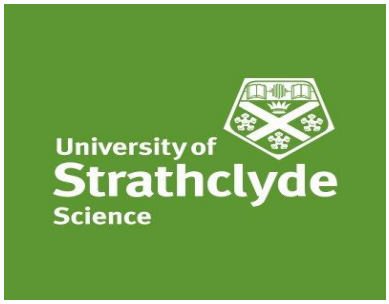

CREATING AND TESTING A WEB-BASED USER INTERFACE FOR THE ADVANCED SYMPTOM MANAGEMENT SYSTEM (ASyMS)

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This dissertation was submitted in part fulfillment of requirements for the degree of MSc Information Management

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Declaration

This dissertation is submitted in part of fulfilment of the requirements for the degree of MSc of the University of Strathclyde.

I declare that this dissertation embodies the results of my own work and that it has been composed by myself. Following normal academic conventions, I have made due acknowledgement to the work of others.

I declare that I have sought, and received, ethics approval via the Department Ethics Committee as appropriate to my research.

I give permission to the University of Strathclyde, Department of Computer and Information Sciences, to provide copies of the dissertation, at cost, to those who may in the future request a copy of the dissertation for private study or research.

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I would like to express my gratitude to the University of Strathclyde for giving me an opportunity to do this project. I would to thank my Supervisor for being always available throughout the process of this project as well as the clinicians who took time to be interviewed.

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Abstract

Health sector face different clinical-oriented tasks using different methods to take care of the patients faced with different health conditions. Rapid growth of technology usage has resulted in web interfaces designs to monitor cancer patients symptoms in order to improve their quality of life.

This project aimed : to encourage clinicians to enhance the quality of life in cancer patients through the use of technology (ASyMS), to enhance in the understanding of the usage of the eSMART/ASyMS interface by clinicians, to allow successful technology communication between clinicians and cancer patients in future.

This project conducted a two phase qualitative research using Think- Aloud and thematic analysis method. This project used video and audio recorded to observe clinicians in using the original and the prototype designed eSMART interface.

Overall, clinicians perceived as the eSMART web-based interface as highly usefull in monitoring cancer patients symptom and improve their quality of life. The recommendation of this study suggested for clinicians, patients and all stakeholders to be included in the actual design and implementation of the eSMART interface

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Chapter One: Introduction

1.1 Overview of the study

Health is one of the crucial luxury in one's life and every step required to save lives should be seriously tracked. The health sector has started to recognise technology utilization advantages for efficiency and quality healthcare service delivery to their patients Therefore, the health industry have been targeted in different health situation through the usage of web based interface. Web based interface programs have been designed in the health sector for patients with conditions such as diabetes, HIV and AIDS, alcoholism, migraine, stroke to mention few and they all have positive effect on improving the quality of life in patients. To date several researchers are focused on developing web based interface continuously in helping improve the health care industry in saving lives. The utilization of technology has thus reached a need of technology communication between clinicians to monitor the symptoms in cancer patients in the health sectors.

People living with cancer experience a number of symptoms during and following treatment. Great Britain has reported 359,000 cases in 2017 of people diagnosed with cancer in the United Kingdom (UK), (Cancer in Scotland, 2017). Scotland reported of 31, 331 cases of cancer diagnosis in 2016 (Cancer in Scotland, 2017). Cancer patients are the most affected by side effects with little knowledge of how to control it to improve the quality of life when it occurs at home. Furthermore, Cancer patients are mostly faced with emotional challenges, anxiety, and confusion when symptoms occur before their next chemotherapy. Chemotherapy is a core component of cancer care and with projected increases in the incidence of cancer advances in related treatments, its use is likely to increase considerably (Kearney et al., 2009). Chemotherapy is a difficult time for cancer patients as they are faced with side effects some of which can be serious and even life threatening (Kuderer, et al.,2006) such as nausea, vomiting, fatigue, diarrhoea and neutropenia. Factors of poor communication and misinterpretation of information between clinicians and cancer patients often result in less successful treatment cases and serious life threatening. Cancer patients receiving chemotherapy need education and information on their disease using technology because it is commodity in their daily lives.

Moreover, the effective monitoring and management of symptoms in cancer patients is viable in order to prevent the development of severe toxicities which cause significant distress to the patients and result in prolonged hospitalization which may cause death (McCann et al., 2009).

The implementation of new strategies of care designed to deliver services as efficient as possible and the shift from in- patient to care, means that more patients are receiving treatments on an out-patient basis, resulting in them having to manage symptoms and side effects at home without having to visit the hospital should the symptoms arise (Kearney, et al.,2009). McCann et al., (2018) further stated that , the development of remote monitoring systems in service delivery was awaken by the recognition of the need for regular and systematic approaches to cancer symptom assessment and the need for affordable solutions to address the increasing demands placed on acute care. The use of technology positively ease the provision of 'real time' symptom communication between clinicians and patients and enhance as well as reducing the anxiety in patients. The use of technology by clinicians is patient centred and appear to complement current transitions within health care models, shifting care from the acute hospital setting to the home environment, with technology being used to rationalise and integrate services, where appropriate, based on patient need (Kearney, et al. 2009, p. 6).

The approach has adopted the usage of technology through Advanced Symptom Management System (ASyMS) to reduce hospital visits and costs. An advanced symptom management system (ASyMS) through Electronic Symptom Management System Remote Technology (eSMART) is a real-time remote symptom monitoring device developed for cancer patients by European Union (EU) funding project (Maguire, et al. 2015). The use of the eSMART web interface via ASyMS provides a great advantage between clinicians, cancer patients and the entire health sector at large. The mere fact that a clinician is connected online with the patient, monitoring the symptoms enhancing the quality of life is guaranteed.

In this aptitude, clinicians may support the quality of life in cancer patients through web based interface information dissemination. In order for the data to be as clear and useful as possible to patients and clinicians, it is imperative to have a good user interface that can display information in a clear, logical and enjoyable way. Therefore, the aim of this thesis is to develop a web-based user interface for the ASyMS data and evaluate it using user experience and task-centred metrics.

1.2 Problem area

The researcher outlined in the introduction that the use of technology in the healthcare can enhance the service delivery provided by clinicians to cancer patients. However, the ASyMS web based interface is a new system to the clinicians and even though it has been assessed in countries like Canada (Moradian, 2018), it has has not yet been widely used across the world. ASyMS is a developed and tested system operating on eSMART interface for the EU funded project, nonetheless other health sectors are using ASyMS system on different interfaces. Currently, ASyMS is in operation where clinicians are dealing with registered cancer patients across Europe in monitoring cancer symptoms in patients and improve their quality of life. Repeatedly, there are cases that the system had been evaluated in some areas such as Canada (Moradian, 2018), the interface has not been evaluated by the EU funding body since it came in operation five years ago by the team in Europe and University of Strathclyde clinicians who are involved in the eSMART/ASyMS project currently. ASyMS system on eSMART interface has been developed by Docobo a digital health and telehealth organization which commercialize EU funded projects. Until then, there has not been an experimental research clinical-oriented for cancer symptoms monitoring which created and tested the web based interface in terms of navigation exploration, content appropriateness and usability from the user centred design point of view in ASyMS system. Therefore, the purpose of this project, it presented an experimental of work to develop, test and improve the website features. Furthermore, to develop functionalities for ease of use by clinicians and improve the quality of life in cancer patients.

1.3Research objectives

The main objectives of this dissertation was to develop and test a web-based user interface for the eSMART/ASyMS using clinician's experience and evaluation in the

usage of the current eSMART interface in place. To gain an understanding of this dissertation, the objectives of the dissertation were to (a) enhance the functionalities of the eSMART interface for better understanding and usage of features, (b) helps clinicians to provide quality needed information in a timely manner to cancer patients, (c) have an ease of use of the interface in their daily lives and (d) Improve clinicians service delivery in patients outcome during and after chemotherapy treatment.

Furthermore research questions for this dissertation advanced to the mentioned objectives and they are as follow:

- Is the ASyMS user interface easy to use by the clinicians?
- Is the ASyMS content appropriate to clinicians?
- Is the ASyMS user interface and web based application recommended by clinicians ?

The learning outcomes from this dissertation and evaluation of the web based user interface were to (a) encourage clinicians to enhance the quality of life in cancer patients through the use of technology (ASyMS), (b)to better understand the usage of the eSMART/ASyMS interface by clinicians, (c)understand the language of technology through communication between clinicians and cancer patients in future.

1.4. Study structure

This project comprises of five chapter and employed an empirical study, qualitative method approach. This project followed a criterion provided in the Post-Graduate Dissertation Handbook from the Department of Computer and Information Sciences

Chapter one: Introduction

The chapter have provided the orientation of the proposed study, spelled out research questions, research objectives and the research outcomes from this project.

Chapter two: Literature review and Conceptual framework

This chapter demonstrated the distinctiveness of this project. Firstly, it discusses the background of the ASyMS system operating on eSMART interface which was a focus of this project. The chapter presented how previous literature explorations informed the work of the researcher. The chapter further discusses the conceptual framework why it utilised two software development models used in creating and testing a web based interface which directed this study to it is completion.

Chapter three: Methodology

This chapter presented two phases of the iterations of research methodology of this project and defined methodology mechanisms of each phase.

Chapter four: Analysis

This chapter discussed the findings of this project. This chapter also presented the design of the prototype of ASyMS system on the eSMART interface.

Chapter five: Conclusions and recommendations

This chapter concluded the project through the discussion of contributions and future recommendations of the study.

Chapter Two: ASyMS overview and Literature review and Conceptual framework

2.1 Chapter overview

This chapter presents an overview of ASyMS system usage by clinicians in monitoring cancer patients' symptoms using eSMART interface as part of European Funded project. The chapter introduced the impact of technology to clinicians in using ASyMS. The chapter provided a background and several architectures of how ASyMS system operates on eSMART interface in monitoring cancer patient symptoms or chemotherapy toxicities. The chapter further explored other literatures on the clinicians' usage of web-based interface in monitoring chemotherapy toxicities in different countries particularly Western countries because the project is mainly focused on European countries. Furthermore, the chapter provided conceptual framework with two models as a direction in designing a new web-based interface. Lastly, the chapter concluded with a summary.

2.2 Introduction

As mention in chapter one, the health industry is one of the fast industry in using technology to successfully provide medical services to the clients. Massachusetts Institute of Technology Enterprise Forum which took a place in 2011 Paris, estimated that the industry will grow tremendously by 2020 (Istepanian et. 2004, p.4015). As mentioned in chapter one, the health sector has thus adopted the usage of web based interface in monitoring cancer symptoms in patients. This has been a practice by clinicians in western countries in particular in finding ways to monitor cancer patients' symptoms through the use of web-based interfaces. The Scottish Executive Health Department (2005) has further supported that information and technology usage has become a mean to overcome barriers in monitoring symptoms in cancer patients.

Therefore, technology has become a fast integrated crucial service delivery in assisting clinicians to successfully fulfil their tasks and reduce the risks or catastrophe in cancer patients.

Second to the clinicians, encouraging them to use web-based interface with the right functions in place will give them an awareness of what patients need to save their lives which will have a great impact of using web based interfaces in the health care industry.

2.3 Advanced Symptom Management System (ASyMS)

The ASyMS is one of the adopted systems in the western world to monitor cancer patients symptoms. According to Maguire et al.,(2005) ASyMS has been developed over a period of 5 years to remotely monitor and manage chemotherapy related toxicity in patients with cancer. ASyMS was developed by researchers, cancer clinicians and people with cancer in monitoring the cancer patients symptoms (McCann et al., 2018).

The ASyMS has been developed to facilitate the remote monitoring and management of chemotherapy and cancer symptoms in patients using patient reported outcomes questionnaire and a clinician alerting system (Moradian et al, 2018, p.1). The system sent real time patient information to a secured connection server which further generates symptom advices to the patient in the comfort of their homes. “If the incoming symptom reports are of clinical concern (e.g., indicative of a developing infection), and require an intervention then an immediate red alert is sent to a dedicated ASyMS clinician handset (i.e., the handheld device which will be carried by a designated nurse or ‘alert handler’ in the hospital 24 hours a day). A red alert (to be managed within 30 minutes) is generated for symptoms that are severe or life-threatening (e.g., fever). An amber alert (to be managed within 8 hours), is of moderate concern and will be generated in response to symptoms that have the potential to become more serious (Common Terminology Criteria for Adverse Events (CTCAE 2)” (McCann et al., 2018. p4).

It is further supported that ASyMS stores real- time information on patients’ symptom experiences and has the potential to improve the accuracy and completeness of reporting, increase clinicians understanding of patients’ symptom experience, influence the effectiveness of symptom management strategies, and may ultimately improve the standard of healthcare , (Kearney et al., 2006).Furthermore, the system allows real time patient information to be viewed by the clinicians through a secured

web interface using eSMART upon the patient symptom alert. The clinicians will then advice the patients via the interface following the hospital policies and procedures. The system also provides a clinical portal for clinicians to screen and follow up on the alerts when triggered and review patients specific information (Breen, et al.,2015). The need to use eSMART/ASyMS app in cancer patients and good interface used by clinicians will inform patients about the things they can do to help themselves get well. Moreover, clinicians ability to capture patient- recorded symptom data in real time is a gold standard to improve patients outcome(Breen, et al., 2015). McCann et al, (2018) stated that research has proven that using ASyMS by clinicians improve the management of chemotherapy toxicities in cancer patients through monitoring the symptoms. This has greately resulted in improving the quality of life in cancer patients.

The ASyMS architecture presented below

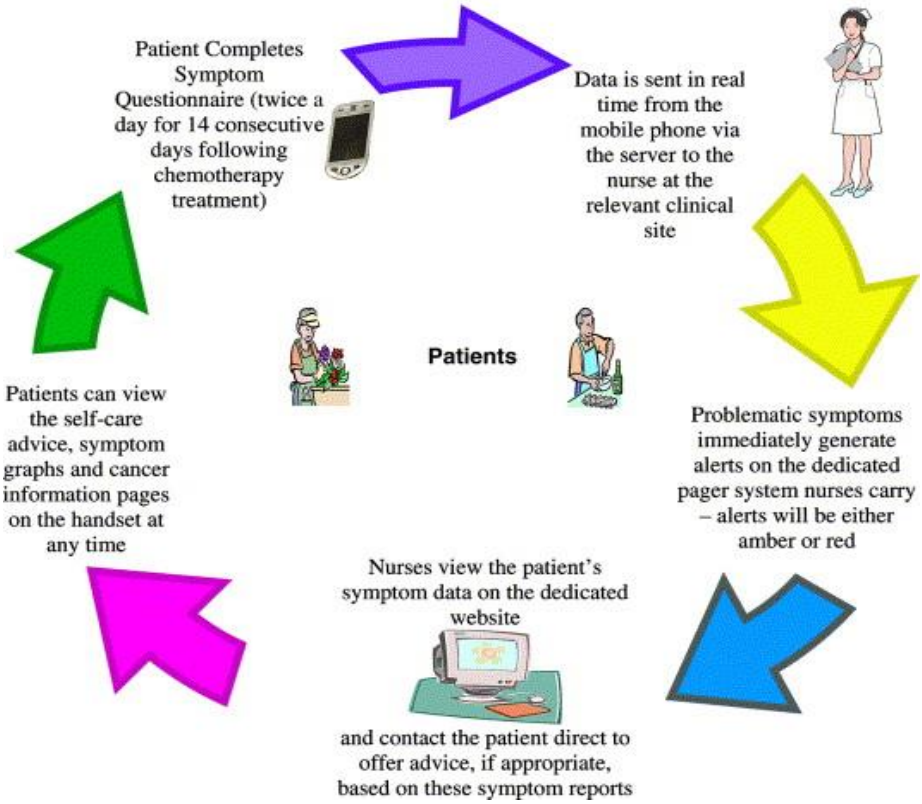


Figure 1 the architecture of ASyMS used by clinicians to patients

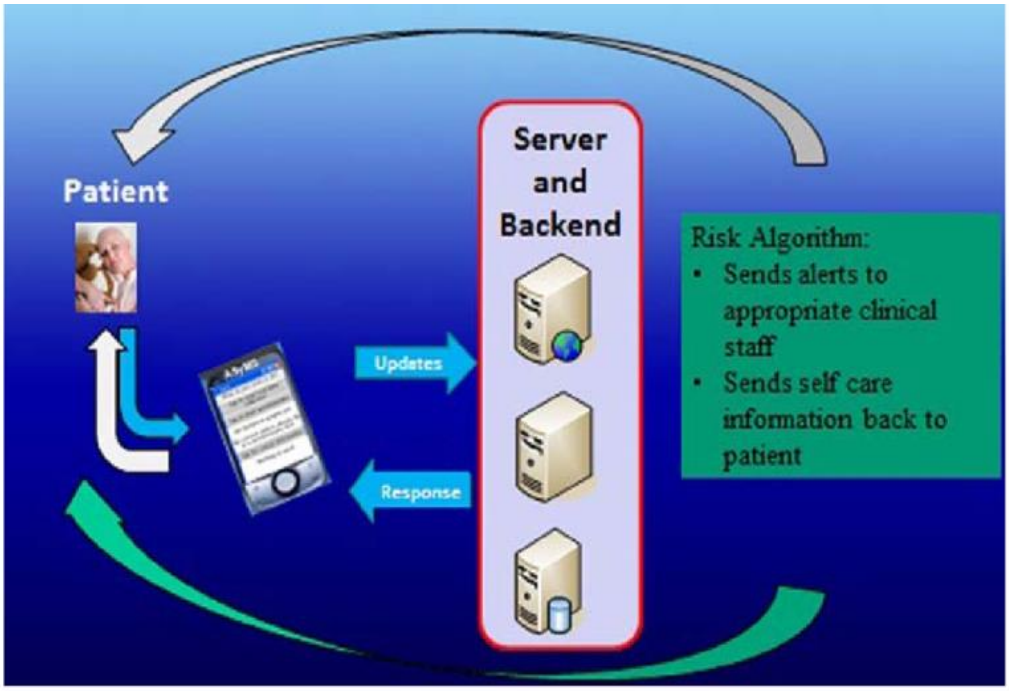


Figure 2 two way communication between clinicians and patients via ASyMS and eSMART

