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Research Article

# Applying User-Centered Design Methods to Improve Perceived Usability of the NHS App

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**The National Health Service (NHS) app was developed to assist millions of people in accessing information about their health and treatment, as well as NHS services in the United Kingdom. However, like most mHealth apps, the NHS app faces various issues, including low task completion rates and poor usability. User-centered design has proven 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 enhancing clinical system accessibility and satisfaction.**
**This study aims to investigate the reasons for the low adoption rate of the NHS app. We identify areas for improvement and demonstrate how User-Centred Design (UCD) methodology 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=25)*. Participants of the study were between the ages of 20 to 80, living in the United Kingdom.**
**The findings of the semi-structured interviews revealed a significant gap between the features the NHS app provides and what users require. Results also indicate that many users experience dissatisfaction with the app, contributing 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 test results showed that applying UCD methodology to develop products increases user satisfaction and improves user experience.**

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## 1. Introduction

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 most systems can still not comprehend[1]. 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 endeavor (Abernethy et al., 2022), with over 1 billion people now having access to mobile broadband Internet and a fast-increasing mobile app industry[2]. The healthcare industry is no exception as patients want to have more control over their health, they want to send messages, book appointments, and order prescriptions all on their smartphones.

In the United Kingdom where hospital treatment is free to people who are ordinarily resident in the country[3], demand for hospital treatment has exceeded capacity even before the COVID-19 pandemic[4]. The number of people awaiting treatment in NHS (National Health

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Service) hospitals in England has hit an all-time high of 5.45 million in 2021 (BBC, 2021).

In 2014, the NHS introduced a strategy to integrate technology into its services, aiming to improve access to treatment and care quality[5]. This strategy emphasizes the importance of embedding technology and digital data to provide patients quicker and easier access to services and health information[6]. The NHS app was launched to empower individuals with more information about their health, treatment options, and control over NHS services[7]. The app allows users to book appointments, order repeat prescriptions, donate organs, and track symptoms[8].

The NHS hopes that introducing this app will provide patients with access to the services they need, hence putting more information at their fingertips, and giving them more power and control over their own care[9]. By strengthening national digital channels, patients can engage with diverse healthcare providers and access additional resources to meet their healthcare needs[9].

From a user experience standpoint, The NHS app like many other mHealth apps, faces several challenges, including, difficulties in using the app, complex navigation, low task completion rates and poor usability. The NHS app has a 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[10]. 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[11].

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[12]. Despite consumers' increased readiness to test mHealth applications, it is critical to understand and appeal to their reasons to reduce barriers to "digital adherence." User-centered (UCD) research is therefore essential for the success of mHealth apps[12]. 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[13]. To guarantee high usability, user-centred design approaches can be used[14]. Usability testing of eHealth applications is highly beneficial for patients, as improved usability can lead to increased productivity, improved user well-being, reduced stress, increased accessibility, and reduced risk of harm[13].

When utilising the NHS app, a primary challenge lies in accurately determining the needs and preferences of patients and the public[14]. To effectively transform healthcare practices, digital health technology must engage end-users, provide clear information, and encourage active participation in treatment decisions[14]. User-centered design (UCD) has proven to be a successful approach for identifying requirements across diverse user groups and integrating them into the development of information and communication technology (ICT) systems, enhancing clinical system accessibility and satisfaction[15]. Apps developed using this approach have demonstrated improved user acceptability, usability, user-friendliness, and adoption rates[14].

In this study, we aimed to investigate the reasons for the low adoption rate of the NHS app, identify areas for improvement, and demonstrate how user-centered design (UCD) methodology can be applied to create a more user-friendly app that meets user needs. The study addresses the following research questions:

1. How can UCD be used to identify user pain points and areas for improvement in the app to produce a better user-friendly app?
2. What are the UCD methods used in developing effective mobile apps in telemedicine?
3. How do we measure the effectiveness and perceived usability of the NHS app?

This article is organized as follows: Section 2 discusses theories and stages of a user-centered design methodology, along with relevant literature on applying UCD to digital health. Section 3 describes the sample, instruments, and procedures used in the study. Section 4 presents the results, while Section 5 summarises the study findings, limitations, and suggestions for future research.

## 2. Theoretical Background

### *2.1. Telemedicine, a subset of digital health*

Telemedicine is described by[15] as "a remote electronic clinical consultation using technology for the delivery of health care and the exchange of information across distance". Handel[16] 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[17]. Griffin et al.[18] 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.[17], 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.[17] study about incorporating users in the development of effective telemedicine apps as is the purpose of this study.

## *2.2. User-Centred Design (UCD)*

According to Ghazali et al.[19], user-centred design (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[19][18]. 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[20] 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[21].

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.

