Asthma patients' perspectives on telehealth in disease management: A focus group study

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ABSTRACT

Objectives: While the effectiveness of telehealth (TH) to improve health outcomes is well established, the utility of *e*health care among adult asthma patients, particularly in patients with limited access to specialty lung clinic services, requires further investigation. This study aimed to explore asthma patients' perceived applicability of TH in asthma self-management practices, to inform a future TH-based interventional study.

Methods: A qualitative exploratory study design was applied during virtual, patient-orientedfocus group sessions and individual telephone interviews. Participants responded to questions spanning 4 main topics: 1) understanding of and beliefs on TH; 2) perceptions about the application of electronic asthma action plans; 3) using tele-communication to interact with a care provider; and 4) prospective TH features for asthma management. Data were collected from 25 patients with asthma (19 attended one of two focus groups and 6 were interviewed individually). Codes and definitions were developed inductively and assembled into a coding framework. Transcripts were subsequently coded, and thematic analysis was performed.

Results: Group discussions and individual interviews generated 4 TH-related themes: 1) past experiences and future use of TH; 2) perceived advantages and disadvantages of TH in asthma management; 3) integration of TH into self-management practices; and 4) features of a practical TH model for the current healthcare system.

Conclusion: Participants input in the design of TH interventions for asthma management could improve access to and quality of virtual care services.

Introduction

Health information technologies (HIT) supplement care by providing virtual appointments, e-prescriptions, online disease-specific information, and education.[1] HIT is proposed to improve patient safety by reducing medication errors, reducing adverse drug reactions, and improving compliance to practice guidelines.[2] Telehealth (TH) is a specific aspect of HIT that utilizes telecommunication technologies to improve the interaction between healthcare providers and patients, while supporting remote care, patient monitoring, and patient consultation.[3,4] The median wait time for an in-person consultation with a respirologist in Canada ranges from 3 weeks to 6 months.[5] In addition, at least 35% of patients reported difficulties seeking needed care services

while travelling an average of 32 km or more to see a health provider.[6] Thereby, TH is a potential supplemental approach to minimize the access and distance burden and facilitate a patient-centred system by improving patient self-management practices, enhancing patient-clinician interactions, and improving patient understanding of medical treatment.[7]

TH interventions are being increasingly adopted in asthma management and showing promising results.[8,9] For instance, a 2020 systematic review found that *e*health intervention outcomes show positive effects on asthma control, quality of life (QoL), and medication adherence.[10] Similarly, a 2021 systematic review found that a TH intervention improved asthma patients' QoL, despite a small effect size.[11] TH is proposed as a convenient platform for asthma education for patients

living in rural areas or underserved communities.[12] Furthermore, innovative mobile asthma applications have been gradually implemented to transition the traditional written Asthma Action Plan (AAP) and asthma diaries to electronic means. AAPs are an integral component of supported self-management in which patients are given individualized written instructions, decided jointly by the physician and patient or their caretaker, on how to manage triggers, symptoms, and medications to minimize the chances of adverse outcomes.[13] The electronic asthma action plans (eAAP) have been suggested to ease access to a patient's plan, positively impacting patients' asthma control and AAP satisfaction.[14]

During the SARS-CoV2 (COVID-19) pandemic , asthma patients were one of many patient groups that were varyingly impacted.[15] With vigorous social distancing measures in place, especially in the early stages of the pandemic, several studies found a reduced number of exacerbations among asthma patients over time.[16,17] Asthma patients' access to appropriate medical supports and equipment (e.g., accessible diagnostic spirometry and availability of respirologists), particularly for patients with severe asthma, was believed to have worsened during the COVID-19 pandemic.[18,19] Moreover, some asthma patients reported requiring a step-up in therapy dosage or frequency due to unfavourable respiratory symptoms,[20] anxiety, and stress from fears related to COVID-19.[21] To help mitigate these issues, TH was diffusely and rapidly implemented during the pandemic to provide care avenues for patients.[22]

Despite promising findings of the effectiveness of TH in chronic respiratory management,[23–25] researchers have also found that asthma patients often feel anxious when using TH interventions for their asthma management. Therefore, a better understating of patients' beliefs about the advantages and challenges of using TH in self-management practices and their viewpoints about features of a usable TH technology can help design and implement suitable interventions to prevent or alleviate this anxiety.[26] In addition, the co-creation of an intervention through involving end-users (i.e., patients) was suggested to improve the effectiveness by bringing an asset-based approach that builds on patients' existing capabilities, transferring knowledge, and respecting equality and power between providers and receivers of care.[27] As such, this study aimed to explore asthma patients' perspectives on the applicability and usability of TH in asthma management and identify patient-suggested features for a TH intervention. Findings from this study will help to inform a large-scale TH randomized controlled trial (RCT) study for asthma patients as part of the co-creation of a disease management TH intervention.

