Cardiff University School of Computer Science and Informatics

MyHealthOnline: Integrated Digital Patient-Centred Health and Care System

Final Report

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Abstract

This report discusses and analyses the application 'My Health Online', which plays a big part in digitising the communication between a patient and GP surgery. It will identify ways it can be improved to make it more effective and efficient for both. The application is separate from the NHS infrastructure, so the new prototype brings in that new connection to make the application involved with the other information systems. This study will analyse the functionality and usability of the application as well establishing the needs of the people involved with the application to identify improvements.

Many methods will be used throughout the project. Soft Systems Methodology will be used to get an overview of the problem and identify what needs to be done. Interviews and questionnaires will be undertaken to gain an insight into the users view and evaluations will be carried out on the application to establish any underlying problems it already has. Requirements will be defined based upon the research that has been gathered to help ensure the prototype will fulfil its needs. The interface needs to be appropriate for all ages and provides the users with the services efficiently to encourage them to use it instead of phoning the surgery.

The study had to consider ethical approval and the participants of the research will be kept confidential. The application holds highly sensitive information of an individual, so a real patient's account can't be used, a Mock-Up of the application has been throughout the report.

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1. Introduction

The NHS in Wales are wanting to make the most of the benefits of our digitised world by changing all their services to be online. There is a need for patients, carers and healthcare professionals to be able to access accurate information much easier whenever and wherever they are. It is becoming more crucial as time goes on due to data constantly growing and there not being a system in the NHS facilities that solves this problem. The NHS have paid for over the phone services for a long time to tackle the problem of poor communication but now as our population is growing and evolving it isn't as effective anymore. It has been said that "poor communication harms patients and wastes money" [1] which increases the need for the NHS to have all services digitised. This will decrease the cost and use of resources to ensure it can run more effectively for the NHS staff and patients. At the moment you can book appointments and get repeat prescriptions online at your GP surgery but there are still many services that haven't been considered. Overall if the NHS continually improve their services "this will enable us to be in control of our own health and well-being and to play an active role in decisions about the services, care and support we need" [2].

1.1 Background Research

Over many years there has been reports on poor communication in the NHS, it is believed that a third of their complaints are behind communication error. It has always been an ongoing problem as NHS fails to keep up with the demand and not being able to evolve with the digitised world. In England, it has been estimated that the amount of wasted resources is costing around an excess of £1 billion a year. Therefore, this particular project is relevant at this time as the communication needs of patients and healthcare professionals need to be identified and fulfilled by online services to help keep up with the demand.

The progress of digitising the services have been taking time over the years to get the systems implemented. Now My Health Online has been up and running a few years it is time to look further into ways of improving patient's communication needs to solve the poor communication issue.

The NHS have a 'NHS Five Year Forward View' that started in 2015 and is aiming to hit targets by 2020. The section that is relevant to this project is Chapter 10 on Harnessing Technology and Innovation. It refers to how it's taking steps towards helping people manage their own health by "increasing how its services can be accessed online, whilst remembering that healthcare is about people and that many patients want and need the reassurance of a real person to talk to face to face" [4]. It states there has been progress as 95% of GP's offer their services online e.g. appointment booking, repeat prescriptions and access to patient's summary care record. The figures in the report say "10.4 million people are now registered for online services with 1.9 million repeat prescriptions ordered online in February 2017, 1.1 million appointments managed online and 1 million views of patient records in the same period" [4]. This demonstrates changes are being made and they are following their plan at a good speed, but the real question is whether these services are fulfilling the needs of the patients as there is no evidence of showing how well it is working across the nation.

Spine

The NHS has a major IT infrastructure to allow communication between the different facilities. Spine supports the NHS IT infrastructure, it is the digital central point that allows NHS systems to communicate to be able to exchange information. It has connected over 23,000 healthcare IT systems in 20,500 organisations in the NHS e.g. pharmacy teams with GP practice staff and the

patients. Spine provides the facility to share information securely through national services, such as the Electronic Prescription Service, Summary Care Record, the e-Referral Service and GP2GP.

The Electronic Prescription Service (EPS) is the connection between GP surgeries and pharmacies as GP surgeries can send electronic prescriptions to the pharmacies through this system. This is trying to remove paper prescriptions. The benefits of this prescription service are: it can be processed more efficiently, it provides a more effective service to patients and patients are able to pick up repeat prescriptions without having to visit their GP.

The Summary Care Record (SCR) is patient's important information stored as an electronic record. It is created automatically by the GP practice and uses the information from the patient's medical record. It can be accessed by only authorised staff who are involved in the patient's care. When visiting their GP practice, patients are allowed to view and add any necessary information they feel is relevant. At a minimum the record holds the patients basic information (name, address, DOB and NHS number), current medication, allergies or bad reactions to certain medicines.

The NHS e-Referral Service (e-RS) is used to book appointments in a hospital or clinic that you have been referred to by your GP. It can be done at the point of referral with your GP, at home on the phone or online when it is convenient to the patient. The online system can be used by signing in with the reference number and password. The patient can choose where they want the appointment too. At this moment in time it is only being used by patients to arrange just over half of the referrals being made, it has been said that "by October 2018 all referrals will be made via this route, improving patients' experience and offering real financial and efficiency benefits" [4].

GP2GP is used to be able to send patient's electronic health records directly and securely to the GP practice the patient has transferred too. This helps improve patient care by making sure accurate detailed information of the patient's medical record has been sent to the right GP.

Currently being developed in the NHS is an IT system called GP Connect. This system will allow GP practice and clinical staff to have access of authorised information to share it between each other. It's about making the patient's medical information available and accessible to the right clinician, across care settings.

My Health Online system

My Health Online was released in April 2014 to provide easy access to your practice in Wales. It is an interactive user interface for the patient's to be able to communicate to their GP practice online. At the moment this application is quite separate to the NHS infrastructure as there are many systems where GP's can communicate with other NHS facilities already in place. This application only has communication between patient and GP, the information cannot be used anywhere else.

The system allows patients to book GP appointments online including being able to view them and easily cancel them. It holds your appointment history and your account information which would be the information your GP practice holds. You can order your available repeat prescriptions that has been put on your account by your GP, this makes it much easier than having to book an appointment every time you need to restock your regular medication. It has many good reviews on it e.g. "It's easy to use and saves me having to phone the surgery", "I find it a very useful tool" and "It's just so much easier to go online" [3]. A lot of people work the opening hours of the surgery and are too busy to pick up the phone to book an appointment, having this online system allows people to do it when it's convenient for them.

Before 'My Health Online' the only way you could book an appointment would be either going into the surgery or calling them. For repeat prescriptions, the patient would need to fill out an ordering slip, that should have been attached to their previous prescription for their next dosage of their prescription and hand it into their surgery. The patient must wait usually two to three working days to be able to collect the prescription to take it to the pharmacy. Using 'My Health Online' you can request your prescription online and go collect in two to three working days.

1.2 Aims and Objectives

For this project the main areas it will focus on is research into the application 'My Health Online', to identify the issues and improvements that could be made to define new requirements for a prototype while also improving the communication in the NHS. Based on the background research the application provides two main services where you can book an appointment or request a repeat prescription, so carrying out further research will help to gain an insight from the public of how they get on with it.

Identify and understand any problems in the application 'My Health Online'

Different methods need to be carried out on 'My Health Online' to discover if its fulfilling its purpose. A heuristic evaluation and a gap analysis will be undertaken to achieve this. Positive and negative implementations need to be identified to work out where there is room for improvements and what needs to be implemented into the new prototype to keep the application's effectiveness. At the moment it only provides two main services which are booking an appointment and requesting a repeat prescription. There are more services that could be digitalised to make it more convenient on the application.

Define requirements for a solution to address identified problems

While carrying out research such as the questionnaire and interviews, this will help determine the final requirements for the prototype to demonstrate the improvements that can be made to the original application, it will show there is room for growth and how effective it would be. This is a welsh application that needs to become widely used by having more surgeries use it, so it will include all the necessary features that have been discovered from the research. This new design could show how effective it could be and how it will benefit the surgery.

Define how the solution can improve communication within the NHS

This objective was not explicitly defined in the initial plan but was identified when doing the research for the project. Improving communication is an important objective for the NHS and any solution proposed in this project should address this issue.

1.3 Structure of the Report

This section provides an overview of what will be covered in each chapter in the report.

In chapter 1, background research behind the communication in the NHS and the issues it has is undertaken. There will be a brief description about the application 'My Health Online' that will be analysed throughout this project.

In chapter 2, methodologies are carried out to get an overview of what needs to be identified to achieve the purpose of this project. The methodologies used is Soft Systems Methodology and Systems Dynamics. Different patient's personas were determined to understand what type of patients there are that need to be considered while defining the requirements. At the end there is a

section explaining the reasons behind the questionnaires and interviews that are necessary for the project.

In chapter 3, the methodologies for collecting primary research are carried out. Many interviews and a questionnaire will be given out to the public to be able to undertake an in-depth analysis to identify what they need as they are the users of the application. Next stage is to analyse the application by a heuristic evaluation and evaluating the requirements of the application using MoSCoW.

In chapter 4, a Gap Analysis report was carried out to help identify the gaps in the features on the application which helps to determine what to add on the new prototype. The gap analysis created the gathered requirements that were needed to help design the interface. They were based upon all the research that has been gathered throughout the project and taken everything into consideration.

In chapter 5, the designing stage took place and it is represented in the report by wireframes, activity diagrams and use cases to show the functionality of the prototype. After proposing the design, it is determined and discussed how the prototype meets the gathered requirements.

In chapter 6, the testing phase has been completed. A cognitive analysis was carried out internally where the author analyses the prototype themselves and user testing is performed using the method Think Aloud where the user talks throughout the different steps of the task. A risk assessment is drawn out to ensure the risks are stated and to have contingency plan if the risk was to happen.

In chapter 7, this section includes a conclusion about the project itself and how well it progressed. A discussion about how well the methodologies were used and the results from them. It also revises the Soft Systems Methodology that was defined at the beginning of the project (Chapter 2) and discusses the future work of the output to carry on making improvements.

In chapter 8, it includes a conclusion reflecting on how well the project has gone overall. Identifying the positive aspects of the project as well addressing the issues to determine where it could have gone better and how.

2. Methodology

2.1 Soft Systems Methodology (SSM)

SSM was created "to provide a tool for investigating an unstructured problem situation. SSM is not a system design tool, but a tool for system requirements investigation" [5]. SSM is a structured approach for identifying problems and it is used for analysing human activity systems into models. Even though it is a modelling tool it isn't used to represent the real world but to structure your thinking about the real world. It is used to constrain your thinking to the situation and to be able to expand your thinking on how to solve it. When the problem has been defined then the solution can be identified through a process of a root definition, CATWOE analysis and developing a conceptual model. The purpose of SSM is to support and structure our way of thinking to ensure we include all the situations identified to be able to find a solution.

CATWOE
CATWOE is a checklist for thinking and used for testing the root definition to make sure all aspects have been defined. It helps create a well-defined and meaningful root definition.
A definition of the CATWOE elements are:
- Customers – Who is affected of the output from the transformation process
- Actors – Who undertakes the activities in the situation
- Transformation – The process itself; what's involved in the process
- Weltanschuauung – Your world view, what is going to influence the transformation process
- Owner – Who controls the system and has authority to make decisions
- Environmental Constraints – Events that could affect the transformation process

From using these elements, a CATWOE can be created specifically for this project. The T and the W must be specified first as these are the main activities that can help us define the other elements.
- Transformation – Provide a user-friendly intuitive interface design for existing communication tools
- Weltanschuauung – I believe in identifying the needs of both the GP/healthcare professionals and patients to help provide a user-friendly intuitive interface design
Now the rest of the elements:
- Customer – NHS patients
- Actor – GP/Healthcare professionals
- Owner – Myself
- Environmental Constraints – Data protection legislation act, NHS protocols, procedures and process and the University unfair practice policies

Root definition
With the CATWOE defined, the root definition can be determined. All the CATWOE elements must be used in the root definition and nothing else. It puts all the elements of the CATWOE in one sentence to be able to describe what the system is.

A root definition constructed from the CATWOE above:

"A system, owned by myself, operated by Healthcare professionals and GP's to provide a user-friendly, intuitive interface design for existing communication tools for NHS patients by identifying the needs of both the GP/healthcare professionals and patients whilst ensuring coherence to data
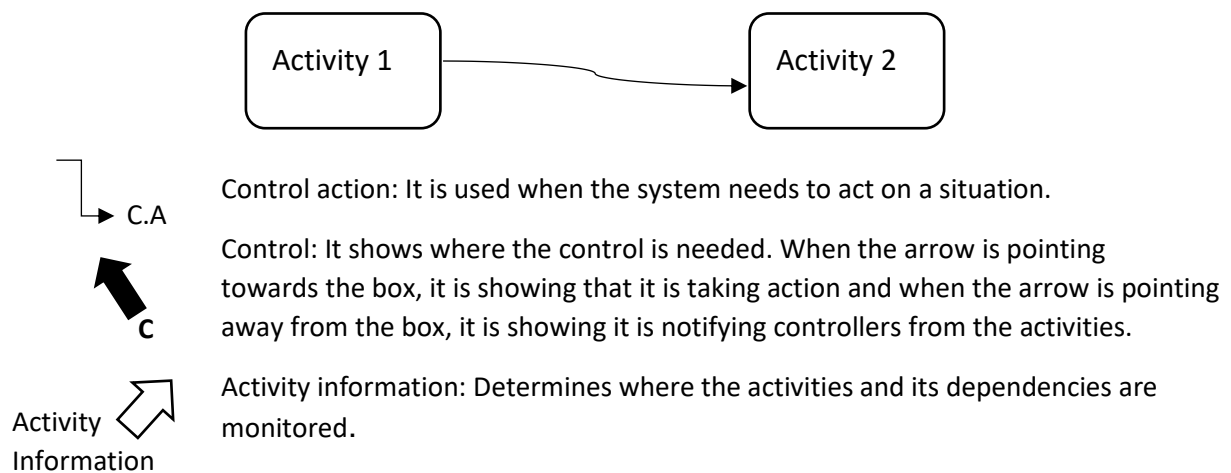
protection legalisation, NHS protocols, their procedures and processes and University unfair practice policies."

2.2 Conceptual Model

A conceptual model "is used as a way to describe physical or social aspects of the world in an abstract way" [6]. It is a representation of a system to help visually display the concepts and ideas within the project. It is constructed from the words used in the root definition and no additional information should be added in the process. The conceptual model needs to demonstrate an ongoing purpose, the means of assessing the performance of the activities, a decision-making process, sub-systems, interactive components, an environment which does or doesn't interact with the system, a boundary between the system and environment, resources that will be used and the maintenance of the continuous actions.

There are different attributes used in a conceptual model and they are explained below:

The boxes are the activities and the arrows are showing the logical dependencies e.g. activity 2 is dependent on activity 1 happening first

Control action: It is used when the system needs to act on a situation.

Control: It shows where the control is needed. When the arrow is pointing towards the box, it is showing that it is taking action and when the arrow is pointing away from the box, it is showing it is notifying controllers from the activities.

Activity information: Determines where the activities and its dependencies are monitored.

Determine how to assess the needs of both the patients and GP/Healthcare professionals → Research both patients and GP/healthcare → Take control action to ensure the interviews of assessing the needs of both the patients and GP/Healthcare professionals is done → C.A

Determine how to assess the needs of both the patients and GP/Healthcare professionals → Assess the needs of both the patients and GP/Healthcare professionals

Monitor the assessing of the needs of both the patients and GP/Healthcare professionals

C

Assess the needs of both the patients and GP/Healthcare professionals → Assess the achievement of providing a user-friendly intuitive interface design for existing communication tools

Decide how to assess the achievement of providing a user-friendly intuitive interface design for existing communication tools

Define the NHS patient's requirements

C

Assess the achievement of providing a user-friendly intuitive interface design for existing communication tools → Take control action to ensure a user-friendly intuitive interface design is being provided for the NHS patients, so they are satisfied → C.A

Define what is meant by user-friendly → Identify means of assessing tools for user-friendliness

Know existing communication tools

Identify means of assessing tools for user-friendliness → Evaluate existing communication tools for user-friendliness

Evaluate existing communication tools for user-friendliness → Assess tools for user-friendliness by using Nielsen's 10 Usability Heuristics

Assess tools for user-friendliness by using Nielsen's 10 Usability Heuristics → Take control action to ensure the assessment of the existing communication tools is done → C.A

Carry out questionnaires on the public

C

Determine the capability required of each activity

Define GP

Define Healthcare professionals

Determine the capability required of each activity → Allocate activities to the GP's and Healthcare professionals

Define GP → Assess GP/Healthcare professional's capabilities
Define Healthcare professionals → Assess GP/Healthcare professional's capabilities

Allocate activities to the GP's and Healthcare professionals → Assess GP/Healthcare professional's capabilities

Activity Information ⇨

Activity Performance Information ⇨ Monitor the match of capabilities to requirements → Take control to match capabilities to requirements → C.A

Activity Information ⇨ Assess the impact on each activity

Assess the impact on each activity → Decide how to react
Assess the impact on each activity → Assemble the impact on each activity
Assess the impact on each activity → Determine the Data protection legislation act. NHS protocols, procedures and process. University unfair practice policies

Decide how to react → Notify each controller

C

Assemble the impact on each activity → Assemble activity constraint information

Assemble activity constraint information → Monitor conformance

Monitor conformance → Take control action to ensure conformance → C.A

C

C

Determine performance measurements → Take control action to achieve expectations → C.A

Determine GP/Healthcare professional's performance expectations → Monitor system performance

Monitor system performance → Take control action to achieve expectations

C

The main parts of the conceptual model that will be investigated is the section highlighted in green assessing the user-friendless of the application and carrying out a questionnaire to gain that information. Another main part that is highlighted in blue will be accessing the needs of the GP and patient by performing interviews on people who fit that criteria. These will be the main areas of the primary research undertaken in the project that will go alongside the heuristic evaluation to be able to determine the new requirements. Another main part is the output of the project that is highlighted in purple is to ensure a user-friendly intuitive interface design is provided. The take control actions are on these areas as its where something needs to be done and it ensures the controller knows that. The boundaries of this model are the patients and GP's as they control how much information they give into this research, it depends on who is asked to be interviewed as everyone has their own views and where they live as this can make a difference to the research. Overall this could determine a different system if personal factors of the respondents were to change.

2.3 System Dynamics

Influence diagram

An Influence diagram is a visual way to describing a problem. It displays the problem broken down into sections to be able to look at it in further depth. It will show the main key elements to allow the diagram to stem off into how that element works and what other aspects are related to that element. They are connected by arrows to show what the elements are linked to and it also displays polarity (+, -) to show whether it increases or decreases the element. When creating the influence diagram and looking at any potential problems, it was decided the focus is on patients booking appointments with their GP.

The influence diagram has made a positive feedback loop which can also be known as 'reinforcement loop' as if the number of patients there are is increased, leads to more patients booking appointments, the need for resources are increased such as number of GP's, when more are taken on then the ability of taking on more patients is increased. A Positive feedback loops enhance changes that can happen to the system; this can make a system more unstable by moving it away from its equilibrium state. This is the affect it could have on the GP practices if the system was to carry on with the way it is at this moment in time.
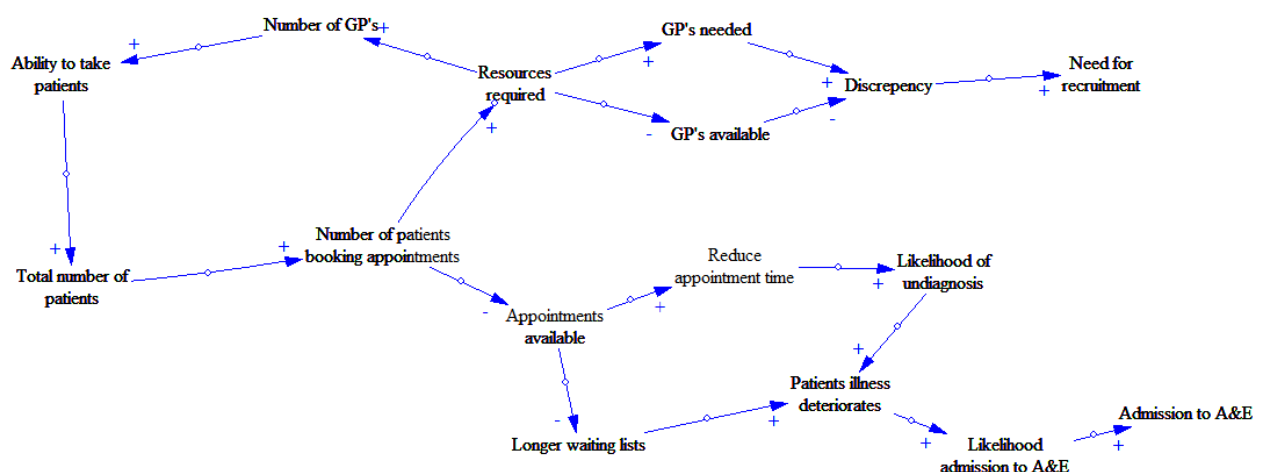
Below is a recreation of the bottom half of the influence diagram to show the effect of using the online system instead of using the phone service. When taking on new patients it will decrease receptionists work load, patients will be in more control of their health by being able to use the services necessary for them. Patients can cancel their appointments online which helps to make more appointments available to the patients who need it. As the NHS is consistently growing creating an application could help reduce the work load of the receptionists and create a better communication in the NHS.
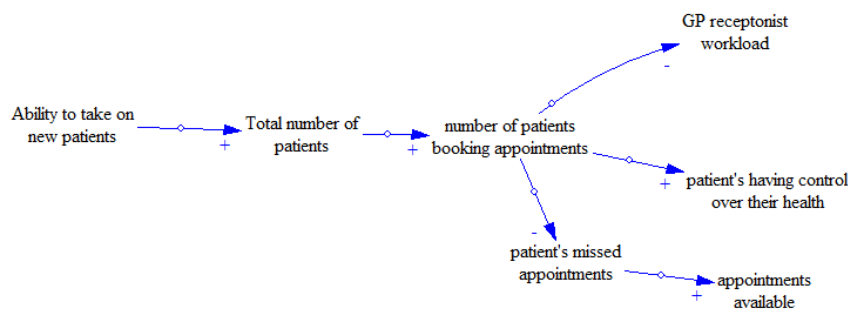
2.4 Personas

A persona is a description of an imaginary person that reflects a type of user to give people an understanding who will use the system. This is a user-centred design methodology that is a useful tool to use in this project as the application is focused on the patients, they are the main aspect to help build an improved application for them. To relate to this project, there are personas on different types of patients there is for GP's. This is to help gain more of an understanding on what kind of needs the system needs to reach. The personas use general information about a human to build to a profile, it includes a picture, a quote, behaviours, facts and goals. There have been 4 different types of patients identified i.e. a patient needing an emergency appointment, a patient needing a non-emergency regular appointment, a patient who needs a home visit and a patient with ongoing treatment who needs frequent appointments.