## *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[22]. 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.,[23] 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[23]. Garrett[24] provided a simpler definition of the term and defined user experience as the experience a product creates for people who use them in the real world. Garrett 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. Garrett also points out that another popular way people think about product design is in functional terms, and a well-designed product is one that does what it claims to do[24].

According to Artson and Pyla[25], user experience cannot be created; it must be experienced. Kaasinen et al.[26] agree with these assumptions and add that, while it is difficult to convince individuals to have a certain experience, designers may try to facilitate a specific sort of experience, i.e., "they design for an experience rather than design 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[25]. 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[25].

## *2.4. Perceived Usability*

Hassenzahl and Monk (2010) define Perceived Usability' as the average perception of ease of use based on self-reported data collected after each task to understand the overall user experience over time Perceived usability is a key part of the broader concept of

usability. It focuses on the user's subjective experience —how easy and intuitive they find a product to use (Brooke, 2013; Lewis et al., 2015; Sauro & Lewis, 2009, 2016). Together with the more objective measures of efficiency (how quickly users can complete tasks) and effectiveness (how accurately tasks are completed), perceived usability forms the classical definition of usability as outlined by ISO standards (1998). Importantly, usability is also a core aspect of user experience, connecting how a product functions with how it feels to the user. In their research Prokopia & Nikolaos (2021) argues that if an interface is user-friendly, users are more likely to engage with the system frequently and focus on its offering rather than struggling with the system itself. Conversely, poor usability can discourage use, as users spend more time figuring out how to use the platform than absorbing using it.

## *2.5. 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 in ISO 9241-11:2018 standard for "ergonomics of human-system interaction"[22]. Graham et al.[27] 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[28]. According to Lowdermilk[29], usability research is the measured observation of consumers' behaviour while using your product. As described by Lowdermilk[29], it is scientific in practice and prefers metrics, measures, and statistics to prove statements. Lynch and Horton[30] 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[30]. Cooper et al. [28] 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.

## *2.6. 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 sections that follow.

### *2.6.1. Think Aloud Technique*

Hartson and Pyla[25] 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[31], 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[31] 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 definitions of some helpful performance metrics that will be utilised in this study to assess the NHS app's usability are provided below.

1. **Task completion:** According to Tullis and Albert[32], task completion assesses how well users can accomplish a particular task. According to Tullis and Albert[32], 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[32], measures how much time users dedicate to a task.
3. **Errors:** According to Tullis and Albert[32], errors can be beneficial in highlighting certain

perplexing or misleading components of an interface.

### *2.4.2. The System Usability Scale (SUS)*

The System Usability Scale (SUS) is a common measure of perceived usability, according to Sauro[33]. The system usability measure was developed in 1996 to allow usability practitioners and evaluators to assess the usability of a specific product or service quickly and simply. It is an excellent choice due to its versatility in evaluating a wide range of interface technologies[34]. According to Hartson and Pyla[25], 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[32], 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[32]. According to Laubheimer[35], 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 in benchmarking findings and understanding them in comparison to peers and rivals, which are less often used survey instruments[35].

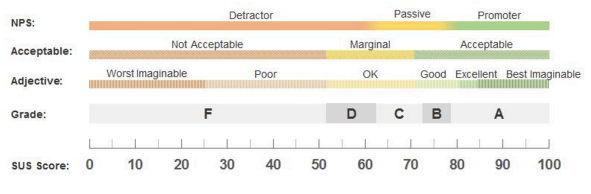


**Figure 1.** Interpreting SUS scores in terms of grades, adjectives, and acceptability[33].

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[19][18]. 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.,[36] correctly stated, quality and value must be easier to detect for digital health solutions to have a higher impact.

## 3. Methods

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 Figure 2, and these phases will be explained in the subsections below.

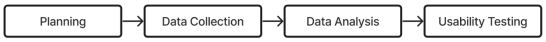


**Figure 2.** Study Phases (Own Creation)

### *3.1. Phase 1: Sampling*

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[37]. 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[20].