Background

To understand the effectiveness of TH interventions in asthma management, our research group previously conducted a critical appraisal of 13 systematic reviews, summarizing 438 articles assessing the impact of TH on asthma outcomes.[28] We concluded that there is equipoise in using TH in asthma management, as also reported by studies from Mammen et al. and Hui et al.[29,30] However, the results of this review revealed that few studies engaged patients during development and highlighted the need to involve patients when developing and implementing asthma TH interventions.[31,32]

The main objective of this study was to gather asthma patients' insights on the applicability and appropriateness of TH in asthma management. The secondary objective was to understand patients' viewpoints on the utility of various TH-related features in asthma care. The study questions were: 1) Do asthma patients believe that TH is appropriate and applicable for their asthma management, and if so why/ why not? 2) What TH features do asthma patients envision being

integrated into their asthma management?

Methods

Study design

A qualitative exploratory study design was applied to explore asthma patients' perceived applicability of TH for asthma management, including the applicability of an eAAP, and their perspectives on potential TH intervention features. This approach was adopted to encompass a flexible attitude in data collection to capture the underlying factors that may be influencing one's perceptions and attitudes toward TH.[33] To achieve this goal, two virtual focus group sessions (N = 19) and six individual telephone interviews were conducted with asthma patients from the Greater Vancouver Area (GVA). Ethics approval was obtained from the Institutional Review Board (approval number: H21–02767).

Participant eligibility & recruitment

Asthma patients who consented to be contacted from a parent study were conveniently sampled between November 2020 and March 2021. The parent study was a nationwide project focused on developing a functional health literacy measurement tool for chronic respiratory patients. As asthma patients from the community had been recruited for the parent study, our team scanned its participant list to assess eligibility. Participants were eligible if they: 1) had a physician diagnosis of asthma; 2) were at least 19 years of age; 3) were able to communicate verbally in English; and 4) were comfortable with virtual study procedures (Zoom for focus groups, phone for interviews). Subsequently, individuals who agreed to participate were emailed an informed consent form (ICF) outlining study objectives and procedures, potential risks and benefits, handling of collected data, and the study team's contact information. ICFs were electronically signed by patients and returned by email prior to participation.

Focus group/interview structure, procedures and data collection

Initially, the team's proposed TH intervention (in development) was consulted to determine gaps in the model. These identifications were then used to guide the development of questions for discussions during the group and individual sessions. Next, a comprehensive literature review to identify strategies to design discussion questions and virtual interviews was conducted; findings were discussed with the research team. An initial draft of questions was developed following the discussion by one research staff (YC) and revised by two team members (MM and IP). In total, there were 14 questions spanning 4 topics: 1) understanding of and beliefs on TH; 2) perceptions about the application of electronic asthma action plans (eAAP); 3) communicating with a care provider via TH; and 4) prospective TH features for asthma management.

