Understanding Systems Development

QAC020C101

A Systems Development Case Study - Health Care System

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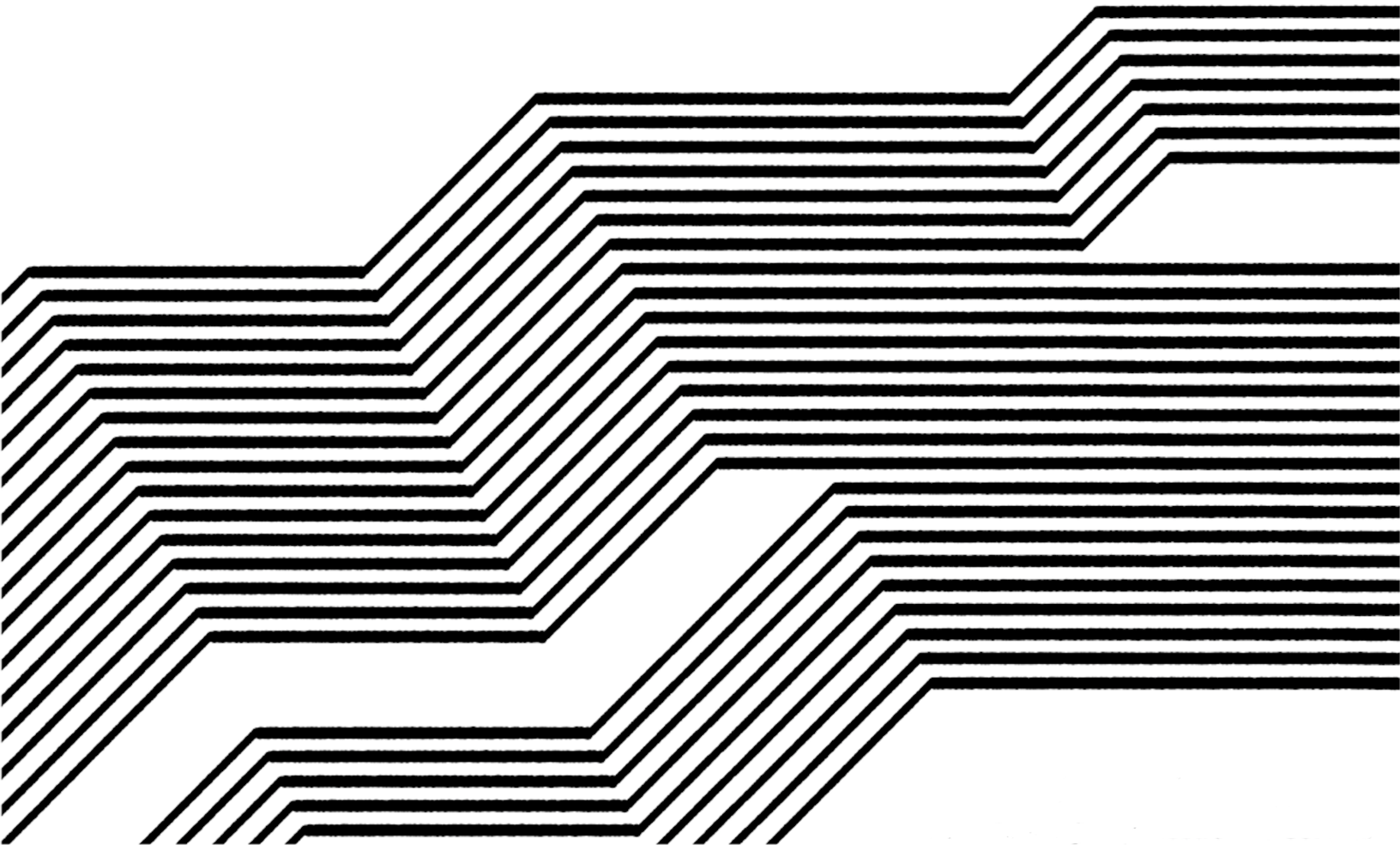

Contents

1 TASK 1 — Systems Requirements Engineering and Feasibility Study [20%]

1.1 Feasibility Study

Purpose The purpose of this system is to allow patients to view their own medical history, book appointments and receive confirmation via email and SMS. In addition to this, the surgery needs to be able to share data with trusted third parties and support recurring prescriptions, whilst remaining secure. Finally, the system should support at home testing for patients, including confirmation and reminder messages. The system should be able to alert patients over 40 about their annual blood test for sugar and cholesterol checks.

Intended Audience The people who will use this new system will be the patients, doctors, and nurses at the practice, meaning that they are all the intended audience of the new system. The patient will be the main intended audience for this system, and will be able to book appointments, view their medical history and take tests at home. The new system will organise patients records in a central place, and will allow staff to share patient data securely and electronically with healthcare professionals. Finally, the new system will also allow staff to be more time efficient by only seeing patients who require one-to-one attention, allowing the others to perform their own tests at home.

Operational This measures well the new system will solve the problem it set out to solve, and how well it fits within the business use case and workflow. If the way the system operates is not thoroughly considered, or the system is not well integrated with the client, the adoption rate will be low and the system will not provide a benefit. This will lead to wasted time for the client and the developers. We are currently aware of how the existing system operates, but not how it is used.

Time-Scale The client has provided us with a time-scale of 6 months. Due to lack of planning, or the inability to plan for unexpected delays, the time scale could go over. If this happened, the budget could also follow, which is undesirable for both parties. Due to the short time-scale, it is important to plan and efficiently use the time that we have.

Economic All the stages of the project must fit the budget, and all tasks performed must provide value in the development of the system. We have already been given a cost and budget for this project, which must be adhered to. A lack of planning and research into how much the deliverables will cost to develop may make us go over budget. The budget provided is the maximum amount the customer is willing to spend on the development of the system. The client may not be willing to pay extra, if the project is over budget, leading to a smaller profit margin for the development team. For this project, the budget we have is 75,000, which should be sufficient to develop the system.

Technical At this stage, the technical abilities of the team must be taken into consideration to ensure that they have the necessary skills to complete the project. If the team does not have the technical ability to produce the solution then the project could overrun, and be over budget. For this project, the technical skills and ability of the team should be sufficient.

Market Research / Alternatives Instead of a bespoke system, the client could opt for a Commercial Off-The-Shelf (COTS) system, where the system is already developed and ready to buy, rather a one size fits all solution. Two examples are:

- oneadvanced.com
- tpp-uk.com: system 1

With COTS the client would expect to get the system deployed and running faster than a bespoke system, but it will most likely be subscription based, not a one off payment for the system. Although COTS will fit what the client wants, they would prefer to have something custom made for them, so we will develop the system.

