Designing Conversational Assistants to Support Older Adults' Personal Health Record Access

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Abstract. Older adults often rely on information provided during doctors' visits or online to manage their health but can experience challenges accessing this information at home. Recently, conversational assistants are being explored to aid navigation of health information included in online portals, but we still know little about users' perceptions of using these tools for managing personal health information. In this paper, we conducted a wizard-of-oz study to better understand older adults' perceptions of a conversational assistant, MIHA, to help with navigating personal health information. Participants saw value in using a tool such as MIHA to help facilitate access to their personal health information and to help them become more engaged in their health. Participants believed MIHA's features helped build confidence in the responses returned, but made suggestions for improving the interactions. We share insights of potential uses and design implications for conversational assistants that help older adults navigate personal health information.

Keywords: Older adults · Conversational assistants · Online health portals · Wizard of Oz

1 Introduction

Formal caregivers including doctors and nurses play an important role in helping older adults manage their health care [1]. Older patients often regard formal caregivers as a preferred and trusted resource to provide answers to health-related questions [2,3]. However, older adults also rely on patient e-health portals [4] to access and remember health-care providers' advice. E-health portals linked to electronic health records (EHRs) can be useful for older adults to access information associated with a visit. Patients can use these portals to review lab results, medications, or doctors' advice provided during visits [5]. E-health portals, however, can pose challenges for older adults with low digital literacy skills or access

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barriers, which in turn makes it harder for them to access the personal health information they need [6,7]. In parallel, online information can often supplement older adults understanding the content provided by their doctors or through e-health portals [8], but older adults can still face difficulties searching for health information due to negative perceptions about online sources [9] making it difficult for them to trust the information [10].

More recently, with advances in artificial intelligence (AI) and speech recognition, there has been an emerging interest in using conversational assistants (CAs) such as voice assistants and chatbots to assist users with their healthcare needs [11–16]. However, there are still gaps in understanding of how CAs can best support individuals' health care needs and promote transparent, trustworthy interactions with users. To uncover older adults' perceptions of CAs for navigating personal health information, we developed a conversational assistant called MIHA (Multimodal Intelligent Health Assistant). MIHA supports older adults with searching and navigating information provided by their doctor and provides tailored answers to users' questions. It also includes several features to support users' understanding of information. Through a within-subjects wizard-of-oz (WOZ) study with ten older adults, we explored perceptions of MIHA and its potential usefulness for supporting access to information stored in e-health portals. We found that participants saw value in using an interface such as MIHA to improve their access to information shared by their physician once outside the doctor's office, but also the ability to stay informed about their health and empower them to better participate as patients. We also found that participants felt that MIHA's features including retrieving responses from verified sources and providing options to understand how responses were derived were useful to improve confidence in responses. However, despite enthusiasm participants also felt that MIHA needed improvements particularly for gauging and responding to user intent in question-answering interactions as well as a broader set of features for summarizing and simplifying medical content. We discuss the potential for CAs such as MIHA to support older adults' access to personal health information and how we might facilitate transparent interactions with CAs for health.

2 Related Work

With aging, self-care and managing personal health and wellness becomes important to acquire better health outcomes [18,19]. To improve health outcomes, it is essential for individuals to maintain their health by making informed decisions [17]. Studies have shown older patients often rely on various sources, including personal notes, information communication technologies (e.g., phone calls, emails), and informal caregivers to manage their health and make decisions at home [3,20]. Personal notes can include information, such as recently prescribed medications, medications schedules, or dietary or treatment plans [4]. However, it can be challenging to organize notes from different doctors [4] and finding relevant information across multiple notes can be time-consuming [21]. Some, therefore, make use of phone calls or emails to connect to their healthcare providers

and follow up with questions [21]; however, this method may take more time as the doctor may not be available to address a concern immediately. Finally, older adults may rely on informal caregivers (i.e., family caregivers), who often seek collaboration with formal caregivers (i.e., doctors, nurses) to provide care by helping them gather and manage information to facilitate care at home [22]. However, family caregivers may not always be available [23].