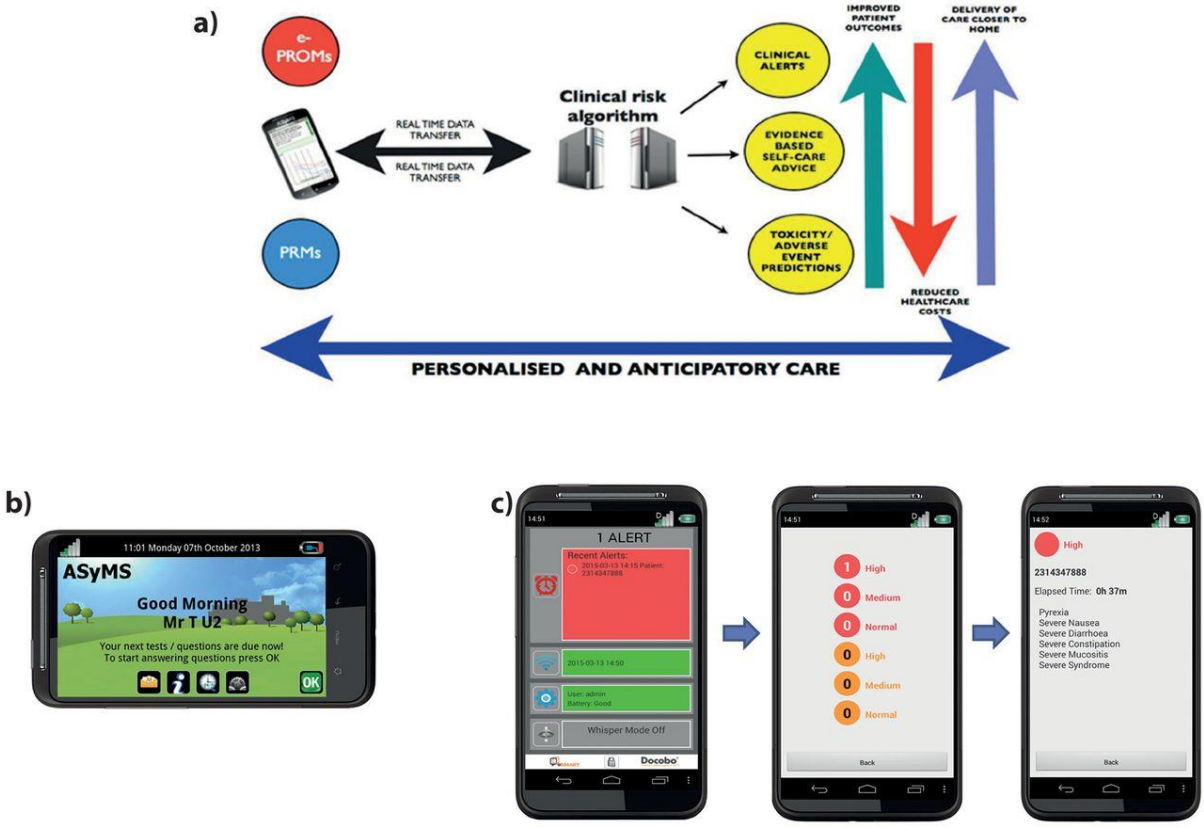


Figure 3 The ASyMS system

2.4. Literature review

The usage of web-based interface in monitoring cancer symptoms or chemotherapy toxifies allows access, communication and feedback that traditional paper method is not able to provide in a timely manner. The key point of designing a successful web-based interface comprise of attributes which need to be considered for ease of interaction between human and technology. Through the designing of the web-based interface, an opportunity to address gaps in current clinicians accessing web enabled applications and interfaces to complete clinical workflow is very important. It was very important for the researcher to be guided by the several literatures on assessing web-based interface based on clinicians' perceptions in monitoring cancer patients' which had been conducted using other web based interface systems.

Most literature for web-based interface clinical oriented in monitoring cancer patients symptoms are from the United States of America. Hu, et al (2011) , designed a user friendly clinician-oriented web-based interface in monitoring prostate cancer symptoms in patients. This was with the aim to help clinicians to successfully interact with the system and provide clinical care to the patients. The research successfully indicated that the system designed enhanced an awareness of clinicians tasks in interacting with the system which will contribute in improving the quality of life in prostate cancer patients (Hu, et al,2011).

Electronic Self-Report Assessment for Cancer (ESRAC) is web-based interface which had been operating in Washington, United States of America (USA) used by clinicians to monitor cancer patients' symptoms. A study done by Wolpin, et al.(2015) aimed at clinicians in testing new features and evaluate the interface focusing on the content, user interface needs. The study used a qualitative focus group approaches through audio recording which was then transcribed for findings interpretation. The study discovered that the interface navigation was rather confusing to clinicians and lacked additional information about cancer symptoms. The study also discovered that some clinicians are internet-naïve users and more training was required. The study suggested for an amount of time for the project to reach it is objective as well time for usability testing. Additionally, the study suggested that it is testing platform is independent from other development exertions.

In 2016, Memorial Sloan Kettering Cancer Centre in New York, USA assessed the perception of clinicians of a prototype web based interface using Symptom Tracking and Reporting (STAR) in monitoring breast cancer patient symptoms. The study discovered that further communication work and strategies for engaging clinicians in harnessing technology to improve care in cancer patients was needed (Basch, et al. 2016). The USA claims to be the most successful with highly web-based interface systems used in health organizations like Kaiser Permanente and the Veterans Administration Health System used by clinicians in monitoring chemotherapy toxicities and embracing information and technology enabled solutions. The researcher confidently utilised these literature for it is widely conducted research with different exploration of cancer symptoms monitoring systems using web-based interface.

Furthermore, European Institute of Oncology (IEO) in Milan, Italy developed Interactive Empowerment (IE) web-based interface prototype which was developed to be used by clinicians dealing with breast cancer patients. According to Gorini, (2016), the IM interface was to investigate clinicians perceived usefulness, perceived ease of use and user acceptance of the interface. Although the clinicians positively embrace the IM interface, further parallel work was required to explore the effectiveness of the interface in different types of cancer.

Prince et al, (2019), designed a web-based interface prototype to manage chemotherapy in cancer patients at the University Health Network in Canada. The study targeted clinicians (Medical Oncologists, Cancer Nurses, Cancer researchers etc) through a focus group. The study aimed at discovering gaps and barriers in the designed web-based interface. The study discovered themes on the need for improved communication, options in care delivery to cancer patients and secure access to credible and timely information to the patients. A study done similarly by Palanica, et. al. (2019) on the perception of clinicians in using the interface monitoring cancer patients in Canada using Chatbots. The study concluded that although Chatbox proved efficacy and cost-effectiveness in the health care sector, Chatbox need to improve it is features which include nutrition, diet to fully address the need of patients information should cancer symptoms recur. Similarly Bolle et al, (2016)

conducted a study at the University of Amsterdam of the user experiences on monitoring cancer symptoms in Netherland's patients with web based health interface using think aloud study. The study focused on usability and navigational barriers, and concluded on designing a usable and comprehensive web interface with clear tools which would help in improving quality of cancer patient's life.

Furthermore, Collins, et al. (2016) piloted a study on a prototyped web-based interface iPrevent in Australia. iPrevent is managed by different healthcare providers in monitoring breast cancer patients. A focus group with primary care Doctors, Breast Surgeons, Breast cancer screening staff was conducted in building an interface which satisfy user requirement. Acceptability of the content, layout, presentation of graphic format was the aim of the web-based interface. iPrevent envisaged that health care providers were satisfied with the prototype of the web-based interface and future launch of the interface was envisioned.

Meanwhile in Finnish cancer centres (Finland) Kaiku health web-based interface was created in monitoring cancer patients' symptoms which involved shortness of breath, decreased appetite and cough to improve their quality of life (Iivanainen et al, 2018). The study indicated that clinician-oriented user-friendly web-based interfaces is very important in improving the quality of life of the cancer patients and monitor cancer symptoms of patients.

A study done by Krogstad (2017) on developing web based used interface using Patient- reported Outcome Measure in Clinical Practice (PROM) was assessed on clinicians. PROM was established in evaluating cancer patients' symptoms and improve quality of life. The study aimed at finding out the perceptions of clinicians on the ease of the web usability and content appropriateness. The study concluded that usability of the interface needed features modification by reducing the features displayed on the screen. In addition, the content needs to be presented graphically for better comprehension. According to Holch,et al., (2018), a web interface was developed in evaluating the perceptions of clinicians in using electronic patient self-Reporting of Adverse-events: Patients and information and aDvice knowns as (eRAPID) , a program funded by National Institute for Health Research (NIHR) in the UK. The web interface aims was to find out the ease of accessibility of the web interface and the content used on the interface by clinicians.

The study concluded that more training on the clinicians and acceptability to use the system was needed by clinicians to fully embrace it.

The University of Oxford medical informatics team looked at other web interface tools that clinicians can benefit from. Kun-Hsing, et al. (2018) evaluated the data mining interface Omics AnalySIs System for PRecison Oncology (OASISPRO). The interface allows clinicians to explore data with ease and provides biological insights into cancer developments and generates robust clinical prediction models that guide clinical cancer management. Kun-Hsing, et al. (2018) emphasized that "The absence of a user-friendly web-based omics data analysis system prevents timely discovery of cancer biomarkers and hinders the study of biological mechanisms leading to different disease phenotypes". A user-friendly web-based interface is thus crucial in the clinician's daily lives in monitoring cancer patients' symptoms successfully and make right informed decisions.

Furthermore, the researcher also explored other cancer web applications which involves clinicians' views on the interface. BOADICEA (Breast and Ovarian analysis of Disease Incidence and Carrier Estimation algorithm) web application has been explored by clinicians from various countries in monitoring and preventing breast and ovarian cancer. Bredart, et al. 2017 conducted a research on the perception of BOADICEA web application user acceptability (clinicians), ease of communicating, data entry time and clinical utility. The findings of the study concluded that clinicians found the web application difficult to use and suggested a technological, service delivery training for clinicians to make use of the interface better.

Lastly, the UK has developed a system prototype for a web-based system in monitoring cancer patients symptoms CancerGrid (Calinescu et al, 2007). The project involves clinicians, cancer researchers, bioinformaticians and software engineers from various prestigious institutions in the UK. The purpose to include individuals from different specialization areas in the project was to align with the design of the web based interface. In addition, to help in execution and successful analysis of cancer clinical queries.

The researcher was convinced there are so various ways used on different paths to create web based interfaces in monitoring cancer patients symptoms or implement system prototypes with the aim to successfully improve the ease of use of clinicians-oriented web based interfaces in monitoring cancer patients symptoms.

2.5 Conceptual framework

The nature of this project is qualitative approach and conceptual framework is viable to guide the project process consistency and provide comprehensive of the project's outcome. Conceptual framework has been a core in qualitative approach for its interpretative reality and has been recommended in empirical research studies (Jabareen, 2009). Conceptual framework has additionally been given similar definition by several authors as a framework which give one meaning to research projects in different disciplines. Conceptual framework is a system of theories or models which support and uniform the research and relationship among them (Robson, 2002). In system software development, there are several steps and directions to be followed when creating and testing a web based interface before they are accomplished. It was sensible to reference models in the conceptual framework due to the nature of this experimental project. Carr and Verner (1997), asserted that in experimental studies where software development and prototype is involved, researchers have tailed and pursued various models to direct in the design of web based interfaces. Therefore, this project adopted conceptual framework models in order to make sense of the web based interface creation by making use of the models which sign-post in the development of web based interface of this project. In addition, when creating of the web-based interface involves clients views before the actual implementation, models for software development are always essential to be referenced to. The aim of choosing the models is to complement the web based interface design and to align with software development principles as supported by authors above.

Therefore, conceptual framework models was necessary to guide and make sense of the concepts of this project.

The researcher identified two framework to successful guide this project Agile software development model and the Information architecture model.

2.5.1 The Agile software development model

The agile software model as it is known was used for this project. According to Abrahamsson (2017), involves iterative combination and process of incremental models with the focus on process adaptability and customer satisfaction by rapid delivery of working software product. Agile software development model is a flexible and adaptable model and the researcher utilised the model to define the minimum viable product which are in this project were features which the clinicians would like to be included on the interface. This model work on iteration approach, design is on features incremental and it is final build is determined by the requirement features by the customers (Stoica, et al, 2013).

Furthermore, the model focuses response to change and is an incremental model and dynamic. Where iteration phase I does not succeed , the model repeats an iteration until it reaches it is desired results without going back to the drawing board to start over the process. This experimental project was conducted on iterations by involving the clinician team to help the researcher come up with the ideal design and testing of the eSMART web based interface features. The researcher had confident that a project which works on an agile model is deemed to succeed and this was sensible for this project to adopt the agile software development model.

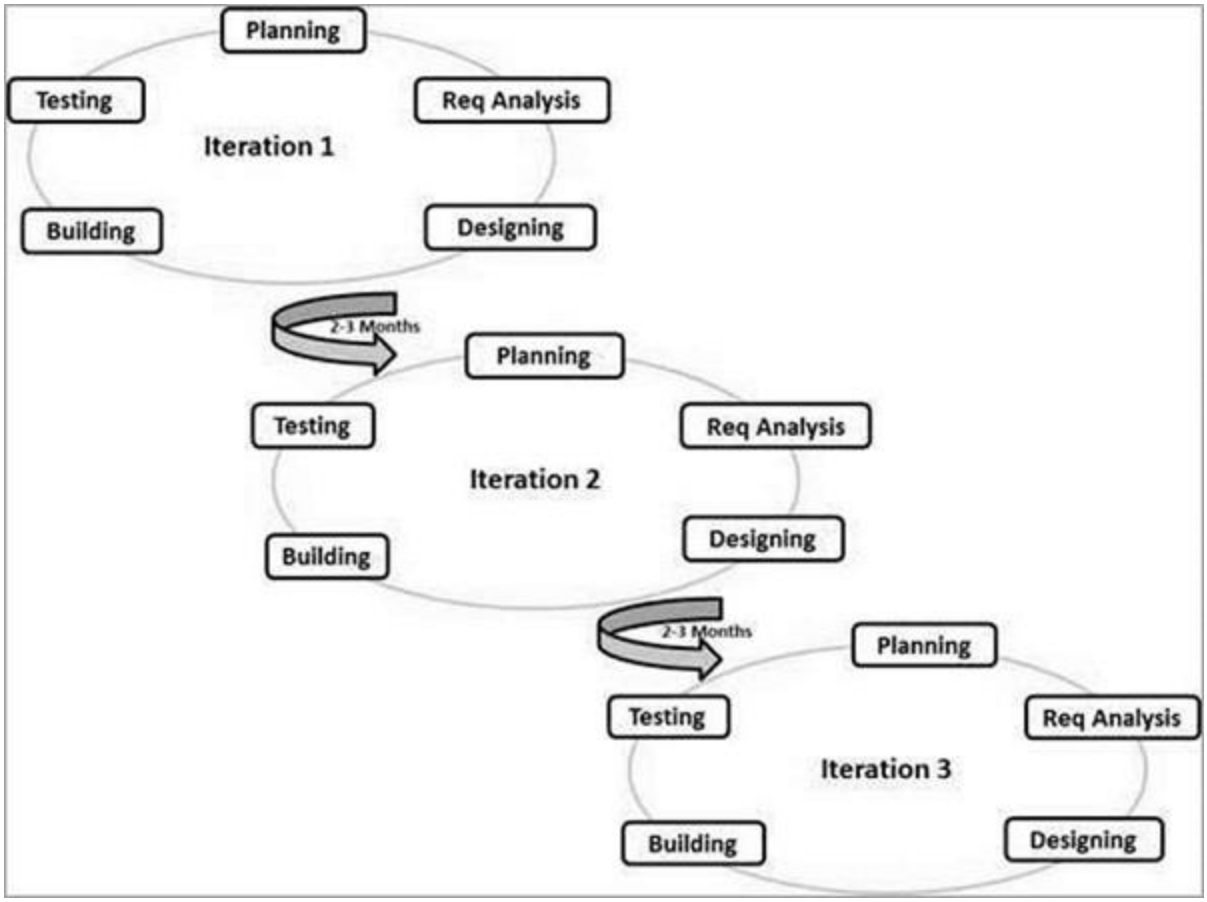


Figure 4 The Agile SDLC model (Bassil, 2012)

2.5.2 Information Architecture model

The researcher adopted Information architecture model known as the infamous three circles of information architecture in designing web interface by (Morville and Rosenfeld, 2007). The infamous three circles of information architecture had been used by over 100 various successful organizations integrating it with Waterfall model in designing web interfaces (Morville and Rosenfeld, 2007).

