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Applying User-Centered Design Methods to Improve The Experience of the NHS APP

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Abstract

The NHS app was developed to assist millions of people in gaining information about their health and treatment, as well as accessibility to NHS services. However, like most mHealth apps, the NHS app faces various issues, including low task completion rates and poor usability. User-centred design has proved to be a successful approach for identifying requirements across diverse user groups and incorporating them into the development of information and communication technology systems while boosting clinical system accessibility and satisfaction.

This study aims to research the reasons for the low adoption rate, Identify areas of improvement and demonstrate how User-centred design methods can be applied to create a more user-friendly app that meets user needs. To achieve this objective, a mixed-methods approach comprising semi-structured interviews and usability testing was adopted for data collection *(N=15)*, Participants were between the ages of 20 to 40; living in the United Kingdom.

The findings of the semi-structured interviews revealed that there is a huge gap between the features the NHS provides and what users require and findings also reveal that many users are experiencing dissatisfaction while using the app, leading to its low adoption rate. Based on these findings, wireframes were designed, and the redesigned solution was then evaluated using a think-aloud method and a questionnaire. The usability result shows that applying UCD methodologies to develop products increases user satisfaction and user experience.

Keywords: User-centred design, perceived usability, user experience, telemedicine, digital health.

1. Introduction

Everyone, regardless of age, should be able to live in good health if at all feasible. However, this is not the case for the vast majority of individuals (Haleon, 2022). In a society where social conditions influence our everyday health; millions of individuals continue to be held back. A study by Statista's (2021) research department found that almost half of Britons feel a staffing shortage is a top challenge facing the country's healthcare sector. Long wait times or lack of access to care

were also considered important difficulties (Statista, 2022). The number of people awaiting treatment in NHS hospitals in England has hit an all-time high of 5.45 million (BBC, 2021). 64.4% of patients seeking treatment had waited up to 18 weeks by the end of March 2021, falling short of the 92% objective (NHS, 2022). The median wait time for patients to begin treatment was 11.6 weeks at the end of March 2021 (NHS, 2022). According to Amaré Health (2023), the NHS faces three main challenges: Health Equality, Digitisation, and Staff Lack. They added that the epidemic taught healthcare professionals how important digital transformation is to the long-term viability of our healthcare system.

Technology is rapidly being considered a crucial component of providing patients with high-quality healthcare services (Nelson and Allkins, 2020). By giving patients access to their digital records and health professionals complete data on services and patient data, technology saves both time and money for both the patient and the NHS, making the healthcare system more efficient and empowering people in their own care (Nelson and Allkins, 2020). The NHS's multiple incompatible patient record systems built to satisfy the demands of local services or specialities, as well as a lack of digitisation, plainly hinder providers' capacity to communicate information efficiently among patients, professionals, care venues, and organisations (Asthana et al., 2019).

In 2014, the NHS issued a strategy to incorporate technology into the NHS, with the goal of enhancing people's access to treatment and the quality of care (NHS England, 2014). This strategy highlights the importance of embedding technology and digital data into NHS services to provide patients with quicker and easier access to services and health information (NHS, 2023). The NHS app was launched to help millions of individuals receive more information about their health and treatment options, as well as have more control over how they utilise NHS services (NHS Digital, 2023). The app enables users to schedule visits at their primary care clinic, acquire repeat medications, donate organs, and track symptoms (Nelson and Allkins 2020). The NHS hopes that releasing this app will help people and their families benefit from digital technology by enhancing access to the services they need, putting more information at their fingertips, and giving them more power and control over their own care (Department of Health and Social Care, 2022). People will have more power over their lives as national digital channels improve. Patients can communicate with diverse health and social care providers and get access to additional resources for addressing their healthcare requirements whenever and wherever they desire (Department of Health and Social Care, 2022).

The NHS app, like most mHealth applications, has a number of concerns, including low task completion rates and poor usability; Most users have difficulty enrolling and authenticating their accounts; without this, most users are unable to access the app to satisfy their needs (Burki, 2019; PKB, 2023). The NHS app had a poor rating of 3.1 stars on Google Play and 2.8 stars on Apple's app store at the time of writing, despite more than 10 million downloads and 32.7K reviews (See Appendix 1), resulting in low app adoption and usage (Burki, 2019). The NHS boasts of numerous features, however, many appear to be absent from the app, and subsequently, technical issues with little or no method to recover from these mistakes (PKB, 2023).

Challenges in evaluating the use of mHealth apps are frequently associated with the technology's relative newness and the rapid rate of market development over the previous decade (Liew et al., 2019). Despite consumers' increased readiness to test mHealth applications, it is critical to understand and appeal to their reasons to reduce barriers to "digital

adherence." Thus, user-centred design research is important to the success of mHealth apps (Liew et al., 2019). Usability is becoming increasingly important in the development of healthcare apps, as those who need to use them may have difficulty using their smartphones due to medical issues (Maramba et al., 2019). To guarantee high usability, user-centred design approaches can be used (Wachtler et al., 2018). Executing usability tests on eHealth applications will be extremely beneficial to patients, as improved usability can lead to a variety of benefits, including increased productivity, improved user well-being, stress avoidance, increased accessibility, and reduced risk of harm (Maramba et al., 2019).

When utilising the NHS app, the main challenge is determining what patients and the public truly desire (Wachtler et al., 2018). To change healthcare practices, digital health technology must engage end users, give clear information, and encourage participation in any treatment recommendations (Wachtler et al., 2018). UCD has proven to be an effective method for identifying requirements across multiple user groups and implementing them into the design and creation of information and communication technology (ICT) systems, all while increasing clinical system accessibility and satisfaction (Smaradottir et al., 2015). Apps produced following this technique, according to Wachtler et al., (2018), have enhanced user acceptability, usability, user-friendliness, and adoption.

In this context, this study aimed to investigate the reasons for the low adoption rate, Identify areas of improvement and demonstrate how User-centred design methods can be applied to create a more user-friendly NHS app that meets user needs.

This article is organised as follows: Section 2 discusses theories and stages in a UCD methodology, as well as important literature on the application of UCD to digital health. Section 3 describes the sample, instruments, and procedures used in the assessment. In section 4, the results are presented, while section 5, summarises the study findings as well as the limitations of this study and suggestions for future research.