Natalie Robinson

"I struggle to book on the day appointments for an emergency."

Natalie is a 22-year-old student at Cardiff University that lives away from home. She originally grew up in town called Windsor in Berkshire. Natalie is currently in the third year of her degree as is unemployed due to the work load of her degree. In previous years she has worked in retail before university and transferred to the store in Cardiff for her first and second year of her degree. Her hobbies would include eating at new restaurants, going to the gym and attending gigs.

Natalie is a very fit and well woman but often suffers from urinary tract infection (UTI) due to it running in the family. She is constantly trying to ring up the doctors to make emergency appointments at a time when she isn't at university. Trying to ring the doctors when she is suffering from a UTI at 8am is always a challenge as the line is always busy or put on hold for a long time before getting through to the receptionist. My Health Online now does not fulfil the needs of patients just like Natalie. Picture source: [7]

Mark Smith

"I find it difficult to get regular ongoing appointments for my condition."

Mark is a 33-year-old man who lives in Swansea, in Wales with his wife of 5 years. His job title is a Senior Accountant at Bevan & Buckland. He left school at 18 years old after he finished his A-Levels to go train as an accountant. He has been working with this company for nearly 7 years, enjoys his job very much and is working towards getting a promotion to take his next step up the career ladder. He used to love playing sports such as football and cricket. He now watches his favourite team Swansea City on the TV when they are playing.

Mark suffers chronic pain in his lower back after a football injury 2 years ago. It has been affecting his life ever since, he needs regular medication from the GP to be able to manage the pain. He only takes the medication when he struggles to deal with the pain. As he has good and bad periods of the pain it's hard to estimate when he will run out of medication. Sometimes it can be too late, and Mark must wait 2-3 weeks for an appointment to get another prescription for his medication. Mark needs the system to offer more available appointments that are within a few days or a week. My Health Online doesn't fulfil Mark's needs at this current time. Picture source: [8]

Helen White

"I am currently unable to travel to the doctors with just my husband's help."

Helen is a 72-year-old woman who is bedbound due to a hip replacement she had a few weeks ago. She lives in Cardiff and has lived here her whole life year working since she was 16-years-old as a hairdresser. She loved her job dearly, enjoyed gossiping and meeting new people. She has a husband and two sons with 5 young children between them, Helen adores being a grandma and will always make the effort to arrange family events. Helen enjoys keeping herself busy by getting a bus into town and having a coffee with old friends.

Helen recently fell over in her home and was sent to hospital to find out she had broken her hip. She needed a hip replacement so within a few days she had an operation to fix the hip. She has returned home but currently unable to move on her own, which means she requires her doctor to come visit at home to be able examine her but there are never any house calls available online, she must ring and hope the doctor is free soon to come visit. Helen needs to be able to book a home visit for when it is needed to get the medication for her condition as soon as possible. This is something My Health Online can't support Helen with, so she must phone through to the practice to be able to speak to a GP receptionist to arrange a home visit. Picture source: [9]

Stephen Williams

"For a non-urgent appointment, I find it difficult to call the doctors as I work the opening hours."

Stephen is 25-years-old and is a finance advisor at Nationwide Building Society in Swansea. He is the total opposite to a sporty man, he loves computer games and very much enjoyed maths throughout his school life. Stephen is very sociable and likes to play darts on the weekend with a few of his friends. He currently lives at home with his mum, dad and two older sisters. He has a girlfriend called Emily of two years and they have started saving for a place of their own for the last few months.

Stephen only needs appointments on rare occasions for check-ups on his asthma and eczema to be able to get some new prescriptions for his medication. He can't call the doctor's as he works 9-5 Monday to Friday which are the opening times of the practice. Booking online would be much more convenient for him as he can do it when he's free before or after work or even on the weekend. He can see when he can get the time off work to attend the appointment. At the moment this is what My Health Online can help with as it saves him phoning the doctors. Picture source: [10]

Overall the needs of each of these patients is about making their life much more convenient by being able to use the system fully to book an appointment when they require it whether its urgent or not and requesting a prescription for when it is needed. 'My Health Online' has potential to fulfil these needs to stop the patients needing to phone the surgery when they can use this system whenever it pleases them.

2.5 Overview of approach to solution

To help determine a new design for the My Health Online interface, the author needs to conduct research into the GP surgeries and patients to be able to identify their needs and what they already think of the application.

Ethical approval

This project has formal ethical approval from the university, it is required due to the research including human participation. Due to user's account on the application holding personal data, throughout the research a mock-up of the application will be used and referred to in the questionnaire. Please refer to the Ethics Appendix for the consent forms, briefing and debriefing sheets that were used for the Interviews.

Interviews

In the conceptual model it was identified to carry out research on the needs of the patients and health care professionals and interviews is the best way to collect this type of data. They will hopefully provide rich qualitative data that is needed to gain a full understanding of what the application needs to achieve when re-designing it. As they are conducted face to face more information can be gained from what they are saying, as you can see their facial expressions and body language that expresses their opinions. Interviews allow more time for the participant to completely express their answers to the questions whereas questionnaires would only be either yes/no or a few words. At the end this wouldn't give much information about them whereas in an interview they can explain their experiences and opinions in more detail.

Questionnaire Planning

This questionnaire needs to achieve the right outcomes for the information to be useful. In the conceptual model, it was stated that an evaluation of the existing tools needs to be performed and a questionnaire is the best way to gain this information by asking the right questions to get a wider perspective. To ensure this goes to plan, the main objective that would provide the correct results is:

Objective: To obtain primary information from patients who have used My Health Online to determine the usability of the application and how well it is being achieved. This will help to gain an insight of their opinion on the interface of the application and discover any other functionality the patients would require on the application.

This objective is necessary as it will help me gain an insight of what people really think about the application, it will give me ideas on how to improve the application to provide better services for the GP surgery. Achieving this objective will be important for helping me determine design requirements for the new interface of the application.

Design of the questionnaire

This questionnaire is a good way to find out what the public think of the application so far to help gather requirements for the new prototype of the interface. Gathering a wide range of opinions from different age groups with a range of experiences from the application to help understand the level of usability that needs to be achieved in the new design. The target audience is anyone that is familiar with the application, has used it to understand how it all works, and is over the age of 18.

To create a questionnaire that is appropriate for its purpose:

a) The style of questions being used

The style of questions is an important factor to consider when designing your questions. They need to be short and concise to make sure they obtain answers that is to the point. From previous experience of answering questionnaires, the questions need to be simple, so they are easy to understand and quick to answer. A mixture of open and closed questions will be used throughout the questionnaire. The open questions will try to encourage more information from the participant to gain more of insight of their opinions and experiences, specifically on any problems they have had with the application. This will allow them to elaborate on the situation they were faced with. There will be more closed questions used throughout the questionnaire as they are quicker to answer due to requiring no elaboration, so it's important to include a mixture. Closed questions will be the most useful in analysing the results as the answers are direct and stops the participants from steering away from the questions. If needed there will be a comment box on the relevant questions to allow participants to elaborate on their selected option to help with answering the question.

Different methods will be used throughout the questions to help keep participants interested until the end of the questionnaire. The different methods that could be used are multiple choice through using checkboxes and drop-down boxes, long and short answer text. Multiple choice has been used for the age question by putting ages into categories to make it easier to summarise the data and has also been used in the question of how easy it is to use by using a number scale. This will help gain the relevant information and no important information is lost from using this method. Check boxes will be the easiest method to use for the multiple choice as it's the best method for when collecting a large amount of data. As these are closed questions, an 'Other' option will be provided to be able to include any other information that the participants see as relevant. Other questions included will require long and short answers to give more of understanding how they use the application and if it fulfils theirs needs. The answer will depend on if they have any experience to express but if they do, the participant can explain it in more depth about the application. As they provide more qualitative answers, they may be harder to analyse but they are vital to the research as it provides a more personal understanding instead of it being a very general view.

b) The time it takes to complete the questionnaire

As people in general lead a busy work lifestyle, it can be hard to get people to complete questionnaires that will take up a lot of their time. It is always best to keep it as short as possible as it will encourage more people to complete it. When a questionnaire is lengthy, participants do get fed up and as a result may not finish completing the questionnaire. Considering these factors, the

questions will be broken up into sections to make it seem it wouldn't take that long to complete. At the beginning of each section, background information will be needed to give the participant an understanding of the reason behind the questionnaire. This must be quick and easy to read so they can carry on with the questions. At the beginning of the questionnaire it will state that the questionnaire will not take longer than 5-10 minutes. It is believed that is a reasonable length of time as most of the questions are just ticking boxes. While checking over the questions, it was ensured they were short and simple and any irrelevant questions were removed so the questionnaire didn't waste any time.

c) The layout of the questionnaire

It was determined that the questions fall into 4 sections: general information, effectiveness and efficiency of the mock-up or similar application, satisfaction of the mock-up or similar application, calling GP surgery vs the Mock-Up/similar application. There is an overview at the beginning of each section why these questions are being asked and how they relevant to the research. There is roughly the same amount of questions in each section to make sure enough information is gained. The questions are not too similar, not too long and are mostly closed to allow for more participants to answer the questionnaire.

d) What platform to use for the questionnaire

There are many platforms to choose from, some need a small monthly fee or have 30-day free trial. When going through the options of the questionnaire makers on the google search engine the easiest option was to use Google Forms. It seemed the simplest to use due to the author already having a google drive account which meant it would be easy to access, and it is free to use all the time. It has a pleasant aesthetic professional look to the layout of the questionnaire which shows the questionnaire had taken time to create. Ensuring the questionnaire has a professional look is very important as if participants have seen you have taken time to create the questionnaire they may be more enticed to take the time answering the questions.

Requirements

To help with gathering the requirements, a heuristic evaluation on the application 'My Health Online' will be undertaken to see if the usability and functionality follows or violates Nielson's heuristics. This method will help influence the direction of requirements that need to be determined for the prototype. A Gap Analysis will also be conducted to see if there are any current gaps in the application, and how it can be improved for the patients.

Design and testing

For the design and testing phase, the prototype will be created on a prototype software that provides dynamic wireframes that can show what the application will look like and the functionality it will include. To help design the prototype before creating it, the creation of use cases and activity diagrams will be needed. The prototype will be evaluated to be able to find any improvements that need to be made.

3. Identifying the Needs of the Patients and GP surgery

Below is a snapshot of the conceptual model, it highlights the stage of researching into the needs of both the patient and GP Surgery. To be able to achieve this part of the conceptual model, interviews will be carried out.
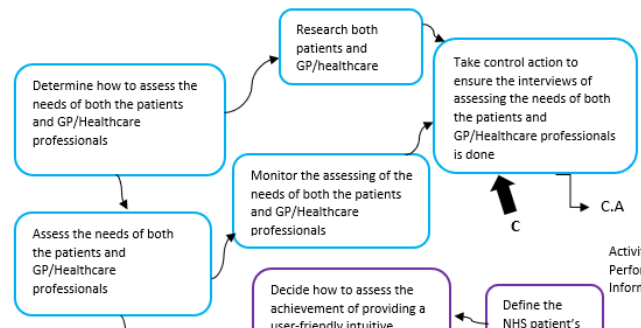
3.1 Interviews

Interview template

- Patient Interview

"This interview is to determine the needs of the patients and find out the issues in the current communication application called My Health Online. This interview will ask questions to a patient who uses the application My Health Online and has a good understanding of it"

Question 1: Do you have a My Health Online account?

This question was asked to find out if they have an account as the interview will not need to carry forward if the answer is no.

Question 2: How often do you need to go to the doctors?

This question was asked to find out what type of patient they are to see how they match against my personas.

Question 3: What do you mostly use the application for?

This question was asked to see why they use the application to see what it is mainly used for.

Question 4: Do you find getting a doctor's appointment for when you need it difficult on My Health Online?

This question was asked to see if its frequent for patients to find it difficult to book an appointment on the application to help with realising important changes that can be made to make the application meet the needs of the patients.

Question 5: Would you benefit from a more efficient online service to help booking an appointment at your GP surgery?

This question was asked to see if they require a better communication service or they think the communication they have now is sufficient.

Question 6: Would you benefit from having direct communication with your doctor?

This question was asked to see if patients need a messaging service with their actual doctor to talk about on-going problems or medication.

Question 7: Do you feel like your needs are satisfied by your GP surgery?

This question was asked to see how they feel about their GP surgery and whether how it runs is sufficient for the patient.

Question 8: How do you feel the communication between your GP surgery and you can be improved on this application?

This question was asked to see what comments the patients has and any improvements they feel are necessary for the communication in general which could be incorporated into the application.

Question 9: Is there any other information from your GP surgery you would find helpful to be stored on your account?

This question was asked to see if the patients would like their medical records being stored on their account so its easily accessible for the patient. That way they can see what the doctors are storing about themselves.

Question 10: Would you be willing to be contacted again to help in further research of my project?

This question was asked to see if they would be willing to help in further research that could be required later in the project.

- GP Surgery Receptionists Interview

"This interview is to determine the needs of the patients of a GP practice and find out the issues in the current communication application called My Health Online. This interview will ask questions to patients who uses the application My Health Online and has been using it for a while"

Question 1: Do you have many people on a regular basis wanting to sign up to My Health Online?

This question was asked to see if the application is popular and patients are wanting to get an account.

Question 2: Do you find your patients of the surgery get along with the system and find it useful?

This question was asked to see what their opinion is on patients using the application and see if they know how well they are getting on with it.

Question 3: Has it made any positive or negative impact to your surgery i.e. less phone calls coming in etc

This question was asked to find out their experience of the implementation of the application, knowing if it's going well or bad for them so far.

Question 4: Do you find the application easy to use on your end by uploading the prescriptions and doctor's appointments?

This question was asked to find out if the application is easy enough to use on their end or if its making their work load more difficult.

Question 5: What other features would you add to the application to help benefit you?

This question was asked to see what the receptionist would want added to the application to be able to make communication better and their life easier.

Question 6: Do you believe the application is benefiting the communication between your patients and GP practice?

This question was asked to find out their overall opinion about if they think the application is working for the right reasons.

Question 7: Do you have an opinion on the communication between NHS facilities and patients?

This question was asked to understand any feelings they have towards communication in the NHS to make sure they are covered in the new design of the interface.

Question 8: Do you think this application can be used anywhere else in the NHS?

This question was asked if they had any suggestions on what else the application could be used for as it could be considered in the design of the new interface.

Question 9: Do you receive any comments/feedback on the application?

This question was asked to see if their patients talk to them about the application and if they have any general comments about the application.

Question 10: Would you be willing to be contacted again to help in further research of my project?

This question was asked to see if they would be willing to help in further research that could be required later in the project.

3.2 Interview Analysis

<u>GP Surgery Receptionists Interview</u>

Interviews with two receptionists from different surgeries have taken place. They were both asked the questions that have been defined above. Please refer to the appendix to view the interview's responses. The interviewees have not been named, however below is their title and which surgery they work for.

Interviewee No.1 - Practice Manager from North Road Medical Practice

Interviewee No.2 - Practice Manager from Meddygfa Canna Surgery

Interviewee No.3 – Receptionist from St David's Court Surgery

Question 1: Do you have many people on a regular basis wanting to sign up to My Health Online?

All respondents have shown that 'My Health Online' isn't widely used in their surgery by stating that only a small amount of their patients is registered. The surgeries clearly do not advertise the application which would help inform patients on how they can perform their services online. The fact that not many patients are using the application, these surgeries aren't moving forward into our digitalised world. The surgeries need to advertise the application by communication through their receptionists/doctors and posters with the required details in the surgery.

Question 2: Do you find your patients of the surgery get along with the system and find it useful?

The respondents have shown good signs that the patients that are registered do manage to use it well with little trouble. This is a positive as it can influence other patients to use the application as they can see how well it is working for the others. They may have not been the best people to ask as two of the respondents aren't on the front desk of the surgery, so they may not get all the feedback fed back to them.

Question 3: Has it made any positive or negative impact to your surgery i.e. less phone calls coming in etc

The respondents haven't measured any of the impact on the surgeries, so it was a difficult question for them to answer. None of them had much to respond to this question, as they don't have many patients using the application it wouldn't even have made any impact yet. There needs to be a huge number of people using it to make a change. There is no indication the application has made a negative impact on the surgeries, so using the service more can only help the surgery. The same solution from question 1 of advertising the application would be beneficial to help make a positive impact to the communication of surgery.

Question 4: Do you find the application easy to use on your end by uploading the prescriptions and doctor's appointments?

As the staff would have had the required training it was useful to find out how they find it from the back end of the application. It was very clear from the respondents that they are happy using it and find it very easy to upload details onto their patients account. If the application wasn't simple to use they may be inclined to publishing it to their patients, this is useful information to know to ensure the receptionists get along with the application as it needs to benefit them as well as the patients.

Question 5: What other features would you add to the application to help benefit you?

Interviewee No.1 has made some good comments on what else the application can be used for. This would be useful additional features to add to make the application more effective as it would keep the patient informed on the status of their prescription. Interviewee No.2 suggested a more streamlined registration, this is a good suggestion as their process for registration in place isn't effective. The application is digitalising the surgery's services, but it contradicts itself by having to have the patient come into the surgery to register, this is something that should be offered online.

Question 6: Do you believe the application is benefiting the communication between your patients and GP practice?

Interviewee No.1 seemed happy to say it was benefiting the surgery, whereas Interviewee No.2 didn't answer the question with a yes or a no. The respondent replied with the only two tasks it can perform and what it can't do, the impression was given that it hasn't made any impact to the surgery yet. The application is making slow progress in these surgeries and needs to be improved to benefit them more. Interviewee No. 3 has made an interesting point of patients wanting to manually request their prescriptions, this is something that needs to change to show people the process is just as effective online.

Question 7: Do you have an opinion on the communication between NHS facilities and patients?

This wasn't an easy question for the first two of the respondents to answer, they didn't have anything to comment on the communication in the NHS. This question was asked to see if they had anything to add about the communication in general as it have could initiated something that could

be used in the application. Interviewee No.3 talked about the communication being an issue down to the language barrier, the system could offer a facility to translate the text into their language to ensure they can use it to the best of their ability.

Question 8: Do you think this application can be used anywhere else in the NHS?

Interviewee No.2 said a really good comment about using the application for hospital appointments too as that would make an improvement in the communication between NHS and their patients. Interviewee No.1 had nothing to add to this question, they believe the application is good for what it does at the moment. The hospital appointments would be a good feature to add into the application to help patients have their appointments in one place, it could ensure they don't book two appointments at the same time. Interviewee No.3 talked about it needing improvements before it could be used somewhere else.

Question 9: Do you receive any comments/feedback on the application?

Two of the respondents didn't have much to say to answer this question. This question was asked to see if they knew of any issues the patients are having with the application. Interviewee No. 3 just stated that their patients find it much more convenient which is the sole purpose of this application. There wasn't anything useful to use from this question that could be used further on the project.

Question 10: Would you be willing to be contacted again to help in further research of my project?

Interviewee No.1 wishes to not be contacted again whereas interviewee No. 2 and No. 3 was happy to help in further research for this project.

Patient Interview

An interview with a young patient has taken place. They were asked the questions that have been defined above. Please refer to the appendix to view the interview's responses. The interviewees have not been named, however below is their title and age.

Interviewee No. 1 – A 22-year-old student

Interviewee No. 2 – A 65-year-old an ex Diabetes Specialist Manager

Question 1: Do you have a My Health Online account?

The respondents have clarified they have an account, so they would be able to answer the following questions.

Question 2: How often do you need to go to the doctors?

Both respondents go to the doctors quite a few times in a year so would fully understand the communication they have with their surgery.

Question 3: What do you mostly use the application for?

The first respondent has indicated that the application isn't very useful to them at the moment and only on the odd occasion do they use it for an appointment due to needing an emergency one. This is something should be made online as then it would be more convenient, and more patients can

book an appointment at once. The second respondent seems to find it useful to them as they find it easy to book an appointment with a specific doctor.

Question 4: Do you find getting a doctor's appointment for when you need it difficult on My Health Online?

The first respondent has shown that they find it difficult to get an appointment when suits them due to their schedule. This interviewee has shown signs that are related to the persona 'Natalie' with needing emergency appointments. The patient needs to have a better experience of communication between themselves and the surgery. It is known calling the surgery at 8am for an appointment is always a challenge with everyone else trying to do the same thing. Another improvement that should be considered is releasing more appointments further in advance as the second respondent stated they find it difficult to plan in advance.

Question 5: Would you benefit from a more efficient online service to help booking an appointment at your GP surgery? E.g. the application offering emergency appointments etc

Both respondents seemed very fond of making this service available online, it would be a very effective feature to have implemented onto the application. This question is very useful to help in re-designing the interface as the respondents showed a positive response means it would be something that should be considered.

Question 6: Would you benefit from having direct communication with your doctor?

This first respondent doesn't need on-going communication with their doctor, they showed no interest in this feature being any use to them. This could be the case for most patients who don't see their doctor regularly but for some patients it could be needed, especially for the elderly as they go to the doctor a lot more on a regular basis. The second respondent believes it would be too much for the doctors as it would increase their work load.

Question 7: Do you feel like your needs are satisfied by your GP surgery?

Both respondents feel like they do have their needs satisfied, even if the appointment does clash with other priorities. As the over the phone service fulfils the needs of the patient it highlights it needs to be made a necessity for the application to do the same. The second respondent has shown that they haven't come across any major issues in their communication.

Question 8: How do you feel the communication between your GP surgery and you can be improved on this application?

The first respondent indicated that changes do need to be made to help improve the communication, this is something they showed passion in. As the respondent showed an interest in changes being made, means that other patients could feel the same. This helps push the project further knowing that changes do need to be made and the changes will be beneficial. The second respondent thinks a telephone is 48 hours isn't as effective, the application could include a feature where they can write a message and allow 24 hours to have a response.

Question 9: Is there any other information from your GP surgery you would find helpful to be stored on your account?