Firstly, content presented in the model represent the data types or document content objects. The researcher considers that the content presented in the web based interface should align with the (participants) clinicians needs or daily work to achieve and serve the purpose of the web based interface. Secondly, context entered in any interface as elaborated in Morvillle and Rosenfeld (2007, p.235), represent technology

infrastructure. The researcher adopted this attribute because the context of the eSMART web based interface creation should be understood by the clinicians . Lastly, users attribute of the model represent the direct users of the interface, whereby users in this regard are (participants) clinicians who will be the direct users of the interface. Their ease of using the interface will be then determined by their behaviours in searching for the information to improve the quality of life in cancer patients. This project found the two frameworks viable to guide the project as well as answer the objectives and research questions for this project. eSMART European team in monitoring cancer patients symptoms as mentioned in the first chapter

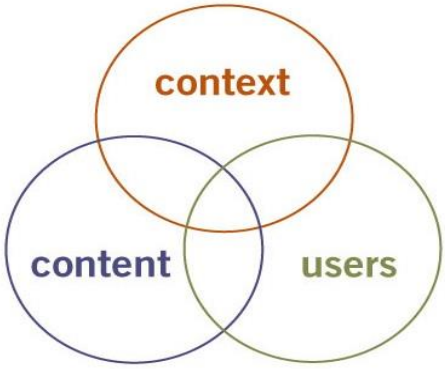


Figure 5 Infamous three circles of Information architecture (Morville and Rosenfeld, 2007)

The software development models assisted the researcher to analyse eSMART interface in place which ultimately aided in redesigned better interaction web based interface which could be used in a friendly manner by clinicians (see chapter three). During the design of the interface the researcher asserts that features of the interface should consider:

a) That, the choice of content to be displayed on the designed interface should be cooperating with the participants needs.
b) That, the information or features display on the interface should be minimal and easy to use and understand even by a technologically challenged user.
c) Colour or themes used should be carefully selected for high readability and clarity

The two model used in this project was deemed to be viable and provided a clear direction in the prototype design of the eSMART web based interface.

2.6. Chapter summary

This chapter outlined different perception of the cancer web based interface in monitoring cancer symptoms by clinicians in different countries globally. The chapter further discussed the outcome that most clinicians faced technological understanding of the web-based interface which make it difficult for the health sector to improve quality of life of cancer patients. Furthermore, the chapter outline the results of some studies which emphasized on the desired content of the web-interface. Lastly, this chapter used two models for software development to guide the process and provide meaningful results for this project.

Chapter Three: Methods

3.1. Chapter overview

This chapter employs an overall procedure of qualitative research method design of this project which perceived the views of clinicians in the current use of eSMART interface. Furthermore, the chapter discussed two phases which had been used in the in the research methods of this project. Section (3.2) provided an introduction of the research approach used in this project. This chapter further outlines the data collection methods and procedures provided in sub sections. The chapter elaborated web design for easier comprehension of prototype design. The chapter discussed the importance of using Think-Aloud (TA) and demonstrated the prototype design procedure. This chapter discussed the ethics considerations as part of any research activity. Lastly, the chapter concluded with by demonstrating of the AS-IS screen shot of eSMART interface and TO-BE designed prototype to provide a better understanding of the eSMART interface.

3.2. Introduction

Research approach in any study stems from research design and methodological issues involved. Offredy and Vickers (2013), asserted that research design outlines and implement research project in practice and should ensure that the research agenda contains design, data collection and analysis to systematically answer the research questions.

Whereas Cresswell (2009) defined research design as the proposal or plan to conduct research, which puts into account the philosophical worldview assumptions of the study, the strategy of inquiry relating to the worldview, the specific methods and procedures of research that translates the approach into practice. Meanwhile, According Lapan et al, (2012), qualitative research is an approach that enables researchers to explore in social and organizational characteristics and individual behaviours and their meaning. Braun & Clarke (2006) emphasized qualitative method is essential to be used in experimental studies because it provides core skills that will be useful for conducting many other kinds of analysis' (p.78).

The researcher was guided by these definitions in order to make informed decisions in the research methodology used in this project. As stated at the beginning of the chapter, this study employed a qualitative research methodology.

The researcher employed qualitative research methods because of personal perspective response and interaction of the interface from clinicians required in this project. The researcher sought to gain in depth understanding and needs of the clinicians experimental and evaluation on the eSMART interface to make informed decisions in the designing of the interface.

3.3. Research methods approach

The nature of this project was experimental which involved an associated software to test the performance of the interface as mentioned earlier in chapter two. This chapter was very important for the researcher to include all the necessary methods required in a user experience project. It was thus practical for the researcher to elucidate on the process steps taken during methodology process on this project. This project employed a usability testing, usability evaluation method (UEM) which functions with think aloud (TA) method because it involves the physical observation and interaction with the web interface of clinicians.

The study sought to develop a comprehensive practical web based interface for clinicians in improving quality of life of cancer patients. Therefore, an in-depth interview with 9 questions was used and employed think-aloud (TA) techniques to deduce the clinicians experience with the current eSMART web based interface in place.

3.3.1 Usability testing method

Usability is the ability to use the interface or system easily and in a comprehension manner by users (Nielsen, 2012). Usability has become a critical factor determining whether an interface will survive or fail in an organization. Nielsen (2012) further emphasized that usability is necessary on the web interface for it to survive, a difficult web interface to use people leave. Navigation, information architecture, terminology and page layout provides an outstanding user interaction (Gardener, 2007, p.63).

Usability testing method evaluates how an interface work for stakeholders and to the extent to which a stakeholder can use the product to achieve a desired goal (Nielsen, 2012).

In principle, usability testing was important to be carried in this project in order to ensure the interface design meets the needs of clinicians and has the optimum impact on care provision to cancer patients (Taylor, Allsop and Bennett 2017). Usability of web based interface is increasingly recognised as an important factor in the design and development of websites or web interfaces, offering multiple benefits for both development teams and end users (Scholtz, 2006).

In a study conducted on usability by (Prince et al, 2019 p.2) “Engaging clinicians in an efficient and accurate interface, results in highly relevancy solutions while avoiding features and functionalities that were not relevant or useful in existing tools”. Therefore, if the interface is not sufficiently usable, users will simply abandon it in favour of alternatives that better cater to their needs”(Alhadretti and Mayhew, 2018, p.2). The selection and employment of effective usability evaluation methods (UEMs) was also a crucial element of product development in this project. Usability of the web based interface had been explored in prostate cancer study user testing interacting tool by (Scalia, et al, 2019). The researcher hence adopted usability testing as part of the user research method. Furthermore, clinicians perceptions in the interviews (see analysis of results) proved that usability methods was essential for this project. The clinicians use some of eSMART functions in the current interface by performing multiple functions in order to successfully monitor chemotherapy related toxicities when interacting with the interface.

3.3.2 Think Aloud (TA) method

Participants interacted with the system during the first and second phases of interviews for the researcher to observe their usability experience as well as to assess their perceptions of the eSMART interface. Therefore TA was used to enable the researcher to have a better understanding of the usability of the system (Scalia et al, 2019).The researcher had an opened eSMART interface with clinicians during face to face interviews, and clinicians where answering the research interview questions based on the navigating and using the interface features. The interview conducted over Skype with a clinician in Ireland, the researcher and clinician both had the

eSMART interface opened and interview questions were answered based on the experience clinician was facing during navigation of the system. Furthermore, the interview held over the phone with a clinician in England, both the researcher and clinician had the interface opened at the same time as well and the research questions were responded through the navigation of the interface and pointing out usability issues. The researcher recorded all sessions by video with the face to face interview and skype interview except for the telephonic interview as the clinician had no access to skype at the time of the interview session.

Because the aim of this study required clinicians perceptions of the interface usage, it was important to identify the satisfaction of the current eSMART interface from the clinicians through the observation of using the interface in order to create a better satisfactory interface referencing TA technique. The researcher has confidently reliably used TA method because of previous research on user experiences on cancer web based interface using TA approach. Bolle et al, (2016), has successfully used TA method in cancer web based interface clinically oriented regarding the usefulness and content appropriateness of the interface. Furthermore, Nikolaus et al, (2014), has emphasized that TA method during data collection has been used previously widely to investigate usability and perceived usefulness of the web based interface. It is additionally supported that TA method had been used in web- based interface evaluation to provide a better understanding of the usability and feasibility (Scalia, et al 2018).

TA technique is mostly employed to examine activities and comments on the user and get feedback on the usability and feasibility of the tool (Scalia et al., 2018). UEM of interfaces contains human factors and in this study clinicians where the human factors and influencers of the web based interface design. According to Scholtz (2006), different UEMs have been proposed in a wide range of enterprises embracing the use of interface between employees and clients. UEM has assessed TA user related method because users verbalize their perceptions out loud as they interact with the system (Moradian,2018).

The researcher was then confident that using TA and UEM method was the best approach of this project because clinicians will be interacting with the system during data collection. Thus TA and UEM were required in this project for comprehensive

result analysis. Furthermore, usability testing method using TA had been used on similar project in health sector using web based tools in monitoring cancer patients symptoms.
A study by Moradian et al, (2018) has used TA and usability methods in evaluating the web based system in monitoring and management of chemotherapy-related toxicities in cancer patients.

The design of the web based interface was required by clinicians for a better intuitive interface as opposed to the current eSMART interface (see analysis of results) hence the adoption of UEM in using TA method in this study. McDonald et al., (2012) stated that one of the remarkable benefit of UEM widely used in the design of web based interface method was think-aloud (TA) protocol. TA methods were originally based on the theoretical framework developed by cognitive psychologists Ericsson and Simon, and was further introduced in the field of science computer science hence the adoption of usability testing (Alhadreti and Mayhew, 2018). The researcher used a usability testing where participants used realistic undertakings and TA while going through the features of the eSMART interface during interviews as mentioned earlier. Repeatedly, TA stems mainly from their ability to offer insight into the thought processes and experiences of users interacting with a particular system during usability testing of the web interface (McDonald et al., 2012).

The benefit of using TA in a web interface design is that, it can provide accurate unbiased results with only few participants involved in a study. This motivated the researcher to use TA method, because other researchers supported that TA method requires low number of participants (Bolle, et al. 2016, p.4). Bolle, et al (2016) further supported that “TA are classic method to assess user experience of web-based interfaces”. Moradian et al., (2018, p.3) has provided that the study on usability testing can detect up to 80% data collection accuracy with only 4 or 5 participants involved in the study.
TA methods provide usability practitioners with verbal and visual indications of the usability of their systems (Clemmensen et al., 2009). Therefore the study used TA method as an interactive tool which allowed clinicians to verbalise their thoughts on the existing eSMART interface in place.

Therefore, TA helped the researcher to gain authentic opinions from clinicians to recommend, identify changes and difficulties faced in navigation and understanding features of the interface.

Clemmensen et al., (2009) also supported the TA as the test method which test participants work on a set of tasks and ask them to verbalise their thoughts and task performance. Partcipants verbal, and behaviour are recorded by a test evaluator and in this study , clinicians views of the web interface was thus recorded as mentioned earlier. It was then important for the researcher to use TA usability methods as there were only 4 participants involved in this study.

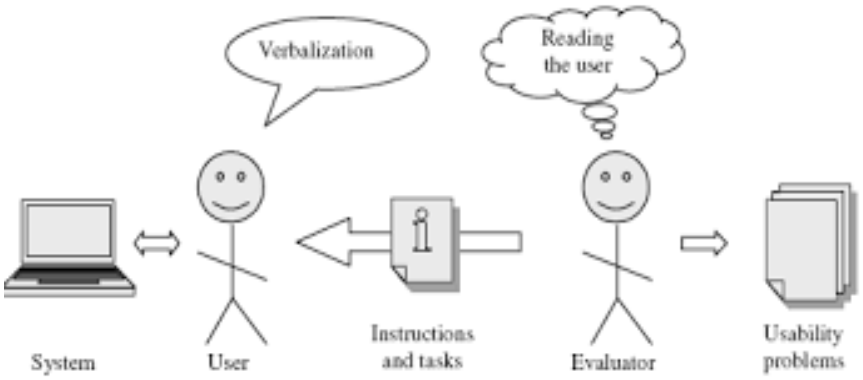


Figure 6 Think-aloud usability testing method (Clemmensen, 2009)

3.4. Data collection

Data collection in general allows researchers to systematically collect information, the phenomenon of the study as well as the settings in which they occur (Chaleunvong, 2009). Data collection adopted an individual level as Lapan et, al (2012, p.90) would state that, the focus of an individual level data collection is on the discovery of the main themes and range of variation in the experiences and practices of individuals.

This project involved two phases which the researcher referred to as iterative phase I and iterative phase II. Phase I (iterative phase I and II) evaluated features and identified the gaps needed to be filled by designing an ease of use eSMART web interface for clinicians. Furthermore iterative phase I was the sentiment of this project in data collection because it served as a guide in aiding the creation of the preferred new web based interface (eSMART) by clinicians. In principle, iterative phase was very important for this project using usability method to allow the eSMART interface to be observed or evaluated through data collection. This project was also an iterative project which involve the clinicians' perceptions on the initial interface. Futhermore, another iteration process was practised in designing a prototype for the proposed interface by the clinicians. Due to this nature, iterative phases during data collection was a reference used in the completion of this project by the researcher. Iterative phase in computer science means problem solving method cyclical and Berente and Lyytinen (2005, p.179) have asserted that iterative phase has to do with functional software testing in a wave of cyclical generation. Iterative process was also viable for this project because it could provide results which are acceptable, comprehensive and future recommendation for eSMART interface for clinicians in monitoring cancer patients' symptoms and improve their quality of life.

3.5. Participants Phase I

Participants chosen for this project were clinicians who are currently involved with the eSMART funded project in Europe. These clinicians are working directly with the interface performing different duties in monitoring cancer patients' symptoms in different organizations across Europe.

The researcher thus video and audio recorded clinicians during the interviews in order to identify the usability problems of the eSMART interface and make informed decisions in redesigning the new interface features.

Clinicians voluntarily and willingly took part in the study. The purpose of the project was explained by the researcher and clinicians were informed prior to their consent that audio recorded information will be discarded immediately after the transcribing (appendix A)

3.6. Participants phase II

Participants only involved two clinicians of the initially four who were interviewed in the first iteration or first phase of this project. One clinicians indicated that was only available when this project has past the submission due date . The other clinicians did not respond to the researcher's e-mail.

3.7. Procedure of iterative phase I

In order for the researcher to meet study aims as stated earlier, this project has been designed as a two phase project. Firstly, the researcher requested the eSMART programming team to gain credential access to the currently operational eSMART interface. Secondly, the researcher studied the existing features on the eSMART interface in place and attained the opinions of participants recommended features during interviews. The clinicians who were involved in the study had a direct usage of the current eSMART interface in place in a way or the other. The research sought consent from the participants via e-mail. Thereafter, the researcher e-mailed the clinicians questions before the actual interviews took place. This was the purpose to

make the clinicians aware and comfortable to decline or agree to answer the questions during interview times.

3.7.1 Research In-depth interview questions Phase I

1. **Web based interface ease of use**

⇒ Do you understand the interface features? If No, which ones do you not understand?
⇒ How easy was it to navigate the interface? What problems have you encountered in navigating the interface?
⇒ The interface has some short cuts, have you used them? Do you understand the purpose of shortcuts in the interface?
⇒ What is the feature/functionality that you would most like to be improved/different? Why, and what should it be instead?

2. **The content appropriateness of the web-based interface**

⇒ Is the content displayed on the interface appropriate for you/clinicians in monitoring cancer patients' symptoms? If no, what is not appropriate?
⇒ Does the content highlight the symptoms which you/clinicians encounter in monitoring cancer patients' symptoms? If no, do you think the interface should opt for you/clinicians to manually enter cancer patients' symptoms?
⇒ Is it necessary for the interface to outline the types of cancer clinicians are dealing with in patients?
⇒ Is the visual layout logical?

Additional question

⇒ Is the anything you would like to add?