2. Theoretical Background and Hypothesis Development

2.1 Telemedicine, a subset of digital health

Technology innovation has altered how we interact with the world, whether in terms of mobility, communication, or health, by supplying information almost in real-time that the bulk of systems can still not comprehend (Maignant, 2018). Recent studies have shown the development and rapid expansion of digital technology over the last several decades have caused a change in almost every aspect of human endeavour (Abernethy et al., 2022), with over 1 billion people now having access to mobile broadband Internet and a fast-increasing mobile app industry (Becker et al., 2014).

Telemedicine is described by (Smaradottir et al., 2015) as "a remote electronic clinical consultation using technology for the delivery of health care and the exchange of information across distance." Handel (2011) defined it as a system or product that assists patients in improving their health in real-time by letting them personalise healthcare decisions and track success. Several writers have vigorously questioned these ideas in recent years. Despite the many potential benefits of telemedicine, pilot studies aiming at analysing its effectiveness have shown conflicting findings, and a quarter

of all app downloads are used only once (McCurdie et al., 2012). Griffin et al., (2019) support this argument and blame the poor design and usability of most mHealth Apps as the reason for suboptimal app usage and, as a result, poor adherence to the behavioural changes for which they are designed. Many telemedicine applications, according to McCurdie et al. (2012), are created based on current healthcare system frameworks and may be less effective than those that incorporate end users in the design process. Moving on from Telemedicine and its use in the NHS, the following section focuses on UCD, which expands on McCurdie et al. (2012) study about incorporating users in the development of effective telemedicine apps as is the purpose of this research.

2.2. User-Centred Design (UCD)

According to Ghazali et al. (2014), UCD emphasizes the importance of user feedback and intuitive design to ensure the quality of design. Studies have shown that UCD involves actively seeking out and incorporating user feedback to ensure tools are developed fully understanding their needs and requirements (Ghazali et al., 2014; Griffin et al., 2019). In their study, Sedlmayr et al. (2019) described UCD as an approach to designing a user-friendly interface by integrating users early in the design process. An important point that has gone unanswered in different studies is why it is so crucial to include users and understand their requirements while developing products. Norman's (2013) work emphasised the need to completely explore the users' wants and goals, as well as the product's intended applications. Studies have demonstrated that consumer engagement increases the effectiveness, efficiency, and safety of products as well as their acceptance and commercial success (Preece et al. 2011).

While many scholars have used various methods in their research, the stages of a user-centred approach can be summarised into four distinct phases which are, 1. Identify end users and context of use 2.Ideation 3. Prototyping 4. Evaluation.

- **Q1:** How can UCD be used to identify user pain points and areas for improvement in the app to produce a better user-friendly app?
- **Q2:** What are the UCD methods used in developing effective mobile apps in telemedicine?

2.3. User Experience Design (UXD)

User experience (UX) is a popular term which is often confused with usability but is different. The International Organization for Standardization (ISO) defines User Experience(UX) as the user’s perceptions and responses that result from the use and/or anticipated use of a system, product or service (ISO 9241-11:2018). They went on to define it as the result of a system, product, or service's brand image, appearance, functionality, system performance, interactive behaviour, and assistive capabilities. It is also influenced by the user's psychological and physical condition due to earlier experiences, attitudes, skills, talents, and personality, as well as the context of usage.

The term ‘user experience’ is associated with a wide variety of meanings, Strömberg et al., (2005) define User experience as a holistic term that can be used to describe the overall experience a user has when using a product or a system. The

user experience research focuses on the interactions between people and products/services, and the experience resulting from the interaction (Strömberg et al., 2005). Jesse Garnett (2011) provided a simpler definition of the term he defined User experience as the experience a product creates for people who use them in the real world. He further explains the misconception around UX being just about aesthetics, a well-designed product looks good to the eye and feels good to the touch. He also points out Another common way people think about product design is in functional terms and describes A well-designed product as one that does what it promises to do (Garrett, 2011).

According to Artson and Pyla (2019), user experience cannot be designed but must be experienced. Kaasinen et al. (2015) agree with these assertions and add that, while it is difficult to force people to have a specific experience, designers may endeavour to assist a specific type of experience, that is, they design for an experience rather than for an experience. Usability and user experience (UX) are seen as major quality factors of any product, system, or service designed for human use, and may thus be regarded as indications of product, system, or service success or failure (Hartson and Pyla 2019). At the same time, individuals frequently misunderstand the words usability and user experience, although they are inextricably linked. To summarise, usability is a subset of user experience, and it is seen as the core of user experience. User experience and usability complement one another (Hartson and Pyla 2019).

2.4. Usability

The International Organization for Standardization (ISO) also defined Usability as the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use (ISO 9241-11:2018). Graham et al. (2019) defined usability as the ease with which a technology or service may be used, learned, and understood. The usefulness of a technology or service is determined by whether it assists stakeholders in achieving their goals or completing tasks. Typically, usability testing is focused on measuring how well users can complete specific, standardized tasks, as well as what problems they encounter in doing so (Cooper et al., 2014, p70). According to Lowdermilk (2013), usability research is the measured observation of consumers' behaviour while using your product. As described by Lowdermilk (2013), it is scientific in practice and prefers metrics, measures, and statistics to prove statements. Lynch and Horton (2016) defined usability as a quality and efficacy metric in their study, stating that it indicates how effective tools and information sources aid us in performing activities (Lynch and Horton, 2016). Cooper et al. (2014) dispel frequent misconceptions regarding the parallels between usability testing and user research, claiming that "tests" might include research activities like interviews, task analyses, and even creative "participatory design" exercises.

2.5. Usability Evaluation Methods

The definition of some helpful assessment techniques that will be utilised in this study to assess the NHS app's user experience and perceived usability is provided in the paragraphs that follow.

2.5.1. Think AloudMethodolody

Hartson and Pyla (2019) have outlined the think-aloud technique as a qualitative data collection method used to elicit participants' verbal expressions of their thoughts, motives, and perceptions concerning their interaction experience, including any encountered usability issues. The method aims to provide evaluators with valuable insights into participants' opinions regarding the task and the interface design. This approach aligns with the definition provided by Jakob Nielsen (1993), who argues that think-aloud involves users' continuous verbalization of their thoughts as they use the system. Through this method, testers gain a better understanding of users' perspectives towards the computer system, making it easier to identify their major misconceptions. Moreover, Nielsen (1993) contends that this approach helps gain insights into users' actual views of the design, including their preconceptions that often lead to suggestions for the redesign. While Virzi et al. (1991) offer a compelling analysis, their study claims that the think-aloud evaluation approach is almost as effective as the heuristic evaluation in discovering difficulties. The think-aloud technique may be advantageous for products or services that can be tested on readily available subject populations. However, these findings must be considered considering potential limitations and biases, such as the participants' self-selection bias and the potential for experimenter bias. The definition of some helpful performance metrics that will be utilised in this dissertation to assess the NHS app's usability is provided in the paragraphs that follow.

