

“Kiss myAsthma”: Using a participatory design approach to develop a self-management app with young people with asthma.

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ABSTRACT

Objective: Young people with asthma often lack engagement in self-management.

Smartphone apps offer young people an attractive, immediate method for obtaining asthma information and self-management support. In this research we developed an evidence-based asthma app tailored to young people’s needs, created using a participatory design approach to optimise user-engagement. This paper describes the participatory design process.

Methods: This multi-phased research included concept generation and ideation of app design by young people with asthma, and development of asthma information by the research team. Clinical review was sought regarding safety and accuracy of app content. Participant’s suggestions for improvement and any problems with the app were logged throughout. Our young co-designers were invited back to test a high fidelity prototype app using a “think aloud” process and completed a usability questionnaire.

Results: Twenty asthma patients aged 15-24 years contributed to the initial app design. Three respiratory specialists and two pharmacists suggested minor corrections to clinical terminology in the app which were all incorporated. Nine co-designers acted as expert reviewers of the prototype app, of whom eight completed a usability questionnaire. Median usability scores (maximum score 6) indicated high satisfaction with app content, usefulness and ease of use [median item score 5.3 (range 4.7-6.0)]. All feedback was incorporated to create an updated prototype app.

Conclusions: A clinically sound asthma app has been developed which is considered highly acceptable to the young co-designers. A six-week test of the engagement, acceptability, and usefulness of the app in young people not involved in the participatory design will follow.

INTRODUCTION

Young people with chronic disease such as asthma often fail to access timely, ongoing health care due to barriers such as lack of health literacy, cost, and the challenges involved in the transition from parental supervision to independent asthma management [1,2, 3]. Research has shown that 10-19 year olds adolescents tend to have poorer asthma control than adults [4]. However, increased engagement with health can occur if young people are supported to develop the autonomy and independence necessary to take control of their own healthcare [5].

With respect to self-management, facilitation of patient *skills* is acknowledged as a critical element of healthcare delivery and support [6]. One such skill is goal setting, a patient-centred process with a sound theoretical basis [7]. As noted by Deci and Ryan [7] “along with improved health outcomes, achieving goals increases confidence and autonomy, essential to life-long transferable skills”. Use of goal setting in asthma has been shown to improve asthma control in adults [8,9,10].

There are limited published data regarding goal-setting in young people with asthma, however using an illustrated worksheet to negotiate a patient-centred agenda was shown to engage 12-18 year olds in setting self-management goals that were complementary to physician recommendations [11]. Clinical experience suggests that especially in young people, the most achievable goals focus on short-term valued activities rather than asthma-specific or obvious health-related goals; for example, “playing football” may be a more effective motivation for improving asthma self-management than “less wheeze” [12]. This highlights the need for patient-led as opposed to clinician-led goals, since patient-led goals are likely to be

of greatest relevance and effectiveness. Moreover, as motivation and confidence are fundamental drivers of behaviour, it is also necessary to address these underpinnings, rather than simply the behaviours themselves. [7]

Digital media such as smartphone apps (sophisticated programs installed on mobile phones) have been developed to help patients manage various chronic conditions including coronary heart disease and systemic lupus erythematosus [13,14]. For young people with chronic disease, apps offer the opportunity for engagement with their health outside of family support and health care services [1]. Apps may supplement existing clinical care by providing young people with self-management guidance, the ability to monitor their health over time, and access to reminders (e.g. for medication use) and feedback [15]. Various Apps have been developed for young people including for pain management in cancer [16], and to measure physical activity [15]. However few if any apps are tailored to the specific needs of young people that would be achieved by involving them in *all* stages of design [17]

In recent years participatory design methodology for health app development has emerged. This recommends a series of key processes including: a stepwise process incorporating a minimum of two iterative cycles of testing and feedback; patient involvement at all stages of the process; and input from clinicians on medical content [13,14,15]. The cycle should ideally include a patient-led approach to the generation of the initial design, patient and clinician input on an initial prototype app, and secondary testing of the final app for acceptability, usability and “bug” fixes. In practice, patient-driven initial design appears to be lacking [13,16]

Moreover, few apps have been built on a foundation of proven behavioural models, such as goal setting [18], or offer information, content or the design of self-management tools that are aligned with evidence-based recommendations [19].

With regard to asthma, a recent Australian survey recommended the development of tailored online and mobile applications to support the wellbeing of young people with asthma, targeting asthma control, mental health, and general wellbeing [20]. Several asthma apps aimed at young people have recently been developed [21-24] but user design from the outset was not evident in any of these.

The aim of the current research was to utilise a patient-driven participatory design approach to develop an engaging asthma self-management smartphone app that incorporates a theory-driven goal-setting module for improving self-management, motivation and confidence in young people with asthma. This paper describes the development cycle, participatory design outcomes and young people's ratings of the usefulness and acceptability of the resulting app.