Online patient portals (i.e., personal health records, e-health portals) are another common tool to help patients access medical records and information shared by doctors during visits. Patient portals often allow individuals to access lab results, treatment plans, and medications discussed during doctor's appointments. However, portals also pose three main challenges for older adults: (1) accessing and navigating portals can be difficult [24], (2) they lack personalization [25], and (3) they have limited support for older patients with low health literacy [27]. Studies have shown that older adults often do not use patient portals for their intended purposes - managing health information [7] - and instead, use them only as a communication channel, diminishing the portal's usefulness. In addition, some older adults have found it challenging to manage multiple portal accounts between different providers [7], which in turn leads to non-use of portals and increases preference for talking directly to a healthcare provider [28]. Some patient portals also do not include doctors' notes which can be valuable to help patients recall information from their visits [56].

Researchers have found that providing patients with access to doctors' notes can positively impact patients' participation in their health [29–31]. For instance, in their study of retrospective use of OpenNotes, an effort that allows patients access to doctors' notes directly, researchers found that groups of patients, including older adults, found significant benefits from reading doctors' notes directly [31]. Karimi and Martin-Hammond, for example, found potential for AI-assisted tools that enable older adults' access to doctors' notes to aid in their recall of information shared during visits [4]. In parallel, researchers have also introduced AI-assisted note-taking tools that automatically generate encounter notes based on patient-physician conversations during a visit. These tools have also been useful for physicians. For example, a study of EmpowerMD [32], demonstrates the potential of AI-based features to document patients' health data for doctors. However, there are still open questions of the value of providing similar access to patients through their personal health records.

To overcome some of the usability issues associated with navigating online portals [26,33–36], conversational assistants (CAs) have gained attraction in health and research has found that these systems can support patients with mental health issues, chronic illnesses, and breast cancer among others [11–16,37]. CAs are a class of technologies, including chatbots and voice-based systems that use conversational interactions to engage users in dialog [38]. A systematic review of using voice interactions to navigate online portals suggests that users perceive CAs as an efficient way to navigate information provided in online portals [39]. In particular, for people with certain disabilities such as motor impairments that prevent them from typing with keyboards, conversational interactions through

voice-based input is seen as a way to make online portals more accessible [40]. CAs are also being explored to support adherence to treatments and medications for different user populations [41,42]. Researchers have found that older adults view CAs that provide medical instructions included in EHR systems as useful [12]. Others noted that some see CAs as potentially useful for navigating electronic health records if challenges can be addressed [39]. This paper builds on this prior work to investigate older adults' perceptions of a CA for navigating patient information included in doctors' notes provided in an EHR system.

3 MIHA: A Health-Related Question Answering Prototype

To enable older patients retrieve and navigate their personal health information, we developed a conversational assistant prototype, called MIHA (Fig. 1). There are three main design principles for MIHA. First, it provides answers to the user's health-related questions from a verified source (e.g., doctor's notes). Trust and transparency are top concerns for patients when interacting with health related intelligent assistants [43]. Therefore, we envision MIHA as being able to support access to existing patient information provided from a trusted source. Second, MIHA aims to provide transparency by enabling users to verify answers provided in the conversational interaction. Prior work suggests that conversational interactions for health search can be less transparent posing potential risk to patients [44]. In an effort to address these concerns, we provide a mechanism for "explainability" by allowing users to view the text used to answer the questions. Third, MIHA attempts to simplify health information search tasks by providing additional support for specific questions about an illness or medication using a trusted consumer health source (Medlineplus [45] and WebMD [46]).

MIHA includes several features to support users' understanding of the responses provided (see Fig. 1). After posing a question (1), MIHA returns a response and additionally (2) asks the user if they would like to view how the response was derived using the doctor's note. A preview of the note including the highlighted portion of text that was used to generate the response is provided. If the user wants to view the entire note, (3) MIHA provides a preview of the file that includes the entire note. (4) To help users with medical terminologies (e.g., prescribed medications), the system asks the user if they want additional information. (5) If the user selects "yes", the system provides the user with a summary of the medication generated from a valid source. Users can enter questions using an open text field or preselected questions recommended by MIHA.

