

Mixed methods process evaluation of My Breathing Matters, a digital intervention to support self-management of asthma

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Abstract

This study aimed to explore user engagement with ‘My Breathing Matters’, a digital self-management intervention for asthma, and identify factors that may influence engagement. In a mixed methods design, adults with asthma allocated to the intervention arm of a feasibility trial ($n=44$) participated in semi-structured interviews ($n=18$) and a satisfaction questionnaire ($n=36$) to explore their views and experiences of the intervention. Usage data highlighted that key intervention content was delivered to most users. The majority of questionnaire respondents (78%; $n=28$) reported they would recommend the intervention to friends and family. Interviewees expressed positive views of the intervention and experienced several benefits, mainly improved asthma control, medication use, and breathing technique. Factors that may influence user engagement were identified, including perceptions of asthma control, current self-management practices, and appeal of the target behaviours and behaviour change techniques. Findings suggested My Breathing Matters was acceptable and engaging to participants, and it was used as intended.

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Introduction

Asthma is estimated to affect 358 million people worldwide¹. In the UK, 8 million people have been diagnosed with asthma². The goal of asthma management is optimal control asthma symptoms, to reduce the risk of exacerbations, and for individuals to be able to lead a full and productive life^{3,4}; however, this is not always achieved^{5,6}. Despite the availability of effective treatments, asthma outcomes remain sub-optimal, resulting in many avoidable deaths, hospital admissions, quality of life impairment, and societal costs^{5,7-9}. Clinical guidelines recommend promoting self-management through the provision of a personalised asthma action plan, attendance at annual asthma reviews, and correct inhaler technique use¹⁰. However, patient adherence to regular preventer medication, such as inhaled corticosteroids, is often low¹¹, patients' inhaler technique can be poor¹², personal asthma action plans are underused, and annual asthma reviews are underattended^{6,8}.

One potentially cost-effective method for promoting self-management is through digital interventions, which offer convenient 24-hour access to relevant and personalised self-management support. There is preliminary evidence that digital interventions for asthma self-management can lead to improvements in asthma control and quality of life, with no evidence of harm^{13,14}. However, there is currently a lack of robust evaluations of digital interventions for adults with asthma.

My Breathing Matters is an internet-based self-management intervention for asthma, which aims to improve the quality of life of adults with asthma through improved pharmacological (e.g. supporting medication adherence) and non-pharmacological (e.g. breathing retraining, stress reduction) self-management¹⁵. Other digital interventions for asthma focus on controlling asthma through pharmacological management or self-monitoring of physiological and behavioural data^{14,16}. Unique to this intervention was the integration of non-

pharmacological self-management, including breathing retraining¹⁷ and several previously evaluated interventions promoting healthy lifestyle behaviours (smoking cessation¹⁸, physical activity¹⁹, weight management²⁰, handwashing to prevent infections²¹). It was developed using theory-, evidence-, and person-based approaches to intervention development to maximise its effectiveness, feasibility and acceptability^{15,22,23}. Trial feasibility outcomes (such as recruitment, retention and randomisation) in our randomised controlled feasibility trial (RCT) with 88 adults with asthma showed that a definitive RCT is feasible²⁴. In addition, we observed consistent trends with improvements in asthma-related patient-reported outcome measures, including quality of life and asthma control. Before a definitive trial can be carried out, it is important to ensure that the intervention is acceptable to its target group and used as intended, to maximise its effectiveness²⁵.

To achieve this, we carried out a mixed methods process evaluation of My Breathing Matters embedded within the feasibility trial. Process evaluations can help support and refine an intervention's 'programme theory', which describes how an intervention is expected to lead to its effects (mechanisms of impact), the key intervention components, and how these interact with contextual factors (e.g. population, setting)^{26,27}. Users' 'engagement' with digital interventions has been hypothesised to moderate the intervention's influence on its mechanisms of impact²⁸. Engagement has been defined in terms of the extent to which an intervention is used (e.g. amount, frequency), the user's subjective experience of the intervention, and engagement with wider behavioural goals, such as behaviour change and self-management^{28,29}. Engagement is influenced by the digital intervention itself (content and delivery) and the context in which the intervention is used²⁸. In asthma, there is a lack of research on potential factors influencing engagement with digital interventions¹³.

We aimed to explore user engagement with My Breathing Matters by examining how participants in the feasibility study used the intervention, and exploring participants'

experiences of the intervention. To refine our programme theory, we sought to identify aspects of the intervention's delivery and content, and contextual factors (any external factors that might interact with the intervention to produce variations in the outcome) that may strengthen or impede users' engagement with the intervention.

Results

Participants

Intervention usage data were available for all 44 participants. The My Breathing Matters Satisfaction Questionnaire was administered to all 36 participants in the intervention group who registered with the intervention (eight participants were given a hyperlink to the intervention, but did not register). Seventeen intervention users and one non-user ($n=18$; 41%) agreed to be interviewed. Participants who did not take part either withdrew before their interview was due ($n=4$; 9%), could not be contacted by phone or email after multiple attempts ($n=18$; 41%) or were too busy ($n=4$; 9%). Table 1 provides the participants' demographics.

How did participants in the feasibility trial use the intervention?

Of the intervention participants, 81.8% ($n=36$) logged into My Breathing Matters at least once and between 1 and 25 times (Median = 4; IQR = 8). Those using the intervention more than once ($n=27$) used it between 1.89 to 337.85 days (Median = 120.96; IQR = 148.23). Each session (total sessions=231) lasted between 0.01-58.81 minutes (Median = 4.69; IQR = 8.33). Of the 34 participants who reached the core intervention content, most (73.5%; $n=25$) looked at both the pharmacological and non-pharmacological content and most (71%; $n=24$) chose to look at the non-pharmacological content first. Table 2 provides information on number of participants using each intervention component. The breathing retraining module was the most viewed component and over half of participants signed-up to the breathing

retraining challenge tool. The other intervention tools were used by less than a third of participants.

What were intervention participants' experiences of the intervention?

In the My Breathing Matters Satisfaction Questionnaire, 86.1% ($n=31$) of the intervention users ($n=36$) reported that My Breathing Matters provided at least some benefit (Figure 1) and 69.4% ($n=25$) reported that there were 'no disadvantages at all' (Figure 2). A large majority of survey respondents (77.8%; $n=28$) reported that they would recommend My Breathing Matters to friends and family if they needed similar care and treatment (Figure 3).

Content analysis of the free-text comments identified 14 benefits of using My Breathing Matters ($n=28$; Table 3) and nine disadvantages ($n=13$; Table 4). Information provision ($n=12$) and provision of breathing retraining ($n=5$) were the most commonly cited benefits. A dislike of the intervention's design ($n=3$) and that the intervention was not accessible on smartphones and computer tablets ($n=3$) were the most commonly cited disadvantages.

Thematic analysis of the qualitative interviews identified four themes, which are outlined alongside the codes in Supplementary Table 1.

The first theme was '*Benefits of My Breathing Matters*'. Many participants reported how they noticed changes in their asthma symptoms since using My Breathing Matters, including reduced coughing, chest tightness, and breathlessness; improved peak flow; feeling more in control of their asthma; and fewer or no asthma attacks.

I'm not coughing when I wake up in the morning any more, or rarely. I'm not waking up in the night feeling tight-chested and that I can't breathe properly. (P14, 31-40 years old, female, asthma 21-30 years)

This change was mainly attributed to the breathing retraining and improved medication use. In contrast, some interview participants said that they did not notice any changes to their asthma since using the intervention.

Participants who used the 4-week medication challenge (see Table 5) explained how this component had helped them get into the habit of using their preventer inhaler and use their inhalers correctly.

I haven't been terribly good at using the brown [preventer] inhaler. But I have pretty much got into the habit now and I would put that very much down to the website reminders. (P4, 61-70 years old, male, asthma 21-30 years).

Others reported how, since using My Breathing Matters, they had not needed to use their reliever inhaler as often. This was because they had not had any exacerbations, were using their preventer inhaler as prescribed, or started to practice the breathing techniques provided in the intervention when they were having symptoms instead.

Sometimes, I forget, you know, and I think, 'Oh actually, perhaps I should have taken it [reliever inhaler]', but then I think let's do my breathing techniques. Sometimes I haven't needed to take it...the website's been good for that. (P1, 41-50 years old, female, asthma 21-30 years)

One participant reported how the intervention reassured them that it was acceptable to use their reliever when they need to (rather than just tolerating symptoms), while another had been told by a health professional that their asthma had improved to a point that meant they no longer needed to use their preventer inhaler.

Many participants spoke how My Breathing Matters improved their breathing awareness, technique and posture.

I just feel that, sort of, before I used to breathe a lot through my mouth . . . And I find that, obviously, that now I'm breathing through my nose, my asthma's not as bad . . . I find that I'm not coughing as much. (P12, 21-30 years old, female, asthma <5 years)

Interview participants reported how My Breathing Matters had helped them to better identify, and deal with, asthma triggers (e.g. air pollution); gave them breathing and relaxation techniques to manage chest tightness and breathlessness; and prompted them to engage in healthy lifestyle changes (e.g. physical activity, healthy eating). A few participants explained how the intervention could help them to decide whether to seek health professional advice, and help them avoid unnecessary GP visits or burdening their healthcare team.