METHODS

Eligibility criteria

Participant eligibility criteria were a self-reported asthma diagnosis by a doctor or nurse; age between 15 and 25 years; and current smartphone use. The younger age was chosen as this is the age at which young people can independently access health apps without parental consent.

Ethics

Ethics approval was received from the institutional ethics committee [University of Sydney HREC 2014/933]. Written informed consent was obtained from all participants (and a parent for those aged under 18 years) before participation.

Participant recruitment

Multifaceted strategies were utilised including advertising on social media and university websites, and flyers placed in community pharmacies, sporting clubs and on university noticeboards. We also approached high school nurses and asthma educators across Australia, as well as organisations providing services for young people e.g. Surf Lifesaving.

App Development Process

The research was conducted in multiple phases using a mixed-methods approach.

Phase 1. Analysis and design phase

1.1. Literature review

A literature review of existing health-related smartphone apps for adults and adolescents and a review of participatory design methods were conducted. The

instructional systems development model featuring the ADDIE processes (Analysis, Design, Development, Implementation and Evaluation) [25], (Figure 1), was chosen as a design framework for the app given its previous use in successful health app development [13, 26].

[Insert Figure 1 here]

1.2. Patient-driven concept generation and ideation of app design

All participants completed a questionnaire, including questions on demographic characteristics, prescribed asthma medication, and asthma control [27]. Descriptive statistics of questionnaire data were calculated using SPSS v22 [28].

An in-depth investigation of participants' lifestyle and asthma needs, concerns and goals, as well as their intended use, design and content preferences of an app for asthma was conducted through a paper workbook and a face-to-face workshop; those who could not attend a workshop only completed a workbook (see Table 1).

The workshop and workbook included activities drawn from participatory design [29] to produce artefacts (e.g. collages and completed worksheets) that answered key research questions. App user needs were generated through participants' input on:

- A. their identity as a young person with asthma (Collage activity)
- B. their life goals (Quest activity)
- C. ideation of app content and features which would make the app practical, useful and engaging (Head, Heart and Mind activity)
- D. creation of screen designs (Prototyping activity)

[Insert Table 1 here]

All workshops were audio-recorded. Recordings were transcribed and workbook content was synthesised. Content analysis of workbooks and workshop transcripts focused on identifying preferred features and characteristics for the app, and asthma resource needs that could be provided by the app. Analysis was conducted by creative specialist with regular contact with the research team to agree on emergent app features and characteristics.

Phase 2 Drafting and developing app 1.0

Based on Phase 1 data analysis, and in keeping with the ADDIE model, iterative app development was then undertaken.

2.1. Drafting the prototype

The creative specialist utilised workshop and workbook data to develop wireframes (paper-based screen templates), which visually represented app navigation, features and core functionalities suggested by participants. Translation of suggested features into design deliverables that the developers could work from involved: creation of personas (fictional user profiles based on information collected from participants) by the creative specialist ; creation of a series of possible scenarios or user flows to simulate ways that users might interact with the app; translation of the user flows into technical functionality requirements for the developers; and creation of wireframes and accompanying content. See supplementary material (Appendix A2-A4) for examples of personas, user flows and the core functionality overview.

Simultaneously the research team developed evidence-based health information for the app using appropriate language for young people.

2.2. Health professional review

Clinicians were asked to comment on the accuracy, evidence-base and completeness of health information in the draft app. All comments were incorporated into the app.

2.3. Ongoing development of the app

Visual designs for the app based on workshop and workbook data (phase 1.2) were initially created as graphic screen mock-ups and then applied to a functioning prototype. Early prototypes of the app were released to the research team for testing and feedback and improved iteratively until a high-fidelity version was provided for user testing.

Phase 3 Evaluation of app 1.0

3.1 User feedback

Consistent with a participatory design approach, participants who co-designed the app (Phase 1.2) were invited to use the developed app 1.0 on their own phone and provide feedback. Participants were asked to vocalise their reactions whilst completing specific tasks. This “think aloud” method allowed the researchers to capture what users liked and disliked, to identify challenges and satisfaction with features, and test the overall performance as participants interacted with the app [26]. Feedback sessions were audio-recorded, and recordings transcribed and analysed using content analysis to extract user preferences to determine the acceptability of the app, and the need for further modifications.

Participants also scored their satisfaction with the app (e.g. content, ease of use, usefulness for asthma) on a 13-item Likert scale questionnaire (1=least favourable; 6=most favourable score; total score=median of all items) adapted from a published

usability questionnaire [30] to which asthma-specific questions were added.

Descriptive statistics of questionnaire scores were calculated using SPSS v22 [28].

3.2. App naming

To ensure acceptability, an invitation to name the app was sent to all participants in the study and also posted on the Asthma Australia 'Young People with Asthma' Facebook page. A panel comprising members of the research team and Asthma Australia chose the winning name.

RESULTS

Participants

The 20 young people (median age 18 years, 60% female) who participated (13 attended a workshop; in addition, they and a further seven young people completed a workbook) had asthma ranging from well controlled to inadequately controlled (median ACQ score 1.2 [range 0.2-4.5]).