The first respondent gave a good comment on other data that could be useful to the patient, having their medical information stored on their account they can see what information is being stored about them. They could find it useful to know the names of the medicines that they know worked

and didn't work. The second respondent made a valid point about the data being protected, this is something that would need to be ensured to the patient as its high confidentiality information about patients being stored on the application.

Question 10: Would you be willing to be contacted again to help in further research of my project?

The first respondent wishes not to be contacted for further research in this project, but the second respondent is happy to help.

<u>Feedback and recommendations from the Interviews:</u>

<u>GP Interview</u>

1. The application isn't very well known

Recommendation: The app needs to offer more services to encourage more patients to use it

2. The application is not fully benefiting the GP surgery

Recommendation: Other services GP surgeries offer need to be integrated into this application.

3. There is room for changes on the application

Recommendation: Three changes that need to be considered is the registration process, emergency appointments and displaying hospital appointments.

<u>Patient Interview</u>

1. The needs are satisfied with the communication between the patient and surgery but not by 'My Health Online'

Recommendation: Consider making changes in what type of appointment patients can book on the application

2. Booking appointments isn't convenient on 'My Health Online' and they believe you can only make doctor appointments.

Recommendation: The application needs to offer more appointments for the patients and make clear that you can choose an appointment with a nurse or phlebotomy as well.

3. The application needs to be changed to suit the needs of more patients

Recommendation: The application could include emergency appointments and patient medical records on their account, so they know what information the surgery is holding about them

4. Analysing the Existing Communication Tools

Below is a snapshot of the conceptual model, it highlights the stage of assessing the existing communication tools. To be able to achieve the first part of this section, a questionnaire will be carried out on patients who have an account on the application 'My Health Online'.
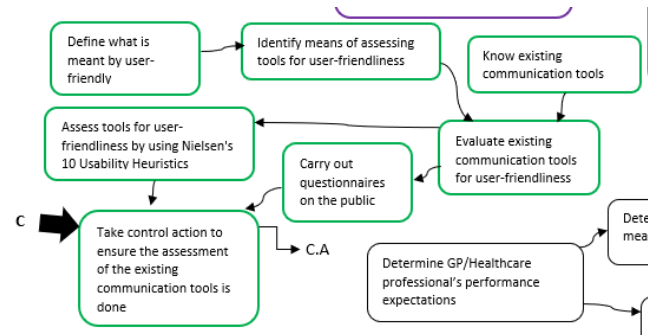
4.1 Questionnaire

The Pilot

Before handing out this questionnaire to the public, checking that it was direct and to the point was important to ensure participants fully completed the questionnaire. It was decided to create a pilot questionnaire to test it on a medical student at Cardiff University. A medical student was the best option as the questionnaire is on usability of the application and they have done placements in a GP surgery, so they have the necessary background knowledge.

The student said if he knew the application well enough he would have been able to answer this questionnaire very easily, the questions were all simple to understand. He recommended a few changes to my questions from open ended to close ended to ensure the participant gives a straight answer and doesn't go off topic.

As he said the questions are short and easy to understand, he had no suggestions on changing the questions because he felt they were good questions to ask to ensure enough information is collected effectively to help understand the usability of the application.

The Questionnaire

Please find attached PDF of the Usability of the Mock-Up Questionnaire.

Gathering responses

The target audience is very small and specific as the questionnaire is only useful to people who have an account on My Health Online and live in wales as it's a welsh application. It was mentioned to friends from University who commute from various areas around Cardiff, but everyone came back explaining that the family and friends had never heard of the application. The questionnaire cannot be made public to all as it wouldn't get many valid answers. Social media was made the targeted area of sharing the questionnaire as specific welsh groups can be found on Facebook to help find people with an account. A description and link to the questionnaire was posted to Facebook groups in Cardiff, Caerphilly and Bridgend to help gain more of an insight of people's opinions from different parts of wales. There were no issues publishing the questionnaire in these groups as they are open to the public, there was a page called 'Cardiff Chatterbox' which had a mixture of ages communicating on it and a few 'buy and sell' pages that brought in a few responses. After the

interviews, it was acknowledged that the hope of having patients answer the questionnaire in the waiting room wouldn't be sufficient due to the small number of patients using the application in a few surgeries in Cardiff.

With the wide range of the users that have been targeted, the responses will not be biased as they do not know the creator of the questionnaire and it will contain accurate information because to be able to answer the questionnaire they must know the application well. After sharing the questionnaire a few times, the users were given just over a week to respond before the author started their analysis.

4.2 Questionnaire Analysis

For the purpose of this project, below is a sample of questions being analysed that are useful and crucial to be incorporated into the prototype. Please refer to the appendix for the rest of the analysis.

Section 1: General Information
In this section, it will show the age ranges of who have an account on the application, how often they use and if they are reliant on it.

Question 1: What ages category do you fall into?

This question was asked to see what age range there is using the application, it was mutiple choice question so the respondents could select which category they fit into.
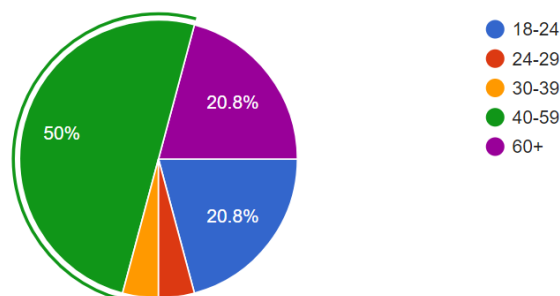
Figure 1: Age group of users

The results above show from 24 responses that 50% are in the age range of 40-59 years old. Each category has at least a few responses so throughout the questionnaire, a comparison can be made between how the younger generation find it to the older generation.

Section 2: Effectiveness and efficiency of the Mock-Up or similar applications
This section is finding out what you have used the mock-up or similar applications for and how easy you find it to perform those tasks.

Question 5: Have you struggled to book an appointment?

This question was asked to see how common it is for patients to have problems with booking an appointment, as this one of the main services it offers. If it struggles to perform that service, the effectiveness of the application is decreased. It was a closed question as it required a yes or no answer.

5. Have you struggled to book an appointment?

24 responses
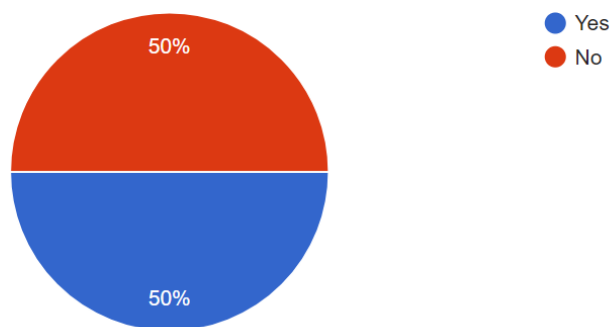
Figure 2: Have they struggled to book an appointment

The responses show 50/50 of patients struggling with this service, this shows there is an issue with the application that needs to be solved. Once again, different age ranges have struggled with booking an appointment.

Question 6: If yes to the question above, can you explain what you struggled with in particular?

This question was asked to find out from the previous question what the patient struggled with when trying to book an appointment as it is useful to know personal experiences to understand the improvements that need to be changed.

The responses were:

"Because none were available for two weeks."
"Availability of a specific doctor"
"I was informed by the Receptionist that they only release a few appointments for online booking."
"Lack of timely and available appointments"
"call the surgery when no available appointments are shown"
"Surgery failed to send login despite three requests"
"It crashed"
"I tried to book an appointment once, but the Dr whom I see on a regular basis wasn't even on the form. I had no idea who the other Dr's were. Since that time, I have never even tried to book an appointment or indeed do anything more using my "account". This can then lead to difficulty, as appointments must be made at 8.30am. When trying to contact my surgery even at this time, the phone is engaged. By the time I am able to get through, which could be about 8.45pm, I am told that ALL appointments have been taken. I questioned this system with a Male GP who I had to see urgently on one occasion. I was spoken to badly and reprimanded. Now I am scared of GP appointments."
"No availability shown, but was when I called"
"No free appointments for times or days I can get there"
"Appointments not available for my surgery. It's v hard to get an appointment"
"When on line no appointment available but one is available for the same time when phoning"

A lot of the responses are about the availability of appointments, this seems to be a constant issue with the application. The procedure of releasing appointments for surgeries needs to be changed to allow this application to grow. Appointments seem to be only available in 3-4 weeks in advance, cancelled appointments should then be released on the application to allow patients to book appointments that is in the next 1-2 weeks.

Question 8: Have you struggled with requesting a repeat prescription?

This question was asked to see how common it is for patients to have problems with requesting a repeat prescription, as this one of the main services it offer. If it struggles to perform that service, the effectiveness of the application is decreased. It was a closed question as it required a yes or no answer.

8. Have you struggled with requesting a repeat prescription?
23 responses
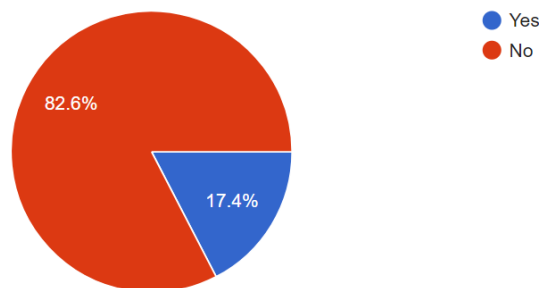
Figure 3: Have they struggled to request a repeat prescription

The responses show an 80/20 split of patients struggling with this service, some of the responses are invalid because if only 12 patients out of 24 have requested a repeat prescription so all the 23 responses can't be valid. Looking at the responses individually majority of the respondents that said yes in the question above answered no for this question. This service clearly has no major issues and seems to be working successfully.

Question 9: If yes to the question above, can you explain what you struggled with in particular?

This question was asked to find out from the previous question what the patient struggled with when trying to request a repeat prescription as it is useful to know personal experiences to understand the improvements that need to be changed.

The responses were:

"The system couldn't cope with the fact that I only need a repeat prescription every two month, whereas it was expecting a renewal once per month (I could take either one or two pills daily, and only took one - which doubled the length of time between prescriptions). The repeat option therefore fell out of the system because it thought I'd left it too long between re-orders."
"Shared care drug"
"The correct prescriptions are not always listed for me"
"Surgery didn't get my request, allegedly"

One patient has been told their request wasn't even received by their surgery, this could make patients not trust the application and will result in doing it the old way of writing out an order slip.

Once again, the application needs to be able to cope with different time lengths in repeat prescriptions as every patient has a different scenario.

Question 14: Are there other services that are missing from the Mock-Up that you need to call the surgery for?

This question was asked to see if there are anything they feel is missing from the application that could be implemented onto the application. This question was opened to the respondents to let them express their situation they feel needs to be online.

The responses were:

"No" (4)
"To book an appointment with the nurse for blood tests."
"Appointments for my children. They are 2 and 4 and I was told I can't use the system on their behalf and they can't have their own accounts as they don't have email addresses or sufficient photo ID."
"Could be helpful to access results online and advise surgery training days as this affects the 48 hours for a prognosis."
"Ability to log in"
"Nurse/phlebotomist/HCA appointments."
"Nurse + phlebotomist appointments."
"yes. I can only book one appointment so it's either with a doctor or the nurse, but I often need both, but it won't let me do this."
"Not for me"
"Don't know as I don't have faith in the application."
"my repeat prescriptions are limited"
"Test results"
"Only used for appointments & to check medication list"
There are very varied responses from the patients on their situations. Trying to book an appointment with Phlebotomist to have a blood test has become a common recommendation. This is an easy feature that can be implemented into the appointment search. There are some features that can't be changed regarding the response on "my repeat prescriptions are limited" as patients' needs to be re-assessed for the prescription. Regarding including children on the application is a feature that would be useful to investigate to see what the regulations are involved in that situation.

Question 15: Do you get given referral appointments from the GP to the hospital?

This question was asked to find out how often it is that patients get referred to the hospital, so the next question could be asked because if most patients don't the next question isn't valid. It was a closed question as it required a yes or no answer.

15. Do you get given referral appointments from the GP to the hospital?

24 responses
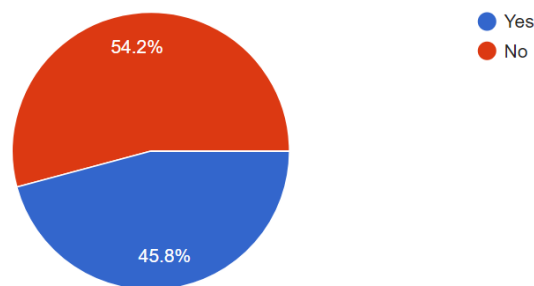
Figure 4: Do you get referral appointments to the hospital

The results show that is fair split of how many patients get referred to the hospital. It was a range of ages that answered yes to this question. As being referred to the hospital has been shown as a common action that is done in a GP surgery, the next question will be very useful in determining extra features that can be added to the application.

Question 16: If yes to the question above, would it be useful to you to have these appointments shown on the Mock-Up as well?

This question asked to get an idea of a new feature that could be added to the application. Depending on the responses from the previous question, it would determine if this question would be useful. It was a closed question as it required a yes or no answer.

16. If yes to the question above, would it be useful to you to have these appointments shown on the Mock-Up as well?

12 responses
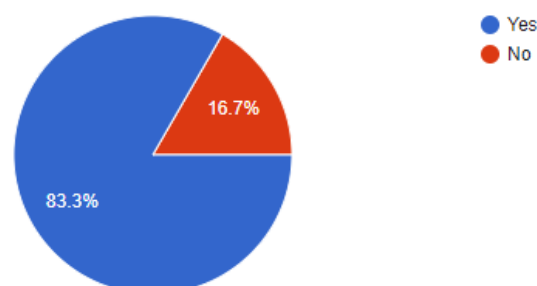
Figure 5: Would it be useful to include hospital appointments on the Mock-Up

This question had a good result of 80% of the responses answering yes to this question, which demonstrates a feature this application is missing. Patients feel this would be something that would be useful to the application. Including all appointments on one application can help ensure patients don't double book themselves and help make the application more effective.

Section 3: Satisfaction of the Mock-Up or similar applications
This section is about identifying issues with the interface itself when trying to perform the tasks.

Question 17: Do you like the layout of the interface? If No, why?

This question was asked to find out whether the patient finds the application appealing to them. The layout needs to be simple and clear to the patient's, so they can see where they can find all the services.

The responses were:

"Yes, it's clear" (8)
"No, it's old fashioned and clunky" (2)
"Yes, it seems easy enough to use (apart from the screen to search for an appointment, there seems to be a bit too much information). My current one is much easier to use."
"It's fine."
"It's horrible to use on a smartphone"
"Yes. Easy to understand layout."
"Not user friendly"
"no. I dislike the red writing warning you of missed appointments. It's not necessary to be so much in your face."
"It's ok not very inspiring quite old fashioned"
"Don't know - As I say I tried to use the form once, but that was enough to ensure that I never use the form again"
"No, ugly and confusing (looks very outdated)"
"The lay out is ok not cluttered but looks old fashioned"
"It's ok - manageable but not particularly intuitive"
"It's satisfactory"

There have been more responses stating that they don't like the layout, it is outdated and not user friendly. Very few patients do like the layout, they said that is easy to use and satisfactory. The elements of the layout should be changed to give it a more professional and modern look, the positions of features can be changed slightly to make it simpler to improve the many responses that don't like it.

Question 21: How easy was it to learn how to use?

This question was asked to see what their experience was like when they first used the application, if they found learning how to use it easy. This question could help decide whether the application needs to be made simpler for all patients to be able to use it. It was a closed question using a scale of 1 to 5 to help make it easier to analyse, 1 being difficult and 5 being easy

21. How easy was it to learn how to use?
24 responses
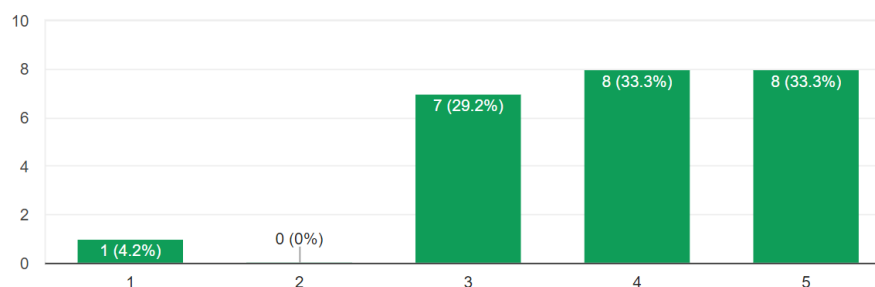
Figure 6: How easy was it to learn how to use

The responses show a good response of how patients find using the application as majority picked the number 4 and 5 which shows they do find it easy to use. There is always going to be someone who doesn't agree with technology and doesn't find it easy. It is hard to avoid this situation with our older generation not getting along with technology as well as the younger generation.

Question 23: Is there anything you would like added to the Mock-Up?

This question was asked to see if there are any other services the GP surgeries deal with that could be implemented onto the application. This question was opened to the respondents to see what their opinion is about which other services that could be useful to them online.

The responses were:

"No" (4)
"Yes, the "practice search" doesn't really work (you have to type something in before it'll give you a drop-down menu to search for). Also, it keeps asking me to retype my registration details because I seem to log into an old version of the site first, which then redirects me to an updated site (with a new login required)."
"Ability to make appointments for dependent children. Hospital referrals and appointments."
"Results"
"Somewhere to leave a comment e.g. if we need to request a prescription early."
"Various appointment types."
"Referral history"
"It's very simple and basic and I feel sure it could be upgraded without making it too complex to use."
"Nurse or HA or other HCP appointments"
"All the Dr's who work at the practice should have their names on the form"
"Ability to text communicate with GP surgery to book appointments"
"Test results"
"Appointments"

Responses have recommended that including hospital referral appointments, referral history and including various types of appointments. There is already a feature where it allows you to pick an appointment with a nurse but if there aren't any available appointments they would need to call the surgery. Including a feature of being able to leave a comment is a good recommendation because it would improve the communication between the GP and patient. These improvements should be considered in the requirements for the new design.

Section 4: Calling GP surgery VS the Mock-Up/similar applications
This section is about what you prefer to do when needing to use a GP service

Question 27: Have you ever struggled with the Mock-Up, so you result in calling the GP surgery?

This question was asked to see whether the patients have an issue with the application as a whole, because if patients are not succeeding with the application and call the surgery it demonstrates the application isn't fulfilling the needs.

27. Have you ever struggled with the Mock-Up, so you result in calling the GP surgery?

24 responses
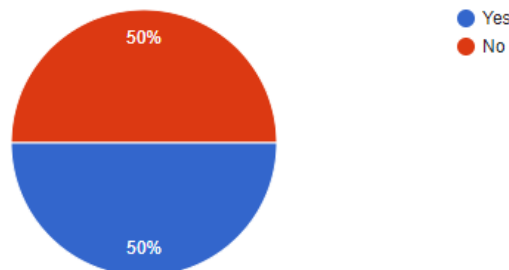
Figure 7: Have you struggled with the Mock-Up, so you result in calling the GP surgery

This outcome isn't the best for the application as it was a 50/50 split, that means that's a lot of patients that have struggled with the application trying to use one of the online services and failed. This demonstrates there is room for improvement on the application by making sure all those services provided can be fully completed by a patient. This application needs to benefit the surgery as well as the patient so if they are still calling the surgery, they will still have the same amount of calls coming in and work load to get through.

Question 28: If yes, could you please explain what you struggled with?

This question was asked to follow on from the previous question to find out what exactly patients have struggled with and their experiences on the situation.

The responses were:

"The system couldn't cope with the fact that I only need a repeat prescription every two month, whereas it was expecting a renewal once per month (I could take either one or two pills daily, and only took one - which doubled the length of time between prescriptions). The repeat option therefore fell out of the system because it thought I'd left it too long between re-orders."
"Making appointments for my children"
"Call the surgery when no available appointments are shown"
"Inability to log in"
"My browser believed the website was down. I called the surgery to check all was okay.
I can't recall the detail now, but I was timed out I think, and I had to contact the surgery to get back online."
"Getting the right prescription"
"The whole subject of accessing the form, only to find that when I eventually "got in" my actual GP was not named anywhere within the form. I was never given an answer as to why this was the case"
"Appointments" (2)
"Couldn't get into a/c, although I used account name & password I couldn't get in"
"Initial registration is unnecessarily complex"

Every response has talked about a different experience with trying to book an appointment, this application needs to be able to handle different scenarios if it's going to offer these services online. Not every patient has the same scenario when it comes to needing an appointment and repeat prescriptions.

Recommendations

Overall the responses were very useful to the research. The main areas that were picked up on in the answers will be used as recommendations, see below:

1. Include Hospital appointments in the prototype

2. Add new features into the prototype e.g. test results, leaving a comment on a prescription

3. Releasing more available appointments to allow patients to book one nearer the time and be able to have more of selection

4. Separate the professions on the search page as it isn't clear to the user that there are more options than selecting a doctor

5. Allows the system to be able to cope with different length of prescriptions

6. The interface requires a more modern, updated look as the respondents don't like the current layout

Reflection on design and data collection

Overall, the questionnaire went well, and the design was sensible for all the respondents.

Design

The questionnaire was designed appropriately for the audience. It was divided into 4 sensible sections to break the questions up for the respondents and it contained a brief description of what that section is about. There was a choice of open and closed questions to help keep the respondents interested as answering multiple choice questions are a lot quicker than writing short text answers. The questionnaire was quite long but no respondents seemed to have a problem with the length of time it took them to answer the questions. The open questions helped the respondents write about their opinions and experience to help the author understand more in depth of their situation. The closed questions were easier to analyse at the end as they were already made into a type of chart on google forms to view the results instantly.

The most important questions were made 'required' to ensure the respondents didn't skip most of the questions. The questions at the end included a 'other' option to allow them to express any other way they perform these services instead of going to the surgery or using 'My Health Online'. The questions were never long so they were quick to read, and the multiple choice was never more than two options apart from the age question. The question itself were in plain English so all the respondents understood, and the author never used any ambiguous words.