1.2 Requirement Clarification

Further clarification of requirements must be obtained before the project can begin, as the provided brief is too ambiguous. This can be achieved by interviews, questionnaires, and one-to-one discussions with the intended audience.

1.2.1 Patient Facing Services

- "From what platforms would the patients' access the booking system?" If you want to allow patients to book from their phones, you may wish to develop a mobile application so that the website wouldn't need consideration for phones. This information could be gathered through the use of a survey for patients to show how they would like to access the booking system.
- "Should the patients' have full and complete access to their medical records?" If patients' have full access, they may be concerned about notes taken by the doctor regarding their health. To obtain this information there may be legal procedures with regards to patient data that all parties must follow to remain legally compliant.
- "Who can access the medical data a person holds?" This refers to allowing family members/carers access to another person's medical data. A full list of how this data can be shared would be needed, so we must accommodate for this. An in-person interview with a senior member of the medical community is required in order to get all the information and to stay compliant.

1.2.2 Integrated Services

- "What data needs to be sent?" This information is required to develop the system correctly, and is collected from the client via a meeting.
- "How will access to the patient's medical data be restricted? Is this dependant on the party?" If access to data must be manually provided, external parties such as pharmacies, would need to be enrolled in the system, allowing the patient to give them access to the their data. This information will be collected by market research and analysis of existing systems.
- "What systems are currently in place for the transfer of sensitive data?" If there are no systems in place, a new communication method will have to be factored into the budget. To get this information an analysis of the existing system is required.

1.2.3 Home Care and Data Analysis

- "How will the doctor be alerted for the medical check-ups of certain patients?" The chosen alert method will affect the development of the system. This is vital to know in the requirement gathering phase. To get this information, a meeting with the client is required, as well as questionnaires aimed at doctors.
- "With the at home tests, is there already a system to process and monitor the patients' health?". If not, then a new system will have to be developed. This information will be gathered by analysing the existing system.

1.3 Software Architecture

See Figure 1 in the appendix attached here

2 TASK 2 — Review of Systems Development Life Cycle [30%]

2.1 The need for a SDLC

SDLC stands for "Systems Development Life Cycle". It is a set of methodologies that dictate the stages of the project's development, from planning to maintenance. These methodologies need to be followed to ensure that every stage in the process will happen efficiently. Each SDLC has a different aim at the core regarding what needs to be optimised. Here are two examples:

2.1.1 Waterfall

Waterfall is the simplest SDLC model. It only consists of 6 stages that all require the previous stage to be completed before the next can start, as shown below:

1. Requirement Analysis
2. Design
3. Implementation
4. Testing
5. Development
6. Maintenance

In order to work, the requirement analysis will have to be finished before the design stage can begin. All the stages have certain inputs and outputs that feed into the stages before and after them.

2.1.2 Agile

The Agile SDLC is different to waterfall as it does not have the same structure, order, and ease of understanding. The main idea of Agile development is to create a functional example as quickly as possible to show your client, then working on what needs to be improved. Starting out with a list of all of the tasks and features that are needed from the system, then rating them all of them based on their importance and difficulty to complete. Then the most important features are selected and worked on in a sprint. A sprint is a small section of time (up to a month) where the team work to add features as quickly as possible. Due to the difficulty rating that each task has, the team can complete the sprint based on how quick they work. At the end of a sprint, the team will then feed back and demonstrate the new features to the client, whilst getting funding for the next sprint. Additionally, every day during a sprint, all the team members will meet and state what they have done and what they will be working on.

2.1.3 Comparison

Here is a comparison between Waterfall and Agile methodologies.

	Waterfall	Agile
Resources	Not a lot of resources are needed as it's a very slow and ongoing process.	A lot of resources are needed due to the speed required to complete each section, Agile is time based, whereas waterfall is task based.
Scalability	Good scalability due to the fact that the same process can happen at a much larger scale, and nothing changes for the individual user, plus the documentation is good.	Scalability is not good due to the fact that regular meetings are required, but this could be managed by a good chain of command.
Speed	Slow speed, as all of the processes have to be finished. Any delay in any stage will force the whole project to slow down.	High speed, this methodology is designed for speed so its fundamentally how it works.
Reliability	Very reliable, as everything is accounted for in the project and documentation is always kept. It is simple and has been around in different forms for many years.	Medium reliability because changes in the individual people will throw off the known sprint velocity. It has worked out to be one of the best methodologies for developing software.
Adaptability	Low adaptability. If any change is made to the requirements for the system after that stage has been done, you will have to start it all from the beginning.	High adaptability. Any change that the customer wants will just be added as another task to the backlog and will be picked up quickly.
Usage	When the project is well defined and the client knows what they want from the system.	When you want the system developed quickly with constant feedback frequently.

Table 1: A Table comparing waterfall and agile SDLC methodologies

2.2 Scope of the Project

ID	FRD	NFRD	Category
1	As a patient, I want to view my medical history online so that I can easily see what history I have.	User friendly layout, can access anywhere	system, legal
2	As a patient, I want to be able to book my appointments online so that I can book my appointment easily and wherever I am	Calendar integration, very simple to do on the customer end	system
3	As a patient, I want to be able to choose my doctor when booking my appointment so that I can be sure I will get someone who knows me well.	calendar integration, suggest based on previous bookings	system
4	As a doctor, I want to ensure my patients don't miss their appointments by reminding them with an email so that I can give them all the treatment they need.	Professional layout and look, contains calendar invitation	system
5	As a doctor, I want to ensure my patients don't miss their appointments by reminding them 24 hours in advance by SMS so that I can give then all the treatment they need.	Calendar integration, appointment details	system
6	As a remote healthcare provider, I want to view all my patient's information so that I can treat them appropriately.	Share only the information needed, sync time is low	system, legal, performance
7	As a patient, I want to ensure that my data is sent securely so that my information stays private.	Very secure algorithm, stored encrypted	system, legal
8	As a doctor, I want to ensure that I know when a patient needs a checkup so that I can check that they are still OK and don't need help.	Info on exactly what they need and what patient is alerted to	system
9	As a patient, I want to be able to perform simple tests at home so that I can do them when I am free and don't take up doctor's time.	Easy for them to do	system
10	As a patient, I want my data to be sent off to the local GP remotely so that I don't have to visit to do so.	Data sent securely and quickly	system
11	As a doctor, I want my patients to know that they have done the test correctly so that I can be sure they have done it correctly and are well.	Information about the test that they have done.	system

Table 2: A table showing functional and non-functional requirements of the project

2.3 Scrum Agile framework

2.3.1 Common challenges to look out for

- Spread out teams
  - The main issue faced when moving to an Agile methodology is trying to organise the team when they are geographically separated. The methodology requires a daily meeting between the team so that they can share their progress. However, when people are separated these team meetings cannot happen.
  - One solution is to split off into smaller teams that are geographically close, so that meetings can still occur. By doing this, the teams can then work together at the end of a sprint in a full team meeting where developers decided how to handle the backlog and what tasks each team will complete in the next sprint. All the teams therefor work together on the same project but they will only work with people who are geographically close to them.
- Losing focus on the original task
  - When a team is deeply involved within a project which is multiple sprints in, they may lose focus on what they have to work towards on the system they are developing, based on what the customer said they need to improve. This, coupled with the time frame driven model, can lead to the developers looking at short-term goals, and not the whole project.
  - This can easily be mitigated by having a good scrum lead, who will direct the team by managing both the long-term and short-term goals for the project.