Two semi-structured focus group sessions[34] occurred via video-conferencing software, Zoom and six individual interviews were conducted via telephone. Three research assistants (YC, MM, and NT) and a senior research scientist (IP) facilitated focus group sessions. The senior research scientist led the discussions and the research assistants ensured participant engagement and handled technical difficulties. Sessions were patient-oriented[35]; hence, discussion questions were introduced by a staff member and participants were invited to contribute, if comfortable. One-on-one telephone interviews were hosted by a research assistant and followed the same structure and question set as focus groups. The two focus group sessions lasted 100 minutes and
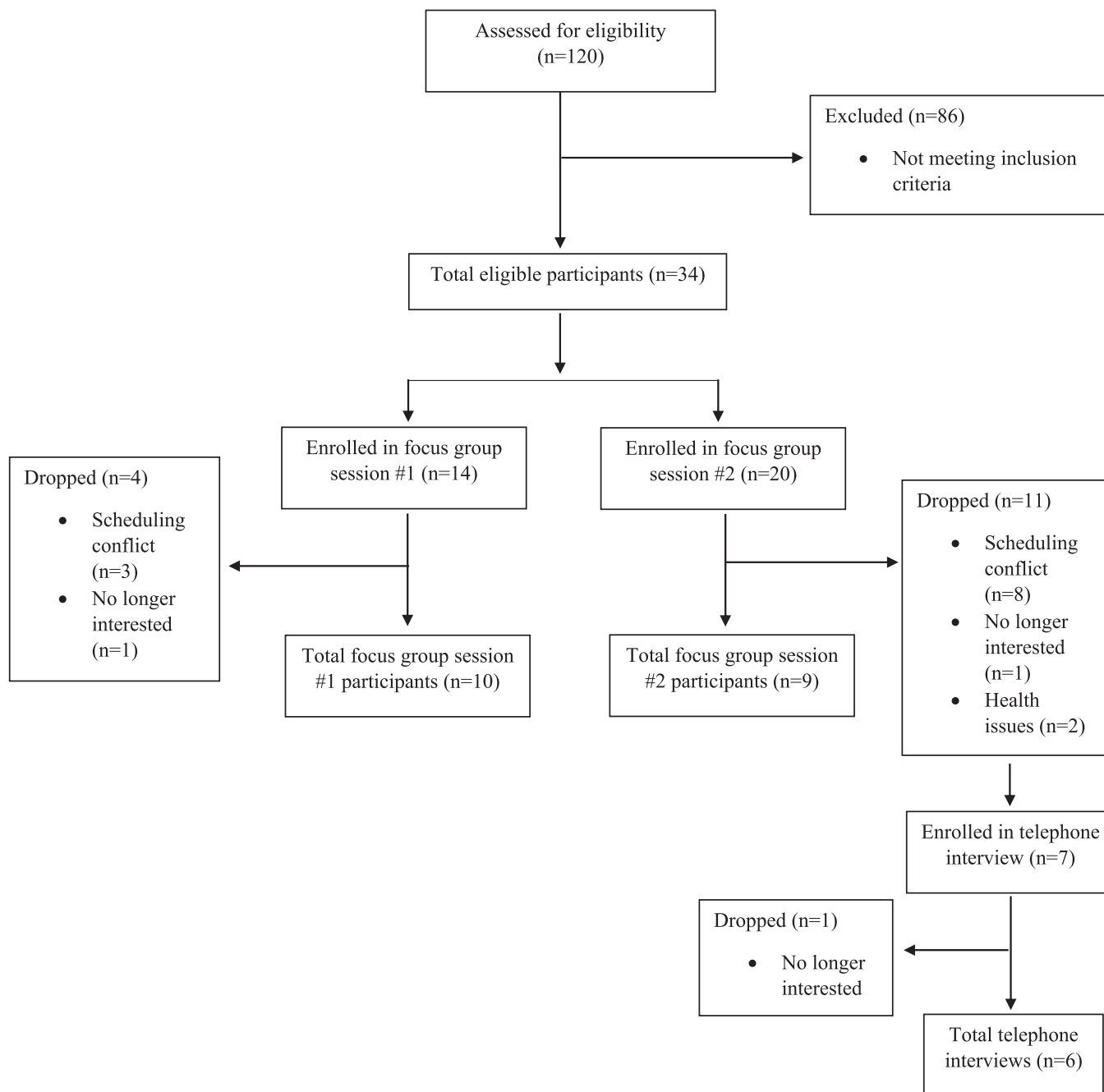
Fig. 1. Participant Recruitment Flow Diagram.

Table 1
Patient Demographics (n = 25).

		N (%)
Sex	Male	6 (24)
	Female	19 (76)
Age	<50 years	9 (36)
	50–70 years	11 (44)
	>70 years	5 (20)
English as first language	Yes	21 (84)
	No	4 (16)
Ethnicity	Caucasian	19 (76)
	Non-caucasian	6 (24)
Education	High school diploma or less	5 (20)
	Post high school diploma (e.g., college or university education)	20 (80)

115 minutes, respectively, and the six individual telephone interviews lasted between 20 and 45 minutes. Sessions were audio recorded and transcribed verbatim by a research assistant (YC) and checked for clarification and accuracy.

Data analysis

Initially, two research staff (YC and NT) thoroughly familiarized themselves with the transcripts and independently created preliminary codes. An inductive approach to code development was taken.[36] Subsequently, the two coders and a third staff member (AM), who acted as the mediator by resolving any coding disagreements or discrepancies, met to consolidate the preliminary codes into a coding framework, consisting of codes and their definitions.

The coding framework was piloted, and inter-rater agreement was assessed. A minimum agreement of 80% is considered a suitable threshold[37] and 10–25% of data is an acceptable test sample.[38] Coding was conducted using Nvivo 12 (QSR International). Initially, a random selection of 15% of the transcript was independently coded, and the coders did not meet the desired agreement threshold. The coders and mediator subsequently discussed disagreements and modified the framework accordingly. Following discussions, an updated coding framework was tested using a new, random 12.5% of the transcript, and > 80% agreement was achieved. The remaining data were divided and coded independently by the coders. Subsequently, the mediator reviewed and confirmed the coding; any necessary changes were discussed and applied.

Following coding, the team conducted a final review and refinement of the applied codes. Once the codes were finalized, coders and the mediator reviewed them and developed the major themes via thematic analysis.[39] Descriptive saturation was considered attained when no new categories or themes emerged from additional analysis.[40]

Results

Overall, 25 community-based adult asthma patients participated in the study (n₁ focus group = 10; n₂ focus group = 9; n individual interviews = 6) (Fig. 1). The demographic characteristics of the participants are shown in Table 1. Our analysis yielded four major themes that were relevant to the research questions: 1) past experiences and future use of TH in asthma management; 2) perceived advantages and disadvantages of TH in asthma management; 3) integration of TH into self-management practices; and 4) features of a practical TH model for the current healthcare system. Each theme is discussed in this section in further detail, with participant quotes provided for context. Additional quotes for each theme can be found in Appendix 1.

