

Talk2Care: Facilitating Asynchronous Patient-Provider Communication with Large-Language-Model

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Abstract

Despite the plethora of telehealth applications to assist home-based older adults and healthcare providers, basic messaging and phone calls are still the most common communication methods, which suffer from limited availability, information loss, and process inefficiencies. One promising solution to facilitate patient-provider communication is to leverage large language models (LLMs) with their powerful natural conversation and summarization capability. However, there is a limited understanding of LLMs' role during the communication. We first conducted two interview studies with both older adults (N=10) and healthcare providers (N=9) to understand their needs and opportunities for LLMs in patient-provider asynchronous communication. Based on the insights, we built an LLM-powered communication system, Talk2Care, and designed interactive components for both groups: (1) For older adults, we leveraged the convenience and accessibility of voice assistants (VAs) and built an LLM-powered conversational interface for effective information collection. (2) For health providers, we built an LLM-based dashboard to summarize and present important health information based on older adults' conversations with the VA. We further conducted two user studies with older adults and providers to evaluate the usability of the system. The results showed that Talk2Care could facilitate the communication process, enrich the health information collected from older adults, and considerably save providers' efforts and time. We envision our work as an initial exploration of LLMs' capability in the intersection of healthcare and interpersonal communication.

Introduction

The communication between older adults and their healthcare providers faces numerous challenges (NCOA 2023), including limited provider availability, information loss, and process inefficiencies (Wang et al. 2021; Vugs et al. 2023). Traditional methods, such as phone calls and messages, often fail to provide timely and effective communication (Malasinghe, Ramzan, and Dahal 2019; Halloran et al. 2019; Bates, Arvind, and Mann 2011; Johnson and Miller 2022; Crossley et al. 2011; Arguello et al. 2023; Schroeder et al. 2017). The recent advancements in Large Language

Models (LLMs) offer promising solutions by enhancing natural conversation and information summarization capabilities. This paper introduces Talk2Care, an LLM-powered system designed to facilitate asynchronous communication between older adults and healthcare providers.

Talk2Care comprises two main components: a patient-facing voice assistant (VA) and a provider-facing dashboard. The VA engages in natural conversations with older adults to collect health information, while the dashboard summarizes these interactions for healthcare providers, highlighting key details and streamlining the communication process. By leveraging the strengths of LLMs, Talk2Care aims to address the gaps in current communication methods, providing a more interactive, responsive, and adaptive experience for older adults and a more efficient information analysis tool for healthcare providers. This paper presents the need-finding study, system design, evaluation, and future implications of the Talk2Care system.

Related Work

Telehealth has shown significant advantages in saving time and effort for both patients and providers (Ding et al. 2019; Wang, Kale, and O'Neill 2020; Lu, Chen, and A. Epstein 2021; Xu et al. 2022b; Chung et al. 2019; Xu et al. 2022a), especially during the COVID-19 pandemic (Blandford et al. 2020). However, existing telehealth applications often lack adaptability and usability for older adults, who typically have lower health and technical literacy (Dorsey and Topol 2016; Shaver 2022; Donelan et al. 2019; Kruse et al. 2020; Park, Lee, and Chen 2012). Studies have highlighted the inefficiencies of current communication methods, which often lead to information loss and delays in response (Rubin et al. 2011; Chesser et al. 2016).

Intelligent conversational agents, such as chatbots and voice assistants, have been explored to support older adults' healthcare needs (Pradhan, Lazar, and Findlater 2020; Desai and Chin 2023; Bérubé et al. 2021; Harrington et al. 2022). These agents provide simplicity and accessibility, aiding in health information seeking and mental support. However, their adoption has been limited due to usability barriers and a lack of personalized, flexible interactions (Harrington et al. 2022; Trajkova and Martin-Hammond 2020; Gudala et al.