Data collection

The process of collecting the data could have gone much more smoothly, the mistake made was not knowing where to share it to get user's responses. Searching for places to publish it was a slow process. It was shared on a few Facebook pages as that was the easiest place to reach people. This was the main place where majority of the responses came from as they would get a notification when the questionnaire was posted in the groups. The author tried to target the groups that had many members to increase the chances of more responses. The questionnaire was published on a community website called Next Door which helped gained a few responses around the author's living area. The target audience is very small and was difficult to find as a small percentage of people

use the application in and around Cardiff, there wasn't much hope going into surgeries and asking people in the waiting room.
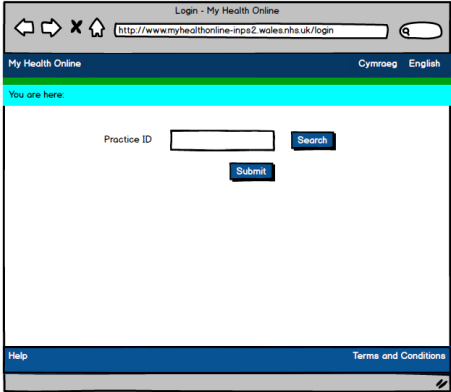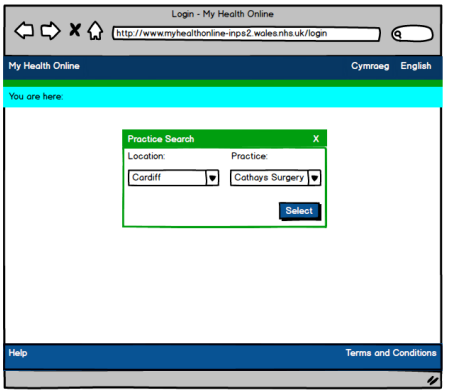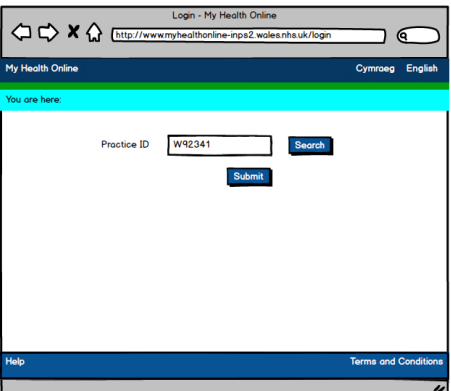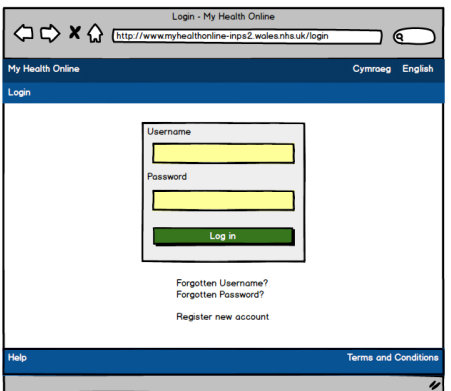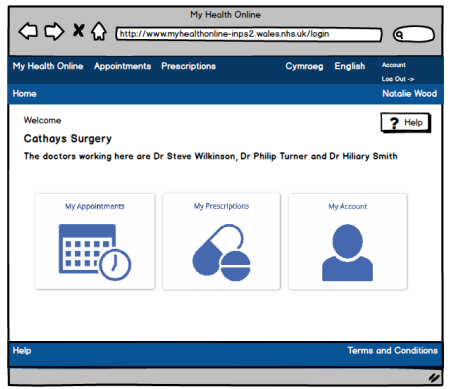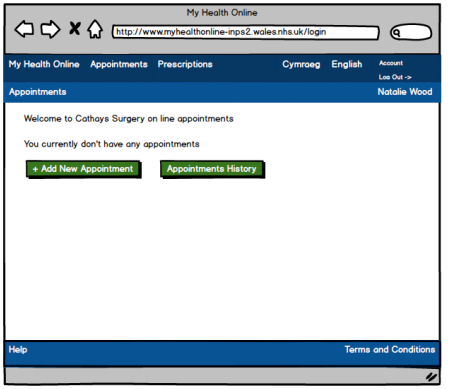
It took a while to gain responses, the questionnaire was shared a few times on the Facebook groups at times when people would be at home and have the time to answer the questionnaire. They slowly added up and overall the questionnaire got 24 responses, if the author found more places to reach users of the application much sooner the number of respondents could have been a lot higher.

5. Evaluating the Existing Communication Tools

To investigate the functionality and usability of 'My Health Online', an analysis needs to be carried out. A heuristic evaluation was chosen to discover the problems within the application and the features that need to be carried forward as they are effective in the application.

Due to being unable to use the screenshots of the application 'My Health Online' because of ethical reasons a Mock-Up of the application has been used. It was created on 'MyBalsamiq' which is a wireframe tool that is used on the internet. Below are the states of the application that will be analysed throughout the rest of the project.

The Mock-Up

State #1 - Practice ID Page	State #2 – Search for Practice Page
State #3 – Found Practice Page	State #4 – Login Page
State #5 - Homepage	State #6 – Appointments Page

State #7 – Searching for An Appointment Page	State #8 – Appointments Booked Page

State #9 – Appointment History Page	State #10 – Prescriptions Page

State #11 – Confirming Prescription Page	State #12 – Accounts page
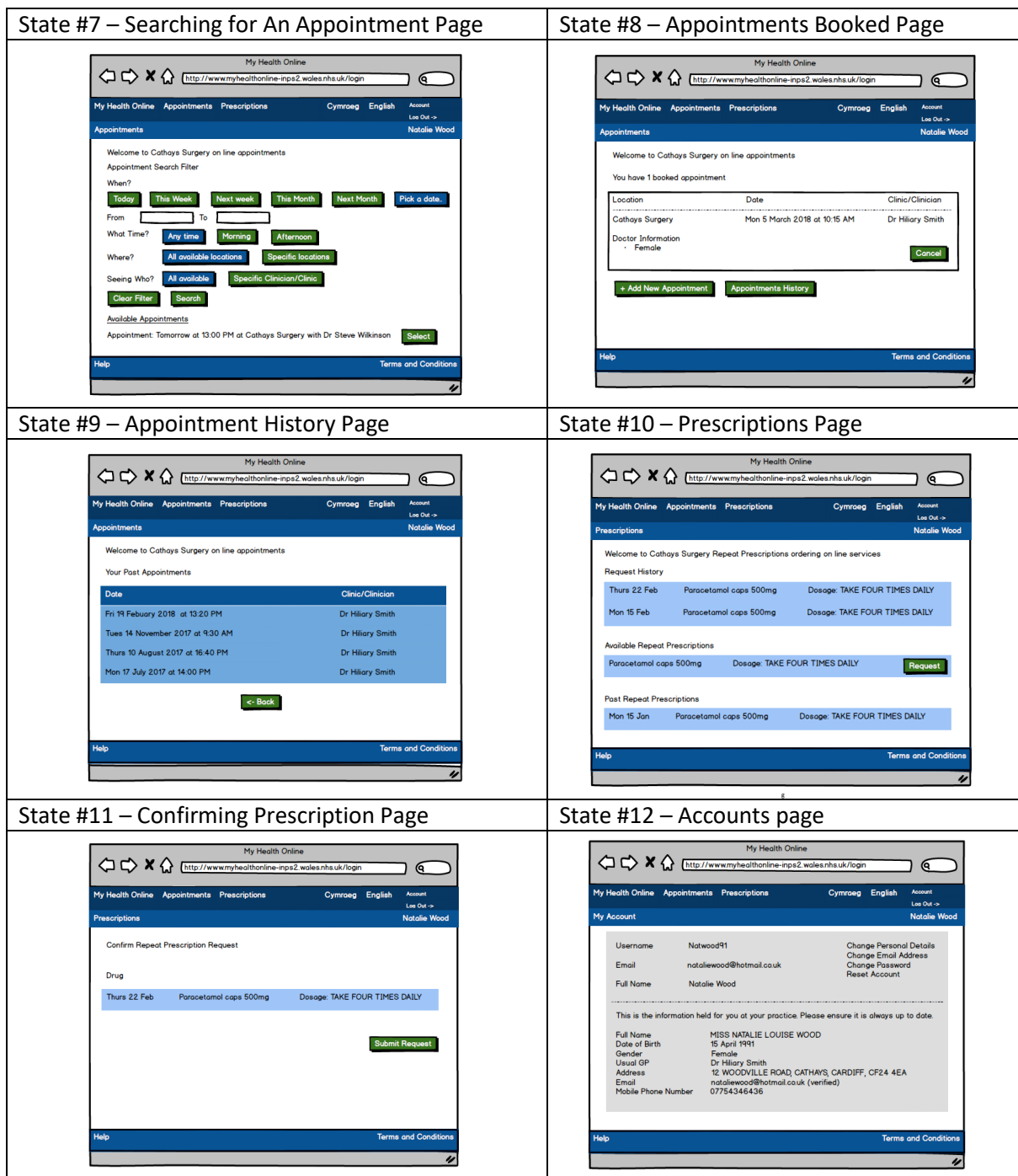
State Transition Networks

The Use Cases for the STN's can be found in the appendix. The have been created to show the three main tasks of the application 'My Health Online'. The diagrams are useful as they show how a task is carried out and the flow between the stages. These are the different states the system can be in during the process of performing a task. Comparing the STN to the Mock-Up you can see the visual flow of each STN and see how a user would perform a task.

STN of booking appointment:
Refer to states in the Mock-Up - #1, #2, #3, #4, #5, #6, #7, #8

First flowchart (Appointments):

Open application on the browser → Click "Search" → Drop down list of surgeries displayed → Click on an area and surgery → The Practice ID is put into the text box → Click "Submit" → Log in page is displayed → Type in log in details and click log in → Homepage is displayed → Click "My Appointments" → Appointments page is displayed → Click "Add new appointment" → Appointments search page is displayed → Select relevant criteria and Click "Search" → Appointments is displayed at the bottom of the page → Click "select" on an appointment → Appointment is displayed on the appointments page

STN of requesting a repeat prescription:
Refer to states in the Mock-Up - #1, #2, #3, #4, #5, #10, #11

Second flowchart (Prescription):

Open application on the browser → Click "Search" → Drop down list of surgeries displayed → Click on an area and surgery → The Practice ID is put into the text box → Click "Submit" → Log in page is displayed → Type in log in details and click log in → Homepage is displayed → Click "My Prescriptions" → Prescription page is displayed → Click "Request" on the prescription the user needs → A confirmation page is displayed → Click "Submit" to confirm → The prescription request is displayed on the prescription page

STN of accessing account details:
Refer to states in the Mock-Up - #1, #2, #3, #4, #5, #12
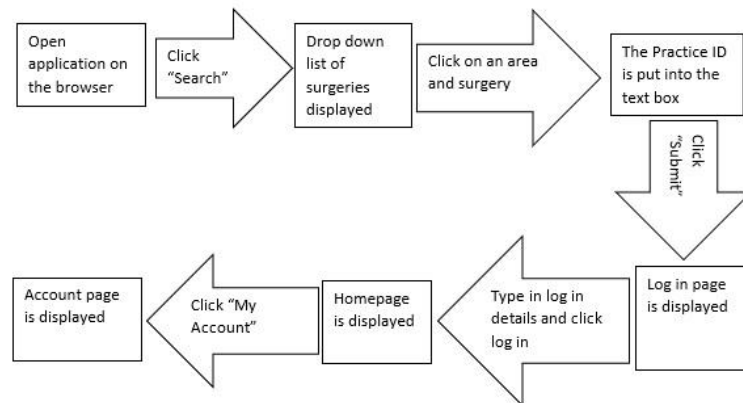
5.1 Heuristic Evaluation

Below is a snapshot of the conceptual model, it highlights the stage of assessing the existing communication tools. To be able to achieve the second part of this section, a heuristic evaluation will be carried out on the application 'My Health Online' to identify any issues.
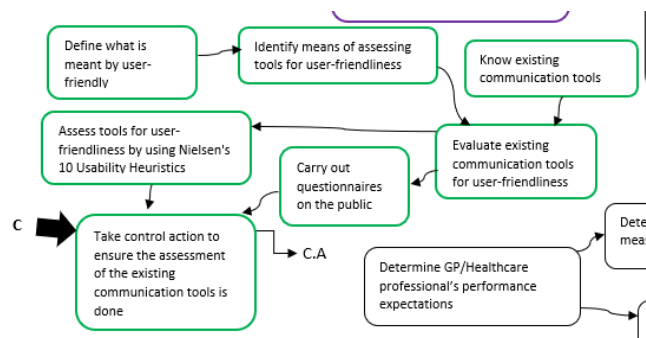
Introduction

This is a heuristic evaluation of the application My Health Online. It will evaluate each use case of the critical tasks of the application. It will be looking at the usability and functionality of the application to see how easy and clear it is to use for patients. This evaluation is also used to identify any problems for the user when using the application for one of the main tasks. The main goal of this heuristic evaluation is the "finding of usability problems in an existing design (such that they can be fixed)" [11].

The heuristics evaluation technique

The heuristic evaluation technique involves going through each individual state of the application. This is done to identify any advantages and disadvantages of each screen that has been used in the STN's. It has been decided to use Nielsen's 10 usability heuristics to be able to compare each state to those heuristics. If they comply with each heuristic it will show an outstanding design that is usable by a user. If it doesn't comply with each one, it can identify problems and ways to improve them. These usability heuristics are listed in the table below:

The 10 Usability Heuristics for User Interface Design [12]:	
1	Visibility of the System Status
2	Match between system and the real world
3	User control and freedom
4	Consistency and standards
5	Error prevention
6	Recognition rather than recall
7	Flexibility and efficiency of use
8	Aesthetic and minimalist design
9	Help users, diagnose, and recover from errors
10	Help and documentation

If problems are identified in the application, the problem will be rated out of 5. This helps establish whether the problem is severe or not for the usability of the application. Rating the problems helps to prioritise which problem needs to be solved first. The severity rankings are 1 to 5, 1 being the least severe and 5 being the most severe. In the table below the rankings are explained:

1	A problem that doesn't affect the user using the application but violates a heuristic.
2	A usability problem that is rarely encountered throughout the application, so it can be easily fixed.
3	A usability problem that occurs frequently throughout the application and makes it difficult for the user to use.
4	A major problem that causes inconvenience to the user, makes it harder for the user to use so needs to be solved immediately.
5	A problem that needs to be fixed as soon as possible as it makes the application unusable for the user.

Next step is to give the problem a rating for an ease of fixing. This works similar to severity ranking but instead it's out of 4, 1 being the easiest to fix by a simple solution and 4 being the most difficult to fix by a more complex solution. This ranking emphasises whether if it difficult or not to fix the identified problem. These rankings are explained in the table below:

1	Problem is quick and easy to fix as it doesn't happen frequently.
2	Problem is easy to fix and doesn't take long to solve.
3	Problem involves multiple aspects of the application, so it requires a more in-depth solution.
4	The problem is very difficult to fix and will require a lot of time and effort to find a solution.

Heuristics evaluation results

The evaluation has carried out on the application 'My Health Online'. This will be evaluated using Google Chrome on a personal laptop.

For the purpose of the report, the tables of the problems and good implementations will be included. The rest of the evaluation can be found in the appendix, where you can see the details of the table in full.

Problems with the Application

After going through the prototype with the heuristic evaluation, 4 problems were identified that affect the usability of this application. Each of these problems they have been given a severity ranking and ease of fixing, so it is clear where priority needs to be taken on fixing these problems.

Problem Number	Problem	Severity Ranking	Ease of fixing	Heuristic Number	States affected
1	Can't login when using the practice ID	5	2	4 & 5	State #4
2	The two-blues used in the colour scheme are too similar	4	2	7	All States
3	The account navigation button being on the other side of the page	1	1	4 & 7	State #5 to State #12
4	There is no message to recognise a search for an appointment has been carried out	3	2	1 & 5	State #7

Good implementations with the Application

in the table below, 4 good implementations have been identified, it demonstrates good usability in the application by showing which heuristics have been honoured.

Good implementation number	Good implementation	Heuristics honoured
1	Good contrast with the text and background	• Aesthetic and Minimalist Design • Recognition Rather Than Recall
2	The layout is consistent throughout	• Help and Documentation • Recognition Rather Than Recall • Aesthetic and Minimalist Design
3	The help assistance on the application	• Help and Documentation
4	The text and buttons are a sensible size for their whole audience	• Aesthetic and Minimalist Design • Consistency and Standards • Match between System and the Real World

5.2 Requirements Evaluation

The application 'My Health Online' was created to digitise services in a GP surgery to help create requesting prescriptions and booking an appointment more convenient to patients. The application does have room for improvement.

Features relevant to the project:
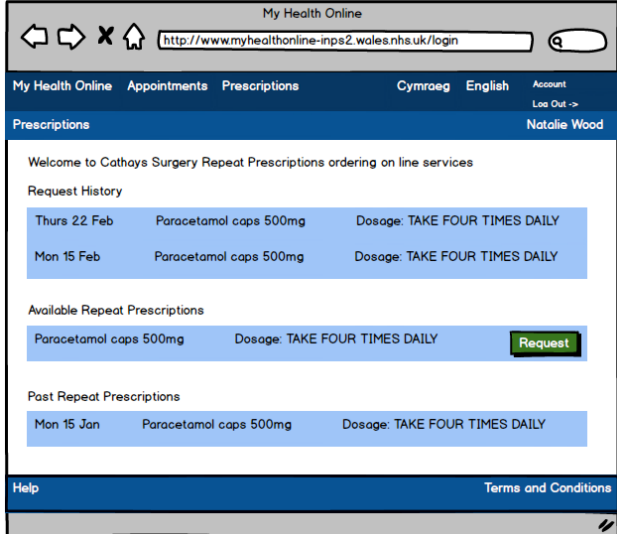
- Ability to book an appointment
- Requesting a repeat prescription
- Viewing your account details
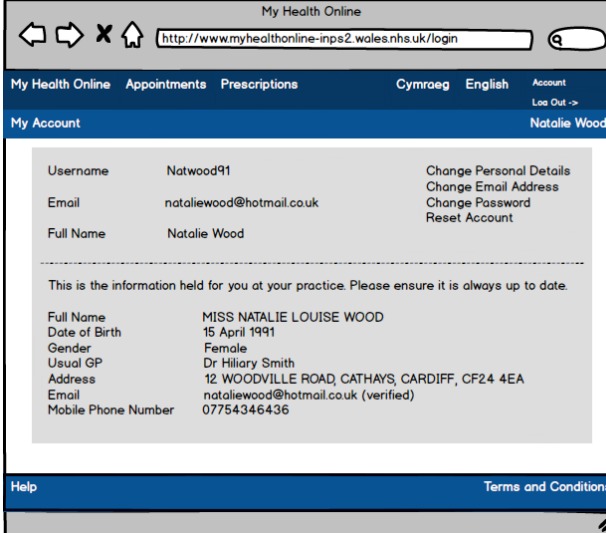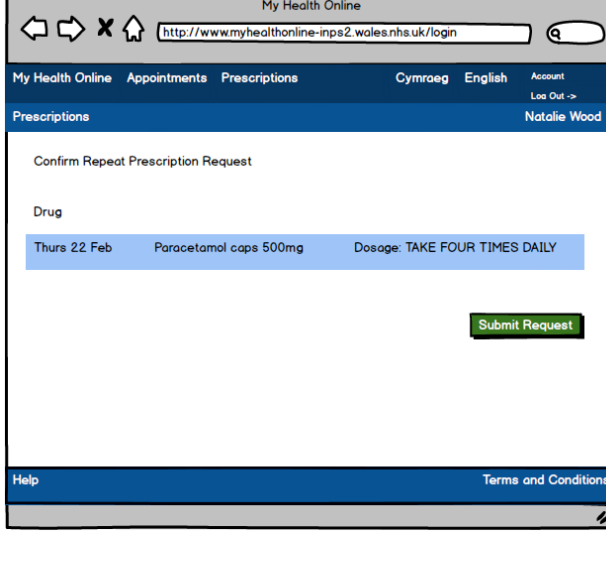
An evaluation of the application 'My Health Online' requirements will be undertaken using the method called MoSCoW. This method is used to identify the priorities for each requirement that is going to be defined for the interface for the application. MoSCoW is seen as "a prioritisation method" that is "used to decide which requirements to complete first, which must come later and which to exclude" [13].
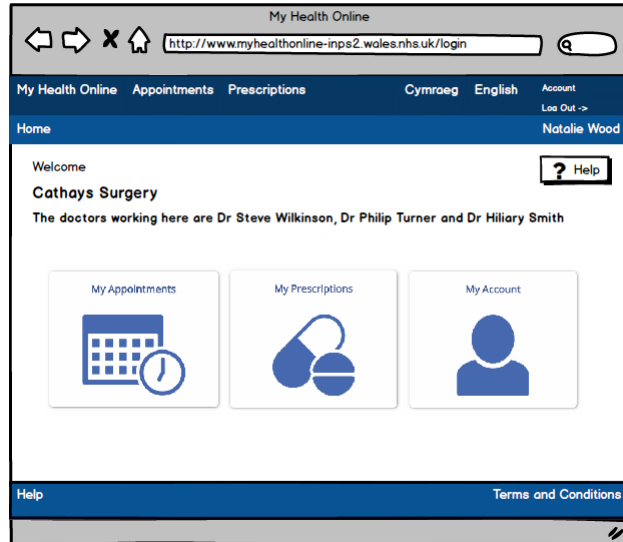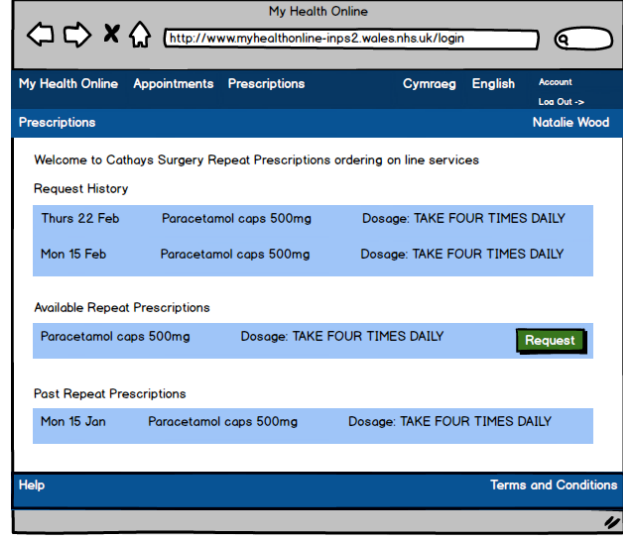
MoSCoW stands for must, should, could and would:

- **M** – the application <u>must</u> have this requirement to meet the patient's needs
- **S** – the application <u>should</u> have this requirement if possible, but application's success does not rely on it
- **C** – the application <u>could</u> have this requirement if it does not affect anything else on the application
- **W** – the application <u>would</u> like to have this requirement later, but delivery won't be this time

Function	MoSCoW	Justification	Adaptations needed	Supporting evidence
Booking an appointment	Must have	Being able to book an appointment is a crucial feature to the application for the project. From the questionnaire there was 70% of the respondents who use an application to book an appointment which shows it is a service that is used. The service is there for convenience to allow people who work the opening hours of GP surgeries to be able to book an appointment when it suits them. This is the main service GP surgeries offer and it would reduce the work load for the receptionists.	In order to be able to book an appointment more needs to be released on the application to allow patients to book the appointments. It offers all the right search criteria to book an appointment but most of the time it alerts the patient there isn't any available appointments. This makes the patient phone the surgery instead, this is not helping it being used to its full potential. It is important this application includes available appointments with the other health care professionals i.e. phlebotomy, nurse or health care assistant.	

| Requesting a repeat prescription | Must have | A repeat prescription is a process that normally involves you going into the surgery to put in your order for the prescription and collecting it. Offering the service online is much more convenient and a quicker process. From the questionnaire 54% of respondents do use this service on an application, it isn't as used much as booking an appointment but still an important service the GP surgery provides. At the moment processing a repeat prescription it is time consuming whereas having it digitised will make the whole process much more efficient. | The process of requesting a prescription seems to be working well as it is stated in the questionnaire. Changes will need to be made as there was one comment from the questionnaire about how the application struggles with different lengths of prescriptions which is an issue. All patients are different, and it needs to be able to handle a patient only needing the prescription at different times i.e. the patient needed their prescription every two months. | |

The user viewing their account details	Must have	The user needs to be able to view details that are being hold about them on their account. It can offer a service to allow the patients to change any details they need too, it is efficient doing it on the account instead of going into the surgery. From the questionnaire 80% of respondents agreed they didn't experience any problems while trying to change their details.	The application displays a clear page displaying personal details about the patient. It is safely stored on their account and includes links to be able to change the details if need be. This is much convenient than going into the surgery. The question in the questionnaire asking if they found changing their details easy and majority said it was straightforward.	
A reminder for a review	Should have	The application at the moment doesn't alert patients when they are on their last prescription and is due for a review. This would be a good reminder to have as it allows the patient to be prepared by booking an appointment when they would need their next prescription. In one of the interviews it was mentioned to include this feature in the application. It would allow the patient to be kept in the loop of the status of their prescription.	Looking at the screenshot on the right-hand side, this is the page that should display this reminder as it's the opportunity to alert the patient that this is their last dosage on this prescription. This would be the easiest place to display the message, so they can go book their appointment while on the application.	