[Insert Table 2 here]

Phase 1: Patient-driven concept generation and ideation of app design

The 'collage' activity about 'identity as a young person with asthma' showed that asthma was seen as an adversary, something to be fought against, that restricts activities such as participation in sports and makes the person feel different and excluded (see Figure 2A).

The 'quest' activity revealed participants' life goals, and the enablers and barriers to achieving these. Goals generally fell into four categories: study; job and career; health and fitness; and spirituality and happiness. Enablers for achieving goals included 'determination', satisfaction and enjoyment from activities, and seeking the opinion of friends and family on goal ideas. Barriers to achieving goals included asthma and lack of motivation (see Figure 2B).

[Insert Figure 2. here]

The 'Head, Heart and Mind' activity, which aimed to identify useful and engaging app content and features, generated several preferences which fell under the themes "Effectiveness and Usefulness", "Practicality and Convenience" and "Emotional Engagement" (see Table 3.)

[Insert Table 3 here]

In the 'prototyping' activity, participants designed several app screens (Figure 3).

Valued features which emerged during this activity included emergency contacts, symptom tracking, and ways to connect socially.

"My home screen... there's a big red cross emergency button so if you're having an asthma attack and like dying, someone can tap it. " (male, 15 yrs.)

[Insert Figure 3 here]

Over the course of workshops, participants expressed preferences for the overall look and feel of the app. Examples included;

"The app should be quite entertaining, like have pictures and just flow really well." (male, 15 yrs)

"Choose colours and fonts really carefully...not too 'in your face' and loud. When they're too colourful it's like 'Eew, that's ugly' and it's not appealing to the eye." (male, 15 yrs)

"So you can see it's for asthma [the screen's] got clouds around it resembling the puff."(female, 18 yrs)

A complete list of suggested app features appears in supplementary material

Appendix A1.

Phase 2 Drafting and developing the prototype app

Drafting the prototype

Twenty seven "wireframe" screens representing the core app functionalities were produced to conceptualise the prototype. Consistent with participant preference, evidence-based app content (e.g. text about asthma, mood, or self-management)

was created using an informal tone in as few words as possible. Example screens can be found in the supplementary material (Appendix A5).

Health professional review

Two pharmacists and three respiratory specialists reviewed the wireframes and app content. Feedback was overwhelmingly positive and mostly pertained to terminology and language used within the app e.g. “Change the word ‘disease’ to ‘illness’.” A few evidence-based issues were apparent;

“We don’t recommend use of a spacer for reliever pMDIs except in young children, or during flare-ups.” (Respiratory Specialist)

“There is no evidence that vacuuming, even with a HEPA filter, reduces allergen levels or improves asthma control.” (Respiratory Specialist)

Development of the app

Software developers created a cross-platform smartphone app (designed to run on both iOS (eg. iPhone) and Android (e.g. Samsung) devices. Main menu items were: “Profile” “About asthma”, “History”/”diary”, “Emergency support”, “Reminders”, “Connect to others” and “Goals” (See Figure 4).

[Insert Figure 4 here]

The ‘Profile’ section allowed users to log their personal details and medications (choosing from a drop down list) as requested by participants:

“When we sign up we should say our age, what medication you take...all those kinds of details.” (male, 15 yrs)

The ‘About Asthma’ section derived from requests for information about asthma:

“Having a lot of information [so] that you can understand what’s happening”

(male, 15 yrs)

The ‘History/diary’ section included symptoms and other data that users wanted to monitor:

“[So I can] just track what’s happened and why I’ve been puffed out.” (female, 16 yrs)

“If you have listed the symptoms then when you go to the doctor you can say this is what I had this night, but this was a bit different.”(female, 18 yrs)

‘Emergency support’ included items such as Asthma First Aid, Action Plans and emergency contacts:

“You’d only be accessing it if someone’s having an asthma attack themselves, I would imagine. [They’d need] easy to follow instructions, in terms of what they should do for an asthma attack.” (male, 16 yrs)

The ‘Reminders’ section was created to address the need expressed by several participants for medication reminders, including default reminders for easy data entry and reminder suggestions:

“Push notifications could come up with ‘reminder: take your preventative’ or ‘remind me later’ or ‘got it’.” (female, 19 yrs)

Having a ‘Connect to Others’ section, including to other young people with asthma, health professionals and to psychological support resources was deemed important:

“Kind of more ‘share your story’ [with other people with asthma], but more of a motivating story ‘That’s how [I] overcame a challenge, an adverse situation’ as opposed to just chatting about how crappy [sic] it is.” (female, 18 yrs)

“A really big thing for me, especially in the past few weeks has been about mental health.” (male, 16 yrs)

The ‘Goals’ section of the app was the only feature conceptualised a-priori, with the aim of providing a theory-driven module [33] for improving self-management motivation and confidence in young people with asthma. The results of the life goals ‘quest’ activity supported the relevance of this module for young people with asthma:

“What supports my goals? Just sort of collaboration with people and expressing my thoughts to other people and getting their opinion on it” (male 16 yrs)

“Obviously an app can’t reward you but it [could] say: ‘You’ve been managing yourself very well.’” (female, 18 yrs.)

