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Patient Preferences for a Touch Screen Tablet-Based Asthma Questionnaire

Running head: Asthma Touch Screen Questionnaire

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WORD COUNT

3120

ABSTRACT

Objective

Assessment of asthma control and provision of asthma action plans are seldom performed in practice, partly due to limited time for physicians to ascertain required information. A patient-facing electronic asthma questionnaire could facilitate information collection. We sought to design a touch-tablet asthma questionnaire for use in the clinic waiting room and to describe patient preferences for the content of such a questionnaire.

Methods

We created a questionnaire prototype based on best evidence and employed rapid-cycle design (semi-structured focus group testing; analysis; corresponding modifications; re-testing) with asthma patients aged ≥ 16 years. We analyzed transcripts using deductive and inductive content analysis. Quantitative measures included Likert-scale questions and questionnaire completion times.

Results

There were 20 participants across five focus groups [15/20 (75%) female, age 49.1 +/- 15.6 years]. Content-related themes included: 1) Comprehensibility (*language*) (how questionnaire language affected ease and accuracy of comprehension); and b) Information collection (issues arising during information collection in the following identified subthemes: *personal asthma symptoms and triggers; asthma control; asthma medications; contact information*). Average questionnaire completion time was 11.7 +/- 5.9 minutes. Summative Likert scale responses suggested high levels of question comprehension and confidence with responses.

Conclusions

Our analysis provides novel insight about how best to formulate and present asthma-related content in an electronic questionnaire. Such questionnaires might facilitate quality improvement by improving efficiency of data collection, enabling better assessment of asthma control and medication adherence, and personalization of asthma action plans. Future studies should measure real-world uptake of such a questionnaire and impact on care.

INTRODUCTION

Asthma affects 7.6% of the adult US population and carries an annual economic burden exceeding \$56 billion.[1-3] Guidelines recommend assessment of asthma control criteria at every clinical visit [4-6], however this occurs in as few as 1% of patients.[7, 8] Similarly, asthma action plans - individualized written self-management plans produced by health care professionals for patients with asthma – are recommended universally by international guidelines,[3, 4, 6, 9] yet only 2-11% of patients receive them.[8, 10] Action plans have been shown to improve asthma symptoms and quality of life while reducing healthcare utilization,[11] and were associated with a 70% reduction in mortality.[12] These care gaps have been attributed to both a lack of knowledge and a lack of time for physicians to ascertain and process patient information.[7, 13, 14]

Use of patient questionnaires may improve the process and efficiency of care, can facilitate both clinical and research data collection, and promotes patient-centered care.[15, 16] Administration of such patient questionnaires through tablet devices has been found to be feasible, and electronic questionnaires are perceived more favorably across age groups and are more cost efficient than paper tools [15, 17]. Accordingly, a touch-tablet patient asthma questionnaire (e.g. completed in the clinic waiting room) could facilitate asthma control and medication adherence assessment and collection of data required to personalize an asthma action plan, with a goal of improving quality of care and patient outcomes. We sought to design a touch-tablet asthma questionnaire for use in the clinic waiting room and to describe patient preferences for the content of such a questionnaire.

METHODS

We developed the questionnaire through a rapid-cycle design process, wherein practical problems were identified and addressed using incremental analysis.[18, 19] Patient preferences and concerns surrounding questionnaire content were assessed in semi-structured focus groups and analyzed qualitatively. We also measured preferences in Likert-scale questions, and documented questionnaire completion times.[20]

Study Setting and Population

We recruited patients aged ≥ 16 years with a self-reported physician diagnosis of asthma through clinician referrals and clinic posters in the Greater Toronto Area. We employed purposive sampling to achieve sample heterogeneity with respect to electronic technology and touch-device experience (from novice to expert), asthma severity (from mild to severe), and age.[21] The study was approved by the St. Michael's Hospital Research Ethics Board.