3.1 AI Model for Question and Answering

Recently, transfer learning has been used as an efficient learning method in natural language processing. In this case, a pre-trained model is trained on a large corpus of texts that can solve various tasks, such as question answering, sentence

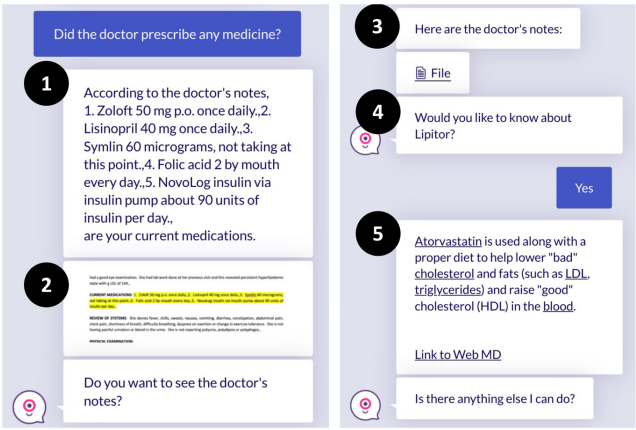

Fig. 1. Once users receive a response, (1) they can preview (2) or view the full doctor's note (3) and ask follow-up questions (4–5).

completion, and summarization [47]. We used the Text-to-Text Transfer Transformer model (T5) [48] to return answers to questions posed to MIHA using the transcription of the doctor's note. T5 is a large Transformer [49] model that is pre-trained on the large Colossal Clean Crawled Corpus (C4). The model is able to differentiate between similar questions (e.g., asking about past vs. current medications) and it supports conditional information extraction (e.g., asking about the patient's history or the doctor's recommendations). The answers returned are a paraphrased version of the corresponding note content.

To test the effectiveness of the T5 model, we used a public benchmark called *Medical Transcriptions* [50] that contains a dataset of 5000 anonymized doctors' note samples. Notes contained four different fields: description, medical specialty, sample name, transcription, and keywords. To prepare the dataset of notes, we first removed duplicates by merging their specialties and keywords, because the same text could appear under different specialties. We then split the different sections and assigned a topic based on the prefix. Due to a large number of different prefixes, we merged labels belonging to the same topic. Finally, we separated each section in the constituent sentences, inheriting the section topic, to obtain the cleaned dataset. For the purpose of our study, we only used two fields: medical specialty and transcription. Figure 2 shows an example of a cardiovascular medical note along with questions and answers returned. We set the minimum and maximum number of words for the returned answer to 10 and 150, respectively. This range allowed the AI model to provide an answer of appropriate length for our application. Initial testing showed that the model was able to handle various types of questions, such as conditional or yes/no questions.

4 Method

We conducted a user study with older adults to evaluate their perceptions of CAs for navigating personal health information (i.e., doctor's notes about visits)

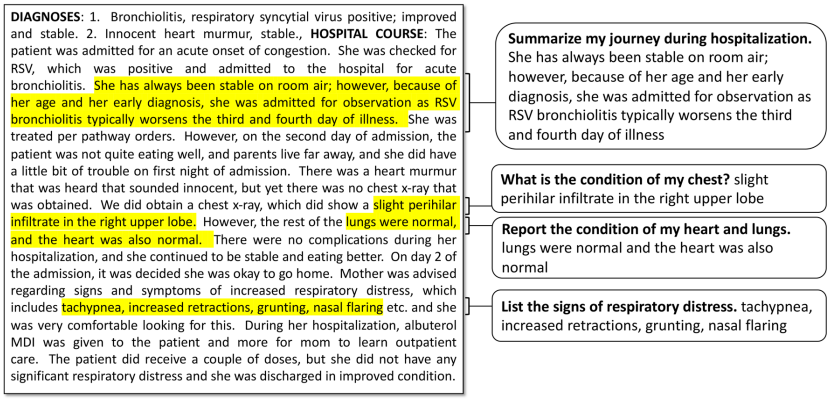

Fig. 2. An example of medical transcript of cardiovascular note highlighted to show answers returned by the T5 model.

and their perceptions of the answers MIHA returned. For the purpose of our study, we used the *Medical transcriptions* [42] dataset that includes doctors' notes available in EHRs. The dataset includes wide range of medical terms that are focused on patients' care. Therefore, while we asked about MIHA's features, we also ask participants how they thought a tool like MIHA might impact access to personal health information more broadly.

4.1 Participants

We recruited 10 older adults, age 60 years and older by reaching out to senior centers that provide services such as wellness and health programs, transportation services and public benefit counseling. Six participants self-identified as female and four participants as male. Participants' ages ranged from 61 to 83 (avg = 66.5, std = 7.38). The number of formal caregivers (e.g., doctors or nurses) involved in participants' health care teams ranged from one to three, whereas the number of informal caregivers ranged from zero to more than five. Moreover, seven participants reported they always use computers, one sometimes, and two rarely. All participants reported they always use smartphones except for one who often uses smartphones. Five participants described themselves as very familiar with computers, two familiar, and three somewhat familiar. Five participants described themselves as very familiar with smartphones, four familiar, and one somewhat familiar. More demographic data is shown in Table 1.

