 to 03 January, 2017

**What will participants be asked to do?** Visit our project website at *(bit.ly link to our webpage)* and follow the instruction to download the APP in the APP’s market. Before and at the end of the study (after 3 months usage), we will send you a short questionnaire for your opinion.

**Who can take part?** Anyone who is living in the UK, is 16 year or over, has been diagnosed with asthma by their doctor; is not under the care of a hospital clinic or been admitted to hospital in the last 3 months for asthma are welcomed.

**Who is conducting the research?** Miss Chi Yan Hui, Io will lead the study as part of her PhD research, supervised by Dr. Hilary Pinnock, Professor Brian McKinstry in the University of Edinburgh and Professor Robert Walton in the London Queen Mary University.

**Who has reviewed the study?** The study has been reviewed by the South East Scotland Research Ethics Committee.

**How will the study benefit people with asthma?** Using the APP will help you to monitor your asthma, though taking part in this research may not benefit you personally. However being involved in the study will help us to develop a better APP for asthma self-management.

**Expenses:** The APP is free of charge in the APP’s market; The APP will backup data in the cloud database, however, the quantity of data used by the APP is very small and is unlikely to have a significant effect on your data plan.

**What next / who to contact:** If you are interested in taking part, please go to our project website for the download instruction: *(bit.ly link to our webpage)*

Any question about the study, please contact Io Hui T: 01316503209 or E: iohui@ed.ac.uk
5. **Advertisement on the AUKCAR website slider (6th October, 2016):** By clicking the links on the advertisements, patients were redirected to my project website for download information.

![Advertisement on the AUKCAR website slider](image)

6. **Advertisement on the AUKCAR PhD page (6th October, 2016):** By clicking the links on the advertisements, patients were redirected to my project website for download information.

<table>
<thead>
<tr>
<th>PhD projects</th>
<th>PhD student</th>
<th>Institution</th>
<th>Funder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing, refining and piloting an integrated IT application to support asthma self-management</td>
<td>Io Hui</td>
<td>University of Edinburgh</td>
<td>Chief Scientist Office</td>
</tr>
<tr>
<td>Project website – download the APP here: APP for Asthma</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Advertisement on the AUKCAR news page (6th October, 2016): By clicking the links on the advertisement, patients were redirected to my project website for download information.

PhD student Io Hui has first paper published

2 October 2016

Congratulations to AUKCAR PhD student Io Hui who has her first paper published in the Journal of the American Medical Informatics Association.

Io and her colleagues have carried out a systematic review on the use of mobile technology to support self-management for asthma sufferers. There are some indications that there are health benefits to be had in this area but the conclusion is that further studies are needed.

Read more about Io on her profile

Io’s PhD project – developing an APP for asthma

Following on from the review, Io and the team are working on developing a new smartphone application, including the incorporation of a Personal Asthma Action Plan (PAAP), to further enhance and improve technological support of self-management and to evaluate the benefits.

Io and the research team are currently recruiting for volunteers to try out a preliminary version of their new app. This is a great opportunity to feedback what you would like to see in a mobile app. Tell us what features can help you manage your asthma and improve your quality of life.

For more information and to download the app go to: www.auskar.ac.uk/ida-app-for-asthma/

Full paper

The use of mobile applications to support self-management for people with asthma: a systematic review of controlled studies to identify features associated with clinical effectiveness and adherence

Io Yon Hui, Robert Walton, Brian McKiernan, Tracy Jackson, Richard Parker, Irina Pinnock

Appendix 21 Practices’ feedback on memo
Appendix 22 Coding summary
## Coding summary in NVivo