2.3.2 Product Backlog

Priority	ID	Story	Story Points
1	2	As a patient, I want to be able to book my appointments online	7
2	7	As a patient, I want to ensure that my data is sent securely	4
3	8	As a doctor, I want to ensure that I know when a patient needs a check-up	3
4	1	As a patient, I want to view my medical history online	6
5	3	As a patient, I want to be able to choose my doctor when booking my appointment	5
6	5	As a doctor, I want to ensure my patients don't miss their appointments by reminding them 24 hours in advance	2
7	4	As a doctor, I want to ensure my patients don't miss their appointments by reminding them with an email	1
8	6	As a remote healthcare provider, I want to view all my patient's information	11
9	11	As a doctor, I want my patients to know that they have done the test correctly	8
10	9	As a patient, I want to be able to perform simple tests at home	9
11	10	As a patient, I want my data to be sent off to the local GP remotely	10

Table 3: A table showing the difficulty and priority of requirements

The team working on this project have a sprint velocity of 11. Due to this, the project should take 7 sprints to complete, with all, apart from the first and hardest sprints, having additional time set aside for customer suggestions. The most difficult sprint is in the middle, so that the team has time to fix problems that may arise. The expected sprint breakdown for this project is:
Sprint velocity = 11

- Sprint 1:
  - ID: 2, cost: 7
  - ID: 7, cost: 4
- Sprint 2:
  - ID: 8, cost: 3
  - ID: 1, cost: 6
  - 2 cost left for bug fixing and client recommendations
- Sprint 3:
  - ID: 3, cost: 5
  - ID: 5, cost: 2
  - ID: 4, cost: 1
  - 3 cost left for bug fixing and client recommendations
- Sprint 4:
  - ID: 6, cost: 11
- Sprint 5:
  - ID: 11, cost: 8
  - 3 cost left for bug fixing and client recommendations
- Sprint 6:
  - ID: 9, cost: 9
  - 2 cost left for bug fixing and client recommendations
- Sprint 7:
  - ID: 10, cost: 10
  - 1 cost left for bug fixing and client recommendations

The burndown chart for the project is below. The blue line shows the expected burndown for the project, operating as shown in the backlog above. The red line shows the time to complete the story points alone, not accounting for spare time at the end of sprints set aside for bug fixing.
See Figure 2 in the appendix attached here

2.3.3 Sprint Backlog

- Sprint 2:
  - ID: 8, cost: 5
    - Create / link to patient database — cost 1
    - Create database scanning software to check for due dates — cost 2
    - Create a way to send a notification to the doctor — cost 1
    - Testing — cost 1

  - ID: 1, cost: 12
    * Create basic interface to test functionality — cost 1
    * Link to patient database — cost 1
    * Implement strict rules on what can be accessed — cost 4
    * Return the correct information — cost 2
    * Rework the interface so user friendly — cost 2
    * Testing — cost 2

The breakdown for the sprint in a more granular list is shown above. All these tasks with a cost, based on how difficult they are relative to one another. From here, certain people are assigned to each role, based on their skills and each sprint is planned out. Because these new values will dictate how difficult the tasks within the features are, not how difficult the feature is, the points that this task have now been assigned in this sprint have been changed.

A sprint burndown chart of how this specific sprint operates with the tasks and their duration is shown below. The cost will represent a day's work for one person. Two developers are in the team so the chart looks as follows: See Figure 3 in the appendix attached here

This sprint takes 9 days to complete, with not much spare time.

- Sprint 3:
  - ID: 3, cost 4
    * Create basic, functional interface — cost 1
    * Link to database/calendar system — cost 1
    * Check for availability and return names based on time selected — cost 1
    * Make the interface user friendly — cost 1
  - ID: 5, cost 2
    * Connect to SMS system — cost 0.5
    * Set up a system to check the database/calendar daily to check for due appointments — cost 1
    * Send text message — cost 0.5
  - ID: 4, cost 1
    * Set up trigger so that when a new booking come in, an email is sent — cost 1

See Figure 4 in the appendix attached here

This sprint takes 4 days to complete, there is a lot of spare time for improvements based on client suggestions and bug fixes.

3 TASK 3 — Systems Investigation & Modelling [30%]

3.1 Use Case and Activity Diagrams explained

3.1.1 Use Case Diagram

A Use Case Diagram is a tool used to demonstrate what parts of the system the user will interact with and how it connects internally. Different shapes are used to show actors, processes and data transfer between the different sub-systems.

- Use Case Diagrams assists in the development process as they allow people to quickly see where access lies within the system and how the data is passed around and used by the users.
- Use Case Diagrams expose what parts of the system need to work together.
- Use Case Diagrams are created very early in the process, even before the project is known to be feasible. This is because diagramming the system will aid the understanding of what needs to happen in the system.

3.1.2 Activity Diagram

An Activity Diagram is a way of showing the logic that a certain system or subsystem will take, along with what tasks aid others. The are many different shapes that connect to show how processes link and branch off.

- Activity Diagrams aid in the development process as they show how a system operates, ensuring that all tasks are performed as required.
- Activity Diagrams expose the subsystems within the system that is being implemented and explain how a single activity in a use case diagram works.
- activity diagrams are used later in the process of developing a system because a high-level understanding of the system is required to understand it at a lower level.

3.2 Use Case and Activity Diagrams examples

3.2.1 Use Case Diagram

See Figure 5 in the appendix attached here

3.2.2 Activity Diagram

See Figure 6 in the appendix attached here

3.2.3 Activity Diagram

See Figure 7 in the appendix attached here

3.2.4 Activity Diagram

See Figure 8 in the appendix attached here

4 TASK 4 — Systems Testing and Quality Assurance [20%]

4.1 Test conditions and acceptance criteria

See Table 4 in the appendix attached here

4.2 The role of Quality Assurance [QA]

- Requirement Analysis
  - Clear segmentation of the tasks for easy testing later on.
  - Preparing the testing plan at a high level.
  - Bug forecasting and prevention.
  - Evaluating what type of testing needs to be done.

