

QUALITY HEALTH CARE IN NHS HOSPITALS: THE IMPACT OF PRESCRIBING SYSTEMS

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Abbreviations

ADR	Adverse Drug Reaction
ASCQHC	Australian Commission on Safety and Quality in Health Care
CFH	Connecting For Health
CP	Chief Pharmacist
CPOE	Computer Physician Order Entry
DOH	Department of Health
eMAR	Electronic Medication Administration Record
EPMA	Electronic Prescribing and Medicines Administration
ePrescribing	Electronic Prescribing
eStat	Once only medication due to the electronic system
EQUIP	An in depth investigation into causes of prescribing errors by foundation trainees in relation to their medical education (1).
GAfREC	Governance Arrangements for Research Ethics Committees
GMC	General Medical Council
HCP	Health Care Professional
HIS	Health Information System
HRA	Health Research Authority
IOM	Institute of Medicine
IT	Information Technology
LF	Latent Failure – “Resident pathogens” in the system arising from decisions made by designers, builders, and top-level management.
MAU	Medical Admissions Unit
MDT	Multidisciplinary team

NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
NIGB	National Information Governance Board
NPfIT	National Programme for Information Technology
NPSA	National Patient Safety Authority
NRLS	National Reporting and Learning Service
PAS	Patient Administration System
PBR	Payment by Results
PRN	As required medication
R & D	Research and Development
REC	Research Ethic Committee
SM	Senior member of staff
Stat	Once only medication
STEEEP	Components of quality – Safe, Timely, Efficient, Effective, Equitable and Patient Centred.
STS	Socio-technical systems
TTO	To Take Out (discharge medication)

Definitions

Hospital in-patient prescription Chart

The structure, design, and arrangement of the prescription information on the prescription chart changes depending on whether it is paper or electronic, also changing slightly between different hospitals. For the purposes of this study the paper and electronic in-patient, prescription chart is defined below.

Paper in-patient prescription chart (drug chart or Kardex)

A paper prescription chart is usually produced in the form of an A4 paper booklet or fold out Kardex; historically the drug chart design is reviewed and updated by the pharmacy department in-house or in collaboration with other Trusts or health care regions. Wales and Australia have a national paper-prescription chart that is used for in-patients. However, England does not have a national chart, but has *Standards for the Design of Hospital In-Patient Prescription Charts* (2).

Electronic in-patient prescription chart (ePrescribing or EPMA)

An electronic prescription chart is produced by software on a computer. The software can be sourced from a commercial IT company, or constructed by specific hospital IT teams. Electronic Prescribing and Medicines Administration (EPMA) systems enable administration of medicines to be recorded in the electronic system, as well as the prescription itself.

Multidisciplinary Team (MDT)

A multidisciplinary team (MDT) is made up of different healthcare professions (Doctor, Nurse, Pharmacist) with specialised knowledge and skills. The HCPs work together as a team to make treatment recommendations that facilitate quality patient care.

Health Care Professional (HCP)

A Health Care Professional (HCP) for the purpose of this thesis is defined as a qualified nurse, medical doctor, or pharmacist working within the NHS hospital setting. All of these HCP groups are the main users of the system and are able to independently prescribe (3), clinically review, or administer medicines in hospital practice. Dentists and Optometrists were excluded based on their specialist background.

Clarity for the purposes of this thesis is a factor that relates to the ease with which the correct meaning of a prescription can be interpreted by the HCPs using the prescribing system.

Terminology used in association with the prescription chart

Type of medicine	Definition
Stat	One off dose of medication, administered immediately, usually outside of the normal medicines administration round times (4).
eStat	Due to electronic automation a one off dose of medication, administered immediately, usually outside of the normal medicines administration round times(4).
Regular	A medication administered on a regular basis, in a predictable set routine.
As required (prn)	A medication only administered, when required by the patient.
Clinical Indication	The reason why the medication is prescribed
Order Sets	An order set is a collection of clinically related medication orders grouped by purpose (5) that can be prescribed all at the same time.

Abstract

The National Health Service (NHS) focuses on quality of care as a priority. With the NHS planning to go paperless by 2018, more hospitals in England are making the transition from paper to electronic prescribing (ePrescribing) systems. The aim of this programme of work was to understand and explore the influence different in-patient prescribing systems can have on key NHS healthcare professionals (doctors, nurses and pharmacists) working practices in England and quality healthcare.

The programme of work, a three phase sequential design, used both qualitative and quantitative approaches. The first phase involved structured telephone interviews with chief pharmacists. Chief pharmacist interviews (n=65) focused upon the type of in-patient prescribing systems in use within each Trust and gained a management perspective of the different prescribing systems. Phases two and three were carried out at three acute NHS hospitals in England, at various stages of developing and implementing their prescribing systems. Phase two data were collected through multidisciplinary team (MDT) focus group discussions. The MDT discussions explored a number of areas associated with the prescribing systems in use: these included clinical workflow, communication, collaboration, patient safety and the use of a clinical indication on the prescription chart. Phase three data were collected using documentation analysis of the prescribing system and medical records, taken from patients cared for by the MDTs involved in phase two. Information extracted included any documentation made of a newly initiated medication, as well as the design of the prescribing system. The clarity and accuracy of documentation in the prescribing system and medical notes were compared to the GMC standards Good Practice in Prescribing Guidelines.

Triangulation of data indicated how a change in prescribing system can impact upon individuals working practices by changing the design and clarity of the prescription chart, enforcing of regulations, accessibility and reliability, communication between key HCPs and the patient. These influences can be considered latent conditions in the systems that need addressing to prevent quality of patient care being compromised. The use of Socio-technical systems (STS) theory considered the interaction between humans and technology when using the prescribing systems. Understanding the issues where social and technical aspects interact in the prescribing system, emphasised where healthcare quality is impacted and therefore facilitated recommendations to improve working practices.

The findings will help healthcare organisations to consider the impact a change in prescribing system can have on working practices and the latent failures that need consideration within the prescribing systems. The Electronic Prescribing and Medicines Administration (EPMA) system design must take into account the visual and physical needs of the user and consider how they can be improved to facilitate clinical workflow.

Author

The Author gained her MPharm degree in 2002 before embarking on a career in hospital pharmacy. She took up a 2-year post as a rotational hospital pharmacist, and successfully completed a postgraduate Clinical Pharmacy diploma at the University of Keele. The author then specialised in the area of Oncology for six years. During that time, she completed an Oncology Pharmacy Practice Certificate and started to consider how patient safety and computerisation could improve pharmacy practice and facilitate other health care professionals' working practices. This interest culminated in the author taking on a full-time PhD in 2011 jointly funded by The Countess of Chester NHS Foundation Trust and Liverpool John Moores University.

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Finally – to my parents, for their certainty when I doubted, and making this achievement possible.

Dedication

This thesis is dedicated to my lovely daughter Nyah, who motivates and inspires.

“Human beings make mistakes because the systems, tasks, and processes they work in are poorly designed”

Lucian Leape

1 THE IMPACT OF PRESCRIBING SYSTEMS ON HEALTHCARE QUALITY

This thesis considers the impact a prescribing system (paper or electronic), within the hospital in-patient setting, can have on health care professionals' (HCPs') working practices and ultimately the quality of care they can provide to their patients. The programme of work compares the effect that prescribing systems can have on quality of care across three perspectives, namely those of pharmacy management, the multidisciplinary team (MDT) made up of key HCPs (doctors, nurses, and pharmacists) and that taken by documentation review. This has enabled exploration of the affects that different prescribing systems (paper or electronic) can have and explores how the effects are inter-related and influence the quality of patient care.

Within this chapter, the literature applicable to this programme of work is reviewed. This begins with the concept of quality healthcare and its importance to the NHS, outlining the need for good communication, guidelines, and policies. The prescribing and medicines administration process is then described leading on to the use of paper and electronic prescribing (ePrescribing) systems and the problems that have been encountered with them. Within this, government policy developments appropriate to creating a prescription, such as the use of a clinical indication on the prescription chart, is deliberated in relation to the prescribing system. The use of socio-technical systems (STS) theory is then explained in relation to the programme of work. STS theory is utilised, to understand how the change in prescribing system can impact upon the quality of care provided. Clinical workflow research surrounding the prescribing process was reviewed to gain a perspective on prescribing systems and clinical workflow in secondary care. The chapter explains how clinical workflow encompasses many of the social aspects of the STS that are required to improve organisational performance. The chapter concludes with the literature search purpose and parameters and a description of the originality of the programme of work.

1.1 Quality Care

The National Health Service (NHS) policy documents *High Quality Care For All* (6) and *Equity and excellence: Liberating the NHS* (7) emphasised that the NHS services

should focus on quality of care as a priority. In the wake of the Mid-Staffordshire enquiry further NHS reports were produced *A promise to learn - a commitment to act* (8) and *Hard Truths, The Journey to Putting Patients First* (9) that shifted emphasis towards patient centred care, along with continuing its commitment to quality care, being the fundamental foundation of the NHS. Within the UK healthcare environment, the NHS defines quality care as “*clinically effective, personal and safe*”(6) . Safety within the context of quality is one of the most significant components; the NHS report (8) defined how the origin of error causation needs to be distinct in order to consider human error or error arising from system failures. Both have multiple causes, many outside the control of the person who makes the mistake (8)(10).

The Institute of Medicine (IOM), a non-profit, non-governmental USA organisation, expanded the components of quality care to include safe, timely, effective, efficient, equitable and patient centred (11). For the purposes of this thesis, these components are abbreviated to STEEEP; see Table 1-1 below for a description of the conceptual components.

Table 1-1 Quality Components – Safe, Timely, Effective, Efficient, Equitable, Patient centred (STEEEP) (3).

Specific aims for quality improvement in healthcare (11)	
Safe	Avoiding injuries to patients from the care that is intended to help them
Timely	Reducing waits and sometimes harmful delays for both those who receive and those who give care
Effective	providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and overuse)
Efficient	avoiding waste, in particular waste equipment, supplies, ideas and energy
Equitable	Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location and socio-economic status
Patient-centred	providing care that is respectful of and responsive to individual patient preferences, needs and values and ensuring that patient values guide all clinical decisions

The STEEEP components that are particularly relevant to the prescribing and administration process and the focus of this study are - Safe (e.g. prescribing safely, avoiding prescribing and administration errors, and the introduction of a national drug chart), Timely (e.g. clinical workflow around the prescribing and administration process),

Effective (e.g. is the in-patient prescription chart designed effectively), Efficient (e.g. comparing paper and ePrescribing systems efficiency and communication changes) and Patient-centred (patient contact to enable responding to patient needs and values).

Without defined ways of communicating between patients, HCPs, departments and throughout the whole hospital, responsibility for providing quality patient care can be diffused and therefore not clearly owned (8). Therefore, it is essential to have clear communication and defined responsibilities to provide quality patient care. It is important to consider that the action of prescribing does not occur in isolation and that communication is vital in order to provide quality care within the hospital setting. Rules, standards, regulations and enforcement all have a place in the pursuit of quality (8). Prescribing by its very nature has a number of local and national policies, processes, and systems that govern and influence it in order to facilitate quality care for the patient. Several policy documents provide recommendations for written communication in the healthcare setting around the prescribing process. The endorsements include guidance produced by the General Medical Council *Good Practice In Prescribing And Managing Medicines And Devices* (12) which provides a standard for documentation of a prescribed medication on the prescription and in the medical notes. It defines that written communication should be clear, accurate and legible, reporting the relevant clinical findings, the decisions made, the information given to patients, and any drugs prescribed (12). Records should be made at the same time as the event occurs or as soon as possible afterwards (12). Clarity for the purposes of this thesis is a factor which relates to the ease with which the correct meaning of a prescription can be interpreted by the HCPs using the prescribing system and is linked with the definition of a clinically meaningful prescribing error;

'a prescribing decision or prescription writing process that results in an unintentional, significant reduction in the probability of treatment being timely and effective or an increase in the risk of harm, when compared with generally accepted practice' (13)

A prescription should therefore provide a succinct piece of communication that is clear, accurate and legible in order to convey the right information timely and effectively so that a medication can be given to a patient safely (12)(13) and enables quality patient care. The National institute for Health and Care excellence (NICE) also emphasises the need for healthcare professionals to communicate information effectively to patients and

colleagues (14); this needs to be done in a timely manner. For example, the time difference between when a prescribing decision is made and documented in the notes, and then actually prescribed is how clinical workflow can affect efficiency. This could lead to a delay in a patient receiving essential medications, influencing a patient's outcome.

1.2 Prescribing and Medicines Administration Process

The prescribing of medicines is the most common form of therapeutic intervention in healthcare (15), thus the quality of the prescription and the prescribing process is fundamental for high quality patient care (15). Each patient in the hospital setting is assigned a prescription chart (paper or electronic) on admission to the hospital. The purpose of the prescription chart is to communicate information about medications, for example, what has been given to the patient, as well as a direction on what is to be given in the future. When prescribing for in-patients, the details of the medicine are entered on to the prescription chart and additional sections prompt the prescriber to include all relevant details, making the prescription chart unique to individual in-patients (16). Doctors and some nurses and pharmacists are able to independently prescribe (3), are the main users of the prescribing system within the hospital, and therefore use the system on a regular basis. The individualised prescription chart is used by key HCPs (doctors, nurses, and pharmacists) as the basis for medicine review, supply, and administration in the hospital. In order to provide quality healthcare for patients, key HCPs must work as part of a MDT, reliant on each other to exchange accurate information in a timely and efficient manner even when they are in different locations across the hospital (17). The interaction that key HCPs have with the prescribing system needs to be facilitated by the design and layout of the prescribing system. Once a prescribing system is in use within a hospital, whether paper or electronic based, that prescribing system must be used; the HCP does not have a choice. The response of HCPs to using the prescribing system must be a positive one, in order to achieve optimal performance and effective implementation.

1.3 Paper prescribing

When the NHS was formed in 1947 hospital prescription charts did not exist, instead hospital prescribers wrote the directions to administer a medication in the patients notes, a nurse would then write them onto a medicines sheet (18). In 1959, it

was acknowledged by Fowler that the process of using medicines sheets was no longer fit for purpose (19). The reasons for why change was necessary included – the number of new medicines being introduced and staff being unable to keep up with new developments, pharmacists could not provide medicines information readily, doctors could not be expected to memorise details of drugs and dosages, and nurses, with other duties can only know new medicines superficially (19). Individual patients were receiving more medications at the same time, changes in treatment were becoming more frequent, and the number of patients moving through the system was growing (19). The reasons given back in 1959 for a change in prescribing system reflect issues that are still present at this moment in time, specifically the number of medicines used and their complexity (20). In 1965 papers published in the Lancet showed studies undertaken in London (21) and Aberdeen (22). They reviewed different types of medication errors, such as omission error and transcription error, which resulted in the creation of a prescription chart. Consequently, hospital in-patient prescription charts were introduced nationwide, but unlike the standard GP prescription sheets, the new hospital prescription charts were not standardised (18). The current UK hospital in-patient prescribing systems are based on a model established some 60 years ago and have remained largely unchanged until recently (20). Traditionally, medicines for hospital in-patients are prescribed on a paper prescription chart. These charts have evolved over the years and included “*Aberdeen sheets*” (23), “*drug charts*”, or “*medication Kardex*”. Pharmacy departments have historically been responsible for the design of paper prescription charts, reviewing the charts and updating them over the years.

Paper prescription charts are low in cost, and do not require hours of training for the user to understand how they work. However, the main problem with this system is that legibility of handwriting can vary and not all prescription details are completed, resulting in inefficient use of HCPs’ time having to contact the prescriber and clarify the prescription (24) (25). Previous studies looking at the quality of a paper prescription chart have taken into account different indicators of quality such as legibility or the completeness of the prescription (25–31) but not always the potential harm the lack of quality prescribing may have caused. Another indicator of quality with paper prescriptions is the issue of identifying the prescriber, leading to a less than robust audit trail (29).

Studies conducted in the UK show that prescribing errors occur in 1.5-14.7% of hand written prescriptions for hospital inpatients (1,13,32–37). A systematic review of the prevalence and incidence of hand written prescribing errors within hospitals internationally noted a median error rate of 7% (37). The EQUIP study involving hospitals in England using paper prescription charts, showed that 8.9% of prescriptions written in hospitals contained errors (1). Other studies have shown error rates of between 10.7% and 14.7% (36)(38). Recommendations in a number of areas were made to improve patient safety through minimising prescribing errors when utilising paper prescription charts: these included changes to the clinical working environment and that a standard drug chart should be introduced throughout the NHS in England to reduce prescribing errors (1).

Currently there is no standardised national paper-based prescription chart in acute trusts across England. Acute trusts or regions have developed their own in-patient paper-based prescription charts, each with varying standards (39–42). A policy move towards utilising a standard national prescription chart across England has occurred with the publication of *Standards for the design of hospital in-patient prescription charts* (2). The report addresses the design standards that should be met by an optimal prescription chart (paper or electronic) with the view that they would be used by hospitals to evaluate local charts and inform a national English chart in the future (2).

The introduction of a standardised paper prescription chart across Australia has shown conflicting results. In 2008 a tertiary hospital in Western Australia critically audited the design of the national in-patient medication chart (NIMC) against its own prescription chart (43). The study concluded that the NIMC was inferior to the prescription chart previously used in the tertiary hospital and that some of the new design features within the NIMC could lead to adverse outcomes (43). However in 2009 another study showed a significant reduction in the frequency of prescribing errors when using the NIMC, the potential risks associated with warfarin management and improved documentation of ADRs (adverse drug reaction) (44). When comparing the studies it is not clear if they were researching the exact same version of the NIMC. Wales also has a national standardised paper prescription chart in place; however, no robust data of its impact has been published. Commentary outlining experiences and possible benefits, between 2004-2012, of the Welsh national chart has been published (45).

1.4 Clinical Indication

One recommendation of the *Standards For The Design Of Hospital In-Patient Prescription Charts* is the inclusion of a space for clinical indication, both for regular and as-required medications (2). The clinical indication of a medication is a design standard on hospital in-patient prescriptions in Australia, however reports from The Australian Commission on Safety and Quality in Health Care (ASCQHC) show that only 14.5% of prescription items had an indication documented (46). Compliance with entering the clinical indication on the National Inpatient Medication Chart (NIMC) concluded in another study was as low as 8.9% (43).

Clinical indications for prescribed medication in secondary care are not always clear or difficult to locate in patients' medical notes, thus making monitoring for medication appropriateness by HCPs difficult (47). This is particularly important when initiating a prescribed medicine within the hospital environment as written communication in notes needs to be clear and succinct (12). The lack of written documentation and the quality of the documentation regarding prescribing decisions in the medical notes was considered to contribute to prescribing errors in a recent study (38). The study highlighted communication issues when the patient is transferred between wards or care settings leading to confusion amongst HCPs and potentially causing patient harm (38). It is essential to ensure that the information provided on a prescription matches the information provided by HCPs in the medical notes. If the information does not match, a prescribing or documentation error may have occurred, highlighting potential patient safety issues.

Incorporating the clinical indication of a medicine on to a prescription, for the use of antibiotics in the hospital setting, was considered to be a more effective process, than previous practice, in reducing the inappropriate prescribing of antibiotic medications, allowing verification of formulary, prescribing errors and facilitating audit (47)(48). However, it has been good practice for a long time regarding warfarin usage; guidelines on oral anticoagulation were produced by the British Committee for Standards in Haematology (49). The use of a clinical indication on a prescription makes clinical sense and fits with the literature concerning specific clinical situations such as anticoagulants and antibiotics. However, the practicalities of incorporating a clinical indication on every

prescription and imposing its use have proven difficult, unless key HCPs can see the benefits (46). The use of a clinical indication on prescriptions in primary care has been supported by the NHS; with its benefits being outlined on a dedicated website (50).

1.5 Electronic prescribing

As discussed previously, since 1959, prescribed medications have increased in number and complexity, with an inherent potential for greater risk to patients (19)(20). With the conception of computer technology, computerisation of prescribing (ePrescribing) and associated administration processes is advocated as the next step in facilitating prescribing and a way of reducing prescribing errors (20). The definition used by NHS Connecting for Health to define ePrescribing is

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 provide a robust audit trail for the entire medicines use process.

Patient safety, along with the growing needs for formulary, financial and audit control, has led to widespread recommendations for the introduction of ePrescribing systems in the UK (20). EPrescribing systems support the efficient management of medicines for both patient and hospital as well as being efficient in integrating with other hospital systems (20). However, ePrescribing systems are not necessarily about increasing the efficiency of individual tasks for HCPs, such as prescribing (51)(52). EPrescribing still requires the same data as paper-based prescriptions but more information is now required, such as the specific formulation of the medication, but illegibility is no longer an issue.

Over the past twenty-years in secondary care, acute trusts have started to implement electronic prescribing and medicines administration (EPMA) systems. At the time of writing, NHS acute trusts within England were at very different stages of implementing ePrescribing. Research prior to 2011, showing the spread of ePrescribing across England in secondary care had used convenience samples to obtain their data (53)(54). These studies were survey-based and showed that the hospitals had a high interest in ePrescribing, but only a small number had actually implemented ePrescribing. A more recent study, conducted in 2011, undertook a detailed review of ePrescribing use in terms of its extent of deployment, comprehensiveness with respect to drugs

prescribed, the decision support functionalities used, and the use of multiple ePrescribing systems within the same hospital (55). The study showed that only 13 Trusts used in-patient ePrescribing across all adult medical and surgical wards (55).

The role in 2002 of the NHS Connecting for Health (NHS CFH), part of the Department of Health Informatics Directorate, was to maintain and develop the NHS National IT infrastructure. NHS CFH provided information on ePrescribing system evaluation, implementation, clinical safety and decision support (56). Yet, as of 2008, there was not one ePrescribing system in use delivered via the national programme (57). With 12 ePrescribing systems available in 2008 across England and the choice to decentralise decision making, NHS organisations were given more variety of IT systems (56). With more localised led decisions regarding ePrescribing, the provision and experience of IT clinicians on the ground was likely to vary according to the level of support and resources they had locally (58). The opportunity for standardisation of ePrescribing and associated interfaces across the country could have been lost at that point in 2008. With a change in government in 2010 a new document *Liberating the NHS: An Information Revolution* was published supporting the linking up of systems at a local level, rather than a national level (59).

Prescribing errors with ePrescribing systems have decreased compared to with paper prescribing systems. However, there is still a prescribing error rate of between 2% and 7.9% being reported with ePrescribing systems (28,32,36). Actual patient harm reported in one study occurred 3.9 times per 1000 patient days, caused by ePrescribing prescription errors, which was the same as with hand written prescriptions (60,61). Another study comparing commercial ePrescribing systems showed a reduction in prescribing errors from 6.25 to 2.12 per admission using the Cerner™ ePrescribing system and a decline from 3.62 to 1.46 prescribing errors per admission using the iSoft™ ePrescribing system (62). However, this drop in error rate was mainly due to procedural prescribing errors such as unclear or incomplete orders rather than clinical error rates (62). Interestingly system related errors, such as wrong drug selection, accounted for 35% of errors after the implementation of ePrescribing (62).

NHS Connecting for Health guidelines outlined the key safety related features that should be present within ePrescribing systems (63). These guidelines recognised that although ePrescribing systems have been shown to reduce prescription errors they have

introduced new types of error, such as incorrect selection error, where a medicine, other than that intended, is mistakenly selected from a list of medicines built into the system (63). Incorrect selection (from a drop down menu) is an error unique to ePrescribing systems and cannot exist in paper systems as the prescriber does not select from a list, but rather writes their choice out. These new selection error types, for example, wrong patient, drug, dose or frequency have been identified in numerous studies (64–70) but the extent of the new error types and how they can be robustly identified is still not clear. Therefore It is not possible to rely solely on the prescriber and the ‘intelligent’ computer to prevent medication errors (50).

A rapid response report from the NPSA in 2010 recognised that the introduction of EPMA introduced new prescribing risks in relation to omitted and delayed medicines and magnified existing ones (4). The nature of the new risks is related to both the prescribing and administration of Stat prescriptions (once only medicines). EPMA systems automatically schedule the time of administration, therefore Stat prescriptions are required depending on what time of day the prescription is created (4). The NPSA accepted that the risks would become more apparent over time (4).

EPMA systems can have the capability to create pre-defined order sets, which are defined as a collection of clinically related orders grouped by purpose (5). Paper prescribing has also included order sets, which have been shown to improve the completion rate of medication orders along with reducing prescribing errors (71,72). In relation to ePrescribing, order sets enable simultaneous prescribing of a standard list of medications used for a specific indication. These order sets have been promoted as a way to speed up ePrescribing, ensure a full regime of correctly prescribed drugs, and facilitate prescribers (20)(73,74). It has been proposed that it is easier to prescribe one order set and then delete unrequired elements than to prescribe each drug individually (20). The efficiency of using pre-defined order sets within the ePrescribing system has shown that although the number of keystrokes is reduced, usability problems can impair efficiency (74). Therefore, the ePrescribing order set can become a “convenience” list if not used in the correct manner, facilitating workarounds (which is a method for overcoming a problem in a computer system), in order to create a prescription (5). For example, the possibility of overprescribing could occur as there is very little information regarding the appropriate use of order sets (5). In the document *ePrescribing In Hospitals – Challenges*

And Lessons Learnt, some users were concerned that order sets could be ordered without considering whether the individual drugs were safe for the patient concerned; the risk of using order sets need to be emphasised in training, and monitored to identify problems (20).

1.6 Clinical Workflow

The Institute Of Medicine in their report, *Preventing Medication Errors* (75), indicated that software alone is insufficient at preventing and detecting prescribing error, within the systems; prescribing systems involve people as well as software, as such clinical workflow and human factors must be considered. It is therefore important to consider both the social and technical aspects of any system. This report concluded that the advancement of a number of technologies, including computerised physician order entry (CPOE), are key factors to future improvements in patient safety and quality care (76). In a recent review of literature the IOM examined the evidence regarding the impact of health Information Technology (IT) on patient safety and concluded that the challenges facing safer health care and the safer use of health IT involve people as much as the technology (77). One of their key findings stated that the safer implementation and use of health IT begins with viewing it as part of a larger socio-technical system (77).

Considering the proposed benefits of ePrescribing (20) and the need to implement technology to achieve a paperless NHS by 2018 (78), the actual implementation and use of a comprehensive ePrescribing system within hospital in-patient areas across England is minimal (55), which is also reflected internationally (79). One of the theories for the inadequate uptake has been the impact that implementation of ePrescribing can have on HCPs' clinical workflow (17). In reality, HCPs' and MDTs' clinical workflow, using a paper prescribing system does not match the clinical workflow imposed by an ePrescribing system and therefore requires a change in practice (17).

Clinical workflow encompasses the activities, technologies, environments, people and organisations engaged in providing a defined outcome such as a prescription (80). Clinical workflow in healthcare is typically distributive, collaborative and interruptive yet ePrescribing systems can enforce a linear, sequential and unidirectional model of prescribing processes, which do not match actual workflow between professionals (17)(81). Socio-technical systems theory views the components of clinical work as a single

work system (80). The multi-professional nature of clinical workflow must be considered when researching ePrescribing systems (82,83). Previous research has shown that ePrescribing systems can encourage prescribers to control other key HCP groups workflow, such as nurses and pharmacists, whose work is interrupted or delayed if the timely and appropriate execution of prescribers tasks do not occur (17). Requiring prescribers and other HCPs to have situation awareness, which is *“the understanding of the activities of others which provides a context for your own activity”* (80), impacts on collaboration and communication, part of the social aspect of the STS.

Prescribing is a critical form of communication between other prescribers, HCPs getting the drug, supplying the drug, reviewing clinical progress all within the MDT, so for communication to be effective the prescription must be clear and unambiguous to a range of HCPs. The consequences of unclear, inaccurate medical documentation are particularly serious and have potentially tragic consequences for patients (84). In addition to concerns around medication safety, unclear documentation results in wasted resources, impaired communication between healthcare professionals, and legal complications (85). Understanding the change in communication between a MDT and their working practices with involvement from all HCPs would provide insight from a MDT perspective to inform and enhance inter-professional training and collaboration in achieving quality patient care.

When reviewing the literature of clinical workflow surrounding prescribing systems, it was predominantly qualitative methodologies being utilised. Qualitative methodologies included semi-structured interviews (17,65,80,83,86–88), observations (89,90), focus groups (86,87,91) and surveys (70,73)(92). A number of systematic reviews and literature reviews have studied the impact ePrescribing can have on workflow (82,93–96). However, systematic reviews have their limitations, they may consider the impact of ePrescribing systems but the importance of aspects influencing the impact could be underestimated (97). Systematic review tries to treat eHealth technologies as scientific objects rather than social artefacts which are complex in nature (97).

The literature review of the impact of ePrescribing and CPOE on inpatient clinical workflow concluded that more multi-method research is needed to explore ePrescribing’s multidimensional and collective impact on clinical workflow (82). After review of the clinical workflow literature, it was noted that the perspective of the Multidisciplinary

team as a whole had not been considered and was identified as a gap that needed further exploration. This gap in the literature led the researcher to consider methodologies that gained a group (MDT) consensus and insight into how prescribing systems impacted upon the MDTs clinical workflow rather than individual HCPs.

1.7 Socio-technical systems theory

The socio-technical concept arose in conjunction with the Tavistock Institute in the British coal mining industry in 1949 (98). Within the coal industry, productivity failed to increase in step with increased automation, so the National coal board required a comparison of mines to understand the changes. This gave rise to the emergence of a new paradigm of work, in which the best match would be sought between the requirements of the social and technical systems (98). From the beginning, the socio-technical concept has developed in terms of systems, since it is concerned with interdependencies (98). Grounded in both social theory and Information Technology (IT), socio-technical approaches to information communication technology evaluation focuses on the interrelation between technology and its social environment (99).