Ability to change the language	Should have	In this country, English is not everyone's first language and it can create quite a few communication barriers. In one of the interviews, one of receptionists mentioned the language barrier they experience as their patients speak different languages. Allowing patients to change the language will let them be able to understand the application a lot more.	At the moment the application allows you to read the text in English or Welsh. There needs to be other languages on offer due to the increase of other languages spoken in the country. A simple feature added to the log in page to allow the patient to change the language can allow them to use the application to their best of their ability.	
Communication with their doctor	Could have	Doctor's surgeries at the moment offers a service that allows you to request a phone call which can take up to 48 hours. After a prescription is issued it would be useful for the patient to be able discuss any issues with the doctors immediately instead of waiting for an appointment. From an interview it was mentioned by an interviewee to include this feature as they stated it would be a lot more useful.	When requesting the prescription there is a feature to allow you to write a comment to the GP surgery but there isn't anything for after you have requested the prescription. Accessing a page by clicking on the prescription can direct the user to a comment box where they can write what they need to tell their doctor, within 24 hours they will have a response from their doctor.	

6. Defining Requirements

6.1 Gap Analysis

This section is about determining whether the system's requirements are being met, it will propose the functional and non-functional requirements for the new design of the interface. These requirements will be based upon the research that has been carried out throughout the project including the interviews, questionnaire and heuristic evaluation of the application 'My Health Online'. Performing a gap analysis "involves working out the size of the strategies needed to move an organization from its current state to a desired, future state" [14]. In this Gap Analysis, the recommended requirements will be compared with the application 'My Health Online' and the manual system of how the services are still carried out in the surgery. The requirements will be separated into two categories that are the functional and non-functional requirements. Functional requirements tend to specify something the system will do and its behaviour. Whereas a non-functional requirement describes how the system should work and how it will behave. These requirements will be divided into different categories to allocate the requirements to the task it is improving in the application. The priority section of each requirement will contain either 'Essential' or 'Desirable'. The 'Essential' requirements are those that must be carried out to ensure the application reaches its full potential and the 'Desirable' requirements are those that would be effective to have implemented into the design if possible, but without following these requirements would not affect the condition of the application.

Due to its size, the full gap analysis can be found in the appendix. A sample from each requirement category is provided below.

Sample 1: General Application Requirements

ID	1.1	
Requirement	The application must include an application form for the patient to sign up	
Justification	In the interview analysis it was a recommendation from one of the interviewees to create a more streamlined registration because at the moment the patient must attend the surgery to sign up	
Acceptance Criteria	The system should provide an application form to fill in the relevant details that could be confirmed by the GP surgery, this will save patients having to go into their surgery to register	
Priority	Desirable	
My Health Online/Manual System Compliance	My Health Online is not compliant. It currently lets you register once you have your registration form from the surgery	The manual system is compliant. The patient can walk into the surgery and manually fill out a registration form to get an account

Sample 2: Booking appointment requirements

ID	2.3
Requirement	The application needs to alert the user a search for an appointment has been carried out

Justification	Alerting the patient on the status of the system is important, it isn't clear the search works as there is no indication it has been carried out	
Acceptance Criteria	An alert message will appear to the user stating that the search didn't find any appointments that match their criteria, otherwise all available appointments will be displayed on a new page	
Priority	Essential	
My Health Online/Manual System Compliance	My Health Online is not compliant. There is no alert message indicating to the patient the search has been carried out	The manual system is compliant as they have more appointments on their system, the receptionist goes through the available appointments with the patient

Sample 3: Requesting repeat prescription requirements

ID	3.2	
Requirement	The application needs to be able handle different lengths of repeat prescriptions	
Justification	In the questionnaire, a respondent stated about their prescription not working due to it can handle the length of the repeat prescription of being every two months instead of one month. Not all prescriptions are the same and it should be able to handle different scenarios.	
Acceptance Criteria	Not all patients need a new prescription once a month, depends on their daily dosage to when they run out. On the prescription page, the prescription will include the length of how long the prescription will last	
Priority	Essential	
My Health Online/Manual System Compliance	My Health Online is not compliant. It allows a standard a repeat prescription of length of a month	The manual system is compliant as the patient can order the prescription when they do need it as they have the order slip

Sample 4: Non-functional Requirements

ID	4.5
Requirement	The interface needs to be consistent throughout
Justification	The layout needs to stay be consistent to make sure it's easy to use. In the questionnaire there was a mixture of how easy it is to use. The layout needs to be clear and used throughout the application to make patients find it easy to learn how to use. It will help it abide by the Nielson's heuristic of 'Consistency and Standards'.
Acceptance Criteria	The interface should have the same layout throughout all the pages of the application and all the required buttons are placed in the same position
Priority	Desirable

6.2 Gathered Requirements

Below are the final requirements that have been defined for the prototype. They have been based on the gathered research throughout the project to ensure these requirements will improve the communication of the application.

1. General application requirements:
1.1 The application must include an application form for the patient to sign up
1.2 The application must comply with the Data Protection Act
1.3 The application should lead straight to the log in page
1.4 The navigation menu buttons need to be grouped in one place throughout the application
1.5 The application displays hospital referral appointments from the NHS e-referral service
1.6 The application should include a feature to access waiting test results
1.7 The application should include a feature to access previous prescriptions
1.8 The application should include a feature that allows you change the language of the text
1.9 The user can only log in with the correct log in credentials to gain access to their account
1.10 The application should include a help feature throughout the different tasks
1.11 A log out button should be included on every page when logged into the user's account
1.12 Patient's medical details from their account and available appointments at the practice will be uploaded to the system GP connect
1.13 The application will be implemented using the programming language Java

Booking appointment requirements:
2.1 The application should separate the professions into Doctors, Nurses, HCA and Phlebotomists
2.2 The application should include a process to book an emergency appointment
2.3 The application needs to alert the user a search for an appointment has been carried out
2.4 The application needs to release more available appointments in the next 4 weeks
2.5 The application should allow the user to cancel either a GP or hospital appointment

3. Requesting repeat prescription requirements:
3.1 The interface should include a feature to allow you to leave a comment on the prescription that will be responded to within 24 hours
3.2 The application needs to be able handle different lengths of repeat prescriptions
3.3 The application needs to alert the patient when they need to book an appointment for a review on their prescription
3.4 A confirmation page is displayed to confirm the prescription the user is requesting

4. Non-functional functional requirements:
4.1 The interface needs to have an appropriate colour scheme
4.2 The interface must be user-friendly and easy to navigate
4.3 The applications data must be encrypted always
4.4 The application should run error free
4.5 The interface needs to be consistent throughout
4.6 The text and icons need to be large to allow all users to read them

7. Solution Design

Below is a snapshot of the conceptual model, it highlights the stage of providing a user-friendly, intuitive interface design to help satisfy the patients. To be able to achieve this part of the conceptual model, a prototype will be designed using the gathered requirements to demonstrate a new improved version of 'My Health Online'.
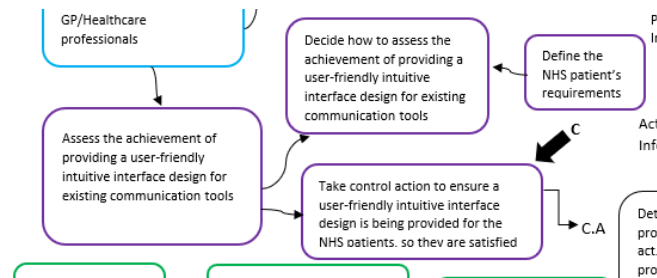
The interface of the application can now be designed using the defined requirements above. A prototype shows the fundamentals of the design and gives an insight into how it will work, "by developing a working prototype, you can demonstrate the functionality to help solidify requirements for the final design" [15]. The prototype of the design will be made up of interactive wireframes using a software called Axure [16]. Axure was chosen because it is aimed at desktop applications and can create powerful interactive wireframes with a professional look. Axure allows you to create designs any size which is ideal for this interface as it needs to be able fit a computer screen due to the focus of this project is it working effectively on a desktop.

Application User Flow
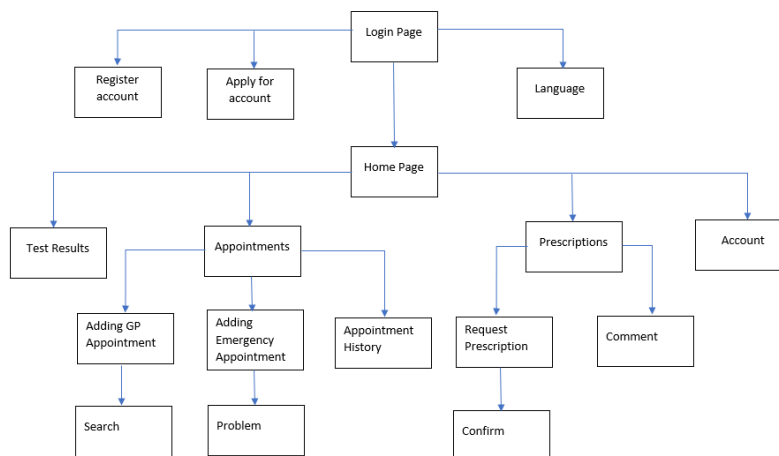
7.1 Interface Design

The design of the interface is a crucial part of the application to allow users to be able to use the application effectively. It must follow the defined requirements to help improve the communication between a patient and GP. The interface needs to be user-friendly to allow different ages to be able to use it.

Wireframes

Wireframes will be designed in Axure. They will present the user with a visual idea of what the application will look like.

Activity diagrams

The activity diagrams will be made in this word document. They present the flow between the wireframes to be able to complete a task, this allows the user to understand how the wireframes will work together and they can see the interactive side of the design.

Use Cases

Use Cases will be created to help determine the step by step process of the main tasks on the application. The use case will help determine the pre- and post- conditions that are important to performing that task, as well containing the different flows that can be taken to perform a task.

1. The user login

The Login page is where the user can log into their authorised account they have registered to enable them to use the application. The user must have registered their account before they use it for the first time.

Wireframe
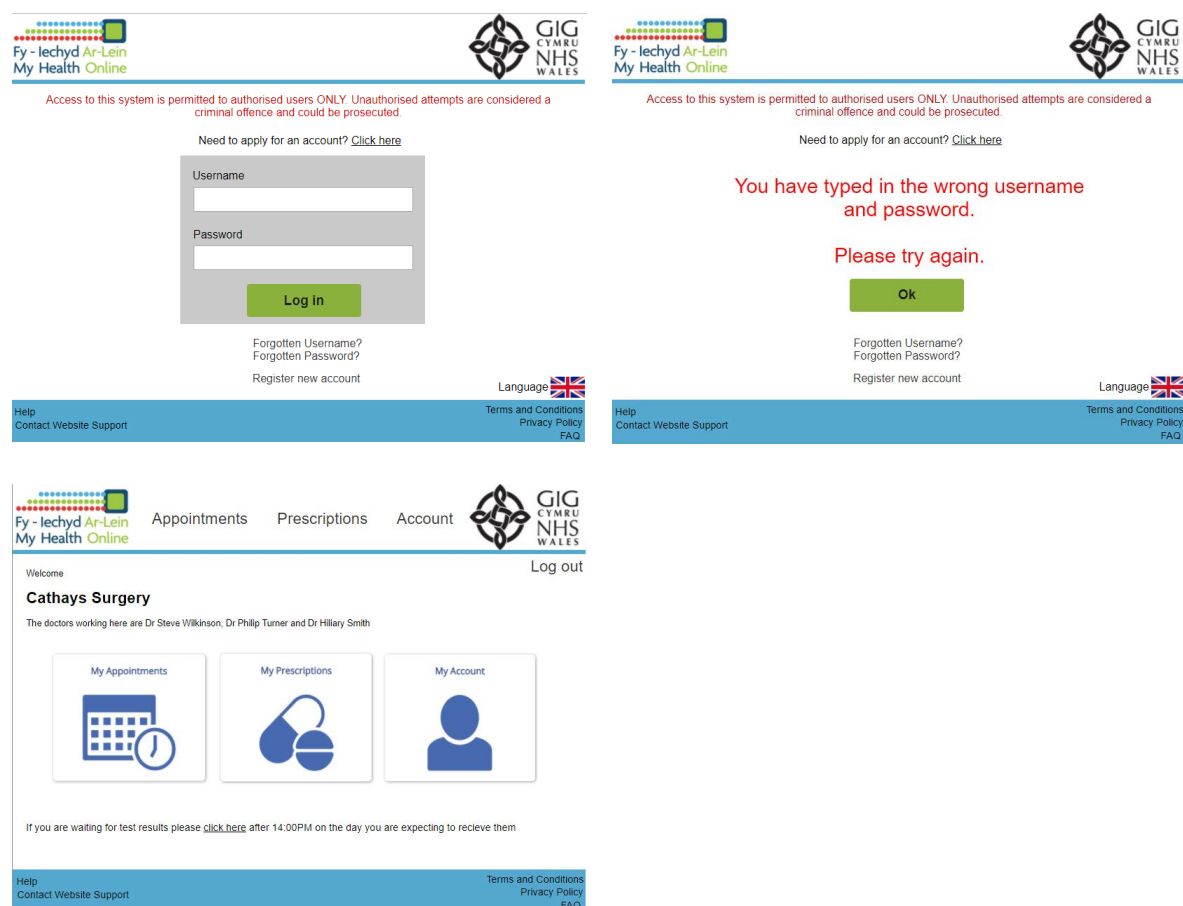
Figure 8: Logging into the user's

<u>Activity Diagram</u>

```
                    ●
                    │
                    ▼
      ┌──────────────────────────┐
      │   User opens log in page  │
      └──────────────────────────┘
                    │
                    ▼
      ┌──────────────────────────┐ ◄──────────────────┐
      │    User enters username   │                    │
      │       and password        │                    │
      └──────────────────────────┘                    │
                    │                                   │
                    ▼                                   │
      ┌──────────────────────────┐                    │
      │      User selects Login    │                    │
      └──────────────────────────┘                    │
                    │                                   │
                    ▼                        ┌──────────────────────────┐
Check the user's  ◇───────────────────────►│ The application provides an│
details are valid                           │       error message        │
                    │                        └──────────────────────────┘
                    │ Yes
                    ▼
                   ◉          User is gained access and is
                              directed to the homepage
```

<u>Use Case</u>

Use Case Name:	The user logging in
User type:	Patient
Description:	The user will use this page to their username and password to access their account
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user will open the application 2. The user types in their username in the correct text box 3. The user types in their password in the correct text box 4. The user clicks 'Log In' to submit the details 5. The user has gained access to their account and is directed to the homepage
Alternative flow 1:	1. The user will open the application 2. The user types in incorrect username/password in the text boxes 3. The user is displayed with an error messaging informing them they have entered incorrect details 4. The user re-enters their username and password 5. The user clicks 'Log In' to submit the details

	6. The user has gained access to their account and is directed to the homepage
Post-conditions:	The user is directed to the homepage and has access to their data.

2. Apply for a new account

This form is accessible to anyone who's surgery is registered on the application, it allows the patient to send the form off online instead of going into the surgery to fill it out and it can be confirmed by the surgery on their system.

Wireframe

Figure 9: Apply for a new account

Activity Diagram
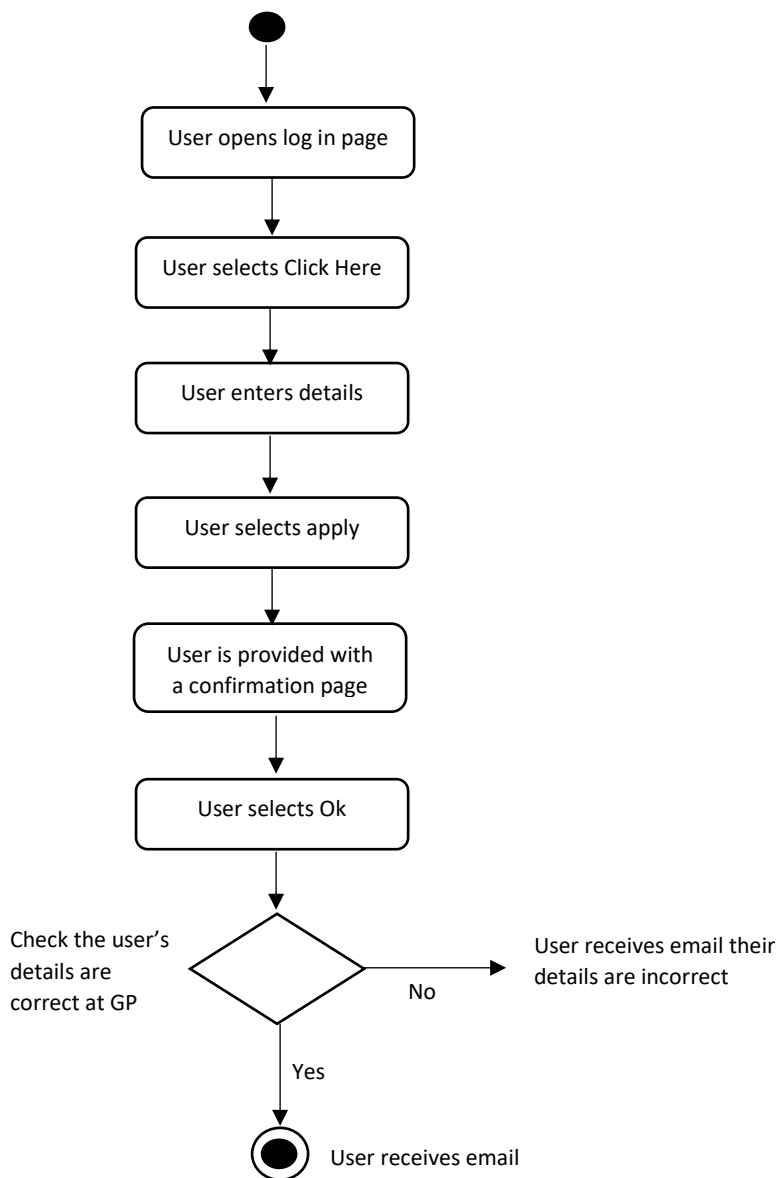
Use Case

Use Case Name:	The user applying for a new account
User type:	Patient
Description:	The user will need to apply for a new account before they can register the account, so the GP surgery has the required details to create one
Pre-conditions:	The user will need to be able to access the start-up page
Basic flow:	1. The user press 'Click Here' where is says apply for a new account 2. The user types in their correct details in the form 3. The user clicks 'Apply'

	4. The user clicks 'Ok' on the confirmation page 5. The user will receive an email to register their account
Alternative flow 1:	1. The user press 'Click Here' where is says apply for a new account 2. The user types in incorrect details in the form 3. The user clicks 'Apply' 4. The user clicks 'Ok' on the confirmation page 5. The user will not receive an email to register their account
Post-conditions:	The user receives an email to register their account

3. Registering the new account

The user can register their account by using the email they have been provided with to use the required details. The user will be able to log in straight after.

Wireframe

Figure 10: Registering their account

Activity Diagram

```
            ●
            │
            ▼
  ┌───────────────────┐
  │ User opens log in │
  │       page        │
  └───────────────────┘
            │
            ▼
  ┌───────────────────┐
  │ User selects      │
  │ Register          │
  └───────────────────┘
            │
            ▼
  ┌───────────────────┐
  │ User enters their │◄──────────────┐
  │ details from email│               │
  └───────────────────┘               │
            │                         │
            ▼                         │
  ┌───────────────────┐               │
  │ User selects      │               │
  │ Register          │               │
  └───────────────────┘               │
            │                         │
            ▼                         │
Check details  ◇                      │
are correct  ◇   ◇─────── No ─────────┘
             ◇ ◇
              ◇
            │
           Yes
            │
            ▼
  ┌───────────────────┐
  │ User is directed  │
  │ to log in page    │
  └───────────────────┘
            │
            ▼
            ◉
```

Use Case

Use Case Name:	The user registering their new account
User type:	Patient
Description:	The user can register for an account when they have received their email with the required details
Pre-conditions:	The user will need to be able to access the start-up page
Basic flow:	1. On the log in page the user clicks 'Register' at the top of the page or 'Register new account' at the bottom of the page 2. The user types in the correct details in the form 3. The user clicks 'Register' 4. The user clicks 'Log In' on the confirmation page

	5. The user is directed to the Login page
Alternative flow 1:	1. On the log in page the user clicks 'Register' at the top of the page or 'Register new account' at the bottom of the page 2. The user types in incorrect details in the form 3. The user clicks 'Register' 4. The user is displayed with an error messaging informing them they have entered incorrect details 5. The user re-enters their correct details 6. The user clicks 'Register' 7. The user clicks 'Log In' on the confirmation page 8. The user is directed to the Login page
Post-conditions:	The user will be able to log onto their account

4. Changing the language of the application

The user can change the language on the log in page to be able to use it in a language they understand.