Prototype Questionnaire Design

The purpose of the questionnaire was to: 1) pose symptom-based asthma control questions in order to enable determination of current control according to guideline criteria (frequency of daytime symptoms, nighttime symptoms, rescue bronchodilator use, absenteeism, and exercise limitation due to asthma);[4] 2) ascertain current medications and how patients were actually using them (number of puffs, number of times per day, and regular versus as needed only use); and 3) collect information that would enable personalization of an asthma action plan (e.g. which symptoms the patient experiences with asthma flares, which physical activities/sports are affected by asthma symptoms, which allergic/irritant triggers cause asthma symptoms, and personal best peak flow).[4, 9, 22, 23]

The questionnaire was designed to be administered in a clinic waiting room, through a web-based application (“app”) on a 2nd generation Apple iPad (Apple Inc., Cupertino, CA, USA), and completed within approximately 10 minutes (about 85% of patients wait 10 minutes or more in a primary care waiting room).[24]. It was later integrated into a point-of-care computerized clinical decision support system (eAMS - the Electronic Asthma Management System), which processed questionnaire data to provide primary care physicians and nurse practitioners with guideline-based care recommendations in real-time, along with a pre-filled personalized asthma action plan for their patients.[25]

Asthma and knowledge translation experts (SG, LPB, AK) developed an initial prototype based on best-evidence for content and electronic questionnaire design.[26] This prototype had a minimum of 7 and a maximum of 30 question slides (the path was dependent on answers provided). We pilot tested this in a convenience sample of 12 users (clinicians and students) who provided unstructured individual feedback, based upon which we made system improvements.

Questionnaire Testing and Outcome Assessment

The rapid-cycle design process involved 4 sequential stages: 1) questionnaire testing in a focus group; 2) analysis of focus group findings; 3) corresponding modification of the questionnaire; and 4) re-testing of the modified questionnaire in a subsequent focus group.[27, 28] We performed this serial focus group testing until no new categories of asthma content or format-related concerns were identified.

Each focus group was facilitated by a moderator and attended by the study coordinator. Sessions lasted 2 hours, included 3-5 participants, and were audio-recorded, with tapes transcribed verbatim. Each session was scripted and began with a slide presentation providing background on asthma, the study’s purpose, and session instructions. Participants then used the device to

complete a survey collecting demographics, asthma background, and electronic device use history. Next, they completed the asthma questionnaire on individual devices while being observed by a moderator and study investigator, who recorded questions/features which appeared to be problematic in field notes. The moderator then debriefed participants as a group, eliciting opinions on each of two pre-set overall themes: *content*-related issues, and *usability*-related issues[29] (data from the latter theme are presented separately). Finally, participants completed a Likert scale-based feedback questionnaire.

Analysis

Focus group transcripts and field notes were independently analyzed by two team members with qualitative research expertise. Analysts independently generated lists of content issues (and solutions, where applicable) and compared these to generate a final list of issues. Investigators used this list to devise corresponding system revisions, which were then made before the next session. After the last focus group, analysts coded all transcripts, applying both deductive and inductive content analysis approaches. Consensus on coding was reached through comparison and discussion between analysts.[30, 31] Demonstrative quotations were collected for each identified sub-theme. Quantitative summary statistics included means and standard deviations, or proportions, as appropriate.

RESULTS

We conducted five focus groups with 20 participants in total (Table 1). Participants took a mean of 11.7 +/- 5.9 minutes to complete the questionnaire (range 5.4 - 26.9 minutes). In exit questionnaire Likert-scale questions, 73.7% of participants understood what an asthma action plan is based on the description in the app; 78.9% indicated that after using the app, they would

remind their clinician to provide them with an asthma action plan; 89.5% agreed that photos of medications made it easy to identify medications that they were currently taking; and 84.2% were confident that they correctly entered the asthma medication(s) that they are currently taking. The System Usability Scale score was 84.2 +/- 14.7, indicating excellent usability.[32]

Issues identified in each focus group were grouped into subthemes under the pre-set *content* theme. Subthemes are described below and further representative quotations are provided in Table 2. Specific issues raised in each subtheme and corresponding modifications to the questionnaire are shown in Table 3.

1. Content

a) Comprehensibility

i. Language.

Ease and accuracy of comprehension of questionnaire content was a function of the language employed. Although we tried to avoid use of jargon and to minimize the required reading level in questionnaire content, participants indicated that certain “unavoidable” terms such as “asthma action plan,” “rescue puffer,” and “peak flow meter” might not be understood by newly diagnosed asthmatics, or by the “average patient.”

“Going back to the previous screen, I’m thinking, a lot of people, if this is their first time, they are going to ask someone, what is an asthma action plan...?” (DEV01)

Similarly, terms such as “usual” asthma symptoms and asthma “medication shapes” were felt to be prone to misinterpretation and required clarification.

b) Information Collection

We categorized specific content issues according to the type of information that was being collected.

i. Personal asthma symptoms and triggers.