  The [QA] is in place to start the project off correctly and to ensure that it will easily be testable in the future. A main task of QA at this stage is the preparation of a test plan for the project, so that when the testing period starts, the tests have been properly considered. However, at this time only a high-level plan can be created as nothing specific has been considered. Additionally, bug forecasting and prevention is done, as this will predict where bugs are most likely to happen and create better test plans for the testing.

- Design
  - Preparing a more low-level test plan.
  - Evaluating if the designs are testable and how long this would take.
  - Looking at the system from the point of view of a user.

  The main document that is produced is a low-level test plan, which is done at this stage because the plans for how the system will work are laid out and understood. Planning the test plans early like this will lead to less time wasted at a later point in the project. Additionally, in this stage, the way that the system will be tested is decided and documentation on how long the testing will take is produced.

- Development
  - Preparing the testing environment.
  - Developing the test cases.

  In this stage, the testing environment for the system is created and set up along with the test cases and the data. This is done at this stage, as the system needs to be created before it can be tested. However, everything will need to be ready for when the system is created.

- Testing
  - Making sure that the tests are done and as planned.
  - Finding bugs so that they can be fixed before the product is released.
  - Ensuring that the bugs are then fixed before the product is released.
  - Performing all the testing that is needed such as Functional, Integration and User Acceptance testing.

  In this stage, the system is tested as per the planning, and the feedback is given to the developers. There are different types of tests that occur in this stage. A selection of them are: functional, integration and User Acceptance Testing. Functional testing tests if the system will perform the task it was set out to do. Integration testing tests how well the new system fits in with existing systems. Finally, User Acceptance Testing is where the customer uses the system and provides feedback on how well it works for them.

- Deployment
  - Creating the user guide for the system.

  In this stage, the system is being rolled out to the customer and so the QA team create an instruction manual for the customer.