1. **Task completion:** According to Tullis and Albert (2013), task completion assesses how well users can accomplish a particular task. According to Tullis and Albert (2013), binary success will be utilised in this study to evaluate users' task completion. Binary success is the easiest and most prevalent way of measuring task performance; users either complete or do not finish a task.
2. **Time of completion:** Time of completion, according to Tullis and Albert (2013), measures how much time users dedicate to a task.
3. **Errors:** According to Tullis and Albert (2013), errors can be beneficial in highlighting certain perplexing or misleading components of an interface.

2.5.2. The System Usability Scale (SUS)

The System Usability Scale (SUS) is a common measure of perceived usability, according to (Sauro, 2018). The system usability measure was developed in 1996 to allow usability practitioners and evaluators to quickly and simply assess the usability of a specific product or service. It is a great choice due to its versatility in evaluating a wide range of interface technologies (Bangor et al., 2008). According to Hartson and Pyla (2019), the SUS questionnaire consists of ten questions. They highlight an innovative tweak to the standard questionnaire: the SUS mixes positively and negatively worded questions to discourage respondents from responding quickly without fully analysing the questions. According to Tullis and Albert (2013), Eight of the questions reflect a usability factor and two reflect a learnability factor. They continued by stating that the mean score is calculated at the end of the session with the interpretations in Figure 1 based on the score calculated (Tullis and Albert, 2013). According to Laubheimer (2018), this technique has several disadvantages, particularly the fact that the scale is so ancient. There is a wealth of industry-wide data accessible to assist you in benchmarking your findings and understanding them in comparison to peers and rivals, which are less often used survey instruments (Laubheimer, 2018).

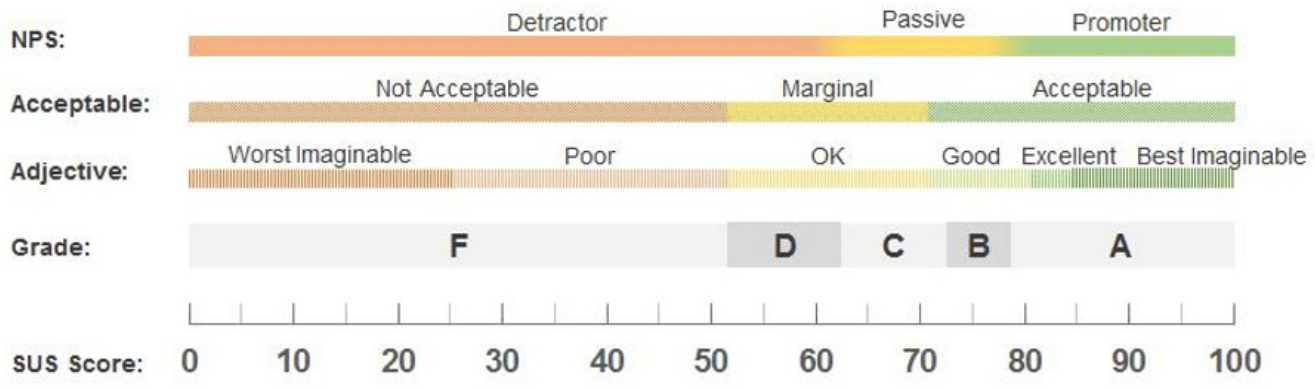


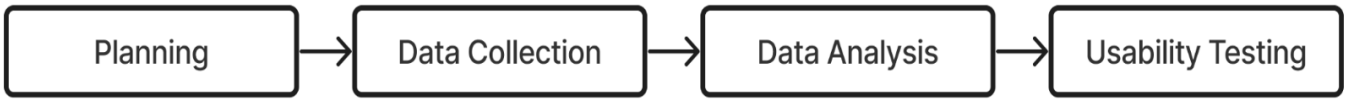
Figure 1. Interpreting SUS scores in terms of grades, adjectives, and acceptability (Sauro 2018).

- **Q:3** How do we measure the effectiveness and perceived usability of the NHS app?

According to the research presented in this section, implementing a UCD strategy into mobile health applications enhances functionality, usability, and the likelihood of intervention efficacy (Ghazali et al., 2014; Griffin et al., 2019). To properly transform healthcare practices, digital health technology must involve end users, give clear information, and promote participation in treatment suggestions. As Mathews et al., (2019) correctly stated, quality and value must be easier to detect for digital health solutions to have a higher impact.

3. Method

In this study, we combined a set of elements from qualitative and quantitative research for a mixed method because this method allows us to address more complicated problems while also collecting a bigger and more comprehensive range of data than any one technique alone (Yin 2014). The study was developed in four phases as shown in Fig. 1, these phases will be explained in the subsections below.



3.1. Phase 1: Planning

This study aimed to improve the experience of the NHS app for this reason, we sought participants who could provide information and had experience using the NHS app (Bryman et al. 2022). We created an interview guide with a list of pre-planned questions, the questions were brief and unambiguous and were formed from the themes from the literature review and the overall usability of the NHS app. The interview questions were selected because they facilitate eliciting

information about the participants' frustrations, interests, intentions, and genuine requirements (Norman 2013).

Purposive sampling was used to recruit participants *(N=15)* for Interviews and usability testing, participants were between the ages of twenty and forty, living in the United Kingdom and have used the NHS and the app to manage their health. This demography was chosen based on a report by Mintel (2022), which indicated this group had the highest percentage of attitudes towards wellness and technology. Also based on their usage of the NHS services and the app, They could provide more information that would be vital for this research. Participants were reached using social media, professional networks, and the student community. Additional interviews were planned if individuals withdrew or did not appear (Blumberg et al. 2014). Among the interviewees, 12 out of 15 were young professionals and students, 4 out of 15 were married, and 2 out of 15 were married with kids. The following table provides anonymized details about the interviewees to ensure their privacy is protected.

