PAPER

A Comprehensive Approach to Enhancing Doctor-Patient Interaction: Bridging the Gap for Better Healthcare

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ABSTRACT

Effective doctor-patient communication is a critical clinical function, and the resulting relationship is the heart and soul of medicine, as well as a critical component in healthcare delivery. Inefficient communication between doctors and patients is the leading cause of patient dissatisfaction, as it directly affects the health outcomes of the patient. The current study aimed to develop a holistic solution to bridge the doctor-patient communication gaps in the cardiology department and facilitate effective communication, ensuring better health outcomes. Desk study and empathy interviews highlighted the doctor-patient communication gaps and their effects on the overall health outcome and patient satisfaction. Various concepts were explored using the insights found using journey maps, causal loops, and affinity walls. User approval was determined by soliciting user feedback, and the System Usability Scale (SUS) was used to evaluate usability. A holistic solution utilizing educational material for quick understanding and recall of all issues reorganized the file, which provides structure to the interaction during the consultation and facilitates two-way interaction and app-based tracking of symptoms for informed decision-making, was developed. The solution was very effective in educating and preparing the patient, involving the patient for higher patient engagement, and assuring the patient for increasing patient adherence. It was found that the patients were able to understand and address their concerns effectively, and doctors were able to communicate more effectively. (SUS score: 78.12 and 75.62 for doctors and patients, respectively). As the solution is easy to adapt in the current system, it would help facilitate effective communication between doctor and patient.

KEYWORDS

doctor-patient communication, communication barriers, chronic heart diseases, user-centric design, experience design, interface design, design intervention

1 INTRODUCTION

We live in an era of shared decision-making, which manifests differently across cultures and diseases. Although doctors are unquestionably the foremost authorities

in their field and possess the necessary skills and knowledge, it can be challenging to see the big picture and understand that, despite the patient's visit for medical care, they are actually dealing with a wide range of issues on a holistic level. Patient satisfaction in India is 66% and is an important indicator for measuring the quality of healthcare [1]. There are six major domains of dissatisfaction where ineffective communication between patient and doctor contributes the most with 43%, and it affects diagnosis accuracy, medical errors, and treatment improvements [2]. Effective doctor-patient communication is a critical clinical function, and the resulting relationship is the heart and soul of medicine, as well as a critical component in healthcare delivery. The successful completion of treatment depends on this communication. Patient discontent is primarily caused by poor doctor-patient communication, which has a direct impact on the patient's health outcomes. Studies on doctor-patient communication have revealed patient dissatisfaction even when many clinicians regarded the communication as good or even exceptional [2]. It was reported that 75% of doctors surveyed believed they communicated satisfactorily with their patients, whereas only 21% of patients perceived satisfactory communication with their doctors [3]. Patient surveys have consistently demonstrated that they want improved communication with their doctors as they are dissatisfied with the consultation and the fact that doctors frequently fall short of providing patients with enough education and better compliance. About 25% of patients express dissatisfaction with their consultation and claim they could not develop a relationship of compliance with their doctors [1]. Many gaps in doctor-patient communication make the patients unsatisfied after consultation with doctors. Patients with chronic diseases tend to experience more healthcare challenges and incur higher costs. Those issues, according to a report from the Commonwealth Fund, can be mediated with strong doctor-patient communication and more convenient access to care. By 2030, there will be 171 million individuals living with a chronic condition [4]. Moreover, patients with chronic conditions, such as heart disease and diabetes, must make decisions every day to manage their disease [5], and they may experience difficulties that must be acknowledged and handled if the goals of a consultation are to be reached. Also, 54.5 million people were recorded to have chronic heart disease in 2016, and 44% of older millennials (40+) are diagnosed with heart diseases, which makes them frightened and concerned about the advent of chronic disease at this age [6], [7]. The three primary goals of doctor-patient communication are fostering positive interpersonal relationships, facilitating information interchange, and including patients in decision-making [2]. Patients who report strong communication with their doctor are more likely to be pleased with their care, especially when it comes to sharing relevant information for the correct diagnosis of their issues, following recommendations, and adhering to the prescribed treatment [8]. Patients' recovery is significantly related to their agreement with the doctor regarding the nature of the treatment and the necessity for follow-up [2]. Hence, this study aims to develop a design-based solution to bridge the doctor-patient communication gap and increase patient engagement for accurate diagnosis and adherence to treatment of chronic heart patients (35–50 years old) for overall positive health outcomes.

2   REVIEW OF LITERATURE

A systematic search plan was adopted to search published literature from electronic databases ScienceDirect and PubMed, which are renowned for their comprehensive and high-quality collections in the healthcare and medical research domain.

Relevant publications from hard-copy journals and books were also reviewed. Combinations of the following search keywords were used: 'doctor-patient communication,' 'healthcare communication barriers,' 'chronic heart diseases,' 'doctor-patient relationship,' 'effective communication in healthcare.'

A total of 65 articles were identified, of which 31 journal articles were finalized by removing duplicate publications. The selected databases provided focused and high-quality literature directly relevant to the study topic. Each selected article offered significant insights pertinent to the study. Given the specific nature of the topic, the literature review required a very selective approach to ensure the inclusion of highly relevant and detailed data. The inclusion criteria were articles published in journals and written in the English language. Finally, data from the 31 selected pieces of literature was synthesized for the current study.

2.1 Causes of increasing doctor-patient communication gap

Patient satisfaction regarding effective communication is 60.5% in India and further decreases when the patients are suffering from chronic illness [9]. Patient's difficulty in communicating issues, lack of interaction outside consultation areas, limited consultation time, and lack of patient involvement are a few of the causes of ineffective communication, which negatively affects the accuracy of diagnosis and treatment improvements [2]. Factors such as lack of adequate information sharing, difficulty in understanding, and negligence of emotional needs also contribute to the increasing communication gap, which directly affects treatment adherence [10].

Difficulty in information sharing. It was found that 60% of patients find it difficult to discuss their symptoms, issues, and concerns with their doctors [11]. One-third of patients with chronic diseases find it difficult to comprehend their own health and the advice they get from their doctor, which is crucial for explaining the difficulties [12]. Additionally, worry and anxiousness cause patients to give incomplete explanations or overlook crucial details. 84% of patients reported that they were too nervous to talk about their concerns in depth with the doctor and were concerned that their privacy may be invaded [13]. A study that was published in the Journal of General Internal Medicine found that 54% of patients were unable to have a lengthy conversation with their doctor because, on average, doctors only give patients 11 to 19 seconds to describe their symptoms or the reasons they are seeking care before interrupting [14]. Only roughly one in three doctors, according to the survey, offer their patients any chance to discuss their medical concerns at the beginning of a visit. Even when the participants were given the chance to speak, doctors cut them off seven out of ten times, and only 5% of them could finish their stories after being interrupted [14].

