Management Science and Information Systems Studies

Final Year Project Report

Patient Diagnostic Assistant and Prescription Generation System for Medicine Management Programme

Andrew King  March 2014
MEDICINE MANAGEMENT PROGRAMME
Patient Diagnostic Assistant and Prescription Generation System

April 2014

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I declare that the work described in this dissertation has been carried out in full compliance with the ethical research requirements of the School of Computer Science and Statistics.

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24/04/2014
ABSTRACT

The aim of this project was to construct a single system that could coherently track and store the results from a clinical trial and use the information to better diagnose a patient and produce a more accurate prescription. There are two main elements to this project. Firstly, to decrease the risk of misdiagnosed prescriptions, a framework was developed and implemented to assist doctors when diagnosing patients. Secondly, to decrease the risk of lost or stolen prescriptions, a system was built to replace traditional paper based prescriptions with unique secure online prescriptions.
PREFACE

The Medicine Management Programme is an initiative by the HSE to increase the cost efficiency of the drugs budget, while maintaining high health standards. It is the responsibility of the MMP to identify areas with high cost medicines and discover if a more cost effective solution exists. Once an area has been identified, it examines all possible drugs and identifies a preferred drug. It identifies the preferred drug by analysing the trade-off between the cost of the drug and the health benefits associated with the drug. The main client contact throughout the project was Professor Cathal Walsh, hereafter referred to as “the client”.

The project has successfully met, and exceeded the terms of reference defined by the client. The initial scope of the project was limited to the construction and evaluation of risk scoring tools. The final system incorporates the risk scoring tools into an overall system of complete diagnosis and prescription.

The scope of the project was the main source of difficulty. While this project exceeded the initial terms of reference, the implementation of a fully online prescription system would require a considerable investment in time and resources from the HSE, far outweighing the resources available for a student project. As such, this project serves as a foundation to base future work on. It will be used as a tool to provide direction for future decisions within the HSE.

I would like to thank the client, Cathal Walsh, for his help and feedback throughout the project. I also wish to thank my project supervisor, Mary Sharp, who provided invaluable advice and direction throughout the project.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>NO.</th>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>INTRODUCTION AND SUMMARY</td>
<td>1</td>
</tr>
<tr>
<td>1.1</td>
<td>The Client</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>The Project Background</td>
<td>1</td>
</tr>
<tr>
<td>1.3</td>
<td>Terms of Reference</td>
<td>2</td>
</tr>
<tr>
<td>1.4</td>
<td>Summary</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>SYSTEM OVERVIEW</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>System Objectives</td>
<td>3</td>
</tr>
<tr>
<td>2.2</td>
<td>System Environment</td>
<td>3</td>
</tr>
<tr>
<td>2.3</td>
<td>System Description</td>
<td>4</td>
</tr>
<tr>
<td>2.4</td>
<td>Technical Environment</td>
<td>7</td>
</tr>
<tr>
<td>2.5</td>
<td>System Overview Diagram</td>
<td>8</td>
</tr>
<tr>
<td>3.</td>
<td>WORK DONE</td>
<td>10</td>
</tr>
<tr>
<td>3.1</td>
<td>Project Methodology</td>
<td>10</td>
</tr>
<tr>
<td>3.2</td>
<td>Review of Existing Tools</td>
<td>10</td>
</tr>
<tr>
<td>3.3</td>
<td>Technical Environment Implementation</td>
<td>10</td>
</tr>
<tr>
<td>3.4</td>
<td>System Structure</td>
<td>11</td>
</tr>
<tr>
<td>3.5</td>
<td>System Elements</td>
<td>13</td>
</tr>
<tr>
<td>3.6</td>
<td>MMP System Presentation</td>
<td>15</td>
</tr>
<tr>
<td>3.7</td>
<td>Problems Encountered</td>
<td>15</td>
</tr>
<tr>
<td>4.</td>
<td>CONCLUSIONS AND RECOMMENDATIONS</td>
<td>16</td>
</tr>
<tr>
<td>4.1</td>
<td>Conclusions</td>
<td>16</td>
</tr>
<tr>
<td>4.2</td>
<td>Recommendations</td>
<td>18</td>
</tr>
<tr>
<td>NO.</td>
<td>SECTION</td>
<td>PAGE</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>A.</td>
<td>Original Project Outline</td>
<td>A.1</td>
</tr>
<tr>
<td>B.</td>
<td>Interim Project Report</td>
<td>B.1</td>
</tr>
<tr>
<td>C.</td>
<td>User Manuals</td>
<td>C.1</td>
</tr>
<tr>
<td>D.</td>
<td>Design Documentation</td>
<td>D.1</td>
</tr>
<tr>
<td>E.</td>
<td>Source Code</td>
<td>E.1</td>
</tr>
<tr>
<td>F.</td>
<td>Test Documentation</td>
<td>F.1</td>
</tr>
<tr>
<td>G.</td>
<td>MMP PowerPoint Presentation</td>
<td>G.1</td>
</tr>
<tr>
<td>H.</td>
<td>Glossary</td>
<td>H.1</td>
</tr>
<tr>
<td>I.</td>
<td>Reference</td>
<td>I.1</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION AND SUMMARY**

This chapter describes the client, outlines the project background, terms of reference, and provides a summary of the remaining chapters of this report.

1.1 **The Client**

The Medicine Management Programme (MMP) is an initiative by the HSE to increase the cost efficiency of the drugs budget, while maintaining high health standards. The HSE drugs budget exceeded €1.7 billion for 2012 under the Community Drugs Scheme. This expenditure represents a greater than fivefold increase over the past decade. It is the responsibility of the MMP to identify areas with high cost medicines and discover if a more cost effective solution exists. Once an area has been identified, it examines all possible drugs and identifies a preferred drug for a particular disease. It identifies the preferred drug by analysing the trade-off between the cost of the drug and the health benefits associated with the drug. For example, if there are two drugs that deliver very similar health benefits, but one drug is substantially more expensive, then the cheaper drug would be identified as the preferred drug. Currently, there are two therapeutic areas being considered – PPI’s and Statins. Proton Pump Inhibitors (PPIs) are prescribed for the treatment of conditions such as peptic ulcer disease and gastrooesophageal reflux disease. Statins are prescribed to reduce cholesterol levels and prevent cardiovascular diseases. The HSE is urging GPs and all prescribers to consider using the preferred PPI - Lansoprazole - and the preferred Statin – Simvastatin - when prescribing for their patients.

1.2 **The Project Background**

Clinical risk scoring is a process that can quantify the risk of progression of disease. It is used to provide an indication for the appropriate prescription of medication. A trial is conducted by inputting the variables of a patient; age, gender, smoker, etc. A predefined formula is executed to determine a level of risk. This level of risk is then used to indicate what level of treatment should be conducted.

This process is effective but it suffers some serious drawbacks.

1. A user has to go to an external location to perform the trial. The risk scoring tool is not integrated into any current system utilised by practitioners.

2. It is time consuming. The user has to enter in the details of a patient manually.

3. There is no inherent connection between the results of the clinical trial and the diagnosis of a patient. When diagnosing a patient, it is up to the discretion of the practitioner to use or not use the results from the trials.

The aim of this project was to construct a single system that could coherently track and store the results from a clinical trial and use the information to better diagnose a patient and
produce a more accurate prescription. There are two main elements to this project. Firstly, to decrease the risk of misdiagnosed prescriptions, a framework was implemented to assist doctors when diagnosing patients. Secondly, to decrease the risk of lost or stolen prescriptions, a system was built to replace traditional paper based prescriptions with unique secure online prescriptions.

1.3 Terms of Reference

The terms of reference for this project are as follows:

- To conduct a thorough research into existing risk scoring tools.
- To develop a mobile responsive user interface to be used as an access point to the risk scoring tools.
- To develop appropriate risk scoring tools for the prescription of medications to the Irish population, specifically new oral anticoagulants, like Warfarin and Dabigatran.

The initial scope of the project was limited to the construction and evaluation of risk scoring tools. The inherent problems associated with these tools would still be present if the project was limited to this. Therefore, the project expanded considerably on the original terms of reference. A complete system of diagnosis and prescription was designed from patient information input to prescription output. The risk scoring tools performed a fundamental role in the system.

1.4 Summary

Chapter 2 gives a general overview of the system and the technical environment. The system objectives are illustrated. An overview of the current environment is conducted. The technical environment is summarised. A walkthrough of the system process is demonstrated, including the system overview diagram as a guide.

Chapter 3 details the work conducted throughout the course of the project. A review of existing risk scoring tools is conducted. The implementation of the technical environment is detailed. The evaluation of each element of the system is scrutinised. The problems encountered and the courses of action taken are described. The presentation of the system to the staff of the Medicine Management Programme is discussed.

Chapter 4 outlines the conclusions and recommendations for this project and suggests further work.
2. SYSTEM OVERVIEW

This chapter outlines the objectives of the system, details the environment the system will exist in, describes how the system operates and provides an overview diagram of the hierarchical structure of the system.

2.1 System Objectives

There are two main objectives to this project.

1. A framework should be developed to assist practitioners in diagnosing a patient. This will decrease the risk of misdiagnosed prescriptions.

2. A system should extend on the first objective to generate a unique secure online prescription. This will replace the traditional paper based prescription and decrease the risk of lost or stolen prescriptions.

There are several implicit objectives that have to be satisfied to achieve the main objectives.

1. The system has to be secure. This requires data encryption, database integration and security checks throughout the system.

2. The system should be convenient to use. This requires the system to be intuitive and easy to navigate. It also requires the system to be responsive. It should be able to adapt to whatever device the user is using.

3. The system should have a high veracity of data collection. This requires a single, central location to avoid redundant data collection. It also requires the data collection process to have direct questions, with little room for misinterpretation.

2.2 System Environment

Currently, there are four national GP systems that are in use by the GPs. The National Healthlink Project is the underlying application that feeds GPs with diagnostic results and also for GP referrals. The National Healthlink Project is a web-based messaging service which allows the secure transmission of clinical patient information between Hospitals, Health Care Agencies and General Practitioners.

Message files are formatted in HL7 which is an internationally recognised standard for exchanging information between healthcare applications. Patient information is generated on the source hospital system and transferred to and from servers using secure network connections. Users log in to the HealthlinkOnline website with a unique username, password and PIN plus a digital client certificate to verify your identity.

The Primary Care Reimbursement Service (PCRS) is part of the HSE, and is responsible for making payments to healthcare professionals, like doctors, dentists and pharmacists, for the free or reduced costs services they provide to the public.
The Health Information and Quality Authority is a statutory, government-funded agency in Ireland which monitors the safety and quality of the healthcare and social care systems. Under the Health Act 2007,[6] the Health Information and Quality Authority (the Authority or HIQA) has a statutory remit to develop standards, assess value for money and cost-effectiveness, evaluate information and make recommendations about deficiencies in health information.

2.3 System Description

The system consists of four main stages. These include the integration and validation of data from databases, the diagnosis of a patient, the generation of a prescription and the connection and transfer of information to pharmacy databases.

Database Integration and Data Validation

One of the implicit objectives of the system is that it has to be secure. There are two main prescreening checks before a user can fully access the system.

1. A secure login system requiring a username and password was constructed.
2. A geoPositioning system was created that can record the longitude, latitude and timestamp.

The initial screening a user is required to pass through is a login screening. A user is presented with a login screen and is required to enter a username and password. This restricts the site to a specific set of approved users. The credentials are encrypted and are examined against a table in a MySQL database and, if they are approved, the user is directed into the site. A record of the login is created. This is important because it allows for a structure of accountability. It is possible to determine who the user is and what prescriptions the user is prescribing.

