The candidate confirms that the work submitted is their own and the appropriate credit has been given where reference has been made to the work of others.

I understand that failure to attribute material which is obtained from another source may be considered as plagiarism.

(Signature of student)
Summary

NHS structural changes came into force on April 1st 2013 which resulted in the abolition of the NHS Connecting for Health organisation. As a result of this there is no longer a central NHS body with overall responsibility for ePrescribing. There are now no central resources for hospitals to call upon when they are considering the introduction of an ePrescribing system. The objective of this project therefore is to create an advisory paper that can be used to inform senior decision makers from within hospitals considering rolling out an ePrescribing system.

The advisory paper will detail the benefits and risks associated with ePrescribing and discuss the hardware, software and networking elements that need to be considered. It also makes recommendations on how an ePrescribing project should be managed and implemented.

The process that was used to create this report will be discussed, from information gathering through to the evaluation of the finished product.
Acknowledgments

I’d like to thank the following people for their support throughout this project:

- My project supervisors Kevin McEvoy and Owen Johnson for their on-going help and feedback throughout the course of the project.
- Lydia Lau my project assessor who provided extremely useful feedback via the mid-project report which helped to clarify the aim of the project.
- Dr James Tattersall for giving his time so generously and for showing me around the renal ward at Leeds Teaching Hospital Trust.
- My friends and family for their constant support, encouragement and cups of tea.
Glossary of Terms

This Glossary of Terms provides a brief explanation of NHS terminology that applies to this project. In the body of the report the full term is used rather than the acronym for ease of reading, unless the acronym has already been expanded in the same paragraph. The following definitions are the author’s own but are sourced predominantly from the NHS Connecting for Health organisation.

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when the patient moves practice.

| Health and Social Care Information Centre | HSCIC | The HSCIC came into being on April 1st 2013, it reports to the Secretary of State for Health. The HSCIC has taken on many of the responsibilities of CfH. HSCIC is responsible for data reporting for the NHS; managing and monitoring NHS IT systems and accrediting new IT suppliers. |
| N3 | N3 | National private NHS network. |
| National Program for Information Technology | NPfIT | The National Program for Information Technology was the implementation program created after a parliamentary commissioned report into how the NHS should adopt technology to improve patient care. |
| NHS Number Services | A unique reference number for every NHS patient in the UK that is used to identify them on all NPfIT programs. |
| Picture Archiving and Communications System | PACS | NPfIT program to electronically store and distribute medical images (X-rays and scans) so they can be linked to the patient record and viewed remotely rather than requiring a physical document to be sent. |
| Quality Management & Analysis System | Points based central NHS remuneration program which pulls data from the GP Clinical System to calculate rewards for GP Practices based on the number and quality of patient interactions. |
| Secondary Uses Service | SUS | A data warehouse which anonymises and consolidates all patient and clinician data from the NPfIT programs to enable querying and reporting on the state of public health in the UK. Now administered by the HSCIC. |
| Summary Care Record | SCR | Individual record for every NHS patient, contains basic information about what medications they are on and allergies, this is held on The Spine and accessible by all NHS personnel. |
| The Spine | A NPfIT data warehouse and transaction messaging program which holds details of all NHS personnel and patients’ SCR and EPR records. It routes all of the NPfIT transactions and messages such as Choose and Book, PACS, NHSMail etc. |
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1. Introduction

There is a wealth of information readily available concerning both the NHS and ePrescribing, however bringing it all together and making sense of it can be extremely challenging. Much of the information is out of date, incomplete and incomprehensible to someone who is not experienced with both the capabilities and terminology of Information Technology and the inner workings of the health care system. The information necessary to gather a good, up to date understanding of ePrescribing is not all collected together in one convenient resource, it is widely scattered and it takes a good deal of time and effort to filter through it, time which a senior decision maker within a hospital will not have.

The NHS and e-Prescribing is in a permanent state of flux as it is heavily influenced by government policy and the rapid advancements in technology. This means that a report that was relevant and instructional a couple of years ago may now be completely irrelevant. As such this project aims to produce a report that is up to date and reflects the current situation.

The decision maker only needs a high level understanding of what will be involved in order for them to be able to manage their team effectively and as such the report will not drill down into great amounts of unnecessary detail on any particular topic but it will cover a broad range of topics.

1.1 Aim

The purpose of this project is to produce an advisory paper aimed at senior decision makers within hospitals considering implementing an e-Prescribing system. It will detail the benefits and risks associated with e-Prescribing and discuss the hardware, software and networking elements that need to be considered in a language that someone unfamiliar with Information Technology terminology can understand.

1.2 Objectives

- Conduct background research into what ePrescribing actually is.
- Conduct research into the history, current political situation and organisational structure of the NHS and how it impacts on ePrescribing.
• Examine how ePrescribing fits into the NHS wide National Program for Information Technology.
• Conduct research into the current adoption levels of ePrescribing with the NHS.
• Conduct interviews and observations with practising clinicians to gather first-hand knowledge of ePrescribing.
• Research ePrescribing system options and vendors and make recommendations.
• Analyse the hardware options associated with ePrescribing and make recommendations.
• Produce an advisory paper aimed at senior decision makers within hospitals.
• Evaluate the advisory paper.

1.3 Minimum Requirements

An advisory paper aimed at senior decision makers within hospitals containing the following elements:

• Examination and explanation of the benefits and risks associated with ePrescribing;
• Evaluation of the available ePrescribing software options;
• Evaluation of the available ePrescribing hardware options;
• Examination of network issues relating to ePrescribing.

1.4 Extensions

• PowerPoint presentation summarising the salient points concerning ePrescribing based upon the feedback received during the initial evaluation stage.
• Conduct research into the Electronic Prescription Service used in GP surgeries and compare and relate it to the systems used for ePrescribing.
• Recommendations on how an ePrescribing project should be managed and implemented based on techniques learned in the COMP3441 Business Issues in Computing module.
1.5 Report Structure

The report is structured into four main sections.

1. The first section articulates the aim, objectives and the methodology for producing the solution.
2. The second section demonstrates understanding of the problem and reviews the existing literature on the topic of ePrescribing. Further understanding of the problem is highlighted in the advisory paper in the third section as this forms part of the background for the senior decision maker.
3. The third section is the advisory paper which would be given to a senior decision maker within the NHS; this is the delivery of the solution.
4. The final section is an evaluation of whether the advisory paper is fit for purpose. Critical evaluation also takes place through the report and is highlighted in the synopsis at the end of each chapter.

The appendices contain reflections on the project experience as well as some of the extensions to the minimum requirements in the form of research into the Electronic Prescription Service used in GP Surgeries. The also includes the PowerPoint presentation developed as a result of feedback during the evaluation phase.

An issue that was faced with the write up of this report is that it is aimed at two target audiences. The advisory paper is written such that a senior decision maker can understand it but the project report itself is written in a way that the assessors could sufficiently understand the terminology and structure of the healthcare system.

1.6 Methodology

This project is not a software development project and as such it did not fit neatly into any of the standard software development frameworks such as Rational Unified Process, Agile Unified Process or Waterfall. According to Boehm (2004) project methodologies range on a scale from adaptive to predictive. This project very definitely falls at the adaptive end of the scale which focuses on adapting quickly to a changing environment. It is not always possible to know at the beginning of a project if someone else is already working on the exact same goal or if the project has in fact already been delivered. At the start of the process it is not always straightforward to identify this, it is only
the background research that brings this to light and this is indeed what happened with this project. The fact-finding, investigative nature of this project meant that it was difficult to predict in advance exactly what did and didn’t already exist. It was only after extensive background reading that some documents were discovered to already be in existence.

The subsequent challenges faced in the production of this project are indicative of the challenges facing the whole of the NHS: it is a massive, complex organisation where one department is not necessarily aware of what the rest of the organisation is doing or trying to achieve.

The original brief for the project was to produce a requirements specification for an ePrescribing system at Leeds Teaching Hospital Trust (LTHT) and a business case to inform their decision as to whether to build or buy an ePrescribing solution. There was supposedly a system developed in-house by one of their clinicians and debates were on-going about whether to continue to develop this system or to evaluate third party suppliers. The structure of LTHT as shown in figure 24 in Appendix G demonstrates quite how complex the hospital trust is.

As such the initial approach was to apply the SQIRO techniques covered in the COMP3441 Business Issues in Computing and COMP2745 Requirements and Evaluation modules. SQIRO research technique for the requirements capture (Background Reading to get a good understanding of what ePrescribing actually is and its current level of adoption within the NHS, Interviewing to get a greater insight to what was actually happening at a specific hospital (LTHT), Observation to validate the background research and in Interviews followed by Sampling of the existing system that had been developed by Dr Tattersall. Questionnaires were not relevant for this project as there was not a large sample of people to question).

The project therefore started with background reading to understand both ePrescribing and Leeds Teaching Hospital Trust with the objective of understanding the complexities of ePrescribing and the structure, objectives and current situation at LTHT.

The background research eventually unearthed that a requirements specification already existed both for the NHS as a whole and a hospital specific business case that had already been developed for LTHT.

As such the decision was taken after the mid-project review to refocus the project on creating an advisory paper that could be used by any hospital in the NHS considering ePrescribing, that gave an up to date evaluation and recommendation on the hardware, software and networking considerations involved in rolling out an ePrescribing system.
The methodology of the project therefore evolved from using a SQIRO approach to a desk based research project which would apply the concepts learnt in the COMP3441 Business Issues in Computing module such as benefits management and change management.

Weekly review sessions were held with the project supervisors to assess progress and raise any concerns.

1.6.1 Research Sources
The project had started using the SQIRO methodology and therefore the initial research focused on resources published by the NHS department responsible for the implementation of all NHS wide Information Technology programs – Connecting for Health. These resources highlighted and prioritised the next phase of research which was the medical and pharmaceutical journals who were publishing on various aspects of ePrescribing.

During the course of the project it was clear that Information Technology programs such as ePrescribing, how the NHS was structured and how decisions were made within the NHS were newsworthy issues. As such a number of research sources are reputable news media websites.

Academic papers that were highlighted during the COMP3441 Business Issues in Computing module and additional sources on these topics were used to select the appropriate management theories and models to analyse ePrescribing in the NHS.

1.6.2 Benefits Management
The political rationale behind the restructuring of the NHS which came into force during the course of the project made it logical that a benefits management approach to the problem was the appropriate methodology to use when recommending how ePrescribing could be rolled out in NHS hospitals. One of the criticisms levelled at the National Program for IT, the perceived failure of which was one of the drivers for restructuring the NHS, was that the strategy and projects were led by IT professionals rather than practising clinicians. Therefore a benefits management approach which advocates engaging the end users of the system up front to identify and own the potential benefits which could arise as a result of the technology solution is the sensible methodology to adopt to counter these criticisms.

1.6.3 Change Management
What also became clear during the course of the research was the extent of the change that implementing ePrescribing in a hospital would be. As such research into the topics surrounding change management (covered on the Business Issues in Computing module COMP3441) was
conducted and an appropriate model for managing change was used in order to make recommendations to the readers of the report about how to implement ePrescribing.

1.6.4 Evaluations
Following the switch in focus of the project, the preferred methodology for evaluating the solution would have been to get an NHS hospital clinician who had rolled out ePrescribing to review the report in the light of what they had learned from their experiences and make recommendations that would make it fit for publishing. During the course of the project it was not possible to identify and gain access to people who were in this situation. The decision was taken therefore to ask practising clinicians within the NHS, to role-play the role of a senior decision maker within a hospital and to review the advisory paper from that standpoint.

1.7 Project Schedule
The advantages of a structured project management approach mean that objectives and timeframes can be established up front, risks can be identified and managed and progress against the milestones can easily be tracked.

However, the changing aim of this project meant that the schedule that was submitted as part of the mid project report was no longer relevant or applicable.

1.7.1 Original Schedule identifying milestones
- Background reading: Weeks 1-5
- Finalise project aim and scope: Week 6
- Give practise presentation to project group: Week 6
- Conduct Interviews & Observations: Weeks 6-10
- Writing of project report: weeks 6-15 (submit final version 08/05/13)
- Create Use Case and Activity diagrams: Week 7
- Evaluate current e-prescribing solutions: Week 8
- Critique existing national and Leeds functional requirements specifications: Week 9
- Write the business case: Weeks 7-12
- Give final presentation: Week 17

The project schedule proved to be one of the most difficult aspects of the project; the constantly evolving scope and the investigative nature of the project meant that it was very difficult to put
delivery times to the milestones on the project schedule. The reliance on external dependencies also made it difficult to assign timescales for the interviewing portion of the project; ultimately the lack of responses from my requests for interviews meant that the purpose of the project had to change. It was lack of access to the relevant people within Leeds Teaching Hospital Trust that necessitated the change in project scope. As such the decision was taken to create a generic solution rather than one specifically designed for LTHT.

1.7.2 Revised Project Schedule
The mid project report feedback highlighted that the original schedule was not clear enough. Therefore once formal agreement from the project supervisors was attained a revised schedule with a defined, agreed upon aim that was not reliant on external stakeholders was created and adhered to.

The revised project schedule is shown in Appendix D.

1.8 Relevance to Degree Program

This broad nature of this project has provided the opportunity to revisit and apply the theory and techniques learned from a number of different modules from the Information Technology degree program.

The study of cultural change, systems theory and the structured approaches of both benefits and change management from the Business Issues in Computing (COMP3441) module have proven very useful as analytical techniques.

The choice of project methodology and the running of the project was learned from Project Management module COMP1945.

SQIRO fact finding techniques learned in the Requirements and Evaluation (COMP2745) module were also applied.
2. Understanding the Problem

The issues associated with implementing ePrescribing solutions within the NHS provide a perfect demonstration as to exactly why the Leeds University Information Technology undergraduate degree course is so essential. It is generally acknowledged there is a language barrier between IT specialists and the people who will benefit from the technology solutions that they can provide. This is especially evident in the NHS, hospitals are run by clinicians on the whole who have minimal business or IT experience.

In recognition of this issue it was decided to undertake a benefits management approach to address this problem. A benefits management approach advocates the engagement of the end users who will be the main beneficiaries of the solution, to identify and take ownership of the benefits that can arise from a technology solution. This not only ensures that the solution being developed is appropriate for the people who will use it but also encourages them to accept the new system.

An approach such as this would have been beneficial in 2002 when the Labour Government of the time created the National Program for IT (NPfIT). The NPfIT was the NHS IT strategy devised by IT professionals and management consultants with minimal input from the people who would actually be using the solutions on a day to day basis i.e. doctors and nurses. A central body was created to roll out these recommendations called NHS Connecting for Health who had responsibility for all the national NHS IT programs. The benefits management approach fits with today’s political agenda for the NHS, that of devolving responsibility to the people who will be using the solution and not imposing a centrally mandated solution across the whole of the NHS.

As part of the solution recommendations are made about potential project management approaches to be considered when rolling out ePrescribing in hospitals. The concept of change management is also covered (section 3.6.1) due to the high level of impact that ePrescribing impacts on the way that many people do their day job. It reflects a cultural shift for an NHS hospital and therefore the audience for the solution need to consider how these issues will be handled.

The implementation of ePrescribing in the NHS is not just a technical problem, the issues can only be understood by analysing the broader context: historical, political and structural, as well as technological. Because of the need to understand all of these factors the background reading covers a wide range of different sources. These sources include:

- Academic papers as referenced in the Business Issues in Computing module COMP3441.
- Pharmacy and medical journals which examine the problems associated with current prescribing methods and the potential benefits from ePrescribing.
- News stories from respected media sources and government publications to understand the political context.

The starting point for the background reading were papers published via the Connecting for Health website, which at that point in time was the central NHS body responsible for all NHS IT projects. The Connecting for Health website published a range of research papers and presentations which formed the basis for further reading. The following section examines the historical, political and technological issues that give the background to ePrescribing and then goes on to examine the challenges associated with traditional prescribing processes.

2.1 Historical Context: The National Program for IT

ePrescribing cannot be fully understood without understanding the historical context and the political drivers behind the use of IT in the NHS that stemmed from the National Program for IT (NPfIT). As learnt in the BIC COMP3441 module on Systems Thinking and Theory it is important when tackling a problem to get an idea of the bigger picture, Bertalanffy’s General Systems Theory proposed (1950) makes it clear that a problem cannot be solved simply by looking at the system itself, the broader context must also be understood.

The National Program for IT (NPfIT) was created in 2002 during the first term of Tony Blair’s Labour Government. The objective was to introduce modern and uniform computer systems into the NHS to improve patient care and services. The NPfIT encapsulated the Department of Health’s strategy for IT for the NHS.

The original objective of the National Program for IT was to enable the NHS to harness developments in technology. The objectives were to improve the availability of information across the NHS, create common NHS wide electronic patient records and establish the NHS as the world leader in the modernisation of healthcare service delivery. The means by which this would be delivered was the creation of a body to standardise system choices and create central solutions based on proven standards. This centralisation was also intended to lead to economies of scale based on better negotiating power and result in cost savings rather than allowing each individual NHS hospital or GP surgery to negotiate with individual suppliers.

In order to deliver the NPfIT recommendations an NHS body was created called Connecting for Health. Connecting for Health was given responsibility for the development of the IT infrastructure
for the whole of the NHS. A core objective was to create a single, central electronic patient record for every NHS patient, connecting the 30,000 GP practices across the UK to the 300 hospitals.

To ensure interoperability, standardisation and to take advantage of economies of scale only a small number of suppliers were appointed, Appendix H details which suppliers were appointed.

The National Program for IT comprised seven main deliverables which are listed below with the name of the software or hardware solution put in place to address them.

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Name of solution</th>
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<tbody>
<tr>
<td>Integrated care records service</td>
<td>NHS Care Records Service (NCRS)/ Lorenzo</td>
</tr>
<tr>
<td>Electronic prescribing</td>
<td>NHS Electronic Prescription Service</td>
</tr>
<tr>
<td>Electronic appointments booking</td>
<td>Choose and Book</td>
</tr>
<tr>
<td>Underpinning IT infrastructure</td>
<td>N3</td>
</tr>
<tr>
<td>Medical imaging software</td>
<td>Picture Archiving and Communication System (PACS)</td>
</tr>
<tr>
<td>Performance management of primary care</td>
<td>Quality Management and Analysis System (QMAS)</td>
</tr>
<tr>
<td>Central email and directory service</td>
<td>NHSMail</td>
</tr>
</tbody>
</table>

Figure 1 – National Program for IT deliverables. Source: Connecting for Health.

The NPfIT programs which affect ePrescribing are the Integrated Care Records Service, Electronic Prescribing and the N3 network infrastructure; each of these deliverables has to take into account many of the same issues concerning data standards and interoperability.

From 2006 onwards both the opposing political party and the media started heavily criticising the NPfIT for the increasing cost of the program, the lack of results and the withdrawal of a number of key suppliers. In 2009 the Commons Public Accounts Committee estimated that some parts of the program were running four years behind schedule. This perceived failure is part of what led to the recent politically driven restructuring of the NHS and the abandonment of the NPfIT.