Lack of patient involvement. Many clinicians prioritize symptom classification and patient diagnosis over the patient's unique demands and way of life. Four out of ten consultations displayed the directing style's traits. Cross-sectional analysis of over 4,000 participants in the diabetes study revealed that 40% of patients who rated their doctors lower on factors such as patient involvement in decision-making, physician empathy, understanding their medication problems, and evoking patient trust were less likely to reorder cardiometabolic drugs than those whose doctors were deemed to be good communicators [15].

Limited consultancy time. In India, consultations last 8.9 to 12.4 minutes on average. According to the most recent data, the mean consultation time is five minutes or less in 18 nations, which accounts for around 50% of the global population. Such a

brief session will probably have a negative impact on the patient's treatment as well as the workload and stress of the consulting doctor. Patient satisfaction with consultation time is typically correlated with improved communication. To properly communicate with patients about their illness, doctors must take the time to listen to them. A clear positive correlation was found between patient satisfaction and consultation time [16].

Lack of information sharing by doctors. Doctors give sparse information to their patients, with most patients wanting their doctors to provide more information than they do [17]. In a 20-minute consultation, just one minute is spent on information exchange. According to research done in a tertiary care hospital in Delhi, 62% of the patients had little to no information at all. Two-thirds of patients reported receiving a new medication in the hospital, yet 90% noted never being told of any adverse effects of these medications. The overall satisfaction with the disease's explanation (54.3%), treatment (57.6%), investigations (59.4%), and prevention-related recommendations (21.6%) was relatively low [9].

Patients and doctors disagree on the relative value of imparting various types of medical information; patients place the highest value on information about the diagnosis and underlying causes of their conditions, while physicians overestimate their patients' desire for information about treatment and drug therapy [18]. Only 6% of the time did doctors overestimate their patient's need for knowledge, compared to 65% of meetings when they underestimated it.

Difficulty in understanding instructions. In more than half of the 800 visits examined, the use of medical jargon by doctors (e.g., oedema) and medical abbreviations (e.g., history) created communication barriers. 16.9% of clinicians fail to inquire about the patient's comprehension of the diagnosis, course of treatment, drugs, and testing. Particularly when it comes to prevention, there is a big disconnect between what physicians think they are saying and what patients really hear. Although 89% of doctors claim to regularly advise their patients about preventative screenings, just 14% of patients agree. It is further troubling that patients with chronic illnesses who are most in need of these lifesaving tests and therapies face an even greater discrepancy.

2.2   Effects of communication gaps on health outcomes

Patients do not follow the recommendations made by doctors, and, on average, 50% do not take their medications or do so improperly because of poor communication and information exchange [11]. It was also found that poor patient communication increases the risk of avoidable negative outcomes [19]. The study was conducted in the MES Medical College's field practice area in Perinthalmanna, Kerala, India. 55% of patients disclosed a bad encounter that led them to lose faith in a healthcare provider. 36% of patients avoided or delayed treatment because they did not agree with how the health care professional presented and communicated the condition and diagnosis. Four out of five individuals say that the provider or health system could not prevent them from losing their confidence following a negative encounter.

2.3   Chronic heart diseases

By 2030, there will be 171 million individuals living with a chronic condition, a number that is expected to continue to rise [4]. In India, 54.5 million people were predicted to have chronic heart disease in 2016. According to a poll conducted by CNBC Make It, 44% of older millennials (40+) are diagnosed with chronic heart health concerns, which makes them frightened and concerned about the advent of chronic

disease at this age [7]. Additionally, with a rating of 65.7% in India, this age group (35 to 50 years old) is the second least satisfied. People who suffer from chronic illnesses are highly interested in learning about their health issues and interested in information on their diagnosis. The Health Literacy Survey Germany (HLS-GER 2) found that more than 82% of respondents with chronic diseases agreed that they wished to know everything about their health [20]. As many as 30 to 40% of people with a chronic heart illness struggle to comprehend the medical information available about their condition and find it challenging to communicate with their doctors.

2.4 Research gap identified and problem statement

Six major gaps were identified (see Figure 1); hence, the design vision and direction were established to allow the healthcare system to bridge these gaps for effective doctor-patient communication and improve patient satisfaction.
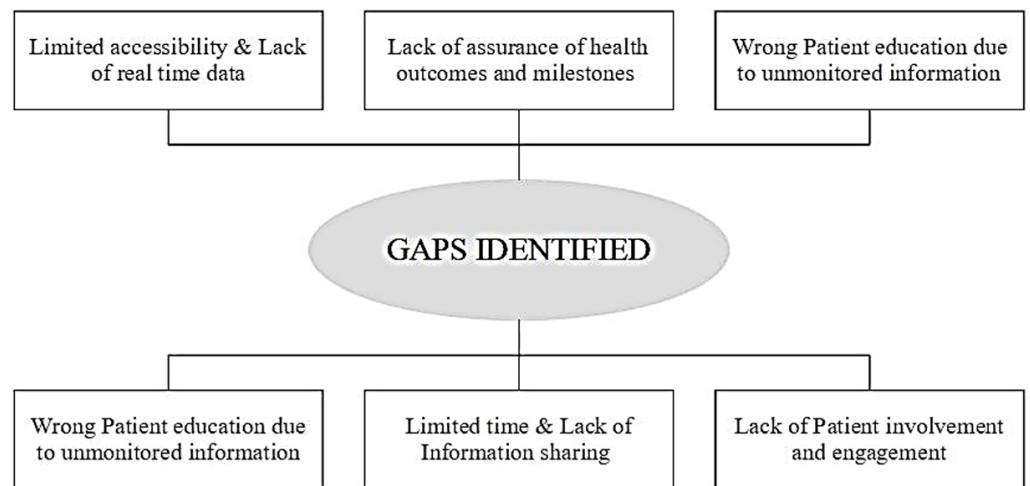

Fig. 1. Research gap identified

Based on the literature review and the insights from primary study, it was derived that effective communication needs to be established between chronic heart patients 35–50 years old and cardiologists, as it has a direct positive correlation to health outcomes. Hence, the problem statement was: "How might we bridge the patient-doctor communication gap and increase patient engagement for accurate diagnosis and adherence to treatment of chronic illness patients (35–50 yrs)?"