Table 1. Sociodemographic characteristics of the participants

S/N	Gender	Age category	Duration of the Interview	Computer usage per week	Family Status
1	Male	25-30	25 mins	40+ Hr/Wk	Single
2	Male	30-35	26 mins	40+ Hr/Wk	Single
3	Male	25-30	20 mins	40+ Hr/Wk	Single
4	Female	35-40	30 mins	10-15 Hr/Wk	Married with kids
5	Female	30-35	20 mins	40+ Hr/Wk	Single
6	Female	20-25	18 mins	40+ Hr/Wk	Married with kids
7	Male	25-30	20 mins	40+ Hr/Wk	Single
8	Male	25-30	17 mins	40+ Hr/Wk	Single
9	Male	30-35	27 mins	40+ Hr/Wk	Married without kids
10	Female	20-25	19 mins	40+ Hr/Wk	Single
10	Male	25-30	25 mins	40+ Hr/Wk	Single
11	Female	35-40	30 mins	10-15 Hr/Wk	Single
12	Female	30-35	35 mins	40+ Hr/Wk	Married without kids
13	Female	20-25	30 mins	40+ Hr/Wk	Single
14	Male	25-30	30 mins	40+ Hr/Wk	Single
15	Female	25-30	25 mins	40+ Hr/Wk	Singe

3.2. Phase 2: Data Collection

For this study, a semi-structured interview was utilised since it allows the researcher to address more particular concerns (Bryman et al. 2022), as well as understand the reasons behind the participants' actions or views and opinions on the NHS app (Saunders et al. 2016). It also enables researchers to 'probe' responses, where you want your respondents to clarify or expand on their comments (Saunders et al. 2016). All interviews were recorded for the researcher to focus on the conversation and obtain the most thorough data for analysis (Blumberg et al. 2014). Before the interviews participants

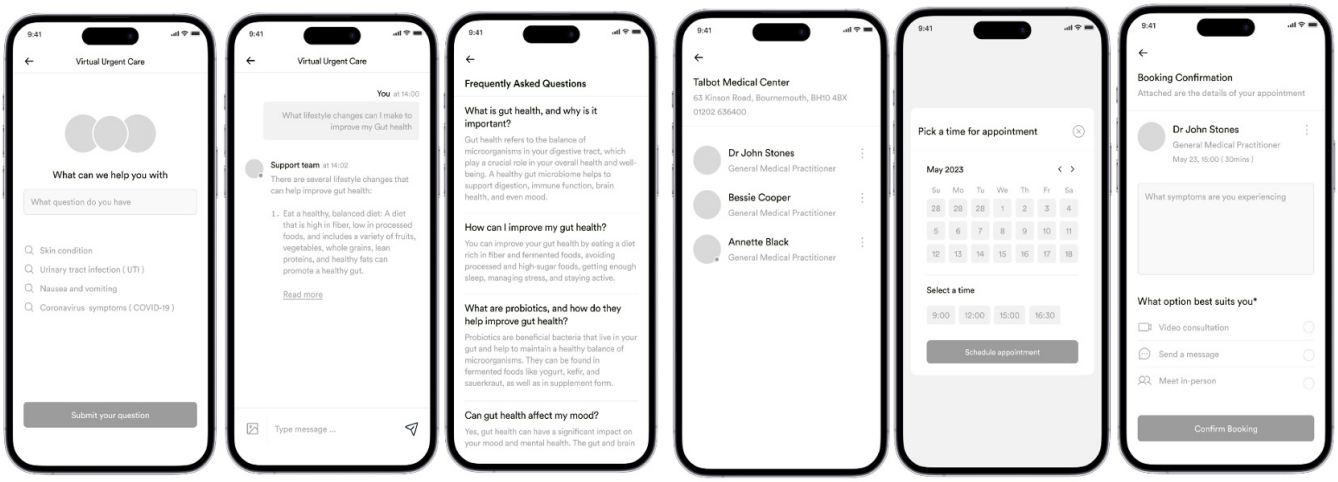
were screened to ensure they used NHS services and were familiar with the app.

3.3. Phase 3: Data Analysis

All the data collected were transcribed manually on Google Docs and analysed by the researchers to respond to the research questions (Bailey 2008). Following each interview session, the collected material was evaluated to synthesise and identify key themes and make collections as themes capture crucial information about the data in connection to the study topic and indicate some systematic response within the data set (Braun and Clarke 2006). For this research, NVIVO v12, a qualitative computer software program, was utilised to assist in arranging and coding the data more precisely and effectively (Creswell and Creswell 2018). This analysis would serve as the basis on which the solution would be built to improve the NHS app experience. These themes were organised into pain points, goals and features that were required by the app to suit the demands of the users.

3.4. Wireframing

The wireframes were created as a direct result of the data collection and are essential for the usability testing session without the design of the interface, the perceived usability of our solution can't be measured. Storyboards were made to draw inspiration from existing mHealth applications, which were then followed by wireframes and prototypes, all of which were created using the Figma software. These interfaces mimic the user's requirements by naturally depicting task items and activities based on the themes analysed (Johnson et al. 2005).



3.5. Phase 4: Usability Testing

As part of our data collection method, testing would commence after concepts for improvement of the new app have been designed. Testing allows us to evaluate the user experience, Platt (2016) argues that researchers need to test designs to know how users feel about the product and the need to test throughout the development process as its omission could be

fatal. This session was conducted using a think-aloud technique. A think-aloud technique is a qualitative data collection technique in which participants verbally externalise their thoughts about their interaction experience, including their motives, rationale, and perceptions of UX problems (Hartson and Pyla 2019). Participants use this strategy to provide the assessor with insight into their thoughts regarding the task and the interaction design (Hartson and Pyla 2019). Performance evaluations are among the most useful tools available to any usability specialist. They are the most effective technique to assess the effectiveness and efficacy of a wide range of products. During the section, the following performance metrics will be evaluated 1. Completion time, 2. Completion rate, 3. Error. After completing all the tasks, the participants were given a post-session questionnaire (SUS), which is primarily used to gauge user satisfaction. The overall SUS score is crucial in interpreting our findings and the perceived usability of this study (Tullis and Albert 2013).