2.2 Political Context

During the course of this project, the changes referred to as “the most radical overhaul since the NHS was created” went live (Nick Triggle, BBC health correspondent April 1st 2013).

These changes were triggered by the government white paper “Equity and Excellence: Liberating the NHS” which was published in July 2010. The white paper had two key strands “put clinicians in the driving seat on decisions about services” and “put patients right at the heart of decisions about their care”. 
The objective of putting clinicians in the driving seat on decisions about services is what has led to the massive changes in how services are “commissioned” or bought in the NHS. One of the effects of this change is the abolition of NHS Connecting for Health body.

2.3 Structural Context: Who Does What?

The switch in focus to putting clinicians in charge of commissioning IT programs means that a central body for commissioning IT programs is no longer politically appropriate. Responsibility for local programs has been devolved to individual hospitals and GP Commissioning Groups. Responsibility for national NHS IT is now split between the Department of Health, NHS England (formerly the NHS Commissioning Board), and the Health and Social Care Information Centre. The Department of Health’s External Relations group is now responsible for the NHS’s information policy. The NHS England organisation, based in Leeds, works with this External Relations body to commission and sponsor national NHS infrastructure, service and standards. They are also responsible for sharing best practise across the NHS. The Health and Social Care Information Centre (HSCIC) is responsible for the collection and analysis of national data on health and social care; a role that is especially timely in the light of the scandal in NHS Mid-Staffordshire that came to light in early 2013. If the HSCIC had already been in place they might have picked up sooner on the abnormally high numbers of patient deaths in the NHS Mid-Staffordshire hospitals and saved lives by launching an investigation sooner. The HSCIC is also responsible for managing and monitoring national IT systems and services and accrediting IT systems against commissioned standards. Although they have been in the planning for over two years these organisations have only just taken up their new responsibilities as of 1st April 2013. As such they currently have a limited amount of resources published and there are definite gaps in the provision of services which previously existed but no longer do, for example, ePrescribing.

2.4 Impact on ePrescribing

The disbanding of the NHS Connecting for Health department means that their website which was the main resource for information relating to IT in the NHS is no longer being maintained from the first of April 2013 and there is a redirect to: http://systems.hscic.gov.uk/. This means that some of the web references are now in the national archive website. The HSCIC website has a section which alphabetically lists the systems and standards that the HSCIC is supporting, this list contains a section for EPS but does not have any information on ePrescribing. A general site search on ePrescribing only turns up two links which highlight a supplier conference from July last year.
Searches on the NHS Commissioning Board and the Department of Health website do not return any results for searches on “ePrescribing”, “electronic prescribing” or any variance thereof. It would appear therefore that this is in keeping with the overall principle of the restructure: devolved responsibility; hospitals are now responsible for deciding and implementing their own ePrescribing solution. There are now no central resources any more offering advice and guidance on the implementation of ePrescribing.

The withdrawal of central support for ePrescribing, while in line with the principle of devolving responsibility appears to run counter to one of the key priorities for the NHS announced by Jeremy Hunt the Health Secretary on 15 January 2013 that the NHS is to become paperless by 2018:

“Today I am setting a new ambition for the NHS. I want it to become paperless by 2018. The most modern digital health service in the world. Patients will be at the heart of this change - which means allowing for those unable or unwilling to engage in technology. But between the NHS and social care, there must be total commitment to ensuring that interaction is paperless, and that, with a patient’s consent, their full medical history can follow them around the system seamlessly.”

(Jeremy Hunt, Health Secretary 15 January 2013).

The infrastructure and systems to deliver the Electronic Prescription Service (EPS) used in primary care (i.e. GP Surgeries and community pharmacies) is already well established, the central resources of the Spine and the N3 network (section 3.5) are in place and EPS is working smoothly across many GP Surgeries (see Appendix F for levels of take up).

However, ePrescribing is one of the core programs which would enable a paperless NHS in a hospital, yet central resource and support has been withdrawn. Recommendations are made therefore in Appendix J about where the NHS and the Department of Health should consider re-introducing central support for hospitals to support ePrescribing.

2.5 What is ePrescribing?

This section is intended as a quick overview for readers not familiar with the NHS or electronic prescribing, the intention is to give a simple overview which will make sense of the subsequent analysis and put it into context.
2.5.1 What is Traditional, Paper-Based Prescribing?

After staff costs, medicines are the highest single element of cost to the NHS (Picton, 2008). They are fundamental to the treatment of many medical conditions. However, while the number, range and complexity of medicines increases every year, the processes and systems to prescribe, dispense and administer them have not been fundamentally reviewed since the 1960s (Cornford, 2009).

As noted during observations on the renal ward St. James’ Hospital, when a patient is admitted to hospital a paper chart, or Kardex, is created which captures their personal details, their symptoms and the medication they are currently on (please see Appendix I for a picture of a Kardex). This chart is transported with the patient on admission to a ward and is then either hung on the end of the patient’s bed or stored in the nurses’ station on the ward. After discharge the chart will be sent to a secure storage room on the hospital site from where it needs to be retrieved when the patient comes in for outpatient care.

The doctor reviews the information held on this chart and writes medication orders directly onto it, the nurse must then use the same chart to find out what medication the patient should be on and record when it has been administered. A pharmacist must approve the medication order before it is dispensed and delivered to the ward or the patient.

This collection of paper becomes very important indeed to ensuring the patient’s proper care.

2.5.2 Problems with Paper Based Hospital Prescribing Process:

The Health Secretary Jeremy Hunt brought this to life with some very clear examples during his speech given on April 26th 2013 at the “Delivering a Paperless NHS” conference in London:

“Because [patient records] are mainly paper-based, they can only be in one place at a time, only seen by one person at a time. So they’re no use to a patient on holiday in Gloucester if his file is in a GP surgery in Godalming. Or to a paramedic picking up a frail elderly woman in an emergency who, if he had her notes, could see she was a diabetic with a heart condition who had a fall last month. They’re no use to a hospital doctor who might not be aware of a patient’s other medication and prescribe drugs incorrectly - potentially lethally - because the notes have got lost. Unaware of a patient’s full history, complications arise in surgery. Diagnostic tests are repeated unnecessarily. And patients find themselves having to repeat their medical history over and over again, sometimes several times on the same day in the same hospital.”
In addition to the problems highlighted above by the Health Secretary there are other issues with the paper prescribing process. There are time delays which are associated with a prescription being written on the ward, then manually delivered to the pharmacy, verified and fulfilled by the pharmacist and physically delivered back to the ward. There are also a number of other problems with paper prescribing relating to human error, for example, doctors are renowned for their illegible handwriting which can lead to errors when their prescriptions are transcribed. Charts can get lost while being transferred from the ward to the pharmacy meaning that the patient’s medical history is lost and needs to be taken again. There are also many instances where doctors do not provide complete information such as which drug, at which dosage, for how long and the time at which it should be administered so the prescription cannot be fulfilled by the pharmacist.

These issues are not just inconvenient to the patient and to the hospital staff, they can be lethal. Giving a patient the wrong medication can harm or even kill. A dose that is too low may have no effect, a dose that is too high can kill, a drug administered that interacts with another drug can cause an adverse drug reaction, a drug administered to a patient who is allergic can kill.

2.5.3 What is Electronic Prescribing?

Electronic Prescribing comprises two different systems and solutions aimed at two different beneficiaries:

- The Electronic Prescription Service (EPS) used in GP Surgeries
- ePrescribing used in hospitals.

Although this report focuses on ePrescribing in hospitals the Electronic Prescription Service (EPS) is also analysed in Appendix F to give context to the broader issues of Electronic Prescribing in the NHS.

ePrescribing is the end-to-end process used within hospitals to enable the prescription, dispensing and administering of medicines to an inpatient or outpatient.

The official definition of ePrescribing comes from the NHS Connecting for Health department (2007):

“The utilisation of electronic systems to facilitate and enhance the communication of a prescription or medicine order, aiding the choice, administration and supply of a medicine through knowledge and decision support and providing a robust audit trail for the entire medicines use process.”
In practice this means the replacement of the handwritten paper prescriptions, which are written by doctors on hospital wards and manually collected and transferred to the pharmacy, with an electronic system that automatically transmits the prescription to the pharmacy.

ePrescribing systems also have decision support functionality which helps the prescriber to select the correct medication and dosage, checking against the patient’s Summary Care Record to highlight potential interactions with other medicines which the patient is taking or any medications the patient is allergic to.

The prescription, which is made on the ward either by a doctor or suitably qualified nurse using a PDA/ tablet/ workstation-on-wheels/ ward computer (section 3.4.1), is automatically transferred to the hospital pharmacy. This negates the need for prescriptions to be hand delivered to the pharmacy or for the pharmacist to visit the ward to collect and validate the prescriptions. Once the prescription is approved by the pharmacist the order is checked against the pharmacy’s available stock and then fulfilled and delivered to the ward by the pharmacy staff. The system then creates a reminder for the person administering the medication, usually the nurse, who then records when the medication has been administered to the patient. This then forms part of the patient’s Summary Care Record.

Figure 2 was created to show the process flow from a doctor prescribing a medication through to the approval and dispensation by the pharmacist. It also shows the administration of the medication to the patient and the various hospital systems that each step of this process need to integrate with.
2.6 Quantifying the Problem

There are many different sources which quantify the problems associated with the traditional paper based prescribing process.

In 2009 at a British Computer Society’s Health Informatics Forum, Glyn Hayes, the former chairman of the British Computer Society's Health Informatics Forum, publicly stated that “the National Programme for IT in the NHS and hospital boards should put ePrescribing at the top of their agenda because of the huge patient safety and financial benefits”.

There are a variety of different studies in the UK which quantify the problems associated with current prescribing methods:

- Prescribing errors occur in 1.5 – 9.2% of medication orders written for hospital inpatients.
- Dispensing errors are identified in 0.02% of dispensing items.
- Medication administration errors occur in 3.0 – 8.0% of non-intravenous doses and about 50% of all intravenous doses.
• Adverse drug events (ADRs) are known to be the single leading cause of medical injuries. One study detailed in the Journal of Clinical Pharmacy and Therapeutics (2006) identified 6.5% of patients admitted to hospital were experiencing an ADR.

(Source: Cornford 2009)

On the 26th April 2013 the Health Secretary, Jeremy Hunt, delivered a speech at a London conference entitled “Delivering a Paperless NHS”:

“Most NHS users would be astonished that information doesn’t flow around the system. In many hospitals the IT systems aren’t even linked within a hospital, let alone between hospitals and other parts of the health economy. That’s I’m afraid a fairly normal situation across the country. Eleven people died last year in the NHS from being given the wrong medication.”

A study by Davies et al. published in 2006 in the Journal of Clinical Pharmacy and Therapeutics showed that Adverse Drug Reactions (ADRs) were the biggest cause of harm by clinicians to patients - they account for 6.5% of patient admissions into hospital.

One of the main reports which fed into the creation of the National Program for IT was the Audit Commission’s 2001 report “A Spoonful of Sugar – Medicines Management in NHS hospitals” which found that prescribing errors accounted for 20% of litigation claims brought against the NHS.

Despite nearly a decade of the National Program for IT in 2010 the National Patient Safety Agency (NPSA) reported that the annual cost to the NHS of medication incidents was £750M. The NPSA 2010 study showed that the majority of errors were as a result of the wrong dose, strength or frequency of the right medication; however, there were many incidences of the wrong medicine being prescribed or patients’ medication requirements being forgotten altogether. According to the NPSA these issues account for nearly 60% of all medication “incidents”. Their study across 20 UK hospitals highlighted that 8.9% of all prescriptions contained an error. Worryingly, of these, 52.8% were classified as “significant”, 5.5% as “serious” and 1.7% as lethal.

A study in Coventry and Warwick in 2005 by Singer showed that two thirds of Adverse Drug Reactions were potentially preventable using the decision support functionality and checks enforced by ePrescribing systems. For the University Hospitals of Coventry and Warwick, preventing the extra length of stays in hospitals as a result of ADRs would have saved the Trust £4m, for the internal medicine department alone.
A 2008 report for the BBC “Unused Drugs costing NHS Millions” by their Scottish Health Correspondent Eleanor Bradford showed that for every £20 spent on medication - £1 was wasted. The real impact of this becomes clear when you understand that the NHS spent £8.81bn on medicines in 2011 (Pharmafile, 2012), the wasted spend equates to nearly half a billion pounds. As can be seen from these statistics there are some significant problems which are preventable as well as considerable financial benefit to be gained from implementing ePrescribing.

2.7 Quantifying the Solution

The healthcare system in the US charges the patient or their insurer for everything, as such, US hospitals were much earlier adopters of ePrescribing technology than the British. They sought efficient ways to track every interaction with a patient, including medication, so they could bill them for it. Many of the studies which quantify the benefits, either financial or medical, of ePrescribing studies come from the US.

Bates’ studies in US (1998) showed a reduction in error rates of 55% and a reduction of “serious” medication errors of 88%. These reductions were attributed to the fact that the systems forced extra checks on the prescriber as well as the decision making support contained in the ePrescribing system to help them choose the right medication. The Leapfrog Group, a US medical research group, have published a lot of research on the impact of ePrescribing in US hospitals – one of their studies showed that the introduction of ePrescribing systems reduced the average patient length of stay by a day. The Leapfrog Group extrapolated their research to state that introducing ePrescribing could prevent between half a million and a million “serious” medication errors each year in the US (Birkmeyer & Dimick, 2004).

In the UK there is only limited published evidence because of to the small number of hospitals who have rolled out full ePrescribing solutions. Doncaster Royal Infirmary identified a 60% reduction in adverse drug events following implementation of JAC’s electronic prescribing solution (First Data Bank, 2009) and the results from the University Hospital of Birmingham are shown in section 3.1.

Connecting for Health conducted a joint study with the George Elliot Hospital Trust in 2005 sponsored by Intel (Hoeksma, 2005) about the impact of using mobile technology on the wards for completing patient charts. The study showed that a ward nurse saved 10 minutes per shift and doctors saved 20 minutes per shift. This can be extrapolated against the number of staff per ward per shift across a hospital as a whole which results in some dramatic time savings over the course of a year. This time can be better spent delivering improved patient care.
The “Spoonful of Sugar, Medicines Management in NHS Hospitals” report by the Audit Commission in December 2001 estimated from population extrapolation that 1,200 people were killed in England and Wales each year as a result of unnecessary medication errors. While it is not possible to identify the source of Jeremy Hunt’s statistics quoted at the Paperless NHS Conference on April 26th 2013, in his speech he stated that during 2012 eleven people were known to have been killed in the NHS as a result of being given the wrong medication. There are no comparable estimates for later years from the Audit Commission, but there is no reason to suspect that current estimates would be significantly lower than 2001.
3. The Solution

This advisory paper is aimed at senior decision makers within the NHS who are considering rolling out ePrescribing.

The report is broken down into six sections:

1. The benefits of ePrescribing
2. Building the case for change
3. ePrescribing software options
4. ePrescribing hardware options
5. Enabling technologies
6. Project Implementation

3.1 Benefits of ePrescribing:

There are many benefits to be gained from ePrescribing. Different benefits exist for each different group of stakeholders involved in the process: prescribers, dispensers, administrators, hospital managers and the patient. These benefits include:

Decision Support

The workflow based questions that every ePrescribing system is based on, linked to the patient’s medical history, helps the prescriber select the right medication and dosage. Every commercially available ePrescribing system is linked to a patient’s Summary Care Record which will red flag if a doctor tries to prescribe a drug which will interact negatively with a drug that the patient is already on or if the patient is flagged as being allergic to the proposed drug.

Reduction in Adverse Drug Reactions (ADRs)

Another benefit is the reduction in Adverse Drug Reactions (ADRs) which in the most serious cases can result in the patient’s death. This reduction is achieved by the improved decision support functionality provided by the ePrescribing packages as well as the fact that they are linked to the Summary Care Record to ensure that drugs being prescribed do not interact with medications the patient is already on.

The number of medication administration errors is dramatically reduced as well because the ePrescribing software triggers reminders for the nurse on the ward to administer the drugs ensuring the patient gets the right medicine at the right time in the right quantities.
An ePrescribing system also provides a complete audit trail of who did what and when they did it. This generates management information which can be used to pinpoint the source of errors and provide training or disciplinary tactics where appropriate.

There are a number of studies which analyse the impact of ePrescribing on ADRs, one that clearly highlights the impact is that of the University Hospital of Birmingham (UHB) where they implemented a bespoke Prescribing Information and Communication System (PICS) in the early part of this century. The system has been constantly developed over subsequent years but they publicly attribute this system as playing a large role in dramatically reducing the number of patient deaths compared to the rest of the NHS. Figure 3 shows how the number of patient deaths steadily decreased over time at UHB compared to the baseline set by other NHS hospitals.

![Figure 3 – Deaths per 1000 discharges UHB. Source: Journal of the Royal Society of Medicine Short Report 2012](image)

There may be other contributing factors leading to the fall in patient deaths highlighted in figure 3 but the University Hospital of Birmingham acknowledges that ePrescribing played a key part in this success.

Efficiency

ePrescribing systems also makes the prescribing process much more efficient; whether the doctor is prescribing on a PDA, tablet, workstation-on-wheels or ward computer (section 3.4.1) the prescription is transmitted immediately to the pharmacy. As such it is not necessary to wait for someone to manually collect the ward prescriptions and deliver them to the pharmacy. An ePrescribing system also forces the doctor to provide all of the necessary information up front, for
example, what drug has been prescribed, at what dosage, how long it should be administered for and at what time it should be administered. The system will not accept the order until this information is provided so there is no risk of a partially completed prescription being sent down to the pharmacy and then queried, also the order is digital so there is no risk of illegible handwriting. Stock levels of the relevant drug are checked even before the pharmacist has verified the order so stock fulfilment triggers can immediately be initiated to order more drugs if necessary. Figures 4 and 5 below give a high level overview of the prescribing process before and after ePrescribing implementation.

![Flowchart of the prescribing process](image)

**Figure 4 - Paper based prescribing process**
Fig. 5 - Prescribing process after ePrescribing implementation

It is easy to see the reduction in the number of steps required to prescribe, dispense and administer a drug. This reduction in steps in the prescription process leads to a more efficient and safer system.

**Reduced Hospital Stays**

ePrescribing helps reduce the patient’s length of stay in hospital; there is less waiting around for a prescription order to be collected from the ward, verified, fulfilled and delivered back to the ward when they are being discharged. This will lead to improved relationships between patients and medical staff as the patient does not get impatient about being kept waiting around, it also frees up the bed for other patients.

**Cost Savings**

There are no definitive studies quantifying the precise cost savings from ePrescribing as historically hospitals have not had measures in place to calculate the number of errors and the costs associated with them that could be averted with ePrescribing. Software vendors are now working collaboratively with hospitals that are rolling out their solutions to ensure that this information is
now collected. This enables the vendors to provide evidence as to the measurable benefits that their solution can provide.

Although the savings cannot necessarily be directly quantified at this stage it is clear that savings will arise from the reduction in the amount of paper needed and from beds being freed up earlier.

