Designing an AI Assistant for Student Telehealth: A Case Study Using Human-Centered Design

Hisham Ghunaim, Troy R. Weekes, and Thomas C. Eskridge
Human-Centered Design
Florida Institute of Technology
Melbourne, FL, USA
teskridge@fit.edu

***Abstract*—The interactions of AI systems in human-autonomy teams are designed to support user understanding, confidence, and trust. This research puts these useful interactions in a broader context of how a healthcare team could work to best meet the goals of the human user. The use of technology including AI and automation solutions to deliver various virtual healthcare services has substantially increased over the past two years following the COVID-19 pandemic. This paper presents a case study on following a service design thinking methodology to investigate the potential impact of AI solutions on the patient-user experience targeted at university student patients using telehealth services. The service design thinking approach is focused on the whole user experience and quality of service. It incorporates temporal processes and considerations of the user's needs throughout their healthcare journey. User needs and requirements were elicited using interviews with a subject matter expert from the healthcare domain and with graduate student users. The collected data were analyzed and used to create two personas and storyboard scenarios. Then, three patient journey maps were created. The first "As Is" journey map demonstrates the patients' pain points. Then, two alternative journey maps were developed to illustrate solutions using AI assistance, providing a holistic view of the patient experience during the telehealth journey. Low-fidelity prototypes and wireframes were produced in the prototyping phase. The added value of the journey map is that it shows where in the patient journey the AI assistant should best be integrated to reduce the risk and increase patient benefits. Moreover, the project identifies five main stages of the telehealth journey and offers key design improvements at each stage. For example, the process improvements point out how using an AI assistant can reduce time and effort by guiding the patient through the decision-making process to navigate the care options. Similarly, the AI assists the healthcare provider by gathering and integrating the patients' required health information to accelerate the care process.**

***Index Terms*—AI Healthcare Assistant, Telehealth, Service Design Thinking, Human-Centered Design**

I. Introduction

In recent years, there has been growing interest in telehealth services that enable people to access health care providers from home [1]. During the coronavirus disease 2019 (COVID-19) pandemic, the use of telehealth services has increased substantially in many countries, becoming a basic expectation of healthcare. A study conducted by Bestsennyy [2] shows that telehealth use stabilized after substantially increasing in April 2020 to maintain 38 times more prevalent than before the COVID-19 pandemic. However, many potential users has difficulties taking full advantage of the telehealth services available to them. This project aims to apply design thinking methods and tools to investigate innovative solutions to improve the telehealth experience. In particular, the target users for this study are university students who have access to free telehealth services.

The World Health Organization (WHO) [3] defines telehealth as the "delivery of health care services, where patients and providers are separated by distance. Telehealth uses information communication technology for the exchange of information for the diagnosis and treatment of diseases and injuries, research and evaluation, and for the continuing education of health professional". The Center for Connected Health Policy (CCHP) [4] defines telehealth as "a variety of telecommunications technologies and tactics to provide health services from a distance." Mechanic et al. [5] defines telehealth as "the use of a technology-based virtual platform to deliver various aspects of health information, prevention, monitoring, and medical care."

According to these definitions, telehealth services have a wide range of applications beyond virtual patient-doctor meetings. This project considers a variety of telehealth applications relevant to the needs of student patients.

II. Background

Our research problem is to understand telehealth services from the perspective of the target population of university students and improve their current patient-user experience.

A. Student Healthcare

The university telehealth context involves young adults who are experiencing multiple life-changing transitions, such as moving from home, new academic responsibilities, and new social situations [6]. The university student demographic is a useful target for this project because many universities provide telehealth services as part of student fees, and younger students have greater experience with technologies commonly associated with telehealth delivery, such as working with mobile devices and video streaming.

1) University students experience specific health problems: Because of the confluence of life-changing transitions and the stress of academic achievement, research in university student populations highlights unique health priorities and identifiers concerning patterns of mental, physical, and behavioral health

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risk factors [7]. Several studies indicate high levels of psychological distress in university students, specifically depression, anxiety and suicide risk [8]–[10]. Moreover, students with psychological distress had a higher risk of academic failures and drop-out [11], [12]. Healthcare providers at universities are well-positioned to help students deal with these health problems and a range of risky behaviors. These health risk factors are interrelated and efforts to change them require a more comprehensive approach that extends beyond the health of individuals to the wellness of an entire campus community.