4.2 Wizard-of-Oz Study and Procedure

To test older adults' perceptions of CAs for navigating personal health information and the answers returned, we conducted a within-subjects, wizard-of-oz study (WOZ) followed by semi-structured interview questions. We defined four

Table 1. Demographic data

ID	Age	Doctors' visits in the last 12 months	Chronic illnesses	Num of years managing illnesses	Level of difficulty navigating online portals
P1-M	62	1–2 times	Hypercholesterolemia	1–2 years	Somewhat difficult
P2-F	60	3–5 times	No chronic illness	NA	Somewhat difficult
P3-M	64	3–5 times	Blood pressure, Hypercholesterolemia	>10 years	Somewhat easy
P4-F	61	3–5 times	No chronic illness	NA	No usage
P5-F	62	0 times	Ulcers, Asthmalittle Arthritis	4–10 years	Somewhat difficult
P6-M	69	3–5 times	Blood pressure, Hypercholesterolemia	>10 years	Moderately difficult
P7-M	67	3–5 times	No chronic illness	>10 years	Moderately easy
P8-F	75	3–5 times	Diabetes, Hypertension	>10 years	Moderately easy
P9-F	62	3–5 times	Not reported	>10 years	Somewhat difficult
P10-F	83	3–5 times	Blood pressure	>10 years	Moderately easy

different scenarios to capture situations in which users pose questions to MIHA about a recent doctor's visit: (1) asking the type of medication their doctor prescribed for type I diabetes, (2) asking the test result following a visit for high blood pressure, (3) asking the results following a visit for chest pain, and (4) asking the treatment plan for various aches and pains after a follow up visit. Within each scenario we asked participants to complete four tasks. The first task required participants to ask a question pertaining to the scenario and type it into the system. Unlike the other tasks, the question was not pre-generated, and participants could type any question of their interest. The purpose of the first task was two-fold: to better understand what types of questions the user might pose and to see if there might be differences in participants' ratings of answers returned by MIHA compared to the answers given to our pre-selected questions. The second task required participants to select a pre-selected question (e.g., "what was my diagnosis?"). The objective of this task was to give users options to select from instead of requiring them to type. The third task gave users the option to select the returned response from MIHA and view the response in the transcript. The purpose of this task was to understand whether providing an explanation of how the answer was derived altered users' perceptions of the system's answer. The fourth task asked participants to select a follow-up question to learn more about a prescribed medication or treatment. Similar to the third task, the goal for this task was to see how transparency pertaining to the information derived contributed to users' perception of the information. The order of the four scenarios were counterbalanced to account for any ordering effect.

For the study, MIHA was implemented using landbot (https://landbot.io/) an interactive interface for prototyping chatbot applications. Landbot was chosen because it included functionality that allowed researchers to return answers from the T5 model in real-time through the chatbot interface as well as send other responses to the user as needed. Therefore, we could mimic a working intelligent chatbot prototype. Participants were first introduced to the purpose of the

study, our chatbot (MIHA), and its features. Studies were conducted remotely via Zoom or phone depending on the participants' preferences. At the beginning of the study, we read aloud the study information sheet. We then asked participants a set of demographic and background questions. After completing the questionnaire, we asked participants to start the first task in the first scenario. Each task was followed by two questions asking participants their perceptions of the systems' response and if they felt it was accurate. A third question included a Likert-scale question that asked users to rate the response on a scale of not relevant to very relevant. After the participant completed the last task, we asked them interview questions focusing on their experience completing the tasks and opinions about the usefulness of the MIHA for assisting them with navigating their own personal health information. All interviews were audio recorded. Our study was reviewed and approved by the institutional review board at Indiana University before any data collection began. Each session took approximately 60–90 min. We provided participants a $20 gift card for their involvement.

4.3 Data Analysis

We analyzed the post task data using descriptive statistics. Additionally, we performed thematic analysis using transcripts of participants' responses to interview questions. In doing so, we first used closed coding based on the interview questions to understand participants overall experiences. We then performed open coding to explore potential themes that might emerge about the design of MIHA and participants' experiences using similar technologies.