Goal-setting support messages were created by the design team. In line with gamification principles, “virtual goal-setting coaches” were suggested by the research team to increase user-engagement. A young person with asthma and the creative specialist co-designed a series of “monster assistants”, each with a unique personality and voice for providing goal-setting support (see Figure 5).

Phase 3. User feedback on app 1.0

Of the 20 Phase 1 participants invited to provide feedback on the developed app, nine evaluated app 1.0 in a focus group (n=4) or individual session (n=5). User feedback consisted of one-time testing where participants downloaded the app onto their own phones and navigated different app features over approximately 20-40 minutes.

Participants expressed overwhelmingly positive views:

“Really nice to see an app that’s designed purely for control of management of your asthma; it’s got first aid, it’s got contacts, and all those other tips in about asthma...it seems like it’s pretty good for its purpose.” (male, 19 yrs)

Participants also commented favourably about the look and feel of the app, including references to ease of use, colour scheme, and amount of text:

“Very clean, easy to use. Not clunky, professional.” (female, 22 yrs)

“Simple log-in. [The] icons are pretty simple too: [I] know what they mean.”(male, 19 yrs)

“[The app] relaxes me with its colours, the blue and the cloud.” (male, 19 yrs)

Popular components of the app were reminders (including reminder suggestions), asthma information, ability to connect to others, and the goal-setting monster assistants:

“I like the option to connect; it’s good for people who are like ‘I don’t know how to make goals happen’.”(female, 19 yrs)

“Cool that you have all the information here relating to asthma. It’s not that easy to access information and your doctor definitely doesn’t tell you enough.” (female, 22 yrs)

“The assistants, I really like that and I think that will appeal to a large age group; it’s really cool that it checks with you.” (female, 22 yrs)

Proposed additions to the app included an introductory tutorial, and more pictures.

Eight of the nine participants who tested the app completed the usability questionnaire. Data revealed mostly high satisfaction with app content, and usefulness for asthma (median total score 5.3 [range 4.7 – 6]; see Table 4). However

some functionality elements such as ease of use, and moving between screens, each received a low satisfaction score from one participant.

[Insert Table 4 here]

Thirteen unique suggestions for the app name were received. The name selected was “Kiss myAsthma”.

DISCUSSION

This study shows that a patient-driven participatory design approach coupled with professional respiratory expertise can result in an engaging asthma self-management smartphone app for young people with asthma. Crucial to the study methodology was the use of the transactional, dynamic model of design and analysis (ADDIE) [26], which led to a systematic, rigorous, and iterative design process. A key finding during design initiation (phase 1) was young peoples' concern with managing their emotional health [34], which led to the inclusion of links in the app to evidence-based mental health support networks for young people. The app combines asthma information with self-management tools, including health behaviour elements such as goal setting [17].

Goal setting is positively correlated with improved self-management and clinical outcomes [9, 10, 35, 36]. Overall, the features suggested by young people with asthma were consistent with the motivational underpinnings of personal goals as proposed in self-determination theory (SDT) [37]. That theory describes three basic psychological needs: *autonomy, relatedness and competence*. During participatory design young people indicated a desire to become more responsible for their asthma management (autonomy), consistent with a survey of young Australians with asthma of whom 56% reported wanting more information about asthma, and 20% reported that they wished to obtain asthma information from smartphone apps or tablets [20]. Connection to others including peers, and health professionals was mentioned by most participants as a key desirable element of app functionality (relatedness). Finally, several participants requested features in the app such as symptom trackers

and medication reminders, which provide users with knowledge or skills that can potentially increase their capacity to handle situations (competence).

Active engagement of young people in the design of this asthma app contributed valuable insights that were critical to its development. The advanced app prototype appears to be an acceptable resource with respect to usefulness (e.g. requesting medication reminders), practicality (advising simplification of information) and emotional engagement (suggesting rewards and feedback). Young people also provided important input on other aspects such as the need for a soothing colour scheme and the use of an irreverent, fun name. The developed app was highly rated by the group of young people with asthma who described it as easy to use, that it did “all the things I expected it to do”; and was helpful in assisting discussions with healthcare providers. Some functionality aspects such as ease of use and moving between screens, which received lower satisfaction scores from a few participants, will be addressed in future iterations by redesigning the home screen and adding “back” buttons consistently throughout the app.