2) Emotions are strong drivers of student behavior: Understanding the students' values and health priorities provide insight into opportunities to make health education more effective [7]. Gross [13] determined that emotions motivate university students' health information seeking. Zillmann and colleagues [14] argued that emotions can lead users to selectively attend to certain types of messages, or aspects of messages, instead of others. While this characteristic is not specific to university students, it is pronounced due to the combination of youth, changing life events and physical, cognitive, and emotional stress that is endemic in this group.

B. Benefits of Telehealth

Healthcare is being digitalized in the interconnected and data-driven world. The benefits of this can be utilized by a broad segment of the healthcare user population and may have particular advantages for those more adept with digital technologies.

1) Improved healthcare access while mitigating expenses: The original concept of telehealth was providing basic care to rural and underserved patients [15], [16]. An early goal of telehealth was the provision of better access to healthcare while mitigating medical expenses [17]–[19]. Generally, telehealth eliminates transportation costs, provides patient education, improves health literacy, promotes medication adherence, and prevents hospitalizations.

2) Convenience and decreased costs with video visits: Powell et al [20] conducted semi-structured, in-depth qualitative interviews with adult patients following video visits with their primary care clinicians. All patients reported overall satisfaction with video visits, with the majority interested in continuing to use video visits as an alternative to in-person visits. The primary benefits cited were convenience and decreased costs. Some patients felt more comfortable with video visits than office visits and expressed a preference for receiving future serious news via video visit in their own supportive environment.

3) Interactions with healthcare information: In 2022, telehealth services included medical education, remote patient monitoring, patient consultation via videoconferencing, wireless health applications, and transmission of electronic health records (EHRs), images and reports [15], [21]. These services involve interactions among patients and healthcare providers through telephone, e-mail, video chats or conferences, the Internet, and remote devices [21], [22].

C. AI Assistant for Student Healthcare

We define AI as software that can perceive and understand the surroundings and act appropriately to maximize its chances of achieving targeted objectives [23]. Even though clinical applications of AI require regulatory approval, previous research has established that there is significant scope to integrate AI in the healthcare industry [24]–[26].

Fully automated medical-image diagnosis systems for radiology, ophthalmology, dermatology, and pathology are arguably the most successful domain of medical AI applications [27]. Even though there has been significant focus on fully automated clinical systems, potential applications of AI in healthcare include interactive AI and more consumer-facing AI solutions [28]–[30]. In spite of the technological advances, the healthcare industry remains highly regulated, capital intensive, and has significant educational requirements for its stakeholders [31].

In addition to the successes in diagnosis, there are two key drivers for the adoption of AI for telehealth in particular; First, the difficulties colocating the appropriate physician, patient, and patient data, and Second, the growing need for specialist services, where clinical demand requires the specialist be immediately available and fully engaged [32]. The adoption of AI technologies that provides education, triage and guidance services could reduce the burden on the existing healthcare system and provide more timely and convenient information and services to users. In particular, patient monitoring through intelligent sensing and patient healthplan management through interactive intelligent chat-bots are two areas where AI systems can help patients play a larger role in taking charge of their own health [32].

The goal of this research is to help university students realize the benefits of telehealth services. We recognize the specific health problems that university students face and investigate the utility of an interactive, personalized, AI-powered telehealth service with integrated end-to-end patient-user experiences that enables students to seek health information and engage in healthy behaviors.

III. Service Design Thinking

This project adopted the service design thinking model in Figure 1 by Stickdorn et al. [33], which consists of four core activities: research, ideation, prototyping, and implementation.

A. Research

The design thinking research activity started with planning and preparation, which was documented in the design brief. We began with secondary research in the literature and augmented this with in-depth qualitative interviews as the primary research method to empathize with target users, i.e., university students, and understand the context in which they used telehealth.