<table>
<thead>
<tr>
<th>Theme (patients)</th>
<th>Nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>About the app</td>
<td>General feedback</td>
</tr>
<tr>
<td></td>
<td>Aware of asthma</td>
</tr>
<tr>
<td></td>
<td>Perceived reasons for sustained use of the app</td>
</tr>
<tr>
<td></td>
<td>Perceived health benefits</td>
</tr>
<tr>
<td>Adoption</td>
<td>Trigger</td>
</tr>
<tr>
<td></td>
<td>Positive motivation</td>
</tr>
<tr>
<td></td>
<td>Negative motivation</td>
</tr>
<tr>
<td></td>
<td>Ability</td>
</tr>
<tr>
<td>Adherence</td>
<td>Trigger</td>
</tr>
<tr>
<td></td>
<td>Position motivation</td>
</tr>
<tr>
<td></td>
<td>Negative motivation</td>
</tr>
<tr>
<td></td>
<td>Reasons for keep using the app</td>
</tr>
<tr>
<td>Difficulties</td>
<td>Age</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
</tr>
<tr>
<td></td>
<td>Technical supports</td>
</tr>
<tr>
<td></td>
<td>About the designs of the apps</td>
</tr>
<tr>
<td>Application features</td>
<td>Action plan</td>
</tr>
<tr>
<td></td>
<td>Asthma data links to every day's weather, exercises, diet and smoking</td>
</tr>
<tr>
<td></td>
<td>Communication with GP</td>
</tr>
<tr>
<td></td>
<td>Crowd sourcing asthma data</td>
</tr>
<tr>
<td></td>
<td>Customisation</td>
</tr>
<tr>
<td></td>
<td>Data logging (peak flow and medication)</td>
</tr>
<tr>
<td></td>
<td>Data storage options</td>
</tr>
<tr>
<td></td>
<td>Diary</td>
</tr>
<tr>
<td></td>
<td>Digital inhaler</td>
</tr>
<tr>
<td></td>
<td>Font size</td>
</tr>
<tr>
<td></td>
<td>Gadget to monitor asthma</td>
</tr>
<tr>
<td></td>
<td>Game elements</td>
</tr>
<tr>
<td></td>
<td>Home interface</td>
</tr>
<tr>
<td></td>
<td>Implementing features for other long term conditions</td>
</tr>
<tr>
<td></td>
<td>Information about the environment trigger</td>
</tr>
<tr>
<td></td>
<td>Learning about triggers and how to affect their asthma</td>
</tr>
<tr>
<td></td>
<td>Low medication reminder</td>
</tr>
<tr>
<td></td>
<td>Map asthma attacks over exercises</td>
</tr>
<tr>
<td></td>
<td>Music and stress free exercises</td>
</tr>
<tr>
<td></td>
<td>Overdose ordering alert</td>
</tr>
<tr>
<td></td>
<td>Panic button</td>
</tr>
<tr>
<td></td>
<td>Privacy</td>
</tr>
<tr>
<td></td>
<td>Repeat prescription ordering</td>
</tr>
<tr>
<td></td>
<td>Smoking cessation</td>
</tr>
<tr>
<td></td>
<td>Training and learning of the app</td>
</tr>
<tr>
<td></td>
<td>Transmission of monitoring logs</td>
</tr>
<tr>
<td></td>
<td>Video and interacting education elements</td>
</tr>
<tr>
<td></td>
<td>Virtual doctor for diagnosis</td>
</tr>
<tr>
<td></td>
<td>Weight loss and exercise supports</td>
</tr>
</tbody>
</table>

| How did the patient fill in the action plan on app | Asking their son or daughter to fill in |
|                                                    | Filling in the plan by themselves |
|                                                    | Filling in the plan with their asthma nurse |

<p>| Self-managing asthma | Communication with GP |
|                      | Extra consultation needs because of the app |
|                      | Looking at their asthma when symptoms is back |
|                      | The learning stage of self-managing |
|                      | Use of action plan (before and after the study) |
|                      | Use of inhaler |
|                      | Views on log peak flow (before and after the study) |
|                      | Views to attend regular consultation, appointment booking system, role of asthma nurses in patients’ management journey, the groups of patient who may get the most benefits from the app |</p>
<table>
<thead>
<tr>
<th>Theme (Healthcare professionals)</th>
<th>Nodes</th>
</tr>
</thead>
</table>
| The advantages to patients of using an app to support their self-management | Avoid loss of action plan  
Encouraging adherence to medication  
Encouraging better knowledge of their own plan  
Encouraging patient to monitor their condition in daily  
Encouraging prompt communication to nurse or GP when asthma get worse  
Encouraging self-management  
Free up nurse for unnecessary appointments  
Good for young people  
Keep the healthcare services up to date to the emerging technology  
Providing easy way to access advice from healthcare professionals  
Reducing works related to the repeat prescription  
Reminding patient to order medication  
This is the future way of medication |
| The disadvantages to patients of using an app to support their self-management | App may not able to check patient inhaler technique  
Data accuracy/ mismatch data between the app and healthcare database  
Data backup  
Data confidential  
Difficult/ extra time to explain the app to patient  
Encouraging adherence to the app is difficult  
Extra works for patients to log their asthma  
IT barriers in the practices  
Languages supports to patients from different countries  
More difficult for elderly  
Not suitable for patient without smartphone/ not familiar with app  
Patient may get bored with the app  
The battery and WiFi coverage are the problems to maintain the app service  
Worry about the impacts in consultation |
| Application features | Action plan  
Appointment reminder  
Data logging (peak flow)  
Data transfer from app to healthcare database  
Diary  
Health report  
Information about asthma  
Inhaler technique checker  
Inhaler video  
Monitoring data and give advice  
Panic button  
Regular consultation  
Social media |
Appendix 23 CASP checklist
CASP Checklist: 10 questions to help you make sense of a Qualitative research