Given that patients usually experience several asthma symptoms, participants requested explicit instructions to choose one or more symptom(s) from a presented list. Similarly, given the diversity of irritant and allergic triggers that can drive symptoms, participants suggested new trigger selections (often sports-related) [“[Add] mountain climbing, biking...” (DEV14)], and descriptive qualifications of existing choices:

What I would like to see is not just smoke in general because smoke in general does not bother me, but cigarette smoke. Oh my goodness. If you smoke a cigarette outside and I get a whiff of it and it comes in the vent.... my throat just starts to close” (DEV08)

ii. Asthma control.

An electronic format with a single asthma control question on each screen presented novel challenges. For example, a *yes/no* question about the presence of asthma symptoms on one or more *nights* of the week was followed by a multiple choice question about how many *days* per week the subject experienced asthma symptoms. In scrolling through, subjects erroneously interpreted the second question as a follow-up on the first, quantifying nights rather than days per week with symptoms. This was addressed by re-ordering these questions.

iii. Asthma medications

Collecting asthma medications presented a particular challenge because of the large variety of similar-looking inhaler devices and confusion between controllers and relievers. Given that several medications are delivered by identical devices with different colours, we chose to introduce medication choices with device names and accompanying black-and-white device photographs (Figure 1a), asking participants to identify their current inhaler(s) by *shape*, before presenting coloured image options in subsequent screens. However, this “unrealistic” depiction created user confusion and rendered identification even more challenging:

“At first I was little bit confused by that [shape] because of my atrovent and my salbutamol both being square, right.” (DEV11)

This was addressed by using realistic sketch drawings of each device type instead of black and white photographs (Figure 1b).

Our controller medication use drop-down lists consisted of regular dosing amounts and frequencies approved for each inhaler. However, many participants indicated that they do not use their controller as prescribed (rather, they sometimes use it as a reliever), and required an appropriate drop-down option to indicate this usage pattern. Users also expressed a desire for the questionnaire to provide a reminder to verify their puffer technique.

iv. Contact information.

We offered to email participants a link to our educational website. Although most were comfortable providing their email address, participants did indicate the importance of making privacy implications explicit in order to create trust, and recommended providing the website link directly to avoid penalizing users who are unwilling to share their email address.

DISCUSSION

Using an iterative process, we successfully designed a touch screen tablet questionnaire for use by asthma patients in the clinic waiting room, and qualitatively described patient preferences for how asthma content should be collected in such an electronic tool. Although clinical use of patient e-questionnaires is growing rapidly in chronic diseases, there have been no prior reports of a systematic development process and patient preferences for a touch screen asthma questionnaire.[33, 34]

Our analysis uncovered valuable insights about how best to formulate and present asthma-related content for patients. Under “comprehensibility,” users indicated that terms such as *asthma action plan*, *rescue puffer* and *peak flow meter* required explicit definitions. Although we considered these to be fundamental concepts among patients with asthma, they were unknown to certain patients. In fact, previous studies across diseases have shown that clinicians often erroneously assume that patients are familiar with certain terms, and that patients’ understanding of terms is the same as their own.[35] In this case, we added a definition for each term as well as memory cues (examples of rescue puffers and a photo of a peak flow meter) (Table 3). Summative quantitative data suggested that the vast majority of patients did understand the meaning of an “asthma action plan” based on this provided definition. In addition to these strategies, developers

should try to minimize the use of jargon terms and to simplify language, given highly variable health and prose literacy in the general population.[21, 36]

The next main content theme, “information collection,” provided insight on how best to collect personal identifiers for chart linkage and more complex information about disease control, symptoms, triggers, and medication use. For example, it became very evident from individual participant feedback that both asthma triggers and sports/activities that are affected by asthma vary widely between individuals. We added a number of additional suggested triggers and sports to our questionnaire, but importantly, programmed the ability for patients to add specific triggers/activities/sports in free-text fields. This information could then be used by clinicians to personalize the patient’s AAP.