Table 2. Scenario and tasks for usability testing

Scenario	Task
You learned about using the NHS app to manage your health and chose to give it a shot. You successfully registered after downloading the program from the app store.	1. Find a GP based on your location 2. Check for new patient availability 3. Register for a GP
You have now downloaded the app and finished your registration. You require medical attention for recurring pain	1. Book an appointment with your GP 2. Check for Information regarding your Headache
The doctor prescribed a headache medication after your appointment with the GP, but you do not yet have a preferred pharmacy.	1. Select your preferred pharmacy 2. View your prescription history 3. Reorder a prescription

3.6. Ethical Considerations

The study was observational by nature was based on the users' Responses to an interface design and did not involve medical intervention. The authors acquired informed consent from the users, and their identities were not revealed in the study. All procedures and research materials comply with the legislation of the country where the research was carried out and were approved by the university's institutional ethics review board

4. Results

Following the collection of primary data, three key themes emerged: (1) identification of user's pain points (2) user goals for using the NHS app (3) Concepts for Improvement (ideation of app features) Each theme is divided into several sub-

themes. Secondly, the findings of usability testing and the questionnaire (SUS) of the redesigned solution. Finally, a discussion is presented at the end of the chapter.

Table 3.

Themes	Subthemes
User's Pain Point	Appointments: Phone call to set an appointment, Difficulties in booking an appointment, waiting time in booking appointments. None of manual record documentation: Usability: Usability issues, complex navigation, security and privacy, Login Issues GP Registration and Management: Difficulties in registering for a GP, Paperwork problems with reordering past prescriptions
User goals for using the NHS app	Seamless GP experience: The difficulties in Registering and Managing a GP, Ideal GP Registration experience Prescription: reordering a prescription, Prescriptions Easier way for users to book Appointments
Concepts for Improvement (Features)	Information Hub Alternatives to Contacting a Doctor: Direct messaging, video conference, bots Preference for booking online: Appointment availability, Patient count for GP Push Notifications Improved Interface

Theme 1: Identification of user's pain points

The thematic analysis revealed three sub-themes under the theme identification of user's pain points as shown in Table 4.

Table 4. Identification of user's pain points.

Sub-Themes	No. of References
Appointments	35
Usability issues on the app	12
GP Registration and Management	17

This theme discusses the user's pain points while using the NHS app which corresponds to the first research objective. To create a user-friendly app, the author conducted interviews to learn more about the users, their goals, and their

frustrations while using the app (Strömberg et al. 2005).

1. *Booking Appointments*

The data revealed that booking an appointment was mentioned the most frequently, with over 30 mentions. This was due to the complex procedure of making appointments, which most participants found difficult. Participants expressed their displeasure during the interview when discussing their experiences trying to book an appointment. Subthemes that developed from this subject were the fact that they had to arrange an appointment over the phone and that most participants were dissatisfied with the wait time. The data also showed that the existing app does not have a feature that allows users to accomplish its primary objective

> *"The thing that frustrates me the most is the long waiting times, especially for specialist appointments. It can be challenging to plan other activities around these appointments, and it can be disruptive to daily life" (Participant 4).*

When asked if they would rather self-medicate and risk the condition worsening utilise the app or make a phone call to plan an appointment, most participants chose the latter.

> *"I've had several health challenges that would have prompted me to seek help, but the process has prevented me from doing so. I have no idea how it works most of the time, and the total process turns me off" (Participant 1).*

To summarise, the app has failed to satisfy users' basic needs; features have been designed to help rather than limit users' access to services; nevertheless, the data indicates otherwise. The entire procedure looks to be difficult, and improving this component of the programme might result in a better overall user experience.

2. *Registration and Managing a GP*

According to the data provided in this study, six of the 10 persons interviewed experienced difficulty registering for a GP. Although the NHS claims that users may search for, register for, and manage their GP through the app, this does not work, therefore users must register manually. This process begins with a search on the internet and a phone call to each GP on the list to enquire about their availability. Participants expressed dissatisfaction with the process, and numerous users have yet to change or locate a GP due to the lengthy and complex process. Participants also expressed dissatisfaction with the amount of documentation necessary for this procedure, which discouraged them from continuing.

> *"While looking for a doctor, I compiled a list and phoned every doctor on it; they all had a waiting list. I eventually received an answer only to discover they were not accepting new patients; I repeated this process until I got one" (Participant 9).*

Participants were also frustrated because they couldn't manage or replace their GP, for example, if they were displeased

with the services or relocated and required a different GP in their new area. The current procedure makes it difficult and, in many situations, results in an unwillingness to change GP, which suggests that a user is without healthcare or does not have a doctor to cater to their requirements.

> *"Currently, I am trying to change a GP because I moved to a new city and it has been difficult to find one close to me and I am currently stuck" (Participant 6).*

Most users, particularly internationals, utilise the app for this purpose; if the procedure is not available through the app and must be conducted manually, it creates a bad first impression and leads to low retention and adoption rates.

3. *Usability Issues on the App*

The importance of usability was discussed in prior chapters; it is a key concern with most healthcare apps (Griffin et al. 2019). The findings reveal that participants were dissatisfied with the app, citing ease of use and task completion as issues. As a result of inadequate navigation design, assessing certain features may be difficult for the majority of participants. Complex navigation results in activities not being executed or information being difficult to find.

> *"Being a multi-user app, the app should be very easy to use, especially the navigation process. Finding Information or completing tasks on the app appears to be difficult" (Participant 1).*
>
> *"The main annoyances have been how fiddly the interface can be and how much personal information must be entered each time manually. It's also very hard to navigate" (Participant 3).*

In the literature review section of this study, usability has been highlighted as a major issue with most mHealth apps. Griffin et al. (2019) criticise the poor design and usability of most mHealth Apps, citing it as the cause of suboptimal usage of these apps. The results of the semi-structured Interview support Griffin et al. (2019) findings, which reveal that most users regard most healthcare applications to have usability issues, which may be a major reason why users exit the app.

Theme 2: User goals for using the NHS app

The thematic analysis revealed three sub-themes under the theme of User goals for using the NHS app as shown in Table 5.

Table 5. User goals for using the NHS app.

Sub-Themes	No. of References
Seamless GP experience	29
Ability to manage Prescription	17
Easier way for users to book Appointments	22

This section outlines the user's goals for using the NHS app, goals help in understanding what users expect from the app and their primary objectives for using it.

1. *An Improved GP Experience*

The advancement of technology has altered how individuals engage with systems and has simplified the delivery of services. Most participants wanted to enhance their GP experience because they considered the existing system irritating. This topic sparked two subthemes: the ease of enrolling and managing a GP, and how they see an ideal registration procedure. Participants are aware of the NHS's staff crisis but need a simpler way to identify, register with, and manage a GP.