How to use this appraisal tool: Three broad issues need to be considered when appraising a qualitative study:

1. Are the results of the study valid? (Section A)
2. What are the results? (Section B)
3. Will the results help locally? (Section C)

The 10 questions on the following pages are designed to help you think about these issues systematically. The first two questions are screening questions and can be answered quickly. If the answer to both is “yes”, it is worth proceeding with the remaining questions. There is some degree of overlap between the questions, you are asked to record a “yes”, “no” or “can’t tell” to most of the questions. A number of italicised prompts are given after each question. These are designed to remind you why the question is important. Record your reasons for your answers in the spaces provided.

About: These checklists were designed to be used as educational pedagogic tools, as part of a workshop setting, therefore we do not suggest a scoring system. The core CASP checklists (randomised controlled trial & systematic review) were based on JAMA 'Users’ guides to the medical literature 1994 (adapted from Guyatt GH, Sackett DL, and Cook DJ), and piloted with health care practitioners.

For each new checklist, a group of experts were assembled to develop and pilot the checklist and the workshop format with which it would be used. Over the years overall adjustments have been made to the format, but a recent survey of checklist users reiterated that the basic format continues to be useful and appropriate.

Referencing: we recommend using the Harvard style citation, i.e.: Critical Appraisal Skills Programme (2018). CASP (insert name of checklist i.e. Qualitative) Checklist. [online] Available at: URL. Accessed: Date Accessed.

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Section A: Are the results valid?

1. Was there a clear statement of the aims of the research?
   - Yes
   - Can’t Tell
   - No
   **HINT:** Consider
   • what was the goal of the research
   • why it was thought important
   • its relevance

   **Comments:** The aim is to identify the adoptive and adherent features that influence patient engagement with asthma self-management. Details reported in section 8.1.3.

2. Is a qualitative methodology appropriate?
   - Yes
   - Can’t Tell
   - No
   **HINT:** Consider
   • if the research seeks to interpret or illuminate the actions and/or subjective experiences of research participants
   • is qualitative research the tight methodology for addressing the research goal

   **Comments:** Details reported in section 7.4

Is it worth continuing?

3. Was the research design appropriate to address the aims of the research?
   - Yes
   - Can’t Tell
   - No
   **HINT:** Consider
   • if the researcher has justified the research design (e.g. have they discussed how they decided which method to use)

   **Comments:** The method and justification are discussed in details (see section 7.4.).
4. Was the recruitment strategy appropriate to the aims of the research?

Yes  
Can’t Tell  
No

HINT: Consider
• If the researcher has explained how the participants were selected
• If they explained why the participants they selected were the most appropriate to provide access to the type of knowledge sought by the study
• If there are any discussions around recruitment (e.g. why some people chose not to take part)

Comments: The reasons, the recruitment methods and discussions are in section 7.4.2.

5. Was the data collected in a way that addressed the research issue?

Yes  
Can’t Tell  
No

HINT: Consider
• If the setting for the data collection was justified
• If it is clear how data were collected (e.g. focus group, semi-structured interview etc.)
• If the researcher has justified the methods chosen
• If the researcher has made the methods explicit (e.g. for interview method, is there an indication of how interviews are conducted, or did they use a topic guide)
• If methods were modified during the study. If so, has the researcher explained how and why
• If the form of data is clear (e.g. tape recordings, video material, notes etc.)
• If the researcher has discussed saturation of data

Comments: Section 8.1.10 explained how to collect data and give justification to the data collected. Individual interview was used in the study. It is explained and justified in section 7.4.1. Section 8.1.10 indicated how the interview was conducted, how to formulate the topic guide and the form of data to be collected. Section 7.4.3 discuss about the data saturation.
6. Has the relationship between researcher and participants been adequately considered?

HINT: Consider
- If the researcher critically examined their own role, potential bias and influence during (a) formulation of the research questions (b) data collection, including sample recruitment and choice of location
- How the researcher responded to events during the study and whether they considered the implications of any changes in the research design

Comments: "Reflexivity" in section 7.4.3. critically examine my own role, potential bias and influence. There were no special events or changes in the study.

Section B: What are the results?

7. Have ethical issues been taken into consideration?

HINT: Consider
- If there are sufficient details of how the research was explained to participants for the reader to assess whether ethical standards were maintained
- If the researcher has discussed issues raised by the study (e.g. issues around informed consent or confidentiality or how they have handled the effects of the study on the participants during and after the study)
- If approval has been sought from the ethics committee

Comments: Section 8.1.9 provide details about consent to interviews. 8.1.1 lists the ethics approval obtained from the ethics committee.
8. Was the data analysis sufficiently rigorous?  