We interviewed two Florida Tech students and one faculty expert who is the Director of the Student Counseling Center. The expert interview was vital to the research since as a medical professional, the expert interacted with students on

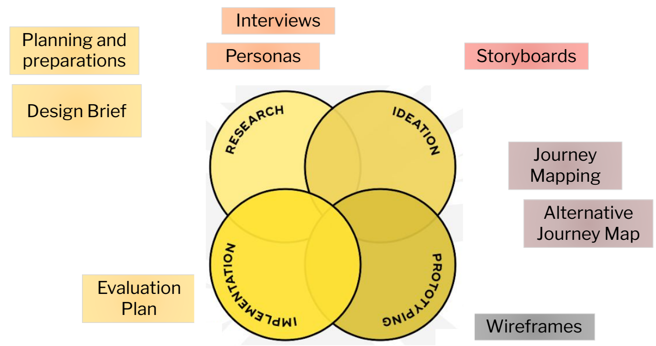

Fig. 1. Four core activities of the service design process and methods used.

a daily basis using in-person and telehealth services. This experience gave them a unique stakeholder perspective of managing a student healthcare service.

The semi-structured interviews comprised the following open-ended questions to understand how the participants use and perceive telehealth services:

- Have you used telehealth before?
- In what context have you used telehealth?
- How did you find telehealth?
- What did you like or dislike about telehealth?
- Do you prefer virtual or in-person healthcare?
- In what areas do you think telehealth is useful?

We acknowledge that the sample size used for this study is well below the level needed for reliable results. However, the application of human-centered design methodologies to the problem allowed us to begin our experimentation of the healthcare space and draw some tentative conclusions. A key finding from the interviews indicated that students were not aware of the free telehealth services provided by the university. One student had experienced telehealth services from an external healthcare provider. Both students agreed that telehealth is more appropriate for routine and low-priority healthcare interactions. One student compared the telehealth experience to a virtual work meeting and suggested to share information before the meeting to maximize efficiency and save time.

The expert user mentioned that many healthcare experiences include more than one visit and usually there are follow-up visits. The expert user stated that students decide the type of the visit, i.e., in-person or virtual, they would like to conduct with the healthcare provider. The students preferred the in-person healthcare option, citing privacy and sensitive information as top reasons.

We developed several personas depicting students and heathcare providers based on the data collected and analyzed from the interviews. For this paper, we focus on a user persona called "Chris". Chris is a 19 year-old full-time undergraduate sophomore student at Florida Tech. He is a student-athlete, and he plays football with the university's official team. He has daily personal training and a weekly practice schedule. Chris does not use healthcare services unless there is an emergency. He is not aware of the benefits included in his healthcare plan. Due to his routine training, he has high exposure to having a sports injury.

B. Ideation

To address the needs identified by our interviewees, we proposed the use of an interactive hybrid AI system with components of a fully automated clinical system and an integrative decision support system. The interactive AI can learn through various types of human feedback and builds a personalized model to comprehend individual human intentions, behavior, and motives, in order to generate explainable and trust-worthy recommendations through contextualized interactions. Within the decision making levels of the AI system the patient-user retains decision-making authority.

To test this hypothesis and guide our methodology, we propose the following research questions:

- What health problems do university students face?
- Are university students aware of telehealth services?
- Do telehealth services interest university students?
- Which telehealth services suit university students?
- How can telehealth services benefit university students?
- How can an AI assistant provide telehealth services?

1) Storyboard: We created the storyboard shown in Figure 2 about Chris to illustrate a possible scenario where he uses telehealth services to solve a healthcare problem.

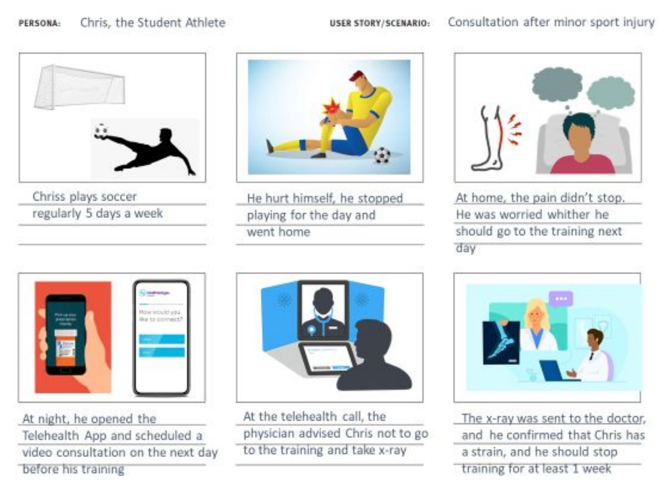

Fig. 2. Storyboard about Chris' telehealth consultation after a sports injury.