A few participants mentioned that their understanding of asthma and its treatment had improved. One participant learned how she should have had an asthma action plan, which she had printed and intended to take to her to asthma clinic.

It might have been useful if I'd had one of these [an action plan] years ago. Then I might have known what to do at the time [I had an asthma attack]. So that was extremely useful. (P8, 61-70 years old, female, asthma 5-10 years).

The action plan also prompted another participant to have conversations with their family about what they should do if he had an exacerbation and could not explain this to them at the time. On the other hand, some participants commented how they already knew a lot of the information, felt there was nothing new in the intervention, found some of the content repetitive, or believed the advice was common sense.

Some participants explained how the breathing retraining and stress management techniques helped them relax or stay calm, in particular when they were feeling tight chested, panicking when having an asthma attack, and for trying to get to sleep. A few participants explained

how My Breathing Matters could make people think more positively about asthma, especially if you have just been diagnosed.

I think maybe that's what I've really gained from it [My Breathing Matters], I've thought about it [asthma] more and if you think about problems or if you think about different things then that's a good thing to, you know, you're actively trying to improve something about it and, yeah, so I'm definitely thinking more positively.

(P11, 41-50 years old, female, asthma 21-30 years)

Other benefits included addressing any asthma concerns you might have (e.g. side effects of medication, symptoms); providing reassurance that there are things that can help them cope; and highlighting that people with asthma are not alone and that there are other people with asthma or similar problems.

The second theme was '*Views on the intervention content*'. Participants particularly valued the breathing retraining, with many finding this the most helpful component. Most participants liked the videos and found the techniques relatively easy to learn. A few people found some of the techniques difficult to learn, including slow breathing and controlled breath holding, with one person preferring to have received the training in person. Another participant did not understand why the breathing exercises were beneficial and found the video irritating.

Some participants did not want to rely solely on their asthma medication to manage their asthma and liked that My Breathing Matters provided alternative management strategies, mainly the breathing retraining.

Anything that helps you only take the amount of medication you really need and helps you to self-control asthma in some way. And if My Breathing helps you to do that, that's got to be a good thing. (P2, 61-70 years old, female, asthma 11-20 years)

Now, after using the website, it's made me think about, well, what other things can I do to help myself, so that I don't have to rely on my inhaler so much? (P12, 21-30 years old, female, asthma <5 years)

In the 4-week medication challenge (see Table 5), participants valued the email reminders, the advice about keeping their inhalers somewhere accessible as a reminder, and the realisation that it was benefiting them. The other intervention components (action plan, annual asthma review, stress management, friends and family) were used to a lesser extent. Most participants either had not yet used the component or found that these components were not relevant to them. None of the interview participants reported contacting the Asthma UK helpline when asked about this.

The third theme was '*Views on the intervention design*'. Participants expressed positive views on the intervention design and found the content easy to understand. Some participants liked that it was designed by an experienced team and that it was associated with a national charity (Asthma UK), and felt that the information was authentic and high quality. Generally, people found the intervention easy to navigate. However, a few people experienced navigation and technical difficulties, including logging on, following URLs in emails, and accessing the intervention by phone or tablet, or on their workplace computer. Participants expressed mixed views regarding the unlocking feature of My Breathing Matters, whereby new content was made available to users over time. Some liked this feature as it structured their learning and stopped them from feeling overwhelmed by too much information, but others found it frustrating or did not understand the reasoning behind the feature.

I'd have been bombarded with it all if it was too much at once, so it was quite nice it came in sections slowly . . . it's too much to take in otherwise. (P1, 41-50 years old, female, asthma 31-40 years)

I wanted to look through other bits that weren't enabled and then had to wait for them . . . I think that probably would discourage me from using it. (P4, 61-70 years old, male, asthma 21-30 years)

Participants liked regularly receiving regular emails with additional behavioural content from My Breathing Matters because they reminded them to take their medication and use the website, provided encouragement and additional advice, and facilitated quick access back to the website. A few people expressed negative views of the emails, including finding the email content irritating or not useful, or that it made them feel guilty for not using the website.

The fourth theme was '*Contextual factors influencing intervention engagement*'. Participants' engagement with My Breathing Matters was influenced by their perceptions of their asthma control. Participants explained how they did not engage with the intervention or specific components (e.g. the Asthma UK helpline, action plan, or the medication section) because they did not think their asthma was severe enough.

I possibly briefly looked at the sort of action plan thing, but decided that, actually, I didn't think it was gonna be beneficial for me . . . I just thought that probably my asthma wasn't severe enough that it was something that I needed to do at that moment in time. (P12, 21-30 years old, female, asthma <5 years)

Likewise, participants explained that they were more likely to use the intervention when their asthma symptoms were bad (e.g. in the winter or during allergy season) and less likely to use it when their asthma was well controlled. A few participants explained how, most of the time, they simply 'forgot' or tried not to 'dwell' on their asthma unless it was significantly restricting their lives.

My asthma is fairly well controlled, I haven't needed to refer to the [My Breathing Matters] site . . . I'm very much a kind of person that, actually, I don't dwell on, you

know, things that might inhibit you in life, and just get on with life . . . You know, I've had far more worse than asthma. (P15, 61-70 years old, female, asthma 31-40 years)

On the other hand, two people were unlikely to use it if their asthma was bad, instead choosing to seek medical attention.

Some participants explained that they did not use certain components because they did not consider them relevant. For example, they already practiced the recommended behaviours (e.g. taking medication, attending reviews, being more active), were not stressed (relating to the stress management techniques), or their family or friends already knew about asthma.

Participants explained how they thought My Breathing Matters would be most useful at the beginning of their asthma journey, once you have been diagnosed with asthma. Likewise, some people who have had asthma for a long time reported it was less useful. A few participants explained how they were not confident with using computers or expressed a dislike towards them. The non-user we interviewed was keen to use the intervention, but felt he lacked the computer skills to log onto it. Other reported reasons for low usage or not using certain components included lack of time or being busy with other priorities (e.g. work, family); and comorbidities that made some of the intervention behaviours (physical activity, breathing exercises) challenging.

What factors may influence user engagement with My Breathing Matters?

Across the qualitative findings, we identified several contextual factors and aspects of the intervention's content and delivery that may influence user engagement with the intervention (Figure 4). Contextual factors were derived from the interview data (theme 4) and included pre-existing beliefs (e.g. perceptions of asthma control/asthma-related quality of life, beliefs about medication), knowledge of asthma management and skills (e.g. confidence with computers), current self-management practices, environmental factors (current season, lack of

time), and health status (time since diagnosis, comorbidities). The interview data and qualitative data from the My Breathing Matters Satisfaction Questionnaire highlighted aspects of the intervention's content and delivery that may influence engagement including appeal and perceived ease of the target behaviours (e.g. breathing retraining); appeal of the behaviour change techniques (e.g. email reminders) and design (e.g. content released over time, instructional videos); novelty, relevance and clarity of the intervention content; and ease of use (navigation and accessing the website). Users reported both positive and negative aspects, and both are summarised along with the perceived benefits of the intervention (derived from theme 1 of the interview data and the qualitative questionnaire data) in Figure 4.

Discussion

This mixed methods process evaluation study explored users' engagement with My Breathing Matters, an internet-based self-management intervention for asthma. Overall, engagement with the intervention was high, it was used as intended, and people with asthma expressed positive views of the intervention, its intervention components, and its design features; thus, demonstrating that it was acceptable to participants. Users reported experiencing several benefits of the intervention, mainly improved asthma control, medication use, and breathing technique. These perceived benefits were in line with the hypothesised intervention mechanisms of impact and outcomes outlined in our original logic model. Our study findings also extended our current programme theory by identifying aspects of the intervention (content and delivery), and contextual factors that may influence user engagement with the intervention.

Despite our attempts to engage those who did not perceive themselves as having active asthma and only recruiting those with impaired asthma-related quality of life, users still

questioned the relevance of the intervention and its components, and did not believe that their asthma was severe enough for the intervention. This mirrors other studies that have demonstrated disparities between perceived and objective measures of asthma control, with patients overestimating how well their asthma was controlled^{30,31}. Notably, user engagement in this study was high despite such beliefs. This may be due to our use of ‘positive illness contexts’ as a key intervention design feature (promoting health rather than preventing illness). In this way, even when users considered the intervention not specifically necessary for asthma control, My Breathing Matters still provided self-management support. Users reported several benefits of the intervention, and our feasibility study observed trends with improvement across a range of asthma outcomes²⁴. This demonstrates that interventions developed using theory-, evidence-, and person-based approaches that target likely barriers to behaviour change can lead to effective user engagement and positive outcomes among individuals with different health beliefs, such as those in heterogeneous chronic disease populations.