> *“I would like to search for the closest GP to me online, check the availability, register then go in with the necessary documentation needed for registration” (Participant 8).*
>
> *“My goal would be to track and manage my GP, I recently moved places and would like to update my GP” (Participant 6).*

The present registration process for a GP is stressful, and most users do not have access to health care as a result. As one participant put it,

> *"What's the point of the app if it's not a one-stop shop for all my health care needs?" (Participant 2).*

2. *To view and reorder a prescription*

According to the data, several individuals stated a desire to read prescriptions and repurchase a prescription. According to other participants who expressed worry or the reason they were cautious about prescriptions due to drug usage, a thorough evaluation by a medical expert is required in case they need to prescribe a different therapy for one of the conditions that have been diagnosed.

> *“I want to reorder my medicine and also view my past prescriptions” (Participant 8).*
>
> *“My goal sometimes would be to reorder medicines that were previously prescribed” (Participant 2).*

> *"Medically, you don't want individuals overdosing on a specific prescription, so the doctor needs to know why so that drug abuse is avoided. Also, the doctor may want to know if the meds are no longer effective or if you should switch to something stronger" (Participant 6).*

Participants also additionally highlighted a desire for notification of supplied medicines as well as advice on how to take these prescriptions. Because most instructions are given verbally, documenting these instructions on the app provides a better experience.

3. *An easier approach to Booking an Appointment*

According to the study's findings, the majority of participants' primary objective is to book appointments. Participants were aware of the waiting period owing to a staff shortage, but the existing functionality does not allow them to arrange an appointment. A third of the participants didn't mind waiting for their appointment; they simply wanted the scheduling procedure to be simple.

> *"My primary goal for using the NHS app is to book an appointment" (Participant 3).*
>
> *"My primary goal would be to access my medical records and schedule an appointment easily" (Participant 4).*

Theme 3: Concepts for Improvement (Ideation of app features)

The thematic analysis revealed five sub-themes under the theme of concepts for improvement as shown in Table 6.

Table 6. concepts for improvement generated by users.

Sub-Themes	No. of References
Information Hub	29
Alternatives to Contacting a Doctor	17
Preference for booking online	22
Push Notifications	12
An Improved Interface design	20

The result of the data analysed is congruent with the findings of Ghazali et al. (2014), Norman (1986), and Griffin et al. (2019) which suggests that researchers should actively seek out and incorporate user feedback to ensure tools are developed fully understanding their needs and expectations. The data collected from the semi-structured interviews identified user goals as well as concepts for improvement to help reach those goals. The identified concepts would serve

as the basis on which the solution would be built to improve the NHS app experience. These themes were subdivided into aspects that were required by the app to suit the demands of its users (Norman 2013).

1. *Information hub*

The findings show that, as some participants pointed out, locating information on the app was challenging, and that the majority of participants indicated a desire for it. As one of our focuses, getting replies to enquiries is critical for most consumers. An information hub would be a centre that keeps a record of commonly asked questions, a repository of all illnesses with an easy way to filter and search, and a bot (support) to answer inquiries and suggest the next steps.

> *"My GP is quite far from where I stay, if I can talk to my GP via chat on the app, I understand using a chat must be a doctor and they can't be online all the time. Hence an FAQ page is important, I wouldn't want to use Google because you get to see a lot of scary symptoms, I also feel the NHS should be more reliable" (Participant 5).*

An information hub would save users time by allowing them to read up on symptoms or articles instead of scheduling an appointment for a minor condition, reducing waiting time and the frequency of patient visits.

2. *Alternatives to meeting a doctor*

Because digital technology is changing the way patients and health professionals engage, digital and online resources should be made available on the current app so that patients may obtain guidance, support, and treatment as soon as possible. Patients can avoid congested waiting rooms by providing alternatives, these alternatives can be a quick and easy way for people to get medical advice, treatment for their symptoms, follow up on a past issue, or make a new request. Data from the interview highlights the usage of direct messaging, video consultation, and bots. Providing alternatives to calling a doctor enhances the user experience and provides options.

The redesign would include offering a face-to-face appointment, calling or video conferencing the patient, or sending a quick text online message (for example, inviting the patient to come in for a blood test).

> *"My GP is quite far from where I stay, if I can talk to my GP via chat on the app, I understand using a chat has to be a doctor and they can't be online all of the time" (Participant 5).*
>
> *"What's most important is to speak to a doctor and provide alternative means to make it easy" (Participant 8).*

Some participants expressed concern about the usage of bots since the responses offered may be generic in comparison to the exact answers they seek, as well as owing to a lack of trust.

> *"It is a health concern for me, so I might not be comfortable with AI giving me defined answers to questions that I ask" (Participant 9).*

3. *Booking appointments online*

The primary goal of most users was to book an appointment using the app. Allowing users to book appointments via the app increases app retention and minimises phone line wait time. Our approach would make it easier for patients to arrange and manage appointments.

> *"A lot of things that could be improved in the NHS app, firstly, would be booking an appointment, I'd like it to be seamless compared to the current method of having to call the hospital to book an appointment" (Participant 8).*

4. *Find, Register and Manage GP*

Registering for a GP is the initial point of contact for most patients, but the present app fails to offer a way for users to find GPs within their area. Our system would give consumers the simplicity of locating a GP and registering. Our system would also make it easy for consumers to update their GP for whatever reasons they have. Participants described their preferred GP registration process throughout the interviews; we would utilise this feedback to build a solution. Participants also expressed the need to access their medical records

> *"Automating this process would be nice, an example would be entering your postcode and seeing GPs with available slots, selecting the GP then a physical appointment to complete your documentation that might improve the process" (Participant 6).*

5. *Push Notifications*

Notifications would quickly inform the user about the app's activity and modifications (Kumar and Johari 2015). For our personas, push notifications could be vital as they provide reminders on upcoming appointments and updates on prescriptions. The redesigned solution will send reminders to patients about their appointment and their medication. The redesign would also give notification of a free slot due to the cancellation of an appointment by another user; this feature is critical since it allows people to rearrange their appointment to a more convenient dat*e.*

> *"Appointment reminders would be amazing, also changing my dates an example would be if I had a date but a closer date comes up due to cancellation, if the system could alert me on the availability, I should be able to move my appointment" (Participant 9).*

4.1. Findings from Usability Testing

From the results of the interview, concepts were designed to respond to the second objective, These prototypes were tested with users, and the point of this test was to validate and evaluate the redesigned app (Cooper et al. 2014). This test aligns with previous research that emphasized the importance of usability testing in building successful health products

(Wachtler et al. 2018). This section will discuss the third objective of this study, which is to test prototypes using the think-aloud method and assess the perceived usability of the revised app using the SUS score (See Section 4.2).