Through user feedback, we were also able to devise a strategy to overcome the complex challenge of having patients identify and document which asthma medications they are currently using, and how (a critical task for any waiting room asthma questionnaire). Given the fact that several asthma inhalers have similar colours, we decided to approach this by first having patients choose the appropriate *shape* of device, before presenting individual device colours within each shape category. We initially presented each shape category as a black-and-white photo image of an individual device (Figure 1a), but patients found this “unrealistic” depiction to be distracting and confusing. Accordingly, we replaced photographs with a cartoon sketch of each device type (Figure 1b), after which patients were shown photos to identify all relevant device colours within each shape category, followed by doses within colour/shape combinations, and drop-down options to indicate usage patterns for each medication. With this approach, 84% of users were confident that they correctly entered their current asthma medication(s). Of particular interest, since controller medications are prescribed for regular as opposed to “as needed” use, the initial

questionnaire displayed only regular dosing regimen options. However, participants requested an option to indicate occasional use, reflecting real-world practice (Tables 2,3). Asthma medication non-adherence occurs in 60-70% of patients, related not only to confusion between reliever and controller medications, but because almost 75% of patients are concerned about inhaled corticosteroid side-effects.[10, 37] This illustrates the importance of building questionnaires that assess *actual* medication usage patterns, as opposed to options corresponding strictly to approved dosing regimens.

Finally, we found it encouraging that patients indicated a desire to receive a URL for web-based asthma educational materials. In prior studies, patients with asthma have been shown to be willing to use electronic tools to help manage their asthma, and this tendency is not associated with a particular gender, age, education level, or socio-economic class.[38] It has also been suggested that use of self-directed web-based asthma education can increase the likelihood of patient adherence to the AAP,[39, 40] while further minimizing practitioner time requirements.

The burden of patient information acquisition is large in asthma, whereby clinical efficiency may be particularly enhanced by gathering these data through a patient-facing touch-tablet questionnaire.[41, 42] Such a tool might enable improvements in the quality of asthma care through several mechanisms. 1) **Asthma control assessment.** An electronic questionnaire enables use of standardized and validated control questions and minimizes missing data.[43] This is particularly important because physicians often forget or lack knowledge regarding appropriate asthma control questions, and instead pose an open ended question (e.g. “how is your asthma?”).[7] As a result, guideline-based ascertainment of disease control occurs in as few as 1% of clinical encounters.[8] Clinician time is another barrier,[44] and questionnaires not only shift some of this time burden directly to the patient, but can enable further clinician time savings

by integrating data with the electronic medical record system.[45] 2) **Asthma action plans.**

Although recommended uniformly across international guidelines, only 4% of primary care physicians report consistently providing a written asthma action plan[46] and only 2% of patients receive one.[47] Although a majority of physicians consider asthma action plans to be important, most fail to provide them due to a lack of experience, confidence, and time.[10, 48-52] Some physicians also believe that their patients would be unlikely to adhere to an asthma action plan if provided.[48, 49, 53] This may be the case if patients are not engaged in their care, if the action plan is presented as a generic tool with no personalization, or if concurrent communication in the form of asthma education is not provided.[40, 48, 54] However, studies have shown that most patients whose asthma action plans are tailored and personalized view them favorably.[55] Also, the majority of patients across a wide range of educational and social backgrounds prefer an active or collaborative role in their asthma management and are less involved in their care than they would like to be.[56] Electronic questionnaires can address many of these issues. They can reduce clinician time requirements by enabling advance data collection, allow for detailed information collection for personalization of the asthma action plan, and empower patients to play a collaborative role in their care. Both knowledge and time barriers can be further addressed if these data are processed through a clinical decision support system to auto-populate the asthma action plan [17], as occurred in our tool.[25] An additional benefit is that questionnaires can be used to coach patients to deliver physician prompts – a quality improvement strategy called patient-mediated knowledge translation.[45, 57] In response to such a prompt embedded in our questionnaire, 79% of participants indicated that they would ask their physician for an asthma action plan after using the questionnaire. 3) **Medication optimization.** It has been suggested that self-administered electronic questionnaires may be more accurate than in-person assessment in

areas where patients are concerned about disappointing their healthcare practitioners, such as might be the case with inhaled corticosteroid non-adherence (discussed above).[43, 58] Indeed, patients requested a drop-down menu option to indicate that they use their controller medication irregularly. Understanding real medication use would not only provide clinicians with required context when assessing current asthma symptoms and considering medication adjustments, but also an opportunity to address poor adherence through education. 4) **Disease Monitoring.** Questionnaires can also enable repeated use of validated outcome questionnaires (such as asthma-related quality of life questionnaires) enabling objective monitoring of disease progression and/or treatment effectiveness. 5) **Education and goal setting.** Electronic questionnaires present an opportunity for delivery of health education to patients (as requested by our subjects), and to enable patients to set their goals prior to seeing the doctor, which increases patient satisfaction.[45, 59, 60]