Wireframe

Figure 11: Changing the language

```
        ●
        │
        ▼
┌─────────────────────┐
│ User opens log in page │
└─────────────────────┘
        │
        ▼
┌─────────────────────┐
│ User selects language │
└─────────────────────┘
        │
        ▼
┌─────────────────────┐
│  User selects language │
│  from drop down list   │
└─────────────────────┘
        │
        ▼
┌─────────────────────┐
│  User selects submit   │
└─────────────────────┘
        │
        ▼
┌─────────────────────┐
│  User is directed to log │
│        in page          │
└─────────────────────┘
        │
        ▼
       ◉
```
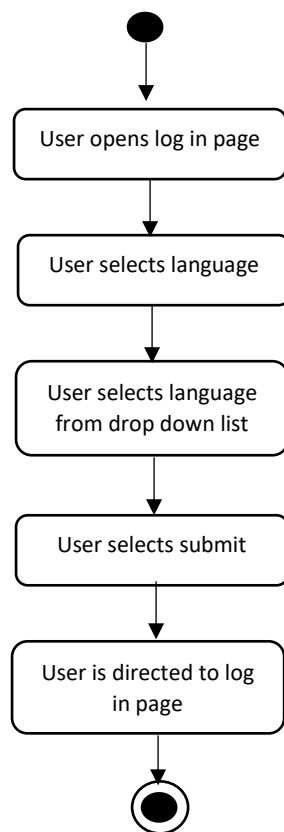
Use Case

Use Case Name:	The user being able to change the language of the application
User type:	Patient
Description:	The user can change the language of the application on the log in page
Pre-conditions:	The user will need to be able to access the start-up page
Basic flow:	1. The user clicks 'Language' on the log in page 2. The user selects language on the drop-down list 3. The user presses 'Submit' 4. The user is directed to the log in page
Post-conditions:	The language will have changed throughout the whole application

5. The user viewing their test results

This page allows the user to open a PDF with their test results which will be written in a way it would be talked through over the phone to the patient.

Wireframe
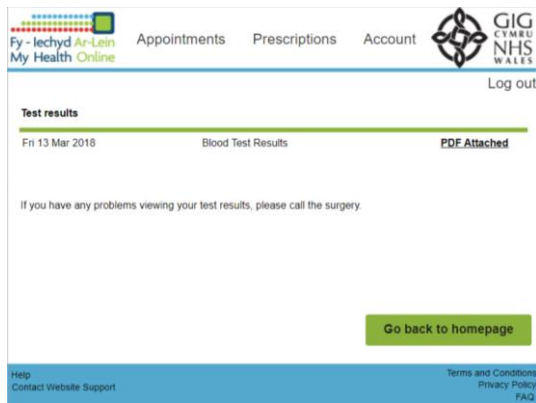
Figure 12: Viewing test results

Activity Diagram
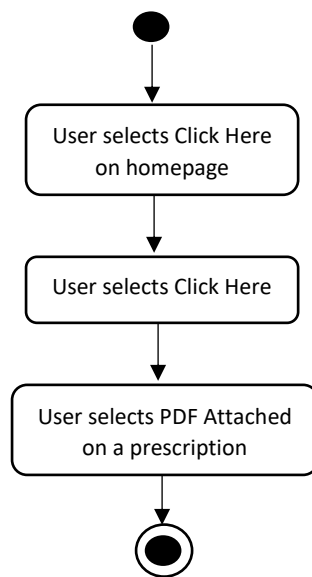
Use Case

Use Case Name:	The user accessing their test results
User type:	Patient
Description:	The user can access results they are waiting for on the homepage instead of phoning the surgery
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Click Here' on the homepage where it says if you are waiting for test results 2. Click on the PDF file for the results
Post-conditions:	The user will be able to read their test results in a readable format in their browser

6. The user viewing their account details

This allows the user to view their account details that is being hold about them and it is what the surgery will have stored about the patient too.

Wireframe

Figure 13: Viewing account details

Activity Diagram
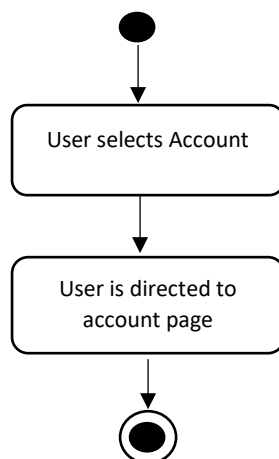
Use Case

Use Case Name:	The user accessing their account details
User type:	Patient
Description:	The user can access their account details and see the personal details the doctor surgery holds about them
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Account' button 2. The user is directed to the account page
Alternative flow 1:	1. The user clicks 'Account' button at the top of the page 2. The user is directed to the account page

Post-conditions:	The user can read the personal details that is being stored on this application

7. The user being able to view all their appointments

All the appointments are placed together on one page in the user's account to make it easily accessible for the patient.

Wireframe

Figure 14: Viewing appointments

Activity Diagram

Use Case

Use Case Name:	The user viewing their appointments
User type:	Patient
Description:	The user can access their account details and see the personal details the doctor surgery holds about them
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Appointment' icon in the middle on the homepage

	2. The user is directed to the appointments page
Alternative flow 1:	1. The user clicks 'Appointment' at the top of the homepage 2. The user is directed to the appointments page
Post-conditions:	The user can see the appointments they have booked with the GP and at the hospital

8. The user booking a GP appointment

The user can book a GP appointment through using the search page and finding available appointments that is convenient for them.

Wireframe

Figure 15: Booking an appointment

<u>Activity Diagram</u>

<u>Use Case</u>

Use Case Name:	The user booking GP appointments
User type:	Patient
Description:	The user can book an appointment with a doctor, a nurse or a phlebotomy
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Appointments' 2. The user clicks 'Add New GP Appointment' 3. The user types in their search criteria 4. The user clicks 'Select' on the appointment 5. The user is directed to the appointment page where it shows it's been booked
Alternative flow 1:	1. The user clicks 'Appointments' 2. The user clicks 'Add New GP Appointment' 3. The user types in their search criteria

	4. The user is directed to a message stating there is no available appointments that match the criteria
	5. The user clicks 'Edit Search'
	6. The user types in a new search criterion
	7. The user clicks 'Select' on the appointment
	8. The user is directed to the appointment page where it shows it's been booked
Post-conditions:	The user has a GP appointment booked and can view it on the appointment page

9. The user booking an emergency appointment

The user can book an emergency appointment through the application instead of phoning at 8am in the morning. The user needs to describe their problem which will be matched against a criterion that will tell if they are eligible for a 'on the day' appointment.

Wireframe

Figure 16: Booking an emergency appointment

Activity Diagram

User selects
Appointments

User selects Add
Emergency Appointment

User types in problem

User selects Submit

Check if
eligible for
emergency
appointment

No

Yes

User is directed to
appointment page

User selects Select on
appointment

User is directed to
appointments page
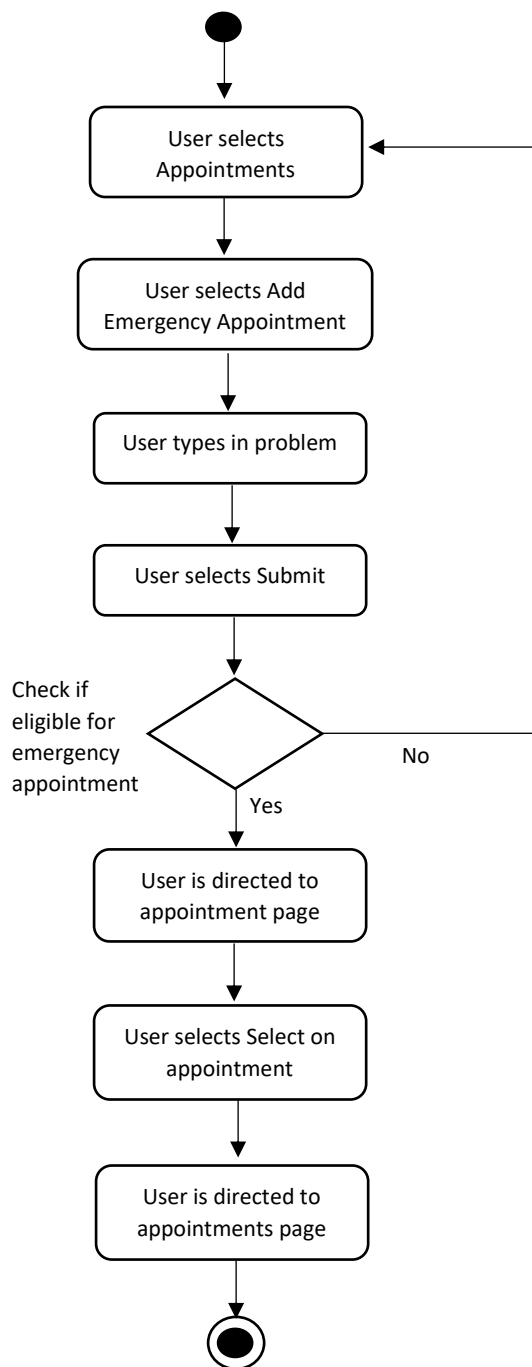
Use Case

Use Case Name:	The user booking an emergency appointment
User type:	Patient
Description:	The user can fill out a form to apply for an emergency appointment through the appointment page
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Appointments'

	2. The user clicks 'Add Emergency Appointment'
	3. The user types in their problem in the textbox
	4. The user clicks 'Submit' on that page
	5. The user clicks 'Select' on the appointment page they have been directed too.
	6. The user is directed to the appointment page where it shows it's been booked
Alternative flow 1:	1. The user clicks 'Appointments'
	2. The user clicks 'Add Emergency Appointment'
	3. The user types in their problem in the textbox
	4. The user clicks 'Submit' on that page
	5. The user has been alerted they aren't eligible for an emergency appointment
	6. The user clicks 'OK'
	7. The user is redirected to the appointments page
Post-conditions:	The user has an emergency appointment booked and can view it on the appointment page

10. The user cancelling a GP appointment

The user can cancel their appointment online by pressing the button next to the appointment, it is much more convenient than calling the surgery.

Wireframe

Figure 17: Cancelling a GP appointment

Activity Diagram

Use Case

Use Case Name:	The user cancelling a GP appointment
User type:	Patient
Description:	The user can cancel their appointment at any time on the appointments page
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Appointments' 2. The user clicks 'Cancel' on the GP appointment 3. The user clicks 'Confirm' on the confirmation page
Post-conditions:	The user can see that the appointment has disappeared from the appointment page

11. The user cancelling a hospital appointment

The user can cancel their appointment online by pressing the button next to the appointment, it is much more convenient than calling the hospital and it will alert the e-referral service.
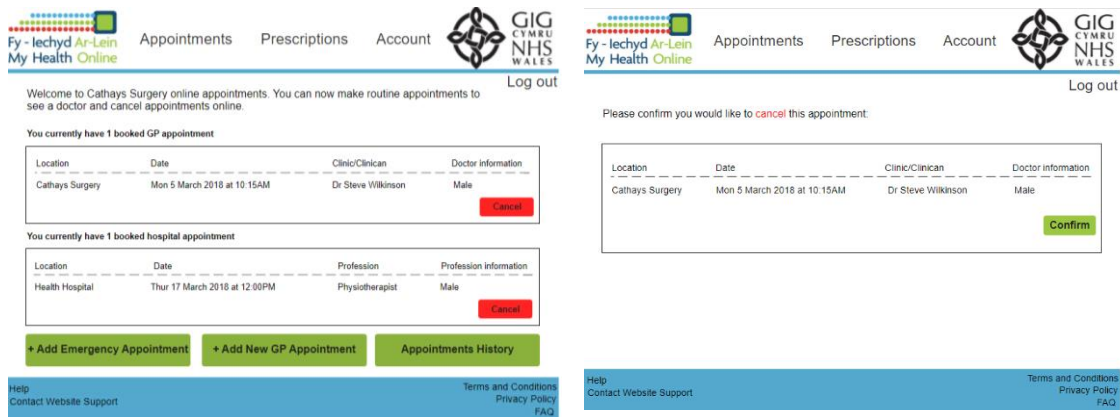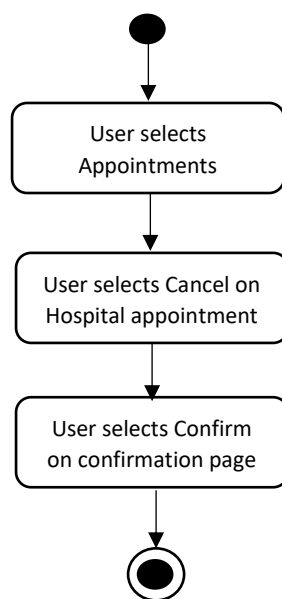
Wireframe

Figure 18: Cancelling a hospital appointment

Activity Diagram

Use Case

Use Case Name:	The user cancelling a hospital appointment
User type:	Patient
Description:	The user can cancel their appointment at any time on the appointments page
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Appointments' 2. The user clicks 'Cancel' on the hospital appointment 3. The user clicks 'Confirm' on the confirmation page
Post-conditions:	The user can see that the appointment has disappeared from the appointment page

12. The user viewing their appointment history and prescriptions in their account

The user can view their appointments they have had previously and can view a PDF document which contains their prescription, so they can see previous medicines they have been given.
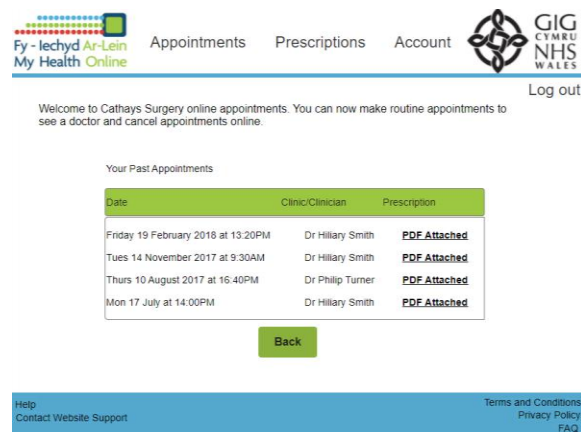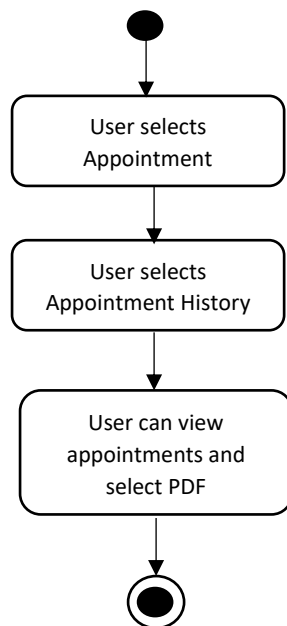
Wireframe

Figure 19: Viewing previous appointments

Activity Diagram

Use Case

Use Case Name:	The user viewing their appointment history and prescriptions
User type:	Patient
Description:	The user can view their appointments and previous prescriptions on the appointment history page

Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Appointments' 2. The user clicks 'Appointment History' 3. The user can see the list of previous appointments they have had 4. The user can click on the PDF for the prescription they want to see
Post-conditions:	The user can see previous appointments they have attended

13. The user requesting a repeat prescription on their account

The user can request the prescription online instead of handing in an order slip into the surgery, they can collect the prescription in a few days from the pharmacy.

Wireframe

Figure 20: Requesting a repeat prescription

<u>Activity Diagram</u>
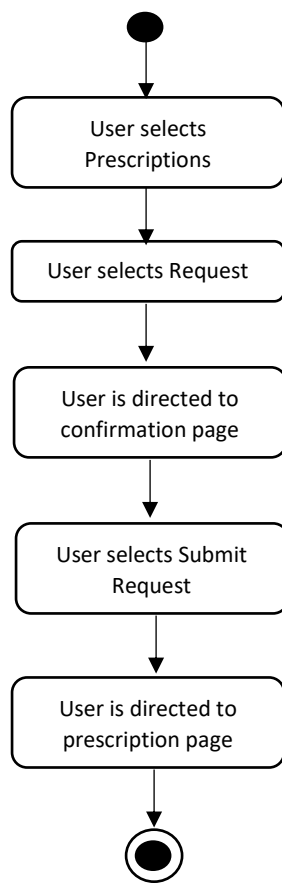
<u>Use Case</u>

Use Case Name:	The user requesting a repeat prescription
User type:	Patient
Description:	The user can request a repeat prescription through the prescription page to go collect from the GP
Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Prescriptions' 2. The user clicks 'Request' on the prescription 3. The user clicks 'Submit Request' on the confirmation page 4. The user is redirected to the prescription page
Post-conditions:	The user must wait for their prescription to be ready

14. The user can leave a comment on a previous prescription they have requested

This a useful service to a patient as they can explain of any problems or side effects they are experiencing with that prescription. The doctor is expected to respond within 24 hours.

Wireframe

Figure 21: Leaving a comment

Activity Diagram
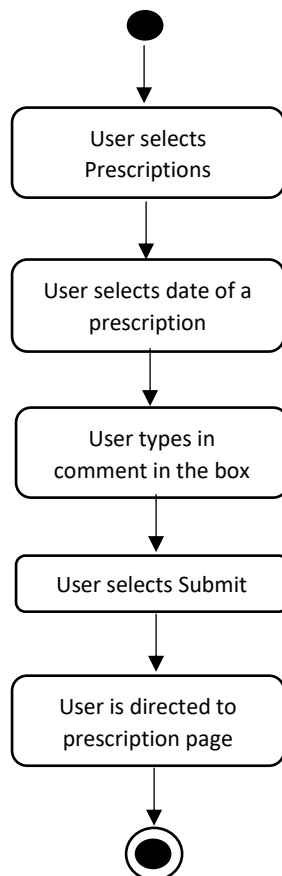
Use Case

Use Case Name:	The user leaving a comment on a prescription
User type:	Patient
Description:	The user can leave a comment on a certain prescription and allows the doctor 24 hours to reply

Pre-conditions:	The user will need to have a registered account to use this service
Basic flow:	1. The user clicks 'Prescriptions' 2. The user clicks on the date of the prescription 3. The user writes the comment in the patient's box 4. The user clicks 'Submit' 5. The user is redirected to the prescription page
Post-conditions:	The user must wait 24 hours to get a response from the Doctor.

7.2 Prototype Design

The size of the interface needed to be decided before the design could go ahead. The design is created to work on any browser that is connected to the internet and can either work on a laptop, tablet or desktop. The design is made for a desktop and the size was determined using https://www.sitepoint.com/designing-for-the-web-resolution-and-size/ to help determine the measurements for the prototype.
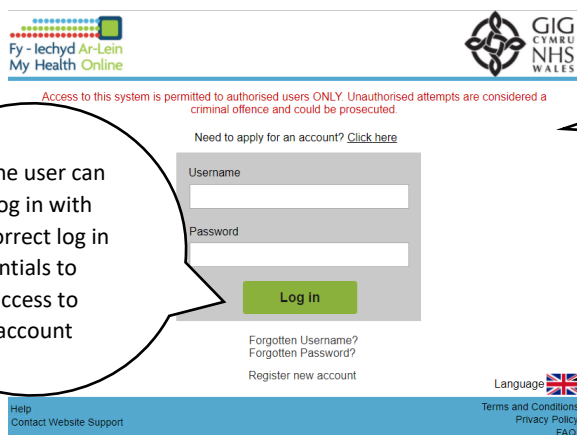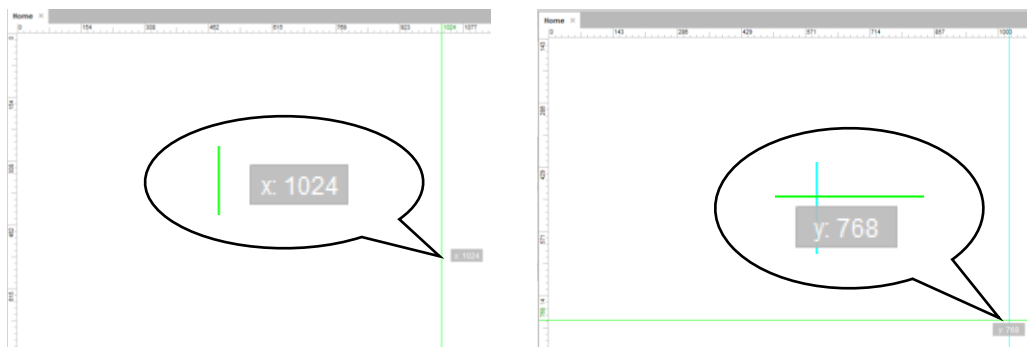
Figure 22: Attempting to log in

When the user opens the application, they are displayed with the page above, they have the choice to either log in, apply for a new account or register a new account. The user will need to apply for an account before they can register their account. This page adheres to the requirement 4.3 which states the application data must be encrypted always.

Figure 23: Form to apply for an account

The form above is to apply for an account and the form below is the form to register the account once you have been sent a registration email explaining they have accepted your application. Using these forms to create an account is adhering to the requirement 1.2 as it is keeping the user's details confidential which is following the Data Protection Act.