- Yes  
- Can’t Tell  
- No  

HINT: Consider:  
- If there is an in-depth description of the analysis process  
- If thematic analysis is used. If so, is it clear how the categories/themes were derived from the data  
- Whether the researcher explains how the data presented were selected from the original sample to demonstrate the analysis process  
- If sufficient data are presented to support the findings  
- To what extent contradictory data are taken into account  
- Whether the researcher critically examined their own role, potential bias and influence during analysis and selection of data for presentation  

Comments: Section 8.1.10 explained the analysis process in depth, the process for framework analysis. Data collected were consistent and "Reflexivity" in section 7.4.3. critically exam my potential influence during analysis and data selection. Therefore, data were presented to multidisciplinary groups to obtain comments to reduce the bias.

9. Is there a clear statement of findings?  

- Yes  
- Can’t Tell  
- No  

HINT: Consider whether:  
- If the findings are explicit  
- If there is adequate discussion of the evidence both for and against the researcher’s arguments  
- If the researcher has discussed the credibility of their findings (e.g. triangulation, respondent validation, more than one analyst)  
- If the findings are discussed in relation to the original research question  

Comments: Chapter 9 gives details of the findings. Chapter 10 provides discussion about the findings against other published literatures. The findings are consistent with the findings from quantitative methods. This is explained in the section 10.3. Section 10.1 discuss how the findings related to the research questions in details.
### Section C: Will the results help locally?

10. How valuable is the research?

**HINT:** Consider
- If the researcher discusses the contribution the study makes to existing knowledge or understanding (e.g. do they consider the findings in relation to current practice or policy, or relevant research-based literature)
- If they identify new areas where research is necessary
- If the researchers have discussed whether or how the findings can be transferred to other populations or considered other ways the research may be used

**Comments:** Chapter 11 discuss the contributions that this study has made to different stakeholders in telehealth developments. The findings are not generalisable to other populations which are explained in section 10.2.
Appendix 24 Risk assessment for asthma self-management apps
1. **Introduction of this technical file note**

This is a technical file note to estimate the risk of the asthma self-management app according to the ISO 14971:2007. The estimated risk is subjected to the user characteristics and the common features described in the following sections. This file note is not aim to provide an acute calculation of the risk which used for producing any comply documents for asthma self-management app. This note aims to provide an estimation risk on general asthma self-management app to narrow down the possible technical aspects to discuss with different stakeholders in the future studies.

2. **User characteristics**

- Adults (≥ 16yrs) on the ‘active’ asthma register of their practices. ‘Active’ asthma is defined as having a coded diagnosis of asthma and having been prescribed an asthma medication in the previous 6 months.
- People who are not with very severe asthma, e.g. under a hospital clinic, or who haven’t had an admission within the previous 3 months (who may be expected to have been provided with a PAAP by the hospital clinic or prior to discharge tailored to their specific clinical needs)
- People who are able to self-manage their own asthma (e.g. in nursing/residential care, cognitive impairment are excluded)
- People who are not, at the GP’s discretion for other severe or more significant conditions (including other lung conditions such as chronic obstructive pulmonary disease, and people on the palliative care register)
2. Common features of an asthma self-management app

1. Data monitoring
   - Manual data logging
   - Auto data logging
     - Log peak flow
     - Log medication usage/triggers
     - Log other health data
   - Use smart gadget to measure health data and directly transfer the data to the app, such as smart inhaler/peak flow meter
   - Use other intelligent machine methods to log data, such as voice recognition, optical character recognition, bar code, QR code, matrix code scan, contactless technology, P2P communication e.g., RFID & NFC

2. Others
   - Self-learning
     - Real-time, streamline video
   - Reminder

3. Interpretation of medication adjustment advice
   - Self-interpretation and adjust medication
     - Share on app's screen during consultation
   - App interpretation and give advice on medication adjustment according to validated guideline/action plan

4. Professional consultation
   - Real-time, streamline video
   - Share on app's screen during consultation
   - Send PDF or graph format via email from the app

5. Data storage
   - Cloud database
   - Patient's device
   - Shared link send via email

- (11x2d) (6x8x1)
- (14) (15x6x1)
- (18)
### Risk matrix per task: Input (I)