The streamlined and more efficient prescribing process will take up less time thereby freeing up the stakeholders time for other activities. The reduction in length of hospital stays and the freeing up of beds will also have a positive impact in reducing the costs associated with caring for these patients. The major areas of cost in the NHS is in people costs i.e. paying the salaries of doctors and nurses.

Another saving that ePrescribing brings about is through the fact that it forces prescribers to stick to the hospital approved drug formularies and protocols. Each hospital or trust will make decisions about which drugs they are willing to prescribe, by using an ePrescribing system the prescriber has no choice but to select the approved drug. This means that the hospital can bulk purchase their selected drugs rather than having to fulfil multiple different variants of the same drug.

The reduction in Adverse Drug Reactions has a definite financial benefit as it will lead to a reduction in the compensation pay-outs that trusts have to pay to patients who have been injured or worse by errors in the drug prescribing process.

3.2 Building the Case for Change

ePrescribing is just one of many priorities within a hospital. It is necessary for the senior decision maker to build the business case for investing in ePrescribing.

There are a number of resources that still exist from when Connecting for Health was providing central support for ePrescribing; the University Hospital of South Manchester has published their business case for ePrescribing which is a very useful starting point for a hospital looking to create their own (Hay & Skipper, 2009).

It is recommended that in addition to the traditional content that goes into a business plan, which focus on the costs of the project and the likely cost savings that will come out of the project, the reader takes a benefits management approach to building the business case.

A benefits management approach to electronic prescribing in the NHS is especially relevant in the light of all the criticisms thrown at the NPfIT and the subsequent structural changes which have been
implemented across the whole of the NHS. Programs were IT led and centrally implemented by the NHS Connecting for Health body, rather than being defined and led by clinicians who would be the primary recipients of the benefits of any changes.

The founding principles of benefits management (Ward & Daniel, 2006) are fundamental to understanding the success of any technology project roll out:

1. There are no direct benefits from IT, it is merely the enabler that creates the capability to derive benefits
2. Things only get better when people start doing things differently.

Benefits management is an approach which was developed by the Information Systems Research Centre at Cranfield School of Management, it was based on three research projects over ten years looking at how organisations realised business benefits and value from their investments in IT (Ward & Daniel, 2006). They looked at multiple different organisations, industries and IT implementations. Their theory finds that frequently IT projects fail to deliver on their expected benefits because the project owner focuses too much on how the project can reduce costs rather than focusing on the potential benefits and that they do not involve the business users who will be affected by the project. The overall objective of a benefits management approach is to identify and articulate the business benefits of the project before it has begun and develop a plan about how these benefits will be delivered, with owners of the benefits identified and the timescales for delivery established. A benefits management approach also provides a means of measuring progress by giving the people running the project a constant reminder of what they were setting out to achieve in the first place.

A key recommendation from Cranfield is that the business stakeholders, in this case doctors, nurses and pharmacists, must be integral to the identification, development and implementation of the benefits plan. A benefits plan is essentially a five step process. Figure 6 is Ward & Peppard’s (2002) benefits management method. This advisory paper is focused on planning and implementing an ePrescribing system as such its focus is on steps one and two. Recommendations on steps three, four and five are covered in section 3.6 on project implementation.
The first step in the benefits management approach is to identify and structure the benefits, ensuring that that the specific owner of the benefit within the hospital is identified. It must also highlight what changes must be made to enable that benefit owner to realise the benefits and that measurements must be put in place so that the success of the project can be measured as it progresses. Figure 7 shows a generic benefits template (Ward & Daniel, 2006) which has been filled in by the author of this report and summarises the benefits, owners and measurements required for a project team wishing to embark upon an ePrescribing project within a hospital.
<table>
<thead>
<tr>
<th>Benefit no., type and related objectives</th>
<th>Benefit description</th>
<th>Benefit owner</th>
<th>Dependent changes and responsibilities</th>
<th>Measures</th>
<th>Expected value</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>Clear and legible prescriptions containing all the necessary information</td>
<td>Pharmacy</td>
<td>Prescriber must use ePrescribing system which won't let them complete a prescription without all the information; system must be set to include all the necessary information</td>
<td>Percentage of prescriptions submitted with incomplete information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved communication (ward staff change over etc.)</td>
<td>Nurses</td>
<td>Nurses must capture medication administered on ePrescribing system</td>
<td>Percentage of drugs administered on time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triggered reminders for drug administration</td>
<td>Nurses</td>
<td>Nurses must capture medication administered on ePrescribing system</td>
<td>Percentage of drugs administered on time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Faster discharge process</td>
<td>Doctors, nurses, patient</td>
<td>IT must integrate the ePrescribing system with the pharmacy system</td>
<td>Length of time from medical discharge to prescription being delivered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical</td>
<td>Aids decision making</td>
<td>Prescriber/ Doctors</td>
<td>Decision flow must be set in ePrescribing system by IT based on advice from doctors/prescribers</td>
<td>Number of Adverse Drug Reactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litigation</td>
<td>Prevents prescribing of contra-indicated combinations of medication</td>
<td>Management, prescriber, administerer, pharmacist</td>
<td>Decision flow must be set in ePrescribing system by IT based on advice from doctors/prescribers AND pharmacist</td>
<td>Number of Adverse Drug Reactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>Better management information</td>
<td>Management</td>
<td>Necessary reports must be defined; system must capture necessary information</td>
<td>Number of reports available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Stick to hospital/ trust formularies</td>
<td>Management</td>
<td>Hospital/ trust formularies must be entered into the ePrescribing system</td>
<td>Number of non formulary medications prescribed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduced compensation pay-outs</td>
<td>Management</td>
<td></td>
<td>Amount paid out in compensation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pharmacy stock control &amp; JIT</td>
<td>Pharmacy</td>
<td>IT must integrate the ePrescribing system with the pharmacy system</td>
<td>Number of items out of stock</td>
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<tr>
<td>Strategic Objectives</td>
<td>How does ePrescribing align with the hospital's overall strategic objectives</td>
<td>Management</td>
<td></td>
<td>Hospital specific</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.2.2 Benefit Dependency Network

The second stage in the process is to identify the one-off enabling changes that need to be made and then the on-going changes to how business is conducted. Ward and Daniel (2006) have developed a template to put together a Benefit Dependency Network which advises organisations to start on the right hand side of the network diagram and work backwards. The first step is to identify the investment objectives, then highlight the benefits that arise from delivering these investment objectives after that comes the business changes that will be necessary to deliver these benefits. The project team then needs to identify any one off enabling changes that are necessary to deliver the project and finally focus on the IT enablers that are required. It forces the organisation to identify the benefits, not just financial benefits, that are expected from the project and which can then be tracked throughout the course of the implementation and the continuing assessment and review of whether the benefits have been realised.

Figure 8 summarises the benefits, business changes and IT enablers that are necessary to implement ePrescribing.
When a full picture of the benefits that can be realised from ePrescribing has been created and specific owners of these benefits have been identified these stakeholders should become members of the project team to ensure that the full range of benefits are properly realised.

3.3 ePrescribing Software Options

This section provides an evaluation of the ePrescribing software options that are on the market.

3.3.1 ePrescribing Software Market Share

Due to the complexity of ePrescribing systems whereby different parts of a hospital may be using different types of ePrescribing software independent of each other it is hard to give a definitive answer about how many hospitals are actually using ePrescribing across the whole hospital.

One of the most useful sources of information on the status of ePrescribing within the NHS is from EHI Intelligence, who are a private company accredited by the NHS to conduct a constant rolling program of telephone surveys conducted with hospitals to identify what hardware and software solutions they have in place. This is a commercial service which EHI sell to software and hardware vendors so they can understand their target market. NHS users are given complementary logins and part of the agreement whereby the NHS endorses EHI and obliges hospitals to respond to their surveys. It is strongly recommended that readers sign up for a complementary login so they can find out what other hospitals are using the same combinations of systems as their own and arrange to visit to see how ePrescribing integrates into existing hospital wide systems.

Figure 9, generated from EHI Intelligence’s market share reporting tool, shows a breakdown of the software systems in place at acute and foundation hospital trusts in England (it does not cover Mental Health Acute or Foundation Trusts).
There are 166 Acute or Foundation Trusts in England, of these 104 confirmed to EHI Intelligence that they are using some form of ePrescribing. One proviso that people should be aware of when reviewing this data in determining whether a hospital uses ePrescribing or not, it is not a simple yes or no answer. In a hospital one department could be trialling ePrescribing and this might be captured by the researchers at EHI but it does not mean that the whole hospital is using an integrated ePrescribing module across all wards and departments.

To a large degree the data is very reliable and the data points have been checked against publicly available information do align, for example they capture the fact that the University Hospital of Birmingham uses their own in-house PICS ePrescribing solution, a fact which can be validated from presentations previously available on the CfH website. However, as discussed it does not give the full picture of whether ePrescribing is rolled out across the whole hospital.

There are still at least a third of hospital trusts who have not rolled out any form of ePrescribing and the situation is unclear as to what level of adoption is in place for those that have rolled out a solution.

Figure 10 below is not a formal network diagram or an organisational structure of a hospital but is an attempt to show the complexity of the systems and departments that exist within a hospital. Within a hospital there are many different medical specialities, as shown by the list on the right hand side of the figure, in addition to these medical specialities there are also many other specialist departments.
all contributing to patient care: laboratory and radiology for testing and X-Rays; pharmacy for dispensing of medications and the emergency wards and theatres that deal with triage, initial care and surgery.

Figure 10 – sample hospital structure and systems

The Clinical Five are the NHS CfH priorities for capitalising on IT technology in hospitals. The Clinical Five must integrate with the patients’ Summary Care Record as held at a high level on the Spine and in more detail on the hospital Electronic Patient Record.

Figure 10 gives an idea of the sheer complexity of a hospital as an organisation and the different tasks, specialities and types of care that are delivered every day. ePrescribing goes across every part of the hospital and impacts on how every doctor, nurse and pharmacist does their job. It must also integrate with all the systems and technologies already in use across the hospital and as such system interoperability needs to be considered.
Decisions on which type of ePrescribing software should be taken in the light of whatever systems the hospital already has in place and whether integration APIs have already been created by the vendor for the hospital’s existing systems.

There are four system options for ePrescribing:

1. Clinical speciality based software
2. Bespoke developed/ “home grown” software
3. Software solutions that have evolved from pharmacy systems
4. Modules of broader hospital software solutions

3.3.2 Clinical Speciality Based Software

Although there is some commonality across the different clinical specialities, each area has its own bespoke requirements. There are some clinical specialities that are more complex than others (e.g. oncology, intensive care etc.) that have had dedicated solutions developed which are used extensively just within these departments.

Many of these solutions have been developed by clinicians working in individual hospitals to make their own department run more smoothly.

Challenges arise when these speciality clinical departments need to interact with other departments across the hospital which are not on the same systems, for example if A&E needed to interact with the Renal department. As such they frequently remain as standalone systems which can be used by the clinicians within that department for improved decision making, and triggered reminders. However, they do not integrate with other departments across the hospital, nor with the pharmacy system, thereby reducing their value.

3.3.3 Bespoke Developed/ Home-Grown Software

The early adopting, pioneer hospitals such as the University Hospital of Birmingham who have been working on ePrescribing for over a decade had to write their own software as there were no appropriate solutions commercially available in the UK at that time.

Cornford’s opinion in the NHS Connecting for Health “Challenges and Lessons Learned” paper (2009) is that this is not a route that hospitals should undertake these days if they wish to implement a
hospital wide ePrescribing system due to the availability of now established commercial solutions in the market.

Some hospitals are developing their own solutions but are advised against doing so predominantly due to interoperability issues with other hospital information systems, for example, Patient Administration Systems (PAS) and Summary Care Records (SCR).

Fundamentally there are now a wide variety of commercially available software packages which can be specifically tailored for each individual hospital. These packages have been developed over the past decade and as such it does not seem sensible for a hospital to start from scratch and re-invent the wheel. These systems have been developed to integrate with hospital PAS and EPR information systems. The systems have been developed such that they can be customised for each hospital and do not force one specific way of working on the hospital. This is vital as what works for one hospital may not necessarily work for another.

Therefore the recommendation of this advisory paper is that hospitals who are now considering rolling out ePrescribing should not consider developing their own software, hospitals are there to deliver the best patient care not develop software and it would be better for the hospital to consider one of the two main kinds of solutions for ePrescribing

(a) a software solution that has evolved from the pharmacy system; or

(b) an ePrescribing module from one of the hospital wide enterprise systems.

3.3.4 Pharmacy System Based Software Solutions

Although ePrescribing goes across just about every department of the hospital, one of the key stakeholders who are most affected by its introduction is the pharmacy. There are a variety of software solutions in the market which have evolved as extensions of existing pharmacy software systems which are based on a drug database and stock control functionality.

JAC and Ascribe are two such solutions which are currently available in the market. Theriak is an Icelandic software solution which was trialled in Leeds but was suspended due to Theriak going into administration (see Appendix G for the LTHT context).
3.3.5 Modules of Hospital Wide Enterprise Solutions

The final category of software solutions are ePrescribing modules that make up part of hospital wide information systems. These systems originated from the solutions which were developed to address the National Programme for IT: Integrated Care Records Service program which sought to create single electronic patient records (EPR) for NHS patients.

These vendors then evolved from the EPR solutions into other hospital information system solutions, ranging from Patient Administration Systems to specific clinical speciality modules for maternity, laboratory, radiology etc.

The main providers in this marketplace are CSC (previously iSoft), Meditech and Cerner Millennium. These businesses have been very acquisitive over the last decade, in many cases buying up businesses who offer speciality modules and integrating them into their overall solutions. LTHT currently has the CSC Patient Administration System, maternity, radiology, laboratory and theatre modules. These providers are now rolling out ePrescribing modules as part of their broader hospital wide solutions.

3.3.6 ePrescribing Software Recommendations

Figure 11 below summarises the pros and cons associated with each of the different software options:
Whichever type of solution is chosen the financial stability of the vendor must be closely investigated, the Leeds ePrescribing vendor, Theriak, went into administration which resulted in two years of work being put on hold.

Consideration must also be given to how the solution will be maintained and developed over time; will the choice tie the hospital in to that vendor or can developers be recruited to work on the system within the hospital.

The main consideration, however, is what systems the hospital already has in place. The tender document that goes to the vendors must ask them to show where and how they have integrated into these other systems before.

When preparing a tender to distribute to the various vendors it is recommended that the NHS ePrescribing functional specification is used as the starting point. This should facilitate discussion with representatives from every department and medical speciality across the hospital, and vendors should demonstrate that they can meet all of these requirements contained in it.

**Figure 11 – ePrescribing software options pros and cons**

<table>
<thead>
<tr>
<th>Software options pros &amp; cons</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical Speciality Based</strong></td>
<td>Best practise for individual speciality</td>
<td>Challenge of integrating into other hospital systems</td>
</tr>
<tr>
<td></td>
<td>Very detailed and captures all speciality specific requirements</td>
<td></td>
</tr>
<tr>
<td><strong>Bespoke Developed</strong></td>
<td>Tailored specifically for how the hospital works</td>
<td>Long time to develop</td>
</tr>
<tr>
<td></td>
<td>Buy-in from users who will have to be consulted to develop the solution</td>
<td>Tied to individuals who develop the software</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not hospital core competency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integration into the NHS national programs e.g. the Spine, SCR &amp; other systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Challenge of integrating into other hospital systems</td>
</tr>
<tr>
<td><strong>Pharmacy Based</strong></td>
<td>Integrates into pharmacy stocking system</td>
<td>Challenge of integrating into other hospital systems</td>
</tr>
<tr>
<td></td>
<td>Captures pharmacy best practise for decision support</td>
<td></td>
</tr>
<tr>
<td><strong>Module of hospital wide system</strong></td>
<td>Integrates into other hospital systems</td>
<td>Supplier power: tied to one supplier who could charge more for development or support</td>
</tr>
<tr>
<td></td>
<td>Integrated into the NHS national programs e.g. the Spine, SCR &amp; other systems</td>
<td></td>
</tr>
</tbody>
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3.4 ePrescribing Hardware Options

This section reviews the component elements of hardware required when rolling out an ePrescribing solution, highlights key considerations that must be taken into account, and summarises the pros and cons associated with each solution which can then be applied by the hospital to their own situation.

The main decision to be made is on which access devices to use.

3.4.1 Access Devices
There are a number of options available for the devices that the clinician can use to prescribe and administer medications. While there are multiple different medical specialities within a hospital mostly patient-care is delivered either (a) on an inpatient ward or (b) in an outpatient setting where patients are mostly seen in individual consulting rooms. Other environments such as A&E, ICU and operating theatres present more of a challenge in determining the appropriate type of prescribing device.

Outpatient care delivered in individual consulting rooms is probably the easiest prescribing situation to address. The clinician can use the standard desk based PC that used for all other computing and communications requirements. This is because the clinician stays at a fixed station and does not require mobile working.

On inpatient wards there are a number of different device options: standard desk based workstations at the nurses’ station, laptops, workstations-on-wheels (WOWs), mobile clinical
assistants (MCAs), tablets or PDAs. There are pros and cons associated with each option. The standard desk based workstations do not require any further capital outlay and are already located on the wards, people already have assigned logins and are familiar with the hardware. However, it would seem to be unfeasible to expect clinicians to visit a patient’s bedside and then run back up the ward to enter the relevant information into the ePrescribing system, if they have to write down the information then it negates any of the benefits of reducing the volume of paper required, has the same risks of inaccurate transcription and has none of the decision making support benefits that the ePrescribing solutions offer. As such the standard desk based workstations are not recommended for ePrescribing.

While laptops can be taken to the patient’s bedside there is the challenge of where to place them in order to bring up the patient’s chart or enter the prescribing information. There is also the challenge of how many laptops to order, where they should be stored when not in use, how to ensure the battery life lasts a full day on the ward where there will be little downtime and 24 hour-a-day care is being delivered. The issues associated with the time that a laptop takes to boot up and the physical hygiene issues associated with moving one piece of kit between multiple patients who may have infections or germs also need to be considered.

A workstation-on-wheels is a computer integrated to a trolley; this addresses the issue of where to place the laptop to use it and can also help address the battery life issues by having larger battery packs stored on the trolley.

![Figure 12 – Workstation on Wheels. Source: Mobile Health Computing](image_url)

However, there are still the challenges of how many to order, sharing one between many doctors and nurses would be impractical as only one patient could be seen at once. However, if they have
one each it would be expensive and cluttering. Where to store these extra workstations also needs
to be considered, storing them on the ward or in the corridor they will add extra clutter to already
crowded environments and they are at risk of being stolen or someone unauthorised accessing
them.

When Connecting for Health held their national ePrescribing conference in 2010 the general
consensus from hospitals who had already rolled out ePrescribing solutions was that PDA screens
were too small to be able to show the necessary information or reports to be able to properly use
the ePrescribing functionality. Many of these issues have been addressed by the developments in
mobile site design over the last three years, however there is the continuing challenge that a smart
phone screen is too small for more than one person to see what is being inputted.