Once the user has logged in, the geoPositioning element of the site activates and the user’s longitude, latitude and time of entry are recorded. This is a secondary screening technique that provides an additional layer of security. An alert can be raised if a user’s login details are inconsistent with their geoPositioning details. For example, an alert can be raised if user that is always located in the North of the country is trying to log in, in the South of the country. This does not guarantee that a user is fraudulent, but it does provide an indication that there is an inconsistency that could be examined.
Diagnostic Assistant

It is possible to conduct a patient trial once a user has logged in. The system is designed to be intuitive to use and minimise the input from the users. The user will need to add the patient's information if it doesn't exist.

For the sake of conciseness, there is a single location for data collection. There are several standard questions asked and then the patient's record is inserted into a MySQL database. A patient id is automatically generated once the record has been created. The patient's id acts as an individual health indicator. An individual health identifier (IHI) is a unique, non-transferable number assigned to all individuals using health and social care services in Ireland, which will last for their lifetime. Its purpose is to accurately identify the individual, enabling health and social care to be delivered to the right patient, in the right place and at the right time [3].

For this project, an auto incrementing number was generated every time a patient's record was inserted into the MySQL database. There is considerable work been conducted in this field with only recent breakthroughs been achieved. As discussed in (Section 4.2), if this project were to be expanded, an obvious recommendation would be to utilize the work done on IHI.

A single location for data collection saves the user from repeatedly entering in the same information throughout the system. It also allows the tests to be run automatically thereby saving the user time during the diagnostic phase.

The initial step of a patient trial is to identify the necessary patient. This is done by inputting the patient id which is generated once the patient record has been created. It is possible to search by name, if a user cannot recall a patient's id. The feature was added so the system can be convenient to use.

The user will be directed to the main trial page once a valid patient's id has been entered. From here, the user can choose the drug class to test for the patient. New Oral Anticoagulants (NOACs) were examined for this project, but the system was designed so that it could easily implement additional drugs classes.

The NOAC drug class has several sequential phases to determine the appropriate course of action. The first screen requires the user to indicate what the main clinical indication is for the NOAC. There are three possible courses of action on this page.

1. Atrial Fibrillation is not the clinical indication.
   In this case, the user is directed to the next screen and the CHADS2 Score is generated.

2. Atrial Fibrillation is the clinical indication, but it is non-valvular AF.
In this case, the user is directed to the next screen and the CHADS₂ Score is generated.

3. Atrial Fibrillation is the clinical indication, but it is valvular AF.

In this case, a prescription is generated for the user recommending Warfarin as the preferred drug.

For the first two courses of action the CHADS₂ Score will be generated. The CHADS₂ Score is automatically generated from the input the user entered when adding the patient record. There are two possible courses of action on this page.

1. If the CHADS₂ Score is equal to or greater than two, a prescription for Warfarin will be suggested.
2. If the CHADS₂ Score is less than two, a more comprehensive risk factor approach will be considered. The CHA₂DS₂-VASc Score will be generated.

Similar to the CHADS₂ Score, the CHA₂DS₂-VASc Score is automatically generated from the input the user entered when adding the patient record. There are two possible courses of action on this page.

If the CHA₂DS₂-VASc Score is equal to or greater than two, a prescription for Warfarin will be suggested.

If the CHA₂DS₂-VASc Score is less than two, no action should be recommended.

A prescription will be generated for every instance other than a CHA₂DS₂-VASc Score less than two.

E-Prescription Generation

The main objective of this project, as discussed in Section 2.1, is to provide a coherent system that has the capability of tracking and storing the results from a clinical trial and use the information to better diagnose a patient and produce a more accurate prescription. A secure electronic prescription will be generated once a user has successfully conducted the appropriate risk scoring techniques.

The final prescription combines the information that has been generated across the previous stages of the trial. The prescription displays the user information, patient information, location of user, timestamp of user and the Universal Unique Identification (UUID). The UUID is a 36 digit, pseudo-randomly generated set of characters. It is a completely unique indicator key that can be used to track any individual prescription. Once the UUID has been generated, the e-prescription is stored in a secure database.
As described in (Section 2.3, page 4), a user can be identified because they are required to provide credentials by virtue of a login system. Therefore, it is possible to monitor the prescription levels of individual GPs. Consequentially, it is possible to determine if a GP is prescribing the preferred drug recommended by the MMP.

Pharmacy Database Connection

Once an e-Prescription has been generated, it is possible to send an alert to a central pharmacy database. It is possible to define the preferred pharmacy for collection. This would give an indication to the pharmacy that a patient has been diagnosed for a particular prescription and the pharmacy should be expected to prepare the prescription.

Once the prescription has been distributed, an entry will then recorded and stored in a table in a MySQL database. This provides a cohesive connection between the administration and distribution of a prescription. It also facilitates the move from paper based prescriptions to a fully secure online prescription service. If it was possible to combine this system with existing pharmacy inventory management databases, then it would be possible to identify the difference between the expected and actual distribution of drugs. This will identify the level of theft, stolen or lost drugs, thereby saving money and potentially lives.

2.4 Technical Environment

There are several steps that need to be completed before a system can be functional. A text editor called Espresso was installed on a personal computer. Espresso was chosen because it was free, but also because it provided the ability of text prediction. This ensured a minimization of syntax error.

The project used an XAMPP stack. This is an open source package that essentially replicates a server onto a personal computer. XAMPP is a cross platform package that comprises of Apache, MySQL, PHP and Perl.

Apache (Apache HTTP server) is a web server developed for Linux.

MySQL (My Structured Query Language) is a relational database management system.

PHP (Hypertext Pre-processor) is a server-side scripting language designed for web development.

Perl is a scripting language used for graphics programming, system administration and network programming. It was not necessary to use it for this project.

It was possible to start coding once a working directory has been specified. Due to working with an XAMPP stack, the project had to be stored in a specific location within the XAMPP
structure. This ensures the system has access to the MySQL databases and the Apache server.

The following diagram illustrates the components of a XAMPP framework. The purple figures are front end components, while the blue figures are back end components.

![XAMPP Flow Diagram](image)

**Figure 2.4.1 – Components of an XAMPP Framework**

### 2.5 System Overview Diagram

The following diagram is an overview of the entire system and the relationship between pages. The dark blue lines indicate the dependencies of files. The light blue solid lines indicate the route of the user through the system. The dotted blue lines indicate the data flow through the system. The diagram is read left to right, top to bottom. This also applies for the positioning of the lines. The light blue circles represent conditional operators which offer a different course of action depending on certain conditions.

The main sessions are identified. Their locations and their dependencies are also identified. For example, the variable `$_SESSION['logged_in']` is created on the index.php page. It is dependent on the variables username and password been posted to the MySQL database.
3. WORK DONE

This chapter details the work conducted throughout the course of the project. A review of existing risk scoring tools is conducted. The implementation of the technical environment is detailed. The evaluation of each element of the system is scrutinised. The problems encountered and the courses of action taken are described. The presentation of the system to the staff of the Medicine Management Programme is discussed.

3.1 Project Methodology

This project structure followed the agile methodology. An agile project is based on iterative and incremental development, thereby allowing for a greater flexibility to change [1]. It was fundamental for this project because the requirements grew more elaborate as the project developed. Agile Programming is explained further on in Appendix D.1. p. D.1.

3.2 Review of Existing Scoring Tools

Clinical risk scoring is a process that can quantify the risk of progression of disease. It is used to provide an indication for the appropriate prescription of medication. A trial is conducted by inputting the variables of a patient; age, gender, smoker, etc. A predefined formula is executed to determine a level of risk. This level of risk is then used to indicate what level of treatment should be conducted.

This process is effective but it suffers some serious drawbacks.

1. A user has to go to an external location to perform the trial. The risk scoring tool is not integrated into any current system utilised by practitioners.

2. It is time consuming. The user has to enter in the details of a patient manually.

3. There is no inherent connection between the results of the clinical trial and the diagnosis of a patient. When diagnosing a patient, it is up to the discretion of the practitioner to use or not use the results from the trials.

3.3 Technical Environment Implementation

XAMPP is designed to be easy to implement. A control panel called XAMPP Control is installed with the package. The figure below illustrates the user interface. It has an easy to use interface with three buttons. It is as simple as clicking a button to initiate the Apache Server and the MySQL Database. Once initiated, it is possible to access the system through the localhost of the computer. It is as simple as typing “localhost” into the URL of a browser. This will direct the user to the root directory of the XAMPP system. From there, the user can navigate to their specified file by appropriately adjusting the URL.
One of the essential aspects of the implementation of the technical environment was the creation of the MySQL database. The phpMyAdmin user interface was used instead of SQL command line interjection. There were five tables created.

The user table consists of an auto incremented user id, username and an encrypted password. The primary key is the auto incremented user id.

The drug table consists of an auto incremented drug id, drug name and drug class. The primary key is the auto incremented drug id.

The login table consists of an auto incremented login id, user id, longitude, latitude, timestamp of login and timestamp of logout. The longitude, latitude and timestamps are generated through JavaScript on the index.php page. The primary key is the auto incremented login id.

The patient table consists of an auto incremented patient id, first name, last name, age and eight binary inputs. The eight binary inputs correspond to yes/no questions asked about a patient’s medical history. The primary key is the auto incremented patient id.

The prescription table consists of an auto incremented prescription id, user id, patient id, treatment, recommendation, timestamp and the UUID. The primary key is the auto incremented prescription id.

3.4 System Structure

The system was designed in a very specific manner. The system tried to minimise the number of pages created. There are several benefits to this.

- There is a reduction in the number of HTTP requests, thereby speeding up the site’s performance.
- Information can be cached and therefore it is not required to load multiple times.
- The overall site has less web pages and therefore takes up less space on a server.
- It is more secure as there are fewer transitions between pages.
Therefore to ensure as few pages as possible, it was required for pages to have multiple functions. The index.php page will be used as an example. There are three main components to the index.php page. There is the initial log in screen, a backend validation check on the user’s credentials and then the general home page, where a user will be presented with a choice of options. The separation can be seen in the below diagram.

```php
if(isset($_SESSION['logged_in'])){
    //Present user with a choice of options.
}else {
    if (isset($_POST['username'], $_POST['password'])) {
        $_SESSION['logged_in'] = true;
        header('Location: index.php');
    }

    <form method="post" action="index.php">
        <input type="text" name="username"/>
        <input type="password" name="password"/>
    </form>
}
```

Figure 3.4.1 – System Structure Outline for index.php

The initial block of code to be run is the form element. $_SESSION['logged_in'], $_POST['username'] and $_POST['password'] have yet to be set, so the respective if conditions return false and the compiler does not proceed with them. The form element requires a user to input his username and password.

Once a user presses submit, the form posts the variables to the index.php page. This essentially refreshes the page, but this time, $_POST['username'] and $_POST['password'] are set, so the compiler runs the code with the if condition.

The code within this if condition performs several validations. It checks if the username and password match a record in the users table in the MySQL database. If this check is positive, it then creates a login id for the user. It also creates the $_SESSION['logged_in'] and assigns a value of true to it. The header function is then called to refresh the page.

The $_SESSION['logged_in'] has been set so the initial if condition is run. This presents the user with a completely different screen where the user has a choice of options.