Our study has several limitations. We had a small sample size (20 participants). However, we had pre-set stopping criteria which were met after 5 focus group sessions. We also recruited participants with varied ages, levels of education, and asthma severity, suggesting that findings may be broadly applicable.[28, 61]

CONCLUSIONS

The use of a patient-facing electronic questionnaire has many potential advantages in asthma. We successfully designed a highly usable touch tablet-based patient questionnaire which enables efficient collection of asthma-related information. We believe that our content-related findings can be applied to optimize the design of patient asthma questionnaires in different settings by ensuring concordance with patient preferences. Future studies should measure the real-world

uptake of such questionnaires, and whether and how these data can be integrated into clinical decision support systems to enable quality improvement.

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DECLARATION OF INTEREST

Authors have no competing interests to declare.

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Figure 1: Questionnaire Medication Choice Modification

(a) Original medication shape choice images (using black and white photographs)

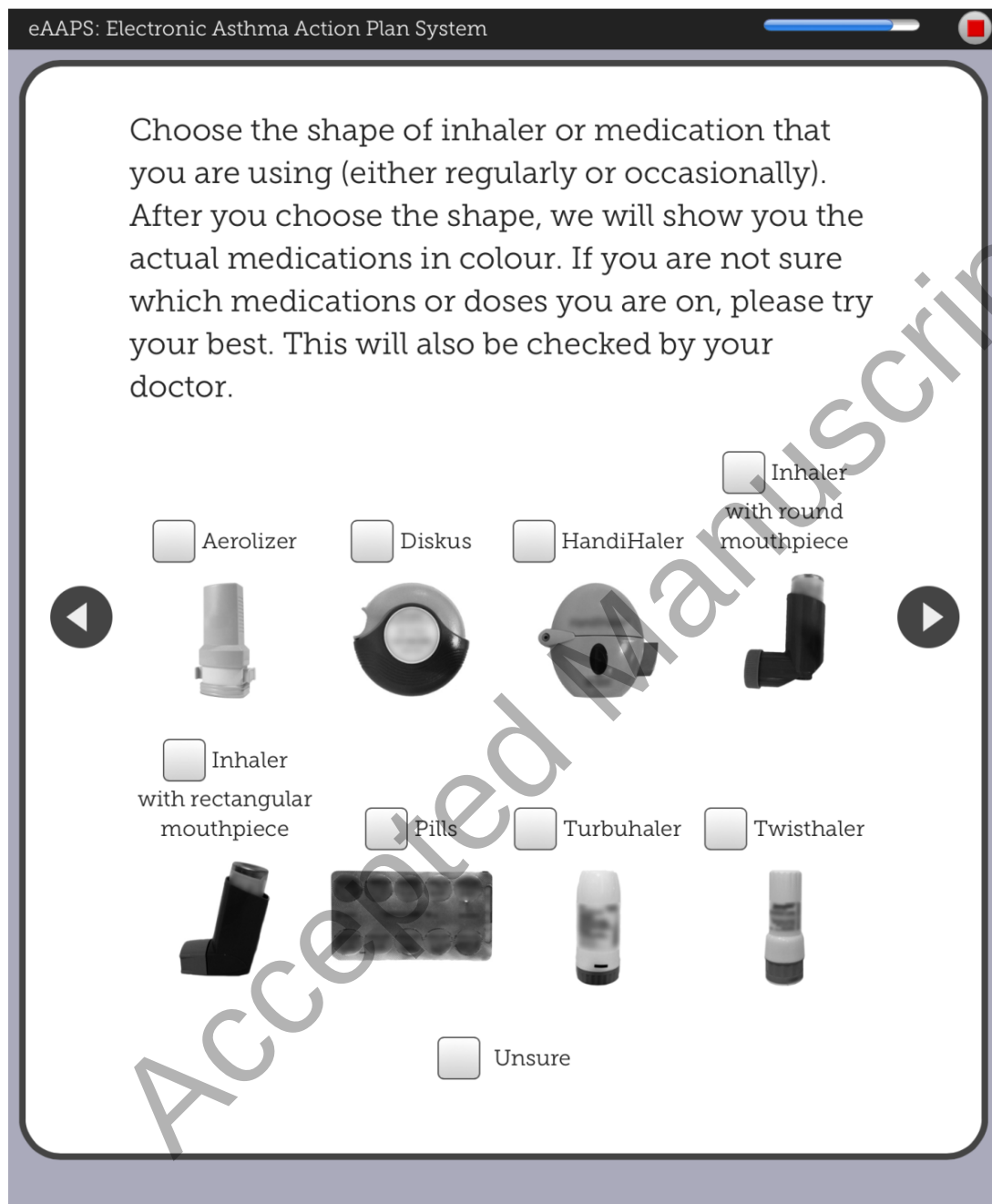
eAAPS: Electronic Asthma Action Plan System