Some studies in the literature used a socio-technical systems theory approach which seeks to identify the dynamics between technology and the social, professional and cultural environment in which it is used (100). One study reviewing electronic prescribing in community pharmacies utilised a socio-technical approach by identifying themes relevant to the social subsystem of the STS framework (101). Another paper developed a new socio-technical model specifically for studying health information technology (HIT) in complex adaptive healthcare systems in which it had eight components, which ultimately reinforced the need to review HIT as interdependent and inter-related concepts (102). The report Health IT and Patient Safety: Building Safer Systems for Better Care provided five components of any socio-technical system and included the technology, people, process, organisation, and external environment as previously discussed (77). Many representations of socio-technical systems theory have been utilised within the literature (103). Having an understanding of the theories roots and its development over time within the literature reinforced that the core principles of the theory do not change. However, it has been proposed that the fragmented understanding of socio-technical

systems theory has resulted in a continuing focus on the performance of the technical system and limited attention to the social system (103).

Socio-technical systems theory considers that every healthcare system includes people (the social system) such as the employees at all levels (for example, junior, and consultant doctors) and the skills, attitudes, values, and needs the employers bring to the work environment (for example, multidisciplinary team communication). The tools, techniques and knowledge used by the people (for example guidelines, protocols, prescription charts), are classed as the technology (the technical aspects of STS) to provide quality healthcare for patients (104).

The complexity of the inter-relationships between people and technology suggests that it is not a matter of simply installing new technology to improve performance. For example, with the introduction of a new prescribing system comes a change to the technology and the way in which people interact with each other on a social level (104), making sure all stakeholders are consulted can enable them to embrace the technology and not reject it.

Wears and berg noted that the underlying reason for such failures is not because healthcare Information Systems are not developed “right” but because “the right systems” are not developed to fit in the socio-technical system of clinical work (105). This calls for more process-oriented, user centred studies to be conducted for the socio-technical design of ePrescribing.

The prescribing and administration process is information and time-intensive; each health care profession collects and documents a set of Patient’s medication related data. The medication data produced by different HCPs should be communicated in a timely manner and integrated with that of other data, in order to optimise quality and shared interaction of socio-technical systems such as clinical workflow, communication and collaboration among the MDTs (106).

Therefore, socio-technical systems theory is used in the thesis to enhance understanding of the interface between the social and technical side of the prescribing and administration process and its impact on quality. Table 1-2 outlines the social and technical aspects of the prescribing process, emphasising the specific areas considered within this thesis.

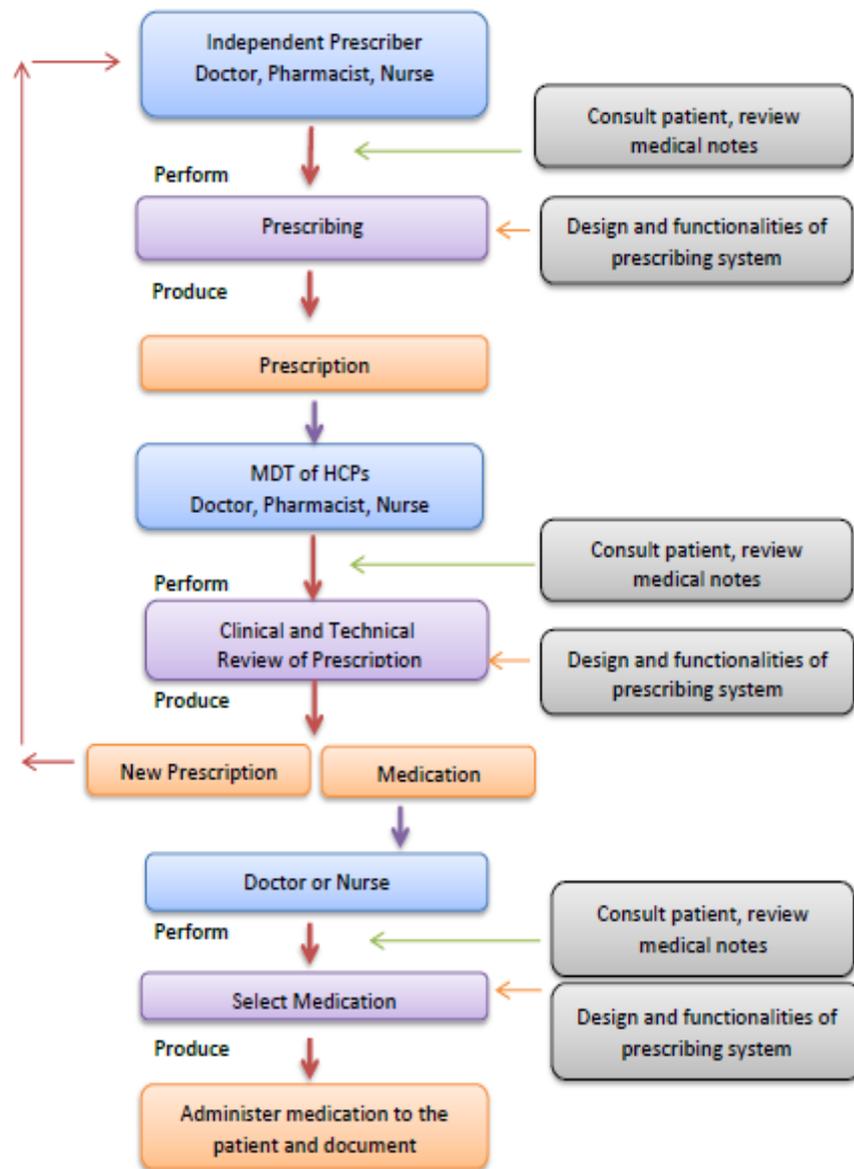
Table 1-2 Socio-technical components of the prescribing process for hospital in-patients.

Technical	Social
Prescribing – Paper and electronic	Communication (written and verbal)
Clinical indication within the prescription	Clinical workflow/ workarounds/ situation awareness
National Drug Chart	Collaboration/Teams
Regulation and Audit	Opinions/views/attitudes/needs/Knowledge/skills
Procedures / guidelines	Culture/approach/value

Figure 1-1 depicts the steps involved in creating a prescription and provides an overview of the prescribing and medicines administration process using either a paper or an ePrescribing system. The model considers and depicts the social and technical aspects of collaborative work, that apply throughout specific elements of the prescribing and administration workflow process (107).

The independent prescriber (actor 1) consults the patient and uses the medical notes (artefacts) to enable the prescriber to perform the action of prescribing (action), within the electronic or paper prescribing system that influences and assists the action of prescribing (design characteristics) and the end-product is a prescription (outcome). The HCPs (actor 2), consult the patient and use the medical notes (artefacts) to enable the HCP to perform the action of clinical and technical review of the prescription (action), within the prescribing system that influences and assists the action of clinical prescription review (design characteristics) and the end-product is a medicine supplied or a new prescription (outcome). The doctor or nurse (actor 3) consult the patient and use the medical notes (artefacts) to enable the HCP to choose the correct medication (action), within the prescribing system that influences and assists the action of choosing the correct medication (design characteristics) and the end product is that the patient receives their medication (outcome).

Figure 1-1 Schematic diagram of the prescribing and medicines administration process (adapted from (107))



Social Technical Systems theory	Prescribing and Medicines administration Process
Social	Actor
Social / Technical interaction	Action
Social / Technical interaction	Outcome
Enable the actor to perform the action	Consult patient, review medical notes
Influence and assists social / technical interaction	Design and functionalities of prescribing system

1.8 Literature search purpose and parameters

Journal papers reviewing the use of paper and electronic prescribing systems in hospitals were initially reviewed to gain an understanding of the subject area. The literature review included both national and international papers, as different prescribing systems are utilised worldwide and within different healthcare systems. However, the core principles are transferable and relevant to the change in prescribing systems. Medline was searched from 01/01/1950 to 01/02/2015, only publications in English were included. The initial search included MeSH terms "Medical Order Entry Systems" also covers (CPOE and CPOE system) * OR "Prescriptions" OR "Drug prescriptions" * OR "Drug Therapy, Computer-Assisted" * OR "Electronic Prescribing". Numerous quantitative methodologies were being utilised to review the safety of the prescribing systems (1,13,28,32–37), yet the amount of qualitative review was limited. Studies showed the importance of workflow issues surrounding prescribing systems and patient safety practices (108). One barrier preventing widespread adoption of ePrescribing was the potential, detrimental impact on clinical workflow (109). The impact that electronic prescribing had on clinical workflow was described as a reason for the slow implementation of electronic prescribing internationally, this became the focus of the main literature review.

A review of the clinical workflow literature was undertaken and after thorough consideration of the databases included; Medline, CINAHL Plus and Cochrane Library. These were included in order to cover the healthcare related journal articles, conference proceedings, and summaries. To include journal articles related to psychology, social, informatics and cognitive sciences the databases Psych Info, IEE Xplore digital library, and Sciences Citation index were also included. MeSH terms and key words to identify prescribing systems and clinical workflow published in the English language were used to detect relevant journal articles published between 01/01/1990 and 01/02/2015.

The following key words were used; For Medline MeSH terms included "Medical Order Entry Systems" also covers (CPOE and CPOE system) * OR "Prescriptions" OR "Drug prescriptions" * OR "Drug Therapy, Computer-Assisted" * OR "Electronic Prescribing" * Medication Errors AND "Workflow" * OR "Physician's Practice Patterns" *. CINAHL Headings included: "Prescriptions, Drug" OR "Drugs, Prescription" OR "Prescribing

Patterns" OR "Medication Prescribing (Iowa NIC)" OR "Medication Systems" OR "Medical Orders" OR "Electronic Order Entry" AND "Task Performance and Analysis" OR "Practice Patterns" or workflow. Other databases searched Prescribing AND Workflow.

The clinical workflow research surrounding the medication process was reviewed to gain a perspective on prescribing systems and clinical workflow in secondary care. A number of published reports relating to clinical workflow were reviewed. These included studies conducted both within and outside the UK with most journal papers from the USA surrounding CPOE systems. The outcome of the literature review has informed the background to this PhD and the methodologies that have been utilised in exploring how prescribing systems and clinical workflow aspects have been investigated.

1.9 Originality

The research outlined examines both paper-based and electronic-based prescribing systems within a hospital environment, in order to explore and compare the different systems and the implications these differences can have on MDTs and therefore key HCPs working practices and the components of quality healthcare (STEEEP). By applying STS theory to the prescribing system, this endeavours to explore how to optimise the interface between the social and technical aspects of the prescribing and administration process to enhance the quality of patient care.

This chapter has reviewed the current literature and outlined the frameworks used to support the findings in a complex healthcare environment. Chapter 2 describes in detail the programme of work. Chapters 3, 4 and 5 outline and discuss the findings of the three phases of the study. Chapter 6 brings together the findings from all methods by triangulation and finally Chapter 7 presents the conclusions.

2 PROGRAMME OF WORK

Having outlined the background to different prescribing systems in the previous chapter, this chapter describes the programme of work by providing its aims and objectives and discussing how these are to be addressed. This is followed by an overview of the three component phases including a description of the methods used and then rationale for the choice of methodology. Within each component, ethical approval, participant recruitment, data collection, and analysis are outlined. The three hospitals in which phases two and three of the programme of work were undertaken are described, along with the rationale for their selection. The chapter concludes with the limitations of the methods used within the programme of work. Further details of the outcomes of each phase are provided in Chapters 3-5. The programme of work is exploratory and requires a system level approach in order to understand how all the complexities of the prescribing system interact and work: this requires a real world setting and is reflected in the aims and objectives.

2.1 Aims and Objectives

The aim of the programme of work was to understand and explore the influence that different in-patient prescribing systems can have on healthcare quality and how the different prescribing systems impact on NHS healthcare professionals (doctors, nurses and pharmacists) working practices in England. The objectives of this programme of work were to explore:

- The type of different in-patient prescribing systems and their design features in acute trusts across England.
- Senior management opinion, on prescribing systems in use within their Trusts.
- The experiences and views of MDT members (doctors, nurses and pharmacists) regarding different prescribing systems, in relation to their working practices and providing quality healthcare.
- The role of clinical indication within prescribing systems, and its impact on quality healthcare and key healthcare professionals working practices.

2.2 Outline of the programme of work

This programme of work has a sequential three phase design, involving qualitative and quantitative (mixed method) approaches. The first phase provides an overview of the use of paper and ePrescribing systems in acute hospital trusts across England; the second and third phases report on the real world intricacies of both paper and ePrescribing systems within three hospital Trusts. The programme of work involved the researcher collecting data, independent of the clinical setting, and analysing data from the three methods. The data from all three methods were then compared and contrasted. This is a valuable approach in providing more robust and valid outcomes and is known as method triangulation (110).

Each of the three phases utilised a different method as follows:

- Phase one: Structured telephone interviews with chief pharmacists.
- Phase two: Focus group discussions with members of MDTs across three hospital sites.
- Phase three: Document analysis of in-patient records under the care of the MDTs involved in phase two.

Data were collected sequentially in the consecutive order shown above. The programme of work enabled the early findings to inform future aspects of the work, with pilot studies incorporated at the start of each phase, assisting the researcher to respond to practical situations that arose.

The three Hospital Trusts providing the in-vivo prescribing system, involved in phases two and three of the programme of work, were at different stages of implementing their prescribing systems. These Trusts are described in detail in Section 2.3. The programme of work design required phases two and three to take place within the same hospitals; this enabled triangulation of the data to take place at the end of the study and inform differences between prescribing systems in different hospital settings.

2.2.1 Design and philosophical location of the study

The use of qualitative research in the area of Pharmacy Practice is slowly on the increase. Within the professional sphere of Pharmacy, its principal research approach has been scientific. Scientific methods involve a systematic study of an area, to minimise the effects of external factors on the data collected and therefore usually involves quantitative methodologies. The primary philosophy on which quantitative methods are based is positivism, which assumes that phenomena are measurable (111). However, not all aspects of pharmacy practice are measurable, especially the opinions of people as in this study. With a transformation in the profession of Pharmacy moving toward a more patient focused profession, the need for interpretivist skills is increasing. Pharmacists as healthcare professionals have more interaction with patients and their relatives requiring good communication skills. Therefore, the methods being utilised in the field of Pharmacy Practice are changing as the philosophical stance slowly brings both a positivist and interpretivist viewpoint closer together.

Conducting qualitative research with a scientific background has provided an understanding of both positivist and interpretivist paradigms when approaching research. Carrying out research in Pharmacy Practice is not straightforward and therefore requires a certain amount of flexibility to designing the research study. Combining both quantitative and qualitative styles has led to a multi-strategy design in order to provide a more complete understanding of a research problem than either approach alone. Qualitative and quantitative approaches should not be viewed as rigid, distinct categories; instead, they represent different ends on a continuum (112).

As a Pharmacist, having previously worked within a multidisciplinary team in the area of Oncology, a less positivist outlook incorporated with a more interpretivist style of questioning has led to a pragmatic worldwide view of research in order to provide the best understanding of the research problem (111,112).

A number of methods have been used to study clinical workflow in relation to prescribing systems and evidence has accrued indicating the efficacy of many different methods. Several studies in healthcare have used a single methodology to investigate clinical workflow surrounding prescribing systems. For example semi-structured interviews alone have been used to explore perceptions and attitudes towards ePrescribing (83,113), surveys alone have been used to look at prescribing systems in use (53–55) or investigate the implementation of ePrescribing and users satisfaction (73,92) and unintended consequences (70).

Focus groups have been used previously in healthcare research to investigate HCPs opinions of prescribing systems. For example experiences and perceptions of hospital pharmacists using ePrescribing (114), the role of computerized physician order entry in facilitating medication errors as discussed by “house staff” (69) and a mixture of HCPs and managerial staff concerns regarding implementation of ePrescribing and the efficiencies or inefficiencies it may bring (87,91). However, no published studies were found in the literature to date, which used MDT based focus groups to understand the perceptions of a whole MDT had about prescribing systems.

A systematic literature review published in 2010 investigated the impact medication systems’ design aspects had on usability, workflow, and medication orders. Of the 19 studies, identified seven were mixed method studies and only four involved the use of more than two methods of assessment. Only three utilised focus groups as a method, none of which included a MDT perspective. Pre and post-tests were prominent within the quantitative methods used. Another literature review that aimed to gain insight into the impact of CPOE systems on clinical workflow reviewed 51 publications. The research designs used were 25 quantitative, 21 qualitative and 5 used a mixed methods approach. The review concluded that more multi-method research is needed to explore ePrescribing’s multidimensional and collective impact on clinical workflow (82)

As the problems in implementing ePrescribing and the impact it can have on clinical workflow were likely to be multidimensional, a methodology was required

that would enable information to be gathered not only about the prescribing systems used but also the opinions of relevant staff. It was therefore decided that, in order to obtain as much information as possible about current impacts on clinical workflow in relation to prescribing systems, the study should have a mixed methodology. An exploratory mixed methods approach was therefore chosen comprising telephone interviews with chief pharmacists, focus groups with MDTs and a retrospective documentation review.

Initially the use of case studies was considered as a design of inquiry for the research to evaluate how the change in prescribing system impacted upon the HCPs working practices (112). The use of case studies would have enabled an in-depth analysis of the three hospitals (110) but not the responses of the chief pharmacists interviewed. Therefore, the research design utilised in the programme of work is an exploratory multiphase mixed methods design that culminated in triangulation of the data from all 3 phases (112). Mixed methods, which include a combination of both quantitative and qualitative techniques, enable a wider range of data to be collected and facilitate triangulation in which findings from one method may be supported or confirmed by findings from another method potentially strengthening results (111)(115). The case study approach to the research design would not have enabled the researcher to carry out triangulation of all three phases, which provides further validity enhancement.

2.2.2 Data analysis: availability of options

There are several specific analytical techniques used to analyse qualitative data and understand how the data was sorted, organised, conceptualised, refined, and interpreted (116). Most qualitative analytic techniques involve generating emergent themes that evolve from the study of specific pieces of information (117). Thematic coding analysis can be used inductively where the codes and themes emerge purely from the researcher's interaction with the data, for example in the grounded theory approach. Other qualitative analysis techniques use deductive data analysis and a priori themes based on theory or extensive research findings, for example Miles and Huberman's framework analysis (117,118). Several

taxonomies of qualitative data analysis have been proposed, these include categorical strategies, for example constant comparative analysis, contextualising strategies, for example phenomenological analysis and qualitative data displays, for example sociograms (117). After review of qualitative data analysis techniques such as the phenomenological approach of Collaizzi's procedural steps (119) and Miles and Huberman's framework analysis (118). The constant comparative analysis method described by Glaser and Strauss, as having four stages, was utilised to carry out data analysis. The core principles of which involve (117)

1. Comparing incidents applicable to each other - each "incident" is compared to a category to which it might (or might not) belong
2. Integrating categories and their properties – comparing "incidents" to tentative versions of rules that will describe the category
3. Delimiting the theory – reducing the original larger list of categories to a parsimonious set of more inclusive, saturated categories
4. Writing the theory

Part of the constant comparative analysis process, as outlined above, was to search for data, which would disconfirm ideas and theories developed, providing the opportunity to refine and modify these ideas. This "negative analysis" is another strategy to minimise bias in the study.

Knowledge of the literature within the field of study can have a role in the analytical process, as proposed by Strauss and Corbin (120). This may enhance sensitivity to nuances in the data. However, where concepts are identified which also appear in the literature, the researcher should examine these to ensure that they are in fact emergent from the data (120). This can be done by comparing their properties, similarities, and differences (120). The strategy of focussing on emerging concepts from the data was adopted, whilst acknowledging the role played by knowledge of the literature in informing the analytical process.

Concerns about the impact of utilising technology when conducting qualitative data analysis were deliberated. Proposed advantages include: Having an organised single location storage system for all stored material that enables quick

and easy access to coded material without using cut and paste techniques (116). The capability to handle large volumes of data and force detailed consideration of all text in the database on a line-by line basis (116). The software can help the development of consistent coding schemes as well as displaying results in many ways, it can also analyse differences, similarities and relationships between coded elements (116). On the other hand, proficiency in their use takes time and effort and can distance researchers from their data. No software package is capable of perceiving a link between theory and data or defining an appropriate structure for the analysis (121). To undertake analysis requires the researcher's analytical skills rather than basic descriptive and counting exercises (121). The dominance of code and retrieve methods to the exclusion of other analytical activities could occur.

The above concerns were considered when carrying out data analysis of the MDT focus groups when using the computer software NVIVO. Having experienced qualitative data analysis without using the NVIVO software, the differences between the two approaches to analysis were noted by the researcher. This provided foresight to the pitfalls of data analysis using computer software. The researcher ensured that whilst using NVIVO, the ability to understand the context as well as the detail within the text was remembered.

2.2.2.1 Method of triangulation

As mentioned in the previous chapter, existing research has sought to investigate the impact prescribing systems can have on HCPs working practices by taking the opinions of individual HCPs perspectives, rather than a MDT perspective. Mixed methods utilised in the research area of clinical workflow and prescribing systems have been minimal. This programme of work was designed to explore each of the HCPs perspectives as well as the MDT perspective and their interrelatedness, in order to take account of a more real-life approach to the impact of prescribing systems on quality of care in the NHS.

Triangulation is a strategy used to enhance validity, by using multiple sources of information to enhance the rigour of the research study. Triangulation is

a common practice in health research and Pharmacy practice (122). It is a useful strategy in overcoming reactivity, researcher bias, and respondent bias.

There are four types of triangulation proposed by Denzin 1988. These include (110):

- Data triangulation – The use of more than one method of data collection
- Observer triangulation – Using more than one observer in the study
- Methodological triangulation – Combining quantitative and qualitative approaches
- Theory triangulation – Using multiple theories or perspectives

Within this research design, various forms of data and methodological triangulation were utilised in order to incorporate rigour into the programme of work and its findings. These forms of triangulation have been established to provide complementary perspectives of appropriateness so that a more complete understanding of the phenomena can be obtained (123). This understanding provides additional evidence about what is known, and not known about the subject and includes the barriers and frustrations experienced by MDTs and Management when considering the impact of prescribing systems, on working practices. Data triangulation involved the data collected from the chief pharmacists, MDT's and patient records. These three different data sources explore the impact of prescribing systems from a variety of different viewpoints. This data also varies in the level of abstraction, the highest being the patient records, next the chief pharmacist interviews, with the MDT's focus groups supplying the richness of detail. Analysis of the data involved inter-relating the varying levels of abstraction but also viewing the prescribing system and process from an individual's level, a member of the MDT and part of the larger organisation.

Since any method can have weaknesses and strengths, method triangulation incorporated into the research design, increased reliability by reducing method error. Methods in the programme of work were carried out in the consecutive order of telephone interviews, focus groups, and document analysis.

Finally, socio-technical systems theory integrated the overall findings from data and methodological triangulation in the programme of work. Socio-technical systems theory provided the backbone and general explanation of the phenomena.

2.2.3 Phase 1: Telephone Interviews

This phase involved structured telephone interviews with chief pharmacists or senior members of staff, nominated by the chief pharmacist. Liverpool John Moores University (LJMU) Research Ethic Committee (REC), on the 9th December 2011 (approval no.11/PBS/014 see Appendix 9.1.1) gave ethics approval.

2.2.3.1 Aims and objectives

The aim of the telephone interviews was to ascertain the extent of different in-patient prescribing systems and their design features used within secondary care by eliciting the views of acute trust chief pharmacists, across England.

The objectives were to explore

- The type of prescribing systems in place in acute trusts across England and how long these have been in place
- The nature and functionalities within the prescribing systems
- The relationship between the prescribing systems and prescribing quality
- Chief Pharmacists' views on the use of clinical indication on the prescription chart as per the published standards.

2.2.3.2 Rationale

The rationale for telephone interviews with acute trust chief pharmacists across England was to gain a senior management opinion about what is happening and what might be happening regarding prescribing systems across the country. By acquiring chief pharmacist's experiences and their appreciation of the prescribing

systems, rather than frontline staff opinions, a senior systems level viewpoint was obtained.

Previous research regarding this area of interest had utilised convenience sample surveys, obtained during ePrescribing conferences to gain an understanding of prescribing systems in use (54). Self-administered questionnaire based surveys can typically have a low response rate (124), however, a recent study designed on a large scale, utilised a self-administered postal questionnaire and gained a 61% response rate through use of extensive follow up and resources, in relation to prescribing systems (55).

A self-administered postal questionnaire was initially considered; however, when comparing response rates between a postal questionnaire and a telephone interview, the telephone interview typically gets a better response rate (124). The need to engage the Trusts with further research was also a secondary objective of phase one, using Telephone Interviews provided a personal contact to build a rapport with potential research hospitals. The Trusts that provided the real world setting for phases two and three were recruited from the hospitals that participated in the telephone interviews. The use of telephone interviews allowed more in-depth responses to be gained than would otherwise be expected from similar open questions in a self-administered questionnaire (124). The high level of knowledge of the interviewees offered the researcher an opportunity to explore issues in depth. By using telephone interviews, the researcher could quickly contact a large number of potential participants and interview them without having to travel all over the country, therefore saving time and money.

2.2.3.3 Participants

Participants in phase one were chief pharmacists or senior members of staff, nominated by the chief pharmacist, with the required knowledge at each acute trust about the in-patient prescribing system within the data collection period. Chief pharmacists working in specialist Trusts such as Children's, Women's, Oncology, Cardio-thoracic, Neuroscience, and reconstructive surgery were excluded

due to the specialist nature of the information required on prescription charts, that would raise difficulties when comparing and contrasting data obtained.

2.2.3.4 Recruitment

From the National Health Service (NHS) (125) database at the time of data collection (accessed through the respective web portal), there were 146 non-specialist acute trusts within England, consisted of 29 small acute organisations, 49 medium acute organisations, 42 large acute organisations and 26 acute teaching organisations.

A letter (a copy is provided in Appendix 9.1.2) was sent to all chief pharmacists across England, whose pharmacy department contact details were obtained from the NHS Choices website (125) to ensure that they were aware of the study before contact via telephone. This letter outlined the background to the study, enclosed the participant information leaflet (a copy is provided in Appendix 9.1.3) and indicated that the researcher would be in contact in a few days.

Telephone contact was made after a standard time frame of three working days to ensure enough time for delivery had passed. Telephone interviews were conducted between Monday 9th January 2012 and Friday 17th February 2012.

The researcher contacted each chief pharmacist to confirm that they had received the letter about the study and if they would be interested in taking part. If the potential participants had not received the letter or they had misplaced it, with permission, the researcher sent on an e-mail version of the letter and participant information sheet. The researcher followed up with at least two phone calls to try to recruit participants. Messages were left regarding the research if it was possible to leave an answer machine message.

2.2.3.5 Data Collection

Informed consent incorporated in the telephone interview schedule (a copy is provided in Appendix 9.1.4) was obtained by explaining the research to the potential participants, if they were happy to continue, the researcher verbalised

each of the statements on the consent form and sought agreement from participants. The telephone interviews were recorded using a digital audio recorder, a separate file being used for each interview. The semi-structured interviews included closed questions as well as asking open questions to encourage conversation. Using open questions allowed the participant to develop their response.

Participants' answers to the closed questions were recorded using a tick box format that was incorporated within the interview schedule. The researcher transcribed open question data obtained from the interview. The interview was to be no longer than 15 minutes with a semi-structured format in order to minimise inconvenience to the participant.

A pilot study was undertaken to ensure that the recruitment procedure and the structured telephone interview questions were clear and appropriate.

2.2.3.6 Data Analysis

Analysis began as soon as the interviews took place. During the interviews, the researcher noted any points that had not previously occurred. The interviews were transferred and saved from the digital audio recorder to a computer after the end of each interview. A unique recording number was allocated to each recording, which became the identification number for each participant and corresponding transcription. The quantitative data were transferred from the interview schedule completed for each interview and put into an Excel[®] document for analysis. The interviews were then transcribed using Microsoft Word 2007. Any personal information was removed at the transcription stage. Data in the excel documents and transcriptions were double-checked for quality assurance purposes prior to any analysis-taking place.

The interviews were analysed using content analysis and thematic analysis. Content analysis was conducted on all the interviews; this enabled the researcher to look at the diversity of data, consider data saturation, and assisted the researcher in becoming more familiar with the data. A stratified purposive sample

of interviews was selected; more details on the sampling criteria are included in the qualitative results (Section 3.3.2.). Thematic analysis was carried out with the purposive sample of the data collected, from the structured telephone interviews. One of the study supervisors, with experience of qualitative data analysis, independently verified key themes to ensure that the theory framework was appropriate and valid. Chapter 3 provides further details and the findings of the structured telephone interviews.

2.2.4 Phase 2: Focus Group Discussions

This phase considered the views of the multidisciplinary team, which consisted of doctors, nurses, and pharmacists, providing quality of care services, and the affect that different prescribing systems can have on their working practices. The staff perspective, gives an understanding of their concerns, along with helping to identify potential solutions to these. Participants were recruited because of their professional role within the multidisciplinary team and their use of the prescribing system.

Research involving the staff of social care providers, is excluded from the normal remit of the National Research Ethics Service (NRES) under the harmonised edition of Governance Arrangements for Research Ethics Committees (GAfREC) (126). Therefore, ethical approval was sought from and granted by Liverpool John Moores University (Appendix 9.2.1). Approval from each of the Trust's research and development (R&D) departments was also obtained in line with NHS organisation policies for research involving NHS staff and premises.

A pilot study was undertaken, to ensure that the recruitment procedures and focus group schedule were robust and ran smoothly without missing any important points relevant to the research. The pilot study did not highlight any specific issues with the focus group recruitment or schedule and as such was included in the data analysis.

2.2.4.1 Aims and Objectives

The aims and objectives of phase two was to explore how different prescribing systems have an impact on the working practices of key Health Care Professionals (doctors, nurses, and pharmacists) within their multidisciplinary teams.

The objectives were

1. To explore key healthcare professionals' opinions of different prescribing systems and the influence prescribing systems have on their working practices.
2. To determine the impact of different prescribing systems on patient safety, as perceived by key healthcare professionals.
3. To explore key healthcare professionals' opinions of including a clinical indication on an in-patient prescription.

2.2.4.2 Rationale

It was considered important to get the MDT members views as a team and not in isolation from each other because the topic inherently influences the complete multidisciplinary team. Moreover, as discussed in Chapter 1, the prescribing systems are not used in isolation by any one HCP within the MDT; HCPs interact with the prescribing system individually and the prescribing system forms the hub of their communication around medicines use. As such, the inputs and outputs from the prescribing system will be influenced by the desire to communicate a point to another user when conveying information and to understand the intention and meaning of others when interpreting information. When the way in which the prescription chart is used by different HCPs is considered, all with certain priorities, different aspects of the prescribing system and prescription chart may benefit some HCPs and not others. Previous research as

outlined in Chapter 1 considered the unintended consequences of new prescribing systems on an individual basis rather than from a team perspective. By using a focus group approach, the method used can mimic, to a point, the work environment of the MDT and consider their interactions within a team setting as well as gaining a frontline perspective.