Uniquely, My Breathing Matters integrated breathing retraining alongside established pharmacological self-management approaches. Consistent with other qualitative evaluations of breathing retraining^{32,33}, users valued how the non-pharmacological approaches in My Breathing Matters could help reduce their reliance on medication, which is an important goal for people with asthma³⁴. Most participants were satisfied with the online delivery of breathing retraining, with just a few users finding the exercises difficult to learn and only one participant reporting that they would have preferred to receive their training face-to-face with a health professional; thus further demonstrating the feasibility of delivering breathing retraining via an unguided digital intervention. A trial of breathing retraining demonstrated that face-to-face delivery was no more effective than DVD delivery¹⁷.

In an attempt to maximise user engagement and ensure all core content was accessed³¹, we implemented a design feature whereby new content was made available to users over time. Although this feature had been used successfully in other interventions³⁵ and some study participants found this feature helpful, others found this feature frustrating and did not understand the rationale behind it. It may be that by restricting users' access to specific content, the intervention may have impaired their sense of control and autonomy, which are important factors for maximising engagement²⁸. In future versions of the interventions, it would be helpful to provide users with a strong rationale for this feature (e.g. to encourage people to practice the techniques they have already accessed before trying new techniques), but allow users to unlock additional content themselves if they wished to maximise user autonomy^{22,28} and avoid disengaging active users.

One strength of this study was its mixed methods design. The triangulation of questionnaire measures with qualitative interviews and usage data enabled us to explore different aspects of intervention engagement and to increase the credibility of the research. Even though some questionnaires such as the My Breathing Matters Satisfaction Questionnaire were not formally validated, we could examine the extent to which the intervention is used, and users' subjective experiences of using the intervention and enacting its target behaviours (e.g. breathing retraining). Due to the limited sample size of the feasibility trial ($n=88$), we were not powered to do a more in-depth analysis of the usage data. A fully powered RCT is needed to explore how process measures, such as perceptions of asthma, pre-intervention levels of medication adherence, and time since diagnosis, is associated with user engagement and asthma outcomes. It would also be worthwhile exploring how usage might change across the seasons, given that some participants explained how they were more likely to use the intervention during certain seasons, when their asthma symptoms were worse. Although we endeavoured to recruit participants across a broad demographic range, participants were

generally older and white, and had high levels of educational attainment. They were also recruited from a feasibility trial sample, so are unlikely to be representative of the wider asthma population³⁶. A wider reach would avoid further worsening the digital divide and health inequalities. Moreover, the small sample size of the feasibility study meant that we could not purposively sample participants based on their usage and were, therefore, only able to recruit one non-user. A larger sample size would have allowed us to better target and capture the views of non-users and those who were less engaged with the intervention. Interviews with the control group would have allowed us to explore their experiences with usual care, in order to explore which perceived benefits are unique to the intervention and not from the feasibility trial itself. Interviews with those who declined to take part in the trial would have also given us useful insights into their reasons for this and how user engagement might be improved³⁷.

Our findings demonstrated that My Breathing Matters is acceptable and engaging to its target group, and the intervention was delivered and worked as intended. The person-based approach to intervention development was key to maximising intervention engagement and acceptability for adults with asthma. Along with the findings from the feasibility trial, the current study supports the move towards a fully powered RCT, including a mediation and moderation analysis, with only minor modifications to the intervention content required. More broadly, our findings highlight aspects of intervention content and delivery (such as targeting key issues using person-based approaches, providing non-pharmacological self-management approaches), and contextual factors (such as perceptions of asthma control, current self-management practices) that may influence user engagement with digital asthma interventions. These should be considered when implementing the intervention or when developing asthma behaviour change interventions.

Methods

Design

A convergent mixed methods design was used for the process evaluation in which qualitative and quantitative methods are implemented in the same research phase and given equal weight, but the data is analysed separately³⁸. The process evaluation was embedded in a feasibility RCT of My Breathing Matters. Trial participants were randomised into an intervention group who were given access to My Breathing Matters or a usual care group. Outcome measures were assessed at baseline, 3 months and 12 months. Further details on the trial methods and feasibility outcomes are available elsewhere²⁴. Quantitative usage data were collected to describe patterns of intervention usage over the 12-month study period. The My Breathing Matters Satisfaction Questionnaire was devised for this study and administered to intervention participants at 12-month follow-up to assess their satisfaction with the intervention. Qualitative interviews were carried out to explore intervention participants' views and experiences of My Breathing Matters. Ethical approval was granted by the University of Southampton and South Central – Berkshire Research Ethics Committee (REC reference: 16/SC/0614). To increase the transferability of the research, the COREQ checklist³⁹ was used to guide reporting the qualitative research (Supplementary Table 2) and ensure a rich description of the participants and the research process.

Intervention

My Breathing Matters was systematically developed using person-, evidence-, and theory-based approaches, drawing upon primary mixed methods research^{17,31,40}, quantitative¹⁴ and qualitative⁴¹ systematic reviews, and consultation with Public and Patient Involvement (PPI) representatives and clinical and intervention development experts.

Following a person-based approach²², guiding principles were created, including intervention design objectives and design features to address key issues, needs and behavioural challenges

of the target population identified in the evidence synthesis stage. One key behavioural issue that emerged from the literature search conducted in the intervention development phase is that some people with non-optimal asthma control do not consider themselves as people with active asthma⁴²⁻⁴⁴. Therefore, one intervention design objective was to specifically engage this group. To do this, the intervention maintained a positive illness context throughout (referring to ‘keeping breathing healthy’ rather than ‘preventing asthma symptoms’), provided optional and flexible support only when needed, and promoted the belief that impaired quality of life can be improved (Supplementary Figure 1). To target influences on asthma control that are not often acknowledged, such as anxiety, stress and lifestyle (e.g. smoking, obesity, avoidance of physical activity), other design objectives aimed to encourage users to engage in non-pharmacological (e.g. breathing retraining, stress management, lifestyle changes), as well as pharmacological self-management, to improve asthma control (see Yardley et al. 2015¹⁵ for this process in more detail).

Theory-based behaviour analysis was used to identify the influences on target behaviours and the intervention components that could address these, and describe the intervention in terms of existing theory and programme level theory. A logic model was created to illustrate the hypothesised mechanisms of impact that explain how My Breathing Matters is expected to lead to improvements in asthma-related quality of life (Figure 5). My Breathing Matters is hypothesised to improve asthma-related quality of life through behavioural adherence (improved pharmacological and non-pharmacological management, engagement with the intervention), improved physiological outcomes (asthma control, lung function, exacerbations), and improved psychological outcomes (stress, mood, enablement). Table 5 outlines the components of the intervention in more detail.

An intervention prototype was developed and, consistent with a person-based approach, the views and experiences of adults with asthma who used the intervention were explored using

iterative qualitative methods (think aloud and retrospective semi-structured interviews) and the intervention was modified in response to this feedback.

On each unique login, users were asked to complete a brief quality of life assessment measuring activities, sleep, stress, illness, and reliever medication use (Supplementary Figure 2). Based on their answers, users were signposted to relevant content. Content was not available all at once, rather different content was ‘unlocked’ at various time points after the user’s first visit to the website to encourage long-term engagement with the intervention (Supplementary Figure 3). The intervention is self-directed, but the contact details for the Asthma UK helpline were given to provide additional support if required. The intervention is available at mybreathingmatters.co.uk.

Participants and recruitment

Participants were eligible for the feasibility trial if they were aged 18 years or over, had physician-diagnosed asthma managed in primary care, had received at least one anti-asthma medication prescription in the previous year, and could use the Internet (self-judged). Anti-asthma medication included all commonly used inhaled and oral preparations for asthma treatment (both regular medication and as-required reliever preparations), such as inhaled corticosteroids, long and short acting beta agonists and leukotriene receptor antagonists. No patients were receiving injected biological treatments or maintenance oral corticosteroids. Participants also needed to have an impaired asthma-related health status at baseline, defined as a Mini Asthma Quality of Life Questionnaire⁴⁵ score of less than 5.5. Full trial inclusion and exclusion criteria are described elsewhere²⁴.

Eligible participants were identified and invited to take part in the trial by seven general practices from the Wessex, UK primary care research network. After the 3-month follow-up, all intervention group participants ($n=44$) were approached by phone or email by a member

of the study team and were invited to take part in a qualitative interview, irrespective of whether they used the intervention. Drawing on the guidelines on information power in qualitative interview studies⁴⁶, we aimed to recruit approximately 20 participants to the interview study. This number was deemed adequate given the study's narrow aim (views on one intervention), the small source population ($n=44$), the specificity of the experiences, knowledge and properties among the intervention trial participants, and the likely high quality of dialogue from using an experienced qualitative researcher. Informed consent was obtained for all trial participants. Participants received a £10 shopping voucher for submitting their follow-up questionnaires at 12 months. Interview participants did not receive any additional incentives for taking part.