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| | Age | Gender | Computer Usage Per week | Family Status |
|---|---|---|---|---|
| **1** | 25-30 | Male | 40+ Hr/Wk | Single |
| **2** | 30-35 | Male | 40+ Hr/Wk | Single |
| **3** | 25-30 | Male | 40+ Hr/Wk | Single |
| **4** | 35-40 | Female | 10-15 Hr/Wk | Married |
| **5** | 30-35 | Female | 40+ Hr/Wk | Single |
| **6** | 20-25 | Female | 40+ Hr/Wk | Married |
| **7** | 60-70 | Male | 0 Hr/Wk | Married |
| **8** | 70-80 | Female | 0Hr/ Wk | Divorcee |
| **9** | 60-70 | Male | 0Hr/Wk | Married |
| **10** | 25-30 | Male | 40+ Hr/Wk | Single |
| **11** | 25-30 | Male | 40+ Hr/Wk | Single |
| **12** | 70-80 | Female | 0 Hr/Wk | Married |
| **13** | 70-80 | Female | 0 Hr/Wk | Married |
| **14** | 30-35 | Male | 40+ Hr/Wk | Married |
| **15** | 20-25 | Female | 40+ Hr/Wk | Single |
| **16** | 25-30 | Male | 40+ Hr/Wk | Single |
| **17** | 35-40 | Female | 10-15 Hr/Wk | Single |
| **18** | 60-70 | Male | 0Hr/Wk | Married |
| **19** | 70-80 | Female | 0Hr/Wk | Married |
| **20** | 30-35 | Female | 40+ Hr/Wk | Married |
| **21** | 20-25 | Female | 40+ Hr/Wk | Single |
| **22** | 60-70 | Male | 10-15 Hr/Wk | Married |
| **23** | 25-30 | Male | 40+ Hr/Wk | Single |
| **24** | 25-30 | Female | 40+ Hr/Wk | Single |
| **25** | 70-80 | Male | 0Hr/Wk | Married |

**Table 1.** *Sociodemographic Characteristics of the Participants*

### *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[37], as well as understand the reasons behind the participants' actions or views and opinions on the NHS app[38]. It also enables researchers to 'probe' responses, where you want your respondents to clarify or expand on their comments[38]. All interviews were recorded for the researcher to focus on the conversation and obtain the most thorough data for analysis[39]. 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[40]. 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[41]. For this research, NVIVO v12, a qualitative computer software program, was utilised to assist in arranging and coding the data more precisely and effectively[42]. 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 cannot 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[43].

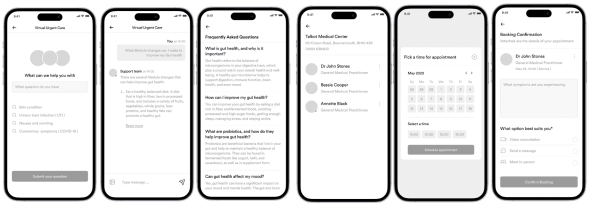

**Figure 3.** Wireframing Example (Own Creation)

### 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[44] 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[25]. Participants use this strategy to provide the assessor with insight into their thoughts regarding the task and the interaction design[25]. 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[32].


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| 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<br>2. Check for new patient availability<br>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<br>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<br>2. View your prescription history<br>3. Reorder a prescription |

**Table 2.** Scenario and tasks for usability testing

### *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.

### *3.7. Validity*

To ensure the validity of this research, external validity was emphasized by aligning the usability testing setup and participants with real-world conditions. Usability testing measured task completion, error rates, and interaction quality within scenarios representative of actual NHS app usage, as suggested by Budiu[45]. Triangulation was employed, combining interviews, usability testing, and questionnaires. This multi-method approach enhanced the study's rigor and depth, ensuring comprehensive data collection and reducing the risk of bias[46][37].

### *3.8. Reliability*

Reliability was achieved by employing strategies outlined by Yin (2014), ensuring that other researchers could replicate the findings using identical methods. A case study approach was adopted with a pre-planned protocol, and all data, including interviews, usability test results, questionnaires, and interface designs, was systematically documented. This documentation, forming a case study database, minimizes potential errors and biases and strengthens the study's reliability[38] (Yin, 2014).

### *3.9. Generalizability*

While the goal of this study was not to generalize findings broadly, theoretical concepts of user-centered design and user experience were employed to provide insights into mHealth application usability. The research focused on a single mHealth product, examining its usability in depth rather than attempting to generalize results to all mHealth apps. This case-specific approach reflects the intent to explore phenomena and generate valuable context-specific insights[38].

## 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 section.


doi.org/10.32388/BYAENM.2

| Themes | Subthemes |
|---|---|
| User's Pain Point | User experience and ease of use<br>Desire for Improved Communication<br>Lack of flexibility in booking appointment<br>Difficulties in registering and managing GP<br>Prescription Management |
| User goals for using the NHS app | Seamless GP experience: The difficulties in Registering and Managing a GP, Ideal GP Registration experience<br>Prescription: reordering a prescription, Prescriptions<br>Easier way for users to book Appointments |
| Suggestions for Improvement | Information Hub<br>Alternatives to Contacting a doctor: Direct messaging, video conference, bots<br>Preference for booking online: Appointment availability, Patient count for GP<br>Push Notifications<br>Improved Interface |

**Table 3.** Themes and Subthemes

### *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.

| Sub-Themes | No. of References |
|---|---|
| Lack of flexibility in booking appointment | 44 |
| User experience and ease of use | 31 |
| Difficulties in registering and managing GP | 39 |

**Table 4.** Identification of user's pain points.

To develop a user-friendly app, the author interviewed users to understand their aims and difficulties with the app[23]. This theme focuses on the frustrations participants encountered while using the NHS app.