Word count not including tables and figures: 2994

5 Appendix

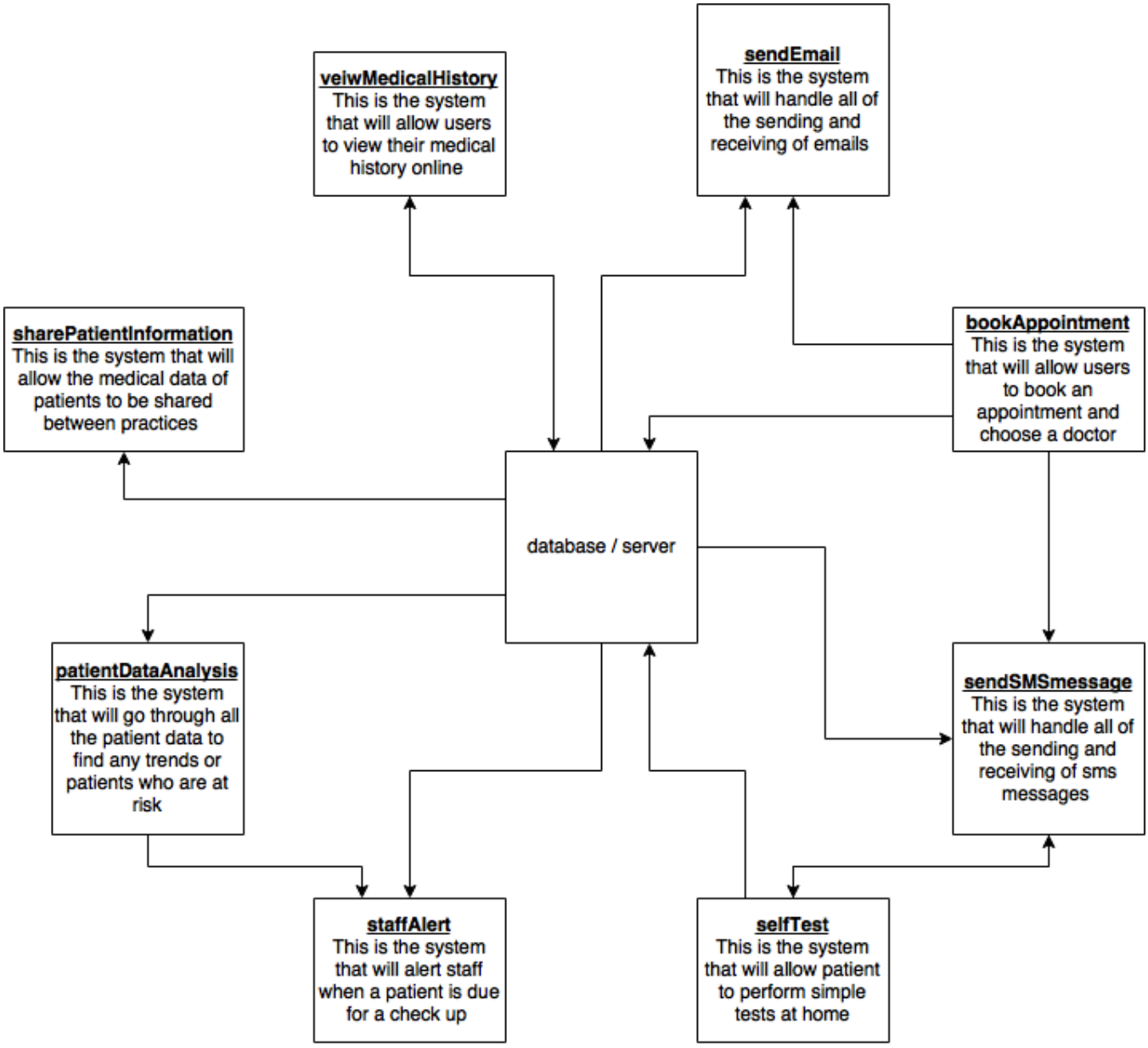

Figure 1: Software Architect Diagram — Return to document

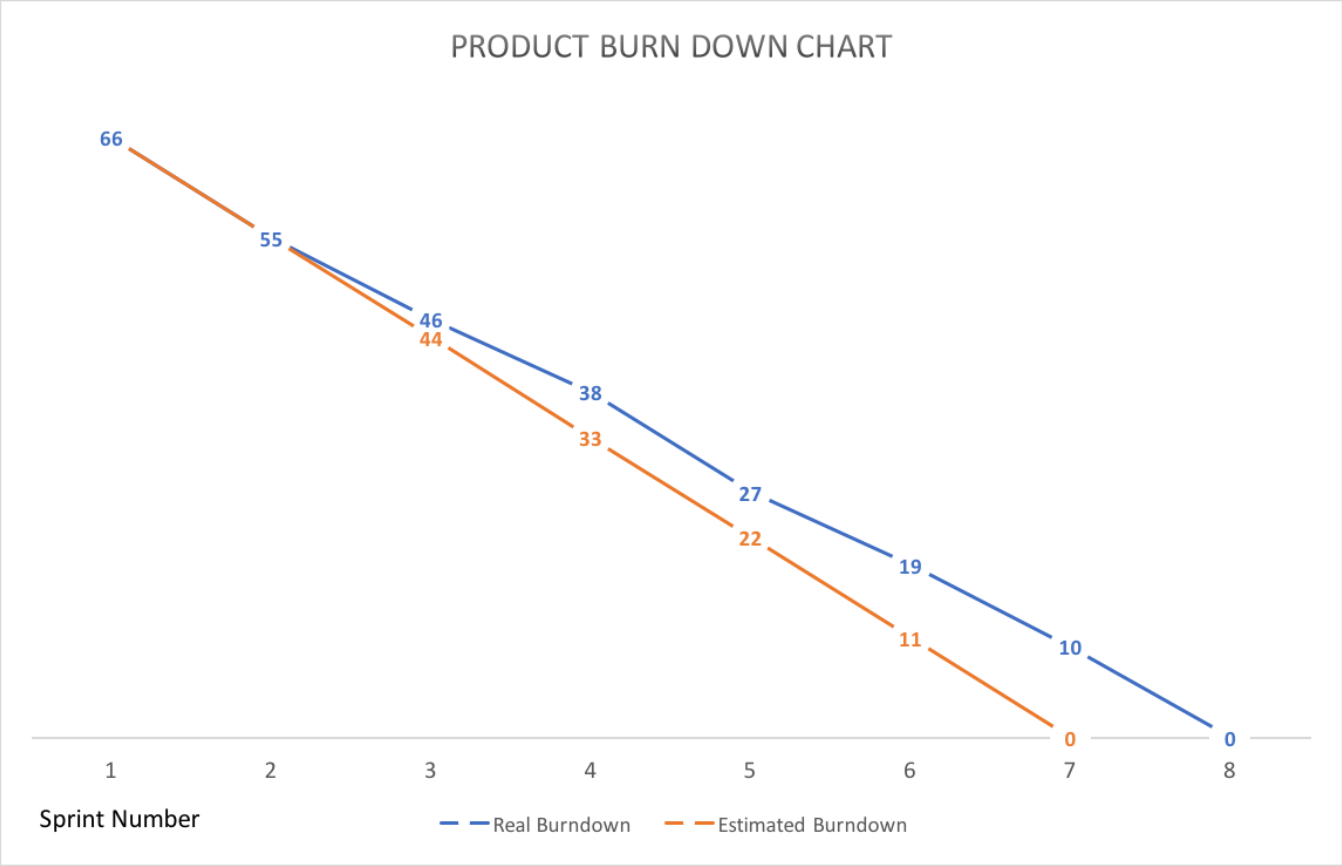

Figure 2: Product Backlog Burn Down Chart — Return to document

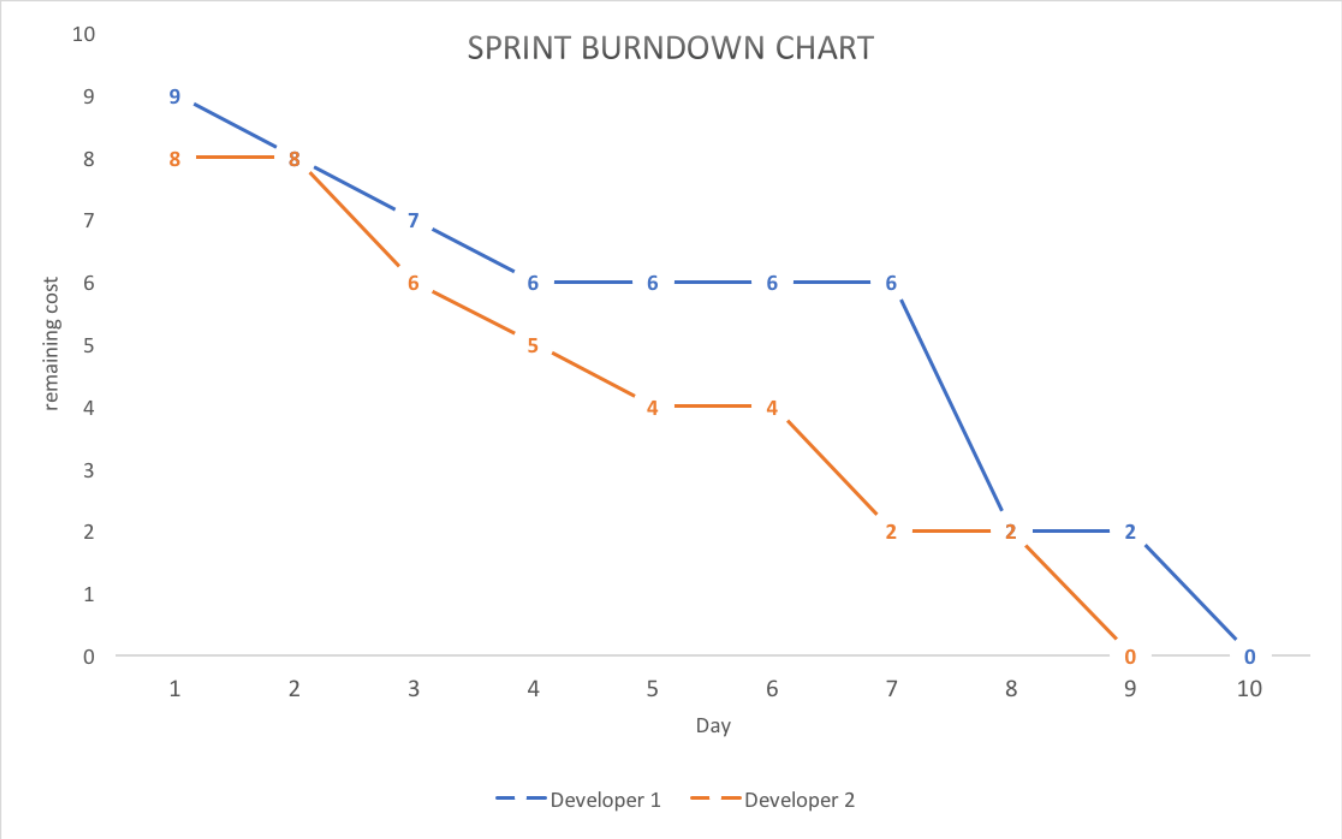