Data collection

Intervention usage was automatically collected by the LifeGuide software (<https://www.lifeguideonline.org>), which was used to create and host the intervention. Data were collected on the number and duration of logins, date of last login, and pages visited. Participants were informed that they could use the intervention as much or as little as they liked.

The My Breathing Matters Satisfaction Questionnaire (Supplementary Note 1) was administered by paper at the 12-month follow-up appointment with a research nurse to those who registered with the intervention. Better understanding of the potential benefits and burdens of health interventions can help us to optimise these interventions and improve their effectiveness^{47,48}. To explore these two aspects, we devised two items to assess benefits gained from using the intervention and disadvantages of the intervention, and open questions allowed participants to report any benefits and disadvantages. These items were developed in discussion with our multidisciplinary intervention development team, consisting of experts in

intervention development and evaluation, behavioural science, and health economics. The one-item NHS Friends and Family Test⁴⁹ assessed how likely participants are to recommend the intervention to friends and family if they needed similar care and treatment using a 5-point Likert scale ranging from ‘extremely likely’ to ‘extremely unlikely’, with a ‘don’t know’ option. This tool is used by NHS England to assess patient satisfaction across a wide range of services.

For the qualitative interviews, a semi-structured interview schedule was developed by experts in health psychology (KG, BA, LY) and asthma (MT, BA, AB), and a PPI representative with asthma (DR). Interview questions were designed to explore the key functions for process evaluation outlined in the Medical Research Council process evaluation guidelines⁵⁰: implementation (what was delivered), mechanisms of impact, and contextual factors. Specifically, the questions explored participants’ experiences of the intervention and its components, how they used the intervention, their perceived advantages and disadvantages of the intervention, times they were more and less likely to use the intervention, and reasons for any non-usage (See Supplementary Note 2 for interview schedule). Open-ended questions were used to ascertain the most important issues or challenges for participants.

Interviews were carried out by telephone by KG (female health psychologist and research fellow who has experience in qualitative research) who was not involved in intervention development and did not know the participants prior to the interviews. Participants were told that the interviews aimed to explore their view and experiences to help improve the research and intervention for future users. Interviews took place between July 2017 and January 2018, lasted between 21-65 minutes, were audio-recorded, and transcribed verbatim.

Data analysis

The intervention usage data and the closed questions of the My Breathing Matters Satisfaction Questionnaire were analysed using descriptive statistics to describe patterns of intervention usage. Content analysis⁵¹ was carried out on the open question data to identify benefits and disadvantages of using the intervention.

The qualitative interviews were analysed using inductive thematic analysis^{51,52}. Data analysis was assisted by QSR's NVivo 11 qualitative data analysis software (QSR International Pty Ltd., 2017). Analysis was informed by guidelines for establishing trustworthiness in qualitative research⁵³⁻⁵⁶. KG familiarised herself with the data through repeated reading of the transcripts. Initial codes were generated that were grounded in the data and a coding manual was developed that listed all codes and themes, including descriptions and example quotes from the text. To increase the credibility of the research, the final coding manual was discussed and agreed with two other researchers (BA and LY) and the final interpretations in the results section were reviewed and agreed by all authors, as well as two PPI representatives. The constant comparison method⁵⁷, a grounded theory technique, was used to compare codes across different participants, contexts, and situations. Disconfirming case analysis⁵⁴ was used to actively identify data that did not fit with the identified themes. These two techniques were used to ensure the analysis was carried out with rigor and to increase its credibility. Participant quotes were used in the final write-up to illustrate the themes and pseudonyms used to refer to these participants. Data saturation was considered reached because participants in later interviews did not indicate any significant new benefits, concerns or barriers to engagement with My Breathing Matters.

Once the qualitative analysis was complete, we reviewed key findings from the interviews and My Breathing Matters Satisfaction Questionnaire to identify contextual factors and

aspects of the intervention's content and delivery that may have influenced user engagement with the intervention.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Competing interests

Neither MT nor any member of his close family has any shares in pharmaceutical companies. In the last 3 years, he has received speaker's honoraria for speaking at sponsored meetings or satellite symposia at conferences from the following companies marketing respiratory and allergy products: GSK, Novartis. He has received honoraria for attending advisory panels with; Boehringer Ingelheim, GSK, Novartis. He is a recent a member of the BTS SIGN Asthma guideline steering group and the NICE Asthma Diagnosis and Monitoring guideline development group. KG, BA, AB, EM, DR, and LY have no competing interests.

Author Contributions

All authors designed the study. KG was responsible for recruitment, data collection and analysis the data, with support from BA. KG drafted the manuscript with initial support from BA, LY, MT, and AB. All authors critically reviewed the manuscript, contributing important intellectual content and approved the final manuscript.

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Figure legends

Figure 1 Participant responses to single item relating to benefits of using My Breathing Matters.

Figure 2 Participant responses to item relating to disadvantages of using My Breathing Matters.

Figure 3 Participant responses to NHS friends and family test relating to how likely they would be to recommend My Breathing Matters to friends and family if they needed similar care and treatment.

Figure 4 Summary of the qualitative findings demonstrating the contextual factors and aspects of the intervention content and delivery that may influence engagement with My Breathing Matters and the perceived benefits.

Figure 5 Logic Model of My Breathing Matters intervention to improve quality of life in patients with asthma. Key: ^aUptake and engagement facilitation; ^bPharmacological support; ^cNon-pharmacological support.

Table 1 Participant demographics at baseline

	All intervention participants (<i>n</i> =44)	Users (<i>n</i> =36)	Non-users (<i>n</i> =8)	Interviewed (<i>n</i> =18)	Not interviewed (<i>n</i> =26)
Age					
Mean (SD)	57.0 (14.2)	56.8 (15.1)	57.9 (10.3)	60.3 (13.2)	54.7 (14.7)
Range	20-78	20-78	43-77	29-77	20-78
Gender n (%)					
Female	27 (61.4)	23 (63.9)	4 (50.0)	12 (66.7)	15 (57.7)
Male	17 (38.6)	13 (36.1)	4 (50.0)	6 (33.3)	11 (42.3)
Ethnicity n (%)					
White	42 (95.5)	36 (100.0)	6 (75.0)	18 (100.0)	24 (92.3)
Other	2 (4.5)	0	2 (25.0)	0	2 (7.7)
Baseline asthma quality of life (AQLQ) score					
Mean (SD)	4.9 (0.9)	5.0 (0.9)	4.2 (0.8)	5.0 (1.1)	4.7 (0.8)
Time since asthma diagnosis (years)					
Mean (SD)	25.2 (17.2) ¹	25.8 (18.0) ²	22.8 (14.4)	24.6 (19.7) ³	25.6 (15.8)
Range	1.3-64.0 ¹	1.3-64.0 ²	3.0-43.0	1.3-64.0 ³	3.0-64.0
Marital status (%)					
Married	28 (63.6)	24 (66.7)	4 (50.0)	13 (72.2)	15 (57.7)
Living with a partner	4 (9.1)	3 (8.3)	1 (12.5)	2 (11.1)	2 (7.7)
Widowed	4 (9.1)	3 (8.3)	1 (12.5)	3 (16.7)	1 (3.8)
Divorced	1 (2.3)	1 (2.8)	0	0	1 (3.8)
Separated	2 (4.5)	1 (2.8)	1 (12.5)	0	2 (7.7)
Single	5 (11.4)	4 (11.1)	1 (12.5)	0	5 (19.2)
Highest level of education (%)					
Postgraduate qualification (e.g. Masters, PhD)	4 (9.1)	3 (8.3)	1 (12.5)	3 (16.7)	1 (3.8)
Undergraduate qualification (e.g. Degree, HNC, HND)	20 (45.5)	19 (52.8)	1 (12.5)	6 (33.3)	14 (53.8)

Further education (e.g. A-Levels, ONC, OND)	5 (11.4)	5 (13.9)	0	2 (11.1)	3 (11.5)
School leaver (e.g. GCSEs, O-levels)	10 (22.7)	7 (19.4)	3 (37.5)	5 (27.8)	5 (19.2)
No formal educational qualifications	5 (11.4)	2 (5.6)	3 (37.5)	2 (11.1)	3 (11.5)
Age left full-time education					
Mean (SD)	19.4 (7.0) ⁴	19.5 (6.8) ⁵	18.9 (8.3)	20.7 (9.0)	18.4 (5.0) ⁶
Internet use per week (hours)					
Mean (SD)	13.1 (12.4)	13.2 (11.9)	12.9 (15.0)	12.4 (13.5)	13.7 (11.7)

Key: ¹ *n*=43; ² *n*=35; ³ *n*=17; ⁴ *n*=42; ⁵ *n*=34; ⁶ *n*=24; GCSEs = General Certificate of Secondary Education; O-Level = The General Certificate of Education Ordinary Level; A-Level = The General Certificate of Education Advanced Level; ONC = Ordinary National Certificate; OND = Ordinary National Diploma

Table 2 Numbers (and percentages) of participants who used each intervention component (n=36)

Intervention component	Participants who viewed at least one page of the session <i>n</i> (%)	Participants who used the main tool in the session¹ <i>n</i> (%)
Pharmacological content		
Medication Advice	21 (58.3%)	n/a
4-week challenge	19 (52.8%)	10 (27.8%) ¹
Personal Asthma Action Plan	16 (44.4%)	6 (16.7%) ²
Annual Asthma Review	16 (44.4%)	1 (2.8%) ³
Non-Pharmacological content		
Breathing Retraining	27 (79.4%)	20 (55.6%) ⁴
Stress Management	13 (36.1%)	6 (16.7%) ⁵
Friends & Family Support	10 (27.8%)	1 (2.8%) ⁶
Lifestyle changes		
Weight management	3 (8.3%)	n/a
Physical activity	3 (8.3%)	n/a
Handwashing	2 (7.7%)	n/a
Smoking cessation	0	n/a

Key: ¹Signing up to the 4-week challenge; ²Viewed blank plan or made online plan; ³Booked an appointment with GP and recorded the appointment online; ⁴Signed-up to breathing retraining; ⁵Using the stress management tools; ⁶Emailed someone a link to the Friend & Family module.