3 METHODOLOGY

3.1 Participants

The study was conducted among 68 participants from Mumbai via a survey to understand the satisfaction level and communication problems faced by chronic heart illness patients and cardiologists. The participants for the survey ranged from 35–50 years old, suffering from chronic heart conditions. Personal interviews were conducted among 30 participants from Mumbai, which included a group of 22 chronic heart disease patients and eight cardiologists, to get detailed insights. For conducting the usability testing of the hi-fidelity prototype of the proposed concept, a SUS was used, and the test was administered to 26 participants (20 patients and six cardiologists).

3.2 Methods and materials

A systematic user-centered design methodology [21] was adopted, and various methods and tools were used to conduct the entire study. The study consisted of four different stages, namely, data collection, data synthesis, conceptualization, and user testing [22], [23] as shown in Figure 2.
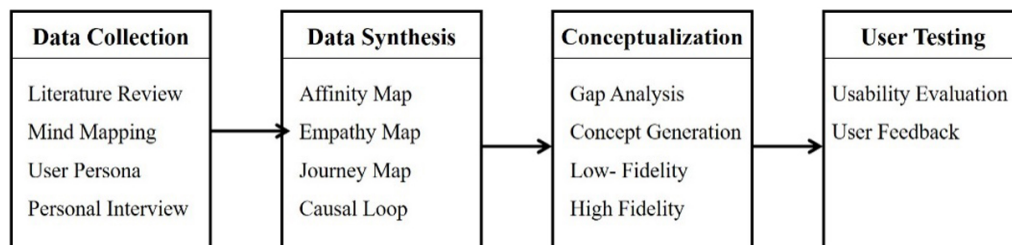
Data Collection	Data Synthesis	Conceptualization	User Testing
Literature Review	Affinity Map	Gap Analysis	Usability Evaluation
Mind Mapping	Empathy Map	Concept Generation	User Feedback
User Persona	Journey Map	Low- Fidelity	
Personal Interview	Causal Loop	High Fidelity	

Fig. 2. Methodology adopted for the study (author-made)

Collection of data. Initially, a literature review was conducted to understand the current situation in the field of doctor-patient communication. Further, two user personas (doctor and patient) for the study were defined based on the parameters of age, occupation, income, and health status, which helped in understanding the pain points and motivations of the user group. To collect data from the users, survey questionnaires were distributed to collect quantitative data swiftly. Personal interviews were conducted to get an in-depth comprehension of the user's mindset. The interviews helped to gain a better insight and understanding of the communication issues faced by patients and doctors. To collect data from the participants, the purpose of the study and the procedure were informed in detail. Informed consent forms were obtained from each participant before participating in the study, and the data collection process followed the Helsinki protocol [24].

Data synthesis. A variety of tools were employed throughout the synthesizing process. An affinity map was used to categorize and organize the data into groups according to the observations and key findings. All the data collected was color-coded based on commonality and then grouped together. Various groups formed here were information sharing, emotional negligence, lack of patient engagement, and current healthcare system flaws. The use of empathy maps helped in gathering unique and deeper insights about the user group. It was made for two user groups: patients dealing with chronic heart conditions and cardiologists. The empathy map [25] had six groups: 'Think & feel,' 'Say & do,' 'Hear,' 'See,' 'Pain,' and 'Gain.' The user's journey was mapped out and divided into three parts: before, during, and after the consultation. This map tracked the stakeholders' actions, emotions, expectations, and pain points. Causal loops were also created, which helped in understanding the interplay between the different variables, such as lack of information sharing, lack of engagement, limited consultation time, and more in the problem area [26].

Identifying design objectives. Based on the collected data, design objectives were formulated. These design objectives are mentioned below:

Educate and Prepare: Educate and prepare the patients before interacting with the doctor to help patients recall what they want to communicate.

Involve: Increasing patient engagement and involvement in the conversation is necessary to establish effective communication.

Assure: Provide assurance to patients in and after consultation to improve adherence.

Cost: Healthcare is already expensive, so the solution should be lower in cost.

In the primary study, doctors acknowledged that they want certain tools to facilitate improved communication but not at the cost of increased workload. Thus, the direction of the solution was to provide a simple, cost-effective, and easy-to-integrate within the existing system without increasing any workload.

Conceptualization. The insights and data gathered helped identify three major aspects of the solution, which are "EDUCATE," "INVOLVE," and "ASSURE," to address the problem holistically, as shown in Figure 3.
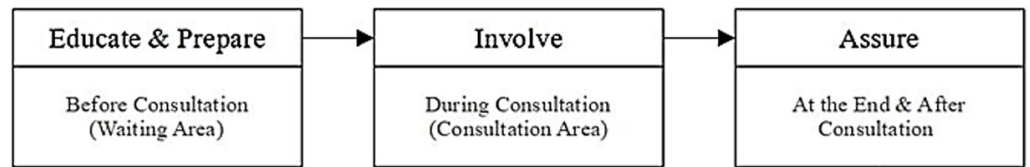

Fig. 3. Aspects of the proposed solution

Multiple concepts were ideated using brainstorming sessions in each solution aspect (see Figure 4) that would help fill the gaps identified.

Prepare and educate: As shown in Figure 4a, multiple concepts were explored in the aspect "Educate & Prepare." While generating the concepts, the main focus was to provide the necessary information for a better understanding of their condition and better communication with doctors about their issues.

Involve: As shown in Figure 4b, multiple concepts were explored to increase the active participation and involvement of patients within the process for a better understanding of their condition.