This structure is present throughout most of the pages on the system. On the trial.php page, the user has to input the patient’s id before a list of available trials is made available. On the prescription.php page, the user has to generate a UUID before the full prescription is available. The full pages can be viewed in Appendix E.
3.5 **System Elements**

The system comprises of several elements, each performing a different function. The login element provides security by restricting the site to an authorised set of users. The geoPositioning is a secondary screening technique that provides an additional layer of security. The mobile responsiveness element allows the site to be accessible by any device. The diagnostic assistant and the prescription generation are the heart of the system. They can coherently track and store the results from a clinical trial and use the information to better diagnose a patient and produce a more accurate prescription.

**Login System**

The initial page a user is presented with is the login.php page. The user is required to enter in his/her credentials. Once the user submits values into the variables username and password, they are then posted to the MySQL database and checked against existing records. The session ‘logged_in’ is created if a successful match occurs. Once a session has been created the page refreshes and the user is presented with a list of options.

**geoPositioning**

The geoPositioning element of the site activates and the user’s longitude, latitude and time of entry are recorded. This is a secondary screening technique that provides an additional layer of security. geoPositioning is a JavaScript function located on the index.php. The function runs once the page has loaded.

**Mobile Responsiveness**

The front end was developed with a free, open source framework called Bootstrap. Bootstrap is a free collection of tools for creating websites and web applications. It contains HTML and CSS-based design templates for typography, forms, buttons, navigation and other interface components, as well as optional JavaScript extensions.

**Patient Trial and Prescription Generation**

Figure 3.5.1 outlines the steps necessary to perform a trial on a patient. The user starts at the trial.php page. The user is required to enter in a patient’s id. If the patient does not have a record, the user is required to create one. Once a record has been created, the user is redirected back to the trial.php page. The user then has to answer a series of yes/no questions about the patient. An appropriate course of action is determined based on the answers provided.
Figure 3.5.1 – Patient Trial Overview
3.6 **Medicine Management Programme System Presentation**

The system was presented to the staff of the Medicine Management Programme. It was initially assumed that the system would be presented to the client, Professor Cathal Walsh, the head of the MMP, Professor Michael Barry, and perhaps one additional member of the MMP. In reality, it was presented to the entire MMP staff comprising of no less than seven people.

The author had the foresight to include the logo of the MMP into the PowerPoint presentation and system demonstration. It was a small gesture of good faith which was well received. It was a good way to break the ice and it was noted on several occasions, including a follow up email, that it was a “nice touch”. The PowerPoint presentation is included in Appendix G.

Following on from the presentation, contact was made with Sarah McCormack, who suggested it would be beneficial to meet with a member of staff from the Primary Care Reimbursement Service (PCRS). As outlined in Section 2.2, the PCRS is responsible for making payments to healthcare professionals. The meeting will be a chance to exchange ideas with a member of the PCRS. It has yet to be scheduled, but it is likely it will occur beyond the deadline of this project.

3.7 **Problems Encountered**

This project is a forbearer to a complete online prescription service. Therefore, the scope of the project was the main source of difficulty. While this project exceeded the initial terms of reference, the implementation of a fully online prescription system would require a considerable investment in time and resources from the HSE, far outweighing the resources available for a student project. As such, this project serves as a foundation to base future work on. It will be used as a tool to provide direction for future decisions within the HSE.

The complexity of the system was an additional source of difficulty. However, there were certain remissions from that. The technical environment was implemented with little hassle. The XAMMP platform was installed on a personal machine to avoid any sources of issue of administrative restriction. Even allowing for these compromises, the system retains a large degree of complexion. There are six different computer languages that have to seamlessly interact with each other. PHP5, HTML5, CSS3, MySQL, jQuery and JavaScript all require unique syntax to operate and in some instances, an element of one language had to be accessed through another language.
4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

As time progressed, the requirements and scope of the project bloomed (outlined in Section 1.3, page 3). A secure, single system was created that could coherently track and store the results from a clinical trial and use the information to better diagnose a patient and produce a more accurate prescription. This is a decision support system for medical staff, to allow them to make better decisions. A user manual is provided to ensure the system is fully understood and easy to use (Appendix C).

This project is a forbearer to a complete online prescription service. There exists a significant opportunity to vastly improve the Irish health service through the implementation of technology. Historically in Ireland, as in many other countries, our national data collections have evolved over time in a largely uncoordinated fashion. Although there are examples of very good practice, this lack of coordination has led to a fragmented health information infrastructure with significant variation in quality, duplication, access problems, and increased costs. In terms of completeness, there are a number of major deficiencies [5].

It will require several significant advances before a fully electronic prescription service is available. The most significant issues that need to be addressed are the unification of all existing systems and the implementation of a structure of electronic authorisation.

Both of these problems are addressed by the integration of this project into the Healthlink system (described in Section 2.2). Healthlink’s core remit is to provide a messaging service that allows patient information to be securely transferred between medical staff. This could be combined with the ability to diagnose and generate prescriptions. A system that can incorporate all these elements is the beginning of a single core system that can be used by the HSE.

There are numerous benefits to a unified, authorization system. It is possible to monitor the prescription levels of individual GPs. Consequentially, it is possible to determine if a GP is prescribing the preferred drug recommended by the MMP. This decreases the influence of drug companies manipulating doctors into prescribing unnecessary prescriptions.

The e-authorisation component utilises the UUID, which is unique for every prescription, to track a prescription and determine if a prescription is genuine. Therefore, it would lead to a reduction in forged prescriptions which saves money and lives.
This system could be expanded out to be completely autonomous and require no input from doctors. It could automatically conduct clinical trials on existing patient databases. Therefore, it can identify existing patients with misdiagnosed prescriptions and alert the necessary authorities. It could conduct periodic reviews of the patient database and identify any progression of disease. If there has been an unusually high increase in a patient’s CHADS\textsubscript{2} score in a short amount of time, then this represents a significant increase in the risk to a patient’s health. The appropriate authorities could be alerted.

In conclusion, the system exists in a prototype state. It calls to self-generated MySQL tables that are populated with test data. It succeeds as a proof of concept, but it requires the additional integration of systems to fully exploit its capabilities.
4.2 Recommendations

It requires little effort to deploy the system. The system has been built using web based languages like HTML5 and PHP. Therefore, all that is required to deploy the system is access to a domain name and a server. The XAMPP platform was installed on a personal machine for testing purposes and to avoid any sources of issue of administrative restriction. The client will be required to register the appropriate domain name and transfer the necessary files onto an external server. Consequentially, the connection details to the database will also have to be altered. They are easily accessible because they are located in a separate file.

The client will also be required to replicate the tables from the MySQL database on the appropriate server. As outlined above and in Section 2.4, the system was trialled on a personal computer implementing a XAMPP stack. Therefore, the MySQL database existed only on the personal computer. The client should use phpMyAdmin to recreate the tables.

The client will be required to determine the appropriate users of the site. A table with generic users was used for testing purposes. This could be repopulated with an existing table of general practitioners. The table could be readjusted to use the health identifiers as a primary key. Health identifiers, proposed by the Health Information and Quality Authority, accurately identify the practitioners who provide health services [3].

The feasibility of the incorporation of this project into a larger system, like Healthlink, should be determined. It should focus on the consolidation of patient information into a single location. A review of the drug distribution structure should be conducted. A database should be compiled of existing pharmacies, prescription centres, and GP offices. This will identify opportunities to establish the cohesive connection between the administration and distribution of prescriptions.
## APPENDICES

<table>
<thead>
<tr>
<th>NO.</th>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Original Project Outline</td>
<td>A.1</td>
</tr>
<tr>
<td>B.</td>
<td>Interim Project Report</td>
<td>B.1</td>
</tr>
<tr>
<td>C.</td>
<td>User Manuals</td>
<td>C.1</td>
</tr>
<tr>
<td>D.</td>
<td>Design Documentation</td>
<td>D.1</td>
</tr>
<tr>
<td>E.</td>
<td>Source Code</td>
<td>E.1</td>
</tr>
<tr>
<td>F.</td>
<td>Test Documentation</td>
<td>F.1</td>
</tr>
<tr>
<td>G.</td>
<td>MMP PowerPoint Presentation</td>
<td>G.1</td>
</tr>
<tr>
<td>H.</td>
<td>Glossary</td>
<td>H.1</td>
</tr>
<tr>
<td>I.</td>
<td>Reference</td>
<td>I.1</td>
</tr>
</tbody>
</table>
A. ORIGINAL PROJECT OUTLINE

Client: Medicines Management Programme / Centre for Health Decision Sciences

Project: Online tools for risk scoring

Location: Trinity Centre for Health Sciences, St James's Hospital, Dublin 8

Client Contact: Prof Michael Barry, SJH, D8

Dept. Contact: Cathal Walsh

Client Background
The medicines management programme aims to promote safe, effective, and cost effective prescribing. It is a recently founded initiative within the HSE. Further information is available at http://www.hse.ie/yourmedicines

Project Background
Clinical risk scores can quantify the risk of progression of disease, or of future events, e.g. http://www.mdcalc.com/abcd2-score-for-tia/ similar tools exist for the appropriate prescribing of medications. The purpose of this project is to develop scoring tools for the Irish population and to make them available in a fashion that is accessible by general practitioners.

Client Requirement
The client requires a review of existing tools,

The analysis should focus on identifying appropriate tools for use in the Irish setting, developing an easy to use interface to these tools – for desktop based and mobile clients. Some knowledge and awareness of the way in which these are used in practice would be useful, in order to ensure that they are focused on the target population.

What is involved for the student?

The student should be familiar with the programming of web based tools, statistical analysis of datasets in order to quantify risk, and the updating of these to reflect the demographics and needs of the Irish population.

Key skills required are quantitative analysis experience, and programming and web development skills.
B. INTERIM REPORT
Management Science and Information Systems Studies

Project: Online Risk Scoring Tools
Client: Medicine Management Programme / Centre for Health Decision Sciences
Student: Andrew King
Supervisor: Mary Sharp

Review of Background and Work to Date

The Medicine Management Programme is a HSE initiative that works to increase the cost effectiveness of the prescription of medication to the Irish population. It seeks to optimise the distribution of more cost effective medications, while maintaining high safety standards.

The purpose of this project is to examine existing risk scoring tools, develop scoring tools specific for the Irish population and make them accessible to general practitioners through a mobile responsive user interface. The user interface will be built using HTML5, CSS3, PHP and MySQL. The mobile responsive element of the user interface will be developed using Bootstrap, an open source, front-end framework. The statistical analysis will carried out through R.

The following has been completed to date:

- Prepared the terms of reference of the project.
- Designed a system overview diagram detailing the layout of the system.
- Incorporated a front-end framework into the user interface.

Terms of Reference

The terms of reference for this project are as follows:

- To conduct a thorough research into existing risk scoring tools.
- To develop a mobile responsive user interface to be used as an access point to the risk scoring tools.
- To develop appropriate risk scoring tools for the prescription of medications to the Irish population, specifically new oral anticoagulants, like Warfarin and Dabigatran.
Further Work

The remaining work has been divided into the following:

**Christmas Holiday**
- The majority of the work will commence during the Christmas break. I plan to complete the user interface using HTML5, CSS3, PHP and MySQL.

**Semester 2 Weeks 1 – 9**
- Continuation of work with regular reports to supervisor.

**Week 10**
- Provide draft of final report and adjust depending on supervisor’s advice.
- Submit final report

**Interim Conclusion**

The aim of this project is small, compared to the size of the task of the medicine programme, but it does have the potential to grow beyond the initial terms of reference. While this project aims to develop tools for the general practitioner, it is quite conceivable to extend this out to the greater public. This system could easily be adjusted to receive input from a user who could upload their results from a smartphone or a tablet.
C. USER MANUAL

C.1 Introduction

This user manual was created to help illustrate the functionality of the site. It provides indication for the successful navigation throughout the site.