Previous studies about the role of digital media in young people with asthma [21-24] have varied in focus, from prioritising features that enhance interaction and communication with health care providers [21], to the provision of digitised action plans [24]. A recent study by Carpenter et al [22] recruited 20 adolescents aged 12-16, who rated the usefulness of features in existing asthma apps. In that study adolescents reported that certain app features increased their ability to self-observe and self-judge their asthma, such as self-check quizzes, reminders, and charting features. An important difference in the present study was that adolescents

participated in the origination of app content and design and continued to provide input throughout each stage of the app development.

A strength of this app is that, in addition to the inclusion of evidence-informed asthma content, its design methodology aligns with the recommendation that app development [14,19] should be informed by end-users (i.e. patients) throughout the process. We used storyboarding, paper prototyping exercises, user narratives, and screen mock-ups for this purpose in an iterative fashion.

It is known that services for young people with chronic disease have been relatively neglected [38]. In addressing the transition from parental supervision to autonomy for young people, it is critical that tools and language are tailored to the cognitive and social development of the young person, and framed within the context of their lives, including their motivations for health. This app uses language and features that were suggested and approved by young people, which bodes well for their growing engagement in asthma care.

Goal setting was incorporated into the design process through partnership with participants, psychologists, learning technology engineers, and respiratory and adolescent medicine, with expertise spanning young people's preferences, design for well-being, clinical content and health behaviour theory [39]. This methodological approach shows great potential for application to the development of apps for other chronic conditions. However, recruitment of participants was a challenge; at six months only two of the 15 planned participants had been enrolled. Recruitment difficulties may have been related to the demands of participatory design methods

on participants, the multiphase nature of the research, as well as difficulty in engaging busy young people. In response, we extended the recruitment period, added several new recruitment strategies and increased the upper age limit to 25 years. Participants may better represent those with a keen interest in asthma or technology and those living in the inner city and attending either a university or a private high school. While this aided the participatory design approach it may limit the generalizability of the study results. This app would benefit from formal evaluation by a larger group of young people with asthma from broad educational and social economic backgrounds.

Conclusion

We have developed a smartphone app for young people with asthma that has incorporated design features that were considered to be important by end-users, including a simple and professional user interface, access to asthma-related information, customisable notifications, ability to connect to others with asthma, and easy access to emergency support. Future research is planned to address the acceptability, usefulness and effectiveness of the app for improving asthma self-management in young people not involved in participatory design through download of the app onto participants' phones and real-life trial for 6 weeks in order to finalise this patient-centric, age-appropriate asthma-support app.

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FIGURES

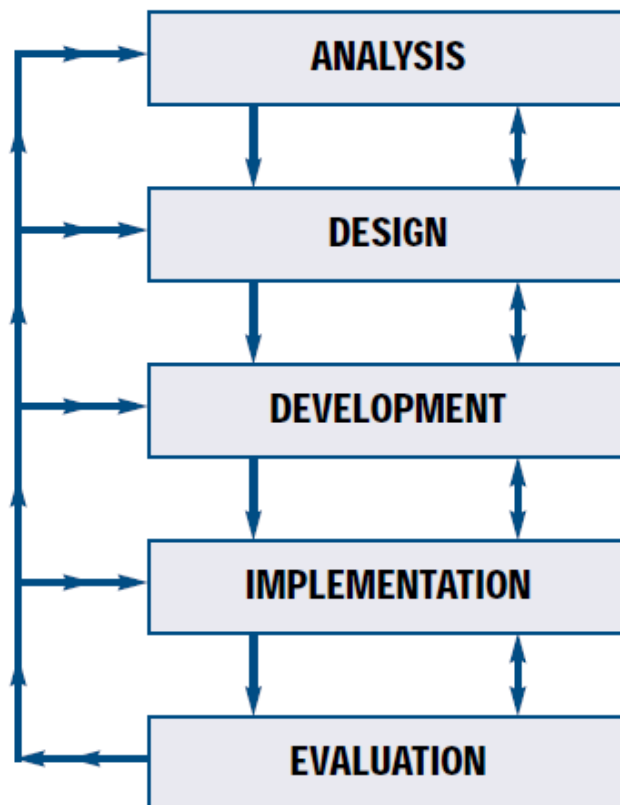


Figure 1. The instructional systems development model featuring the ADDIE processes [26]