5 Results

5.1 Users Initial Thoughts of MIHA

Participants shared that they had a positive experience using MIHA. They were able to recognize without explanation that MIHA provides answers to medical questions. P1 stated: "*We can have multiple medical questions and the system answers my questions regarding the treatment plan, the lab result and future plan.*" Participants also recognized MIHA's ability to remind patients about instructions provided by their doctor and access their medical information after the visit. P6 stated:"*if you forgot to ask something [during doctors' visits]...you can use the system to find out and refresh your memory.*" Therefore, our findings confirm that users' mental models of the system matched our conceptual model of MIHA's design. However, participants also shared other envisioned uses of MIHA and how it compared with their experiences using patient portals.

Envisioned Uses of MIHA. Participants described different scenarios, in which MIHA could be useful to them. This included providing them with the option to verify answers to medical questions after a visit, manage information from multiple doctors, organize personal notes, alleviate health anxiety, and

providing an alternative when not being able to see the doctor. Users mentioned situations in which they felt a system such as MIHA could be used to obtain an answer to their questions at their convenience. For instance, P5 commented: "*sometimes I've noticed some of my friends that are older, they're afraid to ask the doctor questions...So, when you are able to go home and actually look at this in the privacy of your own home, it would help you because you could be able to look at it and process it a little bit easier.*" Another situation was to reference conversations with doctors to track health over time. P9 stated: "*I see the same doctor every six months, so it also gives a reference as to what we talked about last time. And how has things gone with my health.*" Therefore, participants felt that MIHA could provide an alternative way of allowing patients to access and track health information shared during doctors' visits.

Other participants specified that the system could be useful to confirm answers to medical questions while at home. For instance, when asking about examples of situations in which the tool could be useful, P7 commented: "*To verify the definition of a diagnosis...the treatment plan that has already been established...[and] how I should take medication if it's not already on the bottle.*" Some users specified that when they need to have answers to a medical question due to an immediate health concern, the tool can relieve some of the anxiety. For example, P2 commented: "*When you have some symptoms, or you know something [is] going on with [you], you want to know as soon as possible.*" Thus, participants felt that MIHA could supplement following-up with their doctors to also help them become more empowered and informed patients.

Additionally, participants suggested that the tool could help creating personal notes from doctors' records. P5 suggested that MIHA could be helpful for them to organize and track personal notes. They discussed, "*If I would like to have a personal message area..., it [MIHA] would help me to go back from previous visits to see what the doctor had prescribed for me.*" P2 and P9 suggested similar uses of MIHA. P2 stated, "*I can create a history in my notes, because every time I can go to the tool, access it, and use it pretty easily for any questions and add it to my notes.*" Thus, participants saw MIHA as an opportunity to better organize their personal note inventories to manage their health.

Several participants discussed that the system would also give them the opportunity to be more involved in their health. P7 shared, "*It [having access to the doctor's note] would also help to answer questions that I may not have thought about during the visit. It also helped me to read information that the doctor perhaps said during the office visit, but I as the patient didn't hear it.*" P5 made a similar observation, they stated, "*If I go to the doctor...I would appreciate being able to see the doctor's notes and also a verification of what they said.*" Therefore participants felt that MIHA could improve their ability and willingness to engage with information shared in conversations with their doctors.

MIHA's Comparison to Online Patient Portal Experiences. Given that MIHA answers questions using notes generated from an electronic health record system, we asked participants to compare their interactions with the system to

online portals. Participants felt that MIHA could improve their ability to find information. Some participants mentioned that doctor's notes are not always included in the portal, but if they were, the system could allow them to save time in getting an answer to their health questions by using the chat feature. For instance, P9 commented: "*My current portal...they do not have doctor's notes...You can see your test results...but the doctor may [or may not] put his notes in the body of an answer (report).*" P9 also shared, "*I believe this is a good tool for the medical community to have, it would lighten their load as far as me calling into the office...It's actually better than the portal...because it gives you more information.*" Another participant, P1, provided similar feedback stating: "*One of the most useful advantage of using MIHA system is saving time. Because I can see the right answer to my question as soon as possible, whereas with online portals I have to go over all the note to find my answer.*" This implies that the tool has the potential to enhance search by directing users to information which might be more difficult to find when reading through an entire note. Participants also expressed that when the system provides more detailed information about a medical term, it enhances their ability to find information faster. For instance, P5 commented: "*It's [MIHA] just a lot easier to use and it gives you more straightforward answers. Some of the ones [portals] that I had been on have been very confusing. You have to switch back and forth between two to three different screens. And this [MIHA] is a lot more user-friendly.*" Therefore, participants felt that MIHA offered features that could make it easier and faster to navigate information such as non-structured doctors' notes compared to online portals.