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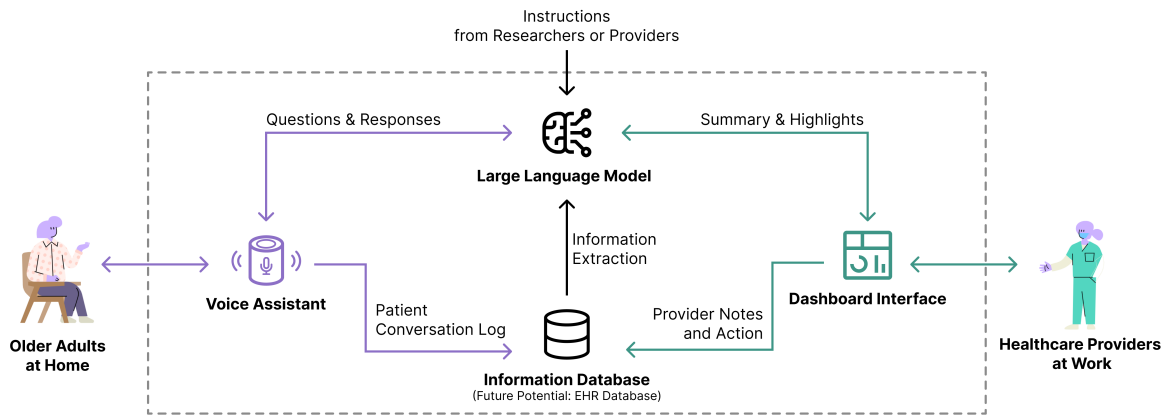


Figure 1: Overview of Talk2Care System. Note that Talk2Care does not provide specific healthcare advice. Our current implementation does not involve an actual electronic health record (EHR) system, which can be a promising future direction.

2022; Zubatiy et al. 2021; Blair and Abdullah 2019).

The recent advancements in LLMs, such as ChatGPT (OpenAI 2022), have demonstrated their potential in engaging in natural conversations (Xiao et al. 2020; Wang, Li, and Li 2023; Liu et al. 2023), health info seeking (Yunxiang et al. 2023; Xiao et al. 2023), and mental health support (Lamichhane 2023; Kumar et al. 2023; Xu et al. 2023; Kim et al. 2024). Despite their promise, concerns about the reliability, potential biases, and ethical implications of LLMs in health remain significant (Kocaballi et al. 2020; Iliashenko, Bikkulova, and Dubgorn 2019; Bérubé et al. 2021). Talk2Care aims to address these gaps by leveraging LLMs to enhance patient-provider communication, focusing on usability, adaptability, and ethical considerations

Need-finding Study

To understand the communication challenges between older adults and healthcare providers, two semi-structured interview studies were conducted. The first study involved older adults (N=10), while the second focused on healthcare providers (N=9). The interviews were recorded via Zoom and transcribed afterward. Thematic analysis was employed to analyze the data. Two authors coded interview transcripts iteratively until they reached a consensus.

Findings from Older Adults

- **Communication Challenges:** Older adults reported difficulties in accessing providers due to limited availability, with delayed responses and fragmented information.
- **Interest in LLM-powered Systems:** Participants expressed interest in a system that could offload some tasks from healthcare providers, provide mental support, and gather comprehensive information.
- **Concerns:** Reliability and privacy were significant concerns, with participants worried about the accuracy of information and the potential for data breaches.

Findings from Healthcare Providers

- **Needs and Challenges:** Providers highlighted the inefficiencies in current communication methods, noting the time-consuming nature of phone calls and the lack of detailed information in messages.
- **Potential of LLMs:** Providers saw the potential for LLM to streamline communication, reduce workload, and improve information quality received from patients.
- **Risks: Concerns:** Reliability was also a big concern for providers. They also mentioned concerns about potential biases and the ethical implications of AI in healthcare.

These findings guided the design of Talk2Care, aiming to address the identified communication challenges and leverage the opportunities provided by LLM technology.

Talk2Care System

The Talk2Care system comprises two main components (see Figure 1): a patient-facing voice assistant (VA) and a provider-facing dashboard. Each component is designed for the specific needs of its user group, ensuring a seamless and effective communication process. Below, we delve into the details of each component and their respective functionalities. More can be found in our full paper (Yang et al. 2024).

Patient Component: LLM-powered Voice Assistant

The patient component of the Talk2Care system is an LLM-powered voice assistant (VA) that facilitates natural and interactive conversations with older adults. This component aims to collect detailed health information from patients in a user-friendly and accessible manner. The VA's design focuses on ease of use, considering the lower technology proficiency often found in older adults. Figure 4 in the Appendix visualized the overall structure.

LLM-powered VA Interface. The core of the patient component is the VA interface, which engages in multi-turn conversations with older adults to gather health information. The VA's natural language processing capabilities allow it to generate appropriate and personalized follow-up questions based on the patient's responses. This interactive approach

helps in collecting comprehensive and accurate health information, which is crucial for effective healthcare delivery.