In this scenario, Chris, the student-athlete, used a telehealth service to carry out a virtual medical consultation shortly after a minor sport injury. The storyboard highlighted the moments of frustration and how to Chris resolved them using the telehealth service.

2) As-Is Journey Map - Conventional Telehealth: We used Smaply.com to design journey maps. We started by identifying the primary stages of patient-user experiences when using telehealth services, which were elicited in the expert interview. We plotted the six main stages of this "As-Is Journey Map" shown in Figure 3, i.e., injury, research, schedule appointment, telehealth session, medical tests, and follow-up.

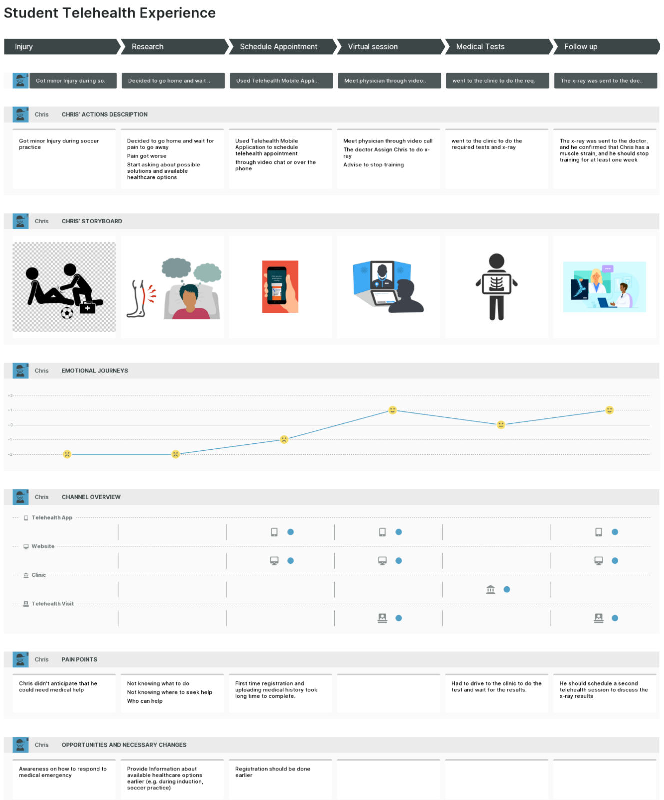

Fig. 3. As-Is Journey Map - Conventional telehealth without AI.

The rows of the journey map included the following elements: a description of patient-user's actions at each stage; a photo to create a storyboard; a graph to plot the patient-user's emotional state; a representation of the communication channel for the user interaction; pain points to elaborate on the patient-user's frustrations; and, pain points reframed as opportunities for changes.

The telehealth journey started with Chris having an injury during soccer practice. He decided to go home and wait for the pain to go away. Instead the pain got worse. Chris started asking himself about possible solutions and the available healthcare options. Chris eventually used the telehealth mobile application to schedule a telehealth appointment through a video call or over the phone. Chris met the physician through a video call. The doctor advised for Chris to complete an x-ray examination and stop training. Chris went to the clinic for the required tests and x-ray. The x-ray was sent to the doctor, who confirmed that Chris had a muscle strain, and he should stop training for at least one week.

The "As-Is Journey Map" was a basis used to highlight issues with the current telehealth services and as a tool for ideation to generate potential solutions.

C. Prototyping

1) Alternative Journey Map - Automated Telehealth: The "Alternative Journey Map" shown in Figure 4 implements an AI assistant in student telehealth services.