Assure: Assurance building is necessary for motivation to follow the treatment. Communicating timelines and goals for better outcomes. Multiple concepts were generated, as shown in Figure 4c, by keeping the aim of providing assurance.
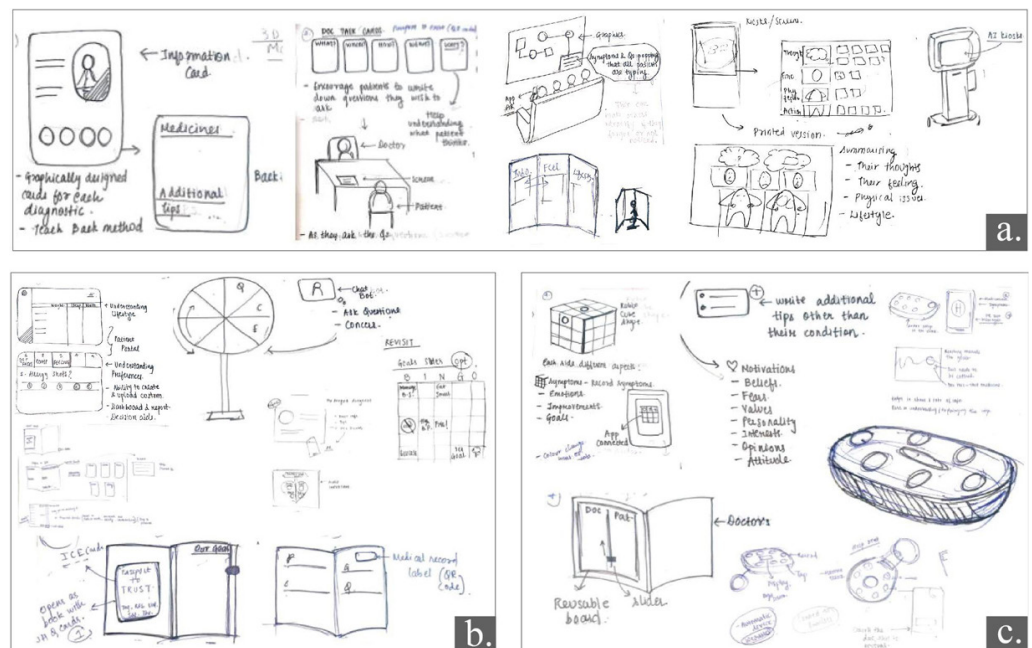

Fig. 4. Ideation of concept for various aspects: (a) educate and prepare, (b) involve, and (c) assure

These concept ideas were analyzed further to refine and create a holistic solution. Out of all the generated concepts, two holistic solution concepts–"Passport to TRUST," a reorganized file along with an application, and "Home Doc," a wearable supported with an application—were taken further. Low-fidelity prototypes of these two concepts were made to gain user feedback on the aspects of the usability and effectiveness of the designed solution. After carefully considering the feedback for low-fidelity prototypes on factors such as feasibility, desirability, and viability in the healthcare setting, the solution concept "Passport to TRUST" was chosen for creating a high-fidelity prototype.

COST: The proposed solution is tailored to be cost-effective and easily blended within the existing healthcare system. Significant portions of the solution have been introduced within the existing tools used by hospitals and clinics, hence enabling easy integration and cost savings. For instance, the reorganization of the doctors' files and the introduction of structured cards can be implemented using existing paper-based or digital systems with minimal additional expense.

Although a new addition, the proposed mobile application represents a relatively small one-time investment. The development of the app is straightforward and not overly complicated. This cost is recoverable as the app helps hospitals provide optimal services by leveraging the database created as users start using the application. By improving patient adherence and outcomes, the app can reduce the long-term costs associated with poor communication and mismanagement of chronic conditions. Additionally, the application facilitates better patient management and follow-up, potentially reducing the need for repeated consultations and hospital readmissions, thereby offering further cost reduction.

4   RESULTS

4.1   Insights from an online user survey

For conducting an online user survey, 68 participants with chronic heart conditions between the age groups of 35–50 years were included to understand their issues. From the response (n = 68), data regarding doctor-patient communication and the satisfaction level of the patient towards the treatment and consultation were extracted. It was found that 42% of the respondents were dissatisfied with the communication with their doctor, while 18% of patients discontinued the treatment with the last doctor due to dissatisfaction regarding communication. The different issues that patients faced at different stages of doctor-patient communication were identified, as shown in Figure 5.
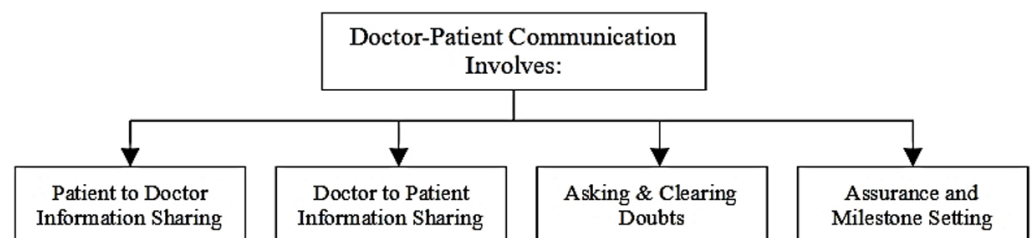

Fig. 5. Elements of doctor-patient communication

Issues faced during patient-to-doctor information sharing. It was found that 39% of patients, while sharing their issues, felt unheard and felt that the doctor did not understand them completely. About 23.2% of patients face problems while explaining all their symptoms to their doctor properly, and 39% of patients face situations where certain symptoms are dismissed by the doctor. It was found that if not dismissed, certain biases, such as weight, menstrual cycle, stress, etc., were held responsible for those symptoms by the doctor, which later on was found to have other causes. It was also observed that about 40% of patients often forget to share some data or remember it after the consultation is over. About 70% of patients feel that consulting time is less than enough to communicate everything in detail, and there is no opportunity to share other information related to lifestyle and emotional needs.

Issues faced during doctor-to-patient information sharing. Patient behavior changes from ignorant to informed and enlightened. It was observed that 64.3% of patients identify themselves as informed patients, and 31.2% of patients identify as enlightened patients. It was found that 50% of patients were not provided with enough information regarding the diagnosis and treatment. It was also found that only 39.1% of patient doctors provide and discuss different ways and options of treatment according to their problems and beliefs. It was also observed that about 35.7% of patients faced issues in understanding the condition and the information provided by the doctor. Other issues include doctors using medical jargon and terminology.

No motivation for asking and clearing doubts. It was found that 25% of patients don't clear their doubts, and only 28% of patients ask questions if they have not understood certain information. Various reasons identified for patients not clearing doubts or not asking questions were feeling judged, limited consultancy time, and relying on Internet information. When patients ask for more information or have any doubts, around 42% of the patients reported being declined, which discourages them from asking further.

Lack of assurance and milestone communication. It was also reported by almost 39% of the patients that they were not given alternatives as per their personal requirements. Also, about 38.4% of patients often reported not following the instructions regarding the treatment. Other main reasons identified for the same include forgetfulness, following Google recommendations, lack of trust, and talking to other family members.

4.2 Insights from the personal interview

Personal and telephonic interviews were conducted with 22 chronic heart patients of the age group of 35–50 years and with eight cardiologists. It was found that 35% of patients don't have a strong rapport with their doctors, while 87% of doctors claimed to have a strong relationship with the patient. There is a huge mismatch of expectations between patients and doctors. It was identified that 86% of patients feel doctor-patient communication is very important, and it has now become a criterion for the continuation of the treatment.