While ePrescribing software will always have to be written so that it can run on PC, tablet and
mobile devices there seems to be a lot of focus on developments for tablets. Medical students in
some teaching hospitals are issued with a tablet or iPad, in the same way that they get their hospital
access pass on their first day. These tablets are integral to their learning experience and there are a
number of applications which they use for decision making and research. It seems logical therefore
that, especially as junior doctors are most frequently the ones prescribing on the wards, tablets will
become increasingly popular as the device of choice on the wards. They address the issues of
battery life and are easier to maintain hygiene levels as they do not have individual keys but can be
wiped down with antibacterial wipes. There is a lot of focus on tablet based Mobile Clinical
Assistants which are developed by specific hardware vendors specifically for the healthcare market.
They focus on the ergonomics of how the device can be held in one hand and have integrated
barcode readers, smartcard swipe access. They have a long battery life and are designed to be easily
cleaned. The only challenge is the cost.

Figure 13: A Mobile Clinical Assistant – Source Philips CliniScape Tablet PC.
The issues of the time to power up the chosen device and the number of devices required per ward need to be addressed for each hospital rolling out ePrescribing. Docking stations for charging and back-up devices in case of problems need to be considered on a ward by ward basis. Each hospital must make its own decisions about whether a clinician’s login and password is sufficient to constitute their digital signature. The hardware must be configured to ensure that the user is logged out after a suitable time to ensure that someone else does not prescribe or administer under their login.

The YouGov 2013 report from February of this year highlights the challenge raised by the fact that many users want to utilise their own device at work – Bring Your Own Device (BYOD). There is no definitive guidance on this subject from the various central NHS bodies now responsible for setting standards, this would appear to be an issue which has been overlooked in the restructuring. It is recommended that hospitals should enforce a strict policy that users can only access hospitals systems on hospital issued devices in order to protect patient data.

It is quite clear that whatever prescribing device is chosen to be used on in-patient wards, desk based workstations are not an appropriate solution; therefore hospitals must also address the issue of the wireless networks required to enable mobile devices to function.

3.4.2 Wireless Networks

Real time access to the latest patient and medication data is essential if clinicians are to accurately prescribe and administer drugs, therefore a wireless network providing constant access to the ePrescribing system is essential. The hospital’s IT department must ensure that there are no wireless dead-spots near patient beds where clinicians need to prescribe or administer medication. It is recommended that the team responsible for rolling out the wireless network should spend time on every ward to ensure that every spot allows access to the network.

Human bodies absorb radio frequencies, therefore devices for use on the wards, specifically workstations-on-wheels, need to have their aerial placed high up on the workstations frame to ensure they have the best chance of accessing the hospital wireless network.

3.4.3 Servers

The critical nature of any hospital setting means that as with any technology the ePrescribing system must be supported by multiple redundant servers to ensure minimal downtime and to enable the back-up server to kick in immediately were the primary server to go down. Updates to servers must be possible without system downtime. There also needs to be a disaster recovery plan which should include off site back up in the event of a local fire or other emergency. There must be the ability to
revert back to a paper based system with information about all prescriptions made via the ePrescribing system and the ability to generate new prescriptions should the need arise. Frequent back-ups must be made of the ePrescribing system to ensure that in the event of a system crash clinicians have access to as recent a version of possible of the medication that has been prescribed to each patient and paper charts can be printed out.

3.4.4 Bar Codes
There are some human errors that ePrescribing cannot address. Without the traditional paper charts how does a clinician ensure that they are accessing the correct patient’s data, especially if they are unresponsive. Solutions that are being trialled to address this issue include integration with patient wrist band bar codes to ensure that the correct patient’s details are accessed. The access device has an integrated reader which is used to scan the patient’s wrist band which has a barcode generated by the hospital Patient Admissions System (PAS). This links to the patient’s demographic data and Summary Care Record, highlighting existing medications and any allergies.

For the hospital considering rolling out ePrescribing it is recommended that they ensure their choice of software vendor and mobile access devices is capable of reading barcodes. The roll out of this functionality should be determined by the status of whether they are using barcodes for their Patient Admission System or not. ePrescribing is complex enough without trying to be the trigger that initiates the roll out of barcodes across all hospital systems.

3.4.5 Integration
As shown previously in figure 10 there are a large number of systems in hospitals, this diagram does not even touch on the administration systems such as HR, finance and payroll.

Whichever solution is pursued this raises the overall point of how ePrescribing is integrated with other hospital systems. A stand-alone ePrescribing system has some benefits but these are extremely limited if they do not integrate with other hospital systems.

All solutions must integrate with the NHS wide Spine which holds the patient’s EPR and Summary Care Record in order to see their medical history and any drug allergies. For the ePrescribing solution to work properly it should be integrated with the hospitals Patient Administration System (PAS) which tracks which ward the patient is on and therefore where medication should be delivered to and administered. To give a full picture of the patient’s medical situation the ePrescribing solution should also integrate with the hospital’s laboratories to show lab results so the medication prescribed can be modified accordingly. For example if a patient’s blood results showed that they
were not responding to a certain drug then the ePrescribing system needs to be linked to these results to provide the clinician with the information to change the medication.

Obviously the ePrescribing solution must be integrated with the hospital pharmacy system, as discussed in the ePrescribing software section, ePrescribing and pharmacy systems can be completely separate and therefore a link between them is essential.

Hardware Options - Recommendations

- Make decisions about sharing of hardware – does everyone get their own, are a certain number allocated to the ward, do nurses use the desk top supported by print outs still?
- Trial with end users to get buy-in
- Support and maintenance issues - what happens when one goes down?
- Consider budgetary implications

3.5 Enabling Technologies

This section on enabling technologies is to educate the reader about the supporting technologies which make ePrescribing possible. There are a number of decisions that need to be taken by each individual hospital about how their ePrescribing solution will interact with the national infrastructure.

ePrescribing systems could not fulfil their basic purposes without a number of the NPfIT programs that created the central database and networking infrastructure that fundamentally enable the electronic transfer of data around the NHS.

This section firstly reviews the database which holds all the pre-existing patient data that is utilised by the ePrescribing software solutions to provide the clinician with the right information to prescribe safely and effectively. This database must then be updated from the interactions captured in the ePrescribing system. The implications of the NHS N3 network are then examined.
3.5.1 ePrescribing Enabler: Database - The Spine

One key aspect which is critical in understanding how the overall NPfIT works is the Spine. The Spine is a national infrastructure program that is integral to delivering all the NPfIT programs. The Spine is essentially a data warehouse which supports the Summary Care Record, Choose & Book, EPS, GP2GP, Quality Management & Analysis System, Secondary Uses Service (SUS) and NHS Number services (see Glossary of Terms for description of each of these services). For more information on The Spine please see Appendix 83.

3.5.2 ePrescribing Enabler: Networking - N3

The N3 network has over 40,000 organisations connected across England and Scotland with over 1.3 million NHS end-users from GP surgeries to large teaching hospitals. There are twelve data centres connected directly to the network core which deliver National Applications and local services.

The overall objective of the N3 network is to connect all NHS organisations using broadband connectivity, or higher, to each other and to National Applications.

The National Applications are the core programs initiated by the NPfIT for example, Choose and Book, the Summary Care Record and the Electronic Prescription Service (EPS).

The N3 network also provides the connectivity for NHSmail (one email address for NHS employees regardless of which location they are working in) and supports the GP System of Choice (GPSoC) links to the Electronic Patient Record and enables them to switch to data centre based, remotely managed systems rather than having to manage their system on the premises. It is also used to transmit patient images as part of the PACS program enabling doctors to transmit X-rays or other medical images.

Voice over IP (VoIP) and video conferencing capabilities are now also provided by the N3 network.

The abolition of the NHS Connecting for Health has resulted in a number of changes; historically CfH was responsible for setting policies for security, IP addressing, Domain Name Service (DNS) and quality of service (QoS).
3.5.2.2 What does the N3 network do?

NHS Connecting for Health broke down the services provided by the N3 network into two main categories – catalogue and foundation services.

Catalogue Services

Different NHS bodies (surgeries/ hospitals etc.) can order their connections from a catalogue containing the approved range of access connections to connect them to the N3 network. Different NHS bodies are connected by different connection speeds based on the number of people on the site and the speed of access required. The GP Next Generation Access Project (NGA) has just started rolling out which will massively upgrade the connection speeds:

- ADSL broadband services are used for smaller sites (e.g. small GP Practises), historically this provided 8Mbps downstream and up to 832kbps upstream, ADSL2+ will upgrade connection speeds to 20Mbps and Fibre To The Cabinet (FTTC) will upgrade connection to 40Mbps.
- Private circuits were provided for medium sized sites providing 2Mbps both ways, under the GP NGA these are mostly being phased out and replaced with either FTTC or lower capacity Ethernet.
- Larger sites have Ethernet access which provides between 10Mbps and 100 Mbps speeds. The NGA project is now providing links of up to 1Gbps.
- Remote secure access is also provided for mobile workers or NHS employees operating from non-NHS sites.

It is likely that hospitals considering rolling out ePrescribing will already have a fast Ethernet connection. As part of an ePrescribing project the IT representative on the project team must coordinate with the person responsible for the network connection to keep them informed of any additional capacity requirements that may arise as a result of implementing ePrescribing.

Foundation Services

Foundation services are the central policies and services which were provided by Connecting for Health prior to April 1st, these cover the security policies of the network; bandwidth and quality of service policies; and managing the Communities of Interest (COINs) and gateways to other networks. CfH (now HSCIC) is also responsible for defining IP addressing policy which is implemented by BT as the service provider on a day to day basis, the same principle applies to DNS records.
3.5.2.3 Security Policies

Given the confidential and sensitive nature of the patient data that is being transmitted over N3, security has always been one of the most important, and most controversial, issues for the network.

Physical Security

As the network service provider BT is responsible for maintaining the physical security of PoPs and the COINs network within their own secure premises which have CCTV systems, limited access and appropriate levels of access control. In addition to this the cabinets where the servers and other equipment are housed have a remotely locking and unlocking solution which means they can only be unlocked by the N3 operational helpdesk who manage access rights.

Firewalls

Firewalls are used to provide a barrier and determine what packets of IP data can pass between the N3 network core and the individual, local networks that link to it (e.g. GP surgeries, individual hospitals etc.). All NHS N3 end users must have a firewall which prevents the N3 network from seeing anything else on their systems in order to control what data is passed over the network. There are additional firewalls between the N3 core network and the various gateways (internet, pharmacy systems etc.) that connect to it, the rules of which are set and managed by CfH/ HSCIC.

For smaller organisations such as GP surgeries, the firewall is within the router on their premises, there is a standard default profile which dictates what can pass through the firewall, these rules can be changed on request by the GP surgery. Larger organisations, such as hospitals, must deploy their own firewalls and set their own rules which comply with the security policies set by CfH/ HSCIC.

The IT representative on the ePrescribing project must coordinate with the person responsible for the hospitals IT security policies and work out a strategy statement for what information will pass back to the Spine.

Security of patient data

Data sent over the N3 network is not encrypted by the network; the network itself does not provide a level of security which complies with the Caldicott Guidelines. The policy set by CfH dictated that the sender and the receiver of the data are responsible for the security of the data, this has meant that security and encryption has been built into each of the National Applications that uses the N3 and not the network itself.
All the major ePrescribing vendors have built these levels of security into their solutions, which is another reason why hospitals should not consider building their own solutions as they would have to address the very contentious issue of data security.

**End user security**

With over 1.3 million NHS end users one of the key issues is ensuring that logins and access rights are carefully managed. End users have a responsibility to ensure that their hardware on their site (PCs/ routers/ servers etc.) are physically secure and that they maintain appropriate anti-virus/ spyware/ malware/ worm software on their computers. Each NHS organisation has a responsibility to create, maintain and enforce their own computing security policy ensuring that it complies with the standards set by CfH which are now developed and updated by HSCIC.

This is a key area where the project team must revisit the hospital wide IT security policy and update it to address the issues that will be created by rolling out a large number of access devices to their ward staff who may not previously have used them. Policies need to cover whether they are allowed to remove the device from the hospital, levels of password security and whether they can use the device to access anything other than hospital systems.

**Networking Implications**

- Engage with person within the hospital responsible for connection to N3 & keep them informed of plans to enable them to capacity plan.
- Wireless network test to ensure coverage across the whole hospital.
- System back up and paper based recovery plan in case of an ePrescribing system failure
- Develop a strict hospital specific security and access policy that sets out what can and cannot be accessed from hospital devices.
3.6 Project Implementation

This section goes beyond the Information Technology issues and decisions that a senior decision maker will have to be aware of and looks at project implementation issues.

ePrescribing will impact on how most people within a hospital conduct their day job, it is not just about the implementation of a technology solution and as such the project leader needs to be a change manager as well as a project manager.

3.6.1 Change Management

There are a number of different management theories about best practice when managing change. One of the most visual ways to communicate the process of change is Lewin’s Unfreeze-Change-Refreeze model, this was created in the 1940s but still holds true today:

![Figure 14 – Lewin’s Model of Change. Source: Mindtools](image)

Simply put, if you have a piece of ice that you wish to change into a different shaped piece of ice, firstly you must melt the ice to make it changeable (unfreeze), then you have to mould the ice into the shape you want (change) and finally solidify the changes into the new shape (refreeze).

The project team needs to be aware of the level of impact that ePrescribing is going to have on the day to day work practises within the hospital and manage employees’ concerns and fears accordingly. As Bocij and Chaffey highlight if impact of technology on how people do their jobs “is not recognised, and managed then resistance to change will occur and the project may fail or not deliver the expected benefits” (Bocij & Chaffey, 2006).

The change curve shown in figure 15 below highlights the emotional states that people affected by change will go through:
When one considers that ePrescribing will affect how nearly every person in the hospital does their day job it is essential that a plan to manage this change is put in place.

There are many different models for managing cultural change but Kotter’s eight stage model provides a useful set of sequential steps that fit well with the challenges and opportunities offered by ePrescribing (Kotter, 2012):

1. Create urgency
2. Form a powerful coalition
3. Create a vision for change
4. Communicate the vision
5. Remove obstacles
6. Create short term wins
7. Build on the change
8. Anchor the changes in corporate culture
1. **Create urgency**

The project leader needs to show why ePrescribing is so important and the impact that it has on patient care. Section 2.6 in this report which quantifies the problems associated with ePrescribing is a useful starting point but the project leader must then make these specific to the hospital they operate in. The must find the statistics that show the number of Adverse Drug Reactions that happened in their hospital and what the cost of resolving these issues in terms of time and money is.

2. **Form a powerful coalition**

ePrescribing will affect how nearly everyone in the hospital will do their day job; as such it is essential that a stakeholder from each group is represented on the team. Figure 16 below shows the key beneficiaries from ePrescribing and the potential benefits which can be realised. It is not enough to just get one representative from each of the benefitting groups. An in-depth understanding of the structure of the hospital should inform where there are commonalities and therefore those groups can have a single representative, e.g. renal and liver specialities have similar work processes; and where there are fundamental differences between how departments operate which need specific representation, for example, nurses within A&E and surgery.

![Stakeholder analysis chart](image)

**Figure 16 - Stakeholder analysis chart**
3. **Create a vision for change**

The vision of what ePrescribing can deliver needs to be developed, not just the generic benefits that are included in this report but it needs to be made specific for each hospital. How this vision will benefit and impact each different stakeholder group within the hospital needs to be articulated. It needs to be made clear up front that ePrescribing will change the way everyone within the hospital works and that the change should not be undertaken lightly.

It is recommended that a benefits template (Ward & Daniel, 2006) is used to structure the creation of a hospital specific benefits plan, identifying the individual who will benefit from the changes and quantifying them. ePrescribing should be seen as part of the overall strategic direction of the hospital. If a hospital is not truly committed to harnessing the benefits that technology can bring to improve patient care then the project is likely to fail.

4. **Communicate the vision**

Communicating the vision cannot be a one off email sent round and then expect that everyone understands the vision and what is trying to be achieved. It must be on going, two-way and tailored. A series of road-shows, and branding the project are recommended to create a big bang. The communications plan must be continuously reviewed and input from all hospital employees should be encouraged. Attending team meetings of all the various stakeholder groups to update them on progress and ask for feedback will ensure the project stays front of mind and that they feel that they have been consulted. This will increase user buy-in. A benefits management approach means that the benefits for each stakeholder group have been identified and the communications to each group should focus on the specific benefits that will arise for them.

5. **Remove obstacles**

There will be some tangible obstacles, such as poor wireless coverage across the hospital, processes that need to be re-worked, or the challenges of integrating with other hospital systems, which need to be identified and managed. However, it is likely that the most intransigent obstacle will be human resistance to change. A plan needs to be developed to engage the blockers and work with them to find a way to address their concerns, to get buy in.

6. **Create short term wins**

Based on the experiences of hospitals who have already rolled out ePrescribing programs it is likely that this will be at least a two year process from deciding to go ahead, building the vision and the team, evaluating suppliers, trialling, to rolling out ePrescribing hospital wide. Keeping momentum
going over such a long period of time will be very challenging and both the project team and the broader hospital need to see some quick wins and benefits arising from the project to keep them engaged. Even without the full ePrescribing solution there will be a variety of wins that can be promoted under the banner of ePrescribing. Rolling out full Wi-Fi across the hospital, getting sign off and trialling the use of mobile clinical assistants or workstations-on-wheels or more specific examples of faster discharge times on trial wards, will enable stakeholders to see the progress that is being made along the way.

7. Build on the change

Both Kotter’s eight stage process and Ward et. al.’s Benefits Management approach have the same theory: the true benefits of a project are lost because success or failure is declared too early. The project should not end once the ePrescribing system has been rolled out. A benefits management approach means that the project needs on-going monitoring and checking to ensure that it does deliver the benefits initially proposed. The ePrescribing implementation team needs to evolve into the on-going support team.

New staff will need to be trained. Existing staff will need refresher training. Bugs that appear in the system will have to be ironed out. A close eye will have to be kept on how people use the system and the work-arounds that they develop need to be evaluated. Should they be discouraged or do they represent changes that need to be incorporated into the ePrescribing system? However, the real added value that comes from this team should not just be policing and supporting the existing solution, but looking at ways that the improvements can be built on. Can the system be developed to further improve decision making support? Are there other systems, or indeed other organisations, that the system should integrate with?

8. Anchor the changes in corporate culture

ePrescribing fundamentally changes the way that people will do their day jobs, as such once the system is fully rolled out and paper charts are done away with it would not be possible for a clinician to continue with paper based prescribing. However, imposing change from above can create long term resistance with the blockers using every opportunity to undermine the change and highlight things that have gone wrong. As such it is essential to continue to promote the on-going progress and publish success figures about the impact of ePrescribing. Recruitment and training of new staff must be based on the ways of working that ePrescribing brings. The practical, tangible implications of rolling out an ePrescribing means that it will change “the ways things are done round here” and will over time become part of the organisations’ culture.
3.6.2 Project Management

Many of the considerations for project managing the roll out of ePrescribing are standard to any project: the need for senior management support, good project management, buy in from the users and getting the right team together are critical for the success of any project.