The interview was held with four clinicians on different dates scheduled according to the clinicians' availability times. Clinicians were from the University of Strathclyde, Scotland, Mount Vernom Cancer Centre, England and St James's Hospital, Ireland. Interview questions merely focused on the current eSMART interface clinicians experiences as shown above.

Each interview session lasted 15 minutes and it was held at the University of Strathclyde Livingston building laboratory 11, which involved either in face to face, telephonic interview or skype interview. The researcher introduced herself at every interview session before proceeding to the interview questions.

The researcher developed an interview protocol with the following evaluation tasks provided on the interview questions above. The researcher selected Livingstone laboratory 11, because it is a Computer and Information Science student's laboratory within the University of Strathclyde, which was also convenient and have a better coverage. This was also beneficial because the researcher could have eSMART interface opened in the browser which provided a better understanding during interviews as clinicians had eSMART interface opened at their sites or in the lab as well during the interviews. In addition, the interview process was efficient for the participants which were outside the UK.

3.8. Qualitative data collection phase I and II steps

The researcher mentioned that this project was a conducted on two phases (Phase I and II). It was sensible for the researcher to create a flow diagram on the steps taken for phase I and phase II in order to provide an idea of the order taken during data analysis in both phases. The researcher defined the steps taken to give a clear understanding of qualitative method I and II. The researcher started off with the qualitative method phase I as described below and analysed results from the first interviews with the clinicians. Thereafter, the researcher designed the prototype and moved on further to qualitative method phase II. The researcher collected data in phase II , analysed and made judgements from the results and the researcher ended the process.

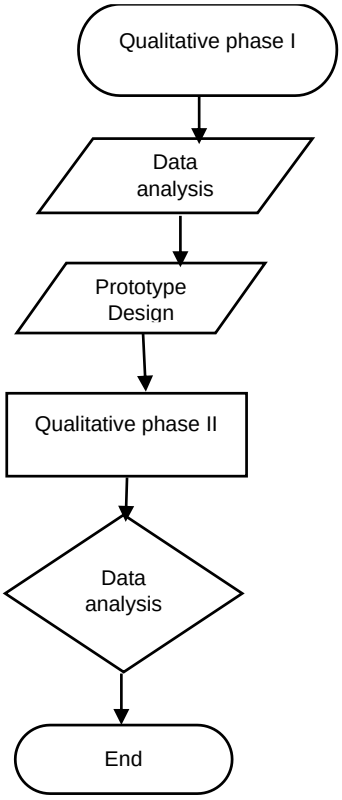


Figure 7 Flow diagram for qualitative method for phase I and II

3.8.1 Qualitative method phase I

The researcher used semi-structured interviews thematic analysis data using TA method to analyse the findings from the clinicians. The researcher video, audio recorded, transcribed and coded the transcribed information into Nvivo 12 software to aid in coding and analyse the project results. Nvivo 12 was recommended by the researcher for coding and themes identification which was best to achieve the objectives of this experimental project.

The researcher's choice of using Nvivo 12 software was also based on the software power for qualitative analysis which is the approach of this project. Nvivo 12 software have been used in similar studies by (Moradian et al, 2018, p.1) in evaluating ASyMS in monitoring and management of cancer symptoms in patients across Canada.

Similarly Bolle et al, (2016) have also used Nvivo 10 qualitative data analysis software in coding qualitative data in the user experiences with web based health information tools in monitoring cancer patient's symptoms.

In addition, Nvivo 12 software is a qualitative research analysis tool and it is recommended to be used by students at the University of Strathclyde where the researcher have attended Nvivo lesson during semester course.

Repeatedly, the researcher used Leedy and Ormrod (2015) guidelines in construction phase II interview questions by:

- ⇒ Keep the interview questions brief and short as possible.
- ⇒ Making the questions simple to enable easier response.
- ⇒ Asking straightforward questions.
- ⇒ Using unambiguous language.

3.9. Data collection Phase II

Data collection of Phase II of this project employed a qualitative analysis. Phase II of Data collection was a result of two apparent key productions in this project (web based interface design and prototype). The researcher designed a rapid prototype elements based on the findings and driven needs of clinicians from the first interview. Data collection method was practical in phase II to better identify and design eSMART web based interface features in the prototype. Clinicians' views and feedback were key apparent issues to add, modify and improve desired features on the eSMART interface. The researcher briefly described web based interface in the phase II because this was the sentiment project.

3.9.1. Web based Interface design

In order for the prototype to be meaningful and answer the objectives of this project, it was important to outline the importance of web based interface design on this project. Although clinicians are not directly involved in the design process but as Rogers et al.(2011) would recite it, users always know what they do not want after seeing and trying out the product (p.24). Thus, for this particular project design of the web based interface was necessary because the researcher could find what clinicians want and what they did not want on the created eSMART interface.

Design of the web based interface was also a product of the prototype hence it was sensible to include it in the data collection phase II. The researcher chose design in this phase because technology is dynamic given that the ASyMS was established five years ago, desired features were needed by the clinicians which could assist the researcher in designing a sensible prototype.

3.10. Prototype design

Prototype is regarded as “a limited representation of a design that allows users to interact with it and explore its usability”, (Rogers et al., 2011, p.530). Prototype is a mean to communicate an idea to the others before actual implementation (Kolodner and Wills, 1996). However, it prototype is very important in developing and designing a product as well as an iterative user centred design which was needed . Developing any product which involves user need satisfaction requires critical structured steps to be fully embraced and utilised by the intended users. For the eSMART/ASyMS web interface to be appropriately developed, prototyping approach was defined. The researcher designed a prototype web based interface to facilitate the monitoring of cancer patients symptoms. The designing of the prototype was influenced by the Phase I findings from the clinicians interviews which supported this project in creating functional requirements for eSMART interface .Therefore, the researcher was guided by an iterative user centred design and functionality needs based on the outcome of the clinicians who were interviewed and interacts with eSMART interface on a daily basis. The design of a prototype was to address the gaps which are missing in disseminating of information to clinicians, in a designed web systems in monitoring cancer patient’s symptoms when using eSMART interface. The researcher has opted for a low-fidelity prototype because it was quick and easier to develop due to the limited constraints of this project. Van Velsen et al, (2008), emphasized that creating a low fidelity prototype is relatively easy and cheap and can already help in verifying the quality of a product. Low-fidelity prototype was also useful in helping the researcher to go through the Agile software development model which would help in software development of eSMART interfaces as a requirement for this project.

Most importantly this is a real life project, the prototype in any software development should be deemed by the developers and should be tested by stakeholders to provide their perceptions and improvement on the navigation and design by the researcher (Elwyn et al, 2009).

Subsequently, when the researcher went through the Agile software development and Information Architecture Model it was necessary for the researcher to begin with the iteration prototype frameworks which was first written on the piece of paper.

3.10.1 Prototype design procedure

Step 1: The researcher looked at the current eSMART interface and went back to make judgements from the participants interviews on the desired eSMART interface functionalities.

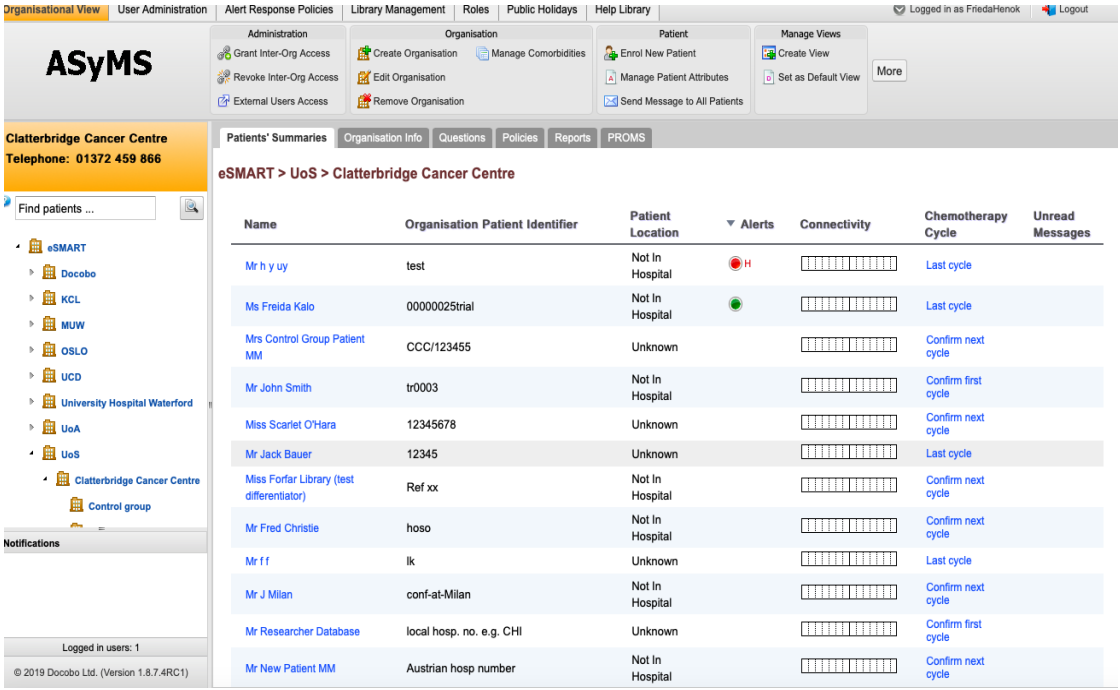


Figure 8 the original eSMART interface

Step 2: The researcher initially created codes in HTML5 and CSS

\\ds.strath.ac.uk\hdrive\84\vib18184\cis\windows\Desktop\Ligola\index.html - Notepad++

File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?

index.html | index.html | style.css

```
<!DOCTYPE html>
<html>
<head>
    <title></title>
    <link rel="stylesheet" type="text/css" href="style.css">
</head>
<body>

<nav>
    <p>eSMART</p>
    <ul>
        <li><a href="index.html">Home</a></li>
        <li><a href="#">Users</a>
            <ul>
                <li><a href="#">Administrator</a></li>
                <li><a href="#">Clinician</a></li>
                </ul>
        <li><a href="#">Organizational view</a></li>
            <ul>
                <li><a href="#">Organization name</a></li>
                <li><a href="#">Organization information</a></li>
                <li><a href="#">Cancer types</a></li>
                </ul>
        </li>
        <li><a href="#">PROMS</a></li>
            <ul>
                <li><a href="#">Patient number</a></li>
                <li><a href="#">Chemotherapy due date</a></li>
                <li><a href="#">Cancer stage</a></li>
                <li><a href="#">Cancer type</a></li>
                <li><a href="#">Symptoms</a></li>
                <li><a href="#">Treatment type</a></li>
                <li><a href="#">Patients information</a></li>
                </ul>

        <li><a href="#">Alerts</a></li>
        <li><a href="#">Helpful tips</a></li>
    </ul>
</nav>

</body>
</html>
```

Step 3: The researcher created tables in MySQL using (Myphpadmin) identifying the attributes associated with the tables created. The researcher created the tables according to the findings from the interview transcripts shown below.

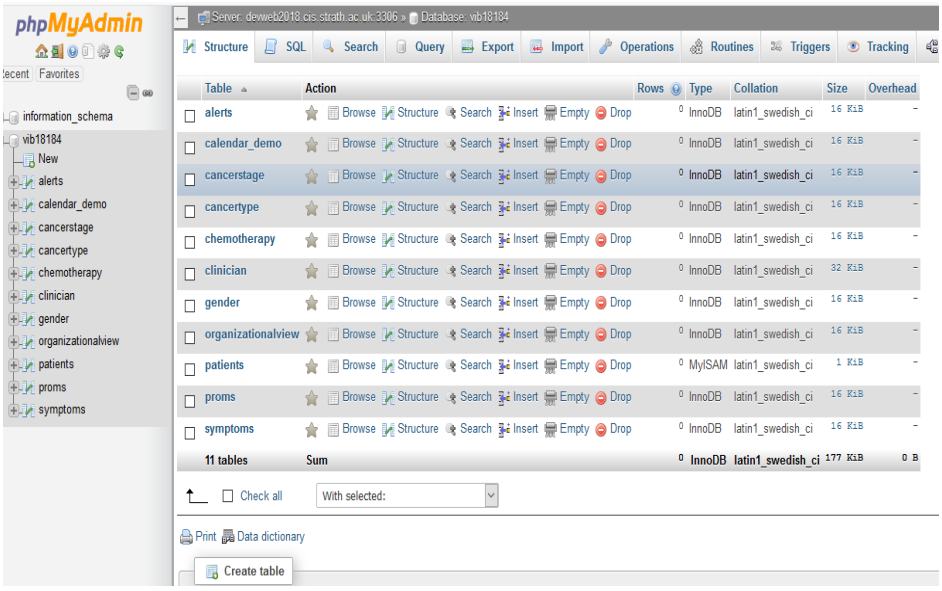
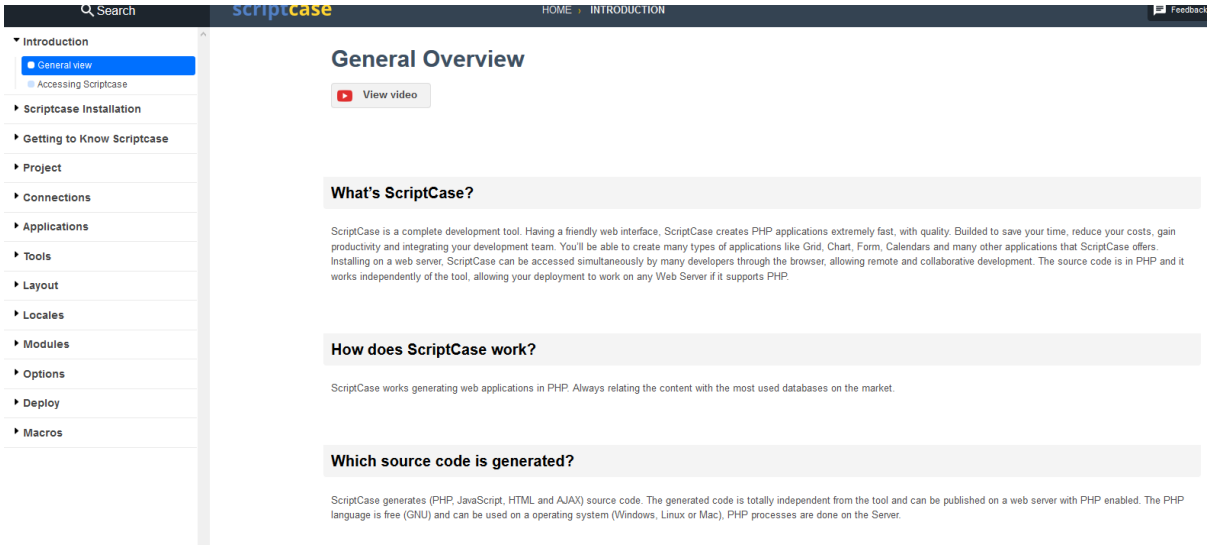
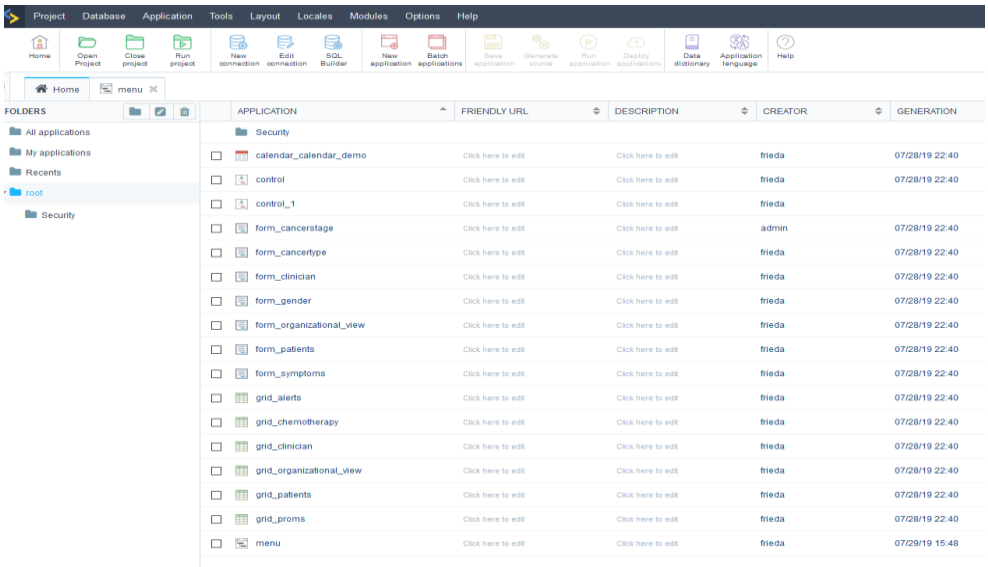


Figure 9 Created tables in phpMyAdmin

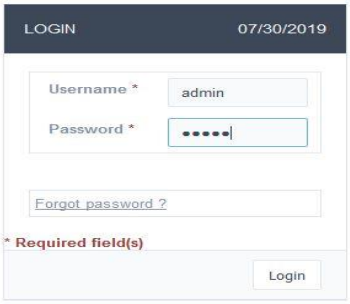
Step 4: The researcher signed up with www.scriptcase.net and downloaded a manual on how to create a project using www.scriptcase.net

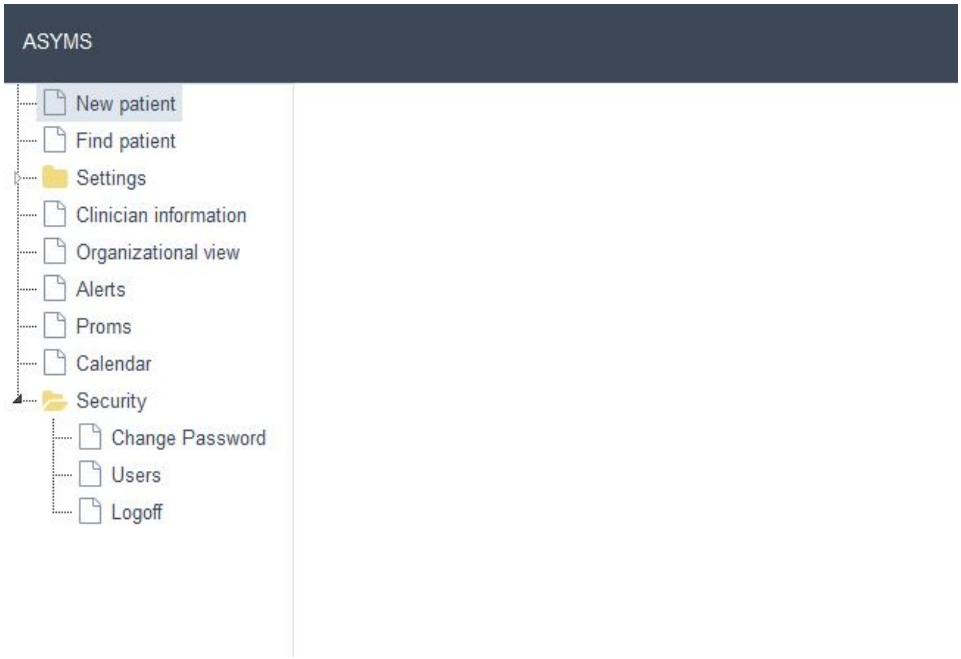


Step 5: The researcher added menu items on the www.scriptcase.net project environment to generate an interface which provided the prototype of the eSMART interface.



