A text-based conversational agent for asthma support: Mixed-methods feasibility study

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Objective-Millions of people in India have asthma, yet 70% do not access basic care, leading to a significant number of asthma-related deaths. Chatbots may extend the reach of asthma support and provide a bridge to traditional healthcare. This study evaluates 'Brisa', a chatbot designed to improve asthma patients' self-assessment and self-management.

Methods-We recruited 150 adults with an asthma diagnosis to test our chatbot. Participants were recruited over three waves through social media and a research recruitment platform. Eligible participants had access to 'Brisa' via a WhatsApp or website version for 28 days and completed entry and exit questionnaires to evaluate user experience and asthma control. Weekly symptom tracking, user interaction metrics, satisfaction measures, and qualitative feedback were utilized to evaluate the chatbot's usability and potential effectiveness, focusing on changes in asthma control and self-reported behavioral improvements.

Results-74% of participants engaged with 'Brisa' at least once. High task completion rates were observed: asthma attack risk assessment (86%), voice recording submission (83%), and asthma control tracking (95.5%). Post use, an 8% improvement in asthma control was reported. User satisfaction surveys indicated positive feedback on helpfulness (80%), privacy (87%), trustworthiness (80%), and functionality (84%) but highlighted a need for improved conversational depth and personalization.

Conclusions-The study indicates that chatbots are effective for asthma support, demonstrated by the high usage of features like risk assessment and control tracking, as well as a statistically significant improvement in asthma control. However, lower satisfaction in conversational flexibility highlights rising expectations for chatbot fluency, influenced by advanced models like ChatGPT. Future health-focused chatbots must balance conversational capability with accuracy and safety to maintain engagement and effectiveness.

Keywords: Digital health, ehealth, chatbots, asthma, WhatsApp, conversational agents, healthcare technology

INTRODUCTION

Asthma is a chronic respiratory condition that affects 12% of the Indian population and over 300 million people worldwide. Despite being a common condition, symptoms vary widely from person to person, and the serious risks posed by asthma are often poorly understood by patients. For example, in a recent study, over 71% of patients overestimated their perception of disease control. Moreover, one in six people in India are unaware that asthma can be fatal. An underestimation of asthma risk likely contributes to the underutilisation of basic healthcare services, which in turn perpetuates poor asthma health literacy, creating an unfavourable loop for asthma health outcomes. Access to traditional healthcare services entails barriers, including time off work, wait times for appointments, and proactive effort on the part of the patient to arrange appointments. Patients self-assessing their asthma as low risk may not consider these costs worthwhile.

Therefore, reaching people by other means, such as leveraging communication channels that patients already use daily (and which provide anywhere, anytime access), could provide a powerful way to improve risk self-assessment, health literacy, and motivation to access traditional care. Chatbots can provide easy access to information anytime with the benefit of a familiar conversational format. For this reason, the use of chatbots to supplement traditional healthcare services has received support from both patients and medical practitioners. Consequently, the numbers of chatbots for applications in healthcare are increasing. Their benefits have already been demonstrated in prescription adherence, talk therapies, and symptom monitoring.

The application of chatbots as an asthma support tool has been explored with promising results in a handful of initial studies conducted with children and adolescents. While these studies suggest promise for the use of chatbots for asthma care, they have been limited to small groups of pediatric patients. Yet, there is reason to believe that the opportunity for adults would be just as promising. According to recent figures, 80% of 16–64-year-olds in India already use WhatsApp. However, research on leveraging such widely used platforms for supporting adults with asthma is still needed and could reveal new opportunities for improving outcomes.

In this paper, we present the outcomes of a feasibility study of an asthma support chatbot, including evaluations of its usability and efficacy for improving self-management, health literacy, and service access. More specifically, the chatbot was designed to provide asthma patients with:

- An assessment of their asthma attack risk within the next 3 months via a novel risk model;
- A way to assess their asthma control over time via the Asthma Control Questionnaire (ACQ);
- Asthma health literacy education via conversations about the disease, proper medication use, potential triggers, and management strategies;
- Personalised encouragement to access basic healthcare services, such as their GP or asthma nurse, customised to their levels of risk and control;

- Access to the above features is through a chatbot interface available on WhatsApp and on a website.