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task</th>
<th>Hazards (Use-related/ Device Failure Hazards)</th>
<th>Possible root cause</th>
<th>Foreseeable consequence</th>
<th>Hazard situation by task</th>
<th>Probability</th>
<th>Possible control</th>
<th>Residual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Bring along the peak flow meter/smart gadget to take log</td>
<td>Use related hazard- No measurement hardware (peak flow meter)</td>
<td>Forget to bring the peak flow meter OR The peak flow meter is broken</td>
<td>(1) No data entry (2) Data missing for interpolation OR (1) Enter the peak flow values when having a new peak flow meter (2) Data missing for interpolation</td>
<td>Cannot Interpretate the asthma conditions in a time</td>
<td>Medium</td>
<td>Apply usability test to design a handy peak flow meter/smart gadget to patient; pop up reminder in the app if the app cannot detect the smart gadget</td>
<td>Low</td>
</tr>
<tr>
<td>12</td>
<td>Use the peak flow meter to measure peak flow</td>
<td>Use related hazard- incorrect measurement</td>
<td>Incorrect use of peak flow meter OR Human error on reading the value on the peak flow meter</td>
<td>Patient unawares of the mistake, keep entering the incorrect peak flow values. Patient takes reference with the wrong data</td>
<td>Patient wrongly steps up/down/remain the medication use Or The logged data</td>
<td>Medium</td>
<td>Provide training on the peak flow meter technique</td>
<td>Low</td>
</tr>
<tr>
<td>I3</td>
<td>Use smart gadget to take measure health data and direct transfer the data to the app, such as smart inhaler/peak flow meter</td>
<td><strong>Device failure hazard- No data transfer to app</strong></td>
<td>Running out of battery, failure of transceiver such as bluetooth/wifi</td>
<td>(1) Patient unawares of the mistake, keep using it for a period (2) Patient aware of missing data but unsure what's happen to the gadget</td>
<td>(1) Missing data (2) Upset patient, quit the tool</td>
<td>Medium</td>
<td>Pop up 'low battery' message to remind patient to charge up/change the battery; Pop up warning message when the data transmission is unsuccessful</td>
<td>Low</td>
</tr>
<tr>
<td>14</td>
<td>Extract environmental data via internet (e.g. import real time environmental data)</td>
<td><strong>Device failure</strong> hazard- Incorrect environmental data</td>
<td>unsynchronized data in offline mode/slow internet connection/unmatched data type and arithmetic precision for triggering calculation</td>
<td>Incorrect data reporting for self-interpolation or advice by app or trigger incorrect programmed actions, such as alarm</td>
<td>Patient feel annoyed, confused with the incorrect advice, quit the tool OR Patient unaware of the false and take the wrong advice as reference</td>
<td>Medium</td>
<td>developer conduct app tests before launch, app's owner (company) provides regular maintenance and technical enquiry service on the app</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>15</td>
<td>Manual take log (peak flow/ medication usage triggers)</td>
<td><strong>Use related hazard</strong>- Incorrect data entry</td>
<td>Enter out of range or incorrect value in the app</td>
<td>Patient unaware of the mistake, keep entering the incorrect peak flow values. Patient takes reference with the wrong data to Interpretate their asthma condition OR Patient aware the mistake in an occasion</td>
<td>Patient wrongly steps up/down/remain the medication use OR The logged data were unusable</td>
<td>Medium</td>
<td>Limited the data range in the input box; regular professional review</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Date enter adjustment</td>
<td>Fail to save update values</td>
<td>(1) Incorrect algorithm (2) Patient forget to press 'save' after update the value</td>
<td>Patient unaware of the mistake, take reference to wrong data, false advice may be made if it is the triggering parameter</td>
<td>patient wrongly steps up/down/remain use</td>
<td>Medium</td>
<td>Auto save for updated data</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>----------------------</td>
<td>---------------------------</td>
<td>-----------------------------------------------------------------</td>
<td>----------------------------------------------------------------</td>
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<td>---------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>16</td>
<td>Setting: patient enters criteria parameters for advice/triggering alarm (non-emergency)</td>
<td>Use related hazard - Enter out of range or incorrect triggering parameters Device failure hazard - Triggering parameters restores to default/null value</td>
<td>Use related hazard- Human mistake: careless, decided the parameters by instinct as opposed by an agreed asthma action Device failure hazard- Device reset by factory recovery mode</td>
<td>Patient unaware of the mistake, take reference to the false advice/alarm</td>
<td>patient wrongly steps up/down/remain use</td>
<td>Medium</td>
<td>Encourage patient to use the parameters in action plan or enter the parameters with practices during consultation</td>
<td>Low</td>
</tr>
<tr>
<td>17</td>
<td>Log data by other intelligent machine methods, such as voice recognition,</td>
<td>Device failure hazard - No data transfer to app</td>
<td>(1) Patient unaware of the mistake, keep using it for a period (2) Patient aware of missing data but unsure</td>
<td>(1) Missing data (2) Upset patient, quit the tool</td>
<td>Medium</td>
<td>(1) Patient unaware of the mistake, keep using it for a period Pop up warning message when the data</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>optical character recognition, barcode, QR code, matrix code scan, contactless technology, P2P communication (RFID &amp; NFC)</td>
<td>what's happen to the gadget</td>
<td>(2) patient aware of missing data but unsure what's happen to the gadget</td>
<td>transmission is unsuccessful; developer conduct app tests before launch, app's owner (company) provides regular maintenance and technical enquiry service on the app</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Risk matrix per task: Advice (A)