Question Generation Module. The question generation module is responsible for creating high-quality questions to gather key health information from older adults. This module leverages GPT-3.5-Turbo. The prompts used in this module are designed meticulously to ensure ethical considerations and avoid generating offensive or biased content. The prompts are structured around five key factors (see an example Figure 5 in Appendix):

- **Patient Information:** Includes the older adult's basic information such as name, gender, age, living situation, chronic conditions, and medical history.
- **Conversation Protocol:** Ensures the VA follows a standard protocol for specific tasks to enhance reliability, which is stored in the information database.
- **System Setting:** Defines VA's role and responsibilities, emphasizing its function as a communication facilitator.
- **Conversation History:** Maintains a log of previous interactions to personalize future conversations.
- **Response Optimization:** Enhances generated questions' quality by iterative prompt designs and feedback loops.

Content Loopback Module. Accuracy in health information is paramount. The content loopback module ensures that key information collected by the VA is accurate by looping back the information to the patient for confirmation. This double-check mechanism helps in reducing errors and ensuring the reliability of the data collected.

VA Hardware. The VA system is deployed on the Amazon Alexa platform, leveraging the well-integrated ecosystem of Alexa devices. The voice-to-text and text-to-voice services provided by Alexa facilitate natural speech interactions, making the system more accessible to older adults. The hardware used is the Alexa Echo Dot, which is widely recognized for its user-friendly interface and reliability.

Information Database. A cloud-based database stores all patient information, conversational protocols, and conversation logs. This database is encrypted to ensure the privacy and security of sensitive health information. The stored data is used to construct prompts for both the question generation and content loopback modules, ensuring continuity and personalization in interactions.

Conversation Flow. The conversation flow can be initiated either by the older adult (in cases of specific health concerns) or by the VA (for routine health check-ins). The VA leads the conversation, asking about symptoms and gathering detailed information iteratively. For instance, in a post-surgery scenario, the VA would start by asking about the patient's overall health and any pain or discomfort, followed by detailed questions to pinpoint the exact nature and extent of the symptoms. This iterative approach ensures comprehensive data collection.

Exception Handling. To handle common exceptions in voice recognition and user input, the system includes strategies like Alexa skill re-prompts and maintaining conversation history to manage unexpected pauses. If voice recognition fails, users can restart the interaction without losing

previous info. Additionally, if users seek immediate medical advice, the system provides general guidance and refers them to consult their providers for specific advice.

Provider Component: LLM-powered Dashboard

The provider component of the Talk2Care system is an LLM-powered dashboard designed to assist healthcare providers in processing and utilizing the health information collected from older adults. This component aims to streamline the communication process, reduce the workload of healthcare providers, and improve the quality of patient care. The overview is shown in Figure 6 in the Appendix.

Dashboard Interface. The dashboard interface provides a comprehensive summary of patient-VA conversations, highlighting key information for quick reference (see Figure 8). The interface allows providers to navigate through conversation summaries, raw logs, and session histories, enabling them to make informed decisions quickly. Providers can also take notes and record follow-up actions directly on the dashboard, which are then stored in the information database.

Conversation Summary Module. The conversation summary module extracts key messages from the conversation log and formats them into a clinical note structure. This module uses GPT-3.5 to generate concise summaries that are easy for providers to review. The prompt design for this module includes (an example in Figure 7):

- **Patient Information:** Details about the older adult, similar to those used in the VA component.
- **Conversation Protocol:** Specifies the task and key information to focus on, ensuring relevant data is highlighted.
- **System Setting:** Defines the AI assistant's role as a summarization tool.
- **Conversation Log:** Provides the complete log of the interaction between the older adult and the VA.
- **Summary Optimization:** Uses in-context learning to ensure high-quality, well-structured summaries.

Information Highlight Module. This module helps providers by highlighting important quotes and details in the conversation log. It uses a similar prompt structure to the conversation summary module but focuses on identifying and marking critical information that requires attention. This feature saves providers time and effort in reviewing detailed logs.

Risk Prediction Module. The risk prediction module assists providers in assessing the health risks of older adults based on the conversation logs. It categorizes patients into low, moderate, or high-risk levels and provides reasoning for these predictions. While this feature offers valuable insights, it is designed with caution, acknowledging the ethical implications and potential inaccuracies of AI predictions.

Information Database. The dashboard component shares the same information database as the VA component. This integration ensures seamless data flow between patient interactions and provider reviews, maintaining continuity and accuracy in health records.