Figure 3: First Sprint Burn Down Diagram — Return to document

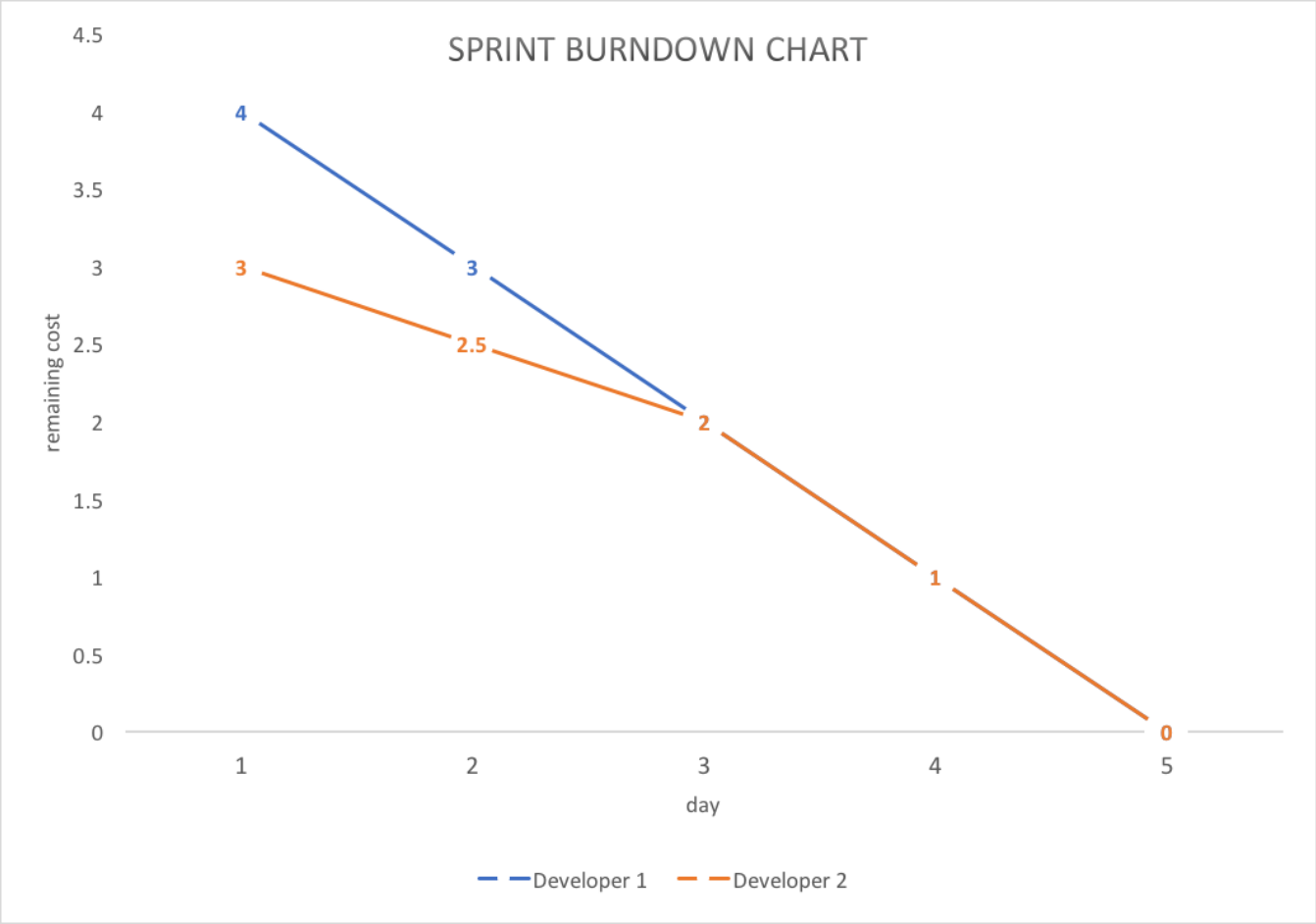

Figure 4: Second Sprint Burn Down Diagram — Return to document

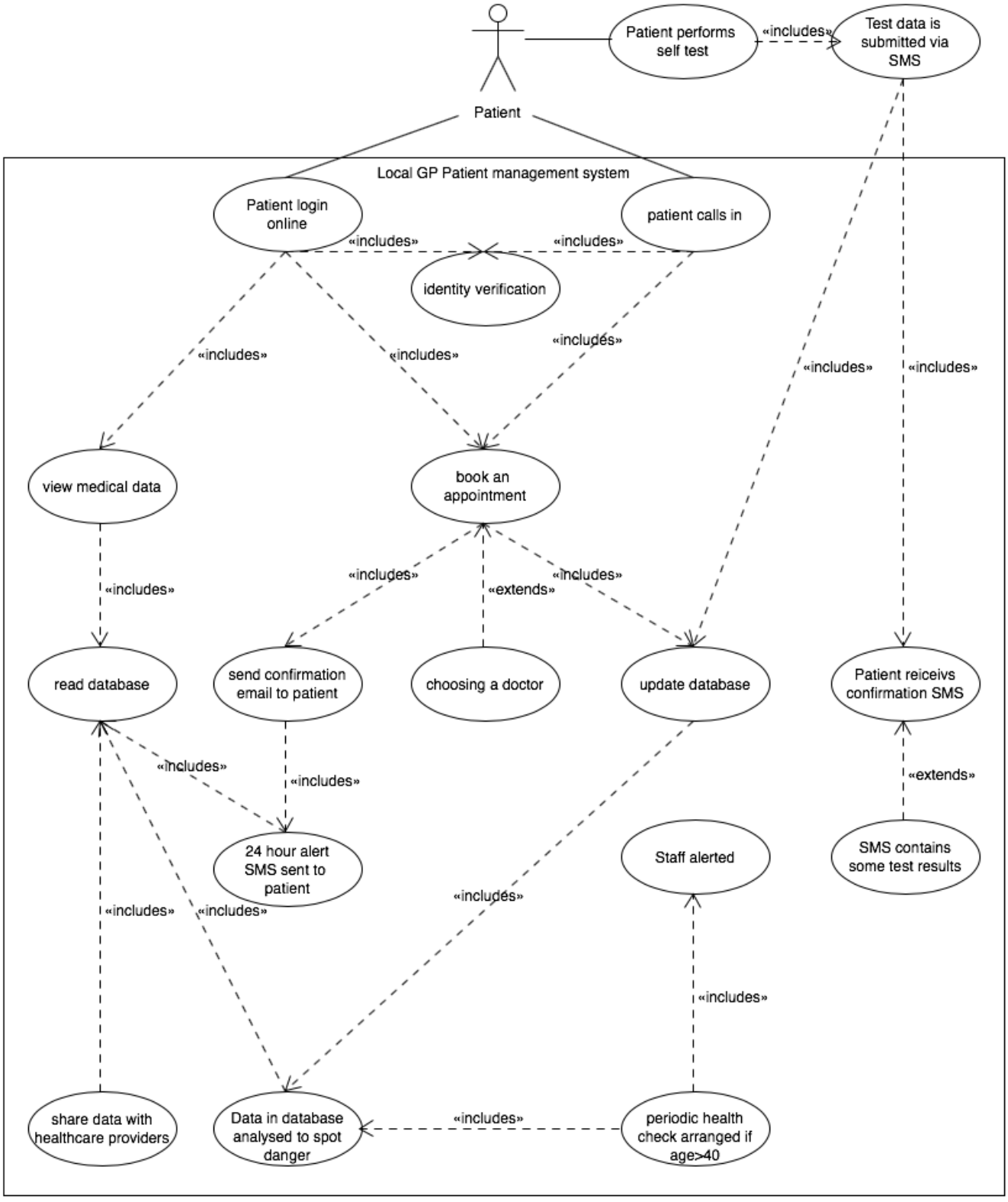

Figure 5: Use case diagram for the local GP Patient Managment System — Return to document