Figure 24: Form to register an account

Figure 25: The homepage

The homepage has clear large icons to display the tasks of the application which adheres to the requirement 4.6 that states the text and icons need to be large to allow all users to read them. This page also adheres to the requirement 1.4 that states the navigation menu buttons need to be grouped in one place throughout the application. They are clearly positioned together at the top of the page and are positioned there throughout the application. It is compliant with requirement 1.6 as it offers a feature to view test results and requirement 1.11 as it displays a log out button for the user.
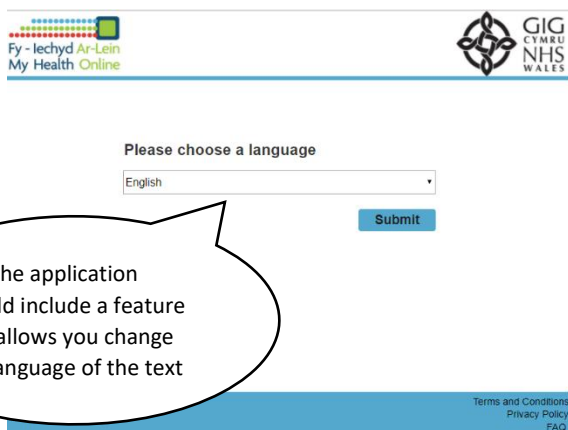
Figure 26: Choosing a language

Above is the page where the prototype allows you to the change the language of the application to be able to improve the communication between the patient and GP with the patients that don't speak very good English.
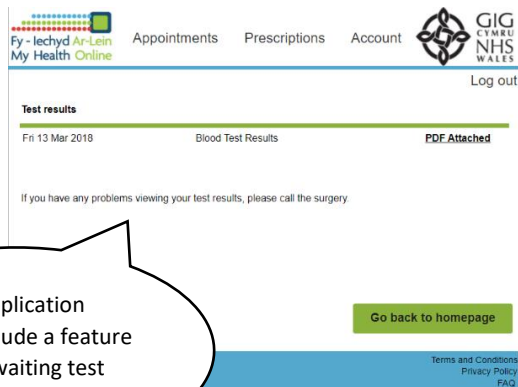
Figure 27: Test results
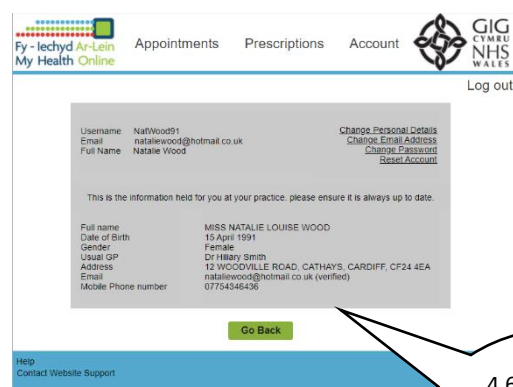
Figure 28: Account details

Figure 29: Searching for an appointment

The search page adheres to the requirements 4.6 that states the text and icons need to be large to allow all users to read them and 2.1 that states the application should separate the professions into Doctors, Nurses, HCA and Phlebotomists. In the doctor's drop-down list, you can request a Home Visit appointment. When pressing search, it clearly displays the search has been carried out by showing a message explaining there are no appointments or showing the available appointments which are both on different pages to make it clearer.
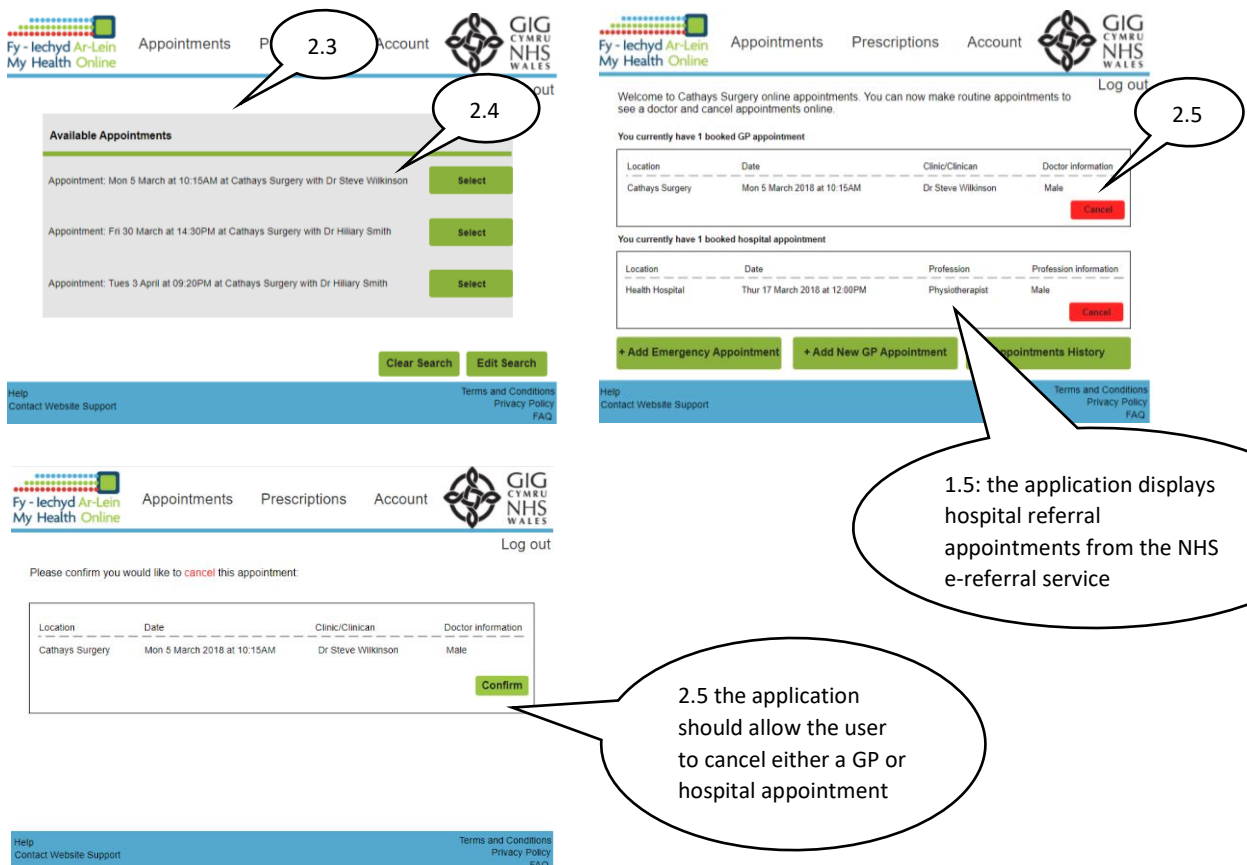
Figure 30: Booking and cancelling an appointment

Booking and cancelling appointments adheres to the requirements necessary. Booking an appointment adheres to requirement 2.3 that states the application needs to alert the user a search for an appointment has been carried out and 2.4 that states the application needs to release more

available appointments in the next 4 weeks. It is displaying appointments which shows the search was carried out and the appointments are over the course of a month. Cancelling an appointment adheres to 2.5 that states the application should allow the user to cancel either a GP or hospital appointment as they can press the cancel button next to any appointment.
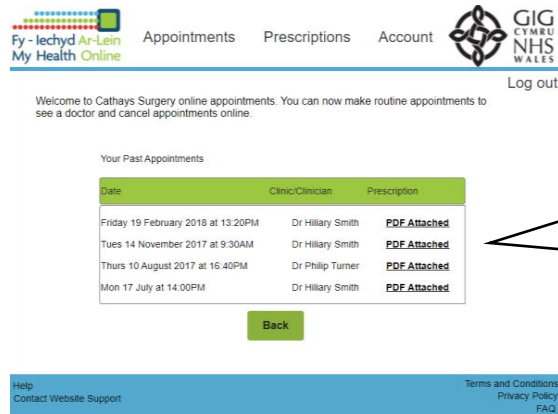
Figure 31: Viewing previous prescriptions

It is important the page above adheres to the requirements 4.3 that states the applications data must be encrypted always as this is highly confidential data due to it containing medical records.
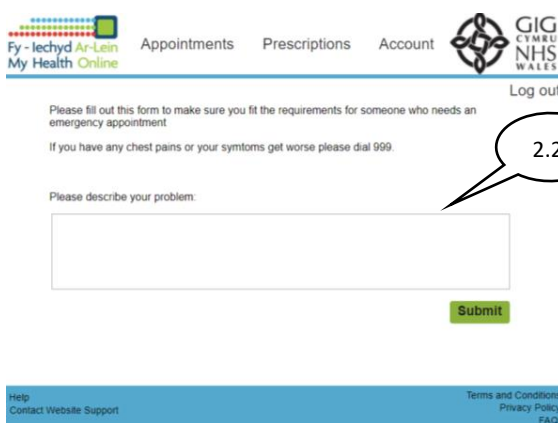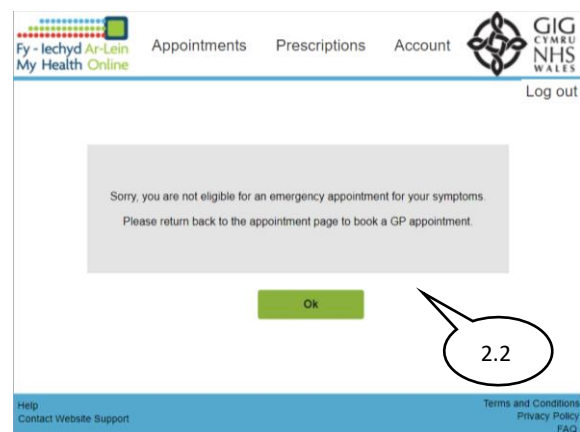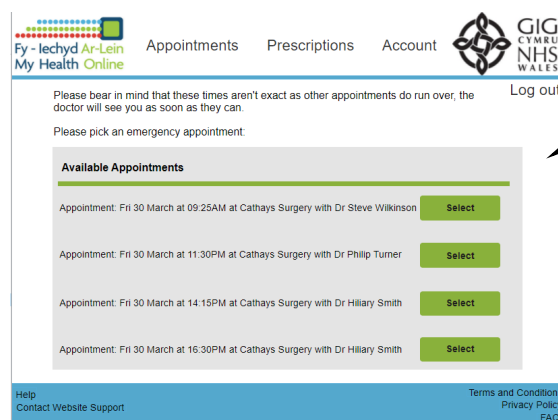
Figure 32: Process of booking an emergency appointment

This is the process for booking an emergency appointment, it adheres to the requirement 2.2 that states the application should include a process to book an emergency appointment. The application

works out if you eligible for an emergency appointment by being connected to a database of the problems that are allowed. Clicking the submit button will compare the answer to the database to then allow you to book an appointment or alert the user they aren't eligible.
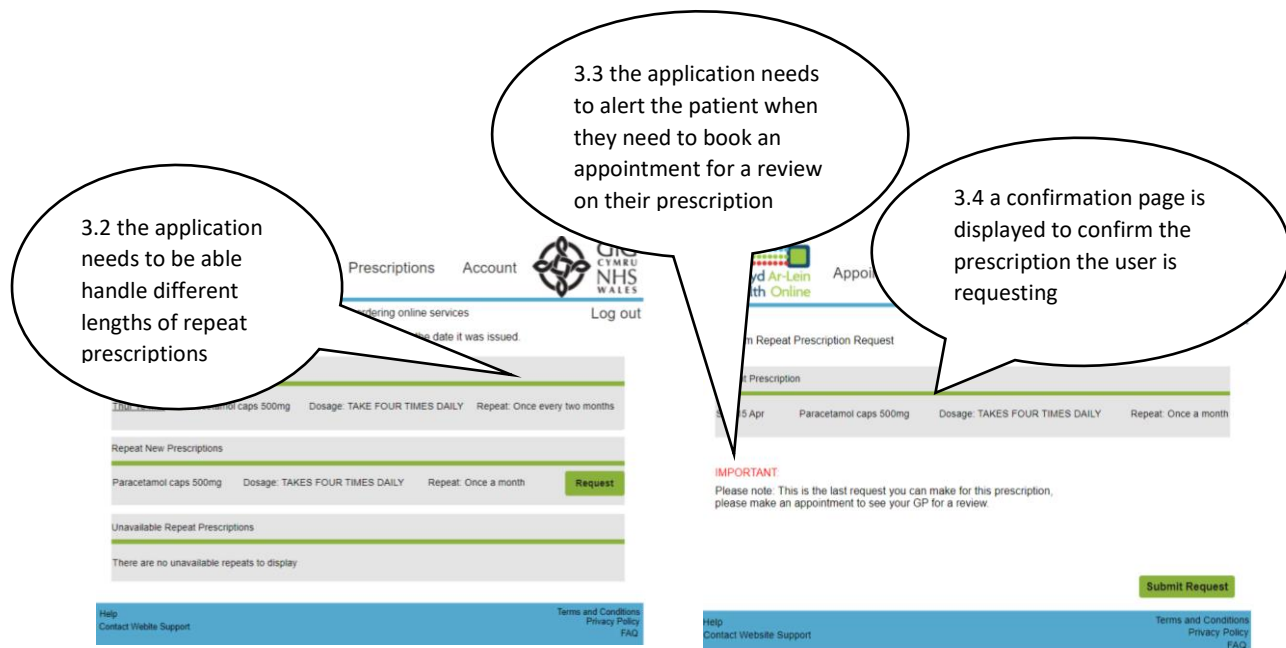
Figure 33: Process of requesting a prescription

There is a simple process of requesting a repeat prescription that follows all necessary requirements. It saves the patient going into the surgery to hand in order slip for a prescription. When they are requesting their repeat prescription, they get an important message on the confirmation page to alert them to book an appointment for a review as you can see in the screenshot above.
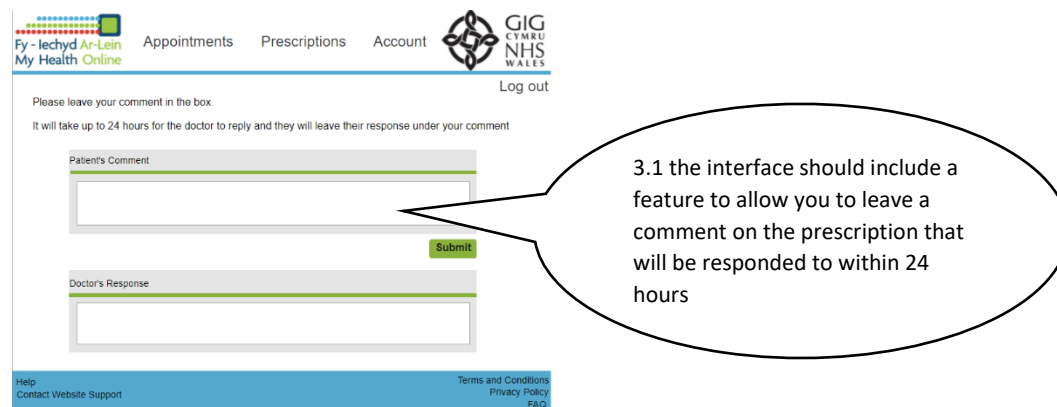
Figure 34: Writing a comment on a prescription

This is a useful feature that is accessible from the prescriptions page to allow them to communicate to their doctor, once again it needs to adhere to the requirement 4.3 that states the applications data must be encrypted always as it contains personal data.

Throughout the design it adheres to the requirements 4.1 that states the interface needs to have an appropriate colour scheme as the colours have been chosen to follow the logo, requirement 4.2 that states the interface must be user-friendly and easy to navigate has been followed as all icons are clear and the tasks are not difficult to perform. Lastly it adheres to requirement 4.5 that states the

interface needs to be consistent throughout which has been proven by the screenshots that the same design has been used throughout the interface.

7.3 How the solution addresses the requirements

This is a discussion of how each of the defined requirements have been met in the solution design.

1. <u>General application requirements:</u>

    1.1 the application must include an application form for the patient to sign up

The interface includes a form where a user can apply for a new account instead of going into the surgery. When the user has filled out the form, it gets sent to their surgery to confirm their details and this confirmation will send the user with a registration letter.

Referring back to the Mock-Up this wasn't included as a feature on the system, this is a new feature to help make it more effective.

    1.2 the application must comply with the Data Protection Act

The user uses their own account on the application which allows them to only see their data and nobody else's. There is Terms and Conditions on the interface that the user can read to know their rights. The Data Protection Act is "a set of principles that organisations, government and businesses have to adhere to in order to keep someone's data accurate, safe, secure and lawful" [17] and these principles need to be applied to the data being stored in this application.

    1.3 the application should lead straight to the log in page

The practice ID page has been removed, as soon as the user open the application it directs the user to the log in page.

Referring back to the Mock-Up, the practice ID wasn't working properly which was identified in the questionnaire analysis and heuristic evaluation. The easiest option was to remove the page as it wasn't necessary, and the account should already be linked to the correct surgery.

    1.4 the navigation menu buttons need to be grouped in one place throughout the application

The navigation buttons are placed together at the top of the page, they are easily accessible and consistently placed in that position throughout the whole application.

Referring back to the Mock-Up, these buttons weren't grouped together as the account button was on the far right-hand side. To help make the navigation bar more effective they were grouped together so it can easily be found for the user.

    1.5 the application displays hospital referral appointments from the NHS e-referral service

The application displays hospital appointments on the same page as the patients GP appointments, so they are easy accessible and can view them at the same time.

Referring back to the Mock-Up, this feature wasn't included and was found to be useful from the questionnaire, so it was added in as a new feature.

    1.6 the application should include a feature to access waiting test results

There is a button on the homepage which allows access to the user to view their test results in a PDF format on a tab in their browser, so they aren't downloaded.

Referring back to the Mock-Up, this feature wasn't included and was one of the answers to the questions in the questionnaire, so it was added in as a new feature.

      1.7 the application should include a feature to access previous prescriptions

On the appointments history page, you can view a PDF file on a tab in their browser that shows the patient their medicine they have been prescribed.

      1.8 the application should include a feature that allows you change the language of the text

On the log in page, there is a button the user can press to go to a drop-down list to allow them to select a language they want to read the application in.

Referring back to the Mock-Up, it allowed you to change the language between English and Welsh as it shows those two options at the top of the page. The prototype has included it on the log in page with many more languages to choose from.

      1.9 the user can only log in with the correct log in credentials to gain access to their account

If the user does not enter the correct log in details, they will be alerted by a message informing them they have.

      1.10 the application should include a help feature throughout the different tasks

This hasn't been implemented yet due to running out of time. This is future work for the application.

      1.11 a log out button should be included on every page when logged into the user's account

A button displaying Log Out has been put in the same position on every page when the user is logged into their account.

      1.12 patient's medical details from their account and available appointments at the practice will be uploaded to the system GP connect

This can't be shown until it has been fully implemented and the system GP connect has been developed. This is a good way to connect the application into the NHS infrastructure 'Spine'.

      1.13 The application will be implemented using the programming language Java

This can't be shown until it has been fully implemented as it is only a prototype. When the developing takes place it will be created using Java.

2. <u>Booking appointment requirements:</u>

2.1 the application should separate the Nurses, HCA and Phlebotomists from the drop-down list of doctors

When searching for an appointment there is a different button for each health care professional and a drop-down list to be able to select the nurse and doctor they require.

Referring back to the Mock-Up, these professions were all included in the search criteria but wasn't noticeable to the user. This section was changed to separate the professions to help make it clearer to the user.

2.2 the application should include a process to book an emergency appointment

There is a feature to find out if the patient is eligible for an emergency appointment, if yes then they are directed to the available emergency appointments for that day.

Referring back to the Mock-Up, it only allowed you to book a routine appointment. Adding this service makes the prototype much more effective as this a very popular service that patients call the surgery for every morning.

2.3 the application needs to alert the user a search for an appointment has been carried out

When the user presses the search button it directs them to either an alert message explaining there is no appointments that fit that search criteria or a page with all the available appointments.

Referring back to the Mock-Up, searching for an appointment wasn't clear as the appointments were displayed at the bottom if there was any, this has been changed to direct the user to different pages to help make it easier to use.

2.4 the application needs to release more available appointments in the next 4 weeks

This is difficult to prove but the available appointments will include ones that are up to a month in advance.

2.5 the application should allow the user to cancel either a GP or hospital appointment

The user has a cancel button next to the appointment to allow them to cancel the appointment on the application to make it easier for them.

3. Requesting repeat prescription requirements:

3.1 the interface should include a feature to allow you to leave a comment on the prescription that will be responded to within 24 hours

There is a comment box through clicking on the prescription to allow the user to write what they need to tell their doctor.

3.2 the application needs to be able handle different lengths of repeat prescriptions

The application can handle different lengths of prescriptions as on the prescription it says how often it needs to be issued.

3.3 the application needs to alert the patient when they need to book an appointment for a review on their prescription

When the user requests their last dosage of their prescription, they get a message on the screen to alert them to book an appointment for a review.

Referring back to the Mock-Up, this feature wasn't included when requesting a prescription. From the interview it was found to be a simple feature that needed to be added in to help make the patients life easier.

3.4 a confirmation page is displayed to confirm the prescription the user is requesting

When the user requests a prescription, they are directed to a confirmation page asking to confirm if this is the right prescription they are needing.

4. Non-functional functional requirements:

4.1 the interface needs to have an appropriate colour scheme

The interface follows colour guidelines by using a contrast with a white background and black text to give the users the best ability to be able to read the text. "Black text on a white background is the ultimate high-contrast color combination because black has a 0% brightness value, whereas white had a 100% brightness value" [18].

Referring back to the Mock-Up, the colour scheme was determined to be good from the answers in the questionnaire, but a few responses said they couldn't read the text. Simplest option was to change the colour scheme to ensure it was better for all users.

4.2 the interface must be user-friendly and easy to navigate

The layout is easy to navigate around as the you can access the appointments, prescriptions and account page by using the menu at the top of the page and the buttons are easily understood.

Referring back to the Mock-Up, the layout of the features and buttons hasn't changed because from the questionnaire most respondents found it easy to use.

4.3 the applications data must be encrypted always

The user must access the application by typing in their username and password to view their details.

4.4 the application should run error free

This is hard to prove until the application's interface has been implemented fully.

4.5 the interface needs to be consistent throughout

The same design is used throughout the whole application to keep it consistent and easy to learn how to use. Consistency helps using an interface as it "means not forcing them to learn new presentations or toolsets for each task" and it is "reducing the length of the thinking process by eliminating confusion" [19].

4.6 the text and icons need to be large to allow all users to read them

The text and icons are a large size and a clear font has been used so it stands out to the user.

Referring back to the Mock-Up, the buttons and text weren't clear to some respondents in the questionnaire. These changes have tried to be taken into consideration in this design by having large text and colourful buttons to help them stand out.

8. Testing

The next step is to test the prototype on the target audience as it is vital to find out if it is fulfilling their needs. Performing different testing methods "can reveal key points on issues that your team did not even know to focus on" [20] and these are improvements to make in the future. The app has been created for anyone 18 years or older as that is the age limitation on the application 'My Health Online'. Therefore, the testing method used will be a think aloud test that will be performed on three people of different ages to get an understanding how each generation finds it. Before carrying out the user testing, a cognitive analysis is carried out first internally before putting it out to the target audience.