In terms of the project management methodology that should be used to roll out ePrescribing in hospitals the Agile or Waterfall methodologies are not appropriate; patient safety is the key driver and iterations that do not work will have potentially fatal implications. More structured methodologies such as Prince2 are more appropriate as they focus more on the risk elements which are crucial in a hospital environment.

3.6.3 Additional Recommendations

In addition to the considerations highlighted in the change management (section 3.6.1) the following very specific steps should be incorporated into the project plan to enable the project team to benefit from the work done centrally by Connecting for Health. The project should learn from other hospitals who have already rolled out ePrescribing.

1. Use the functional specification created by Connecting for Health as the starting point for detailed discussions with clinicians in each area of the business, build on this generic specification and tailor it for specific ways of working within the hospital.
2. Utilise this project report for updates to the software and hardware options that are available to inform choice of suppliers.
3. Use the combination of this document and hospital specific functional specification as the structure for evaluating software and hardware suppliers.
4. Conduct multiple supplier demos which should also be attended by key stakeholders identified during the process of building the project team.
5. Short list potential vendors.
6. Talk to and visit other hospitals who have rolled out the shortlisted vendor solutions.
7. Integration of the ePrescribing solution into the already existing hospital systems (PAS, imaging etc.) needs to be done prior to any trials on wards.
8. A sample database for trials must be created that operates alongside the traditional paper based process.
9. Choose a department to trial the ePrescribing solution in based on the levels of commitment by people working within that department.
3.6.4 Changeover methods:
There is no question that a trial implementation on a limited number of wards is essential to ensure the system is working and to enable the project team to provide support for the first users. The major decision that needs to be made once the trial is working well is whether to go for a gradual roll out across the hospital or a simultaneous big bang approach that would reduce the length of time that there are multiple systems running.

![Changeover options diagram](Bocij et al. 2008)

Cornford’s 2009 report found that: “Running parallel systems is inherently unsafe. Change over from paper to ePrescribing should be swift.” The process would break down whenever a patient changed ward. As such the recommended approach is a Pilot implementation followed by a simultaneous roll out across the hospital to minimise having to run paper and ePrescribing systems. This will have implications on the level of resourcing in the project team, 24:7 support is required.

3.6.5 Risk
As discussed above (section 3.6.2) in terms of project management methodology risk to patient care and health is the biggest issue associated with rolling out ePrescribing. Figure 18 shows a generic risk register which summarises the major risks associated with rolling out ePrescribing. A specific risk register should be developed for each hospital and plans made to mitigate each risk that could arise.
<table>
<thead>
<tr>
<th>Description</th>
<th>Impact</th>
<th>Current Risk Rating</th>
<th>Risk Score</th>
<th>Actions to mitigate</th>
<th>Owner</th>
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<tbody>
<tr>
<td><strong>Systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interfaces</td>
<td>If interfaces to pharmacy and PAS do not work the patient cannot be tracked</td>
<td></td>
<td></td>
<td>Interviews with clinical and informatics staff, discuss with potential suppliers, learn from other hospitals</td>
<td>Informatics/ IT</td>
</tr>
<tr>
<td>Decision support</td>
<td>Too many pop ups could mean clinicians ignore all warnings</td>
<td></td>
<td></td>
<td>Trial usability of early system with clinicians on wards</td>
<td>Pharmacy &amp; clinicians</td>
</tr>
<tr>
<td>Disaster recovery</td>
<td>Must have back up systems in event of system or server failure and ePrescribing goes down</td>
<td></td>
<td></td>
<td>Paper based system in case of failure, back ups to data every half hour for recovery</td>
<td>Informatics/ IT</td>
</tr>
<tr>
<td>Medicines set up</td>
<td>Medication doses or recommendations based on decision trees are wrong</td>
<td></td>
<td></td>
<td>Employ additional pharmacy resource to set up and long trial period</td>
<td>Pharmacy</td>
</tr>
<tr>
<td>Printing</td>
<td>Procedures for printing patient charts in case of system failure</td>
<td></td>
<td></td>
<td>Identify who will be responsible for printing in event of system failure, paper supplies</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Networking and Hardware</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wireless coverage</td>
<td>Gaps in wireless coverage will mean prescription and administration cannot happen at bedside</td>
<td></td>
<td></td>
<td>Testing schedule before ePrescribing rolled out for every ward, bed and location within hospital</td>
<td>Informatics/ IT</td>
</tr>
<tr>
<td>Server goes down</td>
<td>ePrescribing system will go down with impact on patient care</td>
<td></td>
<td></td>
<td>Redundant back up servers off site</td>
<td>Informatics/ IT</td>
</tr>
<tr>
<td>Mobile devices</td>
<td>Failure of mobile devices (battery life/ hard disk failure etc.) means prescribing cannot happen at bed side</td>
<td></td>
<td></td>
<td>Keep spare devices ready charged for loan</td>
<td>Informatics/ IT</td>
</tr>
<tr>
<td><strong>People</strong></td>
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<tr>
<td>Resistance to change</td>
<td>Nearly every role within the hospital will be affected by ePrescribing</td>
<td></td>
<td></td>
<td>Training, communication and engagement</td>
<td>Project team</td>
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<tr>
<td>IT skills</td>
<td>Many doctors are not IT literate, they are used to support staff doing all their IT/ office work for them</td>
<td></td>
<td></td>
<td>Assess needs requirement of all employees and institute appropriate levels of training programs</td>
<td>Project team &amp; IT</td>
</tr>
<tr>
<td>New employees/ locums</td>
<td>New junior doctors or transfers from other hospitals will not be trained on how to use the system</td>
<td></td>
<td></td>
<td>Induction program - all employees must complete ePrescribing system training before they are allowed to prescribe on site</td>
<td>HR/ training</td>
</tr>
<tr>
<td>Patient transfer</td>
<td>If ePrescribing is not rolled out across all wards and specialties simultaneously</td>
<td></td>
<td></td>
<td>Paper versions of the latest ePrescribing record need to be printed out &amp; resource recruited to transcribe non ePrescribing prescriptions &amp; administrations to system in short term</td>
<td>Project team</td>
</tr>
</tbody>
</table>
3.7 Conclusion

It is clear from the wide range of issues that need to be considered and the decisions that need to be made that ePrescribing is a complex, risky and wide-reaching project which should not be undertaken lightly.

ePrescribing has been trialled and used in UK hospitals for over a decade now and many of the technological issues that the early adopters faced have been addressed through the development of commercially available ePrescribing software, the increased range and affordability of access devices and the roll out of Wi-Fi across hospital estates. Despite the criticisms levelled at the National Program for IT the fundamental infrastructure and core programs such as the N3 network, the NHS Number Service, the Spine and the Summary Care Record. These initiatives are now well established and a hospital considering rolling out ePrescribing has a solid base to build on.

There is a broader point, one of the fundamental challenges is the level of comfort that clinicians have with using electronic systems. The earliest ePrescribing projects were over a decade ago and since then everyone in every walk of life has become more comfortable with electronic systems; whether it’s using Amazon to buy books, Google to look up the latest developments in medical technology or quite simply using email to communicate; every aspect of day to day life has gone electronic. Hospital Doctors are among the slower adopters of these types of technology as their jobs are not desk and computer based and they are used to having support staff for many administrative functions, however, the latest generations of junior doctors and nurses (who in many instances are the ones who are most closely involved in prescribing) have grown up with technology and are not so intimidated by it. Using digital technology in their daily lives will have increased medical staff’s willingness to adopt new technologies. However, as emphasised above human resistance to change must not be underestimated and a change management, as well as a project management approach, must be adopted if the project is to be successful.
4. Evaluation

The prime beneficiary of the advisory paper created by this project would be a senior decision maker within an NHS hospital who was considering rolling out ePrescribing. The ideal purpose for the advisory paper would be for it to be published on a central NHS website, providing a single, up to date resource to educate the audience about the issues that need to be considered when rolling out ePrescribing.

The perfect scenario would have been to ask a senior decision maker at an NHS hospital which had already rolled out ePrescribing to evaluate whether the advisory paper created by this project covered all of the necessary issues that they encountered throughout their own experiences of implementing an ePrescribing solution. However, it was not possible to identify anyone who fitted into these criteria to whom access could be gained. In general there was a poor response rate throughout the course of the project when it came to requests for meetings, interviews and introductions to relevant contacts. People working within the healthcare system are busy people and therefore speaking to an undergraduate Information Technology student comes fairly low down their priority list. As such it was therefore necessary to make use of personal contacts who currently work as clinicians within the NHS. These clinicians were asked to role-play the role of a senior decision maker within a hospital, acting as if they were the person whose responsibility it was to roll out ePrescribing. Although not a perfect scenario, this was seen as the best available solution when it came to evaluating the project’s deliverable. It could be guaranteed that these contacts would agree to take part in the evaluation process and it made it possible to schedule when the necessary interviews could take place.

The evaluation stage of the project involved sending the advisory paper to two clinicians currently working within the NHS. This was done via email and was followed by semi-structured telephone interviews whereby the interviewees were asked a series of pre-defined questions but were also encouraged to think aloud and discuss any other issues that they thought were relevant. A speakerphone was used and notes were taken on their responses.

The clinicians were given the option of remaining anonymous if they desired, as per the School of Computing’s ethical guidelines, and both clinicians took this option. This was mainly due to concerns that they were not experts in the field in question. They did agree however that their personal details could be released to the project assessors if necessary and requested.
The objective of the evaluation was to understand whether the advisory paper was appropriately pitched and gave them a good overview of ePrescribing.

The criteria for evaluating the advisory paper were in the form of the questions asked during the telephone interviews:

1. Does the advisory paper read well in terms of flow and clarity?
2. Does the advisory paper use simple non-technical jargon to explain technical concepts?
3. Do you feel you know what software options are available?
4. Do you feel you understand the decisions you need to make about hardware?
5. Do you feel you know where to look if you needed to find out more details concerning a particular topic relating to ePrescribing?
6. Do you have any further comments on possible ways of improving the advisory paper?

The clinicians were emailed the advisory paper a few days before the scheduled interview to allow sufficient time for them to read and digest the paper. The interviews were scheduled three days apart. This gap meant that there was time to respond to issues raised by the first interviewee, a doctor working in a teaching hospital in the East Midlands, and tailor the structure of the subsequent interview accordingly. In addition to her responses to the specific questions the doctor highlighted that as a busy practising clinician she would be unlikely to read a 30 page report and on her advice a PowerPoint presentation was created that summarised the main points of the advisory paper. This PowerPoint presentation was then sent to the second interviewee, in addition to the advisory paper.

The first interviewee thought the advisory paper was simple and well written and she was able to understand the technical concepts. However, she raised the point that she was not actually aware of a number of the NHS acronyms and abbreviations, the advisory report was revised all abbreviations for both NHS and IT acronyms were changed to the use full term to ease the process of reading. She understood the software options and was able to put them into the context of her own hospital. She was very interested in the hardware options as she was unaware of the Mobile Clinical Assistant access devices and was keen to find out more about costs. She was surprised that there were no resources for ePrescribing being maintained by the NHS now that the Connecting for Health website is no longer maintained. For details of responses to each question see Appendix N.

In response to this feedback the recommendation summaries at the end of each section in the advisory paper, which provide a synopsis of all the points covered in that section, were added. A set
of PowerPoint slides which summarised all the information contained in the advisory paper were also created (see Appendix O).

The second interviewee is currently a GP working in a GP Surgery but who completed her training in an NHS hospital and who has many interactions with the local hospitals as she refers patients for acute care.

The second interviewee immediately said that she found the PowerPoint presentation really useful as she was feeling overwhelmed about the prospect of reading a long document. She found it easier to read the advisory paper once she had scanned the summary contained in the presentation as it gave a quick summary of what the advisory paper covered.

She also felt that the paper was well written and structured but the interviewee did at times get confused with the Electronic Prescription Service. This is a function of the fact that as a GP this is the Electronic Prescribing solution used on a daily basis. She felt that although she was unfamiliar with the systems being used in hospitals the different types of software solutions and the things to consider made logical sense. Again she was more excited by the hardware options as she was not familiar with the Mobile Clinical Assistant access device and was keen to see one in action.

In summary the advisory paper did fulfil its evaluation criteria of being simple and easy to read for a non-technical clinician operating in the NHS with the only draw back being that the initial format was a little long for a busy doctor to read. The PowerPoint presentation was very well received.

4.2 Meeting the Minimum Requirements

Part of the success criteria of this project is whether I have met the minimum requirements as set out in section 1.3.

The report which is aimed at senior decision makers within hospitals considering rolling out ePrescribing comprises the whole of section 3.

- **Examination and explanation of the benefits and risks associated with ePrescribing:** this explanation is contained in section 2 where I examine the background to the issue of ePrescribing. I then go beyond this in section 3.2 where I provide templates for the senior decision maker rolling out ePrescribing to modify a generic NHS wide benefits template and risk register for their own hospital.
• **Evaluation of the available ePrescribing software options**: section 3.3 examines the types of ePrescribing software solutions that are available in the market, having identified the fragmented nature of the market with over 20 vendors (see figure 9) currently providing solutions the decision was taken not to analyse each of the individual vendors. Instead I summary of pros and cons of each type of solution that the reader must apply to their own context. My fundamental recommendation is that the decision about which vendor to choose needs to be made based on the interoperability of the ePrescribing solution with the other systems that the hospital is already using.

• **Evaluation of the available ePrescribing hardware options**: I have highlighted all the hardware implications that the decision maker needs to be aware of when rolling out ePrescribing in section 3.4. I focus heavily on the choice of access device as one of the crucial decisions that needs to be made.

• **Examination of network issues relating to ePrescribing**: ePrescribing must link to the single Electronic Patient Record held on the Spine, as such I have examined the implications of connecting ePrescribing to the national N3 network and identified the decisions that the reader must make in relation to security policies and usage for their own hospital.

In all of these areas I make recommendations to the senior decision maker about the factors specific to their hospital that they need to consider in order to make the right decision for their specific hospital.

### 4.3 Exceeding the Minimum Requirements

Due to the fact that the client and title of my project changed and evolved during the course of running the project I exceeded the minimum requirements by examining the broader context of Electronic Prescribing and looking at the Electronic Prescription Service (EPS) that is used in GP surgeries and analysed the reasons behind the different levels of adoption compared to ePrescribing in hospitals. While this section is not included in the main body of the report it was extremely useful particularly to understand the N3 network and how the Electronic Patient Record follows a patient across all their engagements with the NHS.

I have also exceeded the minimum requirements with the creation of the PowerPoint presentation for senior decision makers based on the feedback that I received from clinicians during the first
phase of my evaluation which is contained in Appendix O. The creation of the recommendations summary at the end of each section of the report for senior decision makers also summarises and simplifies the recommendations into a simple checklist for ease of reference.

The report expands beyond the technology side of the issues and challenges associated with rolling out ePrescribing by creating a section on change management recommendations for the reader of the report based on techniques learned in COMP3441 Business Issues in Computing.

There is a brief section on recommendations advice to government about what central resources would be beneficial in Appendix J.

4.4 Comparison with Existing Solutions

The only comparable solution to my report is the Cornford Challenges and Lessons Learned report which was written in January 2009 and published in 2010. The Challenges and Lessons Learned report was an extremely useful one stop resource both for me as a starting point for my research but also for senior decision makers within the NHS considering rolling out ePrescribing. However, as discussed in sections 2.2 and 2.3, the restructuring of the NHS means that this central body to share best practise and promote ePrescribing no longer exists.

My report expands on the Connecting for Health report by focusing more on the technological issues to be considered in much more depth and updates all aspects of ePrescribing in the light of the developments over the last three years and as a result of the restructuring of the NHS.

4.5 Future Work

I believe that my work could be extended into an objective comparison of the ePrescribing software vendors in the market. A company such as EHI could look to produce this piece of work as part of their service to NHS users.
Appendices:

Appendix A – Personal Reflection

I feel that the project has been beneficial in that it has given me the opportunity to put into practise many of the concepts and theories I learnt throughout the Information Technology degree course. Concepts, especially those learnt in the Business Issues in Computing module (COMP4331), were used to analyse a real world business problem and this provided me with extremely valuable experience. I was also able to put into practise my research skills and develop my abilities to conduct interviews and observations to validate or challenge my theoretical understanding of an issue. This project was not just a purely technical issue and gave me a real insight into the need to understand the broader context in order to make technical recommendations.

As can be seen from the project schedule section of my report the aim, client and scope evolved over the course of the project as new information came to light. This has been the area of greatest challenge for me. I was able to continue background reading and research while trying to narrow the scope of the project but the lack of a client commissioning a deliverable and seeking to get something out of the project meant that at times I felt that my research was undirected.

Any mistakes and setbacks along the way taught me valuable lessons as to what to watch out for and how to mitigate against these issues when running future projects. In the section below I have detailed the lessons that I feel I have learned in the form of advice that I would give to future students undertaking a final year project, especially one of this nature. My advice to future students is broken down into sections on choosing the project, defining the aim of the project, scheduling the project, conducting the project and writing up the project.

Lessons learned and advice for future students

Choosing the project

• Ensure the client is fully committed before choosing a particular project and get an idea of what they want to get out of the project and why.
• Be wary of projects that involve external dependencies or clients, if they are not fully committed it will make the project very difficult to schedule and implement.
• Do not pick too broad a topic and do not pick a project involving an area that you know absolutely nothing about (in my case the NHS). I had to conduct a huge amount of research just to try to understand the NHS terminology and this greatly slowed progress. Even though I did not have to understand the clinical specialities in intricate detail a certain level of knowledge was necessary in order to gain a proper understanding of the prescribing process.

• If considering doing a project involving the NHS be aware that it is an extremely complex organisation, very prone to change (political interference, medical and technological breakthroughs). NHS clinicians have critical jobs saving patients’ lives, they may not be able to spare the time to get back to you.

Defining the aim

• It is essential to narrow down the scope to something achievable. Because my project client and aim evolved over time a lot of the background reading, research and interviews were useful to build a broader picture but it has meant that whole areas of research have gone into the appendices. Also because there was not a specific client it meant that my report had to be a generic solution for the NHS which had the unsurprising consequence that it was very broad reaching in scope rather than focusing in on one topic.

• Raise any issues early with your project supervisors, they can’t help you with any issues they’re not aware of. Don’t wait for the weekly meeting if the problem you encounter will slow or stop your progress.

• While having two supervisors was good from the perspective that I got insight and advice from two different perspectives it did present challenges in refining what the aim of the project was and agreeing the evaluation criteria.

• Identify the risks before embarking on the project and come up with contingency plans, potentially in the form of a risk register.

Scheduling the project

• Try to create as accurate a schedule as possible at the beginning of the project, identify what aspects can run in parallel, identify the critical path i.e. which milestones or events will halt project progress if not completed.