Other group methods that were considered for this phase included group debate, group interviews, Delphi groups and nominal groups all of which can provide diverse views on a topic. However, these group methods seek to reach a consensus (127). In addition, the aim of the phase was to explore the MDT's experiences and in-depth information about the quality issues with the prescribing system. Using focus groups provided in-depth information from the team on a specific topic, which consists of open-ended group discussions, guided by the facilitator or researcher.

Focus groups give an opportunity for the team/group to discuss in-depth their team experiences and give the researcher an opportunity to see the group dynamics across the team. The rationale for using focus groups is that they enable rapid identification of different people's views relating to a specific area of interest, without specifically attempting to find a consensus (127). In order to gain a good understanding of MDT's perspectives on the research topic, focus groups provided the methodological rationale for the situation (127). The use of open-ended questions within a focus group facilitated participants, as in the real world, to consider other participants' thoughts and comments and can therefore stimulate and form their own opinion in response to others (127). Having different HCPs from the same multidisciplinary team within a group provides different professional backgrounds, viewpoints, and experiences which can stimulate and enrich the discussion. This can also inspire other group members to look at the topic in a different light.

Bearing in mind a heterogeneous group may risk power imbalances and that a dominant participant could destroy the group process it was important to recruit participants from the same multidisciplinary team in order to have a common

background (127). Group communication was facilitated by having the same multidisciplinary team within a focus group, and then ideas could be exchanged more readily. The amount and range of data that can be gained from a team of people at the same time in focus groups compared to other methodologies provided further rationale. Conflicts and concerns are more likely to be discussed within a homogenous group as participants have a greater sense of safety.

The size of the focus groups is important as it can affect the discussion. Group size is usually four to eight people (128), allowing all of the participants to be part of the discussion and share their thoughts, whilst large enough to obtain diverse opinions on the topic. Smaller groups let participants share more ideas but can result in a reduced pool of ideas (129). Smaller sizes are therefore more suitable where all respondents participate fully, for example health care professionals or experts in the field.

The main barriers to conducting a successful focus group tend to be organisational and practical difficulties: identifying enough participants that can be available at the same time and in the same location (128). Therefore, both face-to-face interviews and focus groups were deliberated and included within the ethics application made to each Trust because of the concern regarding recruitment. However enough HCPs agreed to take part and managed to attend the focus group sessions that took place within each Trust, consequently face-to-face interviews were not conducted.

2.2.4.3 Participants

Participants (members of MDTs) were recruited from three acute trust sites (known as hospital A, B and C) selected from those who participated in phase one. Details of hospital selection and further information about each hospital are provided later in Section 2.3. Healthcare professionals [HCP] (registered doctor, pharmacist or nurse) using the prescribing system on a regular basis (paper or electronic) in use within each hospital were recruited. Where the hospital had a newly implemented ePrescribing system the HCP must have previously used a paper-based system in order to be able to compare systems.

2.2.4.4 Recruitment

The researcher contacted the chief pharmacist (Trust Gatekeeper) of each Trust via email (a copy is provided in Appendix 9.2.2), to obtain their consent (a copy is provided in Appendices 9.2.3 and 9.2.4) for the researcher to contact clinical ward pharmacists within the hospitals. Once the chief pharmacist had agreed to take part in the study, approval from the hospitals research and development (R&D) department was obtained. Once R&D approval had been given, the chief pharmacist introduced the researcher to the clinical ward pharmacists (ward gatekeepers). The researcher discussed the study, and any concerns the ward gatekeeper had about the study. Once their consent (a copy is provided in Appendices 9.2.5 and 9.2.6) was obtained, the study was advertised locally.

The researcher was present at the hospital to help clinical ward pharmacists distribute the recruitment packs on their wards and provide additional information to perspective participants. The clinical ward pharmacists within each hospital recruited HCPs that work together as a multidisciplinary team within the same ward area. The recruitment pack included an invitation letter (a copy is provided in Appendix 9.2.7), Participant Information Sheet (a copy is provided in Appendix 9.2.8) and an Expression of Interest (a copy is provided in Appendix 9.2.10). Those HCPs who were interested in taking part in the study could return a completed expression of interest form with their telephone and e-mail contact details to the researcher via the ward pharmacist, e-mail, or internal post. The researcher then contacted interested participants, by telephone or e-mail, to arrange the focus groups. Those whom were willing to take part were asked to complete and sign an informed consent form (a copy is provided in Appendix 9.2.9).

Focus groups were conducted with the main users of the system, (doctors, nurses, and pharmacists). Multidisciplinary teams were selected; members of the team were then recruited. Medical and surgical MDTs were included from the specialities of gastroenterology, nephrology, endocrinology, cardiology, orthopaedics, colorectal surgery, and general surgery.

The following inclusion and exclusion criteria were:

Inclusion - Currently working as a healthcare professional [HCP] (registered doctor, pharmacist or nurse) using the paper or ePrescribing system in use within the Trust on a regular basis (at least once in every shift/day worked). Where the Trust has a newly implemented ePrescribing system the HCP must have previously used a paper-based system in order to compare the systems.

Exclusion – Healthcare professionals not currently working in secondary care as a registered doctor, pharmacist, or nurse or not using the paper or ePrescribing system on a regular basis (at least once in every shift/day worked).

2.2.4.5 Focus Group schedule and structure

During the focus groups in Hospitals A and B (Section 2.3), the interaction each doctor, nurse, and pharmacist had with the ePrescribing system was discussed and how the system could facilitate or hinder their working practice. The focus groups that took place in Hospital C, without ePrescribing, were asked what their perceptions of ePrescribing were and how they believed it would impact upon their work.

To assist with the focus group process, and to reduce moderator bias, a schedule for the focus groups was developed and designed from existing literature, the findings from phase one and discussions with the supervisory team (a copy is provided in Appendix 9.2.11). The schedule provided an initial structure for the focus groups, with open questions to stimulate participant interaction and debate. The characteristics of participants in each focus group were obtained from the ward gatekeeper, consent form, and introductory questions. Initially, participants were asked about their experiences of the prescribing systems they had worked with in general. The intention was to make the participants comfortable, and for the moderator to discover how participants felt initially about the prescribing system within their hospital. Each focus group then explored how ePrescribing had impacted (Sites A and B) or could impact (Site C) upon the HCPs' working practice. The key areas of interest came from the literature review and phase one findings, keeping the questions very open facilitated discussion around the areas of interest. Key areas of interest included:

- Communication and collaboration
- Clinical workflow
- Patient safety
- Value and effectiveness of including a clinical indication on an in-patient prescription.

Each focus group then concluded with an open question inviting the participants to discuss any information they thought would be useful for the moderator to know, providing an opportunity for all participants to discuss any further subjects they thought were relevant.

2.2.4.6 Data Collection

All the focus groups were conducted at each of the three hospital sites and were organised at a mutually convenient date and time in a suitable location, taking into account healthcare staff workload and pressures. Written consent was obtained from participants prior to the focus group taking place. All the focus groups were recorded using two digital voice recorders.

A pilot focus group discussion was conducted to consider recruitment, assess content validity of the schedule and methodology.

2.2.4.7 Data Analysis

The discussions in the focus groups were transcribed verbatim, before being thematically analysed. All data obtained were anonymised with any names of people or organisations removed. Thematic analysis using the constant comparative analysis framework (130) was undertaken using the computer software NVivo® version 9 in order to explore the views of the healthcare professionals and establish and explore any trends, links or key themes highlighted by the subjects. One of the study supervisors, with experience of qualitative data analysis, independently verified key themes to ensure that the theory framework was appropriate and valid. Further details and the findings of the focus groups are discussed in Chapter 4.

2.2.5 Phase 3: Documentation review

NHS hospitals produce a lot of medical documentation because everything should be documented, especially with regard to the patient and their healthcare treatment whilst an in-patient, therefore providing a good source of data for research. When HCPs enter medical information in the patient's medical notes it tends to read like a "story", which has historically transpired. This story sometimes provides relevant clinical findings, the decisions made, the information given to the patients and any drugs prescribed or other investigation or treatment (12).

There is limited information available about the change in clarity and accuracy of prescription charts when moving from paper to ePrescribing systems. The aim of this phase was to explore how different prescribing systems impact on the clarity and accuracy of the prescription chart and medical records, with a focus on newly initiated medication. A mixed methods approach using concurrent collection of qualitative and quantitative data was used through document review (115).

The National Research Ethics Committee in the North West, Cheshire, and part of The Health Research Authority (HRA) was contacted in September 2012 to confirm that the proposed research was classed as a service evaluation (Appendix 9.3.1). In accordance with GAfREC 2012, the project is considered a service evaluation; consequently, it did not require review by an NHS research ethics committee. Ethical approval was sought and obtained from Liverpool John Moores University (LJMU) (Appendix 9.3.2). Research and development approval from all three hospitals was required and obtained, further information provided in section 5.2.

The same three hospitals in phase two were used for phase three along with the same general medical and surgical wards that the Multidisciplinary Teams worked on when recruited to take part in the focus groups. The wards were included in the study to obtain the patient-related documents connected to the MDT's in phase two.

2.2.5.1 *Aims and objectives*

The aim of this study was to explore how different prescribing systems affect quality components (STEEEP), through HCPs working practices and the clarity and accuracy of the prescription chart and medical records, with a focus on newly initiated medication. Its objectives were:

- To compare the clarity and accuracy of the prescription chart, between prescribing systems
- To explore the factors that affect the clarity and accuracy of prescription charts in Hospitals A, B and C.
- To consider the clarity and accuracy of documentation in a patient's medical records, once a prescription is newly initiated, as a risk factor for medication errors in the in-patient setting
- To consider the timeliness of prescribing and documentation, in newly initiated medications, as an indicator of clinical work-flow and communication
- To deduce how often patients were informed about their newly initiated medications and included in the decision making process

2.2.5.2 *Rationale*

Documentation review is an unobtrusive methodology in that it enables a researcher to analyse material retrospectively, such as the prescription chart or the medical notes of an in-patient, and is therefore non-reactive in that the document is not affected by the fact that the researcher is using it (131). The data are in permanent form, which can facilitate re-analysis, allowing reliability checks and studies to be replicated. Krippendorff (2004) defines content analysis as “a *research technique for making replicable and valid inferences from texts to the contexts of their use*”. His definition stresses the relationship between content and context such that it is important to consider that the documents were produced for a purpose (131). Carrying out documentation review allows the researcher to probe and gain information about the topic being explored and supports or refutes findings from other methodologies used. The methodology utilised by the

professional colleges (2) did not include any electronic prescription charts for review, to inform the standards. It was acknowledged, when reviewing the paper prescription charts that they needed to obtain original paper prescription charts, in order to directly observe the design features often not appreciated using PDF versions, such as variations in colour, boldness of typeface and variation in page size (2). Therefore, when carrying out phase three documentation review, the researcher viewed the “live” EPMA systems, this was important to appreciate the design features of the specific EPMA systems within Hospitals A and B.

Documentation review permitted the researcher to navigate and review the prescription chart and consider its design clarity and accuracy with the support of other patient related documents also confirming the accuracy of the information gained. In addition, certain Trust-specific policies were reviewed.

2.2.5.3 Documents

The documents reviewed at each hospital included patient specific hospital-based healthcare records; medical notes, nursing notes, pharmacy notes, and prescription charts in relation to selected patients over a specified period. In addition, general prescribing policies in place nationally and within each of the Trusts related to the specific patient cases were taken into account.

2.2.5.4 Document selection and permission

The inclusion criteria for document selection were:

- Patient resident on study ward during the specified 7 day period
- New medication initiated during in-patient admission period
- Patients whose length of stay on the specified ward is greater than 24 hours

Exclusion criterion for continued inclusion:

- Patients whose length of stay on the specified ward is less than 24 hours
- No new medication initiated during in-patient admission period

2.2.5.5 Data collection

Each prescription chart along with the medical, nursing, and pharmacy notes were reviewed for each patient admitted to the study ward over a 7-day period following the inclusion and exclusion criteria above. Each patient who was prescribed a newly initiated medication during the course of their stay on the specified ward was identified and their healthcare records relating to that admission were reviewed retrospectively by the researcher.

The recording unit: All note entries made for every newly initiated medication that was prescribed during a patient's admission on the study ward. This was done by identifying all the new medication prescribed; notes were then reviewed and entries copied verbatim if any reference to the newly initiated medication was documented.

A pilot study was undertaken in the same Trust as phase Two, in order to determine which data needed to be extracted from the patient-related healthcare documents to ensure that the data collected were appropriate to meet the aim of the phase.

Other hospital documentation related to prescribing and the prescribing system, but not related to a specific patient case, was collected during fieldwork to deliver context to the study and inform the researcher about the scenarios encountered. For example, the use of order sets and the hospital policy in relation to their use were explained. The documents enhanced the exploration of patient-specific data collected and the overall data collection and analysis process.

2.2.5.6 Data Analysis

All data obtained were anonymised with names and references to organisations removed. Anonymous data were entered into a study database before being analysed. A mixed methods' approach of concurrent mixed data analysis (115) was undertaken; the qualitative analysis of written documentation expanded on the initial understanding gained from the descriptive quantitative analysis. The data were integrated in the interpretation of the overall results.

Document analysis followed a systematic approach, reviewing and evaluating both handwritten and electronic documents. Documentation review was used in order to explore the written documentation made by the healthcare professionals and establish and explore any trends, links, or key themes highlighted. Navigating the EPMA system used in Hospitals A and B enabled the researcher to observe and understand issues emphasised in the previous phases. Documentation review provided case study examples and understanding into why events had occurred. The exploration of healthcare records and the prescription did not set out to look at specific specialities or clinical situations; therefore, the variety of specialities reviewed provide context to the study. Further details and the findings of the documentation review are discussed in Chapter 5.

2.3 Hospital sites for phases two and three

The findings from the telephone interviews indicated that the prescribing systems in place in acute trusts were very different across England (further details are provided in Chapter 3) and varied in terms of both the type of prescribing system used and the size and location of the acute trust hospitals. These informed the selection criteria for the three study sites for phases 2 and 3 in order to capture some of the diversity of the prescribing systems across England.

The three hospitals selected for the programme of work, each had a different prescribing system in place that had implemented within the last 18 months, to enable a comparison between the different prescribing systems to be made. The three hospitals selected had previously taken part in the telephone interviews (phase one) and were amongst those that had agreed to participate in further research. The three hospitals are described below and are subsequently referred to as Hospitals A, B and C in order to distinguish their prescribing system characteristics and variations in relation to the research.

2.3.1 Hospital A Prescribing System

Hospital A is a district general hospital in England with 600 beds (125) that implemented an EPMA system, which is part of a commercially procured system

supplied by *Meditech*[®] (*Medical Information Technology Incorporated*); the system originated in the US in 1969 (132). The hospital wanted a single electronic management interface for patient-related clinical data; as such, since *Meditech*[®] was already providing the hospital with the Patient Administration System (PAS version 5.6) prior to implementation of the EPMA, it was logical to use the *Meditech*[®] EPMA software. This allowed the prescribing system to communicate with the existing hospital software, making it an integrated system that retrieves patient data. The support for making a clinical decision available within the system has many functions; the functions were limited initially to drug interactions and allergies but also included order sets. Certain types of medications such as infusions and taper schedules to decrease or increase the dose and/or frequency of a medication (e.g. Insulin regimens) were still prescribed on a paper prescription but also entered in the EPMA system as a reminder to check for an accompanying paper prescription chart.

Implementation of the EPMA system started in November 2011, using a staggered, yet quick rollout to all in-patient wards over a five-month period. The EPMA system is currently used on all adult in-patient wards. The *Meditech*[®] EPMA system enabled nurses, pharmacists, and doctors to annotate prescriptions and facilitated staff to incorporate their own nursing or pharmacy notes. Paper medical notes, however, were still the mainstay of written documentation for doctors.

In Hospital A, the prescribers' view of the prescription chart appears all in the one process screen with active and discontinued medications (highlighted in blue) for each patient admission in the same list as shown in Figure 2-1. As each prescription item is added an "r" appears next to it in the note column within the process orders screen, once checked by a pharmacist to indicate that the prescription is clinically approved the "r" is no longer visible. The listing sequence of medications as they appear on screen from top to bottom is once only (Stat) medication, PRN medication, regular medication and discontinued medication (in BLUE), within each category they are in alphabetical order.

Figure 2-1 Example of a prescription chart used in Hospital A

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital A, EPMA system.

In Hospital A, Stat medications have to be prescribed independently of any other medication type. At the order type field the prescriber must select one and press <return> and then prescribe the Medication, Dose and Route as for Regular Medications, the start date and time and stop date and time defaults in. Prescription order sets are abbreviated to SETS; they enable simultaneous prescribing of a list of standard medications used for a specific indication (via a Look Up menu for selection of the correct SET). Medications from the SET can be deleted if they are not required or they are duplicate orders.

2.3.2 Hospital B Prescribing System

Hospital B is a teaching hospital in England with 750 beds (125) that implemented an EPMA system, which is part of a commercially procured system supplied by JAC®; the system originated in the UK in 1983 (132). To retrieve patient data, JAC communicates with the existing hospital information system (HIS). The EPMA system during the study was not used on all in-patient wards. Therefore, the prescribing system at Hospital B consisted of a specific paper prescription chart adapted for use on the Medical Admissions Unit (MAU) only, with the EPMA system being used on the rest of the in-patient wards. This study took place on specific in-patient wards excluding the MAU and consequently only the EPMA prescribing system was reviewed.

Clinical decision support within the EPMA system had many functions but was limited initially to drug interactions and allergies, as well as order sets. As with Hospital A, certain types of medications such as infusions and taper schedules to decrease or increase the dose and/or frequency of a medication (e.g. Prednisolone reducing dose) were still prescribed on a paper prescription but also entered in the EPMA system as a reminder to check for an accompanying paper prescription chart.

Implementation of the EPMA system started in January 2011, using a staggered rollout, taking approximately 18 months. Preference was for patients to be discharged from the ePrescribing system: for this reason, feeder wards (e.g. MAU) were left until later to enable patients to move from paper to electronic wards rather than *vice versa* as this involved fewer transcriptions to take place. As such, the EPMA system was used on in-patient wards but not the MAU. The prescribing system in hospital B is a combination of paper prescribing and EPMA prescribing.

The JAC® EPMA system enabled doctors, nurses, and pharmacists to annotate prescriptions and facilitated them to incorporate their own nursing, pharmacy, and medical notes. Paper medical notes, however, were still the mainstay of written documentation.

In Hospital B, the view of the prescription chart is separated into two folders; each folder or “tab” displays the active and discontinued medications for each patient admission as seen in Figure 2-2. As each prescription item is added, it is displayed with a blue background, once checked by a pharmacist the background changes to white. Prescription items are placed in sections, which are separated by yellow dividers and come in the order of regular and Stat medications together, PRN, TTO & Short Term Leave.

Figure 2-2 Example of a prescription chart used in Hospital B

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital B, EPMA system.

In Hospital B the EPMA system performs two functions from one drug selection. When the item is prescribed on a regular basis, an associated Stat can be prescribed at the same time as seen in Figure 2-3.

Figure 2-3 Prescription chart screen used in Hospital B showing how an associated eStat medication is prescribed

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital B, EPMA system.

To do this, the prescriber has to click on the “create associated Stat” order button, in addition to the regular order details. This then processes the regular order, and retains the drug item to enable the eStat order to be created. When all the fields are completed, both orders are added to the prescription in their appropriate sections.

In Hospital B, prescription order sets are called treatment protocols and can be used to enable users to prescribe pre-agreed sets of drugs in one transaction. There is an option when adding a prescription item to select a treatment protocol; in the drug name section, the name of the treatment protocol is entered. If the prescriber does not know the name of the protocol they can enter * as the drug name to reveal ALL protocols. Although the details of each item have been pre-set according to the agreed protocol, any of these fields may be changed. Items can be de-selected which are not required, a red cross appears confirming that the item will not be prescribed.

2.3.3 Hospital C Prescribing System

Hospital C is a district general hospital in England with 480 beds that has a paper prescribing system in place on all in-patient wards. A new formatted paper prescription was implemented in January 2012 after piloting the paper chart, which

is an A4 paper booklet containing 6 pages with the top part removed, so that patient details are always visible, see figure 2-4.

There is no instant clinical decision support available within the system compared to ePrescribing systems. Written documentation by HCPs, once the paper prescribing system was implemented, did not change. Doctors, nurses, and pharmacists could annotate prescriptions by hand; their main written documentation did not change with paper medical notes still the main stay of written communication.

Figure 2-4 Example of a prescription chart used in Hospital C

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital C, paper prescribing system.

2.3.3.1 Chapter Summary

This chapter has outlined the programme of work, including aims and objectives, and described the rationale for the methods used within each of the three phases. The reasons for choosing the three Hospital Trusts where the research took place in phases two and three is given along with a general overview in relation to prescribing systems within the Trusts. The next chapter of the thesis gives an account of the telephone interviews conducted in phase one, and the subsequent chapters describe phases two and three followed by a final triangulation discussion chapter.

3 ONE NHS, MANY SYSTEMS: ASCERTAINING THE TYPE OF PRESCRIBING SYSTEMS USED IN ACUTE TRUSTS ACROSS ENGLAND

Having described in the previous chapter the methodologies, rationale, data collection and analysis for the programme of work, this chapter will focus on phase one. The aims and objectives are reiterated to facilitate the findings that are then presented and summarised, which informed the next phase of the programme of work.

3.1 Aim and Objectives

The aim of the telephone interviews was to ascertain the type of different in-patient prescribing systems and their design features used within secondary care by gaining the views of acute trust chief pharmacists, across England.

The objectives were to explore

- The type of prescribing systems in place in acute trusts across England and how long these have been in place
- The nature and functionalities within the prescribing systems
- The perceived relationship between the prescribing systems and prescribing quality
- Senior Pharmacy Management views on the use of clinical indication within the prescription chart design, as per the published *standards for the design of hospital in-patient charts* (2)

3.2 Method

During January and February 2012, structured telephone interviews were completed with chief pharmacists or their nominated senior staff members. Of the 146 chief pharmacists that were contacted regarding the telephone interviews, sixty-five Acute Hospital Trust chief pharmacists agreed to take part, which resulted

in a 45% response rate. Details of the methodology and a description of the method have previously been discussed in Section 0.

The interview questions were developed based on existing literature, previous questionnaires, discussions with the supervisory team and the pilot study. The pilot study consisted of three telephone interviews with chief pharmacists, one Trust was using ePrescribing, and two Trusts were using paper prescribing. The pilot study interviews ran smoothly, therefore no significant changes were made to the structured telephone interview questions.

The interview schedule consisted of open and closed questions (Appendix 9.1.4). The questions asked covered the following areas: the prescribing system, use of clinical indication and the reporting system for prescribing errors. The interview commenced with the interviewer asking basic questions such as, how many acute hospitals were in the acute trust and what prescribing system was in place, to enable the participant to feel comfortable with the interviewer. Probing questions were included if the participant gave short, one word answers to allow a conversation to build.

A stratified purposive sample (133) was obtained from the sixty-five interviews, for qualitative thematic data analysis, in which acute trust size and Cluster Strategic Health authority (SHA) region were the strata (134), see Table 3-1. One interview for each of the 16 “cells” for paper prescribing were analysed where possible along with the 12 interviews conducted about ePrescribing. Three additional interviews were also selected, as they were particularly information rich, this incorporated extreme case sampling (124). Table 3-1 presents the interviews obtained from each stratum for purposive sampling. Qualitative data analysis of the 12 interviews with chief pharmacists whose Trust used ePrescribing, and 18 from those who used paper prescribing took place.

Table 3-1 Number of interviews obtained from each stratum for purposive sampling.

Size of Acute Trust	SHA Cluster North	SHA Cluster Midlands	SHA Cluster South	SHA Cluster London
Small	4	8 (1)	3 (1)	1
Medium	10 (2)	8 (1)	3	1
Large	7 (1)	4 (1)	3	0
Teaching	5 (2)	3 (1)	3	2 (2)

* Numbers in red represent interviews conducted about ePrescribing

The interview data were collated and pulled into a Word Document under each question and section of the interview bringing together the answers from each interview to be analysed. The initial stage of analysis was to break down each of the interviews to identify codes; the researcher went through each document identifying codes and referring back each time to previous codes to ensure a new code was required or the data were linked, this is referred to as constant comparison analysis (130). Similar codes were identified within the Word document by highlighting specific sections with the same colour for each code represented. These codes were then written on a post-it note and placed onto an A3 sheet of paper for all purposively sampled interviews. The researcher was then able to see all the codes produced from the data. Grouping of the initial codes then occurred by moving around the post-it notes, as required, into a smaller number of themes. The next stage of the analysis involved giving each of the themes a sub-theme and major theme to enable comparisons to be made again between the different interviews and to check if the themes worked in relation to the entire data set. The sub-themes were then compared to discover trends and differences, which were included in the findings report. One of the study supervisors, with experience of qualitative data analysis, independently verified key themes to ensure that the theory framework was appropriate and valid.

The transcribed interviews revealed a number of key insights, which are described below. Quotations were used to support the sub-themes and major themes, which were established. The quotes were left in the language of the

participant to show how the interviewees expressed themselves. The size of the Trust is provided in brackets to preserve the participants' anonymity and confidentiality. The chief pharmacists and nominated senior members had no concerns regarding discussing prescribing systems and related issues within their hospitals, a number were very enthusiastic about the topic. The perceived relationship of the prescribing systems and quality of prescribing were identified.

3.3 Results

A pilot study was undertaken, to ensure that the recruitment procedures and interview questions were robust and ran smoothly without missing any important points relevant to the research. The pilot study did not highlight any specific issues with recruitment or the interview questions and as such, the interviews were included in the data analysis.

Eight participants took the initiative to arrange interview times before the researcher had made telephone contact, five participants used e-mail, and three telephoned the researcher to arrange times.

Follow up e-mails were sent out, 53 in total, 18 of which were sent to the personal assistants of the chief pharmacists. Sixteen of the follow up e-mails led to interviews being conducted. Eight chief pharmacists officially declined to take part in the study due to time constraints and two were willing to take part but unfortunately were not able to complete in the data collection period.

Sixty-five interviews were conducted in total; the average time recording interviews was 16.5 minutes (min 8 min, max 35min SD 5.25min). This time included the initial greetings with personal assistants and participants, verbal consent and future contact details. The interview process continued until as much quantitative data as possible had been collected.

3.3.1 In-patient Prescribing Systems used in each Hospital Trust

The findings from the analysis of quantitative data indicated that the sixty-five chief pharmacists interviewed, 18% (n=12/65) stated that their Trust had

ePrescribing in place or were actively implementing an ePrescribing system for use on in-patient wards. The main EPMA system in place or being implemented was JAC® (n=5) followed by MEDITECH® (n=3), iSOFT® (n=2), PICS® (n = 1) and one in-house created system. Of the Trusts that had a paper drug chart in place, 64% (n= 34/53) planned to implement or change to ePrescribing in the future.

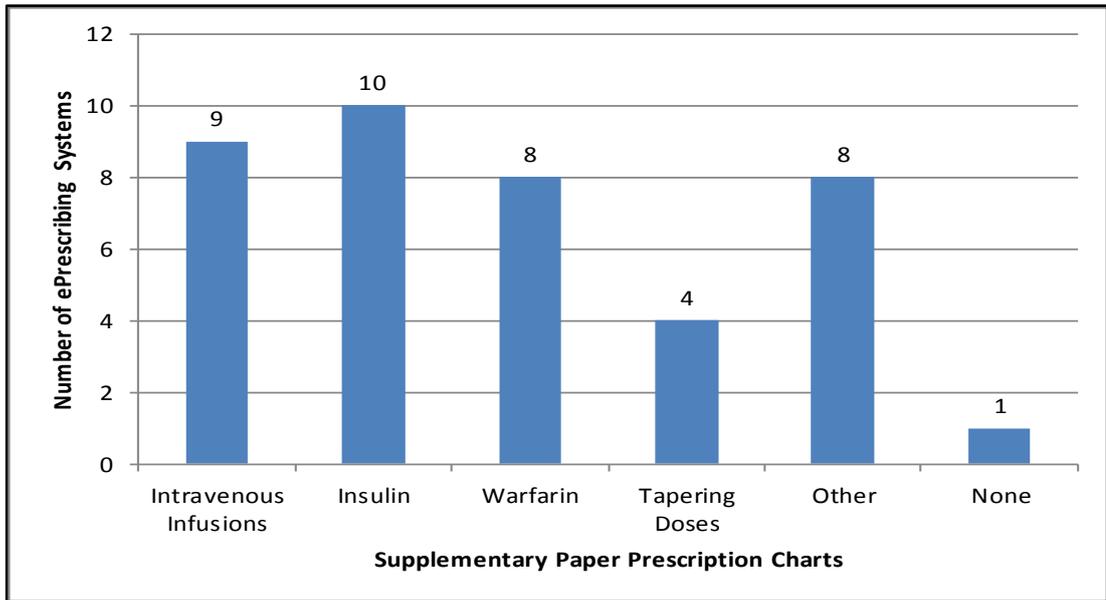
Four Trusts had recently implemented ePrescribing within the last two years. Three of the Trusts had implemented the ePrescribing system provided by JAC® and one had implemented the ePrescribing system provided by Meditech®. Of these Trusts, two were purposively selected for phases two and three based on location in England, prescribing system in place (JAC® and Meditech®) and length of time (less than two years) the system has been in place. These hospitals enabled an insight into the changes that occur when switching from paper to ePrescribing.