5.2 Perceptions for Answering Personal Health Questions

To understand users' perceptions of engaging in dialog with MIHA to answer questions, we examined the conversational interactions supported by MIHA.

Types of Questions Users Posed to MIHA. We collected the open-ended questions submitted to our prototype and examined how participants might engage conversationally with the system to find answers to a question. Out of the 40 open-ended questions posted, we found that nearly 78% (31/40) were interrogatives that asked the system to do something. Interrogative sentences follow the traditional question format of a question word (Who, What, Where, When, Why, or How) followed by an auxiliary, subject, main verb, and optionally extra information. Examples include "What is the result of my chest pain?" and "What type of medication do I need?" The other 22% (9/4) of questions were imperative sentences or commands that tell the system to do something. Examples include "Tell me more about the medication you prescribed" and "I want to know about my results." Half of the participants (N = 5) posed interrogative questions only, and the other half (N = 5) posed a mix of questions and commands. The details provided by participants when posing their questions varied. The majority (67%) of questions (27/40) were basic questions that did not include any additional information to clarify intent. Approximately 33% of

questions posed included an auxiliary, subject, main verb, and additional information such as the name of the illness or symptoms.

Users Perceptions of MIHA's Responses and Explanations. We also asked users to provide feedback on the answers to the questions that the T5 model returned. We were particularly interested in whether or not, based on their perspective, the responses returned were relevant and accurate. We did not provide participants with formal definitions unless they asked us to clarify. Our goal was to therefore distinguish between responses viewed by participants as pertinent or related in some way based on their expectations.

Overall, participants felt that the system returned relevant responses. Open-ended questions were majority positive, with 63% of responses (25/40) rated as relevant or very relevant and 37% (15/40) rated as not relevant or somewhat relevant. We saw a similar trend for closed-ended questions with 80% of responses (32/40) rated as relevant or very relevant and 20% of responses (8/40) rated as somewhat relevant or not relevant. While participants viewed most answers to open and closed-ended questions as relevant, they were more positive about closed-ended responses compared to open-ended. Participants' perceptions of the accuracy of responses were also majority positive. For open-ended questions, participants rated 87% of responses (25/40) as accurate compared to 13% (5/40) as not accurate. Closed-ended questions also received more positive responses. Participants rated 95% of responses (38/40) as accurate compared to 5% (2/40) as not accurate. We believe that the significant positive change found between open and closed-ended questions may have been due to limitations with the T5 model and its sensitivity to question phrasing and also that participants perceptions of responses and explanations were influenced by factors other than relevance and accuracy.

Participants rated 90% of responses as relevant or very relevant after viewing the note compared to 80% before viewing the note. Participants rated 10% of responses as somewhat relevant or not relevant after viewing the "explainability" note compared to 20% before viewing the note. Some participants also changed their views about accuracy after viewing the note, however the majority (34/40) remained positive before and after viewing. Four participants' ratings changed from not accurate to accurate after viewing the note and one participant changed from accurate to not accurate. However, several themes emerged from interviews suggesting that participants' perceptions of the responses returned by MIHA (i.e., the T5 model) were influenced by other factors.

Participants discussed knowing that the responses were coming from validated sources (i.e., doctors' notes, validated online sources, and patients' records) increased their confidence in the information MIHA provided. P2 commented: "*In the beginning for some questions, I didn't receive an accurate answer but after reviewing doctors' notes [I felt] the answer was relevant.*" In a similar vein, P5 said: "*Because you can see responses correlates back and forth with the doctor's notes.*" These statements imply that participants felt that the ability to go back and forth between the answer and note improved their confidence in the answers.

Similar comments were made about being able to view follow-up information that was provided by WebMD, an online source participants trusted. Therefore, participants discussed that having trusted information available increased their confidence in the system. Participants also shared it was helpful when the responses either aligned with their prior knowledge or helped to facilitate learning. When the systems' responses matched their prior knowledge, participants noted that it improved their confidence in the answers. P8 shared that they felt the response to questions were generally relevant because, "*I take diabetes medication. I take hypertension medication, but I knew that Lipitor was cholesterol medication.*" Additionally, participants liked that the system supported learning of how answers were derived within the tool through showing the note. When asked if users could better trust the answer after seeing where the answer was located in the doctor's notes, P8 commented: "*Yes, it did...because it was explained more.*" Including mechanisms to help users understand how answers were derived were viewed as helpful to build confidence in the tool.