• Build in some slack to the project schedule. Things always take longer than you expect they will, especially applying the last minute finishing touches.
Conducting the project

- Study the mark scheme in depth before picking your project to ensure that you can match your project to it and fulfil all of the necessary criteria.
- At the beginning of the project look at past projects of a similar nature (that have got high marks) to get a rough idea of how to structure your own project.
- If conducting interviews research the person and topic in depth beforehand and be as prepared as possible to adapt to unexpected events or revelations. This was a challenge for me as I turned up to my interview with Dr Tattersall having been told that he was the client whereas he was not aware of what my project was about and couldn’t see what was in it for him.
- Ask to record the interviews as you will not remember what was said subsequently and if you have to focus on taking notes the whole time you will may miss key points.

Writing up the project

- Make a template of the empty headings and drop your work into the relevant section as you go. This also gives you a good idea of which areas are sparse or lacking and therefore require more focus. I struggled with this as it is the first year that the Information Technology course has run so there were no relevant past projects to draw inspiration from.
- Aim to have the project fully complete a week or so before the final deadline, finishing touches like formatting diagrams and inputting references take a lot longer than you would think.
- Create your bibliography and referencing as you go along, if you have a topic with a lot of background reading it will be very difficult to remember all your sources if you leave it to the end.
Appendix B – Materials Used

There were no third party materials used during the creation of my project.
Appendix C – Ethics

This project is covered by the block ethical approval attained by the Faculty Research Ethics Committee for NHS projects.

I informed everyone that I interviewed that their participation was voluntary.

At the start of each interview the subject was asked whether they would be willing to be named in the write up of this project, some were prepared to be named and others were not.

No sensitive information was viewed during this project, during my interview with Dr Tattersall no note was taken of any personal data.

There were no other ethical issues associated with the delivery of the project.
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<thead>
<tr>
<th>Revised project timeline</th>
<th>Week commencing</th>
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</thead>
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Appendix E – Original Project Title & Specification

Published Project Brief

Title of project: A requirements spec for e-prescribing
Code of project: OJ04
Client: Dr Tony Shannon or James Tattersall, Leeds Teaching Hospital Trust (LTHT)
Probable Supervisor: Any
Area of interest (e.g. Computer Vision): IT Requirement
Appropriate for degree programmes (e.g. CS, CT, AI, IT, CTfBu, CSwMa): IT, CTfBu
Prerequisites (e.g. C++ programming): Business Issues in Computing; Requirements and Evaluation
Multiple projects can be considered YES/NO: No

Further information:
Leeds Hospital Trust (LTHT) do not yet have a modern e-prescribing system within the hospital. In common with many other hospitals in the UK, patients can find that they have to wait several hours before they can be prescribed and given the medications they need in order to be discharged. Prescribing and dispensing the right medications must be done safely and accurately but the current procedures are often paper based or rely on the manual transcription of information from one system to another. LTHT have a range of options for building or buying an e-prescribing system and the decision is complicated by the poor quality of many of the commercially available solutions and the need to integrate to existing systems and the new patient portal system (PPMP). Building an open source e-prescribing module that extends PPMP is a potentially viable option. This project will allow a student to follow through the full sequence of IT system development life cycle from Inception to Requirements Specification. It will involve interviews and meetings with real users in a variety of clinical settings and the capture of detailed requirements. A successful project will inform procurement or build of a new hospital-wide solution. The key output will be a business case and output based requirements specification. The student will be given support throughout the process and will develop their ability to work as a business analyst.

Skills to be developed: process modelling, project life cycle, requirements, business analysis, consultancy.

Published November 2012
**Aim and Minimum Requirements Form**

<table>
<thead>
<tr>
<th><strong>Title</strong></th>
<th>A new e-prescribing system for LTHT. Build or buy?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Company</strong></td>
<td>Leeds Hospital Trust (LTHT)</td>
</tr>
<tr>
<td><strong>Aim</strong></td>
<td>To provide LTHT with a business case and detailed requirements specification which will inform procurement or build of a new hospital-wide e-prescribing system.</td>
</tr>
<tr>
<td><strong>Requirement 1</strong></td>
<td>Design and create a requirements specification for a new e-prescribing system at LTHT.</td>
</tr>
<tr>
<td><strong>Requirement 2</strong></td>
<td>Create a business case based on my conclusion as to whether LTHT should build or buy a new e-prescribing system.</td>
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<tr>
<td><strong>Requirement 3</strong></td>
<td>Evaluate the strengths and weaknesses of currently available e-prescribing solutions.</td>
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<td><strong>Computer Requirement 1</strong></td>
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<tr>
<td><strong>Computer Requirement 2</strong></td>
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</table>

Submitted Friday 25th January 2013
Appendix F – The Electronic Prescription Service (EPS)

What is EPS
The Electronic Prescription Service essentially enables prescriptions to be sent and stored electronically from a GP’s surgery and retrieved by any EPS compliant pharmacy for fulfilment. It and also handles the link with the NHS Prescription Services department so the pharmacy can be paid.

Why is it important
An examination by Shah et al in 2001 of over 37,000 prescriptions issued by GPs identified an error rate of 7.5%.

<table>
<thead>
<tr>
<th>Type of error</th>
<th>Number of errors</th>
<th>Error rate per 100 prescriptions</th>
<th>% of total errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Directions not mentioned at all</td>
<td>715</td>
<td>1.89</td>
<td>25</td>
</tr>
<tr>
<td>2. Prescribed item was not requested (usually an item on a repeat prescription)</td>
<td>510</td>
<td>1.35</td>
<td>18</td>
</tr>
<tr>
<td>3. Directions incomplete, not legible, or written “as directed”</td>
<td>321</td>
<td>0.85</td>
<td>11</td>
</tr>
<tr>
<td>4. More than one month’s supply given on separate repeat prescriptions without the patient’s request</td>
<td>306</td>
<td>0.81</td>
<td>11</td>
</tr>
<tr>
<td>5. Strength missing where a product existed in various strengths, and no guidance was available in the BNF</td>
<td>260</td>
<td>0.69</td>
<td>9</td>
</tr>
<tr>
<td>6. The prescribed quantity was not clearly written, missing or too large</td>
<td>229</td>
<td>0.61</td>
<td>8</td>
</tr>
<tr>
<td>7. Prescriber’s signature missing</td>
<td>132</td>
<td>0.35</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 19 - Prescribing Errors Listed in Rank Order Source: Shah et al (2001)

Electronic Prescription Service (EPS) Process
EPS has three major actors: the “Prescriber” (GP or Practise Nurse), the “Patient” and the “Dispenser”. To use EPS the Prescriber must have enabled their clinical system to handle EPS and the Dispenser must have implemented EPS on their pharmacy system.

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The following chart shows the EPS process and how it impacts prescribers, patients, dispensers and the reimbursement of prescriptions:

Figure 20 – the Electronic Prescription Process

The Prescriber (GP or practice nurse) logs onto their GP Clinical System using their Smartcard and password, selects the medication for the patient, and then authorises the electronic prescription. The prescription details are then transmitted to the Electronic Prescription Service which sits on the NHS Spine. The patient is issued with a “token”, a physical piece of paper containing details of the prescription, the prescriber’s signature and a unique barcode, that they can take into any EPS compliant pharmacy where it can be scanned by way of a barcode scanner. If a pharmacy is not EPS compliant and as such does not have barcode scanning capabilities the pharmacy can still process the prescription using the information supplied on the token and the doctor’s signature as authorisation.

In the case of repeat prescriptions the patient can nominate a pharmacy at which they wish to regularly collect their prescription, this nomination is done at the pharmacy in question not the GP’s office.
The EPS system will provide management information about the status of each prescription: dispensed, not dispensed, owing or partial. Once the prescription is fully dispensed at the chosen pharmacy the pharmacist will send a notification via their system to the EPS and once this is done the pharmacy can submit a claim for reimbursement from the NHS Prescription Services agency.

Background and recent changes
Like ePrescribing the EPS project came about as part of the NHS National Project for IT which was established in 2002 to review and prioritise requirements for national NHS IT programs, both programs came under the direction of NHS Connecting for Health (which replaced the former NHS Information Authority in 2004) and now falls under the remit of the HSCIC.

EPS has been rolled out in two phases: Release 1 began in March 2005 and was really to test the network infrastructure and EPS system, the paper prescription was still the legal document and the electronic message to the pharmacy with a 1D barcode was just to test the process. Release 2 began in 2009 whereby the electronic prescription acts as the legal document when the patient has signed up for the service. Release 2 also enabled the patient to choose which pharmacy to have their prescriptions sent to and enabled the prescriber to send repeat prescriptions and to cancel prescriptions electronically. Release 2 enabled the pharmacy to submit electronic reimbursement claims to the NHS Prescription Service for payment.

The NHS structural changes that came into effect on 1st April 2013 now mean that Primary Care Trusts no longer have to be authorized by the Secretary of State to allow their GPs to issue electronic NHS prescriptions. Now GP surgeries can decide for themselves when to implement EPS; as long as their clinical system has been approved by HSCIC they coordinate with their EPS provider to give HSCIC eight weeks notice that they intend to connect to the Spine. The following GP Clinical Systems have been approved:

- iSoft Synergy
- Microtest Evolution 11
- TPP SystmOne
- InPS vision

Advanced Health and Care is the only major provider who has no plans to integrate with EPS Release 2 as of the latest update by Connecting for Health in May 2012.
The other changes to EPS as a result of the NHS restructuring mean that while the HSCIC is now responsible for authorising GP Practises to connect to the Spine, GP Practices will deal with their local/ regional team in NHS England for the issuance of Smartcards (the individual access card each NHS employee has to logon to the GP Clinical System) and getting EPS “tokens” (the paper documents that are used to print prescriptions on with the barcodes to be scanned by the pharmacy). NHS England handles the central budget and authorises the one off payments to pharmacies to incentivise them roll out EPS and also handles any complaints from GP Practices or pharmacies about the use of the service. Some aspects that were previously handled by Primary Care Trusts or referred to the Connecting for Health body for resolution now do not have a definitive owner: for example PCTs previously brought together GPs and pharmacists to discuss changes and help facilitate the deployment of EPS, as of April 1st 2013 this role no longer formally exists.

A pharmacy can roll out EPS whenever they want as long as their pharmacy system has been approved by HSCIC, the chart below shows which pharmacy systems, listed along the left hand side, and their progress against the various integration and approval stages set by the HSCIC:

![Figure 21 – Status of GP Clinical Systems March 2013 Source: Connecting for Health](image)

The main support for pharmacies comes from the system suppliers themselves who will help them understand the costs, conduct training and actually roll out the software. However, in addition to this the pharmacy must ensure that they are connected to the N3 network, some systems suppliers will do this for the pharmacy as part of an overall roll out package but the larger chains of
pharmacies such as Boots or Lloyds Pharmacy have had to ensure themselves that their entire network is connected. Pharmacies must deal with their regional/ local Registration Authority department within NHS England to get the Smartcards which have to be used to logon to the EPS system. This is quite a detailed process as each person applying for a card must provide at least three forms of ID and have a face to face meeting with the Registration Authority. Their details must then be confirmed and authorised by a sponsor and the level of access appropriate to their role is assigned. These details are all held on the NHS Care Records Service User Directory.

It is then down to the individual pharmacy to communicate the existence and possibilities of EPS to their customers and provide a means for the patient to nominate that pharmacy as the one they want their prescriptions to be sent to. It is also left to individual pharmacies to establish good ways of working with the relevant GP Practices.

**EPS Systems**

GP Practices considering implementing EPS are in a very different position than hospitals considering ePrescribing solutions. For a GP Practise the only major decision they have make is the choice of GP Clinical System.

There is an NHS program, GP Systems of Choice (GPSoC) whereby the NHS funds the GP clinical system. The GP Practice can choose from an approved list of established suppliers who are accredited by the NHS.

A GP Clinical System is the system all the GPs and practice nurses (and indeed reception and support staff) work on a day-to-day basis. The system links to the Electronic Patient Record and Summary Care record held on The Spine via the N3 network. The GP Clinical System also allows the GP to capture all interactions with the patient including more personal, detailed notes about the patient and their conditions which are held locally on their system, it also has scheduling facilities for booking out rooms and GP’s time which are managed by the administrative staff.

It is the GP Clinical System which integrates with the EPS system held on The Spine, it is the responsibility of the GP Clinical System vendor to integrate with the centrally held EPS and in practise the GP Surgery does not have to do anything other than request that the HSCIC that their connection to the central EPS is approved.

All the GP Clinical Systems and pharmacy systems utilise the same dm+d drugs database which ensures that each GP’s prescription means exactly the same drug is prescribed. The Spine holds all
the patient’s demographic and contact data, as well as the history of what medication they have previously been prescribed. The patient nominates which pharmacy they wish to be able to collect their prescription from and a database of all these pharmacies is held on the EPS. As such the EPS is essentially a simple communications channel which sends the prescription written by the GP to the relevant pharmacy where it can be dispensed.

**EPS Software**

**Market share of software vendors**

There are only a small number of approved vendors providing GP Clinical Systems in the UK: CSC Computer Sciences Limited, Egton Management Information Systems (EMIS), Advanced Health and Care, InPractice, iSoft and Microtest. There are no third party, independent market statistics showing exactly who provides what share of the 8,230 GP Practices across the UK so the only information comes from the vendors themselves, as they are accredited by CfH who will provide quotes for their press releases these figures should be reasonably accurate. However, it is a constantly changing picture as GP Practices consolidate or switch between suppliers.

Egton Medical Information Systems (EMIS) provides their GP Clinical Systems to over 50% of GP Practises across the UK, roughly 4,320 GP Practices. Their systems were originally developed by two practising GPs and as such have a very high level of acceptance from their users. The SystmOne solution was developed by CSC Computer Sciences but is sold, configured and supported by a reseller called TPP. According to the TPP website they now provide SystmOne to over 2,000 GP Practices.

InPractice have third position in the market and although they do not publish the number of practices they support it is clear that even just the top two providers cover over 75% of the market.

**EPS Hardware**

There are no hardware specific implications for GP Surgeries implementing EPS, the doctors already have desktop workstations to utilise their GP clinical systems and the N3 network access also has to be in place for access to the EPR and SCR on the Spine.
Current Status of EPS

Release 1 has now been rolled out to over 90% of UK GP surgeries and pharmacies. The HSCIC in their new role reporting on NHS data have given the latest statistics for Release 2:

- **672** GP practices live
- **9,319** Dispensing contractors live
- **4,116,121** Release 2 prescriptions sent
- **9,572,231** Items dispensed and claimed
- **1,571,747** Nominations set

Difference between EPS & ePrescribing:
ePrescribing is not just about electronic transmission of prescriptions as is the case with the EPS
system used by GP surgeries and community pharmacies. ePrescribing is a complex systems that
links ordering, prescribing, dispensing, patient health data and decision making tools to prescribers.
It is a far more complex system and the current low levels of adoption by UK hospitals is reflected
upon in Cornford’s 2009 report “Electronic Prescribing in Hospitals: Challenges and Lessons Learned”

“The limited uptake of ePrescribing by secondary care in the UK is in direct contrast to the
situation in primary care where ePrescribing is now the norm and the electronic
transmission of prescriptions from general practitioners to high street pharmacies is being
implemented through the Electronic Prescription Service (EPS).”

My analysis/ critical evaluation/ lessons learned

Recommendations for GP Practice owners

According to the HSCIC at the time of writing this report more than 90% of GP Practices and
pharmacies across the UK have the functionality for EPS version 1, the additional functionality of EPS
2 has been rolled out to more than 10% of GP Practices across the UK and the process is now very
streamlined.

The NHS provides funding for GP Practices to upgrade to EPS2 so financial constraints should not
influence the decision of whether to upgrade or not. Ultimately, as with all new services and
innovations, user demand, in this case patient demand, will drive the adoption of EPS2 across
remaining GP Practices, as patients become more aware of the service they will request it from their
GP.

Therefore my recommendation to GP Practice owners would be to work out a roll out plan for
training for their GPs and practice staff in conjunction with their clinical system vendor.

GP Practice owners need to do this themselves is as a result of the abolition of Connecting for
Health. Previously NHS CfH in conjunction with the PCT would organise regional road-shows where
GP Practice owners and their local pharmacies were brought together to keep each other up to
speed with their EPS roll out plans and ensure collaborative working. Under the new NHS structure
this responsibility has not been picked up and therefore it is down to the individual GP Practices and
pharmacies to engage directly.
Risk Register

Below is a risk register showing the generic risks for a GP Surgery rolling out EPS; it is not feasible do the risk rating likelihood and impact as these will vary for each specific instance.

<table>
<thead>
<tr>
<th>Description</th>
<th>Impact</th>
<th>Current Risk Rating</th>
<th>Risk Score</th>
<th>Actions to mitigate</th>
<th>Owner</th>
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<tr>
<td><strong>Systems</strong></td>
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<tr>
<td>Smartcards</td>
<td>If GP does not have smartcard they cannot log on to the system to prescribe</td>
<td></td>
<td></td>
<td>Spare smartcard login with process for tracking who is using it when at each surgery</td>
<td>Practice owner</td>
</tr>
<tr>
<td>Interfaces</td>
<td>If interfaces to GP clinical system do not work the prescription cannot be sent via EPS</td>
<td></td>
<td></td>
<td>Approval and testing process for each GP clinical system; only those approved can integrate</td>
<td>IT team</td>
</tr>
<tr>
<td>Decision support</td>
<td>Too many pop-ups could mean doctors ignore all warnings</td>
<td></td>
<td></td>
<td>Trial usability of early system with GPs</td>
<td>GP clinical system supplier</td>
</tr>
<tr>
<td>Disaster recovery</td>
<td>Must have back up systems in event of system or server failure</td>
<td></td>
<td></td>
<td>Paper based system in case of failure, back ups to data every half hour for recovery</td>
<td>IT team</td>
</tr>
<tr>
<td>Printing</td>
<td>Procedures for printing patient charts on paper in case of system failure</td>
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<td>Identify who will be responsible for printing in event of system failure, paper supplies and printers</td>
<td>Reception staff</td>
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<td><strong>Networking and Hardware</strong></td>
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<tr>
<td>Connection to the Spine &amp; EPS</td>
<td>N3 connection going down will mean link to EPR and SCR will not exist</td>
<td></td>
<td></td>
<td>Paper based back up system</td>
<td>IT team</td>
</tr>
<tr>
<td>Server goes down</td>
<td>GP clinical system will go down with impact on patient care</td>
<td></td>
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<td>Redundant back up servers off site</td>
<td>IT team</td>
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<tr>
<td><strong>People</strong></td>
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<tr>
<td>Resistance to change</td>
<td>New way of doing things - some doctors will want to stick to old familiar systems</td>
<td></td>
<td></td>
<td>Training, communication and engagement. Patient demand will drive change</td>
<td>Practice owner</td>
</tr>
<tr>
<td>IT skills</td>
<td>Many doctors are not IT literate, they are used to support staff doing all their IT/office work for them</td>
<td></td>
<td></td>
<td>Assess needs requirement of all employees and institute appropriate levels of training programs</td>
<td>Practice owner &amp; IT</td>
</tr>
<tr>
<td>New employees/locums</td>
<td>Locums will not be trained on how to use the system</td>
<td></td>
<td></td>
<td>Induction program - all employees must complete system training before they are allowed to prescribe</td>
<td>HR/ training</td>
</tr>
</tbody>
</table>

**Figure 23 – sample EPS Risk Register, authors own**
Appendix G - Understanding the LTHT context

Organisation structure:

As with all large complex organisations (of which the NHS is pretty much the biggest and the most complex – it is the fifth largest employer in the world) communication across LTHT departments is challenging and individuals within the Trust are not aware of all other projects that exist across the organisation. Based on published information the organisation chart in figure 24 reflects the top-line departmental structure of LTHT:

Based on information published in 2010 LTHT has:

- 5 hospital sites
- 114 wards
- Approximately 2,500 beds
- 14,000 staff
- A medicines budget of approximately £80m p.a.
- 9 dispensaries
- Nearly 500 pharmacy staff
**Systems in use:**

Much of this section which covers what is currently happening in LTHT has come from online, third party published information such as press releases from vendors who want to publicise clients they are working with or news stories about progress on trials.