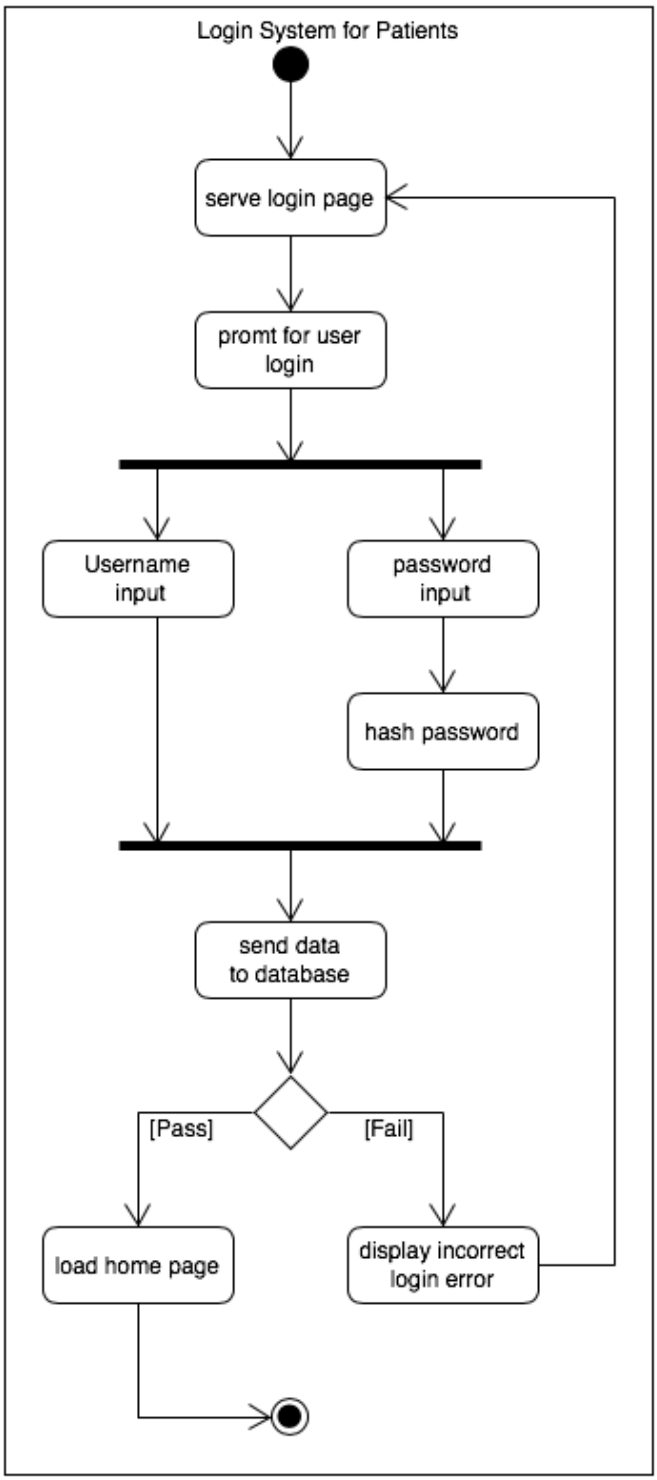

Figure 6: Use case diagram for the local GP Patient Managment System — Return to document

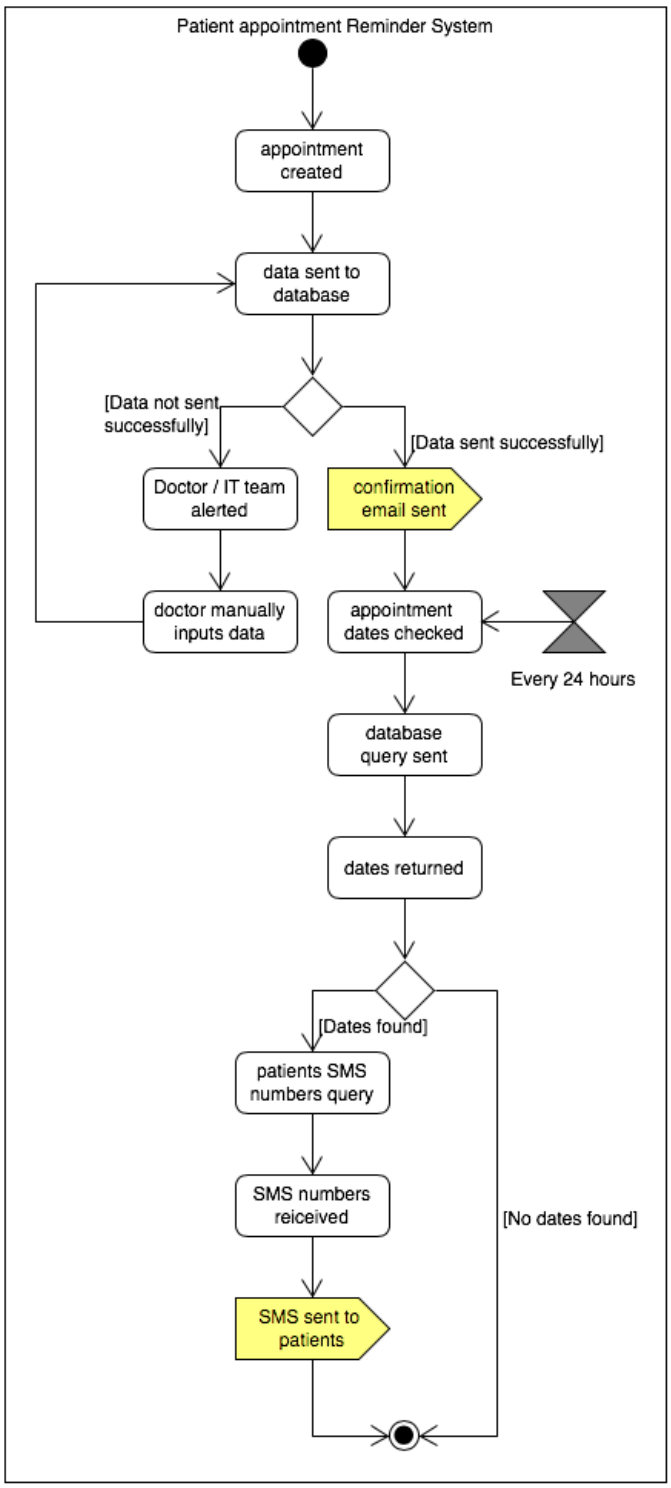

Figure 7: Use case diagram for the local GP Patient Managment System — Return to document