According to the usability metrics as summarised in Figure 1, participants had little trouble navigating the app because most activities fit with their mental model and were also their primary goal for using the app. Tasks 1-8 had a 100% completion rate (See Table 7), indicating that participants completed them without help. Task 8 had the greatest error rate because the design says "prescription renewal" although the task was about prescription history (See Table 9). "The terminology differs from what is on the interface," one participant remarked, "and prescription history should not be under prescription renewal." Booking an appointment with a GP took the longest time (See Table 10), although most participants were pleased that they could schedule an appointment more readily than before.

S/N	Tasks	Completion rate	Errors	Completion time (seconds)
1	Find a GP based on your location	100%	0.4	0.72
2	Check for new patient availability	100%	0	0.10
3	Register for a GP	100%	0.4	0.07
4	Book an appointment with your GP	100%	0	1.13
5	Check for Information regarding your Headache	100%	0.4	1.06
6	Select your preferred pharmacy	100%	0.4	0.23
7	View your prescription history	100%	0.8	0.51
8	Reorder a prescription	100%	0	0.26

Table 7. *Usability metric from the testing session*

Participants applauded the redesign's appearance, describing it as "user-friendly." One participant described it as "clean and easy to figure out," while another noted that the redesign covers the key tasks necessary in an NHS, in contrast to the original app, which had many minor features and a lot going on at the same time. Participants were generally pleased with the app, rating it as a major advance over the current app in terms of design, usability, convenience of use, and feature relevancy.

Completion Rate (1= completed; 0 = Not completed)

Task	P1	P2	P3	P4	P5
Find a GP based on your location	1	1	1	1	1
Check for new patient availability	1	1	1	1	1
Register for a GP	1	1	1	1	1
Book an appointment with your GP	1	1	1	1	1
Check for Information regarding your Headache	1	1	1	1	1
Select your preferred pharmacy	1	1	1	1	1
View your prescription history	1	1	1	1	1
Reorder a prescription	1	1	1	1	1

Table 8. *Task completion rate*

Error Rate

Tasks	P1	P2	P3	P4	P5
Find a GP based on your location	0	0	1	1	0
Check for new patient availability	0	0	0	0	0
Register for a GP	0	0	0	0	2
Book an appointment with your GP	0	0	0	0	0
Check for Information regarding your Headache	1	0	1	0	0
Select your preferred pharmacy	1	0	0	1	0
View your prescription history	2	1	0	1	0
Reorder a prescription	0	0	0	0	0

Table 9. *Error rate on tasks*

Completion Time in minutes

Tasks	P1	P2	P3	P4	P5
Find a GP based on your location	1:49	0.28	0.19	1.32	0.33
Check for new patient availability	0.05	0.02	0.20	0.12	0.10
Register for a GP	0.07	0.05	0.09	0.11	0.04
Book an appointment with your GP	1:37	0.49	00.26	1.41	1.29
Check for Information regarding your Headache	1:21	0.53	0.59	2.49	0.47
Select your preferred pharmacy	0.12	0.13	0.21	0.51	0.17
View your prescription history	0.33	0.51	0.49	0.23	1.01
Reorder a prescription	0.35	0.21	0.16	0.42	0.15

Table 10. *Completion time on tasks*

4.2. Findings from the System Usability Scale

The SUS Questionnaire findings for overall satisfaction showed that all five participants were extremely happy with the redesigned app, with the lowest rating of 70 and the highest rating of 100. The total score was 85.5 as shown in Table 11 which is interpreted as the “best imaginable”. The results from the questionnaire suggest the system is easy to navigate, recovers from errors and the overall experience is excellent. The score also indicates that if the solution is adopted, user satisfaction and adoption will increase (Bangor et al. 2020) as is the aim of this study. It also suggests that the redesigned app was a well-designed and user-friendly system that fits the demands of its intended users.

Question Number	P1	P2	P3	P4	P5
1	2	4	4	2	3
2	3	4	4	4	3
3	4	4	3	3	3
4	3	4	4	4	4
5	3	4	3	4	3
6	2	4	3	4	4
7	2	4	3	3	2
8	3	4	3	4	4
9	3	4	4	3	3
10	3	4	4	4	4
TOTAL	28	40	35	35	33
SUS SCORE	**70**	**100**	**87.5**	**87.5**	**82.5**

OVERALL SUS SCORE	85.5	Excellent

Table 11. *SUS score for participants and the overall rating*

5. Discussion and Conclusion

5.1.

Discussions of Methods

The adoption of the User-Centered Design (UCD) method in this study stems from its proven effectiveness in discerning user needs and creating solutions that align with those needs (Sedlmayr et al., 2018). UCD, recognized for improving product usefulness and usability (Mao et al., 2005), is applied here to identify areas of enhancement in the NHS app. The aim is to showcase how UCD methods can be instrumental in developing a more user-friendly app that caters to user needs.

Addressing the first research question involved conducting semi-structured interviews to determine the current app's alignment with user needs and to identify user frustrations—a pivotal step in designing user-friendly apps (Abras et al., 2004). The use of usability evaluation and the System Usability Scale (SUS) provided valuable insights into the perceived usability of the redesigned solution (Lynch and Horton, 2016). To tackle the second research question, various methods highlighted in the literature review, such as ideation, personas, wireframes, prototypes, and think-aloud sessions, were

employed (Graham et al., 2019). Following Norman's UCD project initiation model (2013), a semi-structured interview aided in uncovering user context and task scenarios, while also contributing to the creation of personas. Prototypes and wireframes were derived from data analysis findings and were crucial in subsequent usability sessions for user feedback and perceived usability assessment.

To address the third research question, the System Usability Scale emerged as an effective method for measuring perceived ease of use, satisfaction, and overall usability (Sauro, 2016). In conclusion, the application of User-Centered Design methods facilitates a profound understanding of user needs, pinpointing pain points and proposing solutions that cater to those needs (Strömberg et al., 2005). By employing methods such as interviews, focus groups, ethnography, prototypes, and usability testing, researchers can develop user-friendly apps that align with user needs (Lowdermilk, 2013).