### *1. Lack of flexibility in booking appointment*

The data revealed that booking an appointment was mentioned the most frequently, with 44 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. Difficulties in registering and managing GP*

According to the data provided in this study, majority interviewed had trouble 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 could not 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. User experience and ease of use*

The importance of user experience was discussed in prior sections; it is a key concern with most healthcare apps[18]. 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 most participants. Complex navigation results in activities not being executed or information being difficult to find.

> *"Being a multi-user app, the app should be extremely 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 is also extremely 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.[18] 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.'s[18] findings, which reveal that most users regard most healthcare applications to have usability issues, which may be a major reason 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.

| Sub-Themes | No. of References |
|---|---|
| Seamless GP experience | 35 |
| Ability to manage Prescription | 27 |
| Easier way for users to book Appointments | 29 |

**Table 5.** User goals for using the NHS app.

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 do not 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 did not mind waiting for their appointment; they wanted the scheduling procedure 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: Suggestions 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.

| Sub-Themes | No. of References |
|---|---|
| Information Hub | 32 |
| Alternatives to Contacting a doctor | 23 |
| Preference for booking online | 29 |
| Push Notifications | 17 |
| An Improved Interface design | 31 |

**Table 6.** concepts for improvement generated by users.

The result of the data analysed is congruent with the findings of [19], Norman[47], and [18] 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[20].

## *1. Information hub*

The findings show that, as some participants pointed out, locating information on the app was challenging, and that many participants indicated a desire for it. As one of our focuses, getting replies to inquiries is critical for most consumers. An information hub would be a center that keeps a record of commonly asked questions, a repository of all illnesses with an effortless 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 cannot be online all the time. Hence an FAQ page is important, I would not 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[48]. 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 date.

> *"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[28]. This test aligns with previous research that emphasized the importance of usability testing in building successful health products[14]. 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 Table 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 3). "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 4), 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 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 5 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[49] 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. Discussion of Methods and Findings*

### *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[50]. UCD, recognized for improving product usefulness and usability[51], is applied here to identify areas of enhancement in the NHS app. The aim is to highlight 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[52]. The use of usability evaluation and the System Usability Scale (SUS) provided valuable insights into the perceived usability of the redesigned solution[30]. To tackle the second research question, various methods highlighted in the literature review,


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such as ideation, personas, wireframes, prototypes, and think-aloud sessions, were employed[27]. Following Norman's UCD project initiation model[20], 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[53]. 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[23]. By employing methods such as interviews, focus groups, ethnography, prototypes, and usability testing, researchers can develop user-friendly apps that align with user needs[29].

### *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 primary areas: 1) the extent to which the current application fulfils users' needs, and 2) users' frustrations and challenges encountered while interacting with the application[52]. The results indicate a misalignment between the offerings of the NHS app and the genuine needs of consumers. Despite an exhaustive literature review on UCD and its applications in numerous industries, few studies were 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[54], is evident in issues related to GP registration, prescription ordering, and appointment booking. The findings were meticulously analysed 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 whether our findings would align with Sedlmayr et al.'s[50] suggestion of increased perceived usability, prototypes and wireframes were developed based on our data analysis. These prototypes were crucial for gathering user feedback and measuring perceived usability during usability testing sessions, following the methodologies outlined by Norman[20] and [52]. The study's usability testing results indicate a significant improvement in perceived usability, with participants expressing elevated levels of satisfaction and effectiveness, as evidenced by an excellent SUS score of 8.5[55]. These findings suggest the potential for increased user experience, adoption, and engagement.

While this study represents a substantial step forward in enhancing the NHS app experience, further research is necessary to evaluate the prototype's scalability, explore diverse user demographics, and gather additional feedback to assess its overall effectiveness. This research contributes to the existing literature by addressing the gap in understanding UCD application in telemedicine and providing insights into the perceived usability of the NHS mobile app, consistent with the findings of Wachtler et al.[14] and Sedlmayr et al.[50].

### *5.2. Implications for Theory and Practice*

The findings highlighted critical usability issues and gaps between user needs and app features. By addressing these gaps in the redesigned app, users experienced a more efficient and satisfying experience. This research also addresses a common issue in mHealth apps which is low adoption due to poor usability. By identifying and solving these issues, the NHS app can serve as a model for other mHealth applications, driving higher adoption and better healthcare delivery.

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[56][57]. The NHS can contribute to social and economic regeneration and reduce its own ecological footprint through lower carbon emissions[58].

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[57]. Also, reduced patient travel lengths and shorter travel times will result in fewer carbon dioxide emissions, affecting long-term sustainability[57].

### 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 Twenty-Five participants for the initial interviews and five participants for the usability are small[59], 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[60]. 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. [43].

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[43]. 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[61].

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.[50] and Mao et al.[51]. 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[54] 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[14][50].

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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