Interview of cardiologists. The doctors pointed out that patients actively participated in their treatment when they were provided with information on

their condition, medication, and preventive measures. For certain follow-ups or problems, the patient wants to talk on call as they don't want to wait in the waiting room, resulting in a lack of improvement in treatment. Even after having trust in the doctor, patients still doubt due to exposure to so much information available on the Internet, which is mostly unmonitored. Technology can help in various aspects, but there is a need to find a middle ground as healthcare itself is expensive.

Insights of patients interview. Patients often find it difficult to convey their problems and symptoms, as they sometimes know how they are feeling or pain but can't explain due to a lack of understanding of the condition or vocabulary. The omissions that patients do with the sharing of problems indicate that patients are unaware of what information is pertinent and valuable to doctors. Patients want more than just an understanding of their condition, such as preventive measures and side effects of medicines and lifestyle changes. Also, it was pointed out by patients that they feel discouraged while dealing with chronic illness due to a lack of understanding of their improvements, which makes it difficult to stay consistent with the treatment. About a 3–6 month gap in the two-consultancy session–there are small issues, ups and downs, which are difficult to convey to the doctor due to forgetfulness and lack of tools to track symptoms. Family involvement is important, but they often say certain contradicting things, resulting in patient confusion.

4.3　Potential concept selection

Different ideas and concepts were generated with the focus on establishing effective communication between patients and doctors by providing simple additional tools to fill the communication gaps, which can be easily integrated into the existing system without increasing the workload of doctors. Two potential solution concepts were narrowed down, and low-fidelity prototypes were built, as shown in Figure 6. A brief description of both concepts is given below:

Concept 1 (Passport to TRUST): In this approach (see Figure 6a), a program is created that uses educational content for rapid learning and retention of all symptoms, as well as reorganizing the doctors' file, providing structure to the medical interaction, and facilitating two-way dialogue and informed decision-making.

Concept 2 (Home Doc): In this (see Figure 6b), an application is developed for a visual summary of the problem faced by the patient and a symptom tracking device for continuous monitoring, which can enable improvement in treatment and act as a tool for easy information gathering.

Both the prototypes were explained and were examined by four cardiologists and 14 patients. The users appreciated both concepts for their ease of adaptability in the current scenario.
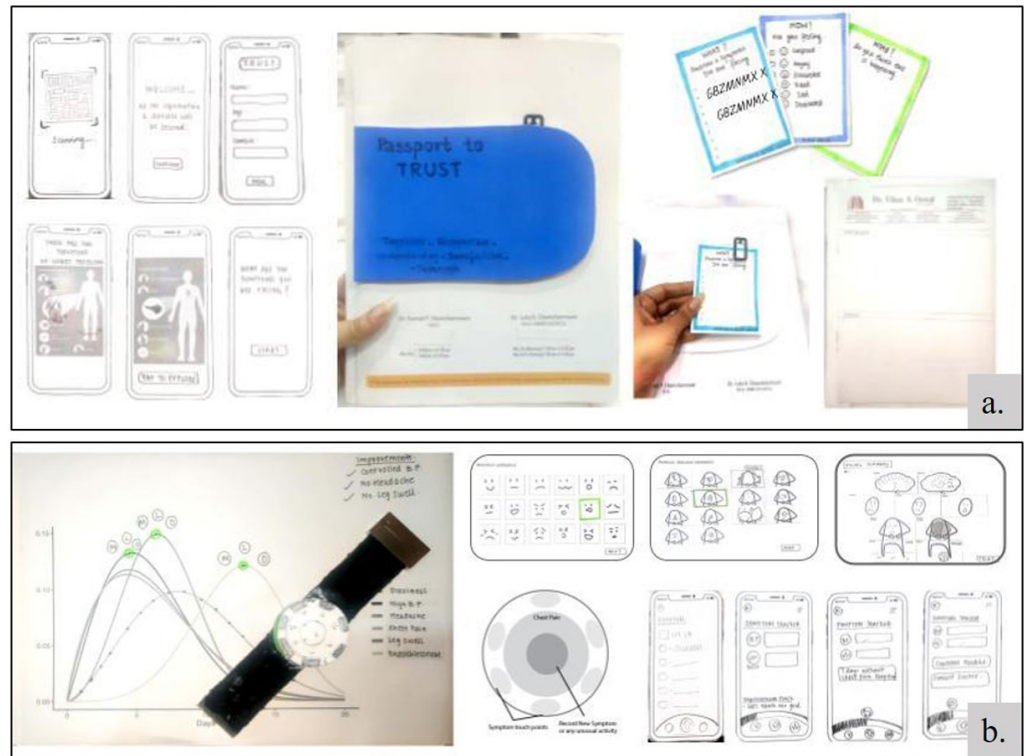
Fig. 6. Low-fidelity (a) concept 1–passport to TRUST, (b) concept 2–home doc

However, based on the feedback and to facilitate effective patient-doctor communication and encourage patients to be active and informed partners in their care, a tool was devised, which is termed: "Passport to TRUST."

4.4 Final concept

A holistic solution was developed utilizing educational material for quick understanding and recall of all issues. The doctors' file was reorganized, which provides structure to the medical interaction and facilitates bidirectional communication and app-based tracking of symptoms for informed decision-making. "TRUST" is a solution for patients and doctors that enables effective communication between them. The solution contains three stages.

Stage 1: Educate and prepare. Patients receive the "TRUST" file containing general information and a note from the doctor to start building that relationship before the meeting. Patients are instructed to scan the QR code, which is on the cover of the file. The patient gets on a quick onboarding process of the application. After completing the onboarding, the next step is to inform patients about various symptoms and help them analyze and recall their symptoms accordingly. Next, they are asked how they are feeling and are provided assurance. The next step is using the mobile app to identify the possible causes. The different solution components of 'Educate and Prepare' are shown in Figure 7.
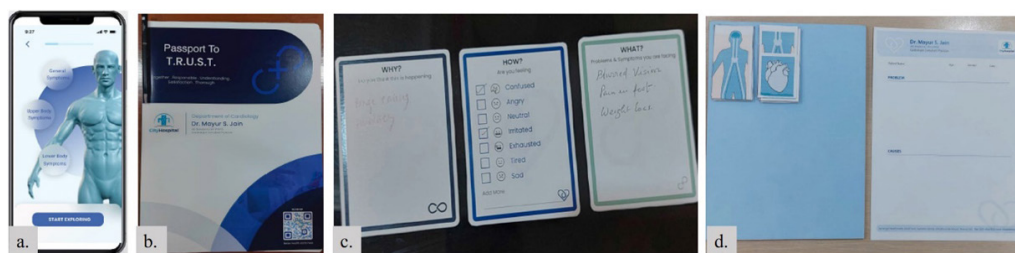
Fig. 7. Solution components for educate and prepare: (a) TRUST application, (b) patient file with QR code, (c) cards, and (d) doctor's notepad

At the end of the consultation, the patient is guided to fill in the cards provided within the file. The 'What' card asks the patient to fill in all the problems he is facing, the 'Why' card asks to fill in the possible causes of the problem that the patient feels, and the 'How' card asks to fill in how the patient feels.