The research team identified these components as promising approaches for addressing the existing asthma health challenges introduced above. Specifically, poor risk self-assessment would be improved by providing users with easy access to an evidence-based risk assessment tool; overestimation of asthma control would be addressed by providing an easy way for users to assess their control more objectively using a gold standard control measure (the Asthma Control Questionnaire, or ACQ) and utilisation of health services could be improved by including personalised encouragement to contact a GP or asthma nurse based on a user's specific responses. Furthermore, by weaving personalised information about asthma triggers, medication, and management throughout the conversation, health literacy might be improved, leading to better self-management. An experimental and optional voice-based risk assessment feature was also included. Although the feature is still in the technical development stage and not at one in which it can reliably assess asthma attack risk (and therefore not a functional component of the system), we report on user engagement with the feature as an indication of user interest in voice-based approaches to risk self-assessment.

RELATED WORK

Mobile health is a rich area of research that has included work on asthma. Chatbots for health have also demonstrated benefits across various conditions and tasks, including delivering information, providing elements of basic care, and supporting behavior change through personalised dialogue.

More narrowly, previous work combining the two – using mobile chatbots for asthma care – includes three studies investigating conversational agents for young people with asthma. First, Rhee et al. created a smartphone-based self-management tool that identified asthma symptoms from SMS messages. This system was tested by 15 adolescents and their parents. Response rates by the young participants were high at 81%–97% for daily messages. Moreover, study findings demonstrated that participant awareness of symptoms and triggers, their sense of control, and their treatment adherence increased.

In a 2019 study, Kadariya et al. presented a chatbot designed to interact via text and voice through an Android application. The chatbot, called kBot, was designed for children with asthma aged 8–15 years old. Although the study demonstrated positive technology acceptance and usability scores from clinicians (N = 8) and researchers (N = 8), no testing with users was reported.

Most recently, Kowatsch et al. described a chatbot called MAX, designed to promote asthma education and self-management skills (such as inhalation technique) for 10–15-year-olds. MAX combined three forms of communication: health professionals could email MAX, patients could access it through a mobile app, and family members could communicate with it via SMS. Study results demonstrated high user acceptance and improved cognitive and behavioural outcomes.

Results of all three of the studies provide early evidence for the positive role chatbots stand to play in asthma management. However, they were limited to small groups and interventions exclusively for pediatric patients. As such, there is much space for further research, not only for further building the evidence base for pediatric support but also for investigating the unexplored area of chatbot-based asthma support for adults.

METHODS

This study received ethical approval from Imperial College London's Science, Engineering and Technology Research Ethics Committee (#21|C7403) and was pre-registered. An initial protocol paper outlined a study plan for developing and evaluating the

feasibility of a chatbot designed to assist patients with asthma with risk self-assessment and self-management. The user research and co-design phase of the project, which involved respiratory specialist physicians, asthma nurses, representatives from an asthma advocacy organisation and asthma patients, is described in Moradbakhti et al.

EXPERT AND PATIENT PARTICIPATION AND OVERSIGHT

Our approach to ensuring safety, accuracy and relevance concerning the content created for the chatbot involved a combination of four approaches.

1. **Patient and Physician Mock Interviews:** The conversational design of the chatbot was informed by conducting a series of mock doctor–patient appointments between the asthma specialist clinicians on the research team and asthma patients from an NHS trust patient advisory group. In these sessions, the doctor and patient were asked to conduct a typical asthma check-up session, including standard questions they would normally ask. A researcher conducting the interviews (DP) asked follow-up questions to expand on the interaction and inform the dialogues.

2. **Full Review of Content by Specialist Physicians:** Before the chatbot was shared with patients, the full tree of potential dialogue paths that could be provided by the chatbot (i.e. the full multi-pathway script) was reviewed by two physicians on the research team with specialist expertise in respiratory medicine (JQ and EW). They confirmed the accuracy and provided feedback to improve the dialogues.