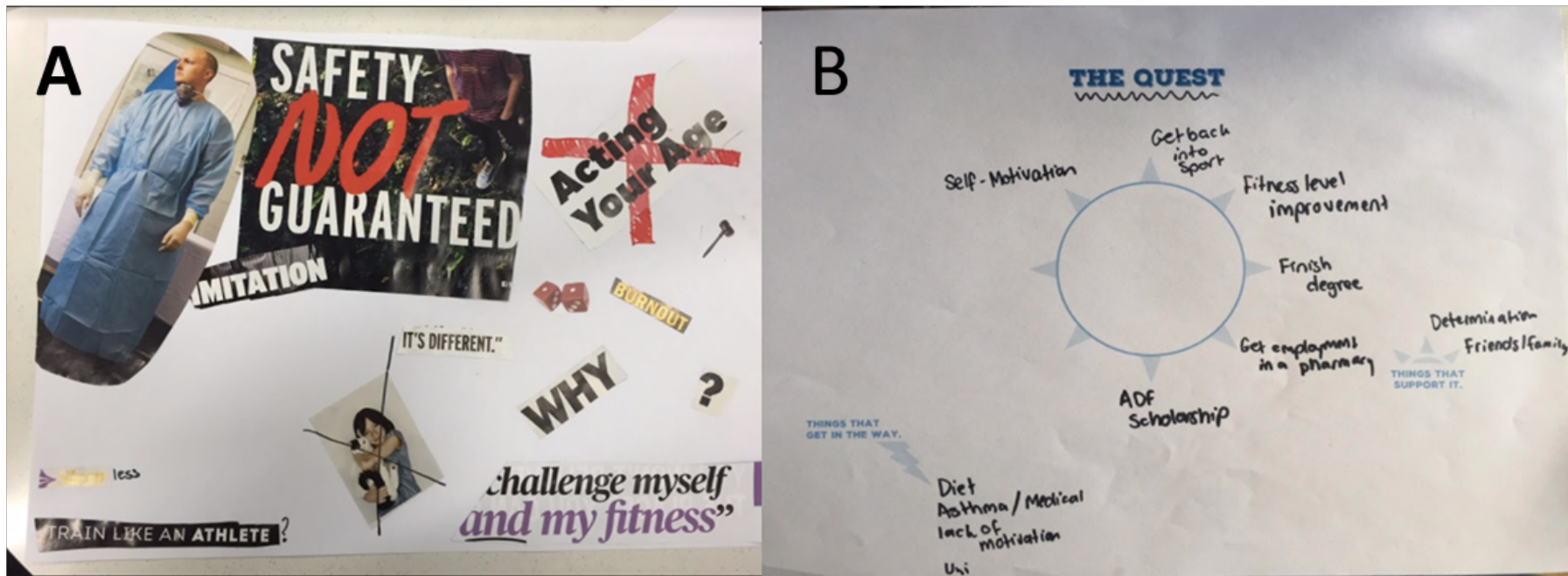


Figure 2. A: Participant collage for “identity as a young person with asthma” collage: B: Participant “life goals” quest

Figure 3. Screens designed by a participant

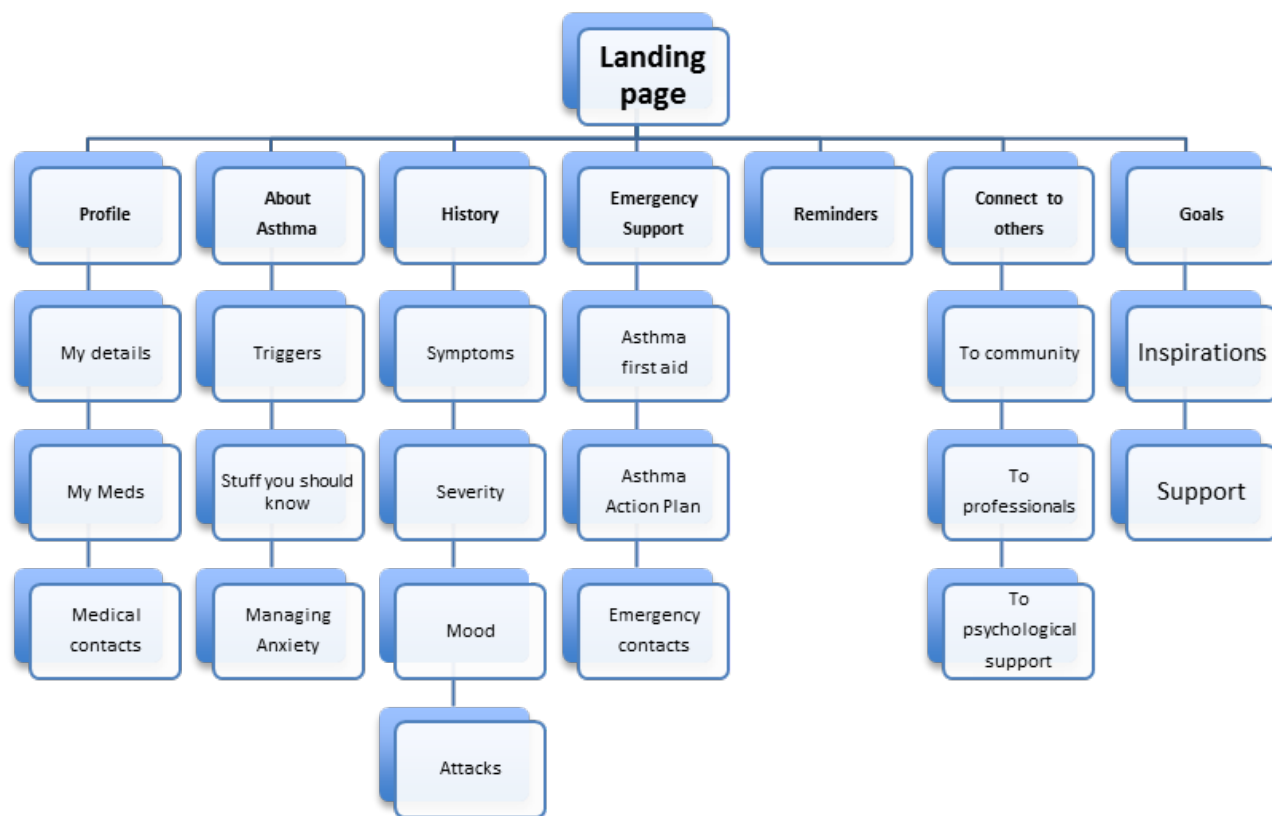
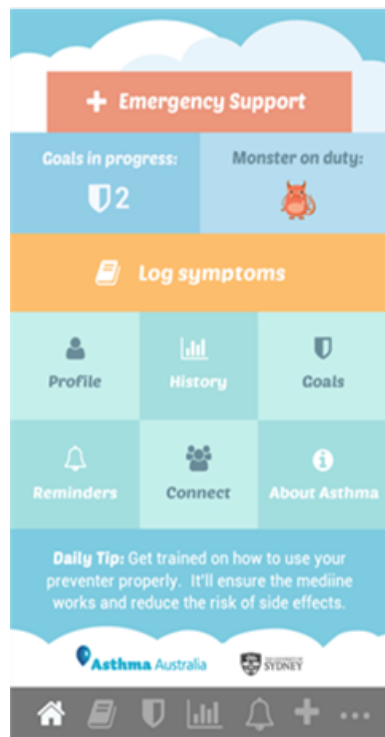