Step 6: The results of the designed prototype





The researcher initially built HTML codes for the interface prototype referencing https://www.w3schools.com presented below. Since eSMART is already a functional interface and needed a redesign in functionalities, the syntax of the HTML5 and CSS framework did not align with the functionality layout of the eSMART. The researcher further explored Bootstrap framework referencing https://www.w3schools.com which was not satisfactory enough due to generic sites templates provided and it is a drag and drop software. By referencing the Agile software development model and information architecture model as one of the rapid prototyping method and going through all the stages, the researcher discovered that the interface creating and testing requirements for this project was hasty and required a framework which could positively impact the web based interface design in a three month project period.

As a result, the researcher further researched on the previous used open-source web frameworks in similar cases (developing web based interface for cancer patients) which could help in generating interfaces using limited time to design the interface. The researcher also looked at other software frameworks used in collecting and managing cancer patient information such as TreatQuest in a study conducted by (Hu,2013). The researcher then discovered www.scriptcase.net as a compatible software which generated the ASyMS interface prototype for this project.

The researcher initially created tables in phpMyAdmin (appendix) (researchers workstation) in the University of Strathclyde database management system This was used to get a clear meaning of the needed parameters to be successfully displayed in the newly created interface. After the researcher created tables in phpMyAdmin, it was easier to enter those details in scriptcase framework and use them to generate the eSMART interface.

The researcher decided to use https://www.scriptcase.net in creating a prototype since, it was easier to make use of the created tables in phpMyAdmin and it was also time effective which provided a better layout to be understood by the clinicians. The researcher made reference to the current eSMART interface features in place and wanted to redesign the interface at the replication fidelity standard.

The clinicians' findings did not request for a brand new over an existing eSMART interface in place. The issue needed to be altered was better features and functionalities for ease of use and content appropriateness.

Scriptcase framework was also helpful to the researcher because, it takes time for clinicians to respond to the researcher's e-mails and schedule an interview due to clinicians busy schedule or their availability in Glasgow. Clinicians are also working in the field sometimes and this was one of the decisions to use www.scriptcase.net to finish the design on time and trace clinicians for a second interview. However, Scriptcase does not perform a drag and drop job as other software web builders, it requires intellectual work to create a project, position items and tables for the parameters needed for the desired interface.

The researcher used Scriptcase software pulling out the information created in phpMyAdmin database in www.devweb2018.strath.ac.uk. The researcher then created the prototype guided by the scriptcase manual offered online (evidence shown in the prototype procedure below). Thereafter, the researcher deployed the project in a zip file from the laptop which could not be fetched by the University's local host (server) https://devweb2018.cis.strath.ac.uk/~vib18184/acms/_lib/. The researcher also learnt that, the expert to host the researcher's work in the University server was on leave and will return only after a week. The researcher sought an external server to send the prototype to the participants after contacts with a member of ethics committee (see appendix). The researcher prepared a guideline (see appendix) on how the prototype work and recorded herself to make it easier for the participants when navigating menu items in the prototype.

The prototype design is essential in any software development because requirements should be documented, design, implementation, testing and maintenance should be performed in creating an interface (Bassil, 2012). The researcher concluded that prototype design was also essential to ensure that clinician's needs are met in able to navigate the interface appropriately and efficiently. Whereas, the needs of the clinicians are not met in the prototype, further recommendations will assist in the next creating and testing the interface software system.

3.10.2. Guideline provided to the clinicians before phase II of interviews

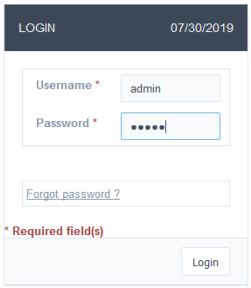
Prototype of the ASyMS guideline manual

Step 1 Open the link and input the credential as requested

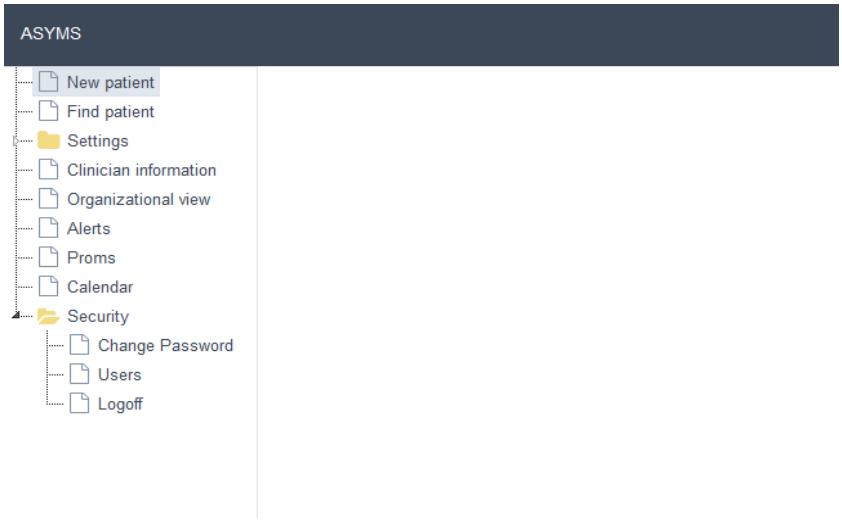
Click on this link: https://www.quiversoft.net/vib18184

Username: admin

Password: admin

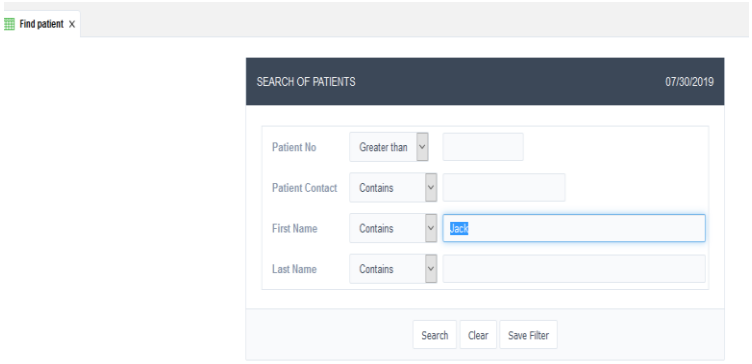


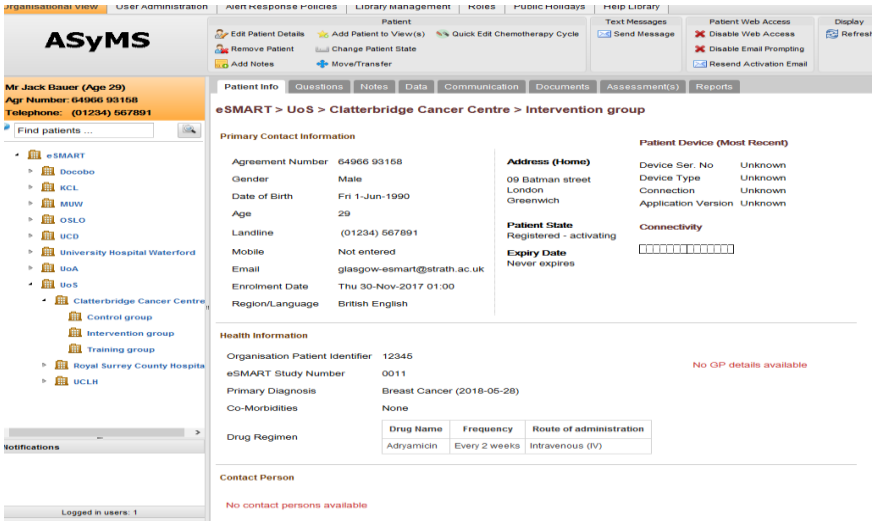
Step 2 this is how the interface look like



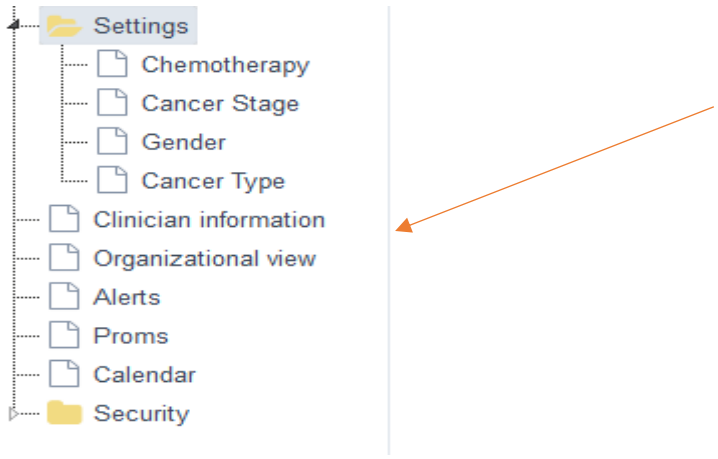
Step 3

Test the menu items e.g searching for a patient Jack Bauer from ASyMS





Step 4 Click on settings and see other necessary fields available



Clinician information is for the Clinicians associated with eSMART/ASyMS project. **Organizational view**, is extracted from docobo but might not show at the moment because of the field's entry in the database I created. **Alerts** are notifications from patients and **Proms** should have reports of patients on their entire treatment cycles. The ASyMS questionnaire can also be included on the Proms if this make sense. The **calendar** helps in reminding Clinicians on patient's treatment follow- ups or questionnaire days.

3.11. Think aloud (TA) evaluation phase II

The prototype involved TA was relevant to be repeated in the iterative II of this project. Since the first interviews was completed using TA, TA evaluation was required to be used in the second phase of this project (iterative II). As Krug (2013) stated that TA allows participants navigate a website and raise their judgements. This method was useful to the researcher to identify recommended and less satisfying features on the prototype design through the actual experience of clinicians' reactions when using eSMART interface. This was helpful to the researcher to make the meaningful recommendations and conclusions of the designed web based interface.

3.12. Procedure of iterative II

As stated earlier in the chapter, Phase II knowns as iterative II employed qualitative method approach. The researcher designed interview questions after the design of the prototype shown below. The researcher further designed a guideline manual on how to navigate and use features on the designed interface. Furthermore, the researcher prepared a video demonstrating the features provided on the designed interface. Clinicians were sent the prototype design of the web based interface through the e-mails to schedule and indicate their availability for the next interview. Clinicians were asked questions according to the designed features of the prototype. The researcher interviewed two participants who participated in the first iterative of this project. The interview session took about twelve and ten minutes respectively. The researcher transcribed records.

Research in-depth interview questions

1. **Web based interface ease of use**

⇒ Do you understand the interface features on the new interface?

⇒ How easy was it to navigate the interface features?

⇒ Are you satisfied with the new features or functionalities on the interface? If No, what would you like to be added on?

2. **The content appropriateness of the web based interface (website)**

⇒ Do you think the features or functionalities added on the interface (website) will help you as a clinician to successfully monitor cancer patient's symptoms? If No, kindly elaborate why?

⇒ Do you like the additional features such as symptoms, calendar added on the interface OR would you like have preferred something different?

⇒ Are you supporting the overall design of the interface? If No, why?

Additional question

⇒ Is there anything that you would like to add?

3.13. Qualitative method phase II

The researcher used semi-structured interviews with two clinicians who were available to take part in the second interview. The researcher decided to repeat the same method used in the first phase. Thematic qualitative data was used using TA method to analyse the results of the designed prototype. Nvivo 12 software was used to code, identify themes and analyse data for the consistency of this project.

3.14. Ethical consideration

Ethical issues mostly fall in the following categories: protection from harm, voluntary and inform participants, honesty and right to privacy (Leedy and Omrod, 2015). Leedy and Omrod (2015) defines ethics as norms which are expected to be followed and may also be referred to as principles of good behaviour. The researcher conducted a qualitative research which comprises of personal communication and interaction between participants. It was thus important for the researcher to adhere to the ethical principles.

Furthermore the researcher was guided by three basic principles (Lapan et al., 2012 p.22) namely:

Beneficence: Researchers should strive to maximise the good outcomes for science and humanity and minimise risk or harm to individuals in the research.

Respect: Researchers should treat the people in their study with respect and courtesy, to freely choose to participate in the study or refuse to participate.

Justice: Researchers should ensure that the people who participate in the research are those who reap the benefits of the research. Researchers should achieve this by the use of procedures that are reasonable, non-exploitative, carefully considered and fairly administered.

The researcher informed participants that any information and their identity will be kept confidential and the project will be strictly kept in the University of Strathclyde password protected database. The researcher practiced ethical principles as the rule in conducting any research. Furthermore, It was also necessary to give participants to decide to either take part or withdraw from the study should they feel uncomfortable or simply decide not to take part. Lastly, the researcher had gained approval to conduct this study from the Computer and Information Science research ethics department.

3.16. Chapter summary

The chapter discussed the research approach methods employed in this project. The chapter outlined procedures and the importance of adopting other methods because of the nature of this study such as usability methods, TA and UEM. The study presented the prototype design as well as the procedure as suggested from the clinicians. The chapter concluded with ethical issues which was very important for this project to proceed.

Chapter four: Analysis

4.1. Chapter overview

This chapter presents and discusses the analysis and findings from the interviews of clinicians. The analysis results are presented in phases, Phase I and Phase II respectively.The analysis was based on the usability testing of the web interface in place and the prototype design of the interface. The analysis are presented in theme results of phase I and II of the interviews with clinicians. Section (4.2), introduces analysis of this project, section (4.3), identified and discussed key interview themes. Lastly (4.4), the chapter summarised the analysis and findings from the interviews.

4.2. Introduction

Data analysis is what researchers depend on it when analysing the findings of the studies. Because this was an empirical research, the study used thematic analysis to make informed decisions of this study as stated in previous chapters. Thematic analysis is used in qualitative research to classify and identify themes of the study (Ibrahim, 2012).

4.3. Analysis of results

The study used interview transcripts and thematic analysis was needed to categorize texts or themes to analyse the data of this project. According to (Castleberry and Nolen, p.2) defined thematic analysis as the data breakdown that is a commonly used technique throughout all qualitative designs successfully. The researcher used thematic analysis to analyse the participant interviews. Braun and Clarke (2006), stated that thematic analysis helps providing insights from reading from data, report patterns and create interpret themes.

The thematic analysis of the interviews transcripts carried out by the researcher answered the research questions: user friendliness of the interface (ease of use and improving the navigation of the interface features), content appropriateness, recommended features by clinicians.

The researcher transcribed four interviews from all four participants and saturated the data in Nvivo 12 software for analysis in phase I. The researcher further transcribed two interviews for phase II using Nvivo 12 software.