Choose the shape of inhaler or medication that you are using (either regularly or occasionally). After you choose the shape, we will show you the actual medications in colour. If you are not sure which medications or doses you are on, please try your best. This will also be checked by your doctor.

☐ Aerolizer ☐ Diskus ☐ HandiHaler ☐ Inhaler with round mouthpiece

☐ Inhaler with rectangular mouthpiece ☐ Pills ☐ Turbuhaler ☐ Twisthaler

☐ Unsure

The image is a screenshot of a web-based questionnaire titled "eAAPS: Electronic Asthma Action Plan System". The interface is framed by a dark grey border. At the top, there is a blue progress bar and a red close button. The main content area has a white background with a rounded rectangle. Inside, there is a paragraph of text asking the user to choose the shape of their inhaler or medication. Below the text, there are eight options, each with a small square checkbox and a black and white photograph of the medication. The options are: Aerolizer (a vertical cylindrical device), Diskus (a circular disc), HandiHaler (a circular device with a central opening), Inhaler with round mouthpiece (a small L-shaped device), Inhaler with rectangular mouthpiece (a larger L-shaped device), Pills (a blister pack with multiple small circles), Turbuhaler (a vertical cylindrical device with a rotating cap), and Twisthaler (a vertical cylindrical device with a twist-off cap). At the bottom, there is an "Unsure" option with a checkbox. Navigation arrows (left and right) are visible on the sides of the choice area. A large, diagonal watermark "Accepted Manuscript" is overlaid across the center of the image.

(b) Improved medication shape choice images (using realistic sketch drawings).

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☐ Unsure

TABLES

Table 1. Background, Demographics, and Asthma-Related Information (n = 20)

		Number (%)
Gender	Male	5 (25)
	Female	15 (75)
Age (years)	<30	4 (20)
	30-39	5 (25)
	40-49	5 (25)
	50-59	0 (0)
	≥60	6 (30)
Highest level of education completed	Elementary school	0 (0)
	High school	1 (5)
	College/Trade school/Other	6 (30)
	University	13 (65)
Asthma diagnosed by:	Primary Care Physician	11 (55)
	Pulmonologist	9 (45)
	Other	0 (0)
Number of emergency room visits for asthma in the last 1 year	0	16 (80)
	1-3	2 (10)
	4-6	2 (10)
Ever received a written asthma action plan	Yes	6 (30)
	No	14 (70)
Current asthma medications*	No controller medication‡	1
	ICS+/- rescue SABA	3
	ICS+LABA+/- rescue SABA	15
Asthma symptoms (regular or occasional)*	Cough	17 (90)
	Wheeze	19 (100)
	Shortness of breath	16 (84)
	Chest Tightness	14 (74)
Nocturnal arousals 1 or more nights each week*	Yes	8 (42)
	No	11 (58)
Number of days in each week with asthma symptoms*	Less than 1	7 (37)
	About 1	3 (16)
	About 2	2 (11)
	About 3	0 (0)
	4 or more	7 (37)

Number of times in each week a rescue puffer is used*	None (rarely)	9 (48)
	About once	1 (5)
	About 2 times	3 (16)
	About 3 times	0 (0)
	4 or more	6 (32)
Missed work, school, and/or other activities because of asthma (in the past 3 months)?*	Yes	5 (27)
	No	14 (74)
Limitations in physical activities or sports when asthma is flaring?*	Yes	17 (89)
	No	2 (11)
Had to stop exercising because of asthma symptoms (in the past 3 months)?*	Yes	12 (63)
	No	7 (37)

* only 19 participants answered this question

‡ no asthma medication or a short-acting beta agonist only

SABA denotes short-acting beta-agonist; ICS denotes inhaled corticosteroid; LABA denotes long-acting beta-agonist