5.3 Improving MIHA

Participants also provided suggestions on how MIHA could better serve their needs. These recommendations include simplifying interaction with medical terms, supporting better conversational interactions, and integrating new design features. For example, when asking about how the tool might improve to meet their needs, P4 commented: "*Changing the terminology for the responses, making them simpler, reader friendly. Because if I'm not a doctor or I don't know anything about the medication, I need the medication information to be simplified.*" P8 shared that the systems' inability to simplify information led to some lower ratings. They shared, "*because at one time, it [MIHA] named another medication, it didn't say it was a generic name, it should have explained it.*" Therefore in addition to simplifying navigation, participants also felt more needed to be done to facilitate understanding of medical terminologies.

Participants shared that improvements in MIHA's ability to gauge the intent of the question would further build their confidence in the system. They mentioned while answers were relevant, they were not always what they were expecting. P7 shared, "*The majority of the answers were relevant, but there was one where I as a patient was asking a very broad question - Tell me more about the medications that I was prescribed? - and the system just answers what would be on the bottle. That's not more information.*" P4 shared a similar experience, they stated that in one instance, "*Yeah it [MIHA] didn't answer my question accurately. I asked what side effects and it just gave me the prescribed medicine. So I guess I am just supposed to go look that up.*" Participants also mentioned that they preferred when the system provided them with different options to choose from instead of requiring them to type in questions. For instance, P5 commented: "*I liked the idea of just having the choices to click on...rather than typing it out myself.*" Participants discussed that this would remove the challenges they might have while typing but also help with reducing cognitive burden of formulating a query. Some users also suggested using voice as an alternative

option to interact with the system. P5 also commented: "*That sounds excellent [using voice]. Especially for older folks that have problems with typing or with clicking buttons or whatever, it's a lot easier to just talk-to-text.*" Participants made other suggestions for improving conversational interactions such as restating questions and providing features to show that MIHA is thinking.

Finally, users pointed to potential interface design features that could improve the usefulness of MIHA. Features included adding a calendar that shows doctors' visits with notes organized all in one place. Some participants discussed making MIHA more personable such as including a photo of the doctor. P6 shared, "*I miss the old days ... we used to have doctors...they knew your family, the kid's ages, what they are doing now. Now you go and there are just numbers...a lot of times you don't see your own doctor.*" Participants also suggested including an option to chat with the doctor directly in case the system could not find an appropriate answer. For example, P4 and P6 noted that sometimes people are not able to go to the doctor in person. Both participants shared that it would be useful if they could connect with the doctor using MIHA as well.

6 Discussion

Our findings suggest that participants perceived a conversational assistant such as MIHA that supports navigating and improving interactions with personal health data as useful. Participants also felt that the features to support understanding and transparency of information were helpful for building their confidence in the responses. We discuss design implications for designing conversational interactions that support older adults' access to health information and for facilitating user confidence in conversational tools for health information search.

6.1 Using CAs to Support Older Adults' Access to Health Information

Several researchers have found that older adults prefer talking directly with a healthcare provider to ask questions about their health [3,8], though individuals' experiences can vary [3]. Some older patients are not comfortable following-up with their doctor during or after visits [3,8], or may sometimes miss information due to anxiety, stress, or accessibility challenges [51]. At the same time, tools such as online portals which allow patients to revisit instructions from their doctor can be challenging for older adults to navigate [7,25,27]. For these reasons, our participants envisioned that having a tool like MIHA that was connected to a verified source could alleviate some of the challenges they experience accessing their personal health information. Participants felt that a tool similar to MIHA could empower them to become more knowledgeable and involved in their health.