4.3. 1 Interview findings from thematic analysis: Phase I Results of Interview

Firstly, the researcher adopted Word Cloud to generate a visual summary and analyse data through the revealing of word frequency which had appeared in the interviews.

The researcher used the advantage of using word cloud in qualitative analysis from different authors supporting the method in qualitative analysis. Word Cloud had been used in the health sector and it is increasingly being adopted as a simple tool to analyse research results. McNaught and Lam (2010, p.632) emphasized that “Word clouds reveal an understanding of the general composition of the main themes in the text and highlight points of interest”. The researcher selected word cloud because it was simple, easy to understand and a fast analysis which was viable for this project.

The researcher identified the relationships of themes in the word cloud such as **interface, symptoms, patients, participants (which are clinicians).**

Figure 10 Word cloud of first interview analysis

Theme1: Ease of use of the interface

Scalia, et al (2019), stated that usability of the system comprise of the ease of use and the satisfaction degree associated with navigating the system. This theme reflects the ease of use of clinicians navigating the system to monitor cancer patients symptoms. Clinicians reported having a problem of navigating through the system. Clinicians reported of the system having too much information and not intuitive enough, which was a barrier in navigating the system. Clinicians in Participants through think aloud techniques and interviews commented on the need for improving the ease of use of interface functionalities.

Participant 1

….I think it mhhm, it has got too much information on it*. Ehm there is also different things you can do with that. I think to just look at that, it is too far busy ehm I don't think it land safe to find information.*

I don't know what library management would be or why anyone would be changing the library*. Ehm I know we talked about a lot to clinicians about public holidays but I think it was quite a complicated thing to deal with. You know a couple of times to focus on something which really didn't happen that much, ehm and they had library.*

I think the names of things on the interface are wrong that doesn't make, these things don't make sense to me *and I had been working in the project for four years so they should instantly be recognizable to mean to me as to what they are referring to and it is not intuitive in that way at all.*

Participant 3

….. ***Yeah, I did have some problems navigating the interface so there when you look at ehm..the timeline, when you go into the system, the due dates if you like to answer the questionnaire, like the hospital is not there, so*** *you have to try and track across from one way to the other is hard because there is no use to cross reference with.* ***So its just harder when you are trying to look up things quickly to do it quickly. It is hard to remember hospital number etc.***

These indicated that clinicians faced difficulty in navigating through the system due to the fact that either the interface is not intuitive enough and does not have clear functionalities to allow clinicians to carry on with their duties in the timely manner.

Theme 2: Functionalities to be improved on the interface

Theme 2 reflects the functionalities clinicians thought should be improved on the eSMART system. Some clinicians suggested on the symptoms functionalities to be improved because at some point cancer patients are faced with different symptoms.

Some patients suggested drugs prescription results to be made visible to all clinicians instead of one person and updated all the time on the system. Furthermore some clinicians suggested on the chemotherapy and calendar dates to be a visible functionality.

Participant 1

…… ***What we would really like to…I think that what would be good to be improved is being more able to see patients symptoms over time****. So if a patient alerts on a symptom you can see what that's been for the last few days or weeks. So that you know whether there is a symptom that they experience a lot or its just a brand new thing to them. Ehm because you may not know that patient particularly well. It could be that you do but equally it could that you don't. And if you are not familiar with the individual before you actually speak to someone, you should make yourself aware of the particular case. There is nothing worse than just ehm calling up someone and finding your way through of the cuff. I think what should be very quick to access is that patients information you know a bit about the patient, a bit about the treatment and let you see what symptoms had been over the past week or two weeks. So that you can then deal better with that symptoms.*

Patient's symptoms functionalities are mentioned on the above results as a required functionality to be added on the interface.

Participant 2

….. ***ehm the Proms section so where patients ehm are scheduled to do a follow up proms that could be improved by allocating the dates of when they are due rather than to say when they are due****. Because ehm there is an interview of Friday window patients to be completed , we do not exactly know what dates were released by the web page. So it would be handy if we knew the exact date of the relieved, so what we did in Dublin was…we used the Google calendar so tracked ourselves what date would be relieved ehm so we split between the two so we'd know ehm…but I think if that would be interpreted in the website, that would make it easier to use. It obviously did at with patients chemo…can be delayed and to forget ….that might be a challenge but it will be worthwhile and make sure our target is met.*

Here the clinician indicated that dates on the interface could be improved.

Participant 3

…Yes, quite a lot sorry ehm I found the e-mail of web access very confusing and it doesn't work well for me. ***I did most of the study not realizing how patients complete meeting proms and how patients complete other proms. So for example when a patient was , when we had a bank holiday and a patient wouldn't be attending to chemo or dates and they needed to fill in their prom online, I would be turning on web access, I am turning on the e-mail prom team****. I didn't realize the two buttons are controlled separately and the patients won't see the questionnaire at home even when they are coming to the hospital. Does that make sense?*

Also when you are entering data if you didn't have all information on drugs*, there is no way you will add on notes. You really need to number them, say new patients were sending say they are on the diabetic level, the ….if you don't have the dose you wouldn't add information ya? So there were a lot of drugs which were missing in your information because we couldn't just have them because patients couldn't remember the dosage and medical notes and all of patients…..*

The clinician in this case indicated on the confusion of the information on the interface.

Participant 4

…. I would like the interface to be made as far as possible fully compliant with the latest disparity and accessibility controls as no of general statement

. There are few places where there are things that I think could be done a little better that is in the personal review section and that couldn't go forward. I don't believe in use a working model would be unnecessary. And we did become aware part way through the randomized control trial of things we wish we have done differently but because it was a randomized control trial we could not later the software.

The clinician vividly suggested on the improvement of the interface functionalities.

Theme 3: Content appropriateness be included of the interface

This theme reflects the content appropriateness to be included on the interface. Clinicians reported of protecting patients identify. The actual eSMART interface display patients names upon log in the system. Clinicians also suggested that instead of the patients name display on the system when you first log in, there should rather be graphs showing patients symptoms.

Participant 1

….. Ehm, I don't know, I don't know if this is always there. I don't know if this list of patients is always there. I don't know that you should, when the system comes up .. I am not sure whether you should be seeing patient's names ehm. I don't think that is particularly correct. I don't think we should have names*. It should be maybe the most recent alerts that comes up or for your particular site, I don't know you certainly don't need to see every other side involved in the study because that is absolutely of no concern to the clinicians. The clinicians are dealing with patients at their site. So all of these in relation to the other site is useless and it is taking up space. Ehm, I do think the connectivity I think that really is to do that not to have the same symptoms report over the last few days, that is helpful to know ehm. Yeah, I don't think there should be names, I think there should be only dealing with what comes up should be your site and your alerts and if you want to look at all other patients, maybe you have got somebody coming back for another cycle chemotherapy, then you could go into different folder and see all your patients and have a look at how they have been ehm I don't think the first thing should be everybody's names.*

Participant 2

…Ehm, I suppose on the main page is just a list of patients. So the patient names and the number but when you go into it, when you go into it …patients are..it just gives kind of contact details…ehm but I think would be nice if there was like a graph to symptoms*. So you have a right quick overview of what they had been going through..ehm based on the day captured it by the time you go to ehm..talk to them about your proms ehm and also it will be, it will be a satisfaction that clinicians will have a quick overview of what symptoms are about on the main page ehm yeah.*

Given the results from the first iteration phase of collecting data, the researcher went through all participants' interviews to make sure that word frequency tally with the word cloud. This has then guided the researcher to come up with the idea to initially create a database and the interface using themes of the most desired features by the clinicians as identified in the word cloud as showed in the prototype design procedures.

4.3.2 Interview findings from thematic analysis: Phase II Results of Interview

Phase II employed TA approach, clinicians were interviewed by the researcher while navigating the designed prototype. This has allowed the researcher to observe their actual engagement and experience during interview sessions. The researcher adopted word cloud in phase II of interviews to identify themes using Nvivo 12 software. The researcher identified key items which were **interface, patients and chemotherapy**.

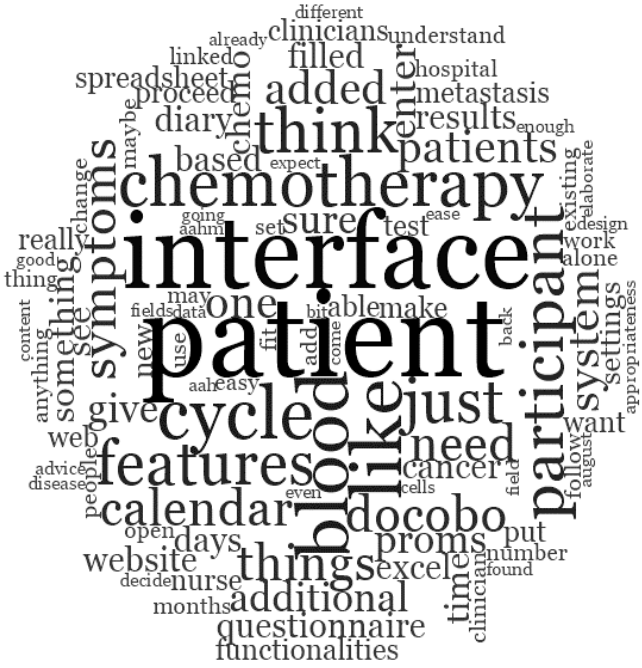


Figure 10 Word cloud for the phase II data collection

Interview Theme 1: interface

Web based interface ease of use

Theme 1 reflected the ease of use of the designed prototype of the interface. Clinicians indicated that they found it easy navigating the system. However, some of the menu items listed on the interface were preferred to be placed somewhere within the interface.

Participant 1

*It was easy technically but I found that the **words settings** there, did not to me indicate the sort of things underneath. I think of the word settings more to do with "do you want GPS on or do you want to be able to do this way or the other? So you want the start than actual the things you have underneath there in settings.*

*The find patients bit I thought that you need to be able to let the user search for more fields, more variables there might be local id's and all sorts of things**. Iyaa so because there is a patient number but which is system based but there is no patient id which is used within the hospital. So that would be one and maybe date of birth and other fields like that.***

Interview Theme 2: Patients

The content appropriateness of the web based interface (website)

Theme 2 reflected the content appropriateness of the web based interface. Clinicians suggested that the content should be about patients who are receiving treatment. Clinicians reported of having a problem with the content on the system because the content displayed on the system has administrative issues. Administrative issues faced were that, the system authorised only specific person to perform one task such as entering blood test but not all clinicians are authorised to perform that.

Participant 2

Not being able to see the patient name again on docobo so you have to write down the patient name and you have to write down the hospital number and you have to go into Proms pages which only has the hospital number and if you had gone to your diary and delete from your diary and also on the excel spreadsheet and you try to try to track people alone. ***So there is a whole set of administrative actions*** *to follow up on patients which could be a bigger job to follow up all set of patients in order to keep control of the whole data set of patients.*

So we had one person who puts in all of the blood results so lets say you are testing cycle 2, he put all the blood test results to test*. If the patient was fit for cycle 2 or cycle 1 and each cycle was out of blood test…would be moved for every circle and that was automatic job. So just by having something on the website when you enter the blood that proceed the cycle was infront of the cycle to check the patient is finished with that cycle, I think that's really important.*

Theme 3: Chemotherapy

Features added on the prototype

Theme 3 reflected the additional features added on the designed prototype. Clinicians supported the idea of adding a calendar in making chemotherapy consistent in patients. However, clinicians added that calendar functionality should be align with patient's handset and should not complicate the chemotherapy days that are normally entered in an excel spreadsheet.

Participant 1

I think the calendar is a great idea aahm it may in some hospitals duplicate something that they already have but in other hospitals I know they don't have anything*. So that would be nice and the symptoms bit again I wasn't quite sure if it was which type of symptoms that was designed to track because* ***, the patient will report the chemo related side effects through the patient handset information whatever system.***

Participant 2

I think your idea for the diary calendar is really good *but it could a complicated diary. I don't know how you are going to wrap that right. What we did, the patients that we had, we had an excel spreadsheet and we worked out on the spreadsheets the dates of start of chemotherapy. And if the chemotherapy was in 3 weeks, we would pluck when we expect them to come in. And we could pluck in on that excel spreadsheet. When we expect 3 months , 6 months follow up or length of 12 months…given those predicted days, we could work out the proms questionnaire for 45 days. And we could give ourselves a window of excel spreadsheets of days we expected Proms to open and Proms to close.*

4.4. Results Analysis of Phase I and Phase II

The findings of this project highlighted the important of creating and testing a web interface for the ASyMS system which operated from eSMART interface. The findings of this project integrate the project's results which was the qualitative analysis of the semi- structured interviews as addressed in chapter three. The results which has been analysed addressed the research questions as outlined in chapter one. The researcher drew research questions from the main project topic: Creating and testing a web based interface for the Advanced Symptom Management System (ASyMS) operated from eSMART interface. This is an EU funded project and involves different clinicians from different background. Therefore the researcher included general aspects of crucial research questions to which could allow clinicians to provide reliable answers for a better interface design which could benefit all clinicians working across Europe on the eSMART project to improve the quality of life in cancer patients.

This project was an iterative process of two phases (Phase I and Phase II). The project focused on answering the following questions in all phases (Phase I and Phase II): (a) is the ASyMS user interface easy to use by the clinicians?, (b) Is the ASyMS content appropriate to clinicians? and (c) is the ASyMS user interface and web based application recommended by clinicians?. The first thematic analysis focused on the web based interface ease of use.

The thematic analysis on the web based interface ease of use discussed in research questions was to find if the clinicians understand the ASyMS features on the interface. Thematic analysis identified themes in research questions which tried to find out if clinicians find it easy to navigate the interface or if they encounter any problems in navigating the eSMART interface. Furthermore, the research questions further tried to find out if clinicians would like any changes on the features of the existing eSMART interface.

The thematic analysis presented on the content appropriateness of the web based interface attempted to find if the content displayed on the eSMART interface was appropriate for clinicians in monitoring cancer patients symptoms. The thematic analysis attempted to find out if the content on the eSMART interface highlight the symptoms of cancer patients which clinicians deal with every day in their daily work. The thematic analysis results further tried to find out if it was necessary for the interface to outline the kind of cancers clinicians are dealing with in patients. Furthermore, thematic analysis results tried to find if the logical layout of the interface was appealing to clinicians.

The participants on this project as presented in chapter three were clinicians who work at different cancer organizations and the University of Strathclyde which are funded by the EU eSMART project across Europe. Some clinicians were either researchers or nurses and clinicians attributes were considered by the researcher as important in positively contribute to the future successful and better functional eSMART interface, to improve the quality of life in cancer patients.

4.5. Discussion of Findings

4.5.1. ASyMS user interface easy to use by the clinicians

This objective was met because this study found that in Phase I all interviewed clinicians did not find the eSMART interface easy to use. The project results found that the interface either contained too much information displayed on the interface which made it difficult to use and navigate as presented in the analysis of the results. This is contrary to the study conducted by Wolpin et al, (2015) outlined in chapter two which discovered that interface navigation was confusing to clinicians and that clinicians are internet- naïve users hence navigation problems.

However, in phase II where two clinicians were the only interviewed, the project reached it is objectives because clinicians indicated that the navigation was technically easy as outlined in the analysis of results in chapter four.

The results of this study further indicated that although clinicians across Europe are involved in one project (eSMART), the researcher discovered that the interface as designed by docobo (Digital Health and Telehealth Solutions) present different features on their workstation depending on the type of duties they are involved in. This has caused a mishap in navigating other features because of restrictions from docobo which also had an effect on the creation and designing a prototype of the web based interface for this project.

4.5.2. ASyMS content appropriateness to clinicians

The study findings in Phase I indicated that the content displayed on the interface was not appropriate because the interface display patients confidential information when clinicians log in presented in chapter four. Content appropriateness in Phase II was two-fold, clinicians were satisfied by some content such as the calendar functionality displayed on the interface. Some content was not appropriate as the desired content could be included in the designed prototype by the researcher. However, the entire content was not appropriate because clinicians have different features presented on their interface which affected results from interview questions. The project found that, limited access of navigating the actual eSMART had an implication on the content appropriateness to clinicians.

Considering the content to be displayed on the eSMART interface as requested by clinicians will have a positive impact as well as smooth service operation by clinicians in monitoring cancer patients' symptoms.

4.5.3. User interface and web based applications recommendation by clinicians

The study met it is purpose and objectives because clinicians were in support of the web based interface applications in phase I and Phase II (chapter four) in harnessing technology to monitor cancer patient symptoms. In Phase II of the designed prototype, for example one of the clinicians indicated that the web based interface is recommended because clinicians are communicating with patients between the interface and handset. This evidence is provided on the ASyMS architecture in chapter two literature review, even though the focus of this project was entirely clinician-oriented on creating and testing a web based interface for the ASyMS system. The researcher have confidence that a friendly web based interface should be created which accommodate all cancer patients' information without restrictions. This will enable clinicians to have a smooth process in monitoring cancer patients' symptoms and ease of communication with patients. The web application of the eSMART interface can also adopt the approach from other successful web applications in monitoring cancer patients symptoms in other countries such as USA.