Theme 1) past experiences and future use of telehealth in asthma management

Most patients had some knowledge and experiences using TH technology, mainly to communicate with a family physician. Of the few patients who had not used TH, lack of experience using digital technologies was the main reason for avoiding the service. A female participant stated: '*I have to tell you, I'm not [a] smartphone user. And I know that there are tons of apps out there for various things that I [haven't] tried.*' Despite some patients having no experience using TH, almost all participants had a positive attitude toward TH. Additionally, several patients agreed that TH was a good idea, but in-person interaction with a practitioner was still important. A female patient said: '*I think there are things that I would want to see my doctor face-to-face for.*'

Some patients expressed how TH use may depend on the context. A male patient claimed: '*There may be situations where [TH] is difficult to apply, and you may need to see the doctor personally. Depends on your injury, or ailment.*' Patients were also open to communicating with different health practitioners via TH. For instance, a male patient suggested: '*I don't see why we couldn't have [communication with] somebody who is not a doctor, who has some medical training.*' In terms of frequency of access, many patients stated that they would use TH when they had questions or experienced non-emergency health situations.

Theme 2) perceived advantages and disadvantages of telehealth in asthma management

A main perceived advantage of TH was improved access to resources and healthcare services. A female patient claimed: '*I actually think TH is quite advantageous because… a lot of time is saved. You don't have to drive to the doctor's office… you don't have to deal with traffic… I think it's great that you are just able to pick up the phone or [get] an app and visit a doctor.*' Moreover, a female patient stated that due to improved convenience, they would be more inclined to attend a virtual appointment compared to an in-person appointment: '*No matter how crummy you feel, you cannot cancel the appointment because you can't go… You still have to make the appointment and it is a very good thing because then you cannot avoid it.*' Further, shorter wait times to see a physician was another perceived advantage by a female patient: '*Maybe you can get in faster to [speak to somebody] on the phone and [you] don't have to wait in the waiting room.*' A few patients also mentioned that TH can improve access to prescription renewals. One female patient stated: '*If I can do [a prescription refill] in a call, it is much more efficient and better.*' Several patients also saw TH as advantageous during the COVID-19 pandemic due to improved safety. For instance, a female patient claimed: '*I see a lot of advantages to [TH], particularly in our current situation because you don't have to go into an office; you don't have to expose yourself to other contagion.*' Another perceived advantage of TH included the ability to proactively engage in

conversations with care providers and other patients.

Several disadvantages were mentioned by participants. The most frequently mentioned disadvantage was the lack of in-person interaction with a care provider, including insufficient examination and impersonal interactions. For example, one female patient mentioned: '*The disadvantage is that if there is an exam that needs to be done... You may not convey the actual sounds or [physical symptoms] that... the patient may be experiencing.*' Another perceived disadvantage was the reduced available appointment call times. A female patient stated: '*I feel like if you're in-person, they're more accommodating to [when] you can be off of work... But with [TH], they've [physicians have] been shortening their days, so I only have from a certain window to call them ... which makes it more difficult to [schedule] an appointment.*' Moreover, one female patient acknowledged potential inequities associated with TH: '*Not everyone has a socioeconomic access... to phones and computers... there are still a lot of communities and people that don't have it because of where they are located... or that those families can't afford it.*'

Theme 3) integration of telehealth into self-management practices

Only a few participants had a personalized AAP, and the majority did not have an AAP or knowledge of what an AAP was. Among the few who did have an AAP, most viewed it positively in disease management. Patients who did not have an AAP believed it could help their asthma management when they were explained what an AAP was. A female patient stated: '*I've had [asthma] for twenty-five years and it's been under control, but sometimes it does [worry] me... So, it does lead to an action plan.*' Similarly, all participants had a positive outlook on an eAAP for improved accessibility and practicality. For example, a female patient highlighted: '*I can see the benefit of having an action plan. I can certainly see the benefit of having it on a phone because... pieces of paper get lost, and I think if you do [develop] an app... that is accessible by phone or tablet... I think that would be a real benefit.*'

Theme 4) features of a practical telehealth model for the current healthcare system

Suggestions were made regarding possible TH intervention features. These suggestions are described below.