Table 2: Content Themes With Representative Quotations From Focus Groups

Themes	Representative Quotations
Content	
a) Comprehensibility	
Language	Participants suggested that most users would be unfamiliar with the term “asthma action plan:” <i>“...what does that mean to anyone? It means something to me because I have worked with it. But a lot of people wouldn’t have a clue what that means”</i> (DEV01) The term “rescue puffer” also raised concerns: <i>“Whenever you use language that is particular to a discipline or a particular problem... rescue means something to people who are in the system but people who are just starting...”</i> (DEV01) <i>“...this is a very multicultural city, so words couldn’t mean two different things. If you are a new immigrant, rescue puffer is not going to register...”</i> (DEV03) Participants also believed that the term “peak flow meter” would not be familiar to many users: <i>“I’ve seen different incarnations of it. I think if you were someone brand new, you would never have seen it...”</i> (DEV06) In ascertaining which symptoms were caused by patients’ asthma, the questionnaire inquired about “usual” asthma symptoms, but this term also raised a concern, as it was felt to imply that patients have symptoms all the time: <i>“At times you don’t have any symptoms as well. So the asthma action plan has to take into consideration too, are you having just a maintain therapy you know, so you are not having any symptoms”</i> (DEV05) One participant struggled when asked to choose all “medication shapes” of inhalers he/she currently used: <i>“I think I read that first sentence... medication shapes that you take, like 5 times...because I was just...had no idea what that meant and instead of moving on, I just kept trying again to understand that sentence.”</i> (DEV15)
b) Information collection	
Personal asthma symptoms and triggers	Participants suggested qualification of certain generic asthma triggers: <i>“Strong smells I don’t think is accurate. ... Dog feces isn’t going to trigger an asthma attack...”</i> (DEV03) <i>“Maybe a parenthesis along with strong smells... fragrance, chemicals, paints...”</i> (DEV05) <i>“Because air pollution is all the time, but smog is sometimes a particular day. In the super heat wave in certain seasons, but it’s really specified to that season.”</i> (DEV17) Participants also suggested explaining that more than one asthma symptom (displayed in tick boxes) could be selected: <i>“Potentially select any of the following symptoms that you have experienced.</i>

	<i>To make sure that somebody knows that they can choose more than one... ”</i> (DEV15) Participants called for a wider variety of options for sports activities that could trigger asthma symptoms: <i>“I find those very strange choice of sports... I didn’t understand the choice of the sports”</i> (DEV11) <i>“Yeah, I don’t cycle when I have asthma.”</i> (DEV10)
Asthma control	One participant misinterpreted the asthma control question as a follow up to the nighttime symptoms question before it: <i>“I just read it. I still thought it was about how many times a week at night. I piggy backed on that so I mis-answered...”</i> When it was suggested that “how many days” could be in bold typeface, the participant said: <i>“I think that would make it much easier to look at... it’s day and night and yet you don’t ask the same things for day and night.”</i> (DEV22)
Asthma medications	Participants identified challenges with identifying their inhalers on the first screen in the medication selection process. This screen showed black and white device images and device names, requesting a shape choice before moving on coloured images of specific inhalers): <i>“It should have been also in colour, I mean, I was familiar with the one I use and...with a couple of the other because I have used it in the past but for the... I don’t know what the airolizer is...the handihaler...the discus...the twist...”</i> (DEV06) Participants also wanted to indicate that they do not necessarily use their controller inhalers daily, but rather occasionally, as needed (this option was not initially provided for controller inhalers, as they are not <i>intended</i> to be used in this way): <i>“There is another... I wasn’t sure, because some of them I use... every day and some of them I use occasionally.”</i> (DEV09) Participants also indicated that the questionnaire should have a reminder for patients to verify their puffer technique: <i>“Maybe put a note on there saying ask your pharmacist for instruction. Because they can instruct you on anything that they need to give you, you know, that is a very important tool for people. Especially now with the ways the pharmacies are changing over and the pharmacy techs are setting up to do more and pharmacists will eventually will be writing prescription for things...”</i> (DEV03)
Contact information	Participants also indicated that a link to an asthma education website should be offered directly on the tablet screen (the tablet offered to email such a link to patients and asked them to remind clinicians to provide them a “sticky note” with the link): <i>“I don’t mind the sticky note, but I may lose it...And I wonder too if you might as well it printed there... if someone has spare time... jot it down because you don’t always remember to ask those things. You have so many things to ask when you go and see you doctor.”</i> (DEV17)