Stage 2: Involve. The patient goes to the consultation room with the filled cards. The doctor asks about the 'How' card to understand the patient's emotional needs and can start the conversation accordingly. The conversation starts by aligning the cards to the TRUST encounter document. The patient explains and shares all the issues using the 'What' card as their notes, and then the doctor uses visual post-it's to mark the problem the patient is diagnosed with and also writes the main points. Then, the patient is asked to tell what they think are the possible causes using their 'Why' card. This helps the doctor to understand the patient's perspective and provides an opportunity to correct them. The doctor then explains the causes and writes them down. Doctors can use visual posts to explain how the treatment will work, which makes it clearer and easier for the patient to understand. The end of the page asks about the patient's thoughts and doubts. The patient is asked to fill in the six major symptoms that need to be monitored, as mentioned by the doctor earlier. The doctor verifies those entries in the application. This method is called the talk-back method, which identifies the patient's understanding. The different solution components of 'Involve' are shown in Figure 8.
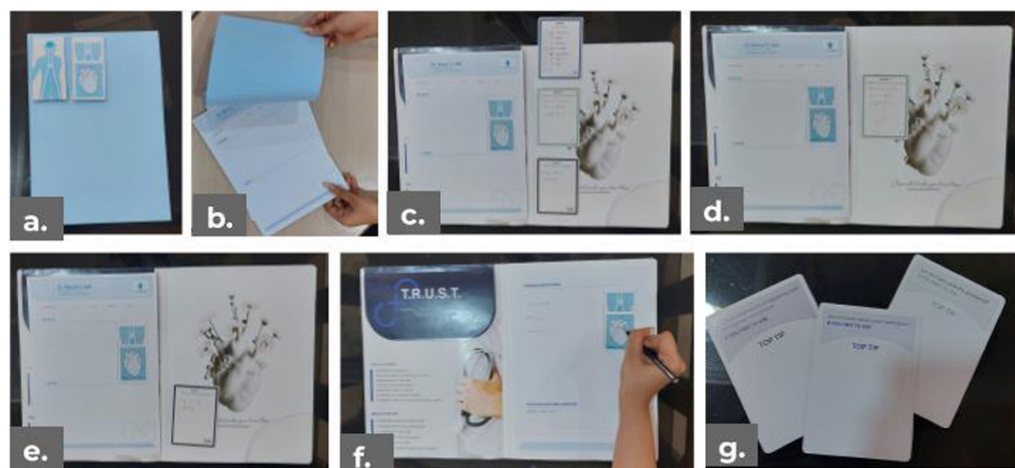
Fig. 8. Solution components for involve: (a) Visual post-its, (b) TRUST encounter form, (c) Cards aligned with the form, (d) What card aligned with the problem, (e) Why cards are aligned with causes, (f) Visual post-its used to explain the treatment, and (g) Top tips card

Stage 3: Assure. As the consultation session ends, the doctor provides a few non-medical tips behind the cards. The next step for the patient is to record their

symptoms daily and pain with its intensity. Multiple nudges are provided by asking daily questions about the symptoms and showing the health improvements, which helps build assurance regarding treatment working. This helps patients follow the instructions and treatment properly. With any unusual increase in symptoms, patients are notified to consult the doctor, and even the doctor and receptionist are notified to contact the patient. The high-fidelity prototype of the "T.R.U.S.T" application in the 'Assure' stage is shown in Figure 9. The prototype of the application was developed using the Figma tool.
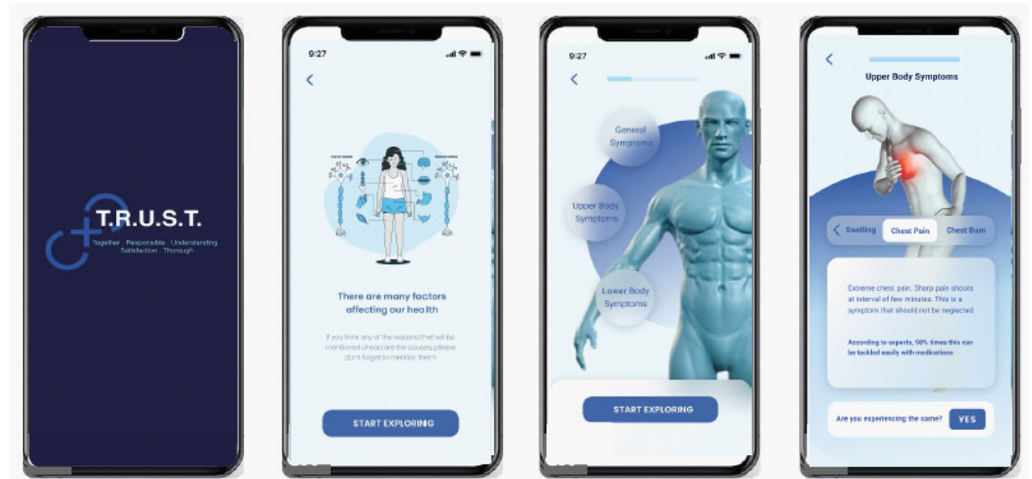

Fig. 9. Hi-fidelity prototype of "T.R.U.S.T" application (author-made)