Figure 4. Home screen and algorithm of app sub screens

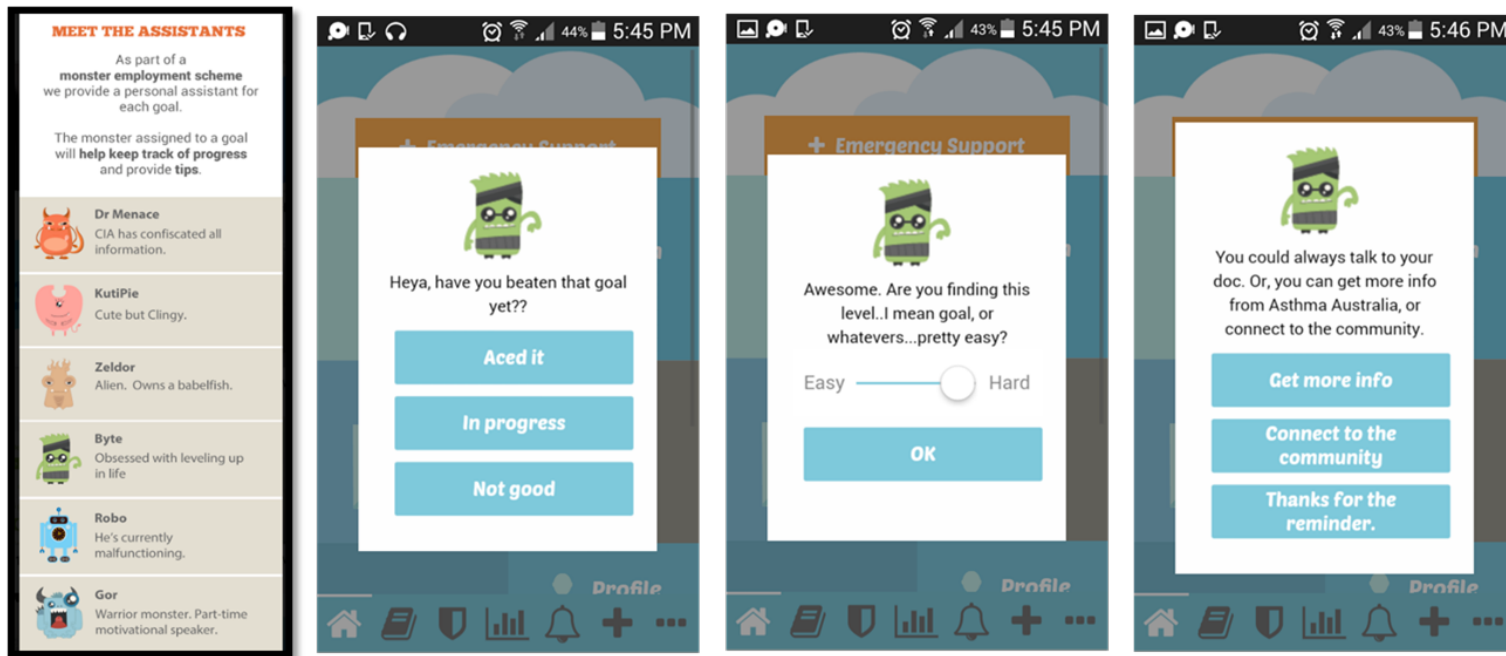


Figure 5. Some goal-setting “monster assistants” and example support messages

TABLES

Table 1. Methods, activities and resources to identify the app preferences and design ideas of users