- CSC (previously iSoft) provide Leeds with their Patient Administration System (Support Services: Patient Admission department) as well as the systems to run their maternity (Women’s, Children’s, Head, Neck & Dental Department), radiology (Diagnostics & Therapeutics Department), laboratory (Diagnostics & Therapeutics Department) and theatre departments (Specialist Surgery and Oncology & Specialist Surgery Departments).
- Oncology (Oncology & Surgery Department) use a very specialist ePrescribing module called ChemoCare which is provided by CIS Healthcare.
- A business case prepared 3 years ago asking the Leeds board to roll out ePrescribing resulted in the project team getting approval to trial Theriak in two departments.
- CIS Healthcare were responsible for the trial to anglicise the Icelandic ePrescribing module Theriak. The developments to tailor Theriak had been underway for two years when Theriak went bankrupt leading to the suspension of the trial as the product is now unsupported. CIS Healthcare said in March 2012 that they were considering purchasing the software from the administrators and trying to continue the trial but this has not come to fruition at this point.
- The previous ePrescribing trials (Theriak) came under the Medicines Management & Pharmacy Services department which is part of Diagnostics and Therapeutics.

The organisation chart highlights how wide reaching the ePrescribing project is. Every department listed at this level and below will be affected by the project, whether it is because they will have to use ePrescribing in the course of their day to day work or whether it is because ePrescribing will need to interact with other systems in use.

The systems in use summary above highlights just how complex the existing systems are and this is not a complete picture. There is also the risk that the concept of ePrescribing has been tarnished by the failure of the Theriak trial.
Appendix H - Who built the NHS Systems?

Due to the size, scale and scope of the NPfIT the decision was made to split the work into national and local programs and tender them separately. The country was divided into five geographic local regions known as clusters and work was tendered to be delivered by Local Service Partners (LSPs): Southern (Fujitsu), London (BT Health London), East & East Midlands (Accenture), North West & West Midlands (CSC Alliance), and North East (Accenture). Accenture pulled out of the project in 2007 transferring the majority of their responsibilities to CSC Alliance and Fujitsu were terminated in 2008 and the Southern program was transferred to BT Health London.

The national infrastructure programs were for projects that apply to all users. BT had responsibility for the N3 network and the NHS Care Record Service; Atos Origin and Cerner delivered the Choose and Book service and Cable & Wireless delivered the NHS Mail project.

There have been massive, very public criticisms of the way these projects were delivered and the NPfIT was ultimately disbanded in 2011 - the then Health Secretary, Andrew Lansley stated "Labour’s IT programme let down the NHS and wasted taxpayers' money by imposing a top-down IT system on the local NHS, which didn't fit their needs.” In line with the overall theme of the strategic reorganisation of the NHS responsibility has been devolved to a local level and it up to local trusts to ensure that the systems they create interoperate with the national standards and programs already implemented.
Appendix I - Paper Charts Versus Electronic Charts

Kardex/ Paper Chart

![Sample Kardex Chart](image)

Figure 25 – Sample Kardex - Source: Collins et.al. 2012

Electronic Chart

![Sample ePrescribing Patient Chart](image)

Figure 26 – Sample ePrescribing patient chart. Source: Connecting for Health.
Appendix J – Recommendations to government

The devolution of decision making responsibility to GP Commissioning Groups or individual hospitals achieves the government’s aim of empowering the people who are delivering patient care to invest in the systems that they feel will address their requirements.

The National Program for IT did deliver the building blocks on which future developments can be built and it is appropriate that centrally devised solutions are not imposed on individual hospitals. However, there are some resources which have been lost during the restructuring of the NHS that would be beneficial if reintroduced. These organisations should not impose standards or solutions but instead should facilitate the sharing of best practise and act as facilitators to coordinate the various parts of the NHS to share knowledge.

The only conferences that are organised on ePrescribing now are by private commercial organisations which makes it harder for them to maintain their neutrality as many of them are sponsored by vendors. The Health and Social Care Information Centre would be a logical organisation to take on responsibility for coordinating networking and conferences for hospitals to get together and learn from what the other is doing.
Appendix K – The Spine

The Spine holds the following types of information:

- Demographic information on patients (name, address, NHS number etc.). This information is used for maintaining contact with the patient.
- Clinical information on patients: whenever a patient interacts with the NHS this is captured e.g. GP visits, prescriptions made, hospital admissions, procedures and diagnoses. This information can then be accessed by approved NHS personnel to give them background to the patient and help identify and implement the correct care.

Both the demographic and clinical information are anonymised for reporting purposes, the Secondary Uses Service utilises this data to be able to track overall trends e.g. the number of people with different types of illnesses by age, race, location etc.

The Spine also holds information and access levels of all NHS personnel who are authorised to use various services, it keeps a log of every interaction and search. It registers and authenticates each user.

The Spine also acts as a Transaction Messaging Service which routes clinical messages and requests from approved users of NHS computer systems to the right service and handles the response i.e. it is the backbone that handles and directs requests for the services it supports.

The Spine also supports EPS (See Appendix K) as all GP prescriptions are sent to the Spine and can then be retrieved by the dispensing pharmacy. The record of what has been prescribed to each patient is added to their Summary Care Record (SCR). The SCR can also be accessed in hospitals to see what medication the patient is currently on or if they have any allergies or adverse reactions to drugs.

All of the major ePrescribing hospital wide solutions have already developed integrations to the central NHS spine which is another supporting argument for why hospitals should not attempt to build their own in house solutions.
Appendix L – N3 Network

N3 network overview

The N3 network is based on Internet Protocol (IP) like the rest of the internet. It also acts as a Wide Area Network (WAN), connecting the multiple different sites across the NHS within England & Scotland, including GP surgeries, dental surgeries and hospitals, to each other and, via gateways on the N3 network core, to other networks.

The N3 network itself is based high-speed Ethernet data networking services provided by Virgin Media and BT. The network is based on 57 points-of-presence (PoPs) in England and 5 PoPs in Scotland; these PoPs are where local NHS bodies are joined together and the PoP is connected to the N3 network.

According to the British Telecom N3 website about of third of local NHS bodies have created Communities of Interest (COINs) which can connect to each other without having to go over the N3 network core, this has the benefit of reducing traffic on the core and therefore avoiding contributing to capacity constraints.

All NHS sites are connected to the rest of the internet via a single aggregation and connection point on the N3 network to ensure that while NHS users can access the rest of the internet (with some restricted sites – gambling/ pornography etc.), the rest of the internet cannot access the N3 network and therefore get access to sensitive, confidential patient data.

Access to pharmacy systems is provided via a gateway on the NHS network core. This is because most pharmacies have lower levels of physical and virtual security on their computers than NHS sites and this gateway protects the confidentiality of patient data. Only the information required for EPS discussed in section F is delivered via the gateway.
JANET is the private network used by universities across England and Scotland, access to this network is provided by another gateway to enable doctors, particularly those in teaching hospitals such as Leeds Teaching Hospital Trust, to access this network.

Wales and Northern Ireland have their own equivalents of the N3 network and links between the four countries are provided by another gateway on the N3 network.
Appendix M – Dr Tattersall Interview Synopsis

Interview conducted 19/02/13 at St James Hospital, Leeds Teaching Hospital Trust

About James Tattersall:

Dr James Tattersall (JT from here onwards) is the medical director of a software company (2 days a week) and works on systems to act as a replacement for Electronic Medical Records. He is a renal clinician at St James’s Hospital Leeds. JT writes the software that controls the treatment for renal patients. System that JT designed used in many hospitals around the country but not at Leeds, in use in all the dialysis units in Republic of Ireland and N Ireland and about 7-8 in rest of UK.

Systems currently in place in renal unit of LTHT

Proton

Renal department of LTHT uses a system called Proton (1970s). Proton was originally programmed in Fortran. It was involved in the first ever cure of cancer by a drug (1970s Charring Cross Hospital). It was used in the treatment of Choriocarcinoma (cancer of the placenta). The only option prior to this was surgery (drugs could help but not cure it). It was hard to find the right drug combination as the doctors didn’t know if it was successful till patient died or didn’t die. Also it was hard to decide what quantities of the drug to give and the drugs used are quite toxic so give too much and you could kill the patient, too little and the drugs have no useful effect.

Doctors at Charring Cross needed an IT system that showed the relationship between the tumour marker (a hormone produced by the tumour) and the treatment being given to the patient. The treatments (the prescriptions) needed to be stored in this IT system, what drugs were given when and in what quantities. Doctors wanted to see how the tumour progressed over time; they needed the information in the equivalent of a spread sheet which they could then graph alongside a graph representing drug and dose changes and therefore see what effect if any the drugs were having on the tumour. The IT staff had to work closely with the clinicians in order to develop the system.

Renal doctors at Charring Cross realised that Proton might also be useful for tracking kidney disease. IT guy who created the Proton cancer system when approached said he wouldn’t create a whole new system for renal because ‘life’s too short’, what he did do however is he’d create the tools that would allow the clinical staff to configure the system to do whatever it is they wanted. He created a type of database that is now known as an Entity Attribute Value database (hated by developers as it
goes against modern IT principles). In modern databases you set up tables which represent things in the real world and to do so you need to have an understanding of the business logic/model. What works in other businesses doesn’t work in healthcare though, the processes are much more complex and there are an enormous number of them. It’s hard to define the processes, it’s hard to get the doctors to explain what it is they are doing and even if they did explain the process would probably change in a couple of years. (26 mins) EAV database architecture doesn’t have individual tables for each thing (e.g. Patients, Drugs), it just has one table that contains ‘things’, one row per whatever it is you want to put into it. The table essentially has three columns, one is Entity which is what links it to whatever it is about (e.g. a Patient), the 2nd column is the attribute, last is the actual value that you are storing (e.g. the name of the patient, an X-ray image, a document of text like a letter, a no. representing creatinine level). You end up with a triple e.g. John Smith, Creatinine, 123. The attributes aren’t invented by the developers; they’re created by the clinical staff to describe exactly what it is that they do. The developer doesn’t have to know what the attributes mean they just need to know that it’s a piece of data. Means you don’t have to create lots of different tables, most of the data just goes into one table (30mins). Don’t write queries in the normal fashion, use drag and drop functionality that creates the data entry forms. User has complete control of the function. The company that created this system stopped selling and supporting it about 15 years ago but it’s still used in the majority of renal units as there’s no modern system that can easily replace it. It is essentially maintained by the users.

Proton is now being used in St James’s hospital to show the levels of other disease markers such as Creatinine and helps inform as to whether a patient is receiving the correct amount of dialysis or not. Proton aids decision support, for e.g. Kidney transplant patient, Proton showed Creatinine levels continuing to rise on a graph which informed the doctors they needed to change to a different anti-rejection drug.

Proton originally accessed in LTHT via wired-in terminals, had terminals all over the hospital (lots of wires), now run in terminal emulator (software that pretends to be a terminal) in Windows, LTHT also now has a network. Now users access the server through the network using Telnet protocol (when key pressed sends the ASCI code to the server and the server responds with codes that instruct the terminal emulator to place characters on the screen at certain locations).

Drawback: limited screen real estate 84 chars across 24 chars high. No mouse, user uses number keypad to navigate.
Drug system that is used within renal (34mins) can view all the drugs a patient is on and has been on in the past. Can start a new drug, gives a list of available drugs.

Renal looks after about 2000 patients with functioning kidney transplants and about 600 dialysis patients. These patients need their drugs adjusted maybe monthly. (37mins)

Have a number of different business processes which look at all the patients one by one, check all the blood test results, produce a report detailing the ones that need dose changes and it recommends a dose change (partly based on current situation, partly based on what’s happened in the past with that patient).

(38mins) Give a drug which stimulates the production of red blood cells (Epo), kidney normally makes it but if patient doesn’t have kidney function then you have to give it to them by injection. Have to give exactly the right dose depending on the count of red blood cells in the blood. Takes about 2-3 months for red blood cell count to change after you’ve changed the dose of the drug (because it takes that long to produce the red blood cells) so system (Proton) needs to look back a couple of months ago to see what drug dose the patient was on then and then look at the red blood cell count now and look at how fast it’s rising or falling and then advise any dose changes that are required. It’s very difficult to do that manually just eyeballing the raw data, but it’s an obvious use for business intelligence. Have a lot of that going on but it depends on these drugs lists as well as the blood results.

(40mins) Limitation: System produces report showing group of patients, it overflows the screen so has to be printed out in landscape mode. Shows list of all patients along with a recommendation (drug doses, any extra tests needed). Particular example shown was trying to stabilise haemoglobin levels (red blood cell count).

Users of this system: Doctors, Nurses, Health Care Assistants, Ward Clarks, Receptionists.

(41.35mins) Before coming to Leeds, J.T. worked at another renal unit in Stevenage (north of London) and they didn’t have any paper in their department, not one single chart. They didn’t use the hospital case notes (other departments in the hospital did), whenever there was a significant clinical activity that other departments might need to know about then their system (Proton) would automatically produce a report which would get filed in the case notes (but the renal clinicians themselves wouldn’t actually write in the case notes). (42.08mins). They had online prescribing even on the wards so if inpatients... (tails off)
J.T. suggests taking me on to the wards (42.43mins) to show me how they do prescribing now at LTHT (massive step back apparently).

(43mins) Back to Stevenage... They computerised everything so there was no paper anywhere, just used Proton system, they set it up so it did everything that they needed it to do...

(43.44mins) Quark computer language (vaguely similar to Pascal & Basic). Built into the system (Proton), they use it for reporting. By using this programming language from within Proton and setting up the screens and the attribute editors and so on you could store everything that you needed for the healthcare in their department (renal) in a computerized system.

(44.40mins) Wouldn’t be able to do it with a modern system very easily because you’d have to explain to the developers what you need first. You would need the developers living in your department, interpreting what you’re doing and adapting the system to do what you need.

(45mins) J.T. says what he’s talking about doesn't help with prescribing, he’s been talking about healthcare and IT in general. For prescribing you do want it all standardized and the process for producing a prescription should be the same everywhere (it doesn’t require this flexible EAV approach). If it’s going to be future proof it needs to work in an environment which is mostly flexible and configurable (45.44mins). One standardized component of a system which includes many flexible parts.

(46mins) When J.T. working at Stevenage that’s when he became involved with start-up company producing software for renal units that was designed to replace the Proton system using a modern networked Windows environment and database system. Database that Proton uses is unique to Proton and you can’t query it using standard tools (was developed long before there were any standards for SQL for example or relational databases). Have to migrate data from the old Proton system so J.T. has had to reverse engineer Proton to access the data on a Windows server (hard work). Clinical Computing Limited (still in operation but sells a different Windows based product).

Liver department in LTHT is one of only five hospitals in the UK that does liver transplants (48mins). Just as difficult to look after a liver patient as a renal patient, just as critical to have software that handles everything but you can’t buy a liver system as there’s no software company that would produce software for just five customers. Renal is slightly different as there’s about 200 renal units in the UK so there’s a bit more of a market. In Leeds the liver people used Proton as well and the IT people who were looking after Proton in Leeds configured it so the liver people could use it as well (set up the attributes that they required and the reports that could be generated etc). This wasn’t really sustainable however as the liver department was quite a lot smaller than the renal
department their requirements were given a lower priority and as such they were always a bit dissatisfied with the service they were getting (49.30mins). They eventually decided to create their own system using Microsoft Access, this was ok for a while but then they got into trouble when it came to multiple users accessing it. About 5 yrs ago they asked if J.T. could sort it out for them so J.T. developed this system (50mins), it’s like a modern version of Proton, it also has prescribing in it (but much better than the one he just showed me). It’s a web application with a Microsoft SQL server at the back end. (50.40mins) J.T. shows me a graphical representation of an EAV database (which is what it is). The attributes are: Patient information, Clinical information, Transplant data etc. Liver department decided what information it was they needed to store for transplants (users of system decided what was required). System automatically creates all of the forms that display all of the attributes that they’ve decided upon. There’s a drag and drop interface for them to design it so J.T. didn’t need to do any of that. (53.35mins) The prescribing part: has drug list part very similar to what you see in Proton except you can just click on the drug name and then get the history of the changes…. Doctors don’t have time to mess about so you need a very easy to use interface with a minimal number of clicks. If click on history of a drug you can see when it was started, who made the changes etc. If doctor decides to stop the drug they click on Stop button and they then have to say why they stopped it (because someone in the future might want to restart it, they need to know if was stopped because there were side effects or if it just didn’t work etc). Can’t rely on patient to remember what drugs they’ve been on (especially as the same drug can have different names depending on who made it). The patient may have had a compound drug (a drug in combination with another) so it could have had a completely different name. Unless you have a system recorded in a standardised way which understands all of the ingredients of a drug then you’re destined to repeat the same mistakes over and over again (by mistakes he means trying previously ineffective drugs again or re-using ones with side-effects). In the prescribing system there’s the ‘All drugs’ option which shows all the drugs that have ever been prescribed for the patient (can see the history of each drug the patient has been on). Liver department call the system Liver Information Management Software (LIMS). IN healthcare LIMS usually means Laboratory Information Management Software (57.23mins). They use it also in renal to do things that Proton won’t do, when they use it though they call it the Renal Outlier System (it’s exactly the same code but a different configuration using different attributes to have a completely different function). Same code, different look and function. (58.46mins) In renal when they prescribe a drug (patient can be on many different drugs at the same time) the doctors need to know that it’s not going to interact with any of the other drugs. Without a computerised information system they have a book that’s updated every 3 months called the British
National Formulary (has over a 1000 pages). They look up a drug they want to prescribe using the index, it lists any interactions that drug may have with other drugs. The doctor has to manually check each drug on that list (which might have 40 or so different drugs) against the patients current drug list to make sure there isn’t an interaction. This process will take 15-30mins (59.44mins) if they do it carefully. When they see a patient in the clinic they only have about 5-10 mins so can’t do this thorough check each time. So each time they prescribe a drug manually they risk causing an interaction (59.55mins). The doctors reduce this risk by essentially memorising the common drug interactions (there’s a finite number of drugs that are used on a regular basis). But all the time there are new drugs coming on to the market and these new drugs may interact badly with the existing ones that the doctors thought they were familiar with (they’d need to look it up in the BNF). Patients can have allergies to certain drugs and these drugs have multiple ingredients, the patient might not know which specific ingredient they’re allergic to. All this makes the interaction checking process quite complex.