C.2 About

This application was produced for the Medicine Management Programme by Andrew King.
C.3 Home Page

The initial screen a user will see is the login screen.

The following alert will appear if this is the first time logging into the system.

![Alert](image)

It is requesting permission for the site to use the user’s location. This is used as a security check and permission should be allowed.

The user is then required to enter a username and password.
The following error message will display if the user tries to sign in with entering any input.

![Username and Password Fields](image)

The following error message will display if a user tries to sign in with incorrect credentials.

```
Error: Incorrect Username or Password
```

The main home page will display once a user has successfully logged in. From here, it is possible to conduct all actions. The text “Medicine Management Programme” acts as an anchor which will return the user to this location anytime it is clicked.

```
Medicine Management Programme
Please select from the below options
```

- Add Patient Record
- Perform Test
- Show Available Drugs
- Logout
C.4 Add Patient Record

Before a test can be performed, it is necessary to add a patient's record. This requires the user to input necessary fields like name, age and a series of yes/no questions.
The user can add the patient record once it has answered all the required questions. This will generate a new row in a database with a unique patient id. This id will be required when a user wants to perform a test.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke / TIA / Thromboembolism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Abuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral Vascular Disease / Prior Myocardial Infarction / Aortic Plaque</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Add Patient Record**
C.5 Perform Test

Select Patient Id

The initial step in a trial is to choose the required patient. This is done by choosing the appropriate patient id. The user should click the search by name button, if the user is not aware of the appropriate patient id.
This will redirect the user to a page where it is possible to enter in the patient's first and last name.

![Image of Medicine Management Programme]

**Please enter the patient's name**

- First Name
- Last Name

**Find Patient ID**

The following error message will appear if a user enters in a patient id which does not exist.

**Error: The patient id does not exist.**

Otherwise, the user is directed to the trial screen, where it is possible for the user to determine which trial can be conducted.
Select Drug Trial

**Medicine Management Programme**

<table>
<thead>
<tr>
<th>Patient ID: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew King, 21</td>
</tr>
</tbody>
</table>

Please select a treatment to trial

- Treatment

The information of the patient selected is displayed. Also, the user has the ability to select the trial they wish to perform. NOAC have only been considered for the prototype, but this can be expanded out to include any relevant drug class that needs to be trialled.
NOAC Trial – Clinical Indication

Medicine Management Programme

Patient ID: 1
Andrew King, 21

Please tick as appropriate:

Is atrial fibrillation (AF) the clinical indication for the new oral anticoagulant (NOAC)?

- Yes
- No

Submit
The page will readjust if the user indicates that atrial fibrillation is the clinical indication. There are three possible courses of action on this page.

Atrial Fibrillation is not the clinical indication.
In this case, the user is directed to the next screen and the CHADS$_2$ Score is generated.

Atrial Fibrillation is the clinical indication, but it is non-valvular AF.
In this case, the user is directed to the next screen and the CHADS$_2$ Score is generated.

Atrial Fibrillation is the clinical indication, but it is valvular AF.
In this case, a prescription is generated for the user recommending Warfarin as the preferred drug.

**Please tick as appropriate:**

**Is atrial fibrillation (AF) the clinical indication for the new oral anticoagulant (NOAC)?**

- Yes
- No

**If yes, is it valvular or non-valvular AF?**

- Valvular
- Non-Valvular
NOAC Trial – CHAD S\textsubscript{2} Score

The CHADS\textsubscript{2} Score is automatically generated from the input the user entered when adding the patient record. There are two possible courses of action on this page.

If the CHADS\textsubscript{2} Score is equal to or greater than two, a prescription for Warfarin will be suggested.

If the CHADS\textsubscript{2} Score is less than two, a more comprehensive risk factor approach will be considered. The CHA\textsubscript{2}DS\textsubscript{2}-VASc Score will be generated.

![Medicine Management Programme](image-url)

Patient ID: 1

Andrew King, 21

Age: 0 point.
Cardiac Failure: 0 point.
Hypertension: 0 point.
Diabetes: 0 point.
Stroke: 0 point.
TIA: 0 point.

CHADS\textsubscript{2} Score: 0 points.

Patient ID: 1

A CHADS\textsubscript{2} score of 0 - 1, a more comprehensive risk factor based approach is recommended.

Generate CHA\textsubscript{2}DS\textsubscript{2} Score.
NOAC Trial - CHA₂DS₂-VASc Score

Similar to the CHADS² Score, the CHA₂DS₂-VASc Score is automatically generated from the input the user entered when adding the patient record. There are two possible courses of action on this page.

If the CHA₂DS₂-VASc Score is equal to or greater than two, a prescription for Warfarin will be suggested.

If the CHA₂DS₂-VASc Score is less than two, no action should be recommended.
C.6  Generate Prescription

A prescription will be generated once a user has successfully conducted the appropriate risk scoring techniques.
A Universal Unique Identification will be generated for each prescription. This is a 36 digit, pseudo-randomly generated set of characters.

![Image of Medicine Management Programme](image)
The final stage combines the information that has been generated across the previous stages of the trial. The prescription displays the user information, patient information, location of user, timestamp of user and the UUID. This prescription is then stored in a secure database.

The following error message is displayed if a user tries to refresh the page and submit the same prescription.
D. DESIGN DOCUMENTATION

This appendix describes the chosen software methodology and the structure of tables in the MySQL database.

D.1 Software Methodology – Agile Programming

Software methodologies are useful for giving a structure to the lifecycle of a software project. Agile software development is a group of software development methods based on iterative and incremental development, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. It promotes adaptive planning, evolutionary development and delivery, a time-boxed iterative approach, and encourages rapid and flexible response to change. It is a conceptual framework that promotes foreseen tight iterations throughout the development cycle.

In 2001, a group of programmers created the agile manifesto as an alternative to document driven and heavyweight software development [1]. The Agile Manifesto is based on twelve principles:

1. Customer satisfaction by rapid delivery of useful software
2. Welcome changing requirements, even late in development
3. Working software is delivered frequently (weeks rather than months)
4. Working software is the principal measure of progress
5. Sustainable development, able to maintain a constant pace
6. Close, daily cooperation between business people and developers
7. Face-to-face conversation is the best form of communication (co-location)
8. Projects are built around motivated individuals, who should be trusted
9. Continuous attention to technical excellence and good design
10. Simplicity—the art of maximizing the amount of work not done—is essential
11. Self-organizing teams
12. Regular adaptation to changing circumstances

Development methods exist on a continuum from adaptive to predictive. Agile methods lie on the adaptive side of this continuum [2]. One of the differences between agile and waterfall is that testing of the software is conducted at different stages during the software development lifecycle. In the Waterfall model, there is always a separate testing phase near the
completion of an implementation phase. Agile testing is usually done concurrently with coding, or at least, testing jobs start in early iterations.

D.2 Database Structure

The phpMyAdmin user interface was used to create five tables in the MySQL database.

Login Table

<table>
<thead>
<tr>
<th>login_id</th>
<th>user_id</th>
<th>latitude</th>
<th>longitude</th>
<th>timestamp_login</th>
<th>timestamp_logout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>-6.25096</td>
<td>53.3434</td>
<td>2014-03-20 15:34:01</td>
<td>2014-03-20 15:34:01</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-6.25091</td>
<td>53.3434</td>
<td>2014-03-20 15:34:43</td>
<td>2014-03-20 15:34:43</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-6.25091</td>
<td>53.3434</td>
<td>2014-03-20 15:34:26</td>
<td>2014-03-20 15:34:26</td>
</tr>
</tbody>
</table>

Patient Table

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<thead>
<tr>
<th>patient_id</th>
<th>first_name</th>
<th>last_name</th>
<th>age</th>
<th>gender</th>
<th>smoker</th>
<th>cardiac</th>
<th>hypertension</th>
<th>diabetes</th>
<th>stroke_tia_throm</th>
<th>alcohol</th>
<th>peripheral_vascular</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andrew</td>
<td>King</td>
<td>21</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Antony</td>
<td>Briggs</td>
<td>32</td>
<td>1</td>
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<td>1</td>
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</tr>
<tr>
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<td>43</td>
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<td>1</td>
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<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Richard</td>
<td>Higgs</td>
<td>44</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

User Table

<table>
<thead>
<tr>
<th>user_id</th>
<th>user_name</th>
<th>user_password</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>admin</td>
<td>5f4dccc3b5aa7e5d61d8327deb882cf99</td>
</tr>
<tr>
<td>2</td>
<td>hello</td>
<td>5d41402abc4b2a768b9719d911017c592</td>
</tr>
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</table>

Drug Table

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<tbody>
<tr>
<td>1</td>
<td>Warfarin</td>
<td>NOAC</td>
</tr>
<tr>
<td>2</td>
<td>Apixiban</td>
<td>NOAC</td>
</tr>
<tr>
<td>3</td>
<td>Rivaroxaban</td>
<td>NOAC</td>
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Prescription Table
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<tbody>
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<td>1</td>
<td>9</td>
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<td>Warfarin</td>
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</tr>
<tr>
<td>5</td>
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<td>9</td>
<td>NOAC</td>
<td>Warfarin</td>
<td>1.303561808E+14</td>
<td>BC465D02-C07D-46D8-AF3C-9E557OF419G</td>
</tr>
<tr>
<td>4</td>
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<td>9</td>
<td>NOAC</td>
<td>Warfarin</td>
<td>1.303550111E+11</td>
<td>FA809C3D-49A4-4158-9E89-5700478A82E</td>
</tr>
<tr>
<td>8</td>
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<td>Warfarin</td>
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</tr>
<tr>
<td>7</td>
<td>1</td>
<td>10</td>
<td>NOAC</td>
<td>Warfarin</td>
<td>1.303583034E+11</td>
<td>9466743E-4A1A-4307-90AF-DBD00C0A34E0A5</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>9</td>
<td>NOAC</td>
<td>Warfarin</td>
<td>1.303582799E+11</td>
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</tr>
<tr>
<td>9</td>
<td>1</td>
<td>7</td>
<td>NOAC</td>
<td>Warfarin</td>
<td>1.30358614E+11</td>
<td>9466743E-4A1A-4307-90AF-DBD00C0A34E0A5</td>
</tr>
</tbody>
</table>
E. SOURCE CODE

This appendix contains the source code of the system. The system was built using six programming languages; PHP5, HTML5, CSS3, MySQL, jQuery and JavaScript. The system was built on a free text editor called Espresso and trialled using a XAMPP server package.