Research question	Design method	Activity	Resources provided to participants
What is the current engagement with technology and apps of users?		<i>App experience activity:</i> Describe favourite apps, current and past app usage, attitudes toward notifications features in apps	Workbook
What is it like to be a young person with asthma?	Concept generation of user needs, based on their identity as a young person with asthma	<i>Collage activity:</i> Creation of a collaborative collage representing your experience	Collage materials: magazines, scissors, glue, markers
What do users want to achieve or perhaps change in their lives, if anything?	Concept generation of users' personal goals for health (overall and asthma-specific)	<i>Quest activity:</i> Create a concept map "quest" exercise using a worksheet with basic scaffolding for mapping out life goals.	Prepared worksheet: "Show me your quest" Markers, pencils
What do users envision an app which would help them on their life quest/s might be like? What would the app help to do? What features might it have?	Ideation of app content and features which would make the app practical, useful and engaging	<i>Head, Heart and Mind activity:</i> Create a concept map [write down ideas and place them on a wall} followed by group discussion†	Worksheet on <ul style="list-style-type: none"> • What would make it effective and useful? (Mind); • What would make it practical and convenient? (Hand); • What would make it emotionally engaging? (Heart) Markers, blank post-it notes; wall chart (Mind, Hand, Heart)
Build the screens for your app*	Ideation of app prototype	<i>Prototyping activity:</i> Create a 2-dimensional prototype	Worksheets of phone screen templates, magnetic whiteboards, and magnets to write, sketch and/or paste in user interface components
Specific design features	Ideation of app features	Tips for designers: preferences	Audio recorder

*Participants who completed workbooks did not take part in this activity. † With respect to participatory design, having participants answer individually first in the ideation activity had a number of advantages. Firstly the popularity of ideas is evident as more than one sticky note on the same topic may be collected. Secondly the variety of participant's own terminology can be recorded, and finally everyone gets an equal opportunity to participate.

Table 2. Participant demographic characteristics

Participants	N=20
Age, years (median: range)	18: 15-24
Sex, Female	60% (12)
Occupational status:	
High school student	60% (12)
University student	25% (7)
Working	5% (1)
Asthma Control Questionnaire (median: range) [¶]	1.2: 0.2-4.5
Living in a socially disadvantaged area [†]	20% (4)
Prescribed inhaled corticosteroids	60% (12)

All variables % (n) except where indicated.

[¶] Scored 0 (best) and 6 (worst); ≤ 0.75 =well-controlled asthma; ≥ 1.50 =inadequately controlled asthma [31].

[†] Social disadvantage at home address: 'Disadvantaged' SEIFA Quintile ≤ 3 , 'Advantaged' SEIFA Quintile: 4-5 [32]

Table 3. Participant generated app features

Effectiveness and Usefulness	Practicality and Convenience	Emotional Engagement
Reminders and notifications	Off-line mode (to reduce battery use)	Rewards and feedback
Content relevant to daily tasks	Simple content, visual, and light on text	Opportunity to connect with other young people with asthma
Tracking of activity, medication, symptoms, and triggers	App should be free with no advertisements	Include competition (optional) in the app
Interactive guidance for asthma emergencies	Must work across different platforms i.e. Apple and Android	
Support for goal-setting	Provide first-time app user guidance (which can be skipped if not needed)	Mood diary
Asthma information	Prefer swipe gesture to go back, not separate back button	People with similar interests share success stories to inspire others.
Inhaler location tracking		Personalised: suited to the specific user; "something to keep check of your own health in a way that's not just generic"

Table 4. User satisfaction scores for the asthma app

Questionnaire Item	Item score
	Median (range)*
It was simple to use this app	5.5 (3-6)
After making a mistake it was easy to continue using the app.	5.0 (4-6)
The information in the app (e.g. about asthma) was easy to understand.	6.0 (5-6)
The information was organized clearly on the screen.	5.0 (3-6)
The information in the app could help me take care of my asthma	5.5 (5-6)
The look and feel of the app is appealing.	6.0 (4-6)
The language used in the app is engaging (interests me).	5.0 (3-6)
It was easy to use the interface (e.g. moving between screens, location of buttons etc.).	5.0 (2-6)
This app does all the things I expected it to do.	5.5 (5-6)
This app would make it easier to talk with my doctor about my asthma.	6.0 (4-6)
I like the name of the app.	5.0 (3-6)
Overall, I am satisfied with the app.	5.0 (5-6)
I would recommend this app to a friend with asthma.	6.0 (5-6)
Median total score*	5.4 (4.7-6)

*(Questionnaire scored: 1=least favourable; 6=most favourable score; total score=median of all items).