Eighty-two per cent (n=53/65) had a paper drug chart in place. When asked about how recently the paper chart had been updated within each Trust, 77% (n=41) had reviewed and updated the paper chart within the previous 2 years. Eight Trusts had reviewed or were in the process of reviewing the paper drug chart due to the recent publication of the Royal Colleges publication *Standards For The Design Of Hospital In-Patient Prescription Charts* (2). Trusts were also asked if they had considered the publication, only nine trusts (14%) had not considered the publication, 3 of which were Trusts with ePrescribing.

3.3.1.1 Electronic In-patient Prescribing systems

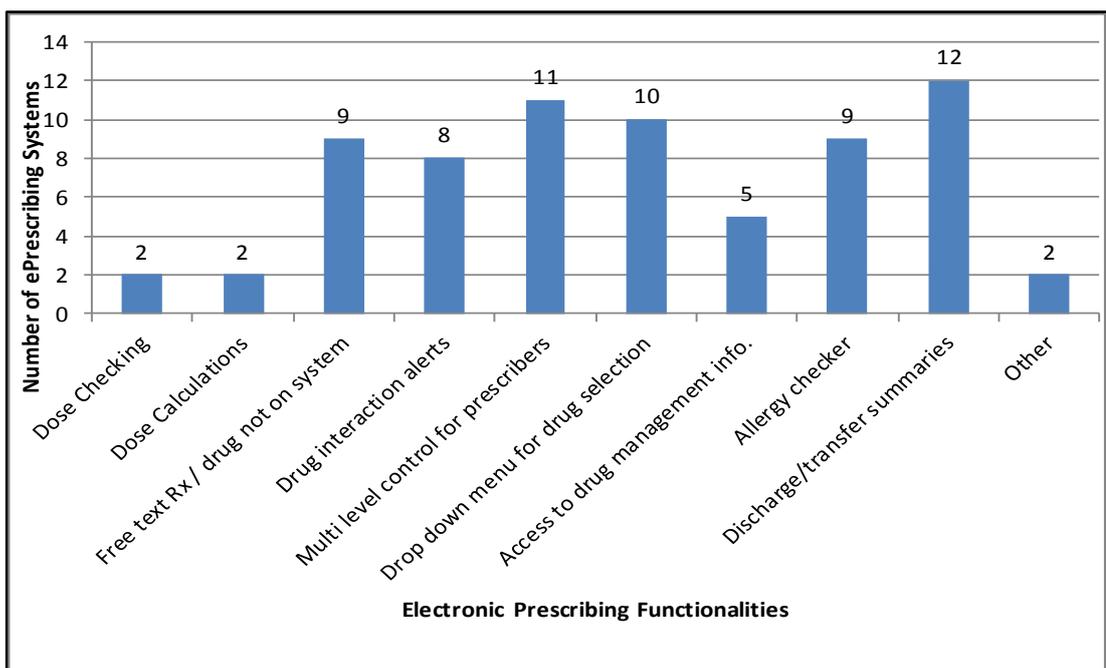
Of the 12 Trusts that had ePrescribing in place, four had ePrescribing on all of their adult in-patient wards, and the remaining eight Trusts had a mixture of paper and ePrescribing systems in use. The interviewees that had ePrescribing in place were asked about the use of supplementary paper prescription charts. All the Trusts with ePrescribing had supplementary paper charts in place to some extent, except for one. The number of supplementary paper prescription charts and type of charts still used in conjunction with ePrescribing are shown in Figure 3-1.

Figure 3-1 Drugs prescribed on a supplementary paper prescription chart in conjunction with the ePrescribing system in the 12 Trusts.



Staffs from the twelve Trusts with ePrescribing in place were asked about the functionalities of the systems and if they felt, they were effective at improving prescribing quality. The main functionality incorporated into the systems was the use of discharge summaries or patient transfers, one of the main drivers for NHS connecting for health. The functionalities are presented in Figure 3-2.

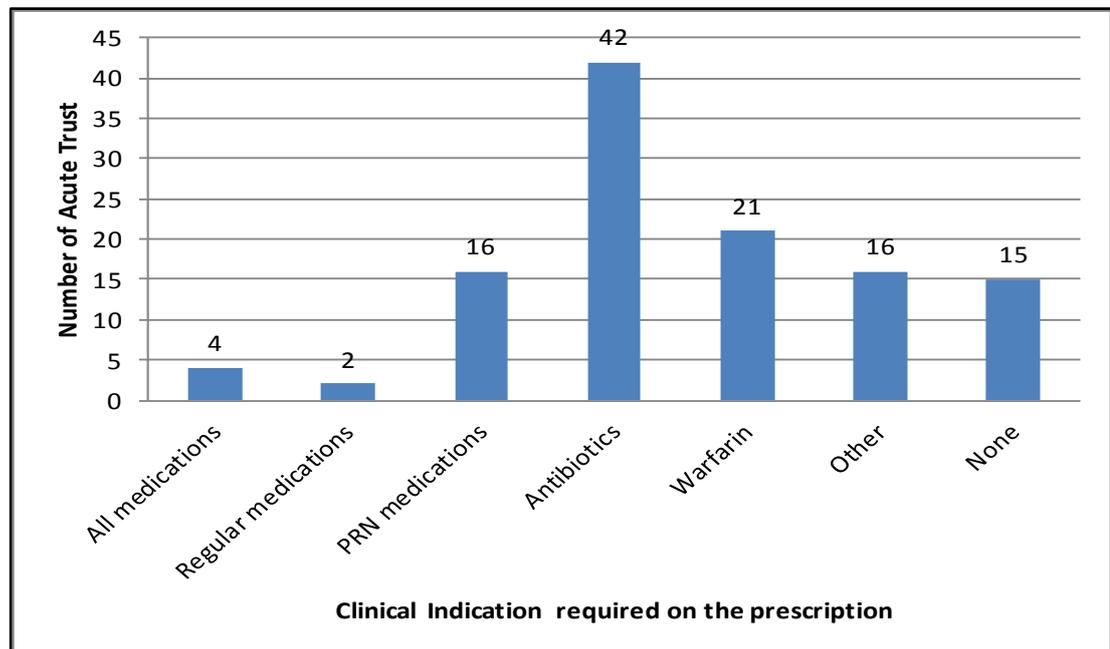
Figure 3-2 Electronic prescription chart functionalities provided by the ePrescribing software in the 12 Trusts.



3.3.1.2 Hospital Trusts inclusion of a clinical indication on the in-patient prescription

Part of the interview focused on the use of clinical indication for a prescribed medication on the paper chart or ePrescribing system, as well as the notes, as a communication tool. One Trust claimed that they didn't know about the use of a clinical indication on the prescription, so only 64 Trusts answered the question. 72% (46/64) of Trusts required a clinical indication to be included on the in-patient prescription for antibiotics (includes all medications) and 39% (n=25/64) for warfarin (includes all medications). Incidentally the antibiotic stewardship national policy was noted as the driver for the introduction of a clinical indication to be documented on the prescription in (31/49) 63% of cases. Twenty-three percent (n=15/64) of Trusts did not require an indication for any medications on their prescription charts, see Figure 3-3 below.

Figure 3-3 Hospital Trusts that require a clinical indication on the prescription for a specific medication



The drugs included in the other category in Figure 3-3 above are; unlicensed medications, Payment by Results excluded medications, National Institute for Clinical Excellence (NICE) drugs, proton pump inhibitors, Low Molecular Weight Heparins, Anticoagulants, Chemotherapeutic agents and immunoglobulins.

Of the 76% (49/64) Trusts that required a clinical indication for a medicine on the in-patient prescription chart, 59% (n= 29/49) stated that the clinical indication was completed all the time or most of the time on the prescription. The remainder stated sometimes, with only one trust stating rarely.

3.3.2 Qualitative Results

The emergent themes included:

- **Regulation** - control, feedback, govern, direction and management.
- **Clinical workflow** - time/efficiency/communication
- **Patient safety** - knowledge /education /compliance /accuracy

The themes are described in relation to the components of quality (**STEEP**), as shown earlier in Table 1-1. Where illustrative quotations from chief pharmacists have been extracted verbatim from the transcripts, the size of hospital to which these quotes are attributable are noted in brackets alongside as follows: (Medium)

3.3.2.1 Regulation: *Effective and Equitable*

In the theme of regulation a number of participants, (n=8/12) indicated that the ePrescribing systems had enabled control and timely feedback that was not previously possible with the previous paper-based system.

“It’s picked up a lot of things we didn’t know before, like how many missed doses there are, which you can tell straight away”. (Medium)

At one hospital, the ePrescribing system had enabled live data on quality to be reported to frontline staff via a quality dashboard; however, this has led to more pressures on staff. It was noted that the extent of the regulation was affecting personnel in a negative way showing a social impact upon the workforce.

“We have some extremely comprehensive quality dash boards...There is also a lot of pressure internally now both on the nurses and the medics because of course the reporting capability within the system means there is nowhere to hide”. (Teaching)

EPrescribing was considered to enforce policies and controls through mandatory fields. Interestingly, policies that were put in place prior to implementation of

ePrescribing were questioned once enforced, showing that the policy had not previously been acknowledged or followed when a paper prescribing system was in place.

“So it was a good illustration of how a well-designed system beats a policy or instruction any time”. (Medium)

Specific policies were noted as a driver for the introduction of a clinical indication on the prescription, the main driver was the policy regarding antibiotic stewardship (47).

“It’s part of the governance around the prescribing of antibiotics and it was something, which became quite a normal thing for...Um...hospitals to adopt as good practice”. (Teaching)

The use of an ePrescribing system in conjunction with a clinical indication was seen as supporting control and feedback on the prescribing process; one interviewee believed that ePrescribing systems would improve control and feedback compared to a paper based drug chart.

“The more information you have got the more you can be sure the prescribing is correct and being used for the right indications. When you are based on a paper based system, it’s very hard to formulary control isn’t it. Whereas when we are moving with electronic prescribing formulary control will become a lot better and a lot greater. It’s a check [clinical indication] that everyone is aware of what they are doing really isn’t it”. (Large)

After Implementation of ePrescribing, in one Trust, the completion rate of a clinical indication on the prescription had become inferior compared to the paper prescribing system. Showing that ePrescribing did not always facilitate greater control over prescribing.

“It [clinical indication] always was for antibiotics when we had a paper system but it’s quite difficult to impose that with our EP system because you have to put it in as a note so that’s not compulsory... So it’s a disadvantage really”. (Medium)

By having the clinical indication on the prescription, it was seen as facilitating audit for financial reasons, providing information to facilitate claims in relation to Payment by Results (PBR) excluded medications.

“Requiring [Primary Care Trust PCT] more and more information from us around PBR excluded and cancer therapy so we do by the end of this financial

year need to be providing the PCT with the clinical indication for PBR excluded meds". (Large)

Governance issues and patient confidentiality were noted as a limitation to the use of incorporating a clinical indication on the prescription. Management felt that patient confidentiality could be compromised, if a clinical indication were provided on the prescription chart and family members or friends were to view the paper prescription chart.

"So my personal view is if we get around the issues to do with err concerns over patient confidentiality then it would be a nice standard to have". (Large)

From a quality initiative perspective, it was emphasised that if the amount of work that had gone into preparing for ePrescribing had been applied before the introduction of a paper drug chart, then maybe that would also have enabled stakeholder buy-in and good quality prescribing on a paper drug chart.

We did a huge amount of work (with ePrescribing)...getting the clinicians to agree on what needs to go on, in what way and what's the protocols...you kind of get people together to talk about these things and having to compromise. In itself that is quite a good quality initiative, if you had only done that for paper well, it's very hard to get people to comply then isn't it. (Teaching)

3.3.2.2 Clinical Workflow; Time, Efficiency and Patient Centred

The theme of clinical workflow with the sub theme of time and efficiency covered both lack of time and more time surrounding the prescribing system and quality of prescribing. As discussed above, the feedback within the ePrescribing system had reduced time taken to audit situations but could also increase the time taken to enter all required prescription fields. This is where both aspects of the socio-technical system interface around prescribing.

The beauty of it (ePrescribing) is you can make it do so many things, so we could actually make it half an hour to prescribe a single drug if we wanted to. So it becomes a balance between workflow, audit information, and safety info. So it's about balance along the line, it probably doesn't have a bearing on for one drug it's when it becomes routine. (Large)

Recently a national shortage of a drug occurred; one of the interviewees explained how ePrescribing had benefited them regarding time and efficiency in terms of implementing a switch to another product which was available.

Had we been on paper (prescribing) that would have been a very time consuming bit of logistics to sort that switch out. It was done within half a day...there are just some things where you know it just makes everything so much easier. (Medium)

On the other hand, it was noted that ePrescribing was perceived to be more time consuming in other situations and inhibited patient contact.

It's definitely more time consuming and people don't speak to patients as much because they can work remotely, those are the two negatives really. (Teaching)

The terms *helpful* and *useful* were used on a number (n=23/65) of occasions regarding the use of a clinical indication on the prescription suggesting that its use may be beneficial in assisting HCPs' communication and clinical workflow around the prescribing process along with providing information to patients. It was also noted that the clinical indication was rarely documented in the patients' notes.

Very pro [about clinical indication], because not only does it help with...I think it helps prescribers, certainly helps pharmacists when checking the prescriptions and also it assists with the information that we are now supposed to be sharing with patients. (Small)

Just having it up their upfront would make life rather simpler; the notes very often don't have that indication any way. (Medium)

The use of an ePrescribing system can result in new 'workarounds' – ways that people discover to get the job done faster or easier, compared to the paper prescribing system. People will, in effect; configure the ePrescribing system to meet their particular clinical workflow needs (20). These were mentioned in the interviews.

You develop or you find out about a lot of workarounds that people put in place [ePrescribing]. (Teaching)

The communication between members of MDTs is essential to ensure that quality patient care is achieved in a timely manner and in an efficient way. Communication regarding the time it takes to try to find the clinical indication in the medical notes was highlighted along with having the clinical indication available when a patient is transferred between wards within the hospital or other transfer situations.

Clearly, on a medical ward, I think that info is...um... Absolutely pertinent when we are transferring patients between different wards, hospitals, primary care, secondary care, GPs. (Large)

One of the chief pharmacists acknowledged that different professions work in different ways and stated - *We need to think about how the medics would work which is very different to the way we work. (Teaching)*

3.3.2.3 Patient Safety; Safe and Effective

A number of interviewees (n=8/12) mentioned that new error types had been encountered within the ePrescribing system such as wrong selection of patient, drug and strength. It was explained how human error was predictable in some cases, due to the design and layout of the ePrescribing system. Prescribing error had therefore been minimised by changing the design of the system, however human error was not completely removed.

People kept picking the enteric-coated (aspirin) so when we put aspirin dispersible at the top of the list followed by enteric coated that sort of reduced that error almost completely. (It's) Funny people do tend to pick the thing at the top of the list because it's what they are expecting to see so it changes the nature of selection errors but it doesn't mean it removes them completely. (Teaching)

The use of a clinical indication within a paper prescribing system and an ePrescribing system was thought to have facilitated the clarity of the prescription, allowing clinical appropriateness of medications to be established. From a patient safety viewpoint, it was thought to confirm that the prescription was correct.

To be clear, it gives [clinical indication] you a lot more understanding that the drug has been prescribed is correct, that the dose is correct and also that the actual treatment length is right. (Small)

However, concerns about accuracy of the clinical indication, compliance in completing the clinical indication, and whether the clinical indication would improve patient safety were debated. Views regarding the extent of medications that should have a clinical indication documented on the prescription varied, they included all medications, newly initiated medications, to a select few. The rationale given for not expecting a clinical indication on all medications concerned junior doctors' abilities to find the clinical indication of a patient's medication on

admission. Several comments were made regarding medications prescribed on admission being more of a transcribing process than a prescribing process and therefore prescribers would not know the indication of each medication.

I think that for certain things it's a good idea [about clinical indication] but I think for particularly some of the regular meds, I would be concerned that actually the junior doctors wouldn't know and would therefore guess. Then you have actually got inaccurate information, so erm...because they won't know when they write that drug up on admission what the clinical indication for everything is. (Medium)

Another reason was about what information would actually be given if the clinical indication was made compulsory on the prescription and therefore remarked about a clinical indication only being beneficial in certain situations. The practicalities of providing a clinical indication for every medication and ensuring it was completed were not realistic unless some electronic support was provided.

I think for many medicines it [clinical indication] would improve safe use of medicines, in reality it is not practical without some electronic support. (Teaching)

One chief pharmacist with paper prescribing in place acknowledged that they had gone as far as possible in designing a safe and effective drug chart. Other interviewees felt prescribing had become of inferior quality over time due to doctors' training; one gave a perceived insight into the training of doctors and the culture of medical training.

It's all about the diagnosis and the treatment is a poor second...I'm not saying it's not a consideration but the therapeutics is second to the diagnosis. (Medium)

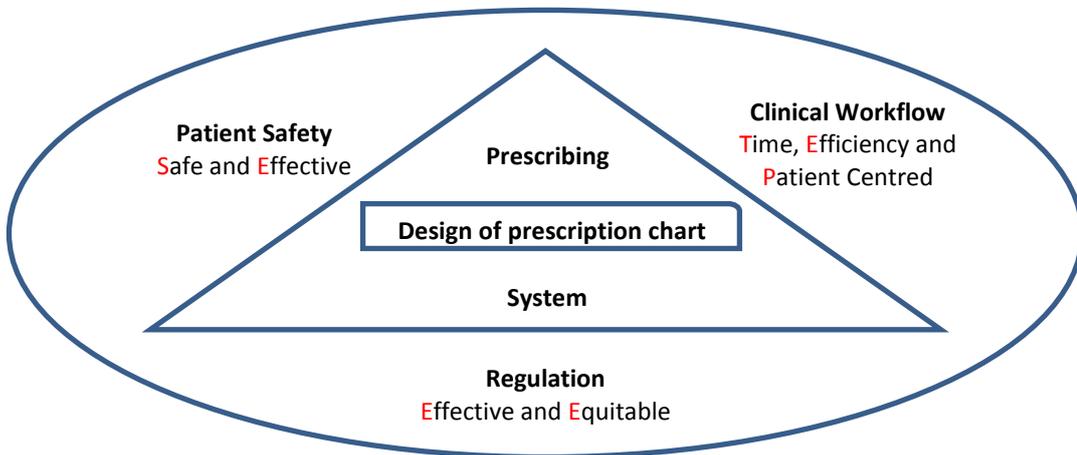
The three themes of regulation, clinical workflow, and patient safety were interconnected, with one quote specifically connecting all three.

The beauty of it [ePrescribing] is you can make it do so many things, so we could actually make it half an hour to prescribe a single drug if we wanted to. So it becomes a balance between workflow, audit information, and safety info. So it's about balance along the line, it probably doesn't have a bearing on for one drug it's when it becomes routine. (Medium)

Figure 3-4 below depicts the quality components in relation to the design of the prescribing system (paper or electronic, with or without a clinical indication) and the findings from phase one. All of the themes identified, to different extents, the

influence a change in prescribing system can have on regulation, clinical workflow, and patient safety in relation to the prescribing and medicines administration process.

Figure 3-4 Quality components (STEEP) in relation to prescribing systems identified



3.4 Discussion

The exploration of the type of prescribing systems in place in acute trusts across England showed that out of the 65 interviews five different ePrescribing systems (JAC[®] followed by MEDITECH[®], ISOFT[®], PICS[®] and one in-house system) were in place in twelve Trusts. The rest of the Trusts had a paper drug chart on which to prescribe in-patient medications. Of the twelve Trusts with ePrescribing in place, each system had different functionalities and supplementary paper prescription charts in use.

The use of a clinical indication on the prescription chart for antibiotics and warfarin differed across the Trusts with 23% (n=15/64) of Trusts not requiring an indication for any medications on their prescription charts. This highlighted the lack of equivalent usage of an indication on the prescription chart across England, and that the Royal Colleges' standards (2) could only advise regarding the inclusion of an indication on the prescription chart.

The main themes, that emerged from the qualitative data, after thematic analysis included regulation, clinical workflow, and patient safety. Socio-technical

systems theory was then explored as a conceptual framework to view the emergent themes and their relevance to prescribing quality (assessed using STEEP framework).

Regulation – is put in place to ensure effective care can be carried out to an equitable standard. In order for regulation to be effective the guidelines, policies, and procedures need to be followed otherwise, there is no point in having them in place. EPrescribing was seen to be both effective and ineffective when enforcing policies within the in-patient prescribing system, for example using a clinical indication on the prescription chart. It was perceived from the results that by having mandatory fields in place, the prescriber is forced to complete all the required fields; this created an effective way compared to the paper prescribing systems to enforce policies and guidelines, yet it could lead to incorrect entry of information. This became apparent when a chief pharmacist explained how HCPs had only become aware of some policies when they were made compulsory through the ePrescribing system. Respondents in trusts with ePrescribing reported workarounds being evident in the working practices of their staff, whereby staff bypass the mandatory fields to streamline their working practices, which may lead to inaccurate information being supplied.

National policies, such as the antibiotic stewardship, are required to enable an equitable NHS and therefore are important to ensure quality care across England. The antibiotic stewardship national policy was noted as the driver for the introduction of a clinical indication to be documented on the prescription in many cases. Another national recommendation regarding *The Standards for the Design of Hospital Inpatient Prescription Charts* were also referred to with 85% (55/65) having considered the standards. The completion rate of clinical indication, on antibiotic prescriptions, with the introduction of ePrescribing, had declined in one Trust compared to when the same Trust used a paper prescribing system. This was because the clinical indication entry was not a mandatory field within the ePrescribing system, showing that without a mandatory field greater control was not always achievable with ePrescribing. Financial incentives were also cited as a reason for incorporating the clinical indication on the prescription in order to be

able to claim back money from the Primary Care Trusts for payment by results excluded medications.

The growing need for formulary control driven by financial incentives and audit, has led to widespread recommendations for the introduction of ePrescribing systems in the UK (20). Coding analysis, (n=8/12) indicated that the ePrescribing systems had enabled timely audit and feedback that was not previously possible with paper prescribing systems.

Clinical workflow that is not impeded in any way should achieve an efficient and timely outcome for patients and healthcare professionals. It was noted that the extent of the regulation through the ePrescribing system had enabled quality healthcare to be audited in a more timely fashion compared to paper prescribing systems, sometimes having “live” quality data available. However, this was stated to have put healthcare workers under pressure, showing how the technology can have a social impact upon the workforce. The technical aspects of ePrescribing and having a clinical indication on the prescription were reported to impact on the shared parts of clinical workflow in a positive and negative manner. The influence on timeliness and efficiency that regulation had imposed to improve patient safety had increased time taken to prescribe each individual drug resulting in inefficiencies, at the point of prescribing, to frontline HCPs’ clinical workflow. However, pharmacy management felt they could now audit and impose regulation, using mandatory fields, in a more efficient manner using ePrescribing.

The change in patient contact was also considered when moving from a paper based prescribing system to an electronic system. It was perceived that ePrescribing had changed working practice by aiding frontline staff to work remotely to the patient, resulting in less patient contact.

The use of a clinical indication on the prescription was considered “helpful or useful” in assisting the prescribing, prescription review and administration process. The clinical indication was perceived to be rarely documented in the notes as mentioned by a number of chief pharmacists “*the notes very often don’t have that indication any way*” and reinforced by previous research (38)(135). Further review

regarding the use of a clinical indication on the prescription, and whether it influences the efficiency of HCPs clinical workflow is required.

Patient safety focuses on safeguarding patients in an effective manner. With the change from paper to ePrescribing systems come new types of prescribing error (65–70). Illegibility is no longer an issue with ePrescribing systems however; incorrect selection could be classed as a comparable new error, such as wrong selection of patient, drug, strength, or frequency. This was discussed in the interviews; the order in which the drugs appeared on the drop-down menu for selection had a bearing on whether the correct drug was selected or not. It was noted that HCPs tend to pick the drug at the top of the list because it is what they were expecting to see. This shows a social interaction with the computer because the order, in which drug names appeared, was perceived to influence the new error type. The prominence of the new error types requires further investigation so that HCPs' can be made aware of the pitfalls that come regarding ePrescribing, particularly those relating to patient safety.

The value and effectiveness of a clinical indication space, incorporated in the design of paper and ePrescribing systems, on all medications requires further investigation, especially from a patient safety perspective. There was debate as to which medication should have a documented clinical indication on the prescription. The medications that were thought to warrant a clinical indication on the prescription were not differentiated by therapeutic area or diagnosis, but by the ability of frontline staff to provide an accurate clinical indication, without impeding their clinical workflow. The examples given were for all medications, newly initiated medications or a select few. The reasons for the debate involved concerns about accuracy, compliance, and patient safety. Several comments were made regarding medications prescribed on admission being more of a transcribing process than a prescribing process and therefore prescribers would not know the indication of each medication. The areas highlighted during these interviews, such as new error types with ePrescribing and the increased efficiency regarding audit, concur with those from other research studies (20)(136). The discussions reinforced the fact

that a balance is required between the social and technical aspects of the system in order to achieve optimal performance.

Limitations

It was noted that this time of year was probably not an ideal data collection period as a number of participants were still on annual leave after the Christmas Break. Due to the time frames of the study, data collection had to go ahead. This led to the data collection period extending over 6 weeks to accommodate participants' busy schedules on return from annual leave. Another difficulty in contacting chief pharmacists arose when it materialised that several chief pharmacists were retiring or moving positions due to imminent Trust mergers and changes in the NHS.

It was acknowledged that the number of chief pharmacists, from the London region, interviewed in the data collection period was low compared to other regions in England. The purposive sample, based on Trust location and size provided an even spread of interviews, therefore limiting, to some extent the bias introduced by region.

3.5 Chapter Summary

Within this chapter, phase one data revealed that the majority of in-patient prescribing systems in hospital are paper systems. The number of different prescribing systems in use within secondary care, at that time, across England highlighted the diversity of prescribing systems, and that a national paper or ePrescribing system across the NHS was unlikely to occur in the near future. However, an initial step to standardising the design of prescription charts had been made, as the standards for the design of hospital in-patient charts had been consulted by 85% of the chief pharmacists interviewed. EPrescribing systems had been implemented with supplementary drug charts for a variety of medications. Functionalities within the EPMA system differed between trusts, making it difficult to compare in the future, let alone standardise their design and use. Qualitative data indicated that the regulation required to provide effective and equitable

patient care was to different extents perceived, in some cases, to be enforced with an ePrescribing system. However, this can then impact accuracy and clinical workflow, leading to workarounds that can be harmful and are not officially documented in policies or procedures. Patient contact was perceived to have diminished with the introduction of ePrescribing possibly leading to a change in patient centred care. The use of a clinical indication on the prescription could improve communication between HCPs and patients regarding prescribed medications. Several of the themes reinforced the need to seek other opinions of frontline HCPs about the different prescribing systems in order to understand more in-depth how the social and technical areas of prescribing systems have changed and how they impact on quality of care.

This chapter has provided the Trust chief pharmacist and managerial perspective regarding both electronic and paper prescribing systems. The next chapter focuses on the MDT member's viewpoints about how the ePrescribing system can or could influence their working practices. Phase two utilises a focus group methodology of teams drawn from three of the sites at which the chief pharmacists worked.

4 THE IMPACT OF PRESCRIBING SYSTEMS ON HEALTH CARE PROFESSIONALS' WORKING PRACTICES

Chapter 3 described how different in-patient prescribing systems are used in acute trusts throughout England and how the prescribing systems are perceived from a pharmacy management perspective. This chapter will focus on how those prescribing systems impact on doctors, nurses, and pharmacists working practices as part of a multidisciplinary team. As well as the aims and objectives, detailed descriptions of the focus group characteristics along with the findings are presented.

4.1 Aim and Objectives

The aim of this phase was to explore how different prescribing systems have an impact on the working practices of key health care professionals (doctors, nurses, and pharmacists) within their multidisciplinary teams.

This phase has three objectives:

1. To explore key healthcare professionals' opinions of different prescribing systems and the positive and negative impacts prescribing systems have on their working practices.
2. To determine the impact of different prescribing systems on patient safety, as perceived by key healthcare professionals.
3. To explore the role of clinical indication within the design of prescribing systems, and its perceived impact on key healthcare professionals working practices.

4.2 Method

As described previously in Chapter 2, this phase is a qualitative study of paper prescribing systems and EPMA systems in use in 2012/2013. The selection criteria for the three study sites (Hospitals A, B and C) captured the diversity of the prescribing systems across England. The selection of the three hospital sites for phase two was previously explained in Section 2.3.

4.3 Results

Eleven focus groups were conducted, each with five to nine participants between September 2012 and May 2013 in the three hospitals. A total of 73 participants: 28 doctors, 25 nurses, and 20 pharmacists took part in the focus groups. The characteristics of the multidisciplinary teams and their medical or surgical background are outlined below in Table 4-1 to provide context to their subsequent comments. The findings are then presented in distinct sections to consider, under emergent themes, the impact that prescribing systems have on the working practices of HCPs within the multidisciplinary team. The impact can be considered moving forward to provide ways in which EPMA technology can be used effectively and to its full potential. Transcriptions were double-checked for quality assurance purposes prior to any analysis-taking place. Where illustrative quotations have been extracted verbatim from the transcripts, the focus group hospital and focus group number to which these quotes are attributable are noted in brackets alongside as follows: *A3 (Hospital A, focus group 3)* at the beginning of each quote the professional role is provided e.g. *Nurse*. The illustrative quotations were also double-checked for quality assurance purposes.

4.3.1 Characteristics of Multidisciplinary team focus groups

The size of the focus groups varied between five and nine HCPs and the overall gender mix was 49 (67%) female to 24 (33%) male. 28 (38%) doctors, 25 (34%) nurses, and 20 (28%) pharmacists represented the different HCPs. Table 4-1 provides the characteristics of the MDT based focus groups in more detail below.

The focus group meetings lasted between 37 and 76 minutes giving an average overall time of 59 minutes. Focus groups were conducted with seven MDTs from a medical speciality and four MDTs from a surgical speciality. There was a different prescribing system in place in each of the three hospitals, an EPMA system in Hospital A, a hybrid paper and EPMA system in Hospital B, and a paper system in Hospital C (See Section 2.3).