Table 3 Content analysis of free-text comments regarding benefits of using My Breathing Matters (n=28)

Code	Description	Frequency
Information provision	Intervention had improved awareness, improved or validated understanding about asthma and its management. Participants liked the lifestyle advice and tips on management. The information in the intervention was reliable and clear.	12
Provision of breathing retraining	The breathing exercises were cited as a benefit of using the intervention. The intervention helped them realise the benefits of the breathing exercises/correct breathing, learn correct breathing and be more aware of their breathing.	5
Medication adherence	The intervention helped people to build a medication habit, 'take notice' of medication, and made them realise they should be using a preventer inhaler regularly.	3
Lifestyle changes	The intervention provided lifestyle advice, including healthy eating, weight management, and physical activity. Participants had lost weight and increased their physical activity since using the intervention.	3
Reassurance	The intervention reassured people that their asthma symptoms were normal, that they were doing the right things to manage their asthma, and confirmed what they already knew.	3
Relaxation	The intervention helped people to relax. Participants started doing the relaxation techniques and they helped one participant get to sleep.	3
Access to information	The intervention provides access to information quickly and easily. The intervention can be accessed at home.	2
Control of asthma symptoms	The intervention helped people to control their asthma symptoms or improved their lung function.	2
Motivation for asthma self-management	The intervention makes people think more about their asthma and gives them to motivation to manage their asthma.	2
Provision of action plan	Being given access to an action plan/made aware of it.	2
Speaking to friends and family	Two participants had discussed asthma and its management with family and friends.	2
Dealing with triggers	The intervention helped one person deal with asthma triggers.	1

General health	The intervention made one person think about their general health, as well as asthma.	1
Support	The intervention made one participant feel they were being taken care of.	1

Table 4 Content analysis of free-text comments regarding disadvantages of using My Breathing Matters (n=13)

Code	Description	Frequency
Disliked design	Aspects of the design participants disliked, in particular the unlocking feature.	3
Not accessible on their device	The intervention could not be accessed on phone or computer tablet.	3
Difficulties logging on	Participants experienced difficulties logging on	2
Too many or too little emails	Participants received too many or not enough emails to keep engaged.	2
Annoying	The intervention was annoying or slow.	1
Boring	The intervention was short and became boring after a few months.	1
Lack of human contact	The intervention did not provide one-to-one human contact to allow the participant's questions to be answered.	1
Patronising	The intervention was patronising.	1
Time consuming	Participant did not have time to do the breathing exercises during the day.	1

Table 5 Description of My Breathing Matters intervention components

Target behaviour	Description
Improved preventer medication adherence	<ul style="list-style-type: none">• Information about the benefits of medication use for prevention of asthma symptoms.• Addressing ‘common concerns’ about asthma medication.• A 4-week challenge (in which users were encouraged to engage in habitual optimal preventer inhaler use) to help people develop positive medication habits.
Appropriate healthcare service use	<ul style="list-style-type: none">• Tools to create and store a Personal Asthma Action Plan and provide encouragement for its use.• Provide encouragement to attend an annual Asthma Review.
Engagement with breathing retraining	<ul style="list-style-type: none">• A breathing retraining programme¹⁷ to help control asthma symptoms, including videos on how to improve your breathing technique.
Engagement with stress management	<ul style="list-style-type: none">• Provision of stress management techniques, including relaxation, and advice on stress management (e.g. time management) and adaptive ways of thinking (e.g. thought awareness, using positive thinking, talking through your worries), to reduce asthma-related stress.
Send information to friends and family to encourage them to engage in asthma management	<ul style="list-style-type: none">• Ability to send friends and family a hyperlink to relevant information about asthma treatment and symptoms.
Lifestyle changes	<ul style="list-style-type: none">• Access to previously developed lifestyle change programmes adapted for asthma, including:<ul style="list-style-type: none">○ StopAdvisor¹⁸ to support smoking cessation,

-
- Getting Active¹⁹ to increase physical activity adapted for asthma,
 - POWeR²⁰ to support weight management,
 - Germ Defence²¹ to promote handwashing to prevent infections.
-