The front end was developed with a free, open source framework called Bootstrap. It contains HTML and CSS-based design templates for typography, forms and other interface components, as well as optional JavaScript extensions. The bootstrap libraries contain several extensive folders comprised of several thousand lines of code. It is impractical to recreate it here. It can be found at http://getbootstrap.com/


geoPosition.js

```javascript
var x=document.getElementById("demo");

function getLocation()
{
    if (navigator.geolocation)
    {
        navigator.geolocation.getCurrentPosition(showPosition, showError);
    }
else{x.innerHTML="Geolocation is not supported by this browser. <a href='http://www.google.com/chrome'>Please download the latest version of Chrome.</a>";}
}

function showPosition(position)
{

document.getElementById('lat').value = position.coords.latitude;
document.getElementById('long').value = position.coords.longitude;
document.getElementById('time').value = position.timestamp;
```
function showError(error)
{
    switch(error.code)
    {
        case error.PERMISSION_DENIED:
            x.innerHTML="User denied the request for Geolocation. It is necessary to allow 
permission for this site to function."
            break;
        case error.POSITION_UNAVAILABLE:
            x.innerHTML="Location information is unavailable."
            break;
        case error.TIMEOUT:
            x.innerHTML="The request to get user location timed out."
            break;
        case error.UNKNOWN_ERROR:
            x.innerHTML="An unknown error occurred."
            break;
    }
}
Connection.php

<?php

//Connects to a MySQL database, fyp, with the username root and no password.
$mysql_host = 'localhost';
$mysql_user = 'root';
$mysql_pass = '';

$mysql_db = 'fyp';

if(!@mysql_connect($mysql_host, $mysql_user, $mysql_pass) ||
!@mysql_select_db($mysql_db)){
    die(mysql_error());
}else{

}

?>
Logout.php

<?php

session_start();

$logout = time();
$login_id = $_SESSION['login_id'];

$sql="UPDATE `login` SET `timestamp_logout`='$logout' WHERE `login_id`='$login_id'";
$query = mysql_query($sql);

session_destroy();

header('Location: ./index.php');

?>
Math.uuid.js

/*!
Used to create a 36 digit pseudo random Universal Unique Identifier

Math.uuid.js
/*

* Generate a random uuid.
*

* USAGE: Math.uuid(length, radix)
*  length - the desired number of characters
*  radix - the number of allowable values for each character.
*

* EXAMPLES:
*  // No arguments - returns RFC4122, version 4 ID
*  >>> Math.uuid()
*  "92329D39-6F5C-4520-ABFC-AAB64544E172"
*
*  // One argument - returns ID of the specified length
*  >>> Math.uuid(15)  // 15 character ID (default base=62)
*  "VcydxgtlxrVZSTV"
*
*  // Two arguments - returns ID of the specified length, and radix. (Radix must be <= 62)
*  >>> Math.uuid(8, 2)  // 8 character ID (base=2)
*  "01001010"
*  >>> Math.uuid(8, 10) // 8 character ID (base=10)
*  "47473046"
*  >>> Math.uuid(8, 16) // 8 character ID (base=16)
*  "098F4D35"
*/
(function() {
  // Private array of chars to use
  var CHARS =
  '0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz'.split('');
Math.uuid = function (len, radix) {
    var chars = CHARS, uuid = [], i;
    radix = radix || chars.length;

    if (len) {
        // Compact form
        for (i = 0; i < len; i++) uuid[i] = chars[0 | Math.random()*radix];
    } else {
        // rfc4122, version 4 form
        var r;

        // rfc4122 requires these characters
        uuid[14] = '4';

        // Fill in random data. At i==19 set the high bits of clock sequence as
        // per rfc4122, sec. 4.1.5
        for (i = 0; i < 36; i++) {
            if (!uuid[i]) {
                r = 0 | Math.random()*16;
                uuid[i] = chars[(i == 19) ? (r & 0x3) | 0x8 : r];
            }
        }

        return uuid.join('');
    };

    // A more performant, but slightly bulkier, RFC4122v4 solution. We boost performance
    // by minimizing calls to random()
    Math.uuidFast = function() {

var chars = CHARS, uuid = new Array(36), rnd=0, r;
for (var i = 0; i < 36; i++) {
    if (i==8 || i==13 || i==18 || i==23) {
       uuid[i] = '-';
    } else if (i==14) {
        uuid[i] = '4';
    } else {
        if (rnd <= 0x02) rnd = 0x2000000 + (Math.random() * 0x1000000) | 0;
        r = rnd & 0xf;
        rnd = rnd >> 4;
        uuid[i] = chars[(i == 19) ? (r & 0x3) | 0x8 : r];
    }
}
return uuid.join('');

// A more compact, but less performant, RFC4122v4 solution:
Math.uuidCompact = function() {
    return 'xxxxxxxx-xxxx-4xxx-yxxx-xxxxxxxxxxxx'.replace(/[xy]/g, function(c) {
        var r = Math.random()*16|0, v = c == 'x' ? r : (r&0x3|0x8);
        return v.toString(16);
    });
};

function genRATE() {
    document.getElementById('fred').innerHTML=Math.uuid();
    document.getElementById('fred').value=Math.uuid();
}
<?php

//The index page runs three separate blocks of code. The 1st IF condition checks if a user has logged in. The first block of code runs if they are not logged in. The first block of code to be run is the code from Line *** to Line ***. This presents the user with a login screen. It requires users to set specific variables, namely username and password. It also sets three hidden variables; long, lat and time. These are set, by a JavaScript function called getLocation(), to contain the user's longitude, latitude and timestamp. These variable can be used as a security check to ensure the user is who they say they are.

//Once the user has inputted the required variables, and hit the submit button, the page will refresh itself by virtue of setting the action property in the form to "index.php". The second block of code will now run. The selection criteria ascertains whether the variables from the first block of code has been set. It then stores them in PHP variables. It then inserts these variables into a MySQL table

session_start();
include_once('..//includes/connection.php');

//Third block of code to be run. This will only be run once the first two blocks of code have been executed.
if(isset($_SESSION['logged_in'])){  

//Unset the SESSION for patient. Therefore they just have to return to the index page if they want to cancel out of a SESSION. Brilliant.
//This is a safety check to ensure all SESSIONs are unset. The information from the previous SESSION will be used if SESSIONs are allowed to remain set.
if(isset($_SESSION['patient'])){  
    unset($_SESSION['patient']);

//Similarly, the same concept applies for prescriptions.
if (isset($_SESSION['prescription'])){  
    unset($_SESSION['prescription']);
}
}
<?>
<html>
<head>
<title>Medicine Management Programme</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">

<!--[if lt IE 9]>
<script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
<script src="https://oss.maxcdn.com/libs/respond.js/1.3.0/respond.min.js"></script>
<![endif]-->
</head>
<body>
<div class="container">
<div class="form-signin">
<h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>
<h2 class="form-signin-heading">Please select from the below options</h2>

<!--[if lt IE 9]>
<script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
<script src="https://oss.maxcdn.com/libs/respond.js/1.3.0/respond.min.js"></script>
<![endif]-->
</div>
</div>
</body>
</html>
<div class="list-group">
  <a href="add_patient.php" class="list-group-item">Add Patient Record</a>
  <a href="trial.php" class="list-group-item">Perform Test</a>
  <a href="show_drug.php" class="list-group-item">Show Available Drugs</a>
  <a href="logout.php" class="list-group-item">Logout</a>
</div>

<?php

else{
    // The second block of code to be run.
    // Checks if variables have been set from further on in the code.
    if(isset($_POST['username'], $_POST['password'], $_POST['long'], $_POST['lat'], $_POST['time'])){}
        $username = $_POST['username'];
        $password = md5($_POST['password']);
        $long = $_POST['long'];
        $lat = $_POST['lat'];
        $time = $_POST['time'];

        if(empty($username) || empty($password)){
            ?>
            <div class="alert alert-danger"><strong>Error:</strong> All fields are required.</div>
            <?php
        }else{
            ...
        }

else{
    ...
}
$query = "SELECT * FROM users WHERE user_name = 'username' AND user_password='password';"
$sql = mysql_query($query);

$num = mysql_num_rows($sql);

while ($row = mysql_fetch_array($sql)) {
    $user_id = $row['user_id'];
    $user_name=$row['user_name'];

    //These SESSIONs will be used in the prescription.php page
    $_SESSION['user_id'] = $user_id;
    $_SESSION['user_name'] = $user_name;
}

if (!empty($long) || !empty($lat) || !empty($time)) {
    $sql = "INSERT INTO `login` (`user_id`, `latitude`,`longitude`,`timestamp_login`) VALUES ('$user_id', '$long','$lat','$time');"
    $query = mysql_query($sql);
}

$query = "SELECT `login_id` FROM `login` WHERE `user_id` = '$user_id' AND `timestamp_login`='$time';"
$sql = mysql_query($query);

while ($row = mysql_fetch_array($sql)) {
    $login_id = $row['login_id'];
}

if($num == 1){
    //Setting two SESSIONs. One for the login_id which contains an integer.
// The other contains a boolean value set to true
// The page is then redirected to the top again, which
will now run the code inside the first condition which determines
    // if SESSION['logged_in'] = true;

$_SESSION['login_id'] = $login_id;
$_SESSION['logged_in'] = true;
header('Location:index.php');
exit();
}else{
?>
<div class="alert alert-danger"><strong>Error:</strong> Incorrect Username or Password</div>
<?php
}?>

<!-- The first block of code to be run. The user will input the required variables, and the page
will refresh itself by virtue of the action property in the form. The code above will run. -->

<html>
<head>
<title>Medicine Management Programme</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0"/>
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">

<!-- Bootstrap core CSS -->
<link href="../dist/css/bootstrap.css" rel="stylesheet">
<!-- Custom styles for this template -->
<link href="signin.css" rel="stylesheet">

<!-- HTML5 Shim and Respond.js IE8 support of HTML5 elements and media queries -->
<!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
<!--[if lt IE 9]>
<script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
<script src="https://oss.maxcdn.com/libs/respond.js/1.3.0/respond.min.js"></script>
<![endif]-->
</head>

<!-- The javaScript function getLocation() retrieves the user's latitude, longitude and timestamp. These are then stored in three hidden HTML elements-->
<body onload="getLocation()">
  <div class="container">
    <form class="form-signin" method="post" action="index.php" autocomplete="off">
      
      <h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>
      
      <h2 class="form-signin-heading">Please sign in</h2>
      
      <p id="demo">Please allow permission for this site to identify your location.</p>
      <input id="lat" name="lat" type="hidden" value="" />
      <input id="long" name="long" type="hidden" value="" />
      <input id="time" name="time" type="hidden" value="" />
      
      <input type="text" class="form-control" name="username" placeholder="Username" required autofocus>
      <input type="password" class="form-control" name="password" placeholder="Password" required>
    </form>
  </div>
</body>
// This page follows the same format as the index.php page.
// It has three separate block of code that should be executed from the bottom up.
// The first block of code asks a user to enter a patient id.
// The second block validates the user's selection.
// The third block allows a user to select a trial they wish to evaluate.

session_start();
include_once('includes/connection.php');

// IF condition to determine if a user has logged in. This is to stop people
// navigating to this page without logging in.
// The user will be redirected to the index.php page if this condition is false.
if(isset($_SESSION['logged_in'])){
    if(isset($_SESSION['patient'])){
        ?></html>
        <head>
        <title>Patient Trial</title>
        <meta name="viewport" content="width=device-width, initial-scale=1.0">
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">

        <!-- Bootstrap core CSS -->
        <link href="../dist/css/bootstrap.css" rel="stylesheet">

        <!-- Custom styles for this template -->
        <link href="signin.css" rel="stylesheet">
        </head>
        <body>
<div class="container">
<div class="form-signin">

<h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>
<br />
<?php
$patient_id=$_SESSION['patient_id'];
$query = "SELECT * FROM 'patient' WHERE 'patient_id'='$patient_id'";
$query_run = mysql_query($query);
$num = mysql_num_rows($query_run);
?>

<div class="panel panel-primary">
  <!-- Default panel contents -->
  <div class="panel-heading">Patient ID: <?php echo($patient_id); ?></div>
  <!-- Table -->
  <div class="panel-body">
    <?php
    while($row = mysql_fetch_array($query_run))
    {
      echo $row['first_name'] . " ". $row['last_name'] . ", ". $row['age'];
      echo "<br/>";
    }
  </div>
</div>