In Basch, et al. (2016) study in chapter two indicated that the USA has the most successful web based interface systems for clinicians in monitoring chemotherapy toxicities.

4.6. Chapter Summary

This chapter analysed the findings from the clinicians' interviews. The chapter provided key themes as generated by word cloud from the qualitative data. The chapter discussed the identified key themes which clinicians suggested as viable to be included in the interface from phase II of this project. Lastly, the chapter discussed the findings of goals and objectives achieved for this project.

5.5. Chapter Five: Conclusions and recommendations

5.1. Chapter overview

This chapter reflects an overview of the project results and a conclusion of how results from the methodology presented in chapter 3 impacted the creation and testing of web based interface for the ASyMS. This chapter introduced and highlighted the importance of conclusions and recommendations of this project. The chapter highlighted the strength and limitations of this project. In addition the project outlined the future recommendations in relation to the eSMART web based interface and lastly this chapter concluded the entire project process.

5.2. Introduction

With the benefit and rapid technology services in the health sector as mentioned in chapter one, technology is fully embraced in monitoring and addressing problems which face clinicians in accomplishing their duties to patients. This project has created and tested a web based interface for the eSMART project in monitoring cancer symptoms in patients.

5.4. Strengths and limitations

This project was a qualitative approach which employed a TA method, usability design methods during data collection which is the sentiment of any project in analysis of the results. The strength and limitations of this project was determined by the analysis of fundamental concerns in data collection in chapter three. Furthermore, this project like any research project had strength and weaknesses in data collection, design of the prototype and analysis of the results. Clinicians who took part in this project were the strength of this project because they responded to the project questions because of their familiarity with the ASyMS system.

The strength of this project was drawn by clinicians from different places as outlined in chapter three. However, the project had low response rate in phase II with only two

participants who were available to perceive their opinions in the designed prototype of the ASyMS system. Phase II data collection was also affected as it could have been very crucial if all clinicians were all available as in phase I.

Additionally, clinicians who took part in the study some are either dealing with different cases and features on the ASyMS system. Another limitation for this project was that the ASyMS system on the eSMART interface is still operating on the tested system which is not yet fully implemented. Therefore, the researcher would stress that, this project was limited to only navigate one area or the other on the ASyMS system which made it difficult to understand some of the perceived views of the new interface features from some clinicians. The generalization of the results of this project was limited because the project involved some clinicians and the actual interface eSMART for the ASyMS systems have different features in different work sites as developed by docobo, the ASyMS system developers.

Furthermore, the researcher need this project to be taken into the next phase given that this was experimental aimed at creating and designing a good web based interface for the ASyMS system which will benefit clinicians and cancer patients in the long run.

5.5. Conclusion

The events of work completed for this project created and tested a web based interface for the ASyMS system operated on eSMART EU funded project. The project designed a prototype on the basis of the clinicians findings on the current usage of the ASyMS system on the eSMART interface. The ease of use of the interface as well as the content appropriateness of the designed interface has the potential of improving the quality of life in cancer patients. The researcher discovered that the designed prototype was very successful through the authenticity of clinicians responses and opinions on the designed prototype eSMART interface. The researcher believed that potential obstacles that was identified in this project are considered temporary because the project was designed on the low fidelity prototype. The researcher conducted this project to address and support the current issues faced by the clinicians in monitoring cancer patients symptoms through the usage of ASyMS system on eSMART interface.

5.6. Recommendations

Following the researchers analysis of this project, the researcher recommended the following:

- Clinicians indicated that they would want blood results entry to be consistent and given entry access to every clinician instead of only one authorized clinician for example, therefore the future system functions should be inclusive to all clinicians.
- The researcher recommends tha using docobo a commercialized organization to create eSMART interface, physical training of the all functions on the interface should be practiced because the training manual provided might be too much to read to clinicians. **As Benjamin Franklin quoted "Tell me and I forget, teach me and I may remember, involve me and I learn.**
- Creating and testing a web based interface of this nature should operate on consistency features used by all stakeholders involved.
- All involved parties in using eSMART interface on ASyMS should be involved in the real world user centred design projects study. The researcher felt that for clinicians to test the effectiveness of the interface, patients should have been included in the study because they use handsets by performing their queries directly to clinicians on the ASyMS system.
- There must be proper requirement documentation in place and enough time should be given for designing the interface because eSMART is still operating a tested interface which will yield successful results on the actual interface.
- The agile software development model and the three circles of information architecture used by the researcher should be used create the actual eSMART interface.

- The researcher recommend that this project to be repeated on clinicians and patients using eSMART , ASyMS system and handset to realistically improve the quality of cancer patients lives.

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Appendices

Appendix A : Consent Form

Department of Computer and Information Science

CONSENT FORM

Title of the research project: Creating and Testing a Web based interface for the ASvMS system

Name of the researcher: Henok Frieda Nelago Ligola

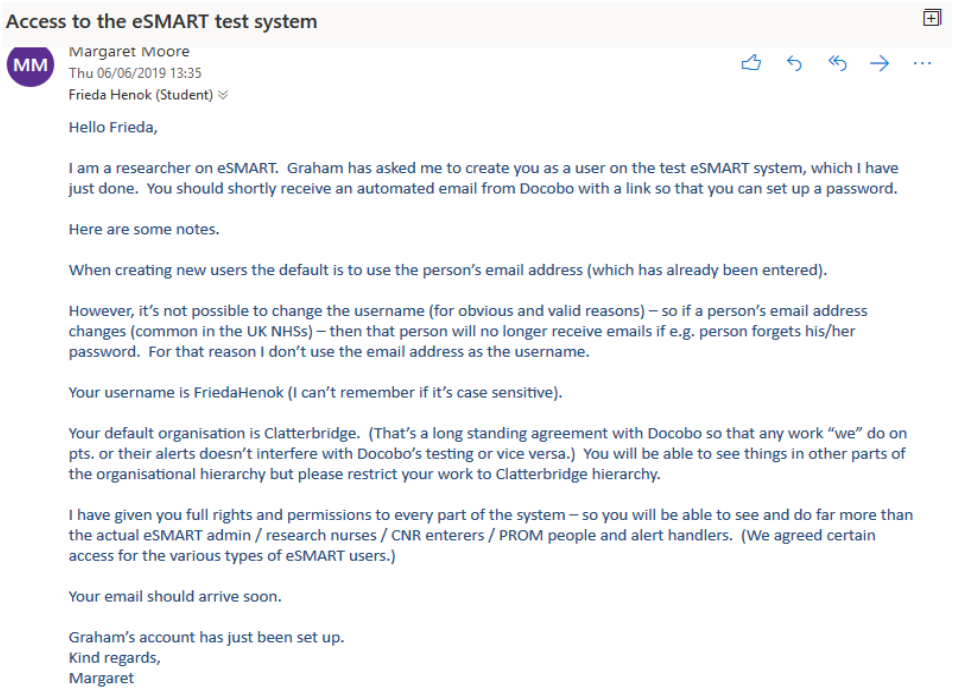
I confirm that I have read and understand the nature of this study.

I agree to take part in the study and I understand that taking part in this study is voluntary and I am free to withdraw from taking part in this study anytime without any reason.

Clinicians	Date	Signature
……	……	……

Researcher	Date	Signature
……	……	……

Appendix B: Communication between the supervisor, researcher, clinicians and ethics committee



Access to the eSMART test system

MM

Margaret Moore
Thu 06/06/2019 13:35
Frieda Henok (Student)

Hello Frieda,

I am a researcher on eSMART. Graham has asked me to create you as a user on the test eSMART system, which I have just done. You should shortly receive an automated email from Docobo with a link so that you can set up a password.

Here are some notes.

When creating new users the default is to use the person's email address (which has already been entered).

However, it's not possible to change the username (for obvious and valid reasons) – so if a person's email address changes (common in the UK NHSs) – then that person will no longer receive emails if e.g. person forgets his/her password. For that reason I don't use the email address as the username.

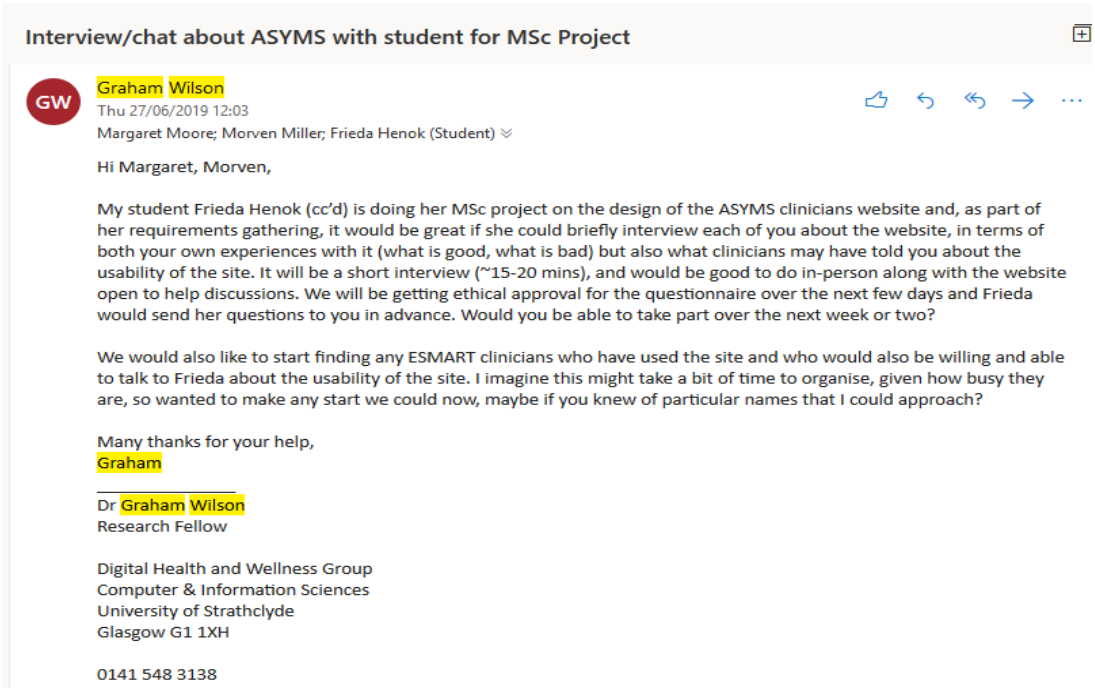
Your username is FriedaHenok (I can't remember if it's case sensitive).

Your default organisation is Clatterbridge. (That's a long standing agreement with Docobo so that any work "we" do on pts. or their alerts doesn't interfere with Docobo's testing or vice versa.) You will be able to see things in other parts of the organisational hierarchy but please restrict your work to Clatterbridge hierarchy.

I have given you full rights and permissions to every part of the system – so you will be able to see and do far more than the actual eSMART admin / research nurses / CNR enterers / PROM people and alert handlers. (We agreed certain access for the various types of eSMART users.)

Your email should arrive soon.

Graham's account has just been set up.
Kind regards,
Margaret



Interview/chat about ASYMS with student for MSc Project

GW

Graham Wilson
Thu 27/06/2019 12:03
Margaret Moore; Morven Miller; Frieda Henok (Student)

Hi Margaret, Morven,

My student Frieda Henok (cc'd) is doing her MSc project on the design of the ASYMS clinicians website and, as part of her requirements gathering, it would be great if she could briefly interview each of you about the website, in terms of both your own experiences with it (what is good, what is bad) but also what clinicians may have told you about the usability of the site. It will be a short interview (~15-20 mins), and would be good to do in-person along with the website open to help discussions. We will be getting ethical approval for the questionnaire over the next few days and Frieda would send her questions to you in advance. Would you be able to take part over the next week or two?

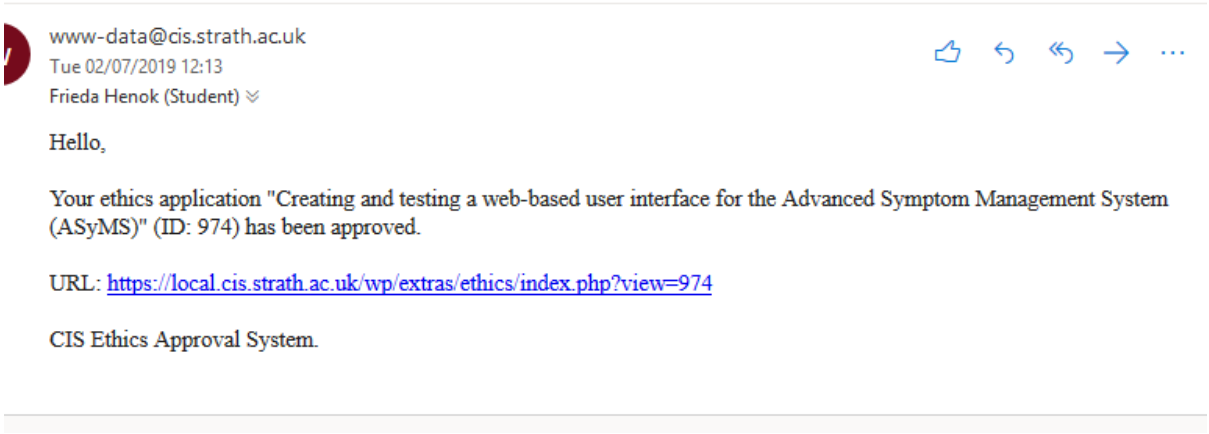
We would also like to start finding any ESMART clinicians who have used the site and who would also be willing and able to talk to Frieda about the usability of the site. I imagine this might take a bit of time to organise, given how busy they are, so wanted to make any start we could now, maybe if you knew of particular names that I could approach?

Many thanks for your help,
Graham

Dr Graham Wilson
Research Fellow

Digital Health and Wellness Group
Computer & Information Sciences
University of Strathclyde
Glasgow G1 1XH

0141 548 3138



www-data@cis.strath.ac.uk
Tue 02/07/2019 12:13
Frieda Henok (Student)

Hello,

Your ethics application "Creating and testing a web-based user interface for the Advanced Symptom Management System (ASyMS)" (ID: 974) has been approved.

URL: https://local.cis.strath.ac.uk/wp/extras/ethics/index.php?view=974

CIS Ethics Approval System.

Appendix C : Interview questions phase I and Phase II

Research In-depth interview questions

1. **Web based interface ease of use**

⇒ Do you understand the interface features? If No, which ones do you not understand?
⇒ How easy was it to navigate the interface? What problems have you encountered in navigating the interface?
⇒ The interface has some short cuts, have you used them? Do you understand the purpose of shortcuts in the interface?
⇒ What is the feature/functionality that you would most like to be improved/different? Why, and what should it be instead?

2. **The content appropriateness of the web-based interface**

⇒ Is the content displayed on the interface appropriate for you/clinicians in monitoring cancer patients' symptoms? If no, what is not appropriate?
⇒ Does the content highlight the symptoms which you/clinicians encounter in monitoring cancer patients' symptoms? If no, do you think the interface should opt for you/clinicians to manually enter cancer patients' symptoms?
⇒ Is it necessary for the interface to outline the types of cancer clinicians are dealing with in patients?
⇒ Is the visual layout logical?

Additional question

⇒ Is the anything you would like to add?

Research in-depth interview questions

1. **Web based interface ease of use**

⇒ Do you understand the interface features on the new interface?

⇒ How easy was it to navigate the interface features?

⇒ Are you satisfied with the new features or functionalities on the interface? If No, what would you like to be added on?

2. **The content appropriateness of the web based interface (website)**

⇒ Do you think the features or functionalities added on the interface (website) will help you as a clinician to successfully monitor cancer patient's symptoms? If No, kindly elaborate why?

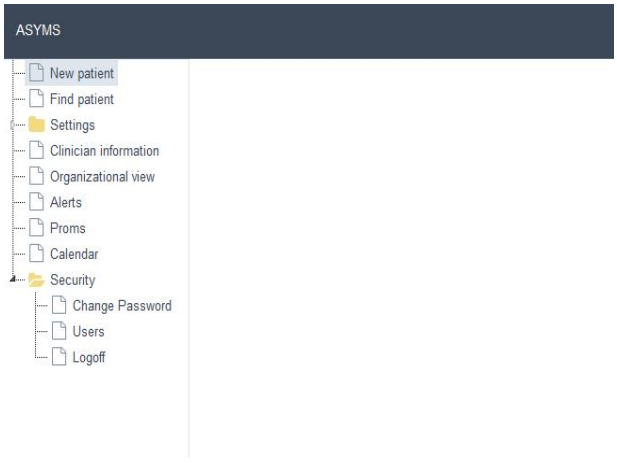
⇒ Do you like the additional features such as symptoms, calendar added on the interface OR would you like have preferred something different?

⇒ Are you supporting the overall design of the interface? If No, why?