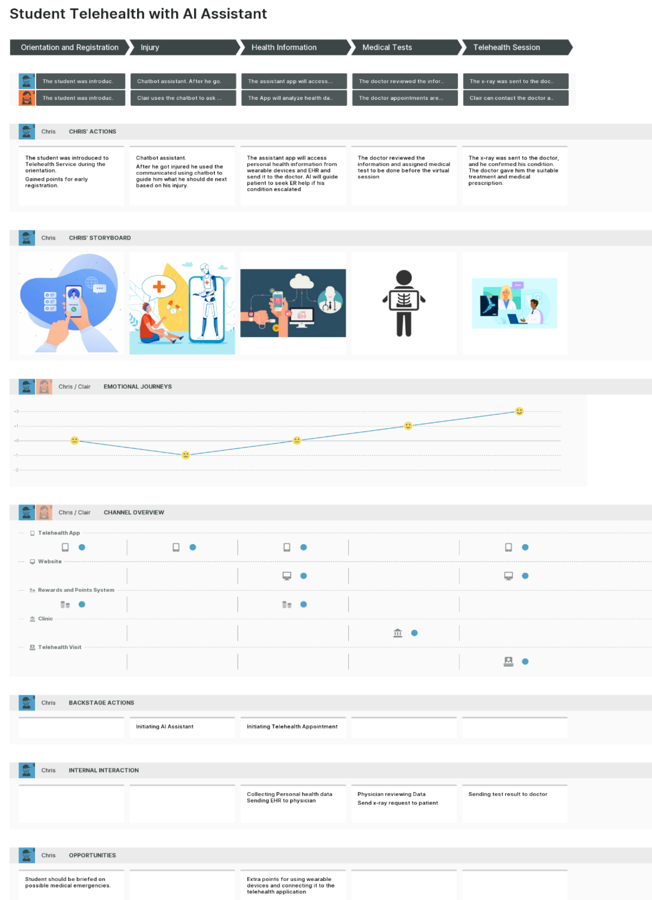

Fig. 4. Alternative Journey Map - Automated telehealth with AI.

A key insight from the "As-Is Journey Map" was the fact that before scheduling the appointment, Chris did not anticipate that he would need medical help and he did not know that the university provided a telehealth option. The "Alternative Journey Map" addresses this opportunity by increasing student awareness on how to respond to medical emergency and promote registration for student telehealth options during induction and soccer practice. Other opportunities for change include Chris' experience where he was required to upload his medical history and he experienced a long wait time during online registration. Chris did not enjoy driving to the clinic to perform the tests or waiting for the results. Chris had to remember to schedule a second telehealth session to discuss the x-ray results.

We reduced the six main stages to five in the "Alternative Journey Map" and included two elements to represent the service blueprint. The backstage actions and the internal interactions between different service providers are crucial elements that the user does not directly observe. These elements help to support the understanding and implementation of the proposed service redesign.

2) Wireframes: As shown in the channel overview section of the "Alternative Journey Map", the user's primary interaction tool with the service is the mobile device. Therefore, an important method to evaluate the user experience was to create wireframes shown in Figure 5 for the mobile application.