Revisit. The patient writes their major concerns in the file, which would help direct the conversation according to it. The doctor has the data of the patient's symptoms printed with all the unusual fluctuations marked, which are discussed with three main factors: medication issues, lifestyle changes, or other factors. This helps the doctor change and improve treatment. The solution components of 'Revisit' are shown in Figure 10.
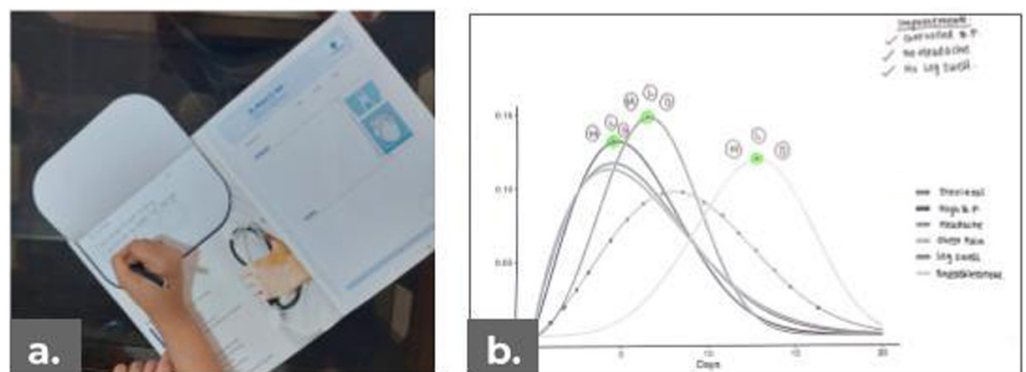

Fig. 10. Solution components for revisit: (a) patient writing top concerns, (b) fluctuation of symptoms

Features and its solution outcomes. The educational and preparation features of the solution for the patients will help in recalling—a better understanding of their condition, leading to effective information sharing in further processes. The feature of involving the patient using the reorganized patient file will further help in bidirectional communication, and app-based tracking of symptoms for informed decision-making will have a positive impact on health outcomes due to increased

adherence and the opportunity to improve treatment accordingly. A flow diagram showing the working of the "T.R.U.S.T" application is shown in Figure 11.
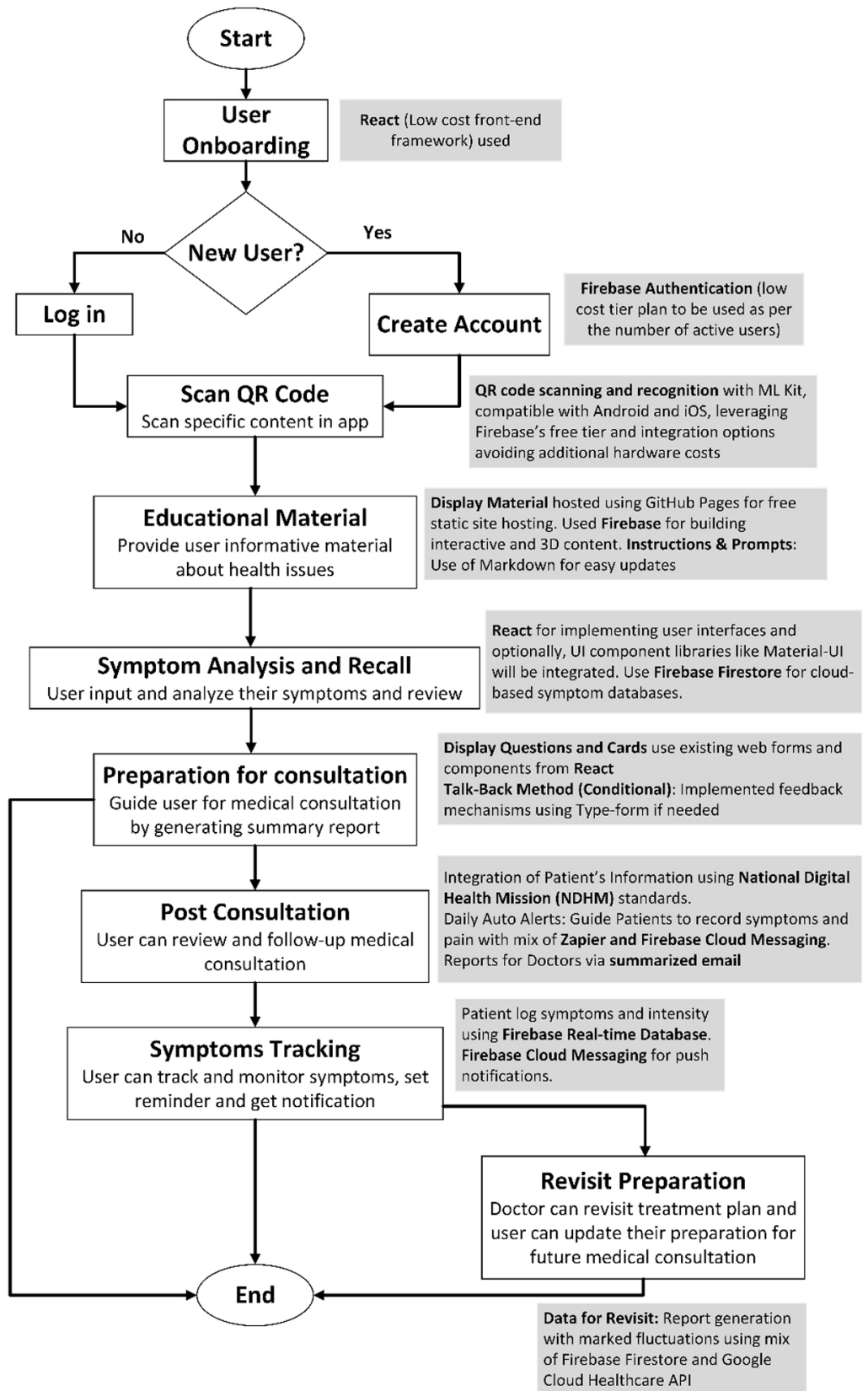

Fig. 11. Flow-diagram of "T.R.U.S.T" application (author-made)

4.5 Usability testing

The prototype model of the "Passport to TRUST" solution and its components were evaluated based on two criteria: efficiency, ease of use, and comprehension. Usability testing of the prototype of the solution was performed on 26 users (6 cardiologists and 20 patients) to obtain feedback and insights on the product. An informed consent form was taken from each of the participants before the start of user testing. Purposive sampling was used to recruit participants for usability testing. The participants were asked to perform tasks on the proposed solution, and then their subjective perception of the solution was captured using a SUS [27], [28], [29], shown in Table 1. Feedback rating (refer to Table 2) was also taken after successfully completing usability testing. The solution was found to be acceptable by all and had positive reviews for the same. Patients found the solution to help communicate their issues, which was expected to have a positive effect on their treatment. Doctors found the solution to be helpful in sharing medical information and assuring the patients.