Figure 1

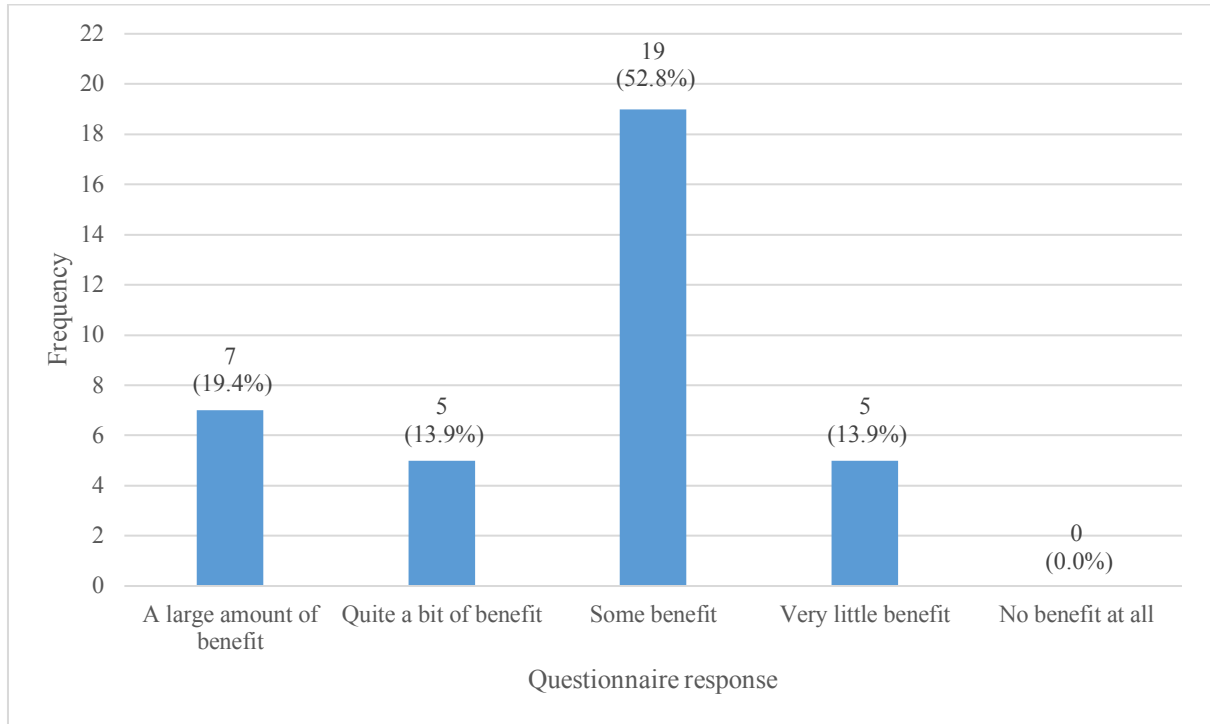


Figure 2

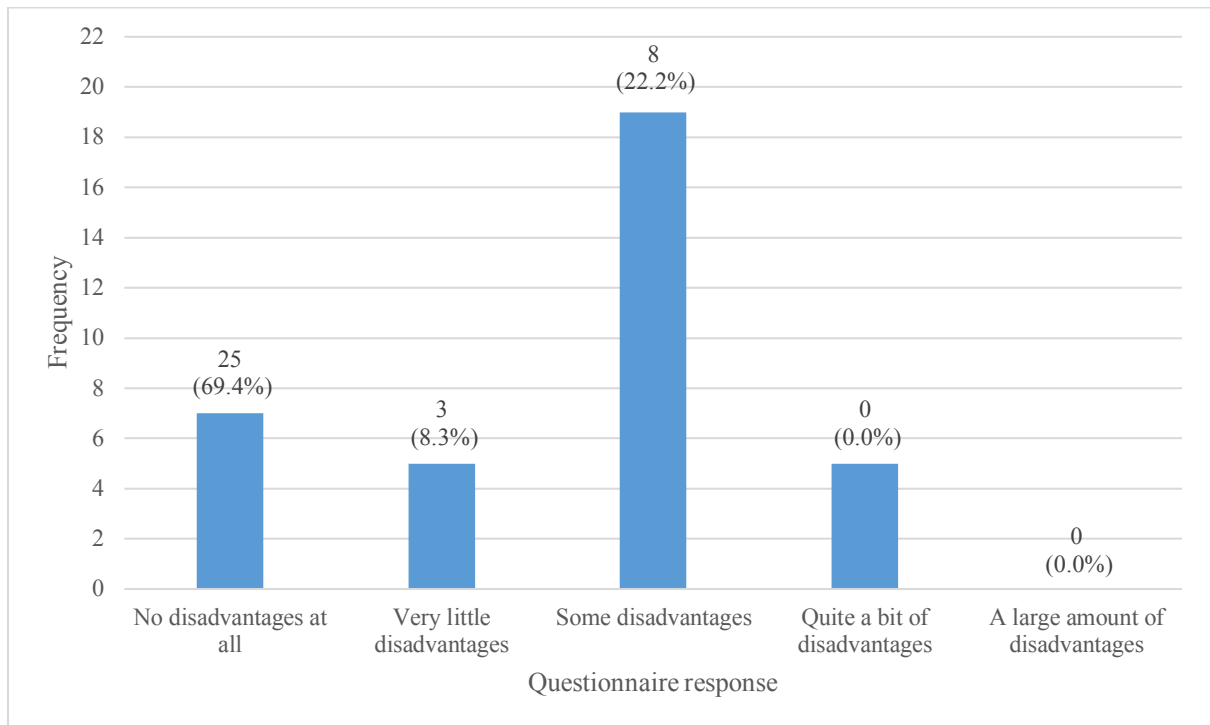


Figure 3

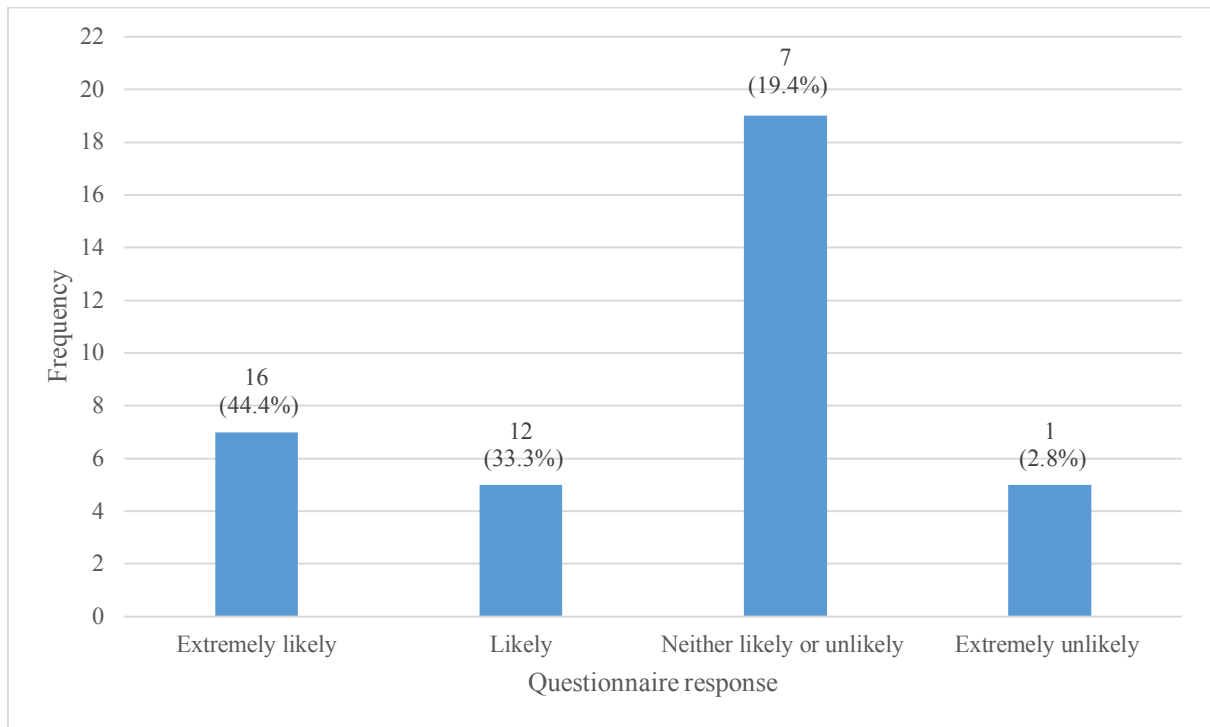


Figure 4

Before the intervention

During the intervention

After the intervention

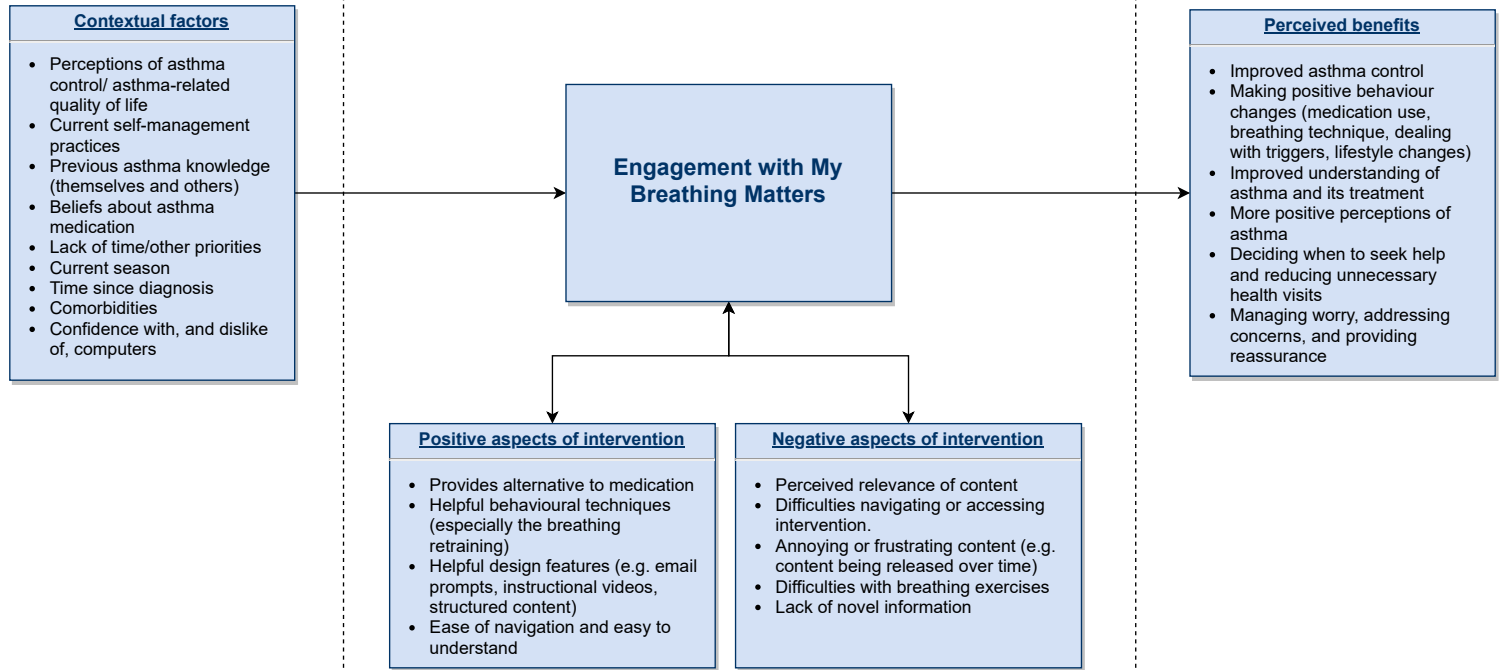
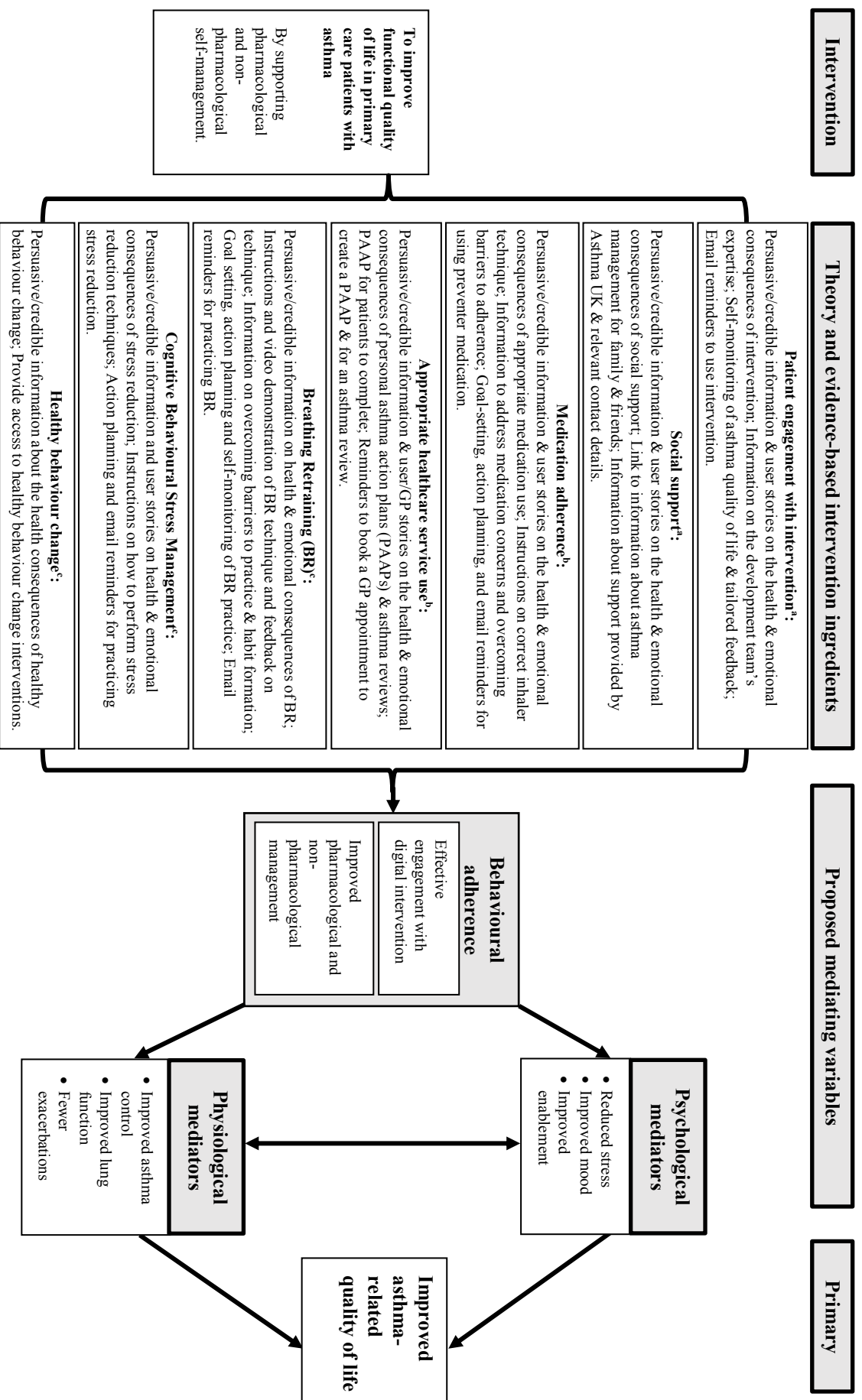