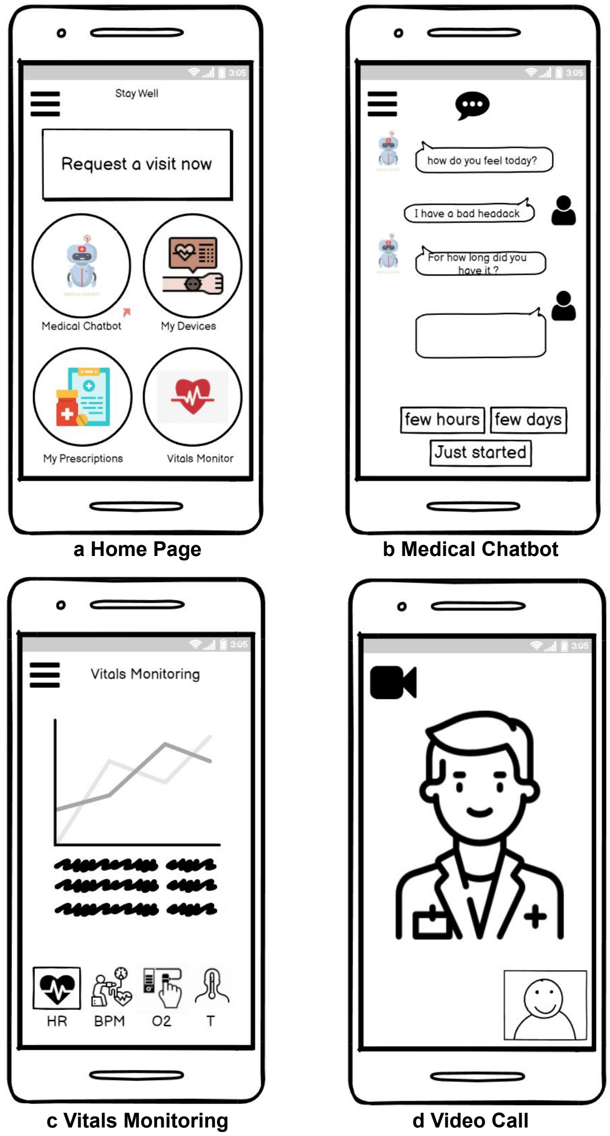

Fig. 5. Mobile application wireframes. (a) Home Page. (b) Medical Chatbot. (c) Vitals Monitoring. (d) Video Call.

Based on the research interviews and ideation with the personas, the design of the home page of the mobile application, in wireframe (a), offers five functions: schedule telehealth appointments, Medical Chatbot, connected wearable devices, my prescriptions, and health vitals monitor. The medical chatbot, in wireframe (b), analyzes the user's symptoms and supports the user's decision by providing trustworthy information about his condition and the available healthcare options. The vital monitoring function, in wireframe (c), provides a simplified representation of the patient-user's four primary health vitals: heart rate, oxygen level, blood pressure, and temperature with explanations. The video call feature, in wireframe (d), allows the mobile application to conduct the telehealth sessions.

D. Implementation

The wireframe prototype was evaluated by the authors through informal heuristic evaluation and modified to correct errors and suggest future enhancements. A plan for future evaluation was prepared to provide human-centered guidance during the implementation of the student telehealth AI assistant. We hope to conduct and report on the results of this evaluation later this year.

IV. Results

At the beginning of this project, we asked the question - how might we improve the design of telehealth services for university students to have a better patient-user experience? We hypothesized that an AI assistant would help to achieve this goal. While we will certainly require a larger sample of interviews and a full evaluation of the prototype capabilities, we have been able to identify several recommendations and key improvements for each stage of the "Alternative Journey Map":

A. Registration

Students should be introduced to telehealth services as part of their orientation process. A simple, explainable points and rewards system should be implemented to encourage students to complete their registration process and update their medical information on the mobile application.

B. Injury or illness

In the event of an injury, the student would already has an active account on the telehealth application and would know where to find medical assistance. The AI of the medical chatbot will guide the student to evaluate his condition's severity and choose a suitable health service for the student.

C. Health information and wearable devices

The student should have his current personal health information and vitals securely logged through the mobile application and wearable devices. This information should be sent to the physician before the telehealth visit. The AI assistant will monitor and analyze the student's vitals and provide advice accordingly. For example, the AI will alert the student to seek emergency help if his condition deteriorates.

D. Telehealth visit

The need for follow-up visits will be reduced since personal health information will be monitored by the AI. Students can always access telehealth visits if they wish to.

V. Discussion

While there are many benefits to AI telehealth services, AI designers in this domain should be familiar with its limitations. Telehealth limits the ability of the healthcare provider to examine the patient similar to in-person visits leading to more erroneous diagnoses. Compared with face-to-face visits, telehealth visits are more vulnerable to privacy and security risks.

VI. Conclusion

The human-centered design process undertaken in this study has resulted in a wireframe conceptual prototype of an AI assistant for university student telehealth services. Although the study was conducted with a very limited pool of participants, the process of working through the first three steps of the human-centered process design thinking of research, ideation, prototyping and implementation enabled us to identify several characteristics of what will be successful applications in the telehealth domain.

In the future, we will conduct additional interviews with students and other expert medical providers to broaden and refine our existing user personas, adding additional personas if the need arises. We will also continue to develop the wireframe prototype into an online, slide-based form that will allow users to step through the application and gain a greater appreciation for the capabilities of the application. As part of our evaluation study, we will conduct a "wizard-of-oz" study, where a human will replace the AI component of the application in the chatbot and with the information and recommendations that are provided. This will enable us to test the effectiveness of the AI components without having to either develop or integrate our own AI models. Beyond this evaluation, we will begin construction of a high-fidelity prototype and a parallel development of the AI capabilities needed to support it.

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