Discussions of findings

This study aims to Identify areas of improvement in the NHS app and demonstrate how User-centred design methods can be applied to create a more user-friendly app that meets user needs and improves the experience. In Phase 1, The interview protocol was designed to explore two main areas: 1) the extent to which the current application fulfils users' needs, and 2) users' frustrations and challenges encountered while interacting with the application (Abras et al., 2004). The results indicate a misalignment between the offerings of the NHS app and the genuine needs of consumers. Despite an exhaustive literature review, no existing study was found to provide a UCD methodology for telemedicine applications, making this research a pioneering effort in shaping future developments in this domain. User dissatisfaction with the app, echoing trends in mHealth apps (Gagnon et al., 2015), is evident in issues related to GP registration, prescription ordering, and appointment booking. The findings were meticulously analyzed and compared with existing theories, serving as a benchmark for future telemedicine applications, particularly in the context of video consultation and GP registration, where a UCD methodology is notably lacking.

To further investigate if our finding will lead to an increase in the perceived usability as suggested in the studies of Sedlmayr et al., (2018). Prototypes and wireframes were developed from the findings of our data analysis, these prototypes would be vital in the usability session to get feedback from users and to measure perceived usability as was in the case of (Norman, 2013; Abras et al., 2004). The study's usability testing results reflect an improvement in perceived usability, with participants expressing satisfaction and effectiveness, as indicated by an excellent SUS score of 8.5 (Bangor et al., 2008b). This improvement suggests the potential for increased user experience, adoption, and engagement. While the study marks a significant stride in enhancing the NHS app experience, further research is warranted to test the prototype's scalability, explore diverse user demographics, and gather additional feedback for comprehensive effectiveness. This research contributes to the existing literature by bridging a gap in understanding the application of UCD in telemedicine and offering insights into the perceived usability of the NHS mobile app, aligning with previous research by Wachtler et al. (2018) and Sedlmayr et al. (2018).

5.2. Implications for Theory and Practice

The findings of the study will have significant societal implications, notably in the areas of sustainability and road accidents. Over 753 air pollution-related deaths, 8,844 lost life years due to air pollution, 85 fatalities, and 722 significant accident injuries have all been connected to NHS-related traffic (Office for Health Improvement & Disparities 2022; RCP 2018). The NHS can contribute substantially to social and economic regeneration and reduce its own ecological footprint through lower carbon emissions (Griffiths 2006).

Remote consultations, using direct messages, videoconferencing and phone calls would have a significant impact on public health in addition to enhancing patient convenience. By reducing NHS-related travel, road traffic accidents would significantly be reduced (RCP 2018). Also, reduced patient travel lengths and shorter travel times will result in fewer carbon dioxide emissions, affecting long-term sustainability (RCP 2018).

5.3. Limitations and Future Research

This study relies on data obtained through semi-structured interviews with participants. As a result, the answers may reflect personal perspectives and points of view. We recommend a larger sample group for future study because ten participants for the initial interviews and five participants for the usability are rather small (Rosala 2021), so the results may not be representative of other NHS user groups.

The primary data-gathering method used in this study was interviews. Observations and usability testing have been recommended as data-gathering methods for future research due to a better argument for generalisation and data reliability (Yin 2018). A usability test should be carried out on both the old and redesigned app; comparing findings helps to see the differences in completion time, error rate and completion rate as well as the SUS score as shown in the study of Johnson et al. (2005).

The usability testing in this study was conducted in a controlled environment, which may not perfectly reflect real-life scenarios and the context of use (Johnson et al. 2005). The semi-structured interview was used to develop activities, which participants were asked to complete, which may have influenced their attitudes and conduct. This may limit the usability metrics' generalizability and the prototype's overall efficiency in real-world usage. Future studies should explore implementing and evaluating in real-world circumstances to help answer concerns regarding the result and performance of the system (Gomm 2008).

While prototypes were designed in response to participants' pain points, only a few wireframes were converted to high-fidelity wireframes owing to time restrictions. The font and design components used were improvised due to a lack of approval to use the NHS-approved typeface and design system.

5.4. Conclusion

This study embarked on a significant exploration to improve the user experience of the NHS app by employing User-

Centered Design (UCD) methodologies. The rationale behind adopting UCD was grounded in its proven effectiveness in aligning solutions with user needs, as established by Sedlmayr et al. (2018) and Mao et al. (2005). The primary objectives were to identify areas of improvement within the NHS app, demonstrate the application of UCD methods in fostering user-friendly app development, and contribute pioneering insights to the underexplored realm of UCD methodologies for telemedicine applications.

Addressing research questions involved a multifaceted approach, encompassing semi-structured interviews, usability evaluation, and the application of the System Usability Scale. These methods not only allowed us to discern user needs and frustrations but also provided a comprehensive analysis of the perceived usability of the redesigned solution. The incorporation of diverse methods, such as ideation, personas, wireframes, and prototypes, mirrored the expansive scope of UCD application in the literature, reinforcing the study's methodology. The findings unveiled a misalignment between the NHS app's offerings and the genuine needs of its users. This not only contributes to the existing discourse on mHealth app dissatisfaction (Gagnon et al., 2015) but also establishes a unique contribution by introducing a UCD methodology for telemedicine applications—a void identified in the literature.

Usability testing results underscored the success of the redesigned app, garnering an excellent System Usability Scale score of 8.5 and indicating significant improvements in perceived usability. These outcomes are pivotal, as they signify the potential for increased user satisfaction, adoption, and engagement—a key goal of this study. Looking ahead, further research is warranted to explore the scalability of the prototype, analyse user demographics comprehensively, and gather additional feedback to ensure the continued effectiveness of the app. This study represents a milestone in enhancing the NHS app experience, aligning with previous research highlighting the positive impact of UCD methodologies in healthcare applications (Wachtler et al., 2018; Sedlmayr et al., 2018).

In conclusion, this research not only contributes to the improvement of the NHS app but also fills a critical gap in the understanding of UCD methodologies in telemedicine applications. As we continue to witness the dynamic evolution of digital healthcare, the insights gained from this study provide a valuable foundation for future research and development in user-centred telemedicine applications.

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