Communication channels

Many participants commented on how a TH intervention could provide avenues for communication with healthcare professionals. One female patient stated: '*[Patient-provider communication via TH] is certainly a way of getting some responses that are directed specifically to you as opposed to... going to doctor Google and trying to figure out what is going on.*' Most patients were open to communicating with a care provider via various methods, including telephone calls, video conferencing, and texting. A few participants weren't supportive of communication via TH, primarily due to wanting to reduce 'screen time.' A female patient highlighted: '*I'm trying to reduce my amount on my device, to be honest.*' Another female patient showed hesitancy due to concerns around untimely responses from a care provider: '*A healthcare professional relying on text... [might] have a hundred messages so [when] are [they] going to look at it?*'

Online community

Another female patient suggested TH feature in asthma care was creating an online community where patients could connect: '*[The] experience of understanding other people, certainly gives you perspective of*

what other people are going through and how they manage it.' However, a few concerns were raised by participants. For instance, a female participant stated: '*I think [each patient's disease management is] such a unique thing... I much prefer to do [a] one-on-one... [with] somebody who could point me in the right direction.*'

Education

Access to credible educational materials was suggested by many participants. For instance, a male patient suggested: '*[I would like to see] ... a bunch of instructional videos that are very easily accessible. For example, puffer techniques.*' Moreover, a few participants advised including scenario-based practice questions to help verify their understanding of asthma management practices. Most participants believed TH should focus on all aspects of asthma management while ensuring adequate and abundant information is present on each aspect. A female patient stated: '*I think that you should manage it so [that] you would have some classes that are wide spectrum and on issues that are [specific] like cough management.*'

Medication and data collection

A digital prescription renewal service was another suggested TH feature by a female patient: '*Not having to go into see the doctor to get a prescription and just being able to do that entirely digitally and then show up to the pharmacy [would be helpful].*' Furthermore, patients recommended that a future TH intervention have existing asthma medication information, including their advantages and disadvantages, stated in lay terms, to inform their decisions and enhance discussions of treatment options with their provider. A female patient commented: '*One of the things that would be interesting is if they [had] the pros and cons of different treatments. So, it would be interesting to have [a] succinct [comparison] of the different options of treatments [and] what some of the risks are.*' Several participants highlighted that a future TH intervention should have a data collection feature in which their asthma-related information is always recorded and easily accessible; however, safety/privacy concerns needed to be considered with access to medical records.

Alerts

Participants suggested a notification feature that reminds patients to periodically check on asthma status, AAP, medication adherence and supply. For example, a female patient stated: '*If I had an app that ... [reminds] me every day that I have an action plan and that I can access it if I need to [that would be helpful].*' Also, many participants suggested that a future TH intervention could provide alerts on environmental hazards, such as poor air quality. A male patient claimed: '*If there was some sort of alert system if there [were] local pollutants or particulate matter that would increase the chances of a flare-up [it would be] very helpful for a lot of people that are a little bit more sensitive.*' Further, some female participants recommended a future TH intervention to always have all relevant environmental hazard information accessible, but not provide alerts: '*It's just one central place that's the most important aspect of that. I don't have to have somebody to alert me because I am smart enough to look it up before I go out, but it is important that I don't have to go hunting for the information.*'

Discussion

This study explored adult asthma patients' perspectives of TH in asthma management and the potential features of an asthma TH intervention. The study also identified opinions on how TH might improve the current standard of asthma care.

Overall, study participants believed incorporating TH into their disease management was a good idea. Several advantages of applying TH technologies in asthma management were highlighted, including improved convenience to speak with a healthcare provider, shorter waiting times to communicate with a physician, and streamlined prescription renewals. These results are concordant with existing evidence.[41] Conversely, perceived disadvantages of TH were also noted, such as lack of appointment times, although this may be due to the COVID-19 pandemic. Moreover, some patients expressed that TH replacing in-person interactions could lead to inaccurate examinations and treatment regimens. Similar findings were observed in previous studies. For instance, a cross-sectional study found that TH users undervalued TH compared to in-person medical appointments due to the inability to be physically examined.[42] These mixed findings indicate a need for conducting larger studies while involving patients from earlier stages of design and implementation phases for further validation of TH assessment and application in asthma management.

Interestingly, while most patients were pro-TH , many could not envision it replacing in-person disease management practices. This may be due to patients' unfamiliarity/lack of knowledge with digital technologies and confidence to properly use technology in self-management practices, for example, among the elderly and patients with low socioeconomic status (SES). A 2017 study found that self-assessed abilities and computer skills were predictive of seniors' willingness to adopt technologies.[43] Additionally, low ehealth literacy was listed as a barrier to adopting TH elsewhere.[44–46] Hence, providing support (e.g., education) for patients to sufficiently use TH could improve the useability of the service. These findings also echo the need for designing and implementing a large randomized controlled trial to improve our knowledge and understanding of a practical and user-friendly TH approach that can enable asthmatic patients (from all ages and SES groups) to control and manage their condition.[10,25]