Table 4-1 Characteristics of the MDT based focus groups

Focus Group No.	Length of Focus Group in min.	No. of Participants	Doctor	Nurse	Pharmacist
Hospital A					
1 (Medical)	59	5 (2Male)	3	1	1
2 (Surgical)	48	7 (1Male)	3	2	2
3 (Medical)	59	9 (4Male)	4	3	2
4 (Surgical)	76	8 (2Male)	3	3	2
5 (Medical)	57	8 (4Male)	3	3	2
Total 5	Average 60	Total 37	Total 16	Total 12	Total 9
Hospital B					
1 (Surgical)	72	7 (4Male)	3	2	2
2 (Medical)	56	5 (0Male)	1	3	1
3 (Medical)	56	6 (1Male)	2	2	2
Total 3	Average 61	Total 18	Total 6	Total 7	Total 5
Hospital C					
1 (medical)	70	5 (1Male)	1	2	2
2 (medical)	59	6 (4Male)	2	2	2
3 (Surgical)	37	7 (1Male)	3	2	2
Total 3	Average 55	Total 18	Total 6	Total 6	Total 6

Thematic analysis identified how interaction with the prescribing system, within the hospital, influenced the MDT members' working practices; all three professional groups considered this, both positively and negatively.

The three emergent themes that were identified are:

- 1) **Interface**; is about the interaction between the HCP and the prescribing system and it includes the sub-themes
 - Logistics
 - Clarity of the prescription
 - Operating the system
 - Using the system
- 2) **Change in working practices**; is about the multidisciplinary team member's change in role due to a change in prescribing system and it includes the sub-themes
 - Key health care professionals roles
 - Situational awareness

- Communication
 - Patient contact
- 3) **External Influences**; is about the decisions made outside the MDT that can influence the prescribing and medicines administration system and it includes the sub-themes
- The NHS as an organisation
 - Hospital management
 - Accountability

The three themes were mapped to STS to explore if the model provided any insight on the interrelated nature of the emergent themes. One of the study supervisors, with experience of qualitative data analysis, independently verified key themes to ensure that the theory framework was appropriate and valid. The themes interact and depend on one another, to show how EPMA is used and impacts on all areas of the complex healthcare system that is the NHS.

4.4 Interface

The interaction HCPs had with the prescribing system in order to create a prescription, review a prescription, administer a medication or gain general information about the patient emerged as a theme from the data. The prescribing system should facilitate HCPs' working practices and so this theme shows how the interface between the HCP and the prescribing system works.

When HCPs interact with the prescribing system, they can influence the system by ensuring it provides the correct or incorrect information, at that moment in time, which can lead to different actions in the future. The introduction of computer technology to prescribing was seen by participants as a way of standardising practice and ultimately eliminating user variability, as one doctor said, "*Because that [EPMA] eliminates then the variability of how good the doctor is*". Other HCPs felt that by being able to read the prescription they could be sure that they were giving the correct medication.

Nurse: I think reading the prescription would be greatly improved, and being sure that you are giving what should be given.

Standardising practice and human error were discussed throughout all the focus groups. Discussions were insightful, with MDT members concluding that they still needed to be mindful that technology can only minimise, not remove human variability. This is also discussed within legibility, see Section 4.4.2.1

Nurse: So I can counter yes, it is easier to read the writing but you've also got the other side is if it's, if it's prescribed wrong it's that little bit harder to see it.
B3

4.4.1 Logistics

The sub-theme of logistics looks at and describes the alteration in physical locality of the prescription and HCP once the prescribing system changes, therefore affecting key HCPs' physical workflow and interface with the system. Logistics, which includes being forced to do things in different places, can introduce new issues. This is picked up in the socio technical systems theory, which recognises how the change of location alters the dynamics and interaction with the system and can have knock on effects that may affect quality patient care.

4.4.1.1 Lost Prescriptions

The change in logistics and re-structure that can take place when moving from paper prescribing to EPMA ensured to a point that the prescription could no longer be "lost", therefore saving time and effort in finding the prescription. This was discussed in all of the focus groups.

Nurse: You don't have to actually run up and down the ward looking for the medicine chart and who had them last. It's all there ready B3

The extent of paper in-patient prescriptions going missing has not been quantified in previous research studies, however qualitative studies have cited it as an issue with paper prescribing (86). Missing paper prescriptions were discussed as an issue in each focus group, to different extents. The NHS Connecting for Health Report (20) acknowledged the issue of missing in-patient paper prescriptions, stating that EPMA would remove the problem of missing charts.

The HCPs who use the hybrid EPMA-paper system described how they still had the problem of "lost" charts and logistical difficulties because the Medical

Admissions Unit uses paper charts and described how this has repercussions on efficiency and time throughout the rest of the hospital wards.

Doctor: ...because we have paper charts that are still used in the emergency form [on the medical admissions ward] there's a lot of extra work in transcribing to EPMA and then that drug chart may go missing so yeah it's a good thing that we don't, the paper charts don't go missing a lot now that we're on EPMA, but they still can. B2

However, a possible reason for why the paper chart tended to be “lost” was discussed in a focus group that had paper prescribing in place. The group stated that the paper chart was used as a physical prompt to remind some key HCPs to communicate with each other or carry out a specific task. Having the paper chart in a specific place encouraged members of the MDT to review or discuss specific things that were needed to carry out quality patient care. This then raised concern about losing that physical prompt when an electronic system was used.

Nurse: Yes we leave them (paper drug chart) out for the doctor, you know, if when they need to rely on our, they need their warfarin prescribing then it will be left out or if they're waiting for something to come up or if something's been prescribed at three o'clock for the afternoon, you know. Pharmacist: And also if I'm working on the wards I might have two or three waiting to go to the doctors and speak to them about all three at once ...C2 (same focus group)

The HCPs nevertheless believed the time and frustration saved by not having to track down a prescription was a huge advantage. They reinforced their frustrations of not having the paper prescription chart available, which caused delays and inefficiency when trying to locate it. Having to-rewrite the prescription, if it could not be located, also led to patient safety concerns.

Doctor: you don't lose the drug charts [with EPMA}, which can be an absolute [with paper-prescriptions]. Which can be...really compromise patient care if somebody has been titrated on a dose and nobody can quite remember what it was? Pharmacist: Yes big-time...And the medical notes don't document the medication changes or whatever so...A1

However, the need for a reliable and accessible EPMA system was stressed, in order to avoid the prescription being “lost” on the computer. If the ePrescribing system was not accessible, it would be pointless, as this could cause further disruption to clinical workflow.

Doctor: The thing with paper drug charts is, I've said we get pulled to re-write them all the time, maybe they've finished or they've fallen apart or they're lost or they've been lost somewhere, whereas this one's just going to be available on the computer, but then obviously you have to make sure it's a reliable system you're using otherwise it's just pointless C1

The HCPs using paper charts deliberated that by having an electronic chart the prescription would be reviewed more because it would be more accessible. Increased accessibility could help key HCPs working practice, especially if the EPMA system facilitated more than one HCP to view the prescription at the same time as another HCP. However the ePrescribing system in hospital B did not allow more than one HCP to view a patient's prescription at the same time as another.

Doctor: So you've got a problem you can only have one person looking at the (paper) chart at a time generally and then first thing in the morning doctors try and do their round, pharmacists try and do their round, nurses try and do their drugs, it can't be with everybody at the same time...So don't know whether you can access electronic systems in many ways but if that's the sort of thing that C3

The extent and detail of prescription review were considered. A paper prescription chart, due to the fact that it can require re-writing, can get a detailed review during the re-write. With ePrescribing the practice of re-writing a prescription is no longer necessary, yet having constant access to the prescription, some HCPs felt they looked at the ePrescribing system all the time, even when it was not necessary. This was because HCPs were concerned about missing any changes that may have occurred, that they were not necessarily informed about by their fellow HCPs.

Pharmacist : you can feel like you should be checking them [ePrescribing] more because they're there and available erm and because things do appear, whereas before if the nurse needed something they'd ring and if I'm not here they'll bleep me to go and get it whereas because it's done on the computer... B2

The reliability of the EPMA system was highlighted by the ePrescribing focus groups when comparing a situation of having a "lost paper drug chart". Examples were given providing first hand insight into the frustrations of hardware difficulties affecting medication ward rounds, delaying patients receiving their medications. This showed how important it is to have a reliable system, to prevent delays or have a prompt response to any hardware difficulties as soon as they occur.

Nurse : If a cart [computer] goes down it's gone down for everybody and you're screwed because IT [Information Technology] take at least an hour to look at the problem so you know that's your, all your meds having to wait an hour and you're way behind time and it's some (patients) on antibiotics and even though they say you can print it off you've got to go to a cart that's working and access a printer that's working to print off all your meds for all those patients which is like another half an hour, hour possibly on top of that, so that is a problem B1

One of the EPMA Trusts did not allow multiple concurrent accesses to the EPMA system, which meant that a patient's record could only be viewed by one HCP at a time. This limited access to the prescription even more than if paper prescribing were still in place because HCPs found that they could not access a certain patient's prescription at all if somebody had not logged out of the system properly leading to confusion about whether another HCP is looking at a patient's prescription or the system was "locked".

Doctor: The difficulty with computers is that if someone else is accessing it then you can't look at the [prescription] .Pharmacist: I don't know if that's happened to you but it happens a lot (laughter) patients can become locked, as in the programme didn't close properly when the person last looked at it and it thinks somebody's still looking at it so it won't let you in. Doctor: Okay I always think somebody else is still looking at it (laughter). B3

Access issues, to the EPMA system in Hospital B and specific patient's prescriptions have caused long delays. The HCP has to ring the Information Technology (IT) department and invariably wait in a queuing system to explain the situation. Once they speak to IT staff, they have standard responses of "have you waited 20 minutes?" HCPs have learnt to say yes to this question so they do not have to wait 20 minutes to access the information and continue with their work, causing a "workaround" (where the user, in order to get the task done will not necessarily follow the intended sequence that was originally set up). This situation has actually added to access difficulties with the EPMA system and caused many delays in HCPs working practice.

Other issues of access to the prescription were discussed in the EPMA focus groups, such as lack of computer availability, or not logging out of the system before changing location. Not logging out of the system then stops the HCP logging onto the system in a different location. This shows how the system and HCP can

affect each other to provide the same outcome of not being able to access the prescription. All of these situations would require the HCP to change their physical location, in order to obtain a solution to the problem and continue to carry out their work.

Doctor 1: It's an absolute nightmare on call because you are not in the same working place...you are on different wards all over the shop so if you forget to log out, then all of a sudden I'm powerless Doctor 2: It's like taking your pen away isn't it! A5

The repercussions of not having a prescription available were discussed. Patient safety and efficiency issues occurred such as delays to all HCPs carrying out their work, minimal reviews of the prescription on ward rounds, patients not receiving medications on time, and re-writing paper prescriptions without detailed documentation in the notes to refer to and therefore not knowing quite what a patient was previously taking.

4.4.1.2 Location of the prescription

The location of the prescription was altered with a change in prescribing system. Generally with paper prescriptions the chart is kept at the end of a patient's bed but with the move to EPMA the computers that are needed to access the prescription can be located anywhere, on the ward or off the ward. The typical position of the computers, away from the patient, has altered how the HCPs carry out their work prompting less natural patient contact and potentially missing important information.

Doctor: You maybe talk about the patients drugs a little bit less with the patient, because you don't have them [medications] all in front of you. So whereas before you might of said ohh have you been on this bisoprolol since you came in or did we start this you know if you've forgotten yourself or if it's a new patient to you, then you maybe don't ask as many questions to when you are at the bedside because you don't have that [prescription chart] at the bedside unless you have brought a computer with you. A1

In the EPMA trusts, the main desktop computers do not require charging and are therefore the most reliable; these are located at the nursing station, away from the patient. Other computers are available *on wheels*, as *carts* or as laptops and can be moved around the wards to the patient bedside. However, these mobile computers

need to be charged whilst not in use, and then unplugged to go around the wards. However, there is variability in how reliable these mobile computers are because the *system* requires staff to plug them in and re-charge them. The battery life of the computers can also be an issue, even if they have been charged long enough. With all the different types of computer available, there were still a number of physical barriers preventing HCPs from carrying out their work. Such barriers included nurses needing the prescription in the clinic room, the physical effort to move the computer around, and computer availability.

Nurse: When you would be getting them [Intravenous medications] ready for administration you would have the drug chart there at the side of you. Now it's on a computer that doesn't fit in the clinical room so it's outside the door...

Doctor: Yes it's a posing case for [hand held device] tablets...A4

The fact that HCPs felt that they had to make an *effort* to take the computer on wheels to the patient bedside was perceived as a barrier and shows how much of a physical hardship it could be, potentially slowing the HCP down;

Pharmacist: you have to make sure you make more of a conscious effort to make yourself go round with the trolley push it round and go and see the patients B3

Concern was raised about the fact that as more medical documentation becomes electronic in the hospital setting; the patient contact would lessen because it would take a conscious effort to go physically back and forth between the computer and patient.

Doctor: Now you are coming backwards and forwards for everything and as they move one...another thing onto electronic, you have less and less reason to be at the [patient] bedside and more and more reason to be away from it. A5

The surgeons defined how their ward rounds differed from the medical doctors, citing how their patients tended to be spread out across the hospital rather than on one ward. The situation does not encourage the use of computers on wheels; things are slowed down even more with difficulty in gaining computer access and logistical issues.

Doctor: Well [pause] we don't, we don't do a round with a, well certainly my [surgical] team, don't do a round with a computer unless we have got just lots of patients on one ward where, otherwise it does tend to slow things down. A4

The medical teams, being normally ward-based, were more likely to use the computer on wheels, as discussed in the medical speciality focus groups. If the computer were at the patient's bedside, it would change patient contact and ultimately patient centred care. It was considered in the focus groups that when the HCP and the computer are both at the patient's bedside, patient-centred care is more likely to take place effectively. Either way, a culture of not having the computer at the patient's bedside along with the HCP was perceived to be developing in both the EPMA trusts.

HCPs felt that being able to discuss with the patient their medications provided them with information about any potential concerns the patient may have and could reveal any patient safety issues. In addition, the patient can be informed about their progress on and experiences individualised patient care. By changing the type and degree of patient contact, the opportunities to discover potential harm and provide quality care can be reduced. Even a slight distance between HCP and patient can be enough to hinder communication.

Pharmacist: Because I used to see every patient every day because that's where I went to go and speak to them and talk to them and quite often it would be the patient that would tell me why things had been changed (laughs) erm and I don't get to do that anymore. B2

Doctor: I mean I know that it's a problem on written prescribing as well, you can still get it wrong, but if you have got a card in front of someone you can definitely, you're more likely to check with them than you are if you are prescribing even 20 meters away that they are not allergic to anything and I think that it...I don't know. A1

Ultimately the solution to having more patient contact, as discussed in the focus groups, was to bring the computer system back to the patient bedside. Suggestions made included hand held devices.

Doctor: Bringing the computer close to the patient will always be...any solution that brings the computer to the patient is going to be more effective than, whether it be a tablet [hand held computer device] or a lap top. A4

4.4.1.3 Accessing the prescribing system remotely

Remote access allows the HCP to view and change the prescription at any computer within the hospital or off-site if the EPMA system is installed on the computer. When on call during unsociable hours, staffing levels of HCPs are minimised and therefore staff have more patients that they are individually responsible for. This can lead to doctors covering several different wards creating logistical difficulties. Having remote access was seen as *a double-edged sword* by the HCPs because it was perceived to save time and improve efficiency by enabling them, especially when on call, to advise or prescribe whilst in a different location to the patient. Yet, they were also very cautious about how remote prescribing was used, potentially causing patient safety issues and ultimately it could facilitate going against GMC advice to have adequate knowledge of the patient's health and that the prescriber is satisfied that the medicine serves the patient's need (12).

Doctor: The thing about remote prescribing that it is a big advantage but to everyone; nurses, doctors, patients when you are on call, that you can just prescribe a pain killer or something when you are on a different ward. A1

Nurses felt that it had saved them time as they no longer had to go looking for the doctor to get a medication started or changed to facilitate patient care.

Nurse: Yeah it's great for on call as well if you're on another ward you can explain exactly what you need for the patients and it can be done pretty much the same, no running round looking for the doctor to go and do it because it can be done. B1

The ability to access the system from home when on call and see everything whilst not in the hospital has enabled the pharmacist to follow up on advice they have given to the HCP requiring advice. They can check that there were no misunderstandings and that the HCP followed the recommended advice. This also facilitated the pharmacist's work, enabling them to stay at home wherever possible, rather than attending the hospital in the night.

Pharmacist: it's especially convenient when you are on call and you give advice over the phone and then you can check up the next ...even like at home you can check up to see what has been done and uhh...it's really really beneficial on call especially when you are not in the hospital and you can see everything. A1

Prescribing remotely raised safety concerns with doctors and pharmacists about not seeing the patient before prescribing or advising. All the focus groups acknowledged how important patient contact was in order for HCPs to carry out their job to the best of their ability and provide compassionate care. One doctor described how he prepared for ward rounds, looking through the patient notes and considering the next step regarding medication, before seeing the patient. However it was explained that the initial plan, prior to seeing the patient can all change once the patient has been seen.

Doctor: You can probably make a very considered decision and think this is the right thing [medication] but I can't tell you how many times I changed my mind after looking at the patient. You do your ward round work up and you think I'm going to go and see him and I will prescribe this, you look at the patient and you think I couldn't be more wrong and change your mind. You need to see them [patient]... A5

Pharmacists explained how they were the second check on prescribing and therefore needed to see the patient in order to carry out this second check competently. Concern about the patient becoming "something on the screen" was explained.

Pharmacist: The second check of the prescribing is the pharmacist and they should actually be seeing the patient because you pick up so much from just seeing the patient, never mind talking to them, erm so I think there is a danger that they [patient] become something on the screen and they pass through the system and you never see them and you think 'that's not my job' you know 'I'm just dealing with the drugs'. C2

With remote prescribing or clinical review, a patient's medical notes or other medications prescribed on paper are not always available, leading to an incomplete patient history when making a clinical decision.

Doctor: Being able to prescribe remotely is useful sometimes, but you just wonder if that brings in another element of risk don't you? If you are on the end of a phone and you don't have access to notes... A2

Pharmacist: A lot of them [pharmacists] will do a full drug history and umm full care plan from their office rather than on the wards, so they have no medical notes A1

Not having the medical notes at hand could also lead to the clinical decision about the patient not being documented in the notes or at least the relevant

documentation being delayed. This was also considered by the focus groups that had paper prescribing in place as a potential patient safety issue with EPMA.

Pharmacist: The only thing is though, could you then access when you're looking at from a distant place [remote prescribing], so you're therefore then not looking at the patient or the notes. C3

The lack of experience of some junior staff to not question what is being asked of them was cited as another concern regarding remote prescribing. Thus making all staff aware of the pitfalls of not examining the patient or not accessing the relevant medical notes needs to be reinforced by the Trust. Safeguards need to be put in place, such as preventing pressure being put on staff to make a clinical decision remotely or to prescribe without all the necessary information, along with a culture of “patient safety” awareness.

Doctor: Again about the laziness, possible ways with long range prescribing and I think it's definitely a good point that junior members of staff might be more inclined to just write up whatever is asked of them. A1

Doctor: Sometimes I think that's a bit of a double edged sword is that you can get asked to prescribe things when you are distant to the patient and when you are on call, it can be helpful if it's appropriate, but occasionally there can be pressure to do things...because you have that ability you have to guard against it. A5

Pharmacists stated how remote access had enabled them to follow up on outstanding queries and that previously this would not have been possible, yet, this had led to less patient contact. The concern by one pharmacist that they may be isolating themselves from the ward and the MDT team was very poignant. However, it was perceived that other pharmacists outside of the MDT team might not have the same viewpoint and that the lack of time on the wards was perceived to be promoting laziness. A cultural change may be emerging with the arrival of EPMA systems that must be considered and highlighted before compassionate patient care is compromised.

Pharmacist: I'm just conscious that I don't want to lose the patient [contact] and the communication with the team because I... I'd much rather be involved with my team and discussing decisions, so I like to be on the ward and be involved in that. A3

The focus groups conducted in Hospital C with a paper prescribing system in place discussed how remote access to patients' prescriptions could be an advantage during staff shortages, enabling a pharmacist to review all the medications of each patient without having to physically be on the ward or see the patient. However the pharmacists still acknowledged that remotely accessing the prescription would take them away from the patients and wards but that the way things were changing in the NHS, it might be necessary even though patient-centred care was a priority.

Pharmacist: I think it would help us in a way if we were really short staffed because it could, we could get to the point where we've got a lot of people off sick, we can't see every patient every day, and if that were the case it would be really good because we could see how patients were being updated, erm what the doctor's changed and we could see that from a distance if we needed to. I think that would be a really beneficial thing for us, not that we would want to move away from it [patient], move away from the wards, but it's getting to the point soon where ...C1

4.4.2 Clarity of the prescription

The sub-theme of clarity of the prescription considers and describes how the legibility and design of the prescription chart impacts on its clarity, whether it is a paper or ePrescribing system and therefore influencing how HCPs interact with the system.

4.4.2.1 Legibility

The EPMA system was perceived as a great improvement now that the prescription was *legible*. Being able to read the prescription without having to try to interpret the prescriber's handwriting was discussed in all the groups and that taking away the inconsistency of prescribers' handwriting was one of the main drivers for patient safety and the EPMA system. However, the uniformity of computer text was considered so clear, in some cases, that it could be overlooked.

Nurse: I think (biggest change) accuracy with the written aspect because there are so many doctors with bad handwriting and, you know, the interpretation of the prescriptions." C1

Pharmacist: I think actually one thing about handwriting as much as it's not always clear there is something distinctive about the shapes whereas it's all typed in block you can sometimes just get reject. B3

One nurse felt that by being able to read the EPMA prescription clearly, he/she could be sure that the patient would be given the medication they should be given. This then raises the question about how much trust the HCPs can place on the information provided in the electronic system when the information provided within the system is still open to human input error.

Nurse: I think er reading the [EPMA] prescription would be greatly improved erm and being sure that you're giving what should be given C2

Key HCPs discussed how the prompt they used to have with the prescriber's handwriting, such as hesitation in the writing, has been lost. These were perceived as warning signs or safeguards that came with illegible handwriting that regrettably, for patient safety, are no longer available with the EPMA systems. It was proposed by the HCPs that the errors in ePrescribing are *quite convincing* and that they were *not as obvious*.

Pharmacist: With EP the errors are quite convincing as well, they are not as obvious because you could...when with handwriting you could kind of spot that they really didn't know what they were doing because it was like illegible so you were then going to the notes to try and decipher what was actually said on the ward round but with EP because it's clear and legible in there its quite convincing that that is actually an instruction as to what you want. So before they used to kind of smack you in the face, the errors and knew it was quite obvious, now they are very subtle and it is looking out for them A3

The ePrescribing system was also seen as possibly facilitating prescribing error, as the system could provide prescribers with lists of possible medications that a patient could be taking.

Pharmacist: If there was something written down and they didn't know what it was then that's not given, but if a doctor thinks 'oh well actually the patient said this it's probably this' then they can match a drug to it, even if it might be the wrong drug they might pick it. Whereas before they would have written down this incomprehensible thing and it would never have got given, so there has been that as well. B2

4.4.2.2 Design of the prescription

HCPs who worked with the EPMA system on a regular basis commented on how the layout and view of the prescription in EPMA actually hindered their work rather than facilitated it, so it is important to get it right. The design of the paper drug chart was considered more favourable for HCPs' working practice needs. The

amount of information provided on each screen was considered too much and distracted from the important information.

Doctor: there's so much more going on, on that screen, isn't there, you know sometimes the most important information doesn't jump out at you; you have to go looking for it...A1

The display and order in which medication information is provided in EPMA can change within the system, with medications appearing in alphabetical order or in BNF category order. This can hinder HCPs ability to recall what medications a patient is taking, therefore hindering their capability to memorise medications when navigating between different screens.

Pharmacist: I find it a lot harder to see on EPMA, than it is on a drug chart and I find it harder to remember what a patient is on because it all looks the same. Also because, depending on whether it comes in the order of the BNF or whether you have got it set to drug name where it comes alphabetically, it can look different each time. B2

The paper prescription chart provides medicines information chronologically and so facilitated the prescribing story that members of the MDT referred to.

Pharmacist: The good thing about the drug charts were that you could sort of see the little story as things were prescribed and the sort of date order...you could see in one place what's been given. B3

Generally, the willingness of staff to engage with the EPMA system is increased if it is easy to use. The *user friendliness* of the system was important to the HCPs stating that a more up to date, *snazzy* and appealing system would motivate staff to interact with the system more.

Doctor: It's taken a while to get used to the system, the system is laborious, I do like Mac and windows based systems and something that looks like a zopped up dos is always a bit of a hard task, especially when the acronyms have been designed by the person who did the programming rather than the doctor. A4

HCPs felt that their ability to perceive risks with the medication and get a clear picture of what medications a patient was taking had been reduced due to the layout and intricacies of the system.

Doctor: I still like looking at a prescription chart and that's my big bug bear with EP is that I can't actually easily, see what they [patient] are on and when it was discontinued and how long have they been on the antibiotics. I'm not

happy with the view of the system...So I still hark back to some of the simplicity of looking at a [paper] chart. A3

General comments were made about the overall system along with more specific difficulties that were encountered. These included small screens, navigation required between multiple screens, lists that cause difficulty in distinguishing medications, the dose a patient should receive, the number of warnings that appear and the use of different colours.

The size of the screen reduced the clarity of the prescription and did not make the EPMA system user friendly; this was commented on in all the focus groups with EPMA in place. Each EPMA system provided a small display of the electronic prescription chart, which never completely filled the computer's visual display unit for the HCPs to view and interact with, in order to get the vital information that they needed. This required the HCPs to pay attention, so as not to miss something, which can be difficult in the healthcare working environment full of interruptions.

Doctor: It does give you the feeling that you are trying to run a hospital through a letter box...and you have got this massive screen [visual display unit] in front of you A5

The EPMA systems rely on HCPs having to view and *remembering* to review different screens to get the full medication information they require. This was a concern that, during busy working periods, the different screens may not always be viewed and having to navigate through the screens had slowed the HCPs down. The time it takes to review the prescription compared to the paper system is potentially inefficient and has implications to patient safety.

Pharmacist: I find it takes a lot longer than what erm than when I used to do it because like I say it's having to look at many different screens to get the same information as looking at one chart. B2

Pharmacist: I think it slows you down and you're definitely more conscious of (pause) looking at...because it's...the EP screen that we have, doesn't tell you all the information so you have to go into a different screen to find out the full information A3

Specific examples of detached information in the ePrescribing system were recognised as causing safety issues, the MDT members provided in detail some of the issues encountered. For example, not knowing if a course of steroid medication

was stopped abruptly or tapered, at a glance, could cause clinical issues and harm for a patient.

Pharmacist: You have to go to different screens each time with EPMA, to know where to look sometimes and also if things get stopped it's harder to see, like if somebody stops a steroid course suddenly. You would of seen it on the [paper] chart it's been stopped, but you have to remember to go to discontinued drugs and that could be something that you don't always, if you're busy, you may not do... every day or time B3

Different screens within the same software could not be viewed at exactly the same time. This had led to key HCPs needing to remember information between different screens, resulting in an increased cognitive load, which can be difficult and lead to error in times of stress and high work pressures.

Doctor: When you get that list of medications like you know came in and not prescribed you have to (laughs) have to close down that notes window to prescribe one medicine and then go back to it. B1

The medications appear as a list to the doctors and pharmacists in both EPMA systems. This had caused difficulty in deciphering and distinguishing each drug, to ensure they are appropriate for the patient. For example, Stat doses (one-off doses) for patients appear first in the list of medications and are thus not always relevant for review (Figure 2-1). This means that the HCP then has to scroll down the page to find the regular medications which are in the same colour and font as all the other medications.

Doctor: Drugs are classified as regular orders, prns [as required], Stats, aren't they pretty much and they come in the order probably Stat, prn, regulars I think don't they. It's difficult to remember that in your head though, so you look at the screen and you see morphine, morphine, on the top and zopiclone plus a lot of morphine and it takes a few minutes, every time I look at the screen to realise that there the ones that have just been given last week and it's not relevant anymore. A5

Pharmacist: That is interesting because that is one of the problems that I have noticed a lot, is that the first screen you get is rubbish, then you have to go through all that to get to what you actually want to see. A5

HCPS explained that in Hospital A, it was difficult to scroll through the medications and get to the specific medication that they wanted to view. The EPMA system did not permit them to page up or down the screen, instead they had to scroll through

each individual medication. This had led to delays in clinical workflow, causing inefficiencies for HCPs.

Doctor: So you are trying to scroll through it [medication list] all and you can't just page up or page down. Pharmacist: Oh yes it won't let you do page up or page down... Doctor: So you can't jump down a whole screen and yes and tap all the way through and then you miss one and it goes off and you try and go back up and it freezes ...

Medications that have been administered, but not officially discontinued on the EPMA system can still appear, leading to delays and possible mistakes in administering the right medications.

Nurse: the admin chart, but then you can have drugs that have been prescribed for three weeks that have been stopped and finished and you might take twenty minutes to find the medication that you want. B3

Pharmacists have taken on the responsibility of trying to *tidy up* the Stat doses to help reduce the number of medications that need scrolling through, before a medication review takes place. This has added to pharmacists' workload, in order to improve the efficiency of other colleagues working practices.

Pharmacist 1: We keep on top of that [discontinuing Stat prescriptions], but on all the other wards, surgical for instance, they do a lot of stat doses; you can't always keep on top of every patient every day. Because that's a waste of time, and then you get them being given again and then that's an incorrect administration. Pharmacist 2: and I've made, (exacerbation) I've gone thinking I am tidying up the prescription and ended up stopping stuff that hasn't been given. A5

The dosing information of drug strength and the total dose a patient should receive caused "confusion" when viewed by doctors and nurses; they recognised that this could lead to potential prescribing and administration errors.

Nurse: The EPMA system here compared to my old one, you have like the dose that it will come in but then like the patients' dose and I found it really difficult not getting them confused. B2

The dosing information within the two EPMA systems in hospitals A and B is not displayed the same way as on a paper prescription or compared to some other EPMA systems. It was perceived that the dose in the EPMA system was set out in that way to facilitate pharmacists, rather than other HCPs.