<form class="form-signin" method="post" action="trial.php" autocomplete="off">
  <h3 class="form-signin-heading">Please select a treatment to trial</h3>
  <!-- Single button -->
</form>
</div>
</div>
<div class="btn-group">
<button type="button" class="btn btn-default dropdown-toggle" data-toggle="dropdown">
Treatment <span class="caret"></span></button>
<ul class="dropdown-menu" role="menu">
<li><a href="trial_NOAC_1.php">NOAC</a></li>
<li><a href="#">Another</a></li>
<li><a href="#">Another</a></li>
</ul>
</div>

<script src="https://code.jquery.com/jquery-1.10.2.min.js"></script>
<script src="../dist/js/bootstrap.min.js"></script>

<?php
}else {
if(isset($_POST['patient_id'])){?
$patient_id = $_POST['patient_id'];

if(empty($patient_id)){

<div class="alert alert-danger"><strong>Error:</strong> A patient id is required.</div>

<?php
}

//Testing if the patient exists
//Add in protection against SQL injection by mysql_real_escape()
$query = "SELECT * FROM `patient` WHERE `patient_id`='$patient_id';"
$query_run = mysql_query($query);
$num = mysql_num_rows($query_run);

if($num == 1){
    $_SESSION['patient'] = true;
    $_SESSION['patient_id'] = $patient_id;

    //Should I create a SESSION for patient_record.
    header('Location:trial.php');
    exit();
} else {

    ?>
    <div class="alert alert-danger"><strong>Error:</strong> The patient id does not exist.</div>
    <?php
    } }
} }

<?
<html>
<head>
<title>Patient Trial</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">

<!-- Bootstrap core CSS -->
<link href="../dist/css/bootstrap.css" rel="stylesheet"
<link href="signin.css" rel="stylesheet">

<body>
<div class="container">
<div class="form-signin">
<h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>
<h2 class="form-signin-heading">Select Patient</h2>
<?php if(isset($error)){ ?><small style="color: #aa0000;"><?php echo($error); ?></small><?php }
<button class="btn btn-lg btn-primary btn-block" type="submit">Search</button>
</form>
<h4 class="form-signin-heading">Alternatively, search by name if you do not know the patient's id.</h4>
<a class="btn btn-primary" href="show_patient.php">Search by name</a>
</div>
</div>
</body>
```php
<?php
    } else {
        header('Location: ./index.php');
    }

?>
```
<?php
session_start();
include_once('../includes/connection.php');
if(isset($_SESSION['logged_in'])){    
    if (isset($_SESSION['patient'])){    

        $_SESSION['NOAC']=true;
        ?>
        <html>
        <head>
        <title>Patient Trial</title>
        <meta name="viewport" content="width=device-width, initial-scale=1.0">
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">
        <!-- Bootstrap core CSS -->
        <link href="../dist/css/bootstrap.css" rel="stylesheet">
        <!-- Custom styles for this template -->
        <link href="signin.css" rel="stylesheet">
        <script src="http://ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js"></script>
        <script>
            $(document).ready(function(){    
                $('input[name="atrial"]').click(function(){    
                    var v = $('input[name="atrial"]:checked').val();    
                    if (v==1) {    
                        $('#fred').fadeIn();    
                    }else {    
                        $('#fred').fadeOut();    
                    }
                })    
            })
        </script>
    </html>
}?>
<?php
//Pull information from table

$patient_id=$_SESSION['patient_id'];

$query = "SELECT * FROM `patient` WHERE `patient_id`='$patient_id';

$query_run = mysql_query($query);

$num = mysql_num_rows($query_run);

foreach($row as $row)
{
    echo $row['first_name'] . "$row['last_name']. ", "$row['age'];
    echo "<br/>"

    $_SESSION['first_name']=$row['first_name'];
    $_SESSION['last_name']=$row['last_name'];
    $_SESSION['age']=$row['age'];
}
<form class="form-signin" method="post" action="trial_NOAC_2.php" autocomplete="off">

<h3 class="form-signin-heading">Please tick as appropriate:</h3>

<div class="panel panel-info">
  <div class="panel-heading"><h4>Is atrial fibrillation (AF) the clinical indication for the new oral anticoagulant (NOAC)?</h4></div>
  <div class="panel-body">
    <label><input type="radio" name="atrial" value="1" required/> Yes</label>
    <label><input type="radio" name="atrial" value="0" required/> No</label>
  </div>
</div>

<br/>

<div id="fred" style="display: none;" class="panel panel-info">
  <div class="panel-heading"><h4>If yes, is it valvular or non-valvular AF?</h4></div>
  <div class="panel-body">
    <label><input type="radio" name="valvular" value="1" /> Valvular</label>
    <label><input type="radio" name="valvular" value="0" /> Non-Valvular</label>
  </div>
</div>

<br/>

<input class="btn btn-lg btn-primary btn-block" type="submit" name="" value="Submit" />

</form>

</div>
</div>
<?php
    }else {
        header('Location: ./trial.php');
    }
}else {
    header('Location: ./index.php');
}
?>

<script src="../dist/js/bootstrap.min.js"></script>
</body>
</html>
<?php
    session_start();
    include_once('../includes/connection.php');
    if(isset($_SESSION['logged_in'])){  
        if (isset($_SESSION['patient'])){  

    }

<html>
<head>
<title>Patient Trial</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">

<!-- Bootstrap core CSS -->
<link href="../dist/css/bootstrap.css" rel="stylesheet">

<!-- Custom styles for this template -->
<link href="signin.css" rel="stylesheet">
</head>
<body>
<div class="container">
    <div class="form-signin">
        <h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>
    </div>
</div>
</body>
</html>

/*So, I should have three different if statements for my 2nd trial page.
If atrial is set and equals 0, then I should proceed with the CHADS^2 scoring.
Should I include if valvular is not set?*/
If atrial is set and equals 1

  If valvular = 0, proceed with CHADS^2 Scoring.
  If valvular = 1, recommend Warfarin.

*/

// I think this determines if trial_NOAC_1.php has been completed
if (isset($_POST['atrial'])) {

  $_SESSION['atrial'] = $_POST['atrial'];

  // Pull information from table
  $patient_id = $_SESSION['patient_id'];
  $query = "SELECT * FROM `patient` WHERE `patient_id`='$patient_id"; 
  $query_run = mysql_query($query);
  $num = mysql_num_rows($query_run);

  if ($_SESSION['atrial']==1) {
  if (isset($_POST['valvular'])) {
    $_SESSION['valvular'] = $_POST['valvular'];

    if ($_SESSION['valvular']==1) {
      ?
      <div class="panel pannel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Patient ID: <p>echo($patient_id);
      ?
      </div>

      <!-- Table -->
      <div class="panel-body">
        <p>echo $_SESSION['first_name'].'.'.$_SESSION['last_name'].'.'.$_SESSION['age'];
        echo "<br/>";
        echo "<br/>";
        echo("Warfarin is indicated for valvular AF");
$_SESSION['recommendation']="Warfarin";

?>
<br />
<br />
<a class="btn btn-primary btn-block" href="./prescription.php">Generate Prescription</a>

</div>
</div>
<?php
else {
//SESSION to be used in prescription.php
$_SESSION['CHADS']=true;
if (isset($_SESSION['CHADS'])) {
?
<div class="panel panel-primary">
<!-- Default panel contents -->
<div class="panel-heading">Patient ID: <?php echo($patient_id); ?></div>
<!-- Table -->
<div class="panel-body">
<?php
while($row = mysql_fetch_array($query_run))
{
    $age = $row['age'];
    $cardiac = $row['cardiac'];
    $hyper = $row['hypertension'];
    $diabetes = $row['diabetes'];
    $stroke_tia_throm = $row['stroke_tia_throm'];

```
echo "$_SESSION[\'first_name\']\" ", "$_SESSION[\'last_name\']\", "$_SESSION[\'age\']");

echo "<br/";  
echo "<br/";

// Check to see if age is over a certain value
if ($age>75) {
    $age=1;
} else {
    $age=0;
}

// Check to see if Stroke, TIA or Throm is present. If they are change
// the value to 2.
if ($stroke_tia_throm==1) {
    $stroke_tia_throm=2;
}

// Output all values
echo "Age: ".$age." point.";
echo "<br/";

if ($stroke_tia_throm==1) {
    $stroke_tia_throm=2;
}

// Output all values
echo "Cardiac Failure: ".$cardiac." point.";
 echo "<br/";
echo "Hypertension: ".$hyper." point.";
  echo "<br/";
  echo "Diabetes: ".$diabetes." point.";
    echo "<br/";
    echo "Stroke/TIA: ".$stroke_tia_throm." point.";
    echo "<br/";
    
$total = $age+$cardiac+$hyper+$diabetes+$stroke_tia_throm;

$_SESSION[\'total\']=$total;
}
<?php echo "CHADS\^2 Score: ".$_SESSION['total']." points."; 

echo"<br /">;?&gt;&lt;/div&gt;

&lt;/div&gt;

&lt;div class="panel panel-primary"&gt;
&lt;!-- Default panel contents --&gt;
&lt;div class="panel-heading">Patient ID: &lt;?php echo($patient_id); ?&gt;&lt;/div&gt;

&lt;!-- Table --&gt;
&lt;div class="panel-body"&gt;
&lt;?php

if ($total >= 2) {
    echo("Warfarin is indicated for a CHADS\^2 score of >= 2");
    $_SESSION["recommendation"]="Warfarin";
}&gt;
<br />
<br />
&lt;a class="btn btn-primary btn-block" href="/prescription.php">Generate Prescription</a&gt;

&lt;?php
}

else {?

&lt;form method="post" action="trial_NOAC_3.php"&gt;

&lt;?php

    echo("A CHADS\^2 score of 0 - 1, a more comprehensive risk factor based approach is recommended.");?

&lt;br /&gt;
<?php

<form><br />
<input class="btn btn-primary btn-block" type="submit" name="" value="Generate CHA²DS²:Score." />
</form>

<?php
}
?>
</div>
</div>
<?php
}

else {
    $_SESSION['CHADS']=true;
    if (isset($_SESSION['CHADS'])) {
        ?>

</div>
</div>

<div class="panel panel-primary">

<!-- Default panel contents -->

<div class="panel-heading">Patient ID: <?php echo($patient_id); ?>
</div>

- Table -->

<div class="panel-body">

<?php

while($row = mysql_fetch_array($query_run))
{

    $age = $row['age'];

}
$cardiac = $row['cardiac'];

$hyper = $row['hypertension'];

$diabetes = $row['diabetes'];

$stroke_tia_throm = $row['stroke_tia_throm'];

echo "$_SESSION[first_name]."."$_SESSION[last_name]."."$_SESSION[age];

echo "<br/>";

echo "<br/>";

if ($age>75) {
    $age=1;
}else {
    $age=0;
}

if ($stroke_tia_throm==1) {
    $stroke_tia_throm=2;
}
echo "Age: ".$age." point.";

echo "<br/>";

echo "Cardiac Failure: ".$cardiac." point.";

echo "<br/>";

echo "Hypertension: ".$hyper." point.";

echo "<br/>";

echo "Diabetes: ".$diabetes." point.";

echo "<br/>";

echo "Stroke/TIA: ".$stroke_tia_throm." point.";

echo "<br/>";

$total = $age+$cardiac+$hyper+$diabetes+$stroke_tia_throm;

$_SESSION['total']=$total;

}?

</div>

<div class="panel-footer">
<?php echo "CHADS² Score: ".$_SESSION['total'].' points.';  

echo"<br/>";?&gt;

</div>
<div class="panel panel-primary">

<!-- Default panel contents -->

<div class="panel-heading">Patient ID: <?php echo($patient_id); ?></div>

<!-- Table -->

<div class="panel-body">

<?php

if ($total >= 2) {
    echo("Warfarin is indicated for a CHADS² score of >= 2");
}

?>

<br />

<br />

<?php
$_SESSION['recommendation']="Warfarin";?>

<a class="btn btn-primary btn-block" href="./prescription.php">Generate Prescription</a>

<?php

} else {

?>

<form method="post" action="trial_NOAC_3.php">

<?php

</form>

<?php

</div>
</div>
echo("A CHADS² score of 0 - 1, a more comprehensive risk factor based approach is recommended.

");

?>

<br />

<br />

<input class="btn btn-primary btn-block" type="submit" name="" value="Generate CHA²DS² Score." />

</form>

<?php

}

}

>

</div>

</div>

<?php

}

}

else {

header('Location: ./trial_NOAC_1.php');

}

}

else {

}
header('Location: ./trial.php');

} else {
    header('Location: ./index.php');
}

?>

</div>
</div>

<script src="../dist/js/bootstrap.min.js"></script>
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js"></script>

</body>
</html>
<?php
session_start();
include_once('../includes/connection.php');
if(isset($_SESSION['logged_in'])){?
    if (isset($_SESSION['patient'])) {
        if (isset($_SESSION['CHADS'])) {
            <html>
                <head>
                    <title>Patient Trial</title>
                </head>
                <body>
                    <div class="container">
                        <div class="form-signin">
                            <h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>
                        </div>
                    </div>
                </body>
            </html>
        }
    }
}
?>
<?php
//Pull information from table
$patient_id=$_SESSION['patient_id'];
$query = "SELECT * FROM `patient` WHERE `patient_id`='$patient_id';
$query_run = mysql_query($query);
//$num = mysql_num_rows($query_run);

?>

<div class="panel panel-primary">
  <!-- Default panel contents -->
  <div class="panel-heading">Patient ID: <?php echo($patient_id); ?></div>
  <!-- Table -->
  <div class="panel-body">
    <?php
    mysql_fetch_array($query_run))
    {
      $age = $row['age'];
      $cardiac = $row['cardiac'];
      $hyper = $row['hypertension'];
      $diabetes = $row['diabetes'];
      $stroke_tia_throm = $row['stroke_tia_throm'];
      $gender = $row['gender'];
      $peripheral_vascular = $row['peripheral_vascular'];
      echo $row['first_name'] . " 
      "$row['last_name'] ", "$age;
    }
    echo "<br/>
  </div>
</div>
if ($age>=75) {
    $age=2;
} elseif ($age>=65) {
    $age=1;
} else {
    $age=0;
}

if ($gender==1) {
    $gender=0;
} else {
    $gender=1;
}

if ($stroke_tia_throm==1) {
    $stroke_tia_throm=2;
}

echo "Age: " . $age . " point."
 echo "<br/>"
 echo "Cardiac Failure: " . $cardiac . " point."
 echo "<br/>"
 echo "Hypertension: " . $hyper . " point."
 echo "<br/>"
 echo "Diabetes: " . $diabetes . " point."
 echo "<br/>"
 echo "Stroke / TIA / Thromboembolism: " . $stroke_tia_throm . " point."
 echo "<br/>"
 echo "Gender: " . $gender . " point."
 echo "<br/>"
 echo "Peripheral Vascular Disease / Prior Myocardial Infarction"
/ Aortic Plaque: "