	Participants were comfortable providing their email address, but felt that privacy implications should be made explicit: <i>“Maybe signify that the privacy concerns will be addressed.”</i> (DEV21)
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Table 3: Content Issues Raised During Focus Groups and Corresponding System Modifications

Themes	Issues Raised	System Modifications in Response to Issues Raised
Content		
a) Comprehensibility		
Language	“Asthma Action Plan:” noted that most patients were probably unaware of what an Asthma Action Plan is (FG1)	Defined Asthma Action Plan as “a simple 1-page plan that reminds you of your usual medications and instructs you on changes to make when your asthma symptoms get worse.”
	“Rescue puffer:” concern that not all patients would know what was meant by a “rescue puffer” (FG1)	Defined a “rescue puffer” as “a puffer that you take for immediate relief of asthma symptoms, not one that you take on a regular basis. Ventolin, Salbutamol, Apo-Salvent, Bricanyl, and Terbutaline are examples of rescue puffers”
	“Peak flow meter:” noted that most patients would be unaware of what a peak flow meter is and how it is used (FG2)	Added description “a peak flow meter is a device, such as the picture above, that you might have at home and blow into to measure your lung function” and a photo of a peak flow meter
	Uncertainty about asthma symptoms question: noted that participants were unsure whether the question: “Which of the following are your usual asthma symptoms?” implied that patients had to have ongoing symptoms (FG1)	Clarified question: changed the wording to: “Which of the following symptoms have you experienced as a result of your asthma (check all that apply).”
	“Medication shapes:” this phrase was confusing to participants (FG4)	Clarified instructions for choosing medication device types: “Choose the shape of inhaler or medication that you are using (either regularly or occasionally). After you choose the shape, we will show you the actual medications in colour. If you are not sure which medications or doses you are on, please try your best. This will be checked by your doctor.”
b) Information collection		
Personal asthma symptoms and triggers	Missing asthma triggers choices: noted certain triggers missing from list (FG1; FG2; FG4)	Enhanced asthma trigger options: Qualified “ <i>strong smells</i> ” trigger with the following bracket “(e.g. fumes, fragrances, cleaning agents),” changed “ <i>pets</i> ” to “ <i>animals (e.g. cat, dog, other)</i> ” and added “ <i>certain seasons;</i> ” added “(e.g. cigarette smoke)” after “ <i>smoke;</i> ” added the trigger

		“smog;” added a free-text box where “Other” triggers could be added
	Choosing more than 1 asthma symptom: noted that it might not be clear that more than one symptom may be selected (FG4)	Clarified number of asthma symptoms that can be selected: Added “Which of the following symptoms have you experienced as a result of your asthma? (check all that apply)”
Asthma control	Lack of diverse choices of sports causing physical activity limitations during asthma flares (FG3)	Added the following options: running, cycling, aerobics, weight lifting, yoga (an free-text “other” box was also present)
	Night time symptoms: noted that patients might think that the question about day time symptoms was a continuation of night time symptoms on the previous page (FG5)	Changed order of screens to ask for day time symptoms first and bolded “how many days”
Asthma medications	Black and white medication images confusion: participants were unclear why black and white device images were presented (FG2) (medication photographs were intentionally kept black and white at this stage as we wanted participants to first identify the shape(s) of the medication(s) they were on as opposed to an individual inhaler, since several different coloured inhalers share the same shape)	Changed images: replaced the black and white medication photographs with a realistic sketch of each device type, and provided an explanation that this screen was to identify correct devices, and coloured photos would be presented on the following screens (Figure 1a,b)
	Desire to indicate occasional use of controller inhalers: participants were concerned that drop-down options for controller inhaler dosing frequencies only contained regular intervals, yet they often used these medications irregularly (FG3)	Added “occasionally, not regularly” to all controller medication dosing frequency drop-downs
	Reminder to speak to HCP for inhaler training: noted that it would be helpful to have a note to remind the patient to ask their practitioner or pharmacist for training on proper inhaler use (FG1)	Added a reminder to physicians in their decision support tool to ensure that they verify patient technique or refer to a pharmacist or asthma educator for this purpose
Contact information	Educational material: noted that a URL for the educational materials should be provided (FG4)	Added educational materials URL on final screen

	Email address privacy concern: noted that some patients might feel more comfortable providing their email address if there was a statement confirming privacy protection (FG5)	Clarified email address privacy: Used an asterisk below the email address bar so that patients would be drawn to the privacy protection statement “Your e-mail address will be kept confidential and will not be given to any third party”
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