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task</th>
<th>Hazards (Use-related/Device Failure Hazards)</th>
<th>Possible root cause</th>
<th>Foreseeable consequence</th>
<th>Hazard situation by task</th>
<th>Probability</th>
<th>Possible control</th>
<th>Residual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Data display on app</td>
<td>(1) Unclear data display (number graph)</td>
<td>1) Small/low resolution screen</td>
<td>Misleading information to decision maker</td>
<td>Patient wrongly steps up/down/remain the medication use</td>
<td>Medium</td>
<td>Apply usability test to design the data display</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2) Misleading graph design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Self-interpolation</td>
<td>Use related hazard - Poor interpolation</td>
<td>Insufficient knowledge / wrong concept on peak flow/medication usage/trigger interpolation, mislead by the reporting result</td>
<td>Incorrect interpolation on their asthma condition</td>
<td>Patient wrongly steps up/down/remain the medication use</td>
<td>Medium</td>
<td>Provide training to patient</td>
<td>Low</td>
</tr>
<tr>
<td>A3</td>
<td>app to calculate by verified algorithm and give advice</td>
<td>Use related hazard – (1) Inappropriate</td>
<td>Use related – (1) algorithm using irrelevant</td>
<td>patient wrongly steps up/down/remain</td>
<td>Patient wrongly steps up/down/remain</td>
<td>Medium</td>
<td>Use related custom set triggering</td>
<td>Low</td>
</tr>
<tr>
<td>Issue</td>
<td>Advice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(three colour and/or alarm to patient or carers)</td>
<td>advice (2) Over rely on the machine logic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Build in algorithm to give advice (asthma control condition/alarm)</td>
<td>triggering parameters, such as using generic peak flow value to defined the ‘worsen’ criteria to trigger advice/alarm</td>
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<td>device failure hazard – false advice/alarm</td>
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<td>advice to manage asthma(2) patient loses conscious to their asthma conditions changes device failure hazard – patient, their carers ignore all the correct and incorrect advices/alarm</td>
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<td>the medication use</td>
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<td></td>
<td>parameters by patient device failure hazard – regular professional review</td>
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<td>A4 Streamline consultation with professional for advice</td>
<td>(1) Poor sound: Echo, mute, volume too tinny/high</td>
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<td>(2) Poor video: buffering (stop), skip, low resolution</td>
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<td>Narrow bandwidth, slow internet speed, slow computer, wrong/poor setting on microphone or computer</td>
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<td></td>
<td>Patient skip the consultation because of annoyed and disappointed with the setting</td>
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<td>keep the original management plan OR step up/down the medication by instinct</td>
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<td></td>
<td>Medium</td>
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<td></td>
<td>Conduct consultation in a site with stable internet access; provide training to professional and patient to use streamline</td>
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<td>Low</td>
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<tr>
<td>A5</td>
<td>Share recorded health data to professionals for advise (record on app's screen)</td>
<td>(1) Unclear data display (number graph) (2) Misleading graph design</td>
<td>(1) Small /low resolution screen /Screen brightness set to be too high /low (2) Use colour without regard for common form of colour blindness, aliasing, distortion, scaling errors, timebase errors, lossy compression, inappropriate graph title</td>
<td>Poor interpolation on patient's asthma condition</td>
<td>Inappropriate advice given by professionals</td>
<td>Medium</td>
<td>Apply usability test to design the data display</td>
<td>Low</td>
</tr>
<tr>
<td>A6</td>
<td>Share recorded health data to professionals for advise (record in pdf or graph format and send via email from the app)</td>
<td>(1) Unclear data display (number graph) (2) Misleading graph design (3) Email address typo by patient</td>
<td>(1) Small /low resolution in the pdf or image format (2) Use colour without regard for common form of colour blindness, aliasing, distortion, scaling errors, timebase errors, lossy compression, inappropriate graph title (3) human mistake: careless</td>
<td>(1-2) Poor interpolation on patient's asthma condition (1) Failure delivery recorded data or data leakage to a third person AND/OR patient receives disturbance from a third person</td>
<td>(1-2) Inappropriate advice given by professionals (3) Recorded data to be used by a third person</td>
<td>Medium</td>
<td>Apply usability test to design the data display; ask patient to enter the email address twice before send out the email</td>
<td>Low</td>
</tr>
<tr>
<td>A7</td>
<td>Share recorded health data to professionals for advise (with link to patient's cloud account to view the record)</td>
<td>(1) Unclear data display (number graph) (2) Misleading graph design (3) Forget login username and password</td>
<td>(1) Small flow resolution in the pdf or image format (2) Use colour without regard for common form of colour blindness, aliasing, distortion, scaling errors, timebase errors, lossy compression, inappropriate graph title (3) Too many username and password to be remembered in daily</td>
<td>Inappropriate advice given by professionals</td>
<td>Medium</td>
<td>Apply usability test to design the data display; ‘Forget password’ service. User can request a new login setting; provide different ways of login to users, e.g. smart card, biometric security access</td>
<td>Low</td>
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<tr>
<td>A8</td>
<td>Share recorded health data to professionals for advise (shared link send via email)</td>
<td>(1) Unclear data display (number graph) (2) Misleading graph design (3) Email address typo by patient</td>
<td>(1) Small flow resolution in the pdf or image format (2) Use colour without regard for common form of colour blindness, aliasing, distortion, scaling errors, timebase errors, lossy compression, inappropriate graph title (1-2) Poor interpolation on patient's asthma condition (3) Failure delivery recorded data or data leakage to a third person AND/OR patient receives disturbance from a third person</td>
<td>Inappropriate advice given by professionals</td>
<td>Medium</td>
<td>Apply usability test to design the data display; ask patient to enter the email address twice before send out the email</td>
<td>Low</td>
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</tr>
</tbody>
</table>
### Table: Human Mistake: Careless