Additional question

⇒ Is there anything that you would like to add?

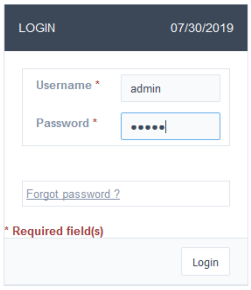
Appendix D: Prototype web based interface design presented to clinicians



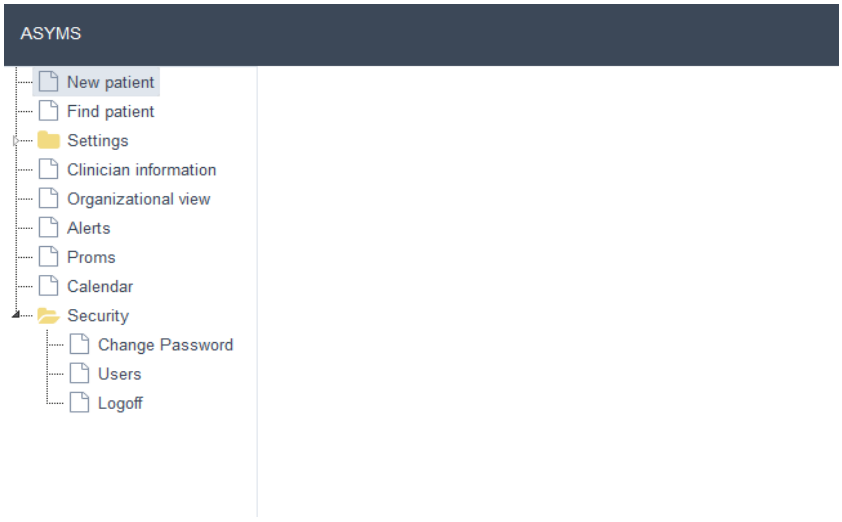
Appendix E: Guideline Manual for the designed prototype

Prototype of the ASyMS guideline manual

Step 1 Open the link and input the credential as requested
Click on this link: https://www.quiversoft.net/vib18184
Username: admin
Password: admin

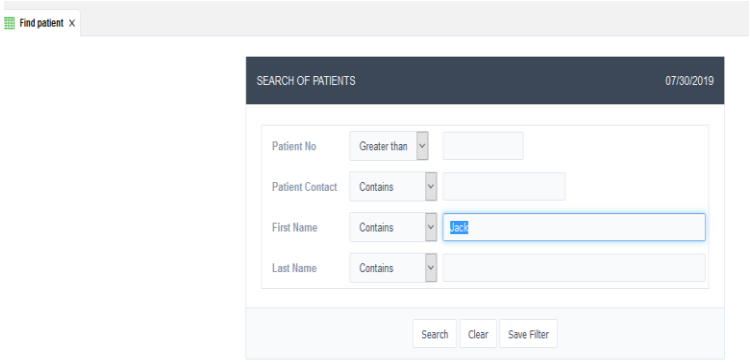


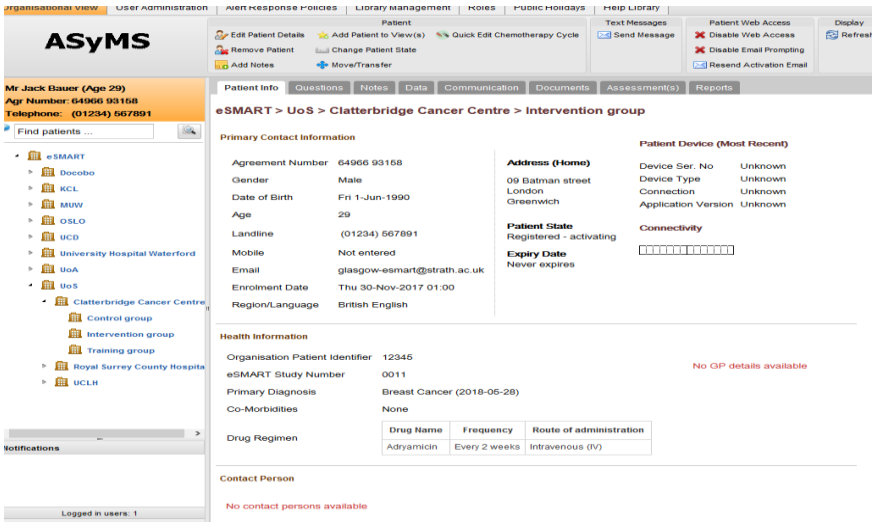
Step 2 this is how the interface look like



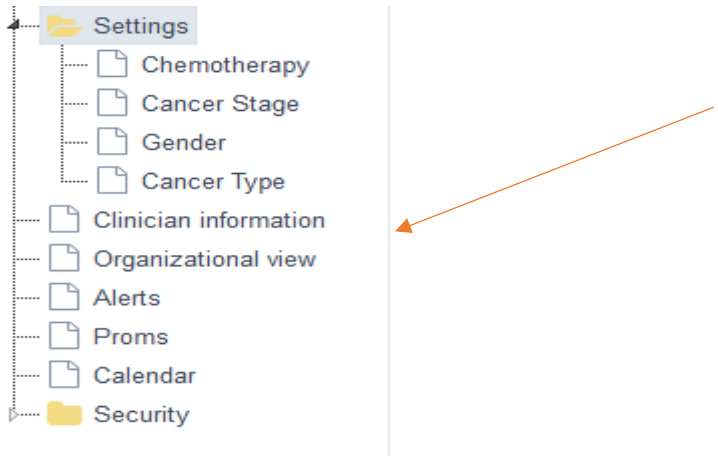
Step 3

Test the menu items e.g searching for a patient Jack Bauer from ASyMS





Step 4 Click on settings and see other necessary fields available



Clinician information is for the Clinicians associated with eSMART/ASyMS project. **Organizational view**, is extracted from docobo but might not show at the moment because of the field's entry in the database I created. **Alerts** are notifications from

patients and **Proms** should have reports of patients on their entire treatment cycles. The ASyMS questionnaire can also be included on the Proms if this make sense. The **calendar** helps in reminding Clinicians on patient's treatment follow- ups or questionnaire days.

Appendix F: The design process from the researcher

The prototype design procedure

Step 1: The researcher looked at the current eSMART interface and went back to make judgements from the participants interviews on the desired eSMART interface functionalities.

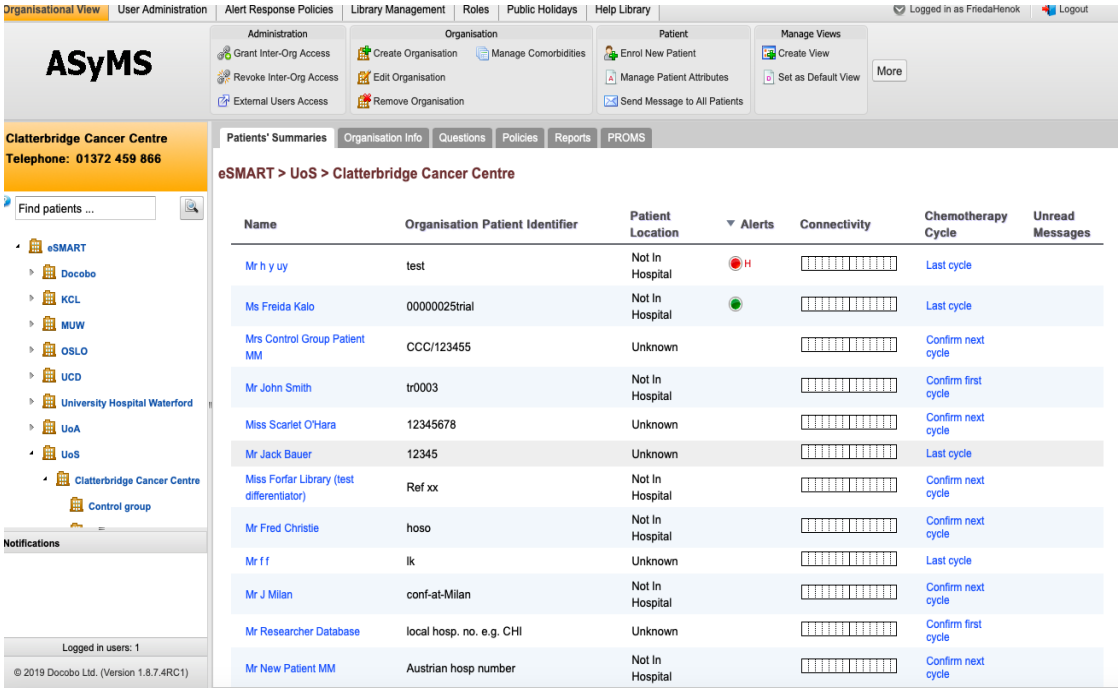


Figure 11 ASyMS original interface

Step 2: The researcher created tables in MySQL using (Myphpadmin) identifying the attributes associated with the tables created. The researcher created the tables according to the findings from the interview transcripts shown below.

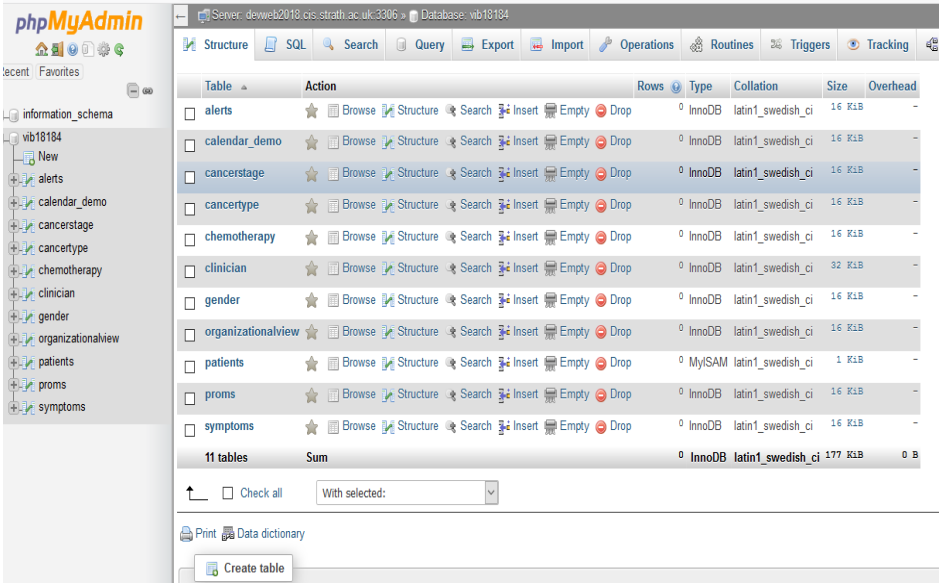
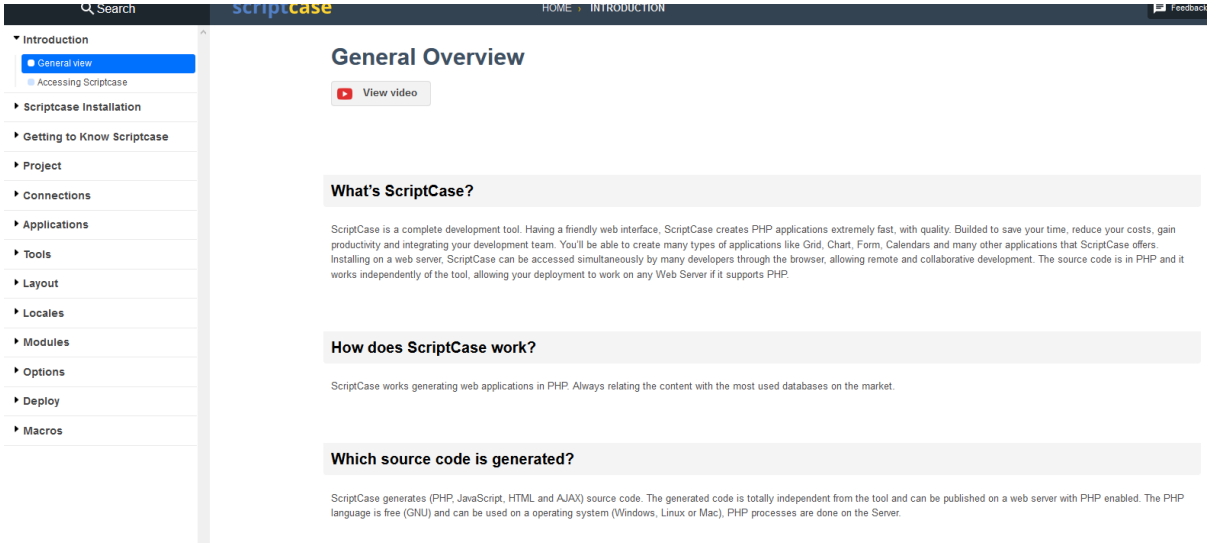


Figure 12 Prototype data entry in phpMyAdmin

Step 3: The researcher signed up with www.scriptcase.net and downloaded a manual on how to create a project using www.scriptcase.net



Step 4 the menu items were added on the www.scriptcase.net project environment to generate an interface which provided the prototype of the eSMART interface.

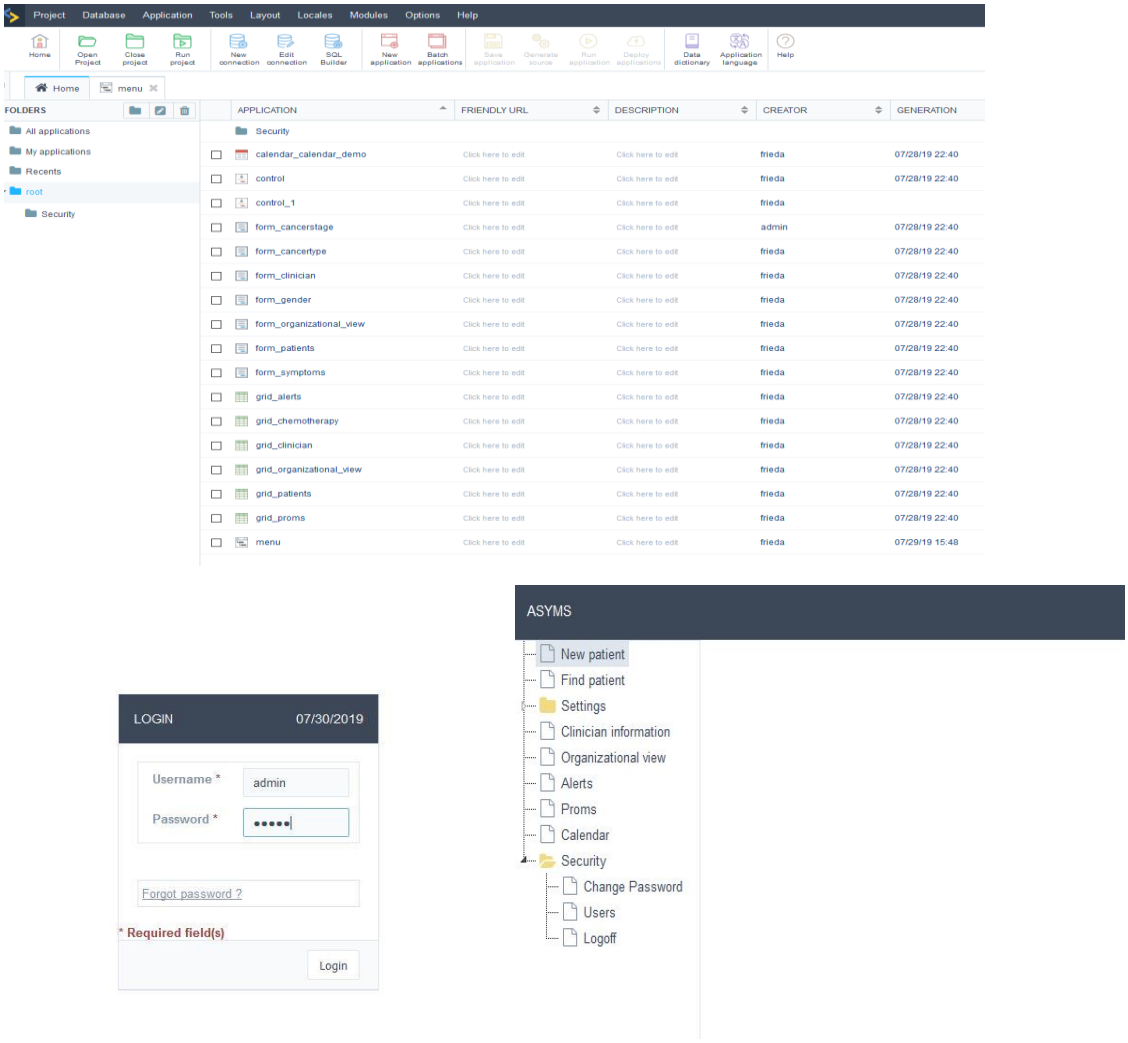


Figure 13 Prototype design of eSMART interface

Table of Figures