It’s hard to write software that keeps track of all the different drug names, ingredients etc, would need a centrally maintained database that listed all of the possible interactions. This is what a modern e-Prescribing system would need built in.

The liver system can display a complete drug list for a patient with links to the online version of the BNF, clicking on a link displays all the relevant information about the drug (dosages, ingredients, side effects and interactions with other drugs with a description of what the problem is if you give the two together). (1.05.10mins) J.T. has brought that information to the clinician in two clicks, considerably more practical than having to manually look everything up in a book. Everywhere else in the hospital apart from the renal department can’t do that at the moment because they don’t have electronic prescribing of any recognisable form. Technically it’s very simple as everything on the web form (I was shown) is dynamically created by the code in the background based on the data that’s stored for the patient and the user defined meta data. (1.06.55mins) In the case of the drugs, as there should only be one way to prescribe a drug, that’s something that J.T. has programmed himself so it isn’t subject to this user configuration. As these drug names were selected from a list and not typed in by the user it’s guaranteed to get the search hit. Most of the work isn’t done by the application, it was the Pharmaceutical Society that produced the drugs lists and the drug information was provided by the BNF…. Turns out the list of drugs actually comes from the UK Pharmacy Reference Group which is part of Connecting for Health. On the server there’s a separate part of the application that everyday logs into the Connecting for Health web server and downloads the latest
version of their list of drugs (which is updated by CFH about every week). J.T. doesn’t have to manually maintain it the system automatically maintains itself and therefore is instantly up to date.

It is possible to make healthcare applications fantastically powerful by making use of information that is available on other systems. One of the main problems is that these information systems don’t talk to one another so people are constantly copying information from one place to another.

(1.12.51mins) The system (J.T’s system) has got an interface to the Patient Administration System (essentially holds master patient records for the hospital). If wanting to add a patient to the system the user can’t do it manually as they might accidentally enter incorrect information so they have to copy the patient details over from the PAS (to ensure all the information is present and correct). A patient can’t be treated in the hospital without a PAS record.

(1.14mins) J.T. searches system for a patient (himself), this can be done using a name or an NHS number. Found four James Tattersalls on the PAS, one had his wife’s name on it as well so he knew that one was his, clicked on it to confirm. Once confirmed the system (J.T’s system) copied the GP data over from PAS. Intended link to GP’s website didn’t work (something must have changed). Because the system is linked to PAS it is also linked to blood results (1.15.25mins) and hospital numbers and patient details (address etc). If it changes on PAS it automatically gets linked in here meaning this system is always working with up to date information. For drug lists, when you change a drug you want the GP to be notified and an email needs to be sent out or a letter generated and that can be done automatically. You need the GP’s address, patient’s address and the patient identifiers to be exactly right so that the GP can link that to the same patient record in their system. The liver system doesn’t automatically generate an email, there are no protocols for it, letters are generated though.

Renal uses mostly Proton, also uses another implementation of this (referring to liver system) for things that Proton doesn’t do. (1.17.27mins) Shows me the renal version of the system: Renal Outliers System. Only things that are different are it’s got these things to do with dialysis and outlier management. This hospital (LTHT) has got several thousand beds, the whole trust has got maybe 10,000 beds spread over different hospitals. The trust runs about 4 or 5 different hospitals, main ones are LGI and St James’s. The renal department at ST James’s (there isn’t another renal department in Leeds). Kidney problems tend to happen in patients with lots of other problems/diseases. Main cause of kidney disease is diabetes for example, a vascular disease that also affects the kidneys. Now if a patient is admitted to hospital for any reason it’s quite likely that they’d be admitted under another specialty (a vascular disease or heart specialist for example) so
the patient may need care from specialists from several different departments. That is what the renal department call an outlier, they’re called an outlier because they’re not actually in the renal department’s beds, they’re somewhere else. This causes them a lot of trouble because the patient can be moved around and renal don’t actually know where they are (1.19.48mins) but they still need to see them/their blood results as they need to give the dialysis. It’s the job of relatively junior doctors/trainees to keep track of these outliers and actually go and see them every day. These doctors work a shift system so when they’re going round the LGI they might go home and the new doctor that is taking over from them might be coming to St James’s, so there will always be a doctor somewhere in Leeds but when they hand over they don’t actually physically meet up. If the doctor ending their shift is going to explain where all these outliers actually are and what treatment they’re receiving they could write it on a massive piece of paper or fax it or explain it on the phone (however verbal handover isn’t exactly acceptable because there’s no formal record of it) but this could cause a lot of problems in terms of managing the patients. That’s why they have the outlier system, the system has a list of all the renal department’s current outliers, what hospital they’re at, what ward they’re on etc. The list can be filtered, for e.g. just look at the patients at LGI, so if one of the doctors is going to the LGI they’ll print out this list telling them what ward the patients are on and their baseline Creatinine level (so they can tell if there’s been any changes) as well as a very brief history of what they’re in for and what is being done to treat it. This list represents the handover between the doctors on different shifts. The list is kept up to date by the doctors by clicking on the patient and then on the edit button which presents the user with a data entry form (1.22.23mins).

One of the problems in healthcare is that different people call things different things (for e.g. a heart attack can be called by many different names) and if you have patients moving from one place to another their condition may be referred to by different names. You need a standard terminology, for that purpose they have SNOMED (Systemised Nomenclature and Terminology of Medicine), a free database updated every month. SNOMED has about 4 million terms, these terms are all the different words that you can use for any medical condition (there will be different terms for different languages as well). There’s a shorter list (just under a million) of SNOMED concepts that are real entities to do with healthcare (e.g. heart attack). When using a health care information system you should be able to record data using whatever term you prefer. All these terms will link back to the standardised concepts that will be stored on the patient’s medical record so it can be completely unambiguous (1.25.34mins). The SNOMED system not only contains a list of terms and their concepts but also stores the relationships that link them together.
J.T.’s system (Renal Outlier System) contains a lot of flexibility but also a lot of standardisation. Can’t use Proton for everything, Proton doesn’t have the interface to the Patient Administration System. J.T. thought that his system could and would completely replace Proton but the Trust IT department thought that it would be too much of a risk to use something that was just a bloke working in one of the departments of the hospital as they had to consider the ongoing support for the system. Also Proton is a regional system, it isn’t just used by the Leeds renal unit, it’s shared by two other renal departments (one in York and one in Bradford, Hull wanted to join as well). J.T. thinks his web application would actually be perfectly well suited to be a regional system, it can access the N3 network (a NHS virtual private network that works over the internet, everything’s encrypted). They have outliers in other hospitals and they can access the systems of the other hospitals over this N3 network. Despite being N3 capable the hospital didn’t go for J.T.’s system they opted instead to buy a system. The software company J.T. works for has developed another system (not the Renal Outlier System) using completely mainstream Windows programming technology where everything is designed by the developers with none of this EAV flexible stuff that he told me about. J.T. programs a lot of stuff for this company but they only do it for renal, they couldn’t possibly do it for other departments (like he’s done for liver with his other system) because it would just be too difficult to maintain. Even just for renal they have a lot of difficulty keeping up with developments in renal medicine.

The hospital trust bought for about half a million pounds a competitor system to the one produced by the company that J.T. works for. They bought it a couple of years ago, it’s not live yet due to lots of problems. They couldn’t migrate the data from Proton into this new system because the Proton system in Leeds has been so highly individualised around the work that they do, the system that the Trust bought didn’t have fields to accommodate this so had to be massively redeveloped to match the function in Proton. Data couldn’t just be moved from one system/application to another as it would risk changing the meaning of the data. Information is always presented in context, if the information is presented in a different application it could potentially change the meaning. Another problem is that the doctors depend very heavily on the generated reports that tell them how to treat the patients for example with the automatic readjusting of drug dosage. The company that made the new system refused to give this report functionality, they said it was too much risk because they would have to understand the clinical care aspects. (1.35mins) Therefore the Trust had to employ application developers to add on the reporting function to the product that they’d bought, this process is still underway. This recently purchased renal system designed to replace Proton is called Vital Data (1.35.33mins), the company selling it is called Vital Pulse (a direct competitor to the company J.T. works for: Mediqal Health Informatics Limited). J.T. thinks the Trust
could have saved themselves half a million pounds by using his system but admits he is biased and can understand why the Trust made the decision they did.

(1.38.25mins) Mediqal actually have a new version of an e-prescribing system that they’re using for renal, but what is really required is something that will work across the whole trust, which Mediqal won’t actually be selling as they’re only interested in renal. You need a standardised system as doctors move between departments; the pharmacy will be accepting prescriptions from different departments. When a patient is admitted to hospital the doctors need to know what drugs they’re on, the patient may be unconscious. In patient prescribing requires specific functions that aren’t required for out patient prescribing. Linking e-prescribing system to SNOMED important as SNOMED can express relationships such as patient having a rash can be a side effect of taking a certain drug. The system could automatically inform doctors of these things rather than them having to memorise the entirety of the BNF, this is an example of how an information system can help you. The information is out there it’s just that no one has actually put it all together.

(1.48mins) J.T. shows a demo prototype for e-prescribing that he was working on (but hasn’t had time to finish it), doesn’t work very well, linked to SNOMED. Key issue with an e-prescribing system is that you want to reduce the number of clicks, for e.g. you don’t want to type something and then have to click a search button. Needs progressive searching (system offers suggestions based on the characters the user has entered), if a doctor types in the complicated name of a drug and gets no hits they don’t know what the problem is with what they’ve typed. (1.52.50mins) When a prescriber stops a drug they have to explain why they’ve stopped it, for example because the patient has had an allergic reaction to a drug or its ingredients. This means that any future prescribers will have a history of the drugs a patient has been on and their reactions to them.

(1.55.35mins) When you see a GP these days the GP listens to what you have to say, tells you ‘Take these 3 times a day’ and gives you a prescription, the GP has got no idea whether the patient has had an allergic reaction to the drug/ingredients when they saw another GP 5 years ago for example. Also maybe the drug was called something different then or the ingredient they had a reaction to is contained in a new drug the GP is considering.
Appendix N – Evaluation Interview Responses

Interviewee one

7. Does the advisory paper read well in terms of flow and clarity?
   - Read clearly and logically
   - Would have preferred more of an introduction to the background to ePrescribing up front
   - Nicely laid out

8. Does the advisory paper use simple non-technical jargon to explain technical concepts?
   - Understood the technology points but not familiar with some of the NHS IT programs

9. Do you feel you know what software options are available?
   - Yes – could put it into the context of what her hospital was currently using and could see how the issue of integration was the key thing

10. Do you feel you understand the decisions you need to make about hardware?
    - Really interested in the Mobile Clinical Assistants – cost/ level of roll out

11. Do you feel you know where to look if you needed to find out more details concerning a particular topic relating to ePrescribing?
    - Bit surprised that there were no central NHS bodies maintaining info on ePrescribing

12. Do you have any further comments on possible ways of improving the advisory paper?
    - Too long – does not even read full medical journal articles unless directly relevant – just looks at summary and diagrams
    - Recommended summary/ presentation to give to people who don’t have time to read it

Interviewee two

1. Does the advisory paper read well in terms of flow and clarity?
   - Yes, very clear. Was useful to have the presentation to summarise everything that the advisory paper was then going to cover

2. Does the advisory paper use simple non-technical jargon to explain technical concepts?
   - Yes very clear. Did not know about a lot of the initiatives but interesting to read about what was going on.

3. Do you feel you know what software options are available?
   - Initial confusion with EPS service, liked the pros and cons diagram

4. Do you feel you understand the decisions you need to make about hardware?
• Keen on the mobile clinical assistants and whether they were applicable for GP Practices

5. Do you feel you know where to look if you needed to find out more details concerning a particular topic relating to ePrescribing?
• Yes, would also ask colleagues

6. Do you have any further comments on possible ways of improving the advisory paper?
• No very good
Appendix O – Advisory Paper Supporting PowerPoint

ePrescribing Advisory Paper

Oscar Keedy

Objective

• The objective of this presentation is to give the reader an overview of what they need to consider when rolling out ePrescribing in an NHS hospital.
• It highlights the questions that must be answered for that specific hospital.
• It gives the reader a list of where to go for more information.
Structure of the presentation

- Background to ePrescribing
- Benefits & Risks of ePrescribing
- Software options
- Hardware options
- Networking considerations
- Managing the process
  - Change Management
  - Project Management

Background to ePrescribing

- Definition:
  - “The utilisation of electronic systems to facilitate and enhance the communication of a prescription or medicine order, aiding the choice, administration and supply of a medicine through knowledge and decision support and providing a robust audit trail for the entire medicines use process.”
Background to ePrescribing – timeline

- 2002 – National Program for Information Technology (NPfIT) in the NHS sets the IT strategy for the whole of the NHS
- 2004 – NHS Connecting for Health created to implement the NPfIT
- 2006 – Open letter from 23 academic computing experts raises concerns about security, cost and viability
- 2009 – Public Accounts Committee criticises progress
- 2010 – Equity and Excellence in the NHS report initiates NHS structural changes
- 2013 – Restructuring of the NHS, abolishment of Connecting for Health, responsibility for ePrescribing devolved to individual hospitals
Benefits & Risks

**Benefits**
- Improved decision making support
- Reduction in ADRs
- Efficiency
- Faster discharge process
- Reduction in hospital stays
- Cost savings

**Risks**
- Acceptance and adoption by users
- Integration with other hospital systems
- Wireless coverage across the hospital
- Reliance on electronic system that could go down
- Roll out
Software Options

1. Clinical speciality based software
   - E.g. Chemocare
2. Bespoke developed/ “in-house” software
   - E.g. University Hospital of Birmingham PICS
3. Pharmacy based systems
   - E.g. JAC, Ascribe
4. Modules of broader hospital software solution
   - E.g. CSC/ iSoft, Meditech, Cerner Millennium

Software Options – Pros & Cons

<table>
<thead>
<tr>
<th>Software options pros &amp; cons</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Speciality Based</td>
<td>Best practise for individual speciality</td>
<td>Challenge of integrating into other hospital systems</td>
</tr>
<tr>
<td></td>
<td>Tailored specifically for how the hospital works</td>
<td></td>
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<tr>
<td></td>
<td>Very detailed and captures all speciality specific requirements</td>
<td></td>
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<tr>
<td>Bespoke Developed</td>
<td>Long time to develop</td>
<td>Not hospital core competency</td>
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<tr>
<td></td>
<td>Buy-in from users who will have to be consulted to develop the solution</td>
<td></td>
</tr>
<tr>
<td>Pharmacy Based</td>
<td>Integration into the NHS national programs e.g. the Spine, SOR &amp; other systems</td>
<td>Challenge of integrating into other hospital systems</td>
</tr>
<tr>
<td></td>
<td>Captures pharmacy best practice for decision support</td>
<td></td>
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<tr>
<td>Module of hospital wide system</td>
<td>Supplier power: tied to one supplier who could charge more for development or support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integrated into other hospital systems</td>
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</tbody>
</table>
Software Options - Recommendations

- The first recommendation is not to develop your own in-house software.
- Identify what other systems the hospital already has in place so that you can integrate ePrescribing with them.
- Use NHS functional specification as starting point to consult with representatives from all departments and clinical specialities.
- Prepare tender document asking vendors to demonstrate:
  - How they integrate with the hospital’s existing systems.
  - How they would modify their software to meet your functional requirements.
  - Contractual commitment to prices.
- Define your strategy for how the system will be maintained and developed over time – can you do this in-house?

Hardware Options – Access Device

- Desk based computers
- Laptops
- PDAs
- Workstations on Wheels
- Mobile Clinical Assistants
Hardware Options – Access Device

**Desk based computers**
- **Pros:**
  - No additional costs to purchase
  - Users already familiar with hardware
  - Users already have assigned login
- **Cons:**
  - Distance from the patient's bed

**Laptops**
- **Pros:**
  - Can be taken to the patient's bedside
- **Cons:**
  - Additional costs to purchase
  - Where to put the laptop at patient bed
  - Storage when not in use
  - Battery life/time to boot up/hygiene

**PDAs**
- **Pros:**
  - No storage issues
- **Cons:**
  - Additional costs to purchase
  - Battery life/time to boot up/hygiene
  - Screen size

**Workstations on Wheels**
- **Pros:**
  - Can be taken to patient's bedside
  - Work surface & lockable castors
  - Longer battery life/big screen
- **Cons:**
  - Storage when not in use
  - Additional costs to purchase

**Mobile Clinical Assistants**
- **Pros:**
  - Can be taken to patient's bedside
  - Designed to be used with one hand
  - Longer battery life/big screen
  - Hygiene – designed to easily clean
- **Cons:**
  - Storage when not in use
  - Additional costs to purchase

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**Hardware Options - Recommendations**

- Make decisions about sharing of hardware – does everyone get their own, are a certain number allocated to the ward, do nurses use the desk top supported by print outs still?
- Trial with end users to get buy-in
- Support and maintenance issues - what happens when one goes down?
- Consider budgetary implications
Networking Implications

- Engage with person within the hospital responsible for connection to N3 & keep them informed of plans to enable them to capacity plan.
- Wireless network test to ensure coverage across the whole hospital.
- System back up and paper based recovery plan in case of an ePrescribing system failure.
- Develop a strict hospital specific security and access policy that sets out what can and cannot be accessed from hospital devices.

Change Management – the change curve

ePrescribing impacts on how everyone in the hospital does their job. The project team must consider and manage the emotional impact this will have on everyone and how they react to the project.

The Change Curve

<table>
<thead>
<tr>
<th>reaction to the change process</th>
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</thead>
<tbody>
<tr>
<td>&quot;I'm really as I am.&quot;</td>
</tr>
<tr>
<td>&quot;This isn't relevant to my work.&quot;</td>
</tr>
<tr>
<td>&quot;I'm not having this.&quot;</td>
</tr>
<tr>
<td>&quot;Could this work for me?&quot;</td>
</tr>
<tr>
<td>&quot;I can see how I can make this work for me.&quot;</td>
</tr>
<tr>
<td>&quot;This works for me and my colleagues.&quot;</td>
</tr>
</tbody>
</table>

satisfaction       Commitment

denial             hope
Change Management – 8 step plan

1. Create urgency
   - What will happen if we don’t do this?
2. Form a powerful coalition
   - Build the project team, identify all stakeholders – blockers & influencers.
3. Create a vision for change
   - What could a future with ePrescribing look like.
4. Communicate the vision
   - Big bang, roadshows, on-going team meetings, tailor to audience, two way communications
5. Remove obstacles
   - Tangible, practical obstacles AND human emotions
6. Create short term wins
   - Identify quick wins and celebrate them
7. Build on the change
   - What next? What can we develop once the initial system is working.
8. Anchor the changes in corporate culture
   - Recruitment/training/the way we do things round here

Where to go for more help?

- Connecting for Health archived resources
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