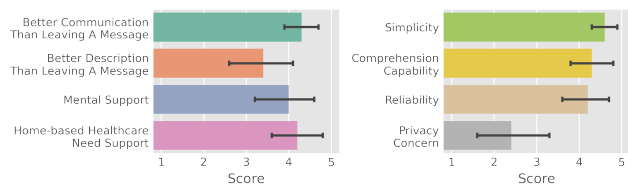


Figure 2: Subjective Ratings on Different Perspectives of The Usability of The VA System. Error bars show the standard deviation. The average SUS score is 75.5 ± 17.1 , indicating good usability.

Interaction Flow. Providers first input instructions and protocols into the system, which are used for both the VA and dashboard components. When new conversation sessions are stored in the database, providers are notified and can review the content, take notes, and decide on follow-up actions through the dashboard. This workflow aims to enhance efficiency and accuracy in communication.

Evaluation

The evaluation of Talk2Care involved two studies designed to assess its usability and effectiveness for both older adults and healthcare providers. The studies were based on realistic healthcare scenarios to ensure practical relevance. Two scenarios were developed to evaluate Talk2Care. The first scenario, "Daily Care Needs," involved older adults initiating communication about unexpected health concerns. The second scenario, "Post-Surgery Follow-up," focused on providers initiating follow-up communication with patients after surgery. These cases reflect common real-world situations where effective communication is crucial.

User Study 1: CA w/ Older Adults

Methods. The first user study involved 10 older adult participants who interacted with the Talk2Care VA system. Participants were asked to communicate their health concerns using the VA and then compare this method to the traditional approach of leaving a message for their healthcare provider. The study included a brief tutorial, followed by interaction with the VA in both scenarios. Participants then completed a questionnaire and a semi-structured interview.

Findings. The results indicated high usability of the VA system, with an average System Usability Scale (SUS) score of 75.5/100. Participants found the VA easy to use and appreciated the natural conversation flow. The VA's ability to generate understandable and relevant questions helped participants provide more detailed health information. This enhanced communication was noted as a significant improvement over traditional message-leaving methods. Figure 2 shows the ratings covering multiple usability aspects.

Participants also reported feeling mentally supported by the VA, as it provided immediate interaction and engagement, reducing feelings of isolation. Despite some concerns about voice recognition errors and privacy, the overall feedback was positive, with participants expressing confidence in the system's ability to support their healthcare needs.

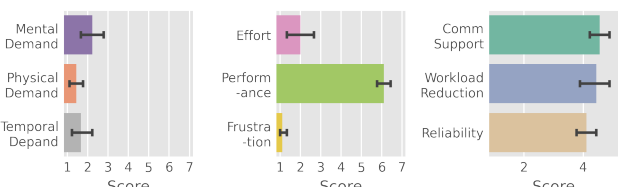


Figure 3: Subjective Ratings on Different Perspectives of The Usability of The Dashboard System Design. The average SUS score is 85.8 ± 9.8 , indicating very good usability.

User Study 2: Dashboard with Professionals

Methods. The second user study involved 9 healthcare providers who evaluated the Talk2Care dashboard. Providers were asked to process patient information using both the traditional method and the Talk2Care dashboard. They navigated through the dashboard, reviewing conversation summaries and raw logs, and provided feedback on the system's usability and effectiveness.

Findings. The dashboard received high usability scores, with an average SUS score of 85.8 out of 100. Providers found the system intuitive and efficient, significantly reducing the time and effort required to process patient information. The dashboard's summarization and highlighting features were particularly appreciated, as they helped providers quickly identify key details and prioritize tasks. Figure 3 summarizes the subjective ratings.

Providers noted that the detailed information provided by the VA system was more comprehensive than traditional patient messages, improving the quality of care they could offer. They also valued the potential for the dashboard to support task triage and long-term patient management.

Conclusion

Talk2Care, an LLM-powered system, was designed to facilitate communication between older adults and healthcare providers. Through two studies, the system demonstrated high usability, enriched information collection, and improved efficiency. While concerns about AI reliability, biases, and ethical implications were raised, the findings suggest that Talk2Care has the potential to address communication challenges in healthcare. Future work should focus on addressing these concerns and integrating the system with electronic health records to enhance its functionality.

Broader Impact Statement

Our work is in the development and evaluation stage, involving user studies with healthy older adults and healthcare providers. We address a gap in the literature by leveraging LLMs to improve asynchronous communication between patients and providers. The system features a conversational interface for older adults and a summarization dashboard for providers. This innovation enhances aging in place by streamlining communication, reducing response times, and improving the quality of health information, ultimately supporting more effective healthcare interventions.

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