```
$_SESSION['total'] = $total;
```
{  
  echo $row['first_name'] . "
  echo "<br/>";
  echo "<br/>";

  if ($_SESSION['total'] == 0) {
    "CHA² DS² score = 0, aspirin or no therapy is recommended"
    $_SESSION['recommendation']="Aspirin or no Therapy";
  } else if ($_SESSION['total']==1) {
    echo "A
    CHA² DS² score = 1, oral anticoagulant or aspirin is recommended"
    $_SESSION['recommendation']='Oral Anticoagulant or Aspirin';
  } else {
    echo "A
    CHA² DS² score >= 2 / 9 oral anticoagulant recommended"
    $_SESSION['recommendation']='Warfarin';
  }
}


<?php

} else {
    header('Location: ./trial_NOAC_2.php');
}

} else {
    header('Location: ./trial.php');
}

} else {
    header('Location: ./index.php');
}

?>

</div>
</div>

<script src="../dist/js/bootstrap.min.js"></script>

<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js"></script>

</body>

</html>
<?php
session_start();
include_once('../includes/connection.php');
if(isset($_SESSION['logged_in'])){ if (isset($_SESSION['patient'])) {
    if (isset($_SESSION['recommendation'])) {
        ?>
        <html>
        <head>
        <title>Prescription</title>
        <meta name="viewport" content="width=device-width, initial-scale=1.0">
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">
        <!-- Bootstrap core CSS -->
        <link href="../dist/css/bootstrap.css" rel="stylesheet">
        <!-- Custom styles for this template -->
        <link href="signin.css" rel="stylesheet">
        </head>
        <!-- Once the body has loaded, the genRATE() function will run. genRATE() is the function to produce a UUID and is found at "./UUID/Math.uuid.js"-->
        <body onload="genRATE();">
        <div class="container">
            <div class="form-signin">
                
            </div>
        </div>
        </body>
        </html>
        ?>
    </html>
}</html>
<?php
if (isset($_SESSION['prescription'])) {

    if ($_SESSION['NOAC']) {
        $trial="NOAC";
    }

    //Pull information from table
    $login = $_SESSION['login_id'];
    $query = "SELECT * FROM `login` WHERE `login_id`='$login';
    $query_run = mysql_query($query);
    $user_id = $_SESSION['user_id'];

    echo "User ID: " .$_SESSION['user_id'];
    echo "<br/>";
    echo "Hello, ".$_SESSION['user_name'];
    echo "<br/>";
    echo "Patient ID: " .$_SESSION['patient_id'];
}
Patient: 

Treatment: 

Recommendation:

while($row =

$patient_id =

$recommendation =

$uuid = $_POST['fred'];

//time in ms

$query = "SELECT `uuid` FROM `prescriptions` WHERE `uuid`='$uuid'";

$sql = mysql_query($query);

$row = mysql_num_rows($sql);
// Checks if a prescription with the same UUID already exists. This protects against the ability to refresh
// the page and constantly generate new UUIDs

if ($row>=1) {
    ?>
    <div class="alert alert-danger"><strong>Error:</strong> This prescription UUID already exists.</div>
<?php
}

$sql="INSERT INTO `prescriptions` (`user_id`,`patient_id`,`treatment`,`recommendation`,`timestamp`,`uuid`)
VALUES($user_id,$patient_id,$trial,$recommendation,$time,$uuid")";
$query = mysql_query($sql);

if($query){
    ?>
    <div class="alert alert-success"><strong>Success:</strong> The prescription has been created. </div>
<?php
} else{
    ?>
    <div class="alert alert-danger"><strong>Error:</strong> Please try again later.</div>
<?php
}

<a href="logout.php">Logout</a>
<?php

} else {

?>

<!--UUID, prescription id, will be generated here-->
<form id="uuid_form" method="post" action="prescription.php">
<h3>Unique Prescription ID</h3>

<!--Readonly removes the risk of a user tampering with the system, whether unintentionally or maliciously-->
<input class="form-control" id="fred" type="text" name="fred" value="" readonly/>
<br />

<!--Set SESSION[‘prescription’] = true. Therefore, once the submit button is pressed, the if condition at the beginning of the page will run. -->
<?php @$_SESSION[‘prescription’]=true;
<input class="btn btn-primary btn-block" type="submit" name="" value="Submit" />

</form>

<?php

} ?>

<!-- End of Panel Body -->
<?php

} else {
    header('Location: ./index.php');
}

} else {
    header('Location: ./trial.php');
}

} else {
    header('Location: ./index.php');
}

?>

</div>
</div>

<script src="../UUID/Math.uuid.js" type="text/javascript"></script>
<script src="../dist/js/bootstrap.min.js"></script>
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js"></script>

</body>
</html>
Add_Patient.php

<?php

session_start();

include_once('../includes/connection.php');

if(isset($_SESSION['logged_in'])){}

if(isset($_POST['first_name'], $_POST['last_name'], $_POST['age'],
$_POST['gender'], $_POST['smoker'], $_POST['cardiac'], $_POST['hyper'],
$_POST['diabetes'], $_POST['stroke_tia_throm'], $_POST['alcohol'],
$_POST['peripheral_vascular']) ){}

//Ensure safety checks against integers

$first_name = $_POST['first_name'];
$last_name = $_POST['last_name'];
$age = $_POST['age'];
$gender = $_POST['gender'];
$smoker = $_POST['smoker'];
$cardiac = $_POST['cardiac'];
$hyper = $_POST['hyper'];
$diabetes = $_POST['diabetes'];
$stroke_tia_throm =
$_POST['stroke_tia_throm'];
$alcohol = $_POST['alcohol'];
$peripheral_vascular =
$_POST['peripheral_vascular'];

//What happens if a patient already exists? It is a poor system that creates another patient record for an existing patient.

//Insert into patient row

$sql = "INSERT INTO
patient(`first_name`, `last_name`, `age`, `gender`, `smoker`, `cardiac`, `hypertension`,
`diabetes`, `stroke_tia_throm`, `alcohol`, `peripheral_vascular`) VALUES
( `$first_name`, `$last_name`, `$age`, `$gender`, `$smoker`, `$cardiac`, `$hyper`, `$diabetes`, `$stroke_tia_throm`, `$alcohol`, `$peripheral_vascular`)";
$query = mysql_query($sql);

if($query){
    ?>
    <div class="alert alert-success"><strong>Success:</strong> The patient record has been created. </div>
    <?php
} else{
    ?>
    <div class="alert alert-danger"><strong>Error:</strong> Please try again later.</div>
    <?php
} ?>

<html>
    <head>
        <title>Add Patient</title>
        <meta name="viewport" content="width=device-width, initial-scale=1.0">
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">
        <!-- Bootstrap core CSS -->
        <link href="../dist/css/bootstrap.css" rel="stylesheet">
        <!-- Custom styles for this template -->
        <link href="signin.css" rel="stylesheet">
    </head>
</html>
<h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>

Add Patient

<?php if(isset($error)){ ?></small>

<?php }

<?php if(isset($error)){ ?><small style="color:#aa0000;"><?php echo($error); ?></small><?php } ?></small>

<h2 class="form-signin-heading">Add Patient</h2>

<form class="form-signin" method="post" action="add_patient.php" autocomplete="off">
  <input type="text" class="form-control" name="first_name" placeholder="First Name" required autofocus/>
  <input type="text" class="form-control" name="last_name" placeholder="Last Name" required/>
  <input type="text" class="form-control" name="age" placeholder="Age" required/>

  <h3>Gender</h3>
  <input type="radio" name="gender" value="1" required/> Male
  <input type="radio" name="gender" value="0" required/> Female<br />

  <h3>Smoker</h3>
  <input type="radio" name="smoker" value="1" required/> Yes
  <input type="radio" name="smoker" value="0" required/> No<br />

  <h3>Cardiac Failure</h3>
  <input type="radio" name="cardiac" value="1" required/> Yes
</form>
<label><input type="radio" name="cardiac" value="0" required/> No</label><br/>
<h3>Hypertension</h3>
<label><input type="radio" name="hyper" value="1" required/> Yes</label>
<label><input type="radio" name="hyper" value="0" required/> No</label><br/>
<h3>Diabetes</h3>
<label><input type="radio" name="diabetes" value="1" required/> Yes</label>
<label><input type="radio" name="diabetes" value="0" required/> No</label><br/>

<!-- There should only be one input field for Stroke, TIA and Thromboembolism. These are indicators that are detecting the same problem. If any one of these indicators are detected, then a yes should be selected.-->

<h3>Stroke / TIA / Thromboembolism</h3>
<label><input type="radio" name="stroke_tia_throm" value="1" required/> Yes</label>
<label><input type="radio" name="stroke_tia_throm" value="0" required/> No</label><br/>
<h3>Alcohol Abuse</h3>
<label><input type="radio" name="alcohol" value="1" required/> Yes</label>
<label><input type="radio" name="alcohol" value="0" required/> No</label><br/>
<h3>Peripheral Vascular Disease / Prior Myocardial Infarction / Aortic Plaque</h3>
<label><input type="radio" name="peripheral_vascular" value="1" required/> Yes</label>
<label><input type="radio" name="peripheral_vascular" value="0" required/> No</label><br/>
<button class="btn btn-lg btn-primary btn-block" type="submit">Add Patient Record</button>

</form>
</div>
</div>

<script src="https://code.jquery.com/jquery-1.10.2.min.js"></script>
<script src="../dist/js/bootstrap.min.js"></script>

</body>
</html>

<?php

} else {

  header('Location: ./index.php');

}

?>
<?php
    session_start();
    include_once('../includes/connection.php');
    if(isset($_SESSION['logged_in'])){?

<html>
<head>
<title>Medicine Management Programme</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<!-- Bootstrap core CSS -->
<link href="../dist/css/bootstrap.css" rel="stylesheet">
<!-- Custom styles for this template -->
<link href="signin.css" rel="stylesheet">
<!-- HTML5 Shim and Respond.js IE8 support of HTML5 elements and media queries -->
<!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
<!-[if lt IE 9]>
<script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
<script src="https://oss.maxcdn.com/libs/respond.js/1.3.0/respond.min.js"></script>
<![endif]-->
</head>
<body>
<div class="container">
<div class="form-signin">
    
</div>

</div>
</body>
</html>
<h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>

<h2 class="form-signin-heading">Available Drugs</h2>

<div class="list-group">
    <?php

    $query = "SELECT `drug_name` FROM `drugs`"
    $sql = mysql_query($query);

    while($row = mysql_fetch_array($sql))