Doctor: its apparent what drugs they are on but it's quite difficult to look at it and just see how much of one drug they are taking... it's not how I think about drugs, it's not how its laid out, its laid out how a pharmacist thinks about drugs to me (all laugh loudly) A5

The numerous warning signs that come up in both the EPMA systems have led to HCPs overlooking the important warnings, leading to what is termed “warning fatigue”, especially as the amount of reported warnings could sometimes go “off the page”. This was discussed within the focus groups, how imperative it was that important warnings needed to be more refined.

Pharmacist: Basically It's the same box comes up for allergy and duplicates which I don't think is a good idea I don't think because it should be a different box for allergies. Doctor: It needs to be a big red box which you can't ignore. A1

The different EPMA systems presented the same vital information; by utilising different colours in one of the systems, it had alerted the HCPs more. However, the frustration of many HCPs was that there did not seem to be any rationale for many of the warnings, which had led to the overall practice of ignoring them.

Doctor: With the very small window that's the point there are so many interactions that come up that you have to scroll down to some that are off the page and I think it's the red ones come to the top no matter what which is, you know, a good feature of the programme but it's to the point that you don't look at them because so many come up that you know are actually the intended benefit of the medication. B1

The use of different colours visually facilitated the HCPs view of the prescription, as discussed earlier with warnings. Although, alternative colours such as “green” led to difficulty in reading the information, and had been relayed back to the EPMA team. However, feedback that the HCPs had received was that the system was too old to change the green colour. This had reinforced the HCPs perceptions that if they did feedback any design concerns, they could not be acted on anyway.

Nurse: I know a lot of people have said the same thing; it's that the green background but apparently the programme that's been written is so old that they can't change it. The language doesn't exist anymore to change the colouring of the background which is probably not great (laughter) B3

4.4.3 Operating the system

Operating the system considers the training and experience required by key HCPs to operate the prescribing system to the best of their ability. The training provided is imperative to enable the multidisciplinary team to provide quality patient care. If the training is not fit for purpose and then HCPs are required to use the prescribing system, patient safety issues can become a major concern. Operating the system can be difficult for staff who are not comfortable with technology and are not necessarily computer literate as well as agency staff who have possibly not had the training needed to provide quality patient care.

4.4.3.1 Training

All staff need training in order to use the EPMA prescribing system. The paper prescription chart was thought, within the focus groups, to be understandable and therefore structured training in its use was minimal. The fact that the knowledge of how to use the EPMA system has to be provided and maintained was seen as an extra time burden but that it was necessary, as it is not something that should be guessed in order to operate the system.

Doctor: It is an extra amount of time and work just to learn it and then it's a laborious system so there is much more work involved in "IT" (Information Technology) than paper prescribing. A4

The system and the information within that system is only as good as the data that are put in by the operators. That is why it is essential to provide quality training in order to prevent prescribing errors, or the wrong information being communicated between HCPs and the patient. All the focus groups mentioned and acknowledged how important training was before using any EPMA system.

Doctor: You can find the information you need on the prescribing system. It's just knowing where to look with it, with the prescription chart you didn't need training for that, you didn't need to be told and you have to retain that information...A3

The training of staff in order to operate the system effectively varied between different professional groups (doctors, nurses, and pharmacists) and Trusts. Each Trust had a "compulsory" training course in place, but this was not always

perceived to be the case regarding doctors that were more senior. It was felt by some focus groups that senior prescribers had not attended the EPMA training course and that there should be no exceptions. It is important that senior staff lead by example; they are responsible for the development of junior staff and their training, which would include prescribing. Senior doctors should be involved in using the EPMA prescribing system and encouraging their junior staff.

Doctor: I think they (consultants) don't, I don't know how much training they received, I think it was sort of more up to them whether they went. B2

However, it would not be unreasonable to assume that senior doctors have attended the compulsory training for EPMA but that their ability to prescribe is impacted by irregular use.

Doctor: I was half an hour late for a ward round because I had to do something first and the consultant was still on the first patient trying to figure out how to use the EPMA. B1

The training of nursing staff also differed between Trusts. Nurses at one Trust were always given standard training by the EPMA team, but new nursing staff members at another Trust were trained on the job by nursing colleagues when they started. This, however, had jeopardised the training quality as there was no time allocated to train new nurses, along with potentially passing on bad habits and workarounds.

Nurse: I mean they don't have training now, the new nurses...we have to teach them now, they don't go. Somehow we are meant to fit it in but we don't. (Uneasy laughs) A2

Each profession had their own specific training within each Trust in order to focus on the part of the EPMA system they would be using the most. MDT members highlighted that even though they all use a certain part of the system, it would be beneficial to be able to navigate their way around the whole system.

Doctor: the doctors were never really told from the nurses point of view, sometimes if you like there's certain things like nursing staff can't give like IV Morphine and like I'd have to do it myself on the system so we like you kind of have to learn on the job how to chart medications and how to transfer patients and put things on the ward we were never formally taught that. B1

Training on how to use the whole system would enable HCPs to have an awareness of what their actions can have, on the work of other HCPs. Pharmacists stated how they use the EPMA system nearly all the time in their job role, yet their training seemed to focus specifically on a combination of doctor and nurse training.

Pharmacist: There's not actually a pack. Yeah 'cos yeah when we went to that training with the EPMA team they had the nurses pack and the doctor's pack and it was where's the pharmacist's pack? and then it was like 'you look at the yellow screen which is what the doctors use' so we kind of use that a bit more but not completely erm and then it was just a lot of playing around really because we kind of we discuss between us in the department don't we you know the different ways we go round things. B1

The training sessions were described as “painful” and “complicated” and generally did not fulfil the needs of the staff so that they could go away and use the system with confidence.

Doctor: It (training) was painful (Laughs)...I think its standard IT training where you spend about half an hour learning how to log on and then the actual...B3

Nurse: I think the training made it more complicated...You came out of the room thinking 'oh my good God this is going to be a nightmare' and then when you actually were there and using it this is ten times easier B3

The format of the training and how beneficial it was for each HCP was discussed, highlighting what could be improved in future training sessions in order to provide a better understanding of how the system works and acknowledging safety concerns with any new system. Opinions raised about new systems would support having a national EPMA system, which, as proposed with a paper prescription chart would facilitate training and minimise patient safety issues.

Doctor: When you start in a new place you are probably in greater risk of making an error and if you are using a new computer system that's probably particularly true and I don't know how good the computer training actually...I mean it's alright but I'm not sure it's that good at identifying the areas where your most likely to make a mistake when you first start and I think that all the computer training I've had has never really said yes this is where you will make an absolute mess out of...so watch it A1

HCPs stated how they had gained experience with the system and that the information should really be utilised to inform further training in the future. The

need for follow up training sessions after the initial one was reinforced when members of the MDT were discussing how they taught themselves.

Doctor: It (training) was lengthy and it was a bit sort of painful to be honest sitting through it and it didn't...all of the things that were discussed in that session were things that I could of figured out for myself, whereas there were other little things like dating and dosing and all that stuff that have taken a little longer to try and figure out...I think all the issues that um are problems you just come up with to figure out for yourself and ask each other A1

The amount of support each profession had after IT training also varied, doctors, nurses, and pharmacists within the same focus group gave different accounts of their follow up after training. The nurses had been informed of somebody coming around their ward a couple of hours each morning if they had any further questions about the EPMA system. The pharmacists mentioned the EPMA pharmacists that were contactable if they had any queries about the EPMA system and the doctors figured it out amongst themselves.

Doctor: It's very different I think when you get trained in a system and then to actually go and use it. You almost could of done with follow up, you know someone coming round, coming to the ward and asking if everything was OK or if you were given an opportunity like that then perhaps more things could have been resolved. A2

A good safety culture needs to be provided by the staff members who provide EPMA, explaining what the EPMA system is able and unable to do. The staff providing the training must also consider the importance of each individual training session in its own right, to ensure sufficient training is given to new staff. This will hopefully ensure that substandard training does not happen and does not have a knock on effect for future patient care.

Doctor: Well you feel like the training session was very, very quick and the people giving it were very keen on saying let's try and get this done quickly so we can all go home and so they burned through everything and every individual step wasn't too complicated to learn...there was so much of it and then we all had to sign a form saying , yes I know how to do this, yes I know how to do this and it wasn't, so then that's taking the liability out of their hands. I've said yes I do...and I'm filling this in and I was kind of shell shocked afterwards, just thinking do I remember to do all that now...A4

When probed about who each HCP went to if they were having difficulty using the EPMA system, some did not have a definite answer, but the HCPs thought of the

pharmacist, rightly or wrongly, as a key person to help them out with the EPMA system.

Doctor: We tend to urm; my experience with our F1s is we tend to ask the pharmacists, urm because they know all the features of the EP quite in depth. Pharmacist: You perceive us to know! (All laugh). A3

One of the focus groups in the Trust without EPMA in place acknowledged how there should be a central person who is responsible for training and support. It has been previously noted that across the NHS, there is a culture of not making a fuss; staff grumble to their colleagues about specific issues but do not report them until they become critical (20). EPMA-support staff must be identified and their details incorporated and clarified throughout the training sessions to ensure HCPs feel they have the support going forward once they have completed formal training.

Nurse: I think from my point of view in that situation I didn't actually know who to go to. Like if you have a problem with EPMA, do you go to pharmacy? Do you go to the pharmacist? And I think that's a little well, from my experience that's a bit of a grey area and no one really knows who to go to if it goes wrong like that. A2

Even after having training on the EPMA system, one doctor did not feel confident to use the system and called upon pharmacy to take them through the process. However, this shows how important it is to have the support in order to provide safe patient care and not to be left having to decipher the system like other HCPs were potentially doing.

Pharmacist: They (anaesthetists) would phone pharmacy and they would demand somebody went up there (theatre) to hold their hands to prescribe, which you could say is right or wrong but at the end of the day they knew how to ask and it was safe, they weren't just using the system blind. A3

It was pointed out that poor training was how bad habits and workarounds were introduced into the system. Because if a HCP is not taught correctly the first time, the correct course of action will not happen and ultimately it is the patient that will be affected.

Nurse: Its getting into the right habit when you first start and if people are in training and they don't get taught to write "drug unavailable edit text, this is what you have to do next", then they will just keep doing drug unavailable and it's your patient that is the one that loses out. A1

However, it came to light in the focus groups that most of the pharmacists, except for those on the EPMA team, had been given the same training as the prescribers on the EPMA system with a limited amount of specific pharmacist training. Therefore pharmacists were advising HCPs in an area that they did not necessarily know themselves, and had taught themselves about prescribing on the job along with understanding the prescribing system for their own use.

Doctor: I'd contact the pharmacist if I don't know, because they seem to know more about how to work EPMA than me to be honest. Pharmacist 1: Yeah I get a lot of queries about it, I'm happy to help them but actually we don't get any training how to prescribe. Pharmacist 2: A lot of our training is on the job and then I feel like sometimes if I don't play around with it I don't know like ,I don't know you know I need to play around with it so I can tell people where to look and stuff. B1

4.4.3.2 Agency Staff

Agency Staff, both doctors and nurses, were discussed regarding their lack of training on the EPMA system. This meant they could not use the system at all, leading to many knock-on effects on the working practices of fellow colleagues. Resentment toward agency staff was noted in one of the focus groups, as it was felt that having agency staff was a bit of a “nuisance” and that it “doubled the work” for regular staff. Prescribing on behalf of the locums was also mentioned, which could lead to legal and ethical issues, along with faults in the EPMA audit trail.

Nurse: they can't use EPMA a lot of agency staff trained nurses so they use downtime...Which is a bit of a nuisance especially for the other staff nurses on because it's more or less double the work for them to do. A4

Doctor: There is always a lot of issues with like locums as well because they don't always have these sign in, so that's an issue where, you know, they can't do their prescribing jobs, they have to wait for the next person B2

4.4.3.3 Computer Literacy

In one of the focus groups, it was felt that they were “quite an electronic literate group” and one specific participant thought that “everybody is these days” showing how sometimes it can be taken for granted that staff can use and embrace technology without any difficulties.

Doctor: I mean, I guess we are quite of sort of an electronic literate group erm but you do notice some...Nurse: I think everybody is these days...Doctor: Some people will take longer with the computer systems and be a bit thrown by pop ups... A3

Thinking to the future of healthcare and how technology was advancing led to acknowledgment of how different generations would embrace the technology.

Doctor: I have been using paper for 30 years then, that's the way you set up as a default isn't it...but it's not just me, there's other people that have made similar comments....future generations are going to get much more used to the computer, electronics... A2

Without regular use, it was acknowledged that efficiency was affected and that EPMA can be difficult to use.

Pharmacist: I do like EP but I find it difficult at the moment because I'm doing a slightly different role, I'm not using EP as a pharmacist regularly, I find it quite difficult then when I cover a ward, to use it, because I'm not having that regular use. A2

4.4.3.4 Experience

There is a distinct difference between training and experience of using the EPMA system that regularly appeared in the EPMA focus groups. HCPs reflected that they learnt more once they started using the EPMA system compared to the training they received.

Pharmacist: the best training though is just doing it, at the end of the day. A1

Nurse: I can't even remember doing the training now but I think you learn more once you start it. B3

Taking people's experience of using the system and ensuring it provides further advantage in the future is important. It needs to be acknowledged that people with experience have a lot of valid information that should be embraced in order to inform less experienced staff how to improve patient safety and care.

Doctor: I just think that sometimes one of the good things if you have got a EP system and you have got pharmacists that are used to it, is to maybe be compiling a list of commonly made mistakes and commonly made errors so that when people start using systems they are already aware of what the errors are rather than making them. A1

4.4.3.4.1 Workarounds

Workarounds are where the user, in order to get the task done will not necessarily follow the intended sequence that was originally set up; creating different ways of getting the same result that are not always the most efficient or safest routes to take. Workarounds navigate the inflexible part of the system and provide alternative ways of getting the job done. With experience of using the system, workarounds can be created when constraints occur within the EPMA system. The workarounds that were not taught in training tend to stay with the person or group that created them and as a result are not identified unless specifically questioned or witnessed.

*Pharmacist: Suddenly you find out that there is a whole new way of doing something that you know you didn't realise...we didn't know what it would do and people try different keys and try to see what happens if you press this, type of thing and very occasionally it produces a good result haha...(all laugh).
A5*

Continual support by the EPMA team is required to uncover the potential workarounds that could be incorporated into training or may need to be discouraged due to the effects it could have on the system as a whole.

Pharmacist: There's always little workaround things you suddenly discover and you go oh 'I didn't realise you could do that'...It's like just using a word document isn't it? You have to understand ... B3

4.4.4 Using the system

A lot of detail about different aspects of using the EPMA system such as prescribing, discontinuing and selecting medications, inputting allergies, and specific medication groups like antibiotics, was discussed first hand, with examples providing insight into specific constraints that were present in the system leading to workarounds and different repercussions on the HCPs working practice and potentially patient care. All of these situations show how using computer technology is not completely effective at standardising practice and eliminating user variability unless the system is specifically designed otherwise.

4.4.4.1 Selection errors

To create a prescription within the EPMA system, several different selection processes have to take place. In order to select the correct patient within one of the EPMA systems a “black bar” is used. Thus, selection of the wrong patient within the EPMA system can have a knock on effect right at the beginning of a long chain of events in order to create a prescription. This has led to the term “selection errors” that can occur through human error.

Pharmacist: The thing with EP or any computerised thing I think is picking errors, so you pick the wrong patient because you may not of moved your black bar down, you might have been looking at that one but you haven't moved your black bar down to the one you really intend ...it's often when you, look at how they have done it, it's the one above or below the actual intended one just from people's perceptions of looking at a list of things. A4

The *phenomenon* of selecting the wrong item within the EPMA system had also been observed in other parts of the Meditech system. For example (quote below) in Hospital A, microbiology eye swabs are ordered frequently on ICU, but this is not because eye swabs are carried out, it is because they are next to the *central line-tip* selection list in the Meditech system. This reinforces the occurrence of human error when inputting information into the system and highlights an issue with the audit trail and quantifying tests that are actually carried out.

Doctor 1: Well that's a regular phenomenon (in the pick list) with Meditech based systems anyway, if you look at the number of microbiological eye swabs that we do in the ITU, we don't do any, but we have got loads of results coming back because its right next door to central line tip... A4

In one Trust, medications have to be selected from a list by choosing a number that correlates with the required medication, rather than physically typing it into the system. One doctor explained that using the system had made his prescribing less safe due to selection errors; this was also reinforced by other HCPs.

Doctor: It's not safer for me because I prescribe the majority of medications so...I don't write the wrong thing but I can click on the wrong thing and if I've written the wrong thing it's because I'm stupid, if I click on the wrong thing it's because I have made a mistake. A5

In both Trusts using EPMA, the fact that staff do not have to physically type out the medication, can lead the HCP to not think through what they are asking the

system to do. For example creating a “discharge summary” or another term “To Take out (TTO), medications for patients to go home on were previously written out by the prescriber. Within the EPMA system, each medication has to be “ticked” to incorporate it onto the TTO. The process of going down the “list” of medications and ticking the correct ones has led to selection errors that can then cause confusion for the patient or harm if the error is not picked up before they leave the hospital.

Doctor: straight down the (TTO) list and people will continue medications that they shouldn't because they're just clicking through whereas if you have to write it out you do at least have to think about what you are writing or at least I do. A3

4.4.4.2 Antibiotic prescribing

The prescribing of antibiotics was focused on in all the focus groups at some point, probably due to external targets set by the Department of Health (DoH) (47) and the funding specifically set aside to improve antibiotic prescribing that had made it an important topic of discussion. In order, for regulation to be effective, the guidelines, policies, and procedures need to be followed. Due to the DoH recommendations regarding antibiotic prescribing (47), existing and new prescribing protocols were capable of being enforced by the EPMA system.

Protocols had always been in place at one of the hospitals to ensure that consultants or registrars were consulted regarding the prescribing of antibiotics and length of course each patient should receive. However this added to the time constraints and barriers that HCPs now faced using the EPMA system when having to prescribe antibiotics. They explained how it wasn't uncommon that you needed to prescribe four times to enter a treatment course for the patient and that every time, extra things needed to be completed.

Doctor: antibiotic prescribing I always say is quite cumbersome because you need to put in your, you have to put a “Y” in the box to say that yes you have discussed it with a senior, even though my electronic prescription it says SPR, I still have to put I have discussed it with myself (everybody laughs) and put my own user name in... A3

The reason why an antibiotic has been prescribed is termed the clinical indication of the medication. The document *Start Smart - Then Focus* requires the clinical indication for any prescribed antibiotic to be documented in the notes and on the prescription, so that all HCPs are aware of why the patient requires the antibiotic and also provides an indication of potential course length (47)(48).

New designs on a paper prescription have enabled a box to be incorporated onto the antibiotic prescriptions in order to facilitate and prompt the prescriber to complete the clinical indication information. Hospitals have been able to audit how often this information is completed on a paper chart and also by increasing awareness of its benefits to the MDT. This information has therefore slowly been incorporated into the patient safety culture within the hospitals to different extents (Section 3.3.1.2). Once EPMA is installed it was thought that providing a clinical indication on an antibiotic prescription would be enforced. This, however, was not possible with one of the EPMA systems, underlining the differences in functionality between the EPMA systems thus effecting HCPs' working practice.

Pharmacist: I think depends if it was forced or if it wasn't forced but you have to put a reason in before you moved on or whether it was optional. If it was good practice it probably wouldn't get done (laughs). The things that you get done like DVT group they all get done because there's a money incentive because there's people on it do you know what I mean when you're so busy isn't it there's often an incentive or if the screen forces you to put something on that's probably the way that would ... B3

Previous work in phase one (Section 3.3.2.1) about the completion rates of an antibiotic clinical indication, had been proposed with the same software to have become worse rather than better since moving to EPMA. The EPMA system in Hospital A did enforce prescribers to complete the clinical indication. Accuracy of the information provided was questioned, as the drop down menu for providing the clinical indication was very long and had no logical order; therefore HCPs were not necessarily picking the correct one or putting "I don't know".

Doctor: antibiotics, it's very difficult often to find the indication that you want from the drop down menu...and then having to find a thing to say I don't know (all laugh). A3

So the quality of the clinical indication information was then brought into question. On reflection, if key HCPs are forced into providing a clinical indication, this raises the question would the information provided be correct.

4.4.4.2.1 Antibiotic course length

A three day antibiotic course length can be automatically populated within the EPMA system or can be pre-printed for three days of administration on the paper chart. These design features of the prescribing systems are in place to facilitate antibiotic discontinuation in a timely fashion. Both paper and EPMA systems have their difficulties regarding this area, but ultimately it comes down to the prescriber putting in the right information in the first place, again showing an area of prescribing more susceptible to human error.

Nurse: Initial treatment's just three days isn't it and then it needs to continue. Pharmacist: But that's because they weren't being stopped which I suppose could be a problem with the electronic ones couldn't it? Just roll on until well, until when actually because (EPMA) drug card will never need re-writing (laughs). Doctor: Yeah I think as well the safety will be to sort of as you prescribe it prompt you to when you want it stopped otherwise you just carry on. Pharmacist: Yeah but the current drug card does that and nobody fills in the stop date. C2

It was considered in the focus groups, conducted in Hospital C, how EPMA might change the discontinuation of antibiotics, possibly leading to the prescription never being stopped. The EPMA systems are able to counteract the potential problem of antibiotics never being stopped, by utilising automatic stop dates within the system. However, the EPMA system may overcompensate, if the stop date is inappropriate, leading to patient safety issues.

Doctor 1: The antibiotic auto stop dates... Doctor 2: That's a minefield isn't it, especially when it hits the weekend, you've got somebody with sepsis day 3, they stop the antibiotic, that's not a good thing at all Doctor 1: No, and you simply don't have time as the SHO providing the service at the weekend to review and continue everyone's antibiotics, at the weekend, it's not feasible. A5

The EPMA system relies on the prescriber inputting the correct course length into the system otherwise it discontinues the antibiotic after three days, unless it is altered by the prescriber. Once the antibiotic course comes to an end the antibiotic

prescription *drops* off the screen; this can lead to patients not getting the right antibiotic course length highlighting a potential patient safety issue that raised concern in the focus groups with the EPMA system in place.

Doctor: even though you know they (patient) are on antibiotics it drops (antibiotic moves to discontinued screen) off like and you don't sometimes realise about it even though you want them (it) to continue (antibiotics)... it's really hard to keep on top of everyone's stop dates all the time... A2

Solutions for the patient safety issues around automatic stop dates for antibiotics, such as a *warning screen* that “*Flashes up and says you know this is due to stop in the next sort of 24, 48 hours and then it kind of alerts you to it*” A2 were discussed in groups, showing that this was definitely an area of concern shared by junior doctors in particular. One doctor provided insight into his rationale for not changing the antibiotic course length when prescribing, as he was concerned about the patient contracting the infection *Clostridium difficile* and could be asked to account for his actions in prescribing a 2 week course of antibiotics, which was necessary for the patient with sepsis. This shows how outside influences and policies can influence a HCP carrying out their job to the best of their ability.

Doctor 2: when you are prescribing you can't put 14 days of Tazocin can you because when they get Cdiff 7 days later you've had it. There's no middle ground. A5

This insight by the doctor did touch on one of the drivers for antibiotic automatic stop dates, but as with any policy there is always a fine balance about how far it should go and how beneficial it is at facilitating effective patient care and patient safety.

Pharmacist: I know when we first started with EP we were hoping that antibiotic prescribing may eventually cut down C. diff figures, I'm not sure that that's happened ... I hope it's made medics stop and think. A3

4.4.4.3 Allergy Status

Information about a patient's allergy status is essential to provide effective and safe patient care, especially if the prescriber is considering a new medication for the patient. On paper charts the allergy status of a patient has to be written on the front of the drug card, in hospital C policies are in place that prohibits the nurse from administering any medication, unless the allergy status of the patient is

documented on the front of the drug chart. In the EPMA system the allergy status has to be entered into the system, which can prove difficult at times.

Doctor: think the allergy data could be better set out... it's like you can have class or generic but then you have to go, you have to fiddle around quite a lot to actually find out what the reaction was. A2

However, if the allergy status of the patient is not done properly, warning signs to alert the prescriber about an allergy do not necessarily appear as described in the following quote.

Doctor: It's an absolute pain...because then if you free type them [allergy], whereas normally then it will say if you hit penicillin and you try and prescribe amoxicillin; no, allergy; so if you prescribe 'other' it won't pick up the potential drug interaction. Pharmacist: And they aren't, there isn't like an order as to how to find your particular drug (laughter). B2

The facility to be able to prescribe medication that is not on the system needs to be available for situations where unusual medications are required; however the system is not able to link potential warnings about the medication prescribed as “not on the system”, consequently the system does not alert the prescriber to a potential error. Awareness of HCPs regarding the “not on system” situation needs to be reinforced to prevent them from using it unless absolutely necessary. This would take into account possible interactions that will not be highlighted.

Pharmacist: Yes the only reason why that (prescribing error) happened was cos it had to be prescribed as “not on system” so usually if sodium bicarbonate is prescribed as sodium bicarbonate it would flag up saying you are duplicating. That doesn't necessarily mean the doctor will still not prescribe it, they will just go yes whatever... A1

4.4.4.3.1 Summary

In summary, the theme “Interface - interacting with the prescribing system” has considered the sub-themes summarised in Table 4-2. Interacting with the prescribing system has changed the logistics of how the HCPs carried out their work within the in-patient setting, depending on where the patient, prescription chart and medical notes were in relation to each other. Multidisciplinary team scenarios such as ward rounds, on call, medication rounds or prescription review, also had to adapt in order to interact with the prescribing system and the patient. The clarity of the prescription and the prescribing story altered due to the legibility of the

prescription and its design. Design features included the number of different screens, the view of the prescription, the order in which medications were listed, the size of the display, the addition of strength and formulation to the individual prescriptions, extra prescription items and gaps of information. Learning how to operate the prescribing system was a task in itself and impacted upon how the HCPs interacted with the system. Depending on the HCPs’ training, experience, computer literacy and whether they were comfortable with their environment or if they were new to the ward influenced their abilities to provide safe, timely, effective, efficient and patient centred healthcare. Specific difficulties in using the EPMA prescribing system were discussed throughout the focus groups; most were highlighted within each group due to the impact they may have on patient safety. These difficulties included selection errors, antibiotic prescribing and allergy status.

Table 4-2 Sub- themes of "Interaction with the system"

Theme	Sub-themes
Logistics	“Lost” Prescription, Location of the prescription, Remote prescribing.
Clarity of the prescription	Legibility, prescription chart design.
Operating the system	Training, Agency staff, Computer Literacy, Experience
Using the system	Selection errors, Antibiotic prescribing, Allergy status.

4.5 Change in working practices

The change in prescribing system from paper to electronic led to a modification of HCPs’ tasks and roles, causing the system to impact on their working practices.

4.5.1 Role of the pharmacist and nurse

The role of each health care professional has had to adapt to a new situation, taking into consideration what the ePrescribing technology can or cannot facilitate in order to provide quality patient care.

4.5.1.1 Pharmacist Role

The use of the EPMA system to prioritise pharmacists' work was considered by all the focus groups. EPMA enabled the pharmacist to prioritise newly prescribed medications for review or any changes that were taking place. However, using this method to prioritise work can prevent an overall look at a patient's medication and possibly hinder more in-depth or holistic patient reviews. For example, there may not be any changes made to a prescription but the patient's condition could be declining requiring necessary advice regarding medications; these situations cannot and should not be overlooked.

Pharmacist: I think it's really helped us prioritise our work as pharmacists, because before we would have had to of looked at every chart to see if there was anything new or any, but now we can, we can really use it to prioritise and review drugs. But I also think now that if something's reviewed you don't always go back and revisit it, so say if you've missed like an interaction or you know it's very. You're focusing on things that have changed rather than, things that are there and already checked. A2

Pharmacists deliberated about how the new "technical" part of checking the prescription, had distracted from their "clinical" check making the process more time consuming as they were "scrutinising" the prescribing system.

Pharmacist: I just find that because you're perhaps concentrating on the technicalities of, has the right drug been selected and in the right dose you always have to take a step back and then review it clinically as well so, whereas a glance at the drug chart (paper system) and you can see everything. A2

Pharmacists considered the errors they were looking for, to be human errors created by the change in prescribing system and not just clinical mistakes made by the doctors. This showed how conscious the pharmacists were that human error might have increased with a change in prescribing system.

Pharmacist: they (errors) are not as apparent as they used to be so you just, it's more time consuming from a pharmacist's point of view because you have got to really, you are scrutinising a system because you know that errors happen and it's because it's a new system, it's not necessarily that you are looking for the doctors making mistakes, it's the system errors that you are looking for. Like have they prescribed a prn (when required) on a regular schedule. A3

As discussed previously in “training” (Section 4.4.3.1) pharmacists have become EPMA guardians and are usually the first port of call if any of the HCPs have difficulties in using the system. This puts more responsibility on the pharmacists to know how the system works. It is therefore important to ensure that pharmacists have a good understanding of the EPMA system, not just for themselves but also for others, and should be factored into training. This requirement for EPMA support means the availability of pharmacists on the wards needs to be ensured in order to facilitate MDT and support to all HCPs.

4.5.1.2 Nurse Role

Nurses found EPMA more convenient to use compared to a paper prescription. By having access to other information, such as blood results on the computer as well as the EPMA facilitated the checking by nurses of blood tests before administering a medication. This was an improvement, as previously some nurses may not have checked. The EPMA system provided a communication tool via a “bubble” that enabled HCPs to provide more detailed information about medications, than compared to the paper prescription. This information, that would previously be hand-endorsed on the paper prescription in a limited space, could now be used to discuss information with patients about their medication; such as administration details, supply comments, counselling comments and/ or discharge letters.

Nurse: We can also teach the patients as well because if there are instructions in the “bubbles”...we then look quite knowledgeable when we tell the patient (chuckles and laughs) we don’t know everything...Doctor: You see EP gives you a higher IQ Nurse: Well you can advise them at the same time of administration, and that’s part of their education ready for discharge isn’t it.
A3

Staff from the hospital with a paper-based system considered how the EPMA system could save time by bringing the medications that were due to be administered for a particular drug round to the top of the list, therefore making the nurses’ medication round more efficient. This provided insight into the possibilities that staff perceived EPMA could provide.