Figure 5



Supplementary Material

Supplementary Table 1 Themes and codes from data analysis for qualitative interviews

Theme	Codes
Benefits of My Breathing Matters	Improved asthma & symptoms
	No noticeable change in asthma or breathing
	Reduction in medication use
	Improved medication adherence
	Provides an alternative to medication
	Improved breathing technique & posture
	Identifying, and dealing with, asthma triggers
	Prompts lifestyle changes
	Managing breathlessness and chest tightness
	Facilitates self-management
	Improved knowledge of asthma and its treatment
	Better use of healthcare resources
	Relaxation
	Thinking more positively about asthma
	Provides reassurance
Feeling less alone	
Views on the intervention content	Views on 4-week challenge
	Views on personalised asthma action plan (PAAP)
	Views on asthma review
	Views on breathing retraining
	Views on stress management

	Views on Friends & Family section
	Views on lifestyle modules
	Views on Asthma UK & helpline
Views on the intervention design	Views on website appearance
	Views on intervention credibility
	Views on delivery format
	Views on emails
	Views on information and advice
	Views on information novelty
	Views on interactive features
	Views on usability
	Views on information architecture
Contextual factors influencing	Relevance of intervention components
intervention engagement	Perceptions of asthma severity
	Time since diagnosis
	Confidence with, and dislike of, computers
	Season
	Other priorities
	Other health problems

Supplementary Table 2 COREQ checklist for qualitative interviews

No	Item	Guide questions/description	Comments	Location in manuscript
Domain 1: Research team and reflexivity				
<i>Personal Characteristics</i>				
1.	Interviewer/facilitator or	Which author/s conducted the interview or focus group?	KG	Methods (Data collection)
2.	Credentials	What were the researcher's credentials? <i>E.g. PhD, MD</i>	KG – PhD, CPsychol.	Methods (Data collection)
3.	Occupation	What was their occupation at the time of the study?	KG – Health Psychologist & Research Fellow	Methods (Data collection)
4.	Gender	Was the researcher male or female?	Female	Methods (Data collection)
5.	Experience and training	What experience or training did the researcher have?	Experienced qualitative postdoctoral researcher.	Methods (Data collection)
<i>Relationship with participants</i>				
6.	Relationship established	Was a relationship established prior to study commencement?	Participants were not known to the researcher.	Methods (Data collection)

No	Item	Guide questions/description	Comments	Location in manuscript
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. <i>personal goals, reasons for doing the research</i>	Participants were told that the interviews aimed to explore their view and experiences to help improve the research and intervention for future users.	Methods (Data collection)
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. <i>Bias, assumptions, reasons and interests in the research topic</i>	The researcher was not involved in intervention development, although she was part of the same digital research team, which may have been a source of bias.	Methods (Data collection)
Domain 2: study design				
<i>Theoretical framework</i>				
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. <i>grounded theory, discourse analysis, ethnography, phenomenology, content analysis</i>	Thematic analysis.	Methods (Data collection)
<i>Participant selection</i>				

No	Item	Guide questions/description	Comments	Location in manuscript
10.	Sampling	How were participants selected? <i>e.g. purposive, convenience, consecutive, snowball</i>	All intervention participants from the feasibility trial were approached.	Methods (Participants and recruitment)
11.	Method of approach	How were participants approached? <i>e.g. face-to-face, telephone, mail, email</i>	All intervention group participants were approached by phone or email by a member of the study team and were invited to take part.	Methods (Participants and recruitment)
12.	Sample size	How many participants were in the study?	18	Results (Participants)
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	Participants who did not take part either withdrew before their interview was due ($n=4$; 9%), could not be contacted by phone or email after multiple attempts ($n=18$; 41%) or were too busy ($n=4$; 9%).	Results (Participants)
<i>Setting</i>				
14.	Setting of data collection	Where was the data collected? <i>e.g. home, clinic, workplace</i>	Telephone	Methods (Data collection)

No	Item	Guide questions/description	Comments	Location in manuscript
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	No	-
16.	Description of sample	What are the important characteristics of the sample? <i>e.g. demographic data, date</i>	Demographic information can be found in Table 1. Interviews took place between July 2017 and January 2018	Table 1; Methods (data collection)
<i>Data collection</i>				
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	The interview schedules can be found in Supplementary Note 2. It was reviewed a PPI representative.	Supplementary Note 2
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	Only single interviews were carried out.	-
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	Audio	Methods (Data collection)
20.	Field notes	Were field notes made during and/or after the interview or focus group?	Field notes were not made.	-

No	Item	Guide questions/description	Comments	Location in manuscript
21.	Duration	What was the duration of the interviews or focus group?	Between 21-65 minutes	Methods (Data collection)
22.	Data saturation	Was data saturation discussed?	Data saturation was considered reached because participants in later interviews did not indicate any significant new benefits, concerns or barriers to engagement with My Breathing Matters.	Methods (Data analysis)
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No	-
Domain 3: analysis and findings				
<i>Data analysis</i>				
24.	Number of data coders	How many data coders coded the data?	One (KG) but the coding manual was discussed and agreed with two other researchers (BA & Y)	Methods (Data analysis)

No	Item	Guide questions/description	Comments	Location in manuscript
25.	Description of the coding tree	Did authors provide a description of the coding tree?	Yes in Supplementary Table 1	Supplementary Table 1
26.	Derivation of themes	Were themes identified in advance or derived from the data?	Derived from the data (inductive analysis).	Methods (Data analysis)
27.	Software	What software, if applicable, was used to manage the data?	QSR's NVivo 11 was used.	Methods (Data analysis)
28.	Participant checking	Did participants provide feedback on the findings?	No, but the final interpretations were reviewed and agreed with two PPI representatives.	Methods (Data analysis)
<i>Reporting</i>				
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. <i>participant number</i>	Participant quotations are presented and each quotation is identified by a pseudonym and their gender, age and asthma duration is noted.	Results (Qualitative interviews)
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	Yes	Results (Qualitative interviews)

No	Item	Guide questions/description	Comments	Location in manuscript
31.	Clarity of major themes	Were major themes clearly presented in the findings?	Yes	Results (Qualitative interviews)
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Diverse cases are discussed. Coding tree presented in Supplementary Table 1.	Results (Qualitative interviews); Supplementary Table 1

Supplementary Table 3 SRQR checklist for qualitative interviews

No	Item	Description	Location in manuscript
Title and abstract			
1.	Title	Concise description of the nature and topic of the study. Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended.	Title identifies research as a mixed methods study, which includes qualitative research.
2.	Abstract	Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	Abstract formatted as per npj Primary Care Respiratory Medicine guidelines.
<i>Introduction</i>			
3.	Problem formulation	Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement.	Given in introduction.