8.1 Cognitive Analysis

A cognitive analysis is a "type of task analysis aimed at understanding tasks that require a lot of cognitive activity from the user, such as decision-making, problem-solving, memory, attention and judgement" [21]..A cognitive analysis was carried out on all the tasks that can be performed in the prototype. Each step of the task was documented and during performing the steps on the prototype a set of questions were answered.

The 4 questions to ask in a cognitive walkthrough [22] on each task:
1. Will the customer realistically be trying to do this action?
2. Is the control for the action visible?
3. Is there a strong link between the control and the action?
4. Is the feedback appropriate?

These questions were chosen as they seemed relevant to the tasks as it is important these questions were taken into consideration while designing the prototype. It is important the user should understand each task, it is clear to them and there is strong link between the actions so it user-friendly for the user. When carrying out the analysis a severity rating was used to the problems identified. This severity is explained in the heuristic evaluation, as they both use the same.

The full cognitive analysis can be found in the appendix, below is a sample of one task.

Task Number	1
Task Name	The user logging into the application
Pre-condition	The user must open the application
Step Number:	Step Description:
1	Type in Username and Password
2	Press 'Log In'

Analysis of task:

Will the user realistically be trying to do this action?
Yes - To be able to use the application the user will need to be able to gain access to their account

Is the control for action visible?
Yes

- The text boxes and button are clear to the user

Is there a strong link between the control and the action?
Yes - The boxes and icons are clearly labelled.

Is the feedback appropriate?
Yes - The feedback is clear for failed logins

Severity of problems encountered:	Reason:
5	Password entered is displayed in free text which is a security risk.

Evidence:

Step 1 – Typing in the user's details

Step 2 – Press "Log In"

The feedback to incorrect log in details

8.2 User testing – Think Aloud

The next stage is performing user testing with real users. This is important as it's "the most fundamental usability method and is in some sense irreplaceable, since it provides direct information about how people use computers and what their exact problems are with the concrete

interface being tested" [23]. The application 'My Health Online' is used by many different ages so it is appropriate that testing is carried out on with people who are of different ages. The testing will be carried out on the main tasks of the design to ensure the user can complete the crucial tasks on the prototype. Many of the other features that are included in the design may not be used very often by most patients so 5 tests have been chosen to test the functionality and usability of the prototype.

The three users who participated in the testing:

User 1 – 65 years old retiree
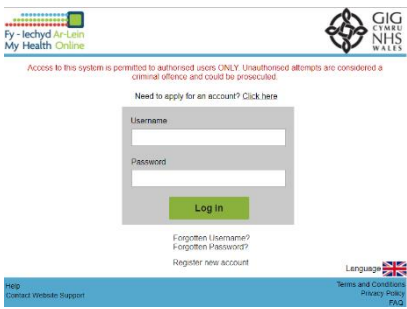
User 2 – 43 years old IT manager

User 3 – 21 years old dentist student

This method is a walk-through assessment of how the user's find performing the tasks. The user is told to perform each task and the section 'Think Aloud' will be written about the observations. Discussions will be carried out to discover any problems that have been found while performing a task. The user will be provided with a laptop with the prototype open on a browser to be able to use the interactivity side of the design.

For the purpose of this project, a sample of each test with identified problems has been provided below. The rest of the user testing can be found in the appendix.
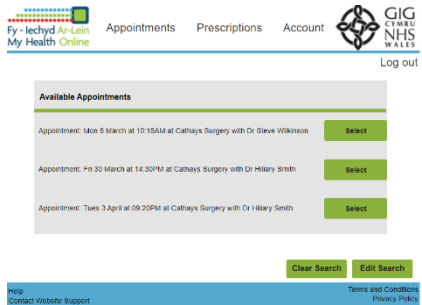
Test 1 – Apply for a new account

Preconditions: The user needs to have the application open				
User	Step	Think Aloud	Problem Areas	Good Usability
1	1	The user couldn't locate the click here to apply for an account	The user didn't find it clear on the log in page where to apply. They got confused between applying and registering an account	
	2	The user found it simple to fill out their details in the text boxes	No problems found	The form was simple and quick to fill out
	3	The user easily pressed 'Apply'	No problems found	The button was clear and large enough for the user

Test 2 – Logging into their account

Preconditions: The user needs to have the application open				
User	Step	Think Aloud	Problem Areas	Good Usability
3	1	The user typed in their details, didn't like their password was on display	Password being on display is a security risk	The layout is familiar to other log in pages on different websites
	2	The user clicked 'Log In' button really quickly	No problems found	

Test 3 – Book a GP appointment
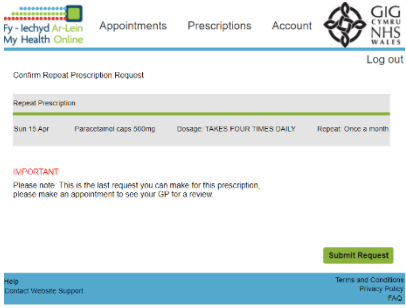
Preconditions: The user needs to be logged into their account				
User	Step	Think Aloud	Problem Areas	Good Usability
2	1	The user located the 'Appointments' button easily	No problems found	The icons are large on the homepage
	2	Easily located the button 'Add New GP Appointment'	Didn't know if they wanted an emergency appointment or not	
	3	The user thought the search page was busy so found it a lot to fill out	No problems found	
	4	The user found it simple to choose an appointment and selected the appropriate 'Select' to the required appointment	Found it difficult to separate the appointments by date and time so it took a while to process them all	

Test 4 – Book an emergency appointment

Preconditions: The user needs to be logged into their account				
User	Step	Think Aloud	Problem Areas	Good Usability

2	1	The user easily found 'Appointments'	No problems found	It's very clear as the icons have good illustrations with the words
	2	The user typed in their problem	No problems found	
	3	The user selected 'Submit'	No problems found	
	4	The user selected their appointment by clicking 'Select' next to an appointment	The same problem as before, they struggled to separate the date and time which took them a while to process	

Test 5 – Request a prescription

Preconditions: The user needs to be logged into their account				
User	Step	Think Aloud	Problem Areas	Good Usability
2	1	The user found 'Prescriptions' button clear	No problems found	
	2	The user found it clear where to request a repeats prescription	No problems found	The repeat prescription page is very clear to the user
	3	The user found the confirmation page clear and selected 'Submit Request' but would have liked to be able to book appointment straight away as being told they need a review	Not being able to go straight to booking an appointment	

User 1 responses:

- Found it simple and easy to use throughout, no task was too complex to perform as it is straight forward what the user has to do
- The pages aren't over-crowded with information and it is has been divided up nicely

User 2 responses:

- With the layout more 'white space' needs to be considered to make it more spread-out
- Grey and Black may not be best to be able to read off

User 3 responses:

- Found the interface aesthetically pleasing to the eye and was well designed
- Didn't have any difficulty fulfilling the tasks, found them easy and simple to perform

Overall from the testing, some good comments have been raised from carrying out the tasks and watching them perform each one. There have been no major problems with the prototype but only minor mistakes that could have been avoided. There are many little improvements to make to increase the effectiveness of the prototype and with the user responses at the end they have shown positive feedback about the design.

8.3 Risk Assessment

Possible Risk	Risk Level	Likelihood of Event	Contingency Plan
User forgets their log in details to their account	High	Likely	User can request forgotten details on the log in page. It needs to ensure it responds quickly with an email to reset the details to get them back into the application.
The application is too complex to use	Medium	Somewhat Likely	Ensure the application has an in-depth help page that is descriptive and using illustrations to help the user. Every task that can be performed in the application is included in the help guide to ensure it covers any issues that could occur.
User doesn't own a device that can connect to the internet (In 2016, "4.2 million people aged 65+ have never used the internet" [24])	Low	Unlikely	Devices are getting cheaper every day, there are reasonable priced 2nd hand devices that could be bought to be able to use the application. To be able to use the application the cost of a device wouldn't be excessive compared to buying a brand-new product. Depends if the convenience of this application is worth the cost to the user.
User leaves themselves logged in on the device	High	Likely	The account needs to have a maximum amount of time of inactivity to log them out automatically. This ensures no other family members or friends can open the application on their device and view that individual's account.

The data stored on the user's account is incorrect	High	Unlikely	If it's the account details they can be changed immediately on the application. Whereas if its other data, it needs to be reported to the GP Surgery as it could be breaching confidentiality. Training will need to be properly carried out with the staff to ensure this doesn't happen.

9. Discussion and Conclusion

9.1 Evaluation of the methodology

From the testing, the prototype has received good feedback about its functionality and usability. There are room for changes and improvements to the prototype to make it even more effective, due to time restrictions in the project it didn't allow all the requirements to be implemented. Those requirements are future developments that are discussed in the Future Work section. The prototype was only interactive wireframes and wasn't programmed, but it still allowed the users to get an understanding of the interface to analyse and test the prototype fully. From the research, recommendations had been gathered to be able to determine the requirements for this prototype. All the research has been beneficial to the study of understanding the communication between the patient and GP surgery. This was a major part to defining the requirements to ensure that they would be beneficial, and these changes were worthwhile. The target audience for this prototype is for everyone and that meant the usability needed to suit all ages. At the beginning of the project Soft Systems methodology was used to identify the need of this project which had been successfully accomplished to help the project to progress. Throughout the project, an effective analysis through heuristic evaluation had been carried out to test the functionality and usability of 'My Health Online'.

In the research both a questionnaire and many interviews were undertaken to be able to identify the needs of the patient and GP surgery. The questionnaire was received well by getting 24 responses, which was good seeing as finding the target audience was very difficult. The Mock-Up used in the questionnaire was based off 'My Health Online', so the respondents needed to have a good understanding of the application to be able to answer the questions. The feedback from the questionnaire was positive and the respondents understood every question asked which helped them answer the questions with no difficulty. Overall the questionnaire gave a good insight into the application and played a big part in defining the requirements. Another research method used was carrying out interviews, two different interviews were undertaken with patients and GP surgeries. This was useful to understand the patient individually to identify their needs and particularly what they would like from the application. Interviewing the GP surgery was just as important as the author wanted to know what they would like the application to offer to be able to ease their work load and benefit them too.

Analysis methods used on 'My Health Online' was a Heuristic evaluation and evaluating the requirements of the application. A few of the problems in the application that was identified by these methods were attempted to be solved in the prototype i.e. the colour scheme and not alerting the user when a search has been carried out. This helped defined the requirements to be more user-friendly to the target audience. The heuristic evaluation was beneficial to the prototype as it identified good implementations that would be useful to make sure they were still shown through in the prototype.

The next step was a Gap Analysis, it helped discovered the gaps in the application 'My Health Online' and gave an insight of what needed to be added to the application as it wasn't compliant to all the recommendations. This report has analysed the application a lot deeper than the previous methods as it identified a lot of functionality and features it doesn't have. This Gap Analysis was developed into the gathered requirements for the prototype which led onto designing it.

Lastly there is the testing phase, it was an important this phase was undertaken to find out what the target audience thought about the prototype. A think aloud user test was carried out to identify any

good or bad implementations of the prototype, speaking to the user throughout performing the tasks gave more information as I could find out what the user was thinking. The feedback was very useful, and all three users gave good criticism to the prototype that should have been considered better in the design. A cognitive analysis was performed internally by myself to take a step back and put myself into a user's shoes to be able to analyse the prototype in depth.

I feel my title "MyHealthOnline: Integrated Digital Patient-Centred Health and Care System" has been fulfilled. I have used many methods throughout the project to analyse the current application 'My Health Online' that is trying to improve the communication between a patient and a GP surgery. As this is a wide audience as anyone goes to the doctor, the prototype needed to be simple to use and use-friendly for all ages.

9.2 Revised Soft Systems Methodology

Reviewing the soft systems methodology from the beginning of the project, it appears that it fits in with the final product. It is clear from the root definition and conceptual model that it has been fulfilled by the new prototype of the application 'My Health Online'. Below is a reminder of the SSM with explanations of how it all comes together and how it is related to the prototype.

CATWOE

- Transformation – Provide a user-friendly intuitive interface design for existing communication tools
- Weltanschuauung – I believe in identifying the needs of both the GP/healthcare professionals and patients to help provide a user-friendly intuitive interface design
- Customer – NHS patients
- Actor – GP/Healthcare professionals
- Owner – Myself
- Environmental Constraints – Data protection legislation act, NHS protocols, procedures and process, University unfair practice policies

Root definition

"A system, owned by myself, operated by Healthcare professionals and GP's to provide a user-friendly, intuitive interface design for existing communication tools for NHS patients by identifying the needs of both the GP/healthcare professionals and patients whilst ensuring coherence to data protection legalisation, NHS protocols, their procedures and processes and University unfair practice policies."

The prototype has been designed based on all the research throughout the project which helped to gather the requirements to make a user-friendly, intuitive interface design. It has included the existing user-friendly communication tools from 'My Health Online' and implementing new ones to improve the communication. The data protection act has been considered in the requirements as it something very important to the application as it holds very highly sensitive information of an individual. The process of how the tasks are performed hasn't been changed drastically, the foundation of them are still the same but with a few amendments to make it more efficient.

Determine how to assess the needs of both the patients and GP/Healthcare professionals

Research both patients and GP/healthcare

Take control action to ensure the interviews of assessing the needs of both the patients and GP/Healthcare professionals is done

→ C.A

Monitor the assessing of the needs of both the patients and GP/Healthcare professionals

Determine the capability required of each activity

Define GP

Define Healthcare professionals

Activity Information

Allocate activities to the GP's and Healthcare professionals

Assess GP/Healthcare professional's capabilities

Assess the needs of both the patients and GP/Healthcare professionals

Decide how to assess the achievement of providing a user-friendly intuitive interface design for existing communication tools

Define the NHS patient's requirements

Activity Performance Information

Monitor the match of capabilities to requirements

Take control to match capabilities to requirements

→ C.A

Assess the achievement of providing a user-friendly intuitive interface design for existing communication tools

Activity Information

Assess the impact on each activity

Decide how to react

C

Take control action to ensure a user-friendly intuitive interface design is being provided for the NHS patients, so they are satisfied

→ C.A

Determine the Data protection legislation act. NHS protocols, procedures and process. University unfair practice policies

Assemble the impact on each activity

Notify each controller

Define what is meant by user-friendly

Identify means of assessing tools for user-friendliness

Know existing communication tools

Assemble activity constraint information

C

Take control action to ensure conformance

C.A ←

Assess tools for user-friendliness by using Nielsen's 10 Usability Heuristics

Carry out questionnaires on the public

Evaluate existing communication tools for user-friendliness

Monitor conformance

C

Take control action to ensure the assessment of the existing communication tools is done

→ C.A

Determine performance measurements

C

Take control action to achieve expectations

→ C.A

Determine GP/Healthcare professional's performance expectations

Monitor system performance

Referring to the conceptual model throughout the research has ensured the take control actions have been carried out, this demonstrates the model is still relevant to the final product.

A heuristic evaluation was a method used to analyse existing communication tools in the application and it used the Nielsen's 10 usability heuristics. This helped to identify any issues and where there is room for improvement. Through the interviews the needs of the patients and GP surgery were identified by asking questions on how they find the application and what other features they would like to be implemented for their benefit. A questionnaire was opened out to the public who have used the application 'My Health Online' to evaluate the existing communication tools for user-friendliness. The results were analysed, and a lot of issues came to light about the problems the patients are facing when they try to use their account.

The conceptual model defined researching into the GP's of the surgeries but as the project progressed this aspect needed to change. It was decided to focus on GP surgery receptionists as they are the people that deal with the application daily by uploading appointments and retrieving prescriptions. They would have a good understanding and a valuable opinion on the application, so the research was changed to focus on them.

9.3 Evaluation of the Output

The aim of the project was to focus on improving the communication in the NHS, particularly between a GP and their patients. This was mainly focused around an application 'My Health Online' which has started to digitise GP services onto an application. Due to identifying the issues with the application and where improvements can be made, a new prototype of the application was created to resolve the issues. Overall, the prototype was a success and proven from the testing with the positive feedback.

The prototype provides users with an account to have access to the services. The user can view their personal information, they can either book a routine GP appointment or an emergency appointment, view test results, request a repeat prescription and leave a comment on a prescription when needing to speak to a doctor urgently. This is an effective and easy to use application as the user can use the application at any time of the day, so they don't need to worry about phoning the surgery in the opening hours. The requirements were determined carefully from the recommendations made in the questionnaire and interviews. In the section Prototype Design, it is shown that the requirements have been adhered to in the prototype. There were different types of patients described at the beginning of the project and they have been included into the prototype as much as possible. There are more available appointments over a longer period to allow patients who need regular appointments to book further in advance. There is a feature where the user can book an emergency appointment for that day and the user can request a home visit appointment in the search criteria.

For some of the requirements they were difficult to fulfil as the prototype was only developed into interactive wireframes and wasn't implemented fully. Due to the time restriction of only 12 weeks and the author's skill set it was not possible to fully implement the application, only a prototype was necessary for the nature of this project. The prototype was created on a software called Axure which gave it a professional look as it was noted from the questionnaire that a few users didn't like the look of the application. I am pleased with the prototype I created as I believe it is a major improvement on the current application 'My Health Online'.

Overall, I feel the prototype went well and the functionality was shown across through the interactive wireframes. The user could experience the full usability of the prototype, so the testing could be carried out sufficiently. The usability of the application 'My Health Online' has been fully analysed effectively using many different methodologies of assessing it, this was all used to help create the final output prototype.

9.4 Outlook on the future work

When designing the prototype there was a few features that weren't taken into consideration. This project could have been taken further by mainly progressing into the development of the prototype by making the changes mentioned in the think-aloud testing and cognitive analysis. There are a few future work developments that would help make the prototype a bigger success, but due to the time restriction of the project these were unable to be completed. These are listed below:

- One of the requirements that couldn't be implemented was a help feature for the application. This would have been included throughout the application to allow the patients to get the help they may require with any of the features. There would be a step by step guide on how to perform each task.
- The application isn't widely used in Wales as each surgery doesn't have many patients signed up. When the application has been implemented, a few methods should be used to invite more surgeries to use it in Wales and potentially get it used over the whole of the UK to make it a universal application. In the surgeries, methods need to be used to advertise the application to entice patients to sign up.
- A few changes to the features in the application were spotted from the think-aloud testing and cognitive analysis. These include moving the language button to the top right-hand corner as it wasn't taken into consideration that it is commonly positioned there on other websites. Another change is creating a button to be able to book an appointment from the confirmation page of requesting a prescription. Next would be only having one button for applying for an account and registering an account on the homepage to take you to a page asking whether you have an applied for an account already and have the registration letter to determine which form the user requires. Lastly changing the PDF links into buttons to stay consistent with the theme of the design.
- The forms included in the application to either apply for an account or register an account needed to be thought out much better. The layout needs to be re-designed to stop the user making any human error mistakes when entering their details and it doesn't tell the user the format that is required i.e. date of birth and address
- Including a better process for booking an emergency appointment as patients may not know whether they need one or not. There could be a drop-down list that could include all the symptoms and illnesses you would need a GP for and choosing one of them that would either let you be eligible for an emergency appointment or take you to book a routine appointment.
- The prototype didn't take any considerations of security as it shows the user's password when logging in, this is a security risk that needs to be fixed and won't take long to alter.
- Further testing of the prototype needs to be conducted, it needs to be carried out on GP surgeries to get their input on how the tasks are performed and whether it is sufficient. A wider audience is necessary to carry out a more effective user testing.
- When implementing the prototype, any further privacy implications will need to be taken into consideration to make sure the Data Protection Act is being followed as the account of

an individual it stores highly sensitive information, so if anything changes it needs to be notified.

- Explore further into identifying ways of being able to link the application more into the NHS infrastructure so it enables the NHS facilities to be able to communication more efficiently.

10. Reflection

Looking back over the project, I am pleased with how it has progressed over the last three months. The project has helped me develop my time management skills which was important due to the short timescale given to complete the project. The initial plan was quite optimistic of when I would be ready to carry out my primary research, this pushed back my plan by a few weeks which meant I had more to do in the weeks nearer the end. The start of the project was a slow progress by starting with SSM it took a couple of attempts. It needed to be effective and accurate to be able to base the rest of the project off the root definition and conceptual model. There was a lot of research that needed to be carried out to understand the problem and know the aim of the project to determine the direction it should go in. This was very important to the project as it was needed to help conduct my questionnaire and interviews. There was a planning process that needed to be undertaken before they could be created to ensure the respondent understood every question and it gave me answers that will help me develop further into my project. This took more time than excepted to plan the questionnaire and interviews, conduct them and analyse the results. This was a major part to the project and it gave a real insight into the application 'My Health Online'. This was where the fundamentals of the design came from. I wish I thought it through a lot more where I was going to get my responses from as I only received 24 and more would have helped me to get a wider perspective of the user's thoughts.

The aspect I struggled with was designing the prototype as it is not something I am confident in doing. I forget to take a few things into consideration and didn't do enough research into where certain features are placed which affected the design's usability. I have encountered several difficulties ensuring I got it right but overall, I think the outcome was good and showed a positive impact on the users.

This project has taken me out of my comfort zone to help me improve my research and personal skills. This project required me to use many skills that I have learnt over the course of my degree such as SSM, system dynamics and heuristic evaluation which helped me put them into action and use them on my own. There were many new techniques I learnt how to use throughout the project such as gap analysis, MoSCoW and cognitive analysis. These enhanced the quality of the information in the report to make it richer, it showed all the research by putting it to use and a more-depth analysis was taken place.

10.1 Communication and Project Management Skills

In the initial plan, it was specified that I would meet my supervisor once a week and discuss my progress which has been followed. Those meeting have been valuable to the project as meeting my supervisor helped me stay on track with my plan and give me a chance to ask any questions I had. The communication between myself and my supervisor has been very regular by emailing back and forth outside of the meetings, and it was easy to share files over a Google Drive folder that was set up.

A lot of skills have been developed throughout this project, I have kept a professional manner towards the meetings by being punctual and writing notes in every meeting to make sure nothing was forgotten. Every week I completed my tasks which helped me to stay on schedule of the project, so I managed to have the time to complete each task sufficiently. My supervisor passed on their knowledge and resources they had to help me throughout the project which was very beneficial.

I hope to be able to express my communication and project management skills across in the oral viva at the end of the project. In the future, I can keep developing these skills which will help me get further in my chosen career.

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