Nurse: Yeah I think it would save a lot of time. At the moment we go through the chart literally start at the front and go through every single page to make sure that you've not missed anything off whereas it would be start at the top and working your way down wouldn't it I suppose? C1

The experience of nurses working with the EPMA system counteracted the potential benefits of bringing the medications that were due together. Nurses, when using the EPMA system, can only see medications that need administering on that medication round. The EPMA system hinders foresight for future medications, therefore requiring nurses to have more situational awareness regarding future medication rounds as explained in the next section.

4.5.2 Situational awareness

As noted in previous research (80) and reinforced in the focus groups, having EPMA in place can, to different extents, bring the information that a HCP requires together in a predictable and standardised way. Yet the EPMA system is detached due to design issues such as different screens and the order in which the medications appear, therefore hindering awareness of the complete prescribing “story”. The amount of information provided for HCPs to review can lead to information overload, which may also cloud a HCP’s judgement and ultimately their situational awareness as explained below.

Doctor: That’s the problem with computer systems it always shows that if you can collect more data, people tend to try and do it then you can see more of what you are doing, but it becomes the fact that you end up with so much data you can’t make decisions because there is just too much, too much to see... A5

4.5.2.1 Time of Day

It is important when prescribing using the EPMA system, to have situational awareness of time; this is because the EPMA system is strictly aligned to the time of day and specific drug round timings. In order to ensure a patient does not go 24 hours or more without a medication, the time that a prescriber inputs a new prescription must be considered. For example, if a “regular” medication is prescribed at 9am in the morning and it needs to be administered at 8am, the medication will not show on the nurse’s administration chart until 8am the next

day, causing a 23-hour delay. In order for the patient to receive a dose on the day of the prescription, an eStat dose must be prescribed.

Previous research (20) has discussed what solutions or workarounds have been employed to prevent this delay in administering medications from occurring. Solutions that have been adopted include adjusting the system clock or giving the first dose as a eStat dose (20).

Within both the hospitals using EPMA, the practice of prescribing an eStat was in place as the official solution to the timing issue. Therefore, eStat doses are now prescribed more frequently to ensure the patient does not endure a delay in receiving a necessary medication when using the EPMA system. The doctors and nurses explained how they required situational awareness, and how it had proved quite problematic.

Doctor: I suppose in terms of, when you prescribe on EPMA will dictate when the first dose is given so if you don't remember to do Stat doses and certain things that might need to be given there and then there may be more less a day in medication. Erm so there's a timing issue with when you prescribed on EPMA as well, which is really hard to remember because if you've, if it's not before eight o'clock they don't get their morning medication. B2

The change in prescribing system had impacted on working practices by requiring the prescriber to duplicate prescribing, when needed, but this had resulted in frustration and inefficient working practices to overcome a latent failure within the EPMA system and avoid patient safety issues.

Doctor: I've got to go back and prescribe a stat so the patient can have their dose...uhhh that can get a bit annoying because its time consuming at times when your, when you thought you had done a job and you know you haven't and it's no one's fault it's just I learnt that it's difficult to understand the timings of it and to get my head around that. A2

Prescribers are also able to change the clock on individual prescriptions making the EPMA system think the prescription was created at 6am rather than 11am and therefore creating a dose to be given. This however appears as a missed dose on the administration section, through no fault of the nursing staff, creating a problem with the audit trail within the system. This is a workaround within the EPMA system and not an official solution to the problem, however it shows how

workarounds can impact upon patient safety and audit trails in order to facilitate timely and efficient clinical workflow.

Nurses are not able to prescribe or modify prescriptions in the EPMA system, whereas before with paper prescribing, amendments could be made to facilitate patient care, such as the time medications should be given. Now the nurses officially have to contact the prescriber to get eStat doses prescribed before they can administer the medication even when the nurses know the patient needs it.

Nurse: But then when I have asked for it to be prescribed today, it's not actually been prescribed for today it's actually been prescribed for tomorrow... so she (patient) has had a day without it, so it's a case then of going back and saying do you think we could have a Stat dose of that...and she didn't ... A1

However, at one of the Trusts it materialised that an unofficial workaround had been adopted by nursing staff in order to circumvent contacting the prescriber. This entailed “borrowing” doses from the following day’s prescription, which then has a knock-on effect for the rest of the following day’s administration.

The fact that eStat doses are now prescribed more frequently than previously on a paper prescription was also discussed in the focus groups under the theme “view” of the prescription because ultimately, with every Stat dose that is prescribed, the prescribed regular medications get pushed further and further down the medication list. This resulted in the HCP having to scroll further and further down the screen to view the “regular” medications. In other EPMA systems, mentioned in previous research (20) the opposite effect occurred where the Stat medications fell off the bottom of the screen as they appeared last in the “list” of medications.

Nurses, when using the EPMA system, can only see medications that need administering during that medication round. The EPMA system hinders foresight for future medications therefore requiring nurses to have more situational awareness regarding future medication rounds. This was explained in the following quote, it reinforces how important it is to have HCPs working as a team and communicating with each other in order to facilitate every aspect of the healthcare system and ultimately the quality of patient care.

Nurse: EP very nicely turns the next doses that are due at the next ward round time green, people were very heavily focusing in on what was going green next and forgetting anything that was in-between... people weren't looking ahead and it was kind of changing the mentality (SA) of the nursing staff to always look for things outside of drug round times... Communication was a big thing in making sure it got given... Doctor: Yes, if the communication had been... if the computers not on or the patients not there no one would notice the red flashing... A4

Regular interactive communication within the MDT is required to a certain extent between HCPs to promote and support situational awareness whilst carrying out their work in the healthcare setting. With the introduction of EPMA, communication within the MDT has changed and with the advent of remote access to EPMA may have potentially detached HCPs from each other, affecting colleagues' situational awareness regarding patient care.

4.5.3 Communication

The sub-theme of communication reviews and describes the adjustment required, once ePrescribing was implemented, and how the multidisciplinary team communicated physically, verbally, in writing and during ward rounds. Socio technical system theory considers how the workforce social situations can be impacted, especially when avenues of communication are altered and how this can affect quality of patient care being provided.

4.5.3.1 Physical communication

In the hospital with paper prescribing in place, concern was raised over the loss of a physical prompt and reminder that the paper chart had in facilitating the HCPs' working practice. With the paper prescribing system HCPs can sometimes see a prescription being written, whereas with the electronic system a physical prompt is not presented anymore, because the prescriber is generally away from the specific patient and might even create a new prescription remotely.

Nurse1: Oh we just have to wait and see what's on there (computer) Nurse 2: I think it depends some doctors will tell you they've prescribed something , if it happens all the time you may just go to the screen and there's a new tablet there. B2

Newly prescribed medications can appear on the EPMA system and has led to different practices being adopted by HCPs. The fact that unless someone is constantly checking the “computer” a new entry or change to any medication will not be seen unless verbally communicated, this was considered exasperating as it had led some HCPs to constantly check the computer.

Pharmacist: I feel a bit of a slave to a computer whereas I didn't before. Plus we could potentially see every change as well and the times it happens, whereas I used to feel more satisfied by seeing the chart once every day, now I feel constantly, see if they need anything else... you can feel like you should be checking them [Computer] more because they're there and available erm and because things do appear, whereas before if the nurse needed something they'd ring and if I'm not here they'll bleep me to go and get it whereas because it's done on the computer... B2

4.5.3.2 Verbal communication

More emphasis on verbal communication within the MDT to facilitate situational awareness and patient care was now required with the introduction of EPMA, especially regarding the “eStat doses” as discussed (Section 4.5.3.1), to ensure patients did not experience a time delay in getting their medications.

Nurse 1; I think now the once only side of things the doctors are physically seeking you out now to say we've prescribed this...Nurse 2: They have to tell you that otherwise we wouldn't know that until the next ward round, the next medication round... A3

Expectations of EPMA are high and it is still assumed by some HCPs that its use will facilitate communication to the point of needing less verbal communication. A surgical consultant had believed from one of the training sessions that the EPMA system would be able to physically alarm or flash red by the patient's name if a medication was overlooked or was not dispensed at the appropriate time, but then realised that unfortunately this wasn't the case. The Consultant explained how, on a number of occasions, antibiotic *Stat* doses required post-surgery had not been given. The consultant felt this may be due to lack of communication between theatre recovery and the ward, however the consideration of communication between prescriber and nurse was overlooked. The fact that it was still a retrospective review of missed medications, all be it in a

shorter time frame, and was not considered good enough and that something more immediate needed to be done.

Doctor; I appreciate now that you have got an electronic flagging up of things that have been missed in the 24hrs after they have been missed, that's useful but at the time I want the antibiotics given at the time, I'm wondering how more immediate that could be. A4

Acknowledging how important communication is in the healthcare system, the EPMA focus groups could not understand that verbal communication still needs to take place to inform different HCPs when a TTO is ready. An assumption made by HCPs was that with the introduction of EPMA, pharmacy knew electronically about TTOs and medication changes; this needed to be clarified across the hospital.

Pharmacist: Well unless we're told what's been prescribed because there's nothing there's no ring bells or I mean even TTOs people think that automatically there's a signal in pharmacy something that shows you what's been done. There isn't until someone verbally tells us, so if you prescribe something you've not told me then I'm not going to know to order it either...

Nurse: You can do it a TTO on a computer system and then you have to physically verbally tell someone that you've done it so the pharmacist can do their bit I find ridiculous, because there's technology and then it sort of breaks down and it goes sort of primitive with communication. B1

In one of the focus groups, the verbal communication between HCPs was described as sometimes being difficult when any of the HCPs were actually using the computer and that it was “impossible” to talk to colleagues as they were concentrating so much on the computer and didn't want to make a mistake.

Doctor: Not all the nurses are tremendously computer literate, and that's probably fair to say of half the staff in the hospital...they are impossible to talk to because they can't hear you, because they are so focused on that screen... I think communication wise I think typically they are so focused on the computer, it's probably for doctors as well, but I have particularly noticed it with nurses doing their medication ward rounds. A5

Not been able to talk to colleagues whilst on a medication round was also touched on in another focus group when a nurse felt that, when using the computer on medication rounds, they experienced a lot less interruptions by colleagues and likened it to previous research conducted around the use of red aprons whilst conducting a medication round.

Nurse: It goes back to the red pinny and 'do not disturb' whereas if you've got that computer it's up there its more daunting you don't want to interrupt somebody if they're on the computer... People do tend to not disturb you as much when you've got a computer as when you have got the red pinny.

4.5.3.3 Written communication

One of the hospitals uses electronic notes within the ePrescribing system; the notes are completed by all the HCPs. It materialised that the result of all the HCPs entering notes into the same section had ended up with an information overload situation that could become overwhelming. This required a HCP with experience to “suppress” the notes that they felt were no longer relevant to the patient. Examples of such were given; this then opened the question up to what information was documented, and how important that was for the MDT to know. What seems important information to one HCP would not necessarily be seen as such to another HCP. The debate about one set of notes for all HCPs versus silo notes for each profession continues.

Pharmacist: So with the notes, someone has got to go in and physically suppress them (irrelevant notes)... there's doctors, nurses, pharmacists but it needs someone to take the initiative to go through and then suppress it. B3

The documentation made on ward rounds was considered to be quite comprehensive and clear. It was felt that doctors were more likely to say what the problem with the patient was, the plan and to explain why they were starting a specific medication. The causes for lack of written documentation in the notes were considered in the focus groups, with the introduction of remote prescribing being cited as one of the reasons. Other explanations for lack of written communication were that the patient had been seen at the weekend or in the evening time by a busy on-call doctor. The difference in written communication between the hospitals was explored in the next phase of work and will hopefully provide more insight into the reasons for lack of clear written documentation.

Pharmacist: They're (on call medic) running around doing all of the jobs, they actually write up the meds that might be needed but the last thing that they actually think to do or have time to do is to write in the notes as to why they have done something, unless it was obviously a major review. Doctor: Or they may of prescribed remotely as we have heard... Pharmacist: Well yes exactly, yes, yes so I tend to find that that's when the documentation isn't as clear or

detailed. Doctor ... I rang through to the ward but we didn't write anything in the notes. I mean probably for best practice you should do... A4

Delays in prescribing were acknowledged by medical staff citing that specialist teams are no longer readily prescribing in EPMA for the patient and are instead recommending in the notes, causing possible oversight by the responsible team leading to an interruption in patient care.

Doctor: Yeah I think specialist teams prescribe less when they come round whereas before they might have been willing to change the drug chart now they will just write in the notes to change this, this and this so a lot of people will feel like it's if they write in the notes that's okay but there is then essentially a delay. B2

Written information within the EPMA system that is needed for the HCP to carry out their specific jobs cannot be seen at the same time. This can be linked in with the theme "view of the prescription"; it shows how written communication is not always accessible when it should be in order for the HCP to carry out their work. For example with paper prescribing, the HCP can physically look at the paper prescription whilst creating a TTO ensuring that the correct information is on the TTO and assisting a double check, along with having the medical records to back up the information provided. With the EPMA system it is not possible to view the TTO, prescription and HCPs notes all at the same time leading to the HCP having to memorise the information whilst navigating through the different screens.

Doctor: So it's impossible for me to do a TTO and at the same time look at the medications, the verified medications that the patient came in on so it's actually quite fiddly to actually get it completely right and to kind of... a lot of it relies on your memory and not been too lazy to not go back in and to see on that list and try and try and go back. A1

Written communication within the MDT used to take place using "post it notes" on the paper chart and then put in the jobs tray which, it was agreed by all HCPs, was not a very formal means of communication and had a lot of problems associated with it as explained:

Pharmacist: With paper charts we often relied, rightly or wrongly, wrongly I think on post it™ notes on drug charts... We had cases where a post it note came off and got stuck on different patients chart and the meds were prescribed for the wrong patient... but you take that system away and then you have to think about another way of communicating jobs whether it be via

job books or heaven forbid actually talking to somebody,... but you also want the security somewhere of having a job record to write it down in because the person that you have spoken to over the phone has a million phone calls about different things and will they actually remember to do that ... A4

Alternative ways of communicating were therefore very important in order to continue lines of written communication. The differences between medical and surgical working practices were discussed showing that diverse circumstances such as ward based F1s and team-based F1s called for different ways of communicating.

Pharmacist: I think the specialities will be very different in the way they handle it (written communication) and are able to... A4

A jobs-book based on the wards had previously been used when paper prescribing was in place on the surgical wards. This had enabled non-urgent jobs to be communicated whilst the team was not accessible, such as in theatre etc. This form of communication via the jobs-book had therefore been adopted on the medical wards once EPMA was introduced now those post it™ notes were not possible. A jobs-book for the doctor and a separate one for the pharmacist had been adopted on one of the wards. However, the use of the jobs-book was questioned and highlighted the fact that it wasn't used that often. Also the possibility of it not being used correctly caused patient safety concerns.

Doctor: a lot of jobs don't get written in there because the doctors don't look at it and the doctors don't look in it because not much gets written in it... it's a bit of a self-prophecy and personally I would prefer just to be bleeped ... then I know about it straight off, I can write it on my jobs list. If it's something urgent, I can deal with it more urgently. That's my preference and that's how I would prefer to get rid of the jobs books... I think it helps me stay on top of things, because I am constantly in contact with everyone. A4

Doctor: you would sometimes find things written in them [jobs book] that were totally inappropriate. A1

Questioning as to whether it was a legal document was also raised. There seemed to be no standard practice within the hospital of using the jobs-book. For example, one pharmacist was communicating the same issue in four different ways, because it wasn't clear what should be done. These situations need to be guided by management and the organisation to improve communication and prevent any patient safety issues or duplicate of work leading to inefficient working practices.

Pharmacist: I found myself writing it in the jobs book, in my pharmacy care plan and in the notes and bleeping the doctor which is completely ridiculous. A4

The way written, verbal and physical communication takes place in all three of the study hospitals is different for a lot of reasons, not just because of the prescribing system. What is important to understand is how best to communicate when the prescribing system does change. One doctor felt that, whatever the prescribing system used, HCPs needed to communicate properly.

Doctor: I think that's true of any kind of communication no matter what urmm system you have in place to communicate between the nursing staff and pharmacy and the doctor. It doesn't work if the actual people doing it do not properly communicate. A1

4.5.3.4 Ward Rounds

Ward rounds became a big discussion point in all the focus groups deliberating about how they, could or had, altered when the prescribing system changed. The importance of the medical ward round to facilitate communication between the multidisciplinary team, and quality patient care was prominent within the focus groups. Once EPMA is implemented, the need to have full representation from each HCP within the multidisciplinary team on the ward rounds becomes more apparent. Staff in Hospital C with paper prescribing in place explained how the prescription was not always “considered” and reviewed by the team if it was not at the end of the bed. The question about if this practice would change once EPMA was in place was raised.

Doctor: The team will come and see the patient and nobody's asked me for the drug chart so they've obviously not even considered looking at the drug chart when they've reviewed the patient, so that whole step's kind of missed, so would an electronic system get reviewed regularly? Would it be ...? C3

It was perceived by HCPs working in the hospitals with EPMA that the prescriptions were not being looked at as much on the ward rounds as they used to be and it was a “habit” that had materialised with the introduction of EPMA.

Pharmacist: Definitely, I think that's something I have noticed since EP has come in, that the prescriptions are looked at a lot less on ward rounds, I think it's a habit thing that's going to get worse Doctor: potentially it's a real problem... A3

Doctor: I've noticed especially comparing it back to when I was a medical student was that the drugs don't get reviewed enough Nurse: Yeah I certainly agree, it used to be obs [observation] chart and the kardex [prescription chart], you know list of the meds and now it's obs chart. B1

Prescribing by consultants was perceived to still happen in Hospital B but mainly on the Emergency Medical Unit that still had paper prescriptions in place.

Doctor: When we do ward rounds seniors never look at the book [laptop], they do but not every time, whereas before when you had a drug chart at the end of the bed they would get it out, they'd look at it, and they do it in EMU [Emergency Medical Unit] as well, the consultants will add medications that they want them to be on or cross things off. B2

The variability in how each consultant carries out the ward round with their multidisciplinary team was discussed in the focus groups. The specialities of medicine and surgery have to contend with different issues when carrying out a ward round as previously discussed under the theme of logistics. This gave insight into the hurdles that doctors had to overcome when carrying out the ward round and what repercussions this had.

Doctor 1: With medical ward rounds they tend to take the ward trolley and computer and it's a slow thing, and their willing to check these things. Surgical ward rounds whilst generally being a bit quicker they don't want to be slowed down by having to ... Doctor 2: If you can get something and just show it as soon as they ask for it like you can do with the paper chart... but if you say 'hang on I'll just go and log onto the computer and bring up the EPMA system'...They're onto the next patient. B1

The speed at which senior medical staff conducted ward rounds was raised, leading to patient safety issues. Senior staff must consider how much time it takes to access and prescribe a medication in the EPMA system, compared to a paper prescription in order to ensure quality of care is not compromised. This should be supported and reinforced by management and the organisation, to ensure that adequate time is allocated to carrying out ward rounds and preventing any patient safety issues.

Doctor: our consultant does things, does his ward rounds at high speed so you have to be able to do things quickly. So it means that things can get forgotten if you are not carefully noting things down umm but... he won't slow down for us to do that so (Laughs) that is an inflexible part of the system. A1

4.5.4 Patient Contact

The change to EPMA has taken the HCP physically away from the patient due to the location of the computers on the wards, and working remotely to the patient, as previously highlighted. Even when every effort has been made by the HCP to ensure they still have patient contact, the quality of that contact has also changed. The increased concentration required by the HCPs when using the EPMA system due to reasons discussed in other themes such as the view of the prescription, operating the system, computer literacy, hardware reliability and verbal communication, has led to the patient perhaps not having as much time with the HCP. Patients may need to discuss specific concerns they may have with the HCPs, whilst they are using the EPMA system. However, being distracted when interacting with the computer and possibly administering the wrong medications was also a cause for concern.

Nurse 1: You have to concentrate on the screen Nurse 2: The patients don't understand do they? Nurse 1: You do try, you do talk to the patient but you can't talk and look at the screen because otherwise you completely lose track of where you are, you know your quite danger... you forget where have I clicked on that or which drug have I just put in the pot... A5

The computer was also foreseen as a physical barrier, sometimes between the HCP and patient unlike the previous paper chart system, potentially leading to a less personal experience of care.

Pharmacist: it's a bit impersonal because you've got that barrier, you know, typing away and stuff. B1

Nurse: I think they [nurses] tend to hide behind them [computers] as well because they're at that height, you can tend to do your medicines hidden behind it whereas when we have the medicine trolleys and the cards I don't think we could hide quite the same. Not that I'm going to hide but I think we can be perceived as hiding behind it... like a barrier between you ware as if you had a card you only had a piece of paper that you were fiddling around with. B3

The theme “change in HCPs working practices” has considered the sub-themes that are summarised in Table 4-3. Communication between the HCPs within multidisciplinary teams and the patient had to evolve upon implementation of

ePrescribing. Situational awareness is required to understand each HCP role as well as the multidisciplinary team’s role in providing quality patient care.

Table 4-3 Sub- themes of "Change in HCPs working practice"

Theme	Sub-theme
HCPs roles	Pharmacists Role, Nurses Role
Situational Awareness	Time of day
Communication	Physical, Verbal, Written, Ward round
Patient Contact	

4.6 External influence

The theme of external influence encompasses the organisation level of regulation, policy and culture that impact upon the HCPs working practices and ultimately what is incorporated in the design of the prescribing system.

4.6.1 The NHS as an Organisation

All HCPs using the EPMA system require longer and more detailed training, compared to the training provided with a paper prescribing system, as discussed previously (Section 4.4.3.1). The knowledge and experience they gain when using specific prescribing systems, to be able to prescribe safely, led to questions about how prescribers would cope moving between different hospitals and potentially different prescribing systems. It was suggested that having the same EPMA system across the country would be a good idea.

An “ideal” universal situation was discussed within the groups, what would be good in theory and considered by the “NHS” or management, was seen as not always being possible in reality. The confidence HCPs had in the NHS and the Trusts being able to achieve this was exposed when they joked about the fact that the NHS couldn’t even decide on a standard observation chart to use, so how could they decide on a standard EPMA system.

Doctor1: A significant portion of your prescribers are people that change hospitals, so moving onto new computer systems , is it a bad idea to have a

variety of different computer systems? each with their own problems that you only start getting fully used to...Whereas at least if everything is written, a lot, most of the cards are very similar you get a certain amount of consistency with it. Doctor 2: It's very unlikely that there will be consensus on what system to use across the board, especially across the entire NHS but even across one general area. Nurse: They can't even decide on what observation chart to use, so you've got no chance... (Everybody laughs loudly) A1

Without the introduction of a national EPMA system, the Royal College's policy *Standards for the Design of Hospital In-Patient Charts*, that have been published to support the design of both paper and ePrescribing systems should be adopted by Trusts across England.

4.6.1.1 Clinical Indication

Within the focus groups, discussions about the antibiotic policy *Start Smart-Then Focus* set by the NHS regarding antibiotic prescribing came up (47). These discussions provided insight into how having a clinical indication on the prescription had been accepted, perceived and followed within the HCPs' working practice and, if changing to an EPMA system, had facilitated or hindered the documentation of a clinical indication. This then led onto discussions about having an indication on all prescriptions, as proposed by the report *Standards for the Design of Hospital In-Patient Charts* produced by the Royal Colleges (2). A unanimous agreement across all focus groups was that to provide a clinical indication on *all* prescriptions would be far too time consuming, and that it wouldn't be realistic in practice. Many of the focus groups concluded that to have a clinical indication on newly initiated medications in the hospital would be beneficial for communication with the patient, especially on discharge and between HCPs. The reasons why it would not be practical to have a clinical indication on all the prescriptions was explained.

Doctor 1: That would take you forever wouldn't it...? I think it would take too long Doctor 2; Very cumbersome. Doctor 3: You definitely wouldn't get to view the patient then would you. Doctor 4: I think that that's very useful for the patient and it often; you know I would say it is more useful in primary care but, on the eprescription antibiotics it's very difficult often to find the indication that you want from the drop down menu, so having to find it for every single medication, the patients on and then having to find a thing to say I don't know (all laugh). A3

Discussions exposed how policies were enforced within the system, but that enforcement had other repercussions in practice. Every focus group explained how when a patient is admitted to hospital they would not necessarily know why the patient was on all their medications and, without being able to confirm with the GP, they would not want to provide a clinical indication in case it was incorrect. A solution to the situation was proposed in one of the groups.

Doctor: I think there's a case [clinical indication] for new things I don't think you could ask somebody who's clerking in the patient who's potentially like confused and really unwell to go through all of their medicines and say why they're on it, particularly when things have got multiple uses. But I think if you're starting something new I think that's probably quite good practice just say why. Nurse: It would be good as well when patients are transferred between wards, you know, why ...B2

Pharmacist: I was thinking that it wouldn't be as time consuming if, when a patient came in you could select as a clinical indication, GP continuation. Then if you did Rx something new, you could put an indication on, so I thought yes that would be a good idea. A1

However, a consensus across all focus groups were that it would be feasible to provide a clinical indication for newly initiated medication in hospital, and that this would facilitate communication with GP surgeries. A comment arose about communication being reciprocal and that GP surgeries should provide a clinical indication with the list they provide of patient medications.

Doctor: Can you have it the other way round then; GPs explain why they're [patient] on medications? C2

4.6.2 Hospital Management

4.6.2.1 Selecting an EPMA system

The decisions about which EPMA system is suitable for a specific hospital are difficult with several factors having to be taken into consideration; one factor would be how considerate and active the EPMA provider is, in improving the system in line with the hospital needs.

The belief by all HCPs that the EPMA system cannot be technically changed or that the supplier refuses to change the software in order to facilitate their work-flow

and improve patient safety, has actually hindered valuable feedback to the EPMA management team. HCPs no longer report difficulties and there is certain apathy toward the system as they believe their improvements could not be acted on anyway. This strengthens the case for in-house developed EPMA systems that have been developed within the NHS system and that can be adapted to improve user interface issues.

Pharmacist: I think with this particular software as well the issues that like we've all identified we can't do anything about to change the system because from what I've been told this particular programme is an American based company it would cost like one per cent of their customer base compared to America and everything has to be done in house by them, we have no control as far as like in house modification of this programme so if they don't do anything about it they won't listen to us if we ask for something because they have to change it as a whole for the whole customer group. Nurse: There are other systems we used for nursing roster we use electronic there and we can suggest things to upgrade it and within weeks improvements are made. Pharmacist: I think it's the same within the programme like we can't influence the future outcome kind of thing to make it better for the Trust we're just stuck with this and it's never going to change because there's no changes you can make. B1

This situation was also acknowledged and discussed in a recent document produced by the Institute Of Medicine (IOM) entitled 'Health IT and Patient Safety' (77). It provided insight into the barriers that are encountered by the users in ensuring adaptations can be made to the prescribing system. The IOM acknowledged how numerous Health IT products can only be maintained by the producer of that product, causing users to keep service contracts with that producer, regardless of whether that producer addresses patient safety issues associated with its product (77).

External influences on prescribing, such as policies, guidelines, drug databases or specific software functionalities, can be put in place and reinforced by the EPMA system to try and ensure that the recommendations are followed. However, the policies are not always appropriate or relevant to every situation and there is no guarantee that staff will follow the policies anyway.

EPMA teams need to consider the relevance of information provided in the EPMA system, and how up to date that information is to ensure quality patient

care. The use of specific software and its functionalities to facilitate HCPs working practices needs to be considered and tested before it is used. For example the “databank” for medication interactions did not always provide relevant interaction information to the HCP. This resulted in frustration and less confidence in the data provided by the system leading to “warning” information being ignored more readily.

Pharmacist: It's just not an intelligent system (warnings) I think for someone has gotten a text file and given us a programme as a cross reference and then that's it; nobody's actually looked at it. B1

In one of the EPMA hospitals, only one person could access a patient's medication at any one time. This restriction had led to many knock-on effects causing delays in HCPs' working practice and patient care, especially as the system could become “locked” if the EPMA system went down or a user did not log out properly. Once the system was “locked” staff needed to wait 20 minutes for the system to unlock a patient profile. Yet, staff had to lie to IT in order to get help in completing urgent jobs and continue the work they needed to be done, resulting in another workaround.

Pharmacist: I've rung IT (about a “locked” patient) and they've gone ‘have you waited 20 minutes?’ and I'm thinking ‘I haven't got 20 minutes to wait for’ and then I go ‘no’ and they go ‘well you have to wait 20 minutes’ and I just automatically say yes now because you know it just gets the job done quicker... especially when you want to do someone like I say an urgent discharge or something it's just a hindrance. B1

4.6.2.2 Information Sharing

Alterations as to how information is accessed or viewed to improve how the EPMA system is used, led by each profession, need to be communicated to the wider user groups so that they can utilise the improved information sharing. The improvements made may not have the desired impact if the wider hospital community is not informed or considered. For example the electronic “note” system, sometimes referred to as the bubble, provided an electronic means of communication between HCPs, and was used in Hospital A by the pharmacists; however, other HCPs did not use the electronic note system as much. The need to promote teamwork and bring everyone together to ensure people know about

changes needs to be done using different communication methods. E-mails are not always checked or screen-savers rarely seen if computers are in use all the time. Those managing EPMA systems cannot rely on electronic communication alone, to deliver important messages.

Doctor: But actually, when I started you know I knew the note system existed but I didn't know it was so widely used by pharmacists. Pharmacist: Same case applies a lot of people aren't aware that it exists. B1

Important information about EPMA changes and support must be advertised and promoted effectively to ensure it is reaching all HCP staff, in order to make them aware of what EPMA support is available and how to access it. Standard cascades providing information to inform HCPs need to be decided for each ward and the rest of the hospital community to ensure staff get the information they require regarding EPMA changes.

Nurse2: It's [EPMA support] not made, it's not notable on the ward anyway, there's nothing to say go to this particular person... Nurse 1: There's no number... A2

4.6.2.3 Hardware

Hardware is ultimately the responsibility of the organisation; the computer technology has to be available, reliable, and portable in order for HCPs to carry out their work. Continual IT support and management are required to ensure that hardware issues do not affect patient care.