No	Item	Description	Location in manuscript
4.	Purpose or research question	Purpose of the study and specific objectives or questions	Aims given in last paragraph of introduction.
<i>Methods</i>			
5.	Qualitative approach and research paradigm	Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., post-positivist, constructivist/interpretivist) is also recommended; rationale.	Mixed methods research; inductive thematic analysis. Approach detailed in the data analysis section.
6.	Researcher characteristics and reflexivity	Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions,	Characteristics of the interviewer, including credentials, relationship with participants and involvement in intervention development, given in data collection section.

No	Item	Description	Location in manuscript
		approach, methods, results and/or transferability.	
7.	Context	Setting/site and salient contextual factors; rationale.	Feasibility trial participants recruited from primary care. Interviews carried out by telephone. Detail given in participants and recruitment section.
8.	Sampling strategy	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale.	Study was nested within a feasibility randomised controlled trial study. All participants from intervention arm were approached. Data saturation was considered reached because participants in later interviews did not indicate any significant new benefits, concerns or barriers to engagement with My Breathing Matters. Detail given in participants and recruitment section.
9.	Ethical issues pertaining to human subjects	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other	Ethical approval was granted and details are reported in the Design section.

No	Item	Description	Location in manuscript
		confidentiality and data security issues.	
10.	Data collection methods	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale.	All data collection methods, including details of the interview and start and stop dates, given in the data collection section.
11.	Data collection instruments and technologies	Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	The interview schedules can be found in Supplementary Note 2. Interviews were audio-recorded (details in data collection section).
12.	Units of study	Number and relevant characteristics of participants, documents, or	Demographic information can be found in Table 1.

No	Item	Description	Location in manuscript
		events included in the study; level of participation.	
13.	Data processing	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding and anonymization / de-identification of excerpts	Transcription, use of pseudonyms, and data handling approach is outlined in the data collection and analysis sections.
14.	Data analysis	Process by which inferences, themes, etc. were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale.	Content and thematic analysis approaches are outlined in the data analysis sections. Structure of codes and themes provided in Supplementary Table 1.
15.	Techniques to enhance trustworthiness	Techniques to enhance trustworthiness and credibility of data analysis,(e.g., member checking, triangulation, audit trail); rationale	Techniques to enhance trustworthiness is outlined in the data analysis and strengths and limitations section.
<i>Results/Findings</i>			

No	Item	Description	Location in manuscript
16.	Synthesis and interpretation	Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	A diagram of the main qualitative findings is presented in Figure 4 and the findings are discussed in relation to prior research in the discussion.
17.	Links to empirical data	Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings.	Anonymised quotes are provided throughout the results section to support the qualitative themes.
<i>Discussion</i>			
18.	Integration with prior work, implications, transferability, and contribution(s) to the field	Short summary of main findings, explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline	The discussion explains how the findings support and build on previous research and highlights the unique contribution of this research.

No	Item	Description	Location in manuscript
		or field.	
19.	Limitations:	Trustworthiness and limitations of findings	The strengths and limitations are outlined in the discussion. Further details of the steps taken to increase the trustworthiness of the research is outlined in the data analysis section.
<i>Other</i>			
20.	Conflicts of interest	Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed.	Competing interests are declared at the end of the manuscript.
21.	Funding	Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Sources of funding are detailed in the acknowledgments section.

'Just my breathing'....

Lots of studies have shown that people with asthma often put up with symptoms thinking that it is normal for them, or that this is just the way it has to be.

People often say "this is just my breathing" not realising that they could be aiming for no symptoms, and be able to do all the activities they want to do !



A large survey in Europe asked people who had asthma that was affecting their life. Most of them thought their asthma was well controlled! Click [here](#) to find out more about this in a new page.

Back

Next

Supplementary Figure 1: Screenshot of My Breathing Matters pages to engage people who do not view themselves as having active asthma

Take a minute for My Breath Check

The aim of My Breathing Matters is to help you stay healthy, with as few signs of any asthma as possible.

My Breath Check will take just a minute, and will help you find information that is right for you. Firstly, please use the sliders to enter some details below about how your breathing has been in the last week.



My breathing has made some activities a bit more difficult (e.g. exercising, sleeping, working, housework, seeing friends).

Sometimes Almost all the time

At times I've been worried, stressed or angry about my breathing.

Not at all Sometimes Almost all the time

In the last month, I've had to use my reliever / blue inhaler more than twice a week

Not at all Sometimes Almost all the time

Next

Supplementary Figure 2: Screenshot of the My Breathing Matters breath check

Breathing Retraining Main Menu

More sessions will become available shortly after you complete each one. In the meantime, why not practice the sessions that are available to you below? The more you practice, the better you'll be!

1. Stomach and Nose Breathing

2. Slow Breathing

New content will be unlocked 24 hours after you've visited the last session.

3. Breathing while walking

4. Advanced Slow Breathing

5. Breathing in Everyday Life



[Click here for advice about how to do Breathing Retraining, or help if you are finding it tough.](#)

If you want to revisit the other parts of My Breathing Matters, you can use the menu buttons at the top of the page.

- If you'd like to reread the information about about the challenge (what it is, and how it works) then click [here](#).
- If you want, you can track your progress using a Breathing Retraining Progress Chart - find out more [here](#).

Supplementary Figure 3: Screenshot of My Breathing Matters breathing retraining with 'unlocking' feature

Supplementary Note 1: My Breathing Matters Satisfaction Questionnaire

INSTRUCTIONS: Please only answer the below questions **if you registered with the My Breathing Matters website in the last 12 months**. Please tick **one** answer for each question.

1. Did you think there were any benefits of using My Breathing Matters?

No benefit at all

Very little benefit

Some benefit

Quite a bit of benefit

A large amount of benefit

If any benefits, please note them down below:

2. Did you think there were any disadvantages of using My Breathing Matters?

No disadvantages at all

Very little disadvantages

Some disadvantages

Quite a bit of disadvantages

A large amount of disadvantages

If any disadvantages, please note them down below:

3. How likely are you to recommend My Breathing Matters to friends and family if they needed similar care and treatment?

Extremely likely

Likely

Neither likely or unlikely

Extremely unlikely

Don't know

Supplementary Note 2: Interview schedule

Interview questions for intervention participants who have logged on

- Q1. Can you tell me what it's like to have asthma?
- Q2. I'm really interested in hearing about your experiences of using My Breathing Matters, can you tell me all about it?
- Q3. Can you tell me about anything you liked about My Breathing Matters?
- Q4. Can you tell me about anything you disliked about My Breathing Matters?
- Q5. Can you tell me about any advantages of using My Breathing Matters for you?
- Q6. Can you tell me about any disadvantages of using My Breathing Matters for you?
- Q7. The research will continue for another 9 months. Do you think you will keep on using My Breathing Matters over this time? [*Prompts: Why/why not?*]
- Q8. Would you recommend My Breathing Matters to other people with asthma? [*Prompts: Why/Why not?*]
- Q9. Since using My Breathing Matters, how do you feel about your asthma now?
- Q10. Can you tell me about anything that you feel has changed from using My Breathing Matters?
- a. Can you tell me about what changed? (e.g. anything different in your day-to-day life, the way you are managing your asthma?)
 - b. Can you tell me how you came to notice things changing?
 - c. Why do you think these things changed?
- Q11. When do you think My Breathing Matters would be most helpful to you?
- Q12. When do you think My Breathing Matters would not be helpful to you?

For each component:

- Q13. **[If didn't use]** Can you tell me why you decided not to use this part of My Breathing Matters?
- Q14. **[If used]** Can you tell me about how you found this section? [*Prompts: What did you like/dislike? Can you tell me about any problems you came across when doing the challenge?*]

Emails:

- Q15. Can you tell me about how you felt when My Breathing Matters sent you emails?
- Q16. Can you tell me what you thought about what the emails said?
- Q17. Can you tell me your thoughts about how often you received the emails?
- Q18. Can you tell me about any other ways you would like My Breathing Matters to contact you?
- Q19. Can you tell me about any advantages of getting these emails?
- Q20. Can you tell me about any disadvantages of getting these emails?

Interview questions for intervention participants who have not logged on

- Q1. Can you tell me what it's like to have asthma?
- Q2. We are interested to hear from people who did not use My Breathing Matters, can you tell me why you have not used My Breathing Matters?
- Q3. What are your thoughts on using a website to help you to manage your asthma?
- Q4. The research will continue for another 9 months. Do you think you will use My Breathing Matters over this time? [*Prompts: Why/why not?*]