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>(3) Human mistake: careless</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A9</td>
<td>Self-adjust mediation</td>
<td>Incorrect adjustment of medication</td>
<td>(1) Adjust medication by instinct as opposed by an agreed asthma action plan</td>
<td>Take over does or under dose medication</td>
<td>Condition not improve</td>
<td>Medium</td>
</tr>
<tr>
<td>A10</td>
<td>App advice medication adjustment according to validated guideline (GINA)/action plan</td>
<td><strong>Device failure hazard</strong> — incorrect calculation</td>
<td><strong>Device failure hazard</strong> — incorrect data entry by user/incorrect data extraction from sources, such as sensor in gadget and web; incorrect build in logic, calculation and algorithm</td>
<td>Patient unaware of the mistake, take reference to the false advice/alarm</td>
<td>patient wrongly steps up/down/remain the medication use</td>
<td>Medium</td>
</tr>
</tbody>
</table>
## 5. Risk matrix per task: Other tasks

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task</th>
<th>Hazards (Use-related/ Device Failure Hazards)</th>
<th>Possible root cause</th>
<th>Foreseeable consequence</th>
<th>Hazard situation by task</th>
<th>Probability</th>
<th>Possible control</th>
<th>Residual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>O2</td>
<td>Self-learning</td>
<td>Misunderstand the knowledge and technique</td>
<td>Learning material is confusing/too difficult</td>
<td>Misunderstand the information</td>
<td>Condition not improve</td>
<td>Medium</td>
<td>Provide interactive tutorial, check with patient’s understanding</td>
<td>Low</td>
</tr>
<tr>
<td>O3</td>
<td>Reminder</td>
<td>Use related hazard – Non adherence to repeated reminder</td>
<td>Use related hazard – Feel annoyed with /used to routine reminder</td>
<td>Use related hazard — Ignore repeated reminder and not taking medication Functional related hazard—Forget to take medication</td>
<td>Condition not improve</td>
<td>Medium</td>
<td>Avoid compulsory reminder, allow patient to on/off reminder</td>
<td>Low</td>
</tr>
</tbody>
</table>
6. Risk matrix per task: Data storage security (S)