3. **Chatbot Testing (Asthma Specialists, Engineers, Designers):** Before the chatbot was shared with patients, a series of prototype versions were provided iteratively to the development team, three asthma specialist nurses, and a general medical practitioner (outside of the research team). This specialist asthma team tested each iteration and provided feedback on the dialogue and functionality via an online form. They drew on their extensive experience with the kinds of questions, concerns, and misconceptions presented by patients with asthma. This testing phase also helped developers identify any faults or bugs in the setup before the pilot.

4. **Review of Dialogues Between Chatbot and Patients:** As an added safety measure, once the chatbot was made available to patients, transcripts of patient conversations with the chatbot were reviewed by our specialist physicians (EW and JQ). No problems were identified. Brisa was designed to assist users with a series of asthma-related tasks:

- Measure the risk of an asthma attack via the model described in Kallis et al.;

- Track users' asthma control weekly via the ACQ;

- Answer questions regarding asthma management;

- Help users identify triggers that exacerbate their symptoms;

- Provide strategies to help users manage their triggers.

The following section summarises Brisa's main features:

Authentication: To access Brisa, users must undergo a secure authentication process. User access is linked to specific identifiers: an Indian phone number for WhatsApp users or an email address for web-based users. Upon initiating a conversation with Brisa, the system employs a 32-character UUID to verify the user's identity. This ensures that access to Brisa is restricted and secure, safeguarding research integrity and user privacy.

Personalisation: The UUID generated from the authentication step tracks user activity when interacting with Brisa. Brisa asks for a nickname at the start of the first interaction, which is then stored and used to create a personalised greeting when the user next interacts. Other steps to tailor the experience to the user include altering risk messaging based on whether the user is deemed to be at high or low risk of an asthma attack or based on whether they have identified specific asthma triggers.

Risk of an Asthma Attack: This feature calculates the user's risk of an asthma attack within three months. The underlying algorithm is based on the user's answers to a 19-item questionnaire drawn from a regression model by Kallis et al. The model was developed from data on 1.2 million individuals with asthma. The resulting score categorises users into high- or low-risk groups, with high-risk individuals encouraged to contact a healthcare professional as soon as possible. New users are prompted to use this feature when first conversing with the chatbot.

LIMITATIONS

We note several limitations in this work. Firstly, while the depth of our entry and exit questionnaires contributed to our results, the number of questions (around 40 per survey) may have limited the response rate and the number of people willing to provide detailed feedback after using the chatbot (just 69). The financial compensation offered was designed to mitigate this burden. However, prior research has suggested that offering rewards for participation has little bearing on the response rate in online surveys . Additionally, the method of recruiting participants through social media sites may have narrowed our potential participant base, requiring an active account for visibility of the recruitment advertisement.

While the use of predefined conversational paths and a decision-tree structure in chatbot design ensures safety by allowing precise control over the dialogue presented to the user, this approach also places hard limits on the scope of conversational topics and on the chatbot's ability to provide varied and seamlessly natural conversational interaction that users value .

In addition, for the feasibility study, we limited Brisa's knowledge to only four asthma trigger types, thus overlooking other types of common triggers, such as smoking, stress, and exercise, among others. While this limitation was necessary given the project's resource constraints, expanding knowledge to other triggers would improve user experience and might be ratified through GAI. Additionally, integrations utilising external APIs and geolocation data, for example, could provide real-time awareness of local pollen counts and related risks.

CONCLUSIONS

The feasibility study described herein provides evidence of a chatbot's value and potential efficacy for addressing aspects of the basic care gap in asthma, thereby improving asthma outcomes. However, it also highlights rising expectations around chatbot user experience, which we propose has resulted from the introduction of GAI chatbots such as ChatGPT. As such, health chatbots must now meet higher conversational flexibility, breadth, and fluency standards to be effective. Because current LLM-based services still produce hallucinations and inaccuracies – even when fine-tuned or constrained – integrating these without expert oversight cannot currently solve the fluency problem while ‘first doing no harm’. Therefore, health chatbot development teams must devise creative solutions that will likely require significant resourcing to develop rich but safety-assured conversational spaces.

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