    {
        echo "<li class='list-group-item'>";
        echo $row['drug_name'];
        echo "</li>";
    }

    ?>
</div>

<a class="btn btn-lg btn-primary btn-block" href="add.php">Add Drug</a>
<!-- jQuery (necessary for Bootstrap's JavaScript plugins) -->
<script src="https://code.jquery.com/jquery.js"></script>

<!-- Include all compiled plugins (below), or include individual files as needed -->
<script src="js/bootstrap.min.js"></script>

</body>
</html>
Show Patient.php

<?php
session_start();
include_once('../includes/connection.php');
if(isset($_SESSION['logged_in'])){?
<html>
<head>
<title>Medicine Management Programme</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">

<!-- Bootstrap core CSS -->
<link href="../dist/css/bootstrap.css" rel="stylesheet">

<!-- Custom styles for this template -->
<link href="signin.css" rel="stylesheet">

<!-- HTML5 Shim and Respond.js IE8 support of HTML5 elements and
media queries -->
<!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
<!--[if lt IE 9]>
<script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
<script src="https://oss.maxcdn.com/libs/respond.js/1.3.0/respond.min.js"></script>
<!--[endif]-->
</head>
<body>
<div class="container">


<div class="form-signin">
    <h1 class="form-signin-heading"><a href="index.php">Medicine Management Programme</a></h1>

    <?php
    if (isset($_POST['first_name'], $_POST['last_name'])) {
        $first_name = $_POST['first_name'];
        $last_name = $_POST['last_name'];
        ?>
    <h2 class="form-signin-heading">Find Patient ID</h2>
    <div class="list-group">
        <?php
            $query = "SELECT * FROM `patient` WHERE `first_name` = ".$first_name." AND `last_name` = ".$last_name.";
            $sql = mysql_query($query);
            $num = mysql_num_rows($sql);
        
            if($num == 1) {
                while($row = mysql_fetch_array($sql)) {
                    $patient_id = $row['patient_id'];
                    echo "<li class="list-group-item">";
                    echo "Patient ID " . $row['patient_id'] . ".
                    echo ".$row["first_name"]. " . $row['last_name'];
                    echo "</li>";
                }
                $_SESSION['patient'] = true;
            }
    </div>
    
    </div>
$_SESSION['patient_id'] = $patient_id;

?>
<br />
<br />
<a class="btn btn-lg btn-primary btn-block" href="trial.php">Perform Test</a>

<?php
}

else {

</div>

<?php


<div class="alert alert-danger"><strong>Error:</strong> The patient does not exist.</div>

</div>

<?php

}


</div>

<?php

}

</div>

<?php

</div>

<?php

</div>

<?php

</form>

<h2 class="form-signin-heading">Please enter the patient's name</h2>

<input type="text" class="form-control" name="first_name" placeholder="First Name" required autofocus>

<input type="text" class="form-control" name="last_name" placeholder="Last Name" required>

<br />
<br />
<button class="btn btn-lg btn-primary btn-block" type="submit">Find Patient ID</button>

</form>

<?php

?></div>
</div>
</body>
</html>

<?php

}else{
    header('Location: ./index.php');
}

?>

<!-- jQuery (necessary for Bootstrap's JavaScript plugins) -->
<script src="https://code.jquery.com/jquery.js"></script>

<!-- Include all compiled plugins (below), or include individual files as needed -->
<script src="js/bootstrap.min.js"></script>
</body>
</html>
**Signin.css**

body {
    padding-top: 40px;
    padding-bottom: 40px;
    background-color: #eee;
}

.form-signin {
    max-width: 480px;
    padding: 15px;
    margin: 0 auto;
}

.form-signin .form-control {
    position: relative;
    font-size: 16px;
    height: auto;
    padding: 10px;
    -webkit-box-sizing: border-box;
    -moz-box-sizing: border-box;
    box-sizing: border-box;
}

.form-signin input[type="text"] {
margin-bottom: -1px;
border-bottom-left-radius: 0;
border-bottom-right-radius: 0;
}
.form-signin input[type="password"] {
margin-bottom: 10px;
border-top-left-radius: 0;
border-top-right-radius: 0;
}
.form-control, button{
    margin: 5px;
    max-width: 330px;
}

h1, h2, h3, h4, a{
    color: #2e4c7b;
}

table h2{
    margin: 5px;
}

select {
    font-size: 12px;
padding:3px;
margin: 0;
background: #f8f8f8;
border: none;
color:#2e4c7b;
outline:none;
display: inline-block;
-webkit-appearance:none;
-moz-appearance:none;
appearance:none;
cursor:pointer;
}

/* Targetting Webkit browsers only. FF will show the dropdown arrow with so much padding. */
@media screen and (-webkit-min-device-pixel-ratio:0) {

    select {padding-right:18px}

}

a:hover{
    text-decoration: none;
}
F. TEST DOCUMENTATION

This appendix outlines the testing carried out during the development of the system.

F.1 Component Testing

It was possible to test all HTML5 and CSS elements within the Espresso text editor. It had a built-in preview display that would render the web pages in real time. This allowed for a rapid response when altering the feel and design of the site. This allowed for many different colour schemes to be tested. The final colour scheme consists of a white background with blue elements. White was chosen for its perception of cleanliness. It was offset with blue for its natural serene quality.

The mobile responsiveness element of the site could also be tested. The jQuery library and an additional bootstrap library were loaded. The mobile responsiveness was tested by adjusting the size of the browser from the desktop size down to a mobile size. On successful implementation of the design, the page elements would readjust to fall one under another. To ensure an optimal transfer from desktop to mobile, images were not considered. Images are unresponsive and have an absolute position on a site. They require sizeable power to load and therefore slow down the site considerably.

F.2 Function Testing

The initial step was the connection to the MySQL database. The connection was encompassed in an if statement. If either the database didn’t exist or the connection could not be made then the system would terminate and an error message appears.

Once the database was connected, it was possible to perform validation checks, like ensuring a user had to be logged in to access the site. It also allowed the site perform all the subsequent validation checks like ensuring a patient id exists or ensuring a prescription can’t be replicated.
This appendix illustrates the presentation given to the Medicine Management Programme.
What is the problem?

- How many prescriptions are dispatched in a year?
  - How many of them are genuine?
  - How many of them are correct?

What is the project?

- Construct a system that would reduce the risk of stolen, lost or misdiagnosed prescriptions.

- Firstly, to decrease the risk of misdiagnosed prescriptions, a framework was implemented to assist doctors when diagnosing patients.

- Secondly, to decrease the risk of lost or stolen prescriptions, a system was built to replace traditional paper based prescriptions with unique secure online prescriptions.
What does the system contain?

- Database Integration and Data Validation
- Diagnostic Assistant
- Prescription Generation
- Pharmacy Database Connection

Database Integration and Data Validation

- Secure Login System
  - Limits the site to specific users
  - Credentials checked in MySQL database

- Secure Information Encryption
  - Ensures safe collection and storage of data

- geoPositioning Integration
  - Longitude, latitude and time of entry are recorded
Diagnostic Assistant

• Single Location for Data Collection
  - Create patient record. Several standard questions are asked
  - Patient’s details then stored in a MySQL table with a unique patient id

• Test Selection
  - User selects the patient id and the test they want to perform
  - Test run automatically from collected patient details
  - Produce a recommendation based on patient’s unique case

21/03/2014

---

e-Prescription Generation

• e-Prescription consists of
  - Administrator Details
  - Patient Details
  - Recommended Course of Action
  - Timestamp
  - Universal Unique Identification

• Once e-Prescription has been generated, it is possible to send an alert to a central drug / pharmacy database

21/03/2014
Benefits

• This system will reduce forgeries, theft and misdiagnosed prescriptions, thereby saving money and potentially lives

• Allows us to move from paper based prescriptions into a fully secure online prescription service

• Ensures practitioners are prescribing the preferred drug, unless they have a valid reason otherwise

Benefits

• Easy to implement

• Ability to monitor a patient over a period of time

• Provides a cohesive connection between administration and distribution

• Detects inconsistencies in prescription distribution
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>The user of the system would be a general practitioner or any other approved medical staff.</td>
</tr>
<tr>
<td>Localhost</td>
<td>A hostname that the computer’s software and users may employ to access the computer’s own network services.</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Service Executive of Ireland</td>
</tr>
<tr>
<td>MMP</td>
<td>Medicine Management Programme</td>
</tr>
<tr>
<td>NOAC</td>
<td>New Oral Anticoagulants</td>
</tr>
<tr>
<td>GP</td>
<td>General Practitioner</td>
</tr>
<tr>
<td>PCRS</td>
<td>Primary Care Reimbursement Service</td>
</tr>
<tr>
<td>MySQL</td>
<td>My Structured Query Language</td>
</tr>
<tr>
<td>CHADS₂</td>
<td>A clinical prediction rule for estimating the risk of stroke in patients</td>
</tr>
<tr>
<td>CHADS₂-VASc</td>
<td>The CHADS₂-VASc score is a refinement of CHADS₂ score and extends the latter by including additional common stroke risk factors</td>
</tr>
<tr>
<td>UUID</td>
<td>Universally Unique Identification</td>
</tr>
<tr>
<td>Bootstrap</td>
<td>Bootstrap is a free collection of tools for creating websites and web applications. It contains HTML and CSS-based design templates.</td>
</tr>
<tr>
<td>geoPositioning</td>
<td>Identification of the real-world geographic location of an object.</td>
</tr>
</tbody>
</table>
I. REFERENCES