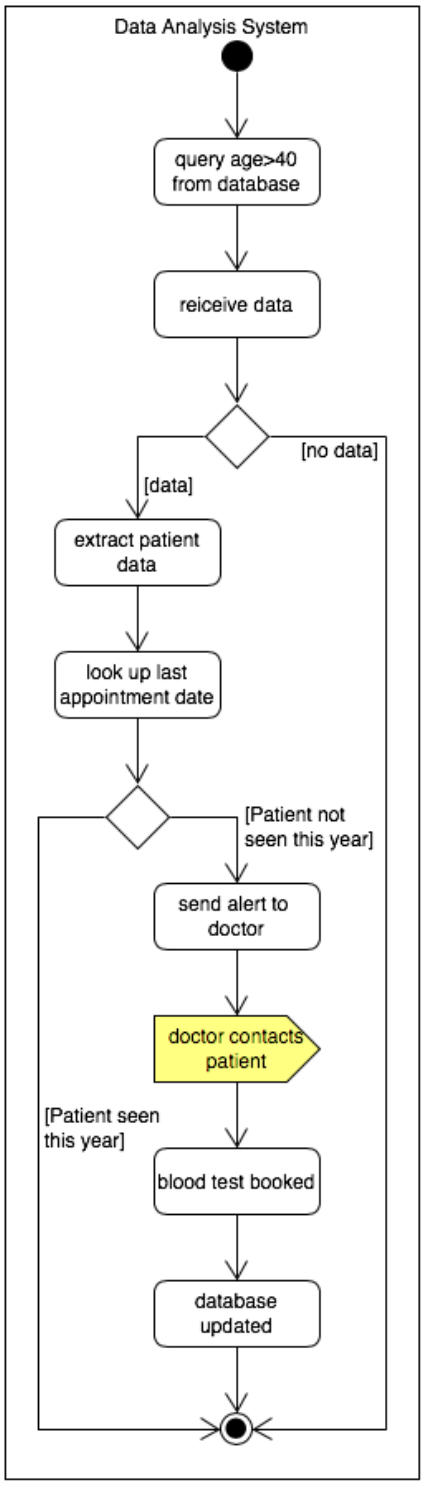

Figure 8: Use case diagram for the local GP Patient Managment System — Return to document

ID	F/NF	acceptance criteria	base data	input data	acceptance test conditions	result	pass
1	Functional	patient will need to log in	registered user data	username and password	the system accepts their username		
					the system accepts their password		
		patient will need to see their own data	medical history and data	queries	only their data displayed		
					is all of their data displayed		
	Non-Functional	patient can access system wherever they are	web server		it works on a phone		
					it works on a mac		
					it works on a windows PC		
		patient can hide sensitive information	medical history and data	toggle	patient can choose what types of information to hide		
					is the information hidden		
2	Functional	patient will need to log in	registered user data	username and password	the system accepts their username		
					the system accepts their password		
		the date is processed and is stored	patient appointments	proposed appointment	the system adds in the new appointment		
					the patient is shown that the appointment is added		
	Non-Functional	patient is given a calendar invite	patient appointments	proposed appointment	the invite contains all the information about the appointment		
					the invite is able to be imported into other calendar applications		
		webpage is easy to use and understand	web server	queries	people don't click on the help link		
					people don't spend a lot of time on the webpage		
3	Functional	list of all available doctors is shown	doctor's calendars	proposed appointment	the doctors show are the only ones that are free at that time		
					any doctor that you select will be assigned to that appointment		

	Non-Functional	doctors suggested based on previous appointments	patient appointments	proposed appointment	only doctors that you have seen a lot are show		
					times that they are free are suggested		
		doctors calendar is automatically booked out	doctor's calendar	proposed appointment	appointment information is sent to the correct doctor		
					all appointment details are correct		
4	Functional	patients sent an email when they book	appointment information	N/A	email contains information about the correct appointment		
					correct patient is sent the email		
	Non-Functional	email contains invitation for appointment for a calendar	appointment information	N/A	patient receives invitation		
					invitation is importable into a calendar		
					invitation contains correct information about appointment		
5	Functional	patients are sent out an SMS 24 hours before an appointment	patient appointments	N/A	SMS is sent 24 hours before the appointment		
					correct appointment is reminded about		
					SMS is sent to correct patient		
	Non-Functional	SMS contains backup invitation	patient's appointments	N/A	backup invitation is the same as the initial one sent out		
					is able to be opened on phones		
6	Functional	patient data sent to other healthcare providers	patient medical data	access pass	all of the patient information is sent		
					data is sent encrypted		
					data is stored securely		
					caught data cannot be read		

		data is synchronised quickly	patient medical data	N/A	data changed at the main GP is sent to remote providers as well		
					this is triggered when the data is changed		
					only relevant data is sent		
7	Functional	data is sent securely	patient medical data	N/A	strong encryption is used		
					test data that is captured cannot be read		
	Non-Functional	data is stored encrypted	patient medical data	N/A	strong encryption is used		
					day is accessed on the server and cannot be read without the password		
8	Functional	doctor is alerted when a patient needs to be seen regularly	patient medical database	N/A	alert is sent out before the appointment needs to happen		
					alert tells the doctor what the appointment is for		
	Non-Functional	doctor provided with patient information in alert	patient medical data	N/A	only a small amount of relevant data is sent		
					doctor has enough information to prepare the appointment		
9	Functional	patient can perform test at home	N/A	test results from device	test devices can actually send and receive the information		
	Non-Functional	the device is easy to use	N/A	N/A	devices contain instructions so that they are easy to use		
					patients don't have to work out how to use a device		
10	Functional	the device will send off the information to the local GP	patient medical database	test results from device	the device can send information to the local GP		
					the local GP gets that information		
	Non-Functional	the data is sent securely and quickly	patient test results	N/A	the data is sent as soon as the test is done		
					the data is encrypted when it is sent		

					captured data cannot be read		
11	Functional	patient sent back conformation that the data was sent off	patient medical data	test information	patient get a confirmation text		
					the text is sent to the patient registered to that device		
	Non-Functional	some information from the test is sent	patient medical data	test information	information from the correct test is sent		
					information for the correct patient is sent		

Return to document