Aligned with prior findings [52,53], participants suggested that drawing information from a verified source would be ideal for a CA. While providing patients with access to doctors' notes is not yet widely available [30,31], the concept of using conversational interactions through online portals is being actively

explored. Azevedo and colleagues found that older adults saw conversational interactions useful for explaining medical instructions included in EHR systems [12]. Kumah-Crystal and colleagues, have also explored using voice technologies to navigate electronic health-records. They note many benefits but also the open challenges such as improving contextual awareness of understanding what information users may want to communicate [39]. Building on this work, our findings highlight older adults' beliefs that conversational interactions would be useful to access and navigate personal health information shared on EHR systems. Several participants discussed that sometimes they are not able to understand, hear, or focus on what the doctor discussed during visits. Thus, they felt having access to a tool similar to MIHA could improve their engagement by allowing them to search and ask questions at their leisure at home. Some users discussed that they currently do not have access to their doctors' notes outside of the visit even within the online patient portal. While providing patients with access to doctors' notes is still controversial [29,30], there has been a move to provide patients with this information which suggests we may see more access in the future. However, doctors have long provided notes [54] to support patients' recall of information, which might be alternative sources of data to support patients.

Participants also discussed potential improvements that they believed would enhance their experiences during conversational interactions including improving query experiences by reducing typing (i.e., pre-selected questions) or introducing voice. These findings suggest that a multimodal approach should be considered due to the variations in preferences among participants. Similarly, we found that participants engaged with MIHA mostly with questions opposed to the commands which are often used to execute voice-based queries on devices such as Alexa and Google Home. This suggests a need to further understand expected interactions with CAs for health. For example, some participants noted that while providing pre-selected questions reduces cognitive burden of generating a query and mobility challenges, it reduces the question set. While voice interaction reduces the above challenges, it also introduces concerns related to speech recognition accuracy that might outweigh ease of use. Therefore, we would need to explore the best way of reducing challenges related to open-ended questions. Participants noted that while MIHA often returned something relevant or accurate, it did not always consider intent highlighting the limitations of the AI model. Thus, in addition to conversational design, improving AI models to support intelligent Q&A will be needed.

6.2 Building Confidence in Conversational Tools for Health Search

While conversational assistants have been used quite often for supporting health tasks [11–16], recent findings have raised concerns about participants' abilities to gauge information from certain types of conversational agents such as voice assistants in consumer health environments [44]. As such, we explored different ways of integrating user confidence into the interaction. Reflecting on [55] and methods for improving transparency in intelligent systems through design, we summarized what needed better explanation to build users' confidence in MIHA's

responses. Participants agreed that connecting MIHA to a verified source would improve their confidence in the responses. In addition, providing an understanding of how the response was derived helped build confidence as they could compare and contrast the two. Participants appreciated the inclusion of some sort of "explainability" feature which allowed them to verify responses if they wish. However, some participants also discussed the need to balance between providing information and assisting understanding. Exploring how to explain features beyond showing the source can be further investigated in the future.

We also found that confidence in the responses differed, which we believe occurred due to the AI model's sensitivity to question wording. One approach could be to include post processing steps to aid users in query generation. However, participants' feedback suggests the need for a broader exploration of methods to reduce challenges related to query generation (e.g., cognitive load) and to provide responses that better match users' intent. Because some responses were related but did not match what participants expected, they questioned MIHA's abilities. In the future, it would be useful to explore approaches to increase the likelihood that responses match users' intent. It might also be helpful to consider whether personalization could support better reasoning. The majority of participants omitted specific details about medical conditions or medications from their questions suggesting an expectation that the system would "know" about prior health history.

Finally, we found that apart from improving characteristics of the responses, participants suggested that MIHA needed additional ways to improve their understanding of medical terminologies. Both simplifying medical terminologies and summarizing medical texts [4,12,52] have been noted as concerns among older adults when interacting with intelligent health tools and we found similar concerns among our participants. Participants mentioned that it was not enough to provide an answer and therefore suggested including features to help simplify and facilitate understanding of content. Other efforts have also highlighted that for older adults, providing content may not be sufficient without also increasing comprehension and presentation of medical content [12,52]. Therefore, future efforts would need to consider factors beyond navigation and access that can help older adults better interact with their personal health information.

7 Conclusion

In this paper, we explore older adults' perceptions of a conversational assistant, MIHA, that aids with navigation and access of health information at home. We conduct a within-subjects WOZ study followed by semi-structured interviews to understand participants' perceptions of the tool. Our findings suggest that MIHA facilitates access and helps older adults to become more engaged in their health. Participants envisioned MIHA as a supplement to doctors' visits and a way to help them manage information about their health. Participants also felt that MIHA's connection to a verified health source and ability to explain how responses were derived were useful for supporting trusting interactions with the

CA. However, they also felt that MIHA could do more to support understanding of complex medical terminology, simplify language, and understand about question intent.

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