Several features were suggested for inclusion in a prospective asthma TH intervention. First, almost all patients were supportive of incorporating education and AAPs into TH (e.g., eAAP). Studies have found that possession of an AAP can reduce the likelihood of asthma emergency department visits and hospitalizations as well as improve patient QoL and knowledge about their condition.[47] AAP with pictorial illustrations was suggested to be even more helpful with self-medication.[48] Therefore, an eAAP could improve asthma control outcomes, similar to the AAP, while also enhancing accessibility and knowledge translation.[49,50] Additionally, most patients hoped TH would allow timely communication between themselves and their care provider through telephone calls, video conferencing, and messaging. Bi-directional patient-provider communication has been proposed and supported in another study as it showed a shift in patient autonomy in disease management.[51] Moreover, bi-directionality was suggested to enhance reassurance and "a sense of security" among patients amid health care crises.[51,52]

Most patients indicated a TH-based social network would be helpful to connect with other asthma patients. A study suggested that a lack of social connection is associated with chronic physical symptoms, frailty, early mortality, depression, and cognitive impairment later in life.[53] Especially during the COVID-19 pandemic, social isolation amongst communities worsened, which may explain asthma patients' desire to connect with fellow patients through TH.[54] Our participants also advised increasing the frequency of follow-up appointments through TH, given the convenience for both patients and providers. A study found that an appropriate follow-up appointment could optimize outcomes after acute asthma episodes.[55] Proposed topics that follow-up appointments should address consist of patients' lack of asthma management knowledge; including how to use AAPs, incorrect use of asthma inhalers, and adverse environmental exposures.[55]

Credible educational materials were another feature that asthma patients hoped a TH disease management intervention would include. Specifically, instructional videos and scenario-based practice questions were advised as they may better equip them for unexpected asthma-related emergencies. A previous systematic review found that virtual education delivered to patients with chronic diseases can be comparable to and even more effective than usual care.[56] In addition, patients wished to be educated on the advantages and disadvantages of asthma medications to clear their doubts and uncertainty. A study found that education and patient perceptions are predictors of medication non-adherence.[57] Therefore, creating an easy-to-follow virtual table with plain medication information could motivate patients to properly use their prescriptions and adhere to them.

Patients also recommended a future TH intervention should allow personalization due to patients' varying disease severity and personal challenges. For instance, even though all patients supported receiving alerts on environmental hazards via the text messaging (SMS) feature, some wished to be informed regularly while others desired an option to change the level of notification frequency. Such findings parallel a previous study that found respiratory clinic patients desiring a choice in requesting an ideal clinic format (face-to-face vs. telephone vs. video conferencing).[58] Irrespective of the level of the alert frequency, informing patients on environmental hazards such as poor air quality could assist patients' disease management by allowing them to take preventive measures and reduce the worsening of symptoms.[59,60]

Limitations

Our study has limitations. First, gathering data through focus group sessions may have introduced social desirability and response biases.[61] As all interview sessions were conducted virtually instead of in-person, those who were not able to use technology or did not own a digital device could not participate. Similarly, with data collection done only in English, participants who do not speak the language fluently may have rejected participating in the study. Further, as participants were conveniently recruited from the parent study, they may not represent the population of interest. Finally, patients' perspectives around TH use may be biased as the present study was conducted during the early phase of the COVID-19 pandemic. For instance, patients may be more approving of TH during a pandemic with limited access to in-person health services.

Implications

There are several implications of this study. When designing TH interventions for asthma management, healthcare providers, and researchers should consider patients' perceived advantages and disadvantages of TH as well as their desired features. Patient engagement in the study design and implementation can minimize misunderstanding of intervention aims and goals by the patients and improve the study outcomes. This will also facilitate a patient-oriented intervention that can generate meaningful findings applicable to both patient and clinician groups, including patients diagnosed with varying types of asthma such as childhood, exercise-induced, and allergic. Additionally, a patient-oriented TH approach provides a possibility for creating safe online communities to allow asthma patients to better connect with fellow patients and be part of a peer group community. Moreover, TH may allow for more frequent online consultations or follow-up appointments, to alleviate an overburdened health system. Furthermore, patient education might be improved by engaging patients in creating instructional videos and scenario-based practice questions as well as better explaining asthma medications in patient-friendly language.

Finally, TH interventions could offer SMS alerts on environmental hazards, with the ability to personalize the system. Ultimately, novel patient-oriented TH interventions should consider asthma patients' perspectives and acceptance of TH and the aforementioned features. These initiatives also require an assessment of effectiveness on asthma outcomes through large-scale randomized controlled trials.