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task</th>
<th>Hazards (Use-related/Device Failure Hazards)</th>
<th>Possible root cause</th>
<th>Foreseeable consequence</th>
<th>Hazard situation by task</th>
<th>Probability</th>
<th>Possible control</th>
<th>Residual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Data stored in cloud database</td>
<td>(1) Data leakage by the party who manage the cloud by third party hacking (2) No data access or unsynchronised data in offline mode</td>
<td>(1) Data sells to cloud data sourcing company to earn money/insufficient protection to the cloud server (2) Slow/no internet connection/cloud server break down</td>
<td>(1) Patient receives disturbance from third party (2) No review can be made/poor interpolation on their asthma condition</td>
<td>(1) Recorded data to be used by the third party (2) Patient wrongly steps up/down/remain the medication use</td>
<td>Medium</td>
<td>Use database from company which compliant with Data Protection Act.</td>
<td>Low</td>
</tr>
<tr>
<td>S2</td>
<td>Data stored in patient's device</td>
<td>(1) Insufficient data records for interpolation (2) Device lose, data lose</td>
<td>(1) Insufficient data storage in the local device (2) Human mistake: careless/device stole by a third person</td>
<td>(1) Poor interpolation on their asthma condition (2) No data review/patient receives disturbance from third person</td>
<td>(1) Patient wrongly steps up/down/remain the medication use (2) No information for interpolation/recorded data to be used by the third person</td>
<td>Medium</td>
<td>Encourage patient to backup their data to the other portable storage such as hard disk or SD card</td>
<td>Low</td>
</tr>
</tbody>
</table>
7. Risk matrix per task: Usage (U)

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task</th>
<th>Hazards (Use-related/Device Failure Hazards)</th>
<th>Possible root cause</th>
<th>Foreseeable consequence</th>
<th>Hazard situation by task</th>
<th>Probability</th>
<th>Possible control</th>
<th>Residual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>Usage</td>
<td>Use related hazard- Non adherence to manual logging</td>
<td>(1) Forget to make log (2) Feel bored with logging; Don't think it is useful/important; The app is not user friendly</td>
<td>(1) Enter data occasionally/initially (2) Not make log anymore</td>
<td>Insufficient data to Interpretate the asthma condition/ adjust the appropriated medication</td>
<td>Medium</td>
<td>Encourage patient to set reminder to log data; Apply usability test to design the app, understand patient's need, provides interesting element to encourage patient engagement, e.g. award;</td>
<td>Low</td>
</tr>
</tbody>
</table>
8. Harm of common features

<table>
<thead>
<tr>
<th>Intended use</th>
<th>Harm</th>
<th>Severity of harm</th>
<th>Probability, P2 (the probability to get the harm from the 240 combinations)</th>
<th>Possible control</th>
<th>Residual Probability, P2'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring peak flow, medication usage, triggers, symptoms and other health data to interpolate asthma condition and self-adjust medication</td>
<td>(1)Wrong self-management strategies applied (2)Poor asthma control</td>
<td>Negligible</td>
<td>(1)Medium (2)Low (from the systematic review)</td>
<td>Regular (annual) consultation</td>
<td>Low</td>
</tr>
<tr>
<td>+Share recorded health data to professionals for advise (record in pdf or graph format and send via email from the app) + Share recorded health data to professionals for advise (shared link send via email) + Data stored in cloud database + Data stored in patient's device</td>
<td>3)Distress patient (not sure what to do if the technology is out of work; data security both in data storage and share data with professionals; self-adjust medication)</td>
<td>Negligible</td>
<td>(3)Medium</td>
<td>Trustworthy services supports which compliant with the data protection act, provide provides regular maintenance and technical enquiry service on the app</td>
<td>Low</td>
</tr>
<tr>
<td>Reminder: prescribed medication</td>
<td>(1)Poor medication adherence (2)Poor asthma control</td>
<td>Negligible</td>
<td>(1)Medium (2)Low (from the systematic review)</td>
<td>Regular (annual) consultation</td>
<td>Low</td>
</tr>
<tr>
<td>Learn about asthma self-management from web and paper based resources: inhaler training, news feed etc.</td>
<td>(1)Poor inhaler technique/actions (2)Poor asthma control</td>
<td>Negligible</td>
<td>Medium</td>
<td>Interactive learning to check patient's understanding on the knowledge; Regular (annual) consultation</td>
<td>Low</td>
</tr>
</tbody>
</table>
9. Summary of this file note

a) This estimation was referenced to the ISO 14971:2007, corrected version 2007-10-01 and PD IEC/TR 80002-1:2009, Medical device software, part 1: guidance on the application of ISO 14971 to medical device software

b) Total: 240 hazard situations
   - **Estimated P1**: Probability of hazard situation by task ($P_{1a}$, $P_{1b}$, ..., $P_{1z}$) is 'low' to 'medium' > the probability of the 240 hazard situations (Product of $P_1$) will be 'low' to 'medium'
   - **Estimated P2**: Probability of a hazardous situation (P2) leading to harm is 'low' to 'medium'. Therefore, the severity of harm is estimated to be 'Negligible'
   - So, the estimated risk is also 'low' to 'medium'>acceptable risk

c) Key to discuss with stakeholders in the future studies
   - The probability of probability of hazard situation by task and the severity of harm

Note: app with the intended use for any emergency case should be examined separately.

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(Accessed date: 15th Jan, 2016)