Table 1. System usability scale items and ratings

SUS Questions	Ratings, % (n), n = 26				
	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
I think that I would like to use this product frequently	0	0 (0)	0 (0)	73 (19)	27 (7)
I found the product unnecessarily complex	35 (9)	65 (17)	0 (0)	0 (0)	0 (0)
I thought the product was easy to use	0 (0)	0 (0)	0 (0)	54 (14)	46 (12)
I would need the support of a technical person to be able to use this product	65 (17)	35 (9)	0 (0)	0 (0)	0 (0)
I found the various functions in this product were well-integrated	0 (0)	0 (0)	11 (3)	58 (15)	31 (8)
I thought there was too much inconsistency in this product	46 (12)	54 (14)	0 (0)	0 (0)	0 (0)
I would imagine that most people would learn to use this product very quickly	0 (0)	0 (0)	4 (1)	65 (17)	31 (8)
I found the product very cumbersome to use	46 (12)	39 (10)	15 (4)	0 (0)	0 (0)
I felt very confident using the product	0 (0)	0 (0)	8 (2)	65 (17)	27 (7)
I needed to learn a lot of things before I could get going with this product	35 (9)	65 (17)	0 (0)	0 (0)	0 (0)

A SUS score value of 78.12 and 75.62 was obtained for doctors and patients, respectively, which shows a good and acceptable usability rating. The ratings for various items in SUS are shown in Table 1. It was observed that the responses were mostly 'agree' for odd-numbered questions, which are positively phrased, in contrast to even-numbered questions, which are negatively phrased, where most of the responses varied between 'disagree' and 'strongly disagree.'

Table 2. Mean feedback score of patients and doctors

Question	Patient (5)	Doctor (5)
I'm satisfied with the solution	4.92	3.93
It was simple to use	3.87	4.52
The terminology used is familiar and understandable	4.20	4.30
I learn to use it quickly	4.63	4.53
It is user-friendly	4.38	4.68
It makes the things I want to achieve easy	4.54	4.54
It works the way I want it to	4.12	4.45

The mean ratings by the patients and doctors are shown in Table 2. An overall feedback score of 4.38 and 4.42 out of 5 was obtained by patients and doctors, respectively. The solution was tested in two settings, one where both parties interacted with the solution separately and the other in a real-life setting where both parties interacted with the solution together. Participants performing the usability testing are shown in Figure 12.

Insights from usability testing and feedback from patients. The insights revealed that the recalling part of the proposed solution was really helpful in sharing all the information. Also, it was noticed that constant assurance really helps in calming an anxious patient. Doctor writing and explaining through visuals helped better understand the problem and its causes. The patients could mark the models, which helped them communicate the pain accurately. It was also found that writing symptoms beforehand worked in a good way as there was time to think and summarize in a better way. It was also proposed that the information on other diseases will help the patient dealing with multiple diseases.

Insights from usability testing and feedback from doctors. It was found that the visual post-it helped the patient understand the treatment and their diagnosis. The doctors also discussed preparing patients before coming into the consultation room, which saved time. The talkback method was found to be the best way to understand the patient's understanding. It was found that encouraging patients to ask their doubts is a good opportunity to check their understanding. Also, including family members with access to the app will improve observation and adherence.

Fig. 12. Participants performing usability testing: (a) patients with heart conditions, (b) cardiologists of private hospitals

5   DISCUSSION

The literature review unveils that patients who report strong communication with their doctor are more likely to be satisfied with their care, particularly when it comes to sharing relevant information for the correct diagnosis of their issues, following recommendations, and adhering to the prescribed treatment. With more complex chronic conditions increasing in the middle age group, the healthcare industry needs to acquire solutions for the patients and the doctors that will help them communicate effectively.

Considering the patient-centered healthcare adoptions and limitations, a final concept was designed, that would work as a facilitation and communication tool, which is termed as 'Passport to T.R.U.S.T. and Application' to cater to the needs of the patients as well as the doctors. The solution was created to reconstruct the medical visit and make bidirectional communication between the doctor and the patient easier. This tool boosted patients' self-confidence in interacting with their physicians. Furthermore, patients reported high levels of satisfaction with their medical sessions, especially their understanding of their ailment and treatment approach. Patients have an important part in their own care, and adherence to prescribed treatment regimens strongly depends on how well they comprehend their disease, convey their concerns, and recall the information presented during consultation. Both patients and physicians are prone to exaggerating their patients' comprehension of medical facts and treatment plan suggestions. Deficiencies in conveying, interpreting, and retaining information, as well as its own symptoms, have serious repercussions, including a lack of employment. Adherence to the suggested treatment program is connected with unfavorable health outcomes and treatment termination. When developing an effective and practical structure for increased communication and patient engagement in their treatment, the time limits of the consultation must be considered. Complex and time-consuming patient teaching strategies are impractical during brief visits. Experts have advised adopting study-based practical methods to help improve patient-doctor communication. The method proposed here seeks to address this hole, and producing an electronic version of the patient file based on participant doctor comments will make the process of reviewing the patient data simpler. Other comparable attempts have been made to improve doctor-patient communication and patients' comprehension and active engagement in their treatment. Previously conducted studies have proposed the M-Thyroid Care App [30], which provides virtual video consultations, chat, file sharing, and appointment scheduling to enhance patient care and reduce unnecessary in-person visits. The distinguishing factor of the suggested tool is that it not only educates and prepares patients before consultation but also provides a formal framework for doctor-patient contact, with the goal of making patients educated and active participants in their treatment.

A detailed user-centered design methodology, starting from conceptualization to prototype development, has been demonstrated in the current study. A similar design methodology was also adopted in the study conducted to design and develop a mobile application for Thai pregnant women [31]. In the current study, SUS was adopted to check the solution's usability, as the tool was reported to be effective even with a small number of participants.

5.1 Limitations and future scope

Although the researchers have taken utmost care, a few limitations exist in the present study as this was a small-scale project with limited physicians and patients. The collaborative user testing was performed at a single hospital and was limited in terms of quantity. Further studies and testing will be necessary to examine the large-scale effects of similar interventions in other settings, such as hospitals in different cities and hospitals with smaller waiting areas. Further studies could fruitfully explore the application of the solution in other chronic illness management by iterating the proposed solution accordingly. A detailed business plan to commercialize the developed solution is beyond the current study's scope and can be taken up in future studies.

6 CONCLUSION

The present study developed a holistic solution through a systematic user-centered design approach. The proposed solution, consisting of a mobile application and a reorganized patient file, is effective, adaptable, simple to use, and has the potential to be easily introduced in the current healthcare setting. It is expected that patients dealing with chronic heart conditions will be able to communicate and understand their issues effectively and get more involved in the conversation and the treatment when they use the solution during their doctor's visit. The proposed solution would be beneficial to patients and doctors in establishing effective communication.

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