Considering the importance of a patient's willingness to adopt behaviour change and apply remote services for their health condition,[62,63] this study aimed to gain knowledge about asthma patients' perspectives on the applicability of TH in asthma management, some of whom already trusted and used virtual services for their asthma treatment during the COVID pandemic. The findings of this study can be summarized on the basis of the COM-B behavioural modification model[64,65] that recognizes the adoption of new behaviour (B) is influenced by different factors, including Capability (C); refers to an individual's psychological and physical ability to participate in an activity, Opportunity (O); refers to external factors that make a behaviour adoption possible, and Motivation (M); refers to the conscious and unconscious cognitive processes that direct and inspire behaviour. With this in mind, scrutiny of the study's qualitative data generated useful information that is aligned with the COM-B 3 key components: CAPABILITY: Our participants indicated knowledge about and understanding of TH, in addition to necessary practical skills (ability to use digital devices) are needed before they can trust and use TH technology in their disease management. OPPORTUNITY: Several participants mentioned the lack of available training or opportunity to learn how to apply TH prevented them from using different technologies. MOTIVATION: Participants indicated that in order to improve their motivation TH should be turned from something they have to do to something they want to do. Many patients did not apply TH due to their belief that TH may minimize in-person interaction with health professionals and provides improper services that are not helpful.[62,63] Patients' willingness to apply TH to control and manage their health condition may be achieved if they receive the necessary training and are motivated to carry on with virtual services post-COVID-19 pandemic. We believe the findings of this study can contribute to the conceptualization and development of effective virtual health intervention for adult asthma patients, improved by applying theoretical insights from a behavioural change model, such as the COM-B approach. We anticipate that identifying practical and feasible features of patient-accepted and trusted telehealth services can provide evidence-based knowledge for the development and implementation of effective virtual care services for adult asthma patients.[26]

Conclusion

As the world comes out of the pandemic, TH will likely be commonplace in asthma care and management. Therefore, it is important to identify patients' appetite and preferences for TH to ensure the co-creation of TH interventions is established to foster optimal self-management practices, including the use of AAP, for asthma patients. Furthermore, adhering to an asset-based approach in framing patients' capabilities and knowledge through TH is crucial to guide the transition of care provider and patient encounters towards greater respect and enhanced asthma care experience.

CRediT authorship contribution statement

Each author has made substantial contributions to acquiring the data, and helping to write, edit and prepare the manuscript. Iraj Poureslami and Yu seon Sarah Chae conceived and designed the study. Yu seon Sarah Chae, Noah Tregobov, Austin McMillan and Iraj Poureslami drafted the manuscript and Celine Bergeron with the rest of the co-authors critically revised the manuscript and gave final approval for submission. All authors contributed to the manuscript development and revisions, read and approved of the submitted version and agree to be accountable for their own contributions. All authors agreed to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

Ethics Statement

The ethics approvals were obtained from the University of British Columbia (UBC) Office of Behavioural Research Ethics. The data collected and analyzed for the current study are available from the corresponding author on reasonable request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix 1

Patients' Perceptions and Suggestions on Telehealth Intervention for Asthma Management.

Theme 1) Past Experiences and Future Use of Telehealth in Asthma Management		
Patients' understanding of TH	Knowledge on TH	My understanding of TH is anything where I am not seeing [someone] face to face. So, any use of technology to discuss my asthma with a care provider (female).
	Do understand TH	For my knowledge, it's just a … faster and simpler way to get information [from] patients without physically seeing them (female).
	Do not understand TH	I'm curious listening to this and I feel like I need a clarification of TH. I was thinking of TH as being virtual health which is including [Zoom] meetings like this… So, are we talking tele as in telephone health or are we talking virtual health or are we talking apps (female)?
Patients' experiences using TH	Have used TH	I haven't used any apps for managing my asthma, so it's only been remote visits with my GP (female).
	Bad at using technology	I'm seventy-five… I'm used to talking on the telephone. I [would] much rather see friends [in-person]… I am not constantly looking at my text and [my] computer (male).
Patients' attitudes toward TH	Pro-TH	[Unless] you need something to be looked at physically, [I] think you know talking to somebody on the phone about a problem [is]a good idea (female).
	Neutral-TH/TH use is case dependent	I don't [think] it just should be [one] approach. I think… if you are having to talk to somebody frequently, the phone [is] good but I think you should… see somebody as well (female).
		There are advantages and disadvantages. Sometimes, it's not the time to have the telephone appointment. You have to be able to see your doctor (female).
Patients' TH use	How often/when to use TH	I think… [using TH for asthma] would probably only happen when… it's more acute in [the] spring and fall (female).
		When you are having problems [it] would be good if you could [access] the system… as soon as possible (female).

Theme 2) Perceived Advantages and Disadvantages of Telehealth in Asthma Management	
Subtheme A: advantages	
Increased accessibility	I agree with [Name] that sometimes it can be really advantageous – it is nice and quick… yeah, so it is really nice that I am sitting at my own home and not in the doctor's office (female).
Shorter wait time	For me, the main advantage would be to avoid waiting in a waiting room at a doctor's office and not having to commute. I think that could save 30 – 45 min at times because it can be pretty excessive (male).
Easier gaining/renewing prescription	There are no additional quotes.
TH and COVID-19	During this [pandemic]… you are not meeting up with other people in the doctor's office. So… I think [TH is] a good idea (female).
Other	Most of us don't remember… we don't have gigantic memories… We're not just going to remember everything the doctor said to us as we walk out and especially if there's some emotional pieces in there, unless we're taking notes, you're going to lose things (female).
Subtheme B: disadvantages	
Decreased accessibility for patients unfamiliar with/do not have access to technology	Technology is not for everyone (female).
Lack of interaction, including physical examination	The disadvantages are that… physical exams are not possible. So, if something needs to be done, then you do have go into the office (female).
Uncertain appointment time	Sometimes it's a two-hour window – you know, you have to wait an hour for the timeframe and then they'll phone in another hour and a half because I appreciate the fact that it is not a concise method (female).
Other	At the beginning, I found it [TH] to be a disadvantage only because it just felt…. It was uncomfortable because it's something new. And um when you have more than one, okay more than two people, it becomes a problem with nobody knowing when to talk (female).

Theme 3) Integration of Telehealth into Self-management Practices		
AAP Status	Do have one	I have a plan (female).
	Do not have one	I don't have an action plan – I never did (female).
	Unaware of AAP	Is [the AAP] something that would be tailored to individual people or is it just a standard thing (female)?
Perspectives on AAP and eAAP	Pro-AAP	I think that is a great idea – having [a] one plan fits all and then they can work it towards them (female).
	Pro-eAAP	I think [education] is very, very important… the action plan is a very good objective structure for that education (female).
		I think it's also handy to have something like a [eAAP] because I think a lot of us are very reliant on our phones (female).

Theme 4) Features of a Practical Telehealth Model for the Current Healthcare System		
Communication	Agree to communicate with a care provider through TH	I think that… the idea of it is very good because again, you don't have to wait for someone, you can send them your question now. And you will get a response from someone [based] on here is what my problem is or here is what I don't understand or can you tell me what to do (female)?
		I'm a very tiny minority of people that don't text [but] I think it is a great idea… So I think that is a great idea in terms of getting information because a lot of the times, what you are texting is specific, it is not general. so you need someone to respond back with 'here is your problem, here is how you can deal with it' (female).
	Agree to involve pharmacist to SMS system	Very much so. I think the pharmacist would be a great person to talk to (male).
	Disagree to communicate with a care provider through TH	I don't think texting is a good format for that because people will be constantly texting. It, it would be… it would be overhead on that would be huge – having people just responding through those texts (female).
	Social network with asthma patients through TH	A message board or [a] chat system within this app as well [would be helpful]… if you need [advice] on what to do then there can be a person on the other end [to] take it step by step with you (female).
	Routine virtual follow ups	Communication and follow-up would be the number one, most important part. I think [that] there aren't enough appointment times (female).
TH education and disease management	Teaching asthma management practices (non-app related)	There also has to be a section on the best practices of how-to… everything from the deep breath down to your belly and bring your moment up through your pursed lips… right down to how to use your inhalers properly, how to make sure that you have your mouth around it properly, how you inhale, how you exhale, how long do you hold it… when do you take your second puff. All those reminders so that we don't have to use certain medications every day really would make the quality of the treatment much higher (female).
	Providing educational content (app related)	Just having that knowledge base [of] things that are triggers [would be useful] (female).
TH disease management focus	Focus on one aspect of disease management	Both [general and specific education] would be beneficial (female).
	Focus on all aspect of disease management	[I would be in favor of] more general [information] (female).

(*continued*)

Theme 4) Features of a Practical Telehealth Model for the Current Healthcare System		
TH data collection and information	Informative charts/tables/graphs on asthma medications	I do like the fact that there is a chart [that] gives you 'if you have this or this is what is happening or here is your symptoms, here are the things you should be doing' (female).
	Data collection	I would personally love a kind of asthma tracking element to whatever communication method I was having with my GP… imagine for a moment if I could say I've been checking my peak flow for the last 'x' amount of time, and I'm going to download that to you and he could say: 'oh I can see that you know, when we started you were on Pulmicort or whatever it was. I can see that your peak flow decreased or whatever' (female).
TH alerts	Reminders to check asthma symptoms and AAP	Having [a] text check-in… is a good reminder, you know? Especially for people who aren't… very compliant… Just a text message from a computer would work (female).
	Alerts on environmental hazards	What I would add to that is if they're just going to tell me I need to stay inside, [then] that doesn't offer me any new information. If they have [actual] steps that I can take and still live an active life that are different, [that would be helpful] (female).
		The thing with pollen is that it only happens at [certain] times a year. Sometimes, I get very irritated and I have no idea why and it would be nice have… a consistent alert system – 'oh that is probably what it is' – that would be a good thing (male).
	Have all environmental hazard information	Personally, I would like it all because I've over the years I've learned various different ways of managing it or ways of avoiding it… Being able to [not] be bombarded with [notifications] but be able to pick and choose when [to access information would be ideal] (female).

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