Doctor: I think one of the biggest problems is access to computers on the ward. None of the laptops seem to work without being plugged into a power supply... There's only two desktop computers, one's permanently got the ward clerk on it and one is shared between every other sort of person in the multi-disciplinary team so... B1

A shortage of computers on the wards was cited as one of the reasons for access delays, with computer availability becoming worse at peak times in the working day when all HCPs required the computers at the same time for their specific job roles. The HCPs have to adjust their working practice quite considerably leading to some physically leaving the ward and then coming back to review notes.

Doctor: I think there are some issues with surgical wards because you may well have four or five teams visiting all in one go, because they have so many different surgeons looking after so many different patients. Nurse: and it's

usually at drug round time in the morning, when 3 of them (computers) are already in use for the drug rounds. A4

Pharmacist 1: On busy wards there can be numerous occasions you cannot get on the computer, which means you can't do any work at all. Pharmacist 2: You are completely stuck then... because you have got yourself a computer and you're in the middle of a patient and you don't want to let that computer go". A5

Poor computer battery life and Wi-Fi issues compounded other difficulties with accessing the EPMA system. Reporting the issues of faulty equipment took too long, which lead to the hardware issues not being fixed, sometimes for weeks. Unreliable Wi-Fi connections could interrupt accessibility during a ward round. Good IT support is essential to keep the system running smoothly and providing quality patient care.

Pharmacist: There's not enough computers, especially if the computers are broken, the buttons are missing. A4

Doctor: And I think when there is an issue like a technical issue like say isn't working a lap top isn't working you're absolutely got your jobs to do and IT are notoriously ... Pharmacist: Slow. Doctor: ... you're fifth in the queue [over the phone] kind of thing you can't wait around and that the issue just gets ignored and its days or weeks, I mean someone has time to report it. B1

Nurse: It's also getting the trolleys to work which is stupid and just now it's taken me twenty five minutes to give three people medications. Because you walk into the bay and... the Wi-Fi cuts out and you've got to wait for it to load back... the same thing happens again and you're literally just constantly walking around to get it to connect up to the ward. B3

This phase shows how important it is to implement the right EPMA system that will improve patient care and safety over and above a paper prescription. At the time of writing, the EPMA systems design, produced commercially, are maybe not adaptable enough to address patient safety needs and therefore are not showing much improvement over paper prescribing.

It is important that the health IT community and researchers are facilitated in sharing information about the design of different IT systems without concern over non-disclosure clauses (77). Ascertaining if in-house designed EPMA systems specific to the NHS compared to commercial systems, produce better quality

patient care and are safer because of their consideration of front line staff working practices, needs further investigation. The use of information technology in healthcare can and will improve HCPs working practices once a system is designed and developed taking into account the needs of the HCP.

4.6.3 Accountability

Accountability and audit trails are seen as a big advantage to using EPMA and enable a lot of information about the prescribing and administration of medicines to be monitored by hospital management. All HCPs commented on how it was easy to change a prescription on a paper system without having an audit trail. They felt it would make a big difference not being able to amend a prescription in the EPMA system without knowing who did it. On paper, the prescription can be changed under the same signature so the original prescriber would be accountable whereas in EPMA this was perceived to be impossible.

Doctor: People not being able to change a prescription, that's really important, people will change your prescriptions; either they will change it for the good or the bad. Change the amount of times, the medication is incorrect and you're the one that's signed for it... C2

Pharmacist: As a prescriber I feel far more secure and reassured with an electronic prescribing system having a complete audit trail of who did what and when and knowing that no-one can alter my prescriptions that I've written without there been a trail of who's done that... A4

Administration of medications to the patient had become an ambiguous area for accountability using the paper system because of its design and layout. This led to confusion about whether a patient had or had not had their medications and whether administration had happened at the correct time of day as per the prescription.

Nurse: The clarification of who's given what. The signatures, the boxes at the moment to write the signature in are very small, you know and somebody will sign and you'll think have they given that because they've signed across two boxes C2

Nurse: it could be somebody's missed signing it and then hopefully the system would help that... you know, if the nurses have got to put something in that box otherwise they can't actually go to the next drug or something that would be a lot better wouldn't it? C1

The ability to check if any medications had not been given to a group of patients was now a lot quicker using the ePrescribing system compared to the paper system. However, checking an individual's patient record for missed doses had become a more complex process, the administration screen being separate to the prescription list, unlike the paper prescription chart. The EPMA system can produce a report identifying medication omissions, the reason for the omission and provide a clear audit trail of nurse signatures therefore helping nurse managers to prioritise the closing of gaps in patient care. It was perceived that the number of omissions had "decreased dramatically".

Nurse: On the paper chart if there were blanks which we might not get to see visually for 3 or 4 days because we can't physically go around everyone's drug chart every day, omissions were made, patients didn't get medications whereas now we can view very easily A3M

When using the paper prescribing system a blank signature box did not necessarily mean that a medication had not been given. This needs to be reflected when the nurse managers consider the number of omitted medications that were possibly happening when using the paper prescribing system.

Nurse: as part of my job role I check for omissions of medications and I have to say since we have being using the EMAR system I think that has decreased dramatically, for drugs not being signed for. A4

Expectations of what the EPMA system could achieve regarding medication omissions, over and above the paper chart were still not being met by one of the consultants. Questions were raised about the possibility of more immediate action being taken if a medication was missed.

Doctor: I appreciate now that you have got an electronic flagging up of things that have been missed in the 24hrs after they have been missed, that's useful, but at the time I want the antibiotics given at the time, I'm wondering how more immediate that could be. A4

4.6.3.1 Limitations of accountability

However, the focus groups from the EPMA hospitals gave examples of how the "audit" trail may not reflect true, real-time practice and that this should always be considered when reviewing the data.

It materialised, in one of the focus groups, that prescribing pressures were being put on junior doctors to prescribe for patients they may not know, possibly going against GMC recommendations, and therefore being put in a difficult position. Senior doctors need to be as confident in using the EPMA system as their juniors, which may require their using it on a regular basis or undergoing further training if required. By not keeping up to date with EPMA training, senior staff delegate prescribing to junior staff putting them and their patients at risk. Requests to prescribe on behalf of another person can happen, but it is up to the hospital culture and management to put a stop to it, providing the juniors with confidence to decline senior staffs' requests to prescribe on their behalf.

Doctor 1: I know a lot of the house officers in surgery get calls from xx saying ermm this person needs VT prophylaxis and this, or antibiotic... and you have to take it as a given over the phone that, that patient didn't have any allergies. Doctor 2: Well I would say that you shouldn't be doing that...you shouldn't be prescribing in the absence of any knowledge of the patient that GMC would not... that is a risk with ePrescribing that anyone from anywhere who has access to prescribing can prescribe without ever getting actually physically near the patient, so it's a benefit but it's a risk. A4

Not having access because senior staff do not have or have forgotten passwords was another reason given for possible "audit" trail issues.

Doctor: I know that a lot of the consultants and registrars don't have them [password], because I spoke to one registrar she doesn't have a password for EPMA and was asking about medication and I just think well why, you know, for you to even be able to look at that [prescription] you need a password. It's I think it's dangerous to be honest. A1

Prescribing under another HCP's log in was raised as an issue; the HCPs explained how their working practice as part of a team lent itself to potential accountability issues. From the following quotes, it was felt that staff did not want to be seen as obstructing a fellow colleague's work especially if they were in a rush.

Doctor: Especially yeah, because when you do have like other teams coming to the ward and they ask to check some of the medications while you're on EPMA because you're on it. So then it's... So you might end up getting involved in someone else's medication that you've not had anything to do with. B2

Doctor: There are an awful lot of prescriptions out there that you think are done by Dr Smith but were actually made by Dr Jones and did those stops (discontinued a medication) that were made by somebody else. Because you

are doing a ward round with 2 or 3 people around it, I've done it this morning... It's just another little, it's another problem that doesn't exist with a pen, its creating another danger, so yes its more accountable and yes you do know who prescribed it but that you know, you might know the wrong person as opposed to not being able to read the squiggle at all. A4

The issue of EP users' not acknowledging pop up warnings that frequently appear in the EPMA system was discussed in all the focus groups. HCPs were aware of the audit trail and speculated how accountable the prescriber would be pressing the “enter” button and overlooking warnings. Questions about how liable the prescriber would be if ignoring a warning, which led to a patient safety issue, were raised and that it needed to be prevented in the future.

The nurses had also found restrictions to recording accountable information in the EPMA system. The HCPs had no knowledge of a facility that would enable them to amend an entry after the event regarding the administration of a medication. This then raised the question as to how HCPs were able to amend the system if they knew they had prescribed or administered something wrong and wanted to rectify the entry.

Nurse: you think they've [patient] taken it all and then you discover they haven't... it [EPMA] doesn't give us the facility to go back and say 'they've refused it' so you think they've had everything and they haven't always. B3

Concern was raised by a doctor that, even if a maximum dose on the EPMA system is prescribed, the system itself still allows the nurses to administer more than the maximum dose prescribed. This shows an insight into how the HCPs want the system to help in preventing patient safety issues over and above what the paper prescription could achieve regarding accountability.

Doctor: And I think the PRNs [as required] kind of erm alarmed me when I first found out about you can actually give as many PRNs [as required], it doesn't stop you giving, say the cycle's [frequency] three times a day, you can still actually administer over three times a day. B1

Changes that HCPs make to the prescription are now audited and therefore what was once possible on a paper prescription, such as changing a medication preparation, e.g. different inhaler types or insulin pen versus insulin vial, is now seen as possibly “writing a prescription” which has steered pharmacists' reluctance

to change a prescription as it may be perceived as prescribing. The fact that the medication is now always prescribed as a specific preparation has possibly increased the error of a wrong prescription and requires the pharmacist to make these changes.

The theme “External influence and instruction on prescribing” has considered the sub-themes that are summarised in Table 4-4. The HCPs considered the NHS as a national organisation and also discussed local organisation level. Considering the external influences and instruction the organisations can have on the prescribing process. A proposed benefit of technology is the ability to audit situations, as previously discussed, and therefore important to organisations is the use of audit and ultimately accountability.

Table 4-4 Sub-themes of “External influence and instruction on prescribing”

Theme	Sub-theme
The NHS as an Organisation	Clinical Indication
Hospital Management	Selecting a EPMA system, Information Sharing, Hardware
Accountability	Limitations of Accountability

4.7 Chapter Summary

This chapter has described what is happening in practice from the viewpoints of HCPs working within a MDT, regarding prescribing systems. The HCPs within their MDTs’ in this phase discussed how their existing or previous work procedures were or would be affected by the implementation of EPMA in both a positive and negative way.

When considering phase two findings, interaction with the prescribing system changed considerably. The need for clarity regarding new communication routes, such as the impact on the clarity of the prescription chart, was highlighted.

HCPs are distributed across the hospital, which does not facilitate multidisciplinary teamwork. The advent of remote prescribing was perceived as disrupting the opportunities for MDT working together and patient contact. The focus groups provided a greater understanding of situations encountered by HCPs and the MDT when using the different prescribing systems. This enabled the researcher to consider the findings when carrying out the next phase of the programme of work. The focus groups had delivered HCPs' perceptions, within a team setting, of what had changed and the issues they encountered. However, what was actually happening in practice needed to be taken into account, as personal perceptions do not always reflect reality.

The next chapter of the thesis gives an account of the retrospective documentation analysis conducted in phase three and considers the clarity of written communication, in relation to prescribing and how it can influence the quality of patient care provided.

5 EXPLORING THE CLARITY AND ACCURACY OF PAPER AND ELECTRONIC PRESCRIPTION CHARTS

Chapter 4 described how the three different in-patient prescribing systems affected HCPs' working practices, as part of a multidisciplinary team. This chapter focuses on how different prescribing systems affect the quality components, through HCPs' working practices and the clarity of written communication via the prescription chart, within the prescribing system and the supporting medical notes. Having described in Section 2.2.4 the methodologies and rationale for phase three, a more detailed description of the documentation review, including data collection, followed by how data analysis occurred is provided. The findings are then presented and summarised.

5.1 Aim and Objectives

The aim of this study was to explore how different prescribing systems affect quality components (STEEEP), through HCPs' working practices and the clarity of the prescription chart and medical records, with a focus on newly initiated medication. Its objectives were:

- To compare the clarity and accuracy of the prescription chart, between prescribing systems.
- To explore the factors that affect the clarity and accuracy of prescription charts in Hospitals A, B and C.
- To consider the clarity and accuracy of documentation in a patient's medical records, once a prescription is newly initiated, as a risk factor for medication errors in the in-patient setting
- To consider the timeliness of prescribing and documentation, in newly initiated medications, as an indicator of clinical work-flow and communication
- To deduce how often patients were informed about their newly initiated medications and included in the decision making process

5.2 Method

The selection criteria for the three study sites were purposively selected to capture the diversity of the prescribing systems across England. The selection of the three hospital sites for phase three was explained in Section 2.3.

5.2.1 Ethics

Due to restrictions in place for HCPs not directly involved in the patients' care, the research and development department within each of the three hospitals must approve access to patient-identifiable information. To gain access to patient identifiable data, in the three hospitals, the National Information Governance Board (NIGB) was consulted about section "251" approval. During that time, the responsibility of the NIGB to provide support relating to section "251" approval moved to the Health Research Authority (HRA). Delays were encountered due to consideration of the different pathways that should be followed.

The decision was that two of the hospitals classed the researcher as a "third party" and so the use of de-identified patient data was considered. It was concluded that this was not possible, as the information included in the study was documented in several locations and each patient needed to be identifiable to the researcher in order to correlate the data with communications written by HCPs about the same patient. Finally, it was decided that patient consent would be required to access patient information in two of the hospitals.

The researcher had to follow different protocols to gain access to patient identifiable information within each hospital. This involved a byzantine process as each NHS hospital required different information and pathways to be completed. Access to patient identifiable information in the three Trusts is provided below; see Section 2.3 for more information on each site.

5.2.1.1 Access to patient identifiable information in Hospital A

As the researcher was employed by Hospital A, the service evaluation within that hospital was classed as a "local" service evaluation that did not involve a third

party carrying out the data collection (137). This enabled the researcher to gain approval by ensuring that the service evaluation occurred according to clinical governance guidelines. Approval from the hospital's Caldecott guardian was obtained, with the Research and Development Department facilitating the process.

5.2.1.2 Access to patient identifiable information in Hospital B

In Hospital B the researcher attended an audit meeting and discussed the proposed study, answering questions from the audit lead, it was concluded that the hospital wanted the researcher to have an honorary contract, rather than approach individual patients to gain consent. They acknowledged the NIGB recommendations, but stated that this was advisory and that the Trust had the final decision. The researcher became an honorary staff member to enable access to patient identifiable information. Approval was gained from the Research and Development Department facilitating the process.

5.2.1.3 Access to patient identifiable information in Hospital C

In hospital C, it was decided by the research and development department to follow the recommendations of the NIGB and so patient consent had to be obtained to view patient identifiable information. This was done by carrying out a prospective patient selection process over a seven-day period, and then retrospective record review determined if they had been prescribed new medications.

The following inclusion and exclusion criteria for approaching a patient in Hospital C were applied:

- Inclusion criteria for approach - Patients resident on the chosen wards over a 7 day period (identified by the Ward Clerk using the hospital Patient Administration System (PAS)) and those patients that ward staff considered suitable to be approached (owing to their current health or their ability to give informed consent).

- Exclusion criteria for approach - Patients that ward staff considered unsuitable to be approached (owing to their current health or their ability to give informed consent).

The researcher asked the ward sister, which patients complied with the inclusion criteria in Hospital C. Consent to review healthcare documents, was sought by the researcher from those identified patients meeting the approach inclusion criteria. Each patient was approached and the study explained to him or her verbally, by the researcher. They were given a copy of the Patient information leaflet (Section 9.3.3). Patients were given a minimum of 30 minutes to consider whether they were happy for the researcher to view their healthcare documents. Patients then either informed the staff nurse looking after them, or the researcher upon her return to the ward to obtain consent using the patient consent form. Once patient consent was obtained, the researcher had no further contact with the patient.

5.2.2 Data Collection

Once the researcher had access to patient-identifiable data each prescription chart along with the medical, nursing and pharmacy notes were reviewed for each patient admitted to the study ward over a seven-day period following the inclusion and exclusion criteria below.

The inclusion criteria for patient selection were:

- Resident on study ward during the specified seven-day period
- New medication initiated during in-patient admission period
- Patients whose length of stay on the specified ward is greater than 24 hours

Exclusion criterion for continued inclusion:

- Patients whose length of stay on the specified ward is less than 24 hours

Each patient who was prescribed a new medication during the course of their stay on the specified ward was identified and the researcher reviewed their medical

records relating to that admission retrospectively. Anonymous data were extracted to a data collection form for subsequent manual entry into a database.

As discussed in Section 2.2.5.5, the recording unit for phase three content analysis that was used to produce the medical entry score was defined as:

All medical note entries made for every newly initiated medication that was prescribed during a patient's admission on the study ward. This was done by identifying all the new medication prescribed; medical notes were then reviewed and entries copied verbatim if any reference to the newly initiated medication was documented.

5.2.2.1 Medical Entry Score

A simple rating scale was devised to grade the depth of written communication around newly prescribed medications, based on the GMC standards (12) and the implications that poor clarity and accuracy of communication can have for the MDT in providing quality patient care. This was carried out using content analysis and the recording unit previously defined in Section 2.2.5.5. In this instance the recording unit was each medical note entry made about a newly initiated medication; this was then rated by the researcher, with a background in Pharmacy, using a 5 point scale similar to previous studies (24). The rating scale was named the Medical Entry Score (MES) and was created by the researcher to provide examples of how medical entries communicate important information about new medications in the medical notes. The MES rating scale, rated the clarity and accuracy of the written content provided in each recording unit and used a 5-point grading scale developed for phase three as shown in Table 5-1 provides examples of each situation where a new medication was prescribed and the written documentation provided. The scale was not validated, however its use and validation may be considered in future work from the results that were discovered.

Table 5-1 The Definition, meaning and examples of the Medical Entry Score (MES) used in this study.

Score	Standard	Meaning	Transcription of entry
1	Clear and accurate direction	Standard of clarity and accuracy is such that the reason for initiation is clearly provided along with the medication details (dose and frequency) and so acted on with confidence.	ATSP re rigors. BG/Admitted xx/xx SOB 2 pulm oedema. 3 x blood cultures –ve MSU xx/xx – E.coli, resistant to Trimethoprim (was on trimethoprim) Susceptible to cefalexin / nitrofurantoin. <u>Imp.</u> UTI – prev. incorrect abx to cultures. <u>Plan.</u> Urine dipstick, MSSU, Nitrofurantoin 50mg qds 3/7.
2	Implied direction	Standard of clarity is such that there is a reason for initiating a new medication, along with the medication name, however no specific medication details provided.	ATSP re: redness at old venflon site. Pt c/o soreness L forearm + hand post venflon, otherwise well. Imp. Localised cellulitis. (P) po clindamycin (penicillin allergy)
3	Implied but no clear direction	Mention of a possible indication within the entry but no specific connection made between medication and indication.	<u>Imp.</u> Headache <u>NOT</u> ENT related? Temporal arthritis. Plan – steroid nasal spray
4	No clear direction	New medication documented as a “group” of meds, +/- indication given	C/O constipation <u>Plan</u> Laxatives
5	No direction	No documentation of indication or new medication	No entry

Key

ATSP – asked to see patient	Re - regarding	BG – Background
SOB – shortness of breath	-ve – negative	MSU – Mid stream urine
<u>Imp.</u> - impression	UTI – Urinary tract infection	Abx – antibiotics
qds – four times a day	3/7 – for 3 days	Pt – patient
c/o – complaining of	(L) – left	(P) – plan
Po – oral	ENT – ear nose and throat	

5.3 Results

The three hospitals and the number of patients admitted to each study ward over a seven-day period are shown in Table 5-2. This gives the breakdown and final patient numbers for review when following the inclusion criteria. Table 5-2 also highlights the number of patients who were approached in Hospital C, and gave consent to the researcher accessing their medical documents.

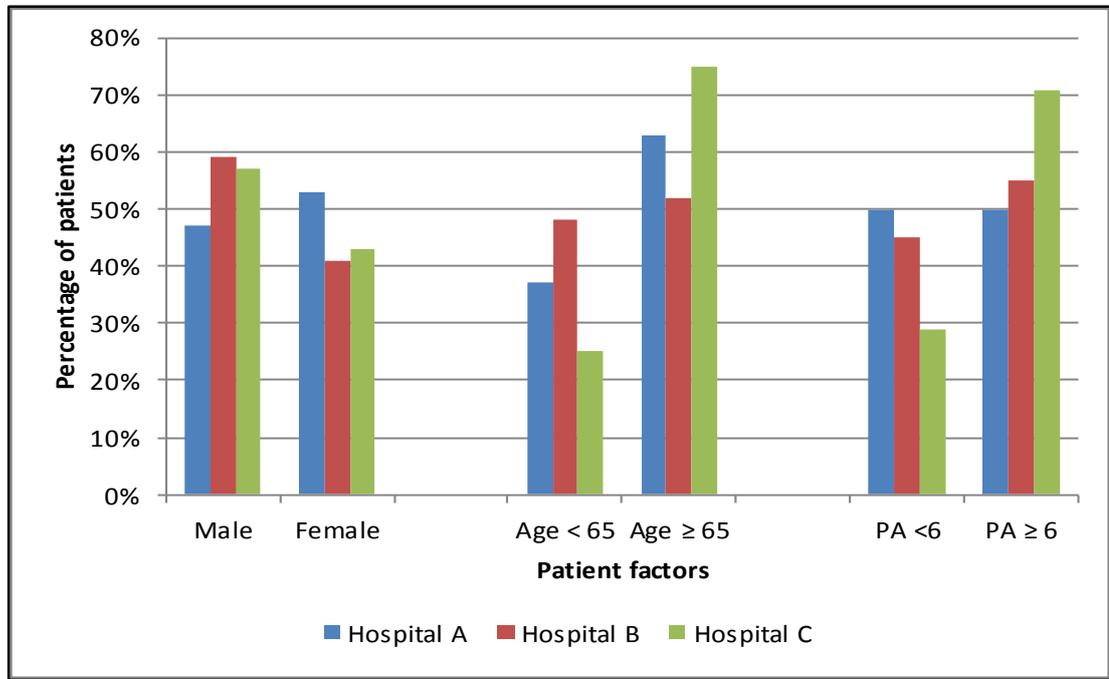
Table 5-2 Final patient numbers reviewed, showing a breakdown summary of number of beds on each ward, number of patients admitted, length of stay, number of newly initiated medications and medical note availability across three wards (Medical 1, Medical 2 and Surgical) for Hospital A, B and C.

Hospital A			
Ward speciality	Medical 1	Medical 2	Surgical
No. of beds on ward	28	28	28
No. of patients admitted in 7 days	25	31	46
No. of patients length of stay >24 hrs	15	17	24
No. of patients prescribed new medicine	14	11	21
Patient notes unavailable	5	2	7
Total reviewed	9	9	14
Hospital B			
Ward speciality	Medical 1	Medical 2	Surgical
No. of beds on ward	28	28	28
No. of patients admitted in 7 days	21	49	42
No. of patients length of stay >24 hrs	19	33	17
No. of patients prescribed new medicine	12	14	10
Patient notes unavailable	3	4	0
Total reviewed	9	10	10
Hospital C			
Ward speciality	Medical 1	Medical	Surgical
No. of beds	12	18	20
No. of patients admitted in 7 days	28	37	39
Length of stay >24 hrs	23	24	28
Unable to consent	10	11	8
Declined	2	3	5
Consented	11	10	15
No. of patients prescribed new medicine	9	9	11
Notes unavailable	0	0	1
Total reviewed	9	9	10

A total of 89 patients healthcare documents were reviewed with approximately 30 patients from each of the three hospitals having new medications initiated in the

Hospital. The characteristics of each patient whose medical records were reviewed provide background and context to the review see Figure 5-1 below.

Figure 5-1 Percentage of patients in Hospitals A, B and C based on gender, age and patients taking less than or more than six pre-admission (PA) medications.



From the 89 patients included in the study, Table 5-3 shows 455 new medications were specifically reviewed, they consisted of 48 Stat medications, 280 regular medications and 127 as required medicines. Table 5-3 shows the number of newly initiated medications that the patients were prescribed and subsequently reviewed. This is then broken down into Stat prescriptions, “e” Stat medicines (with %), regular medicines and as required medicines see list of terms.

Table 5-3 Number of patients prescribed new medications, and breakdown by administration category, of newly initiated medications, in Hospitals A, B and C.

Hospital	A	B	C	Total
No. of patients	32	29	28	89
No. of new medicines prescribed	181	130	144	455
No. of new Stat medicines	23	10	15	48
No. of new eStat medicines	17 (18%)	19 (24%)	n/a	36
No. of new regular medicines	96	79	105	280
No. of new prn medicines	62	41	24	127
No. of order sets	7	4	n/a	11

% - represents the percentage of patients prescribed an eStat medication, to facilitate comparison between Hospitals A and B.

Numbers were double-checked for quality assurance purposes prior to any analysis-taking place. Although no statistical analysis was applied, a number of differences in terms of the clarity and accuracy of the prescription chart and medical records was considered. Findings are presented in Sections 5.3.1 and 5.3.2 to consider the impact that prescribing systems have on the clarity and accuracy of written communication by HCPs. Additionally the positive and negative effects of the systems were deliberated to provide future recommendations of the ways in which EPMA technology can be used effectively and to its full potential.

5.3.1 The clarity and accuracy of the prescription

5.3.1.1 The number of associated eStat doses prescribed

Associated electronic Stat doses (eStat) are prescribed (Sections 2.3.1 and 2.3.2) due to the time of day that an accompanying regular medication is prescribed and the inability of the EPMA system to be flexible. The EPMA software used in Hospitals A and B does not provide any kind of reminder or prompts to alert prescribers that an associated eStat dose may be required when prescribing a regular medication. Prescribers have to consider this option themselves, however the situation is emphasised in their EPMA training. There are also no specific guidelines in place within the two hospitals regarding the use of associated eStat medications.

The number of eStat doses prescribed from the data, was similar in both the hospitals that had implemented EPMA. As a percentage of the newly initiated medication prescribed regularly, 18% (n=17) of the medications also had an eStat dosage prescribed in Hospital A and 24% (n=19) in Hospital B (Table 5-3). In order to prescribe an associated eStat medication, different steps needed to be taken in Hospitals A and B (Sections 2.3.1 and 2.3.2) due to the different software used for prescribing electronically. Nevertheless, in both cases, a similar percentage of eStat medications were prescribed. Prescribing eStat medications created extra work and cognitive load for the prescriber, reinforcing the situational awareness that is required in order to prevent a medication administration being delayed or omitted and causing increased workload in prescribing the medication a second time. As a measurable standard the NPSA (4) suggests for EPMA systems *“Where delays of up to five hours before scheduled administration will occur following a prescription, systems should remind prescribers that an intermediate dose may be required”*. The researcher reviewed all regular medications to see if any additional associated eStat medicines should have been prescribed according to the NPSA statement. It was found that in Hospital A, a further 15% (n=14) of regular medications should have had an eStat dose prescribed and in Hospital B, a further 13% (n=10) of regular medications should have had an eStat dose prescribed. Effectively a total of 33% (n=31) of eStat prescriptions should have been prescribed in Hospital A and a total of 37% (n= 29) eStat prescriptions should have been prescribed in Hospital B to prevent any delays in medication being administered or omitted. The quantitative findings show that extra eStat prescriptions were completed, but not all the time within the ePrescribing system. EStat prescriptions were needed to ensure patients received their medicines on time and that no omissions of medication occurred due to the lack of a prescription.

From a qualitative review of the prescription charts that had eStat medicines prescribed, it could be seen how each extra eStat medication compromised the clarity of the prescription chart. For example, in Hospital A the view of the prescription chart, listing patients’ medications, can only display a maximum of eleven medications at a time on the screen. Medications appear in the

list order of Stat, as required, regular and then discontinued (in a blue colour); within each category, they are displayed in alphabetical order.

In Hospital A when a patient required several medications, the initial display of medications was not always relevant for administration or review by a HCP. This was because some prescriptions remained on the active screen, even if they had been administered, so that HCPs could also see what had previously been given. Extra eStat doses therefore pushed other prescribed medications further down the list on the initial screen, thereby reducing the clarity of the prescription chart. The way the medications are presented in a list order leads to the different types of prescription category, such as Stat, as required or regular medications impact upon the display of each other. This reinforced previous comments made in the focus groups (Section 4.4.2.2) about the initial EPMA view of the medication had to be scrolled through before relevant medications, that needed review, could be seen. Consequently, the design and arrangement of medications affect the clarity of the prescription, workload, and efficiency of HCPs' working practice. It materialised that HCPs, usually the pharmacist, had to discontinue the medications in order to make the prescription clearer but that sometimes this could also lead to patient safety issues (Section 4.4.2.2).

In Hospital B (Section 2.3.2), the regular and Stat medications appear together under the title of regular medications with the "as required" medications being displayed separately below the regular medications. Because the regular and Stat medications appear together in the electronic display, the regular medication and its associated eStat medication appear together, because each category can appear in alphabetical order or BNF order depending on how the user arranges them. Discontinued medications can be seen on a separate screen. This meant however that as required medications, when reviewing medications via the prescribers screen, got pushed further down the electronic prescription screen and needed scrolling down to be seen.

The use of separate sections for each medication, as with a paper chart may provide a clearer picture than is currently the case with the list view in the EPMA

systems. The administration information, due to the design and layout of the EPMA system is not visible in the prescriber's viewing screen. This provides understanding about the lack of clarity and accuracy on the medication "story" at a glance.

The fact that prescribers, still need to inform the HCP looking after the patient that a Stat medication had been prescribed and needed administering was discussed in the focus groups (Section 4.5.3.2). Nevertheless, both EPMA systems prompt the prescribers to administer the Stat medication themselves or to inform a nurse that the dose needs to be given. It was perceived in the focus groups that technology could somehow inform HCPs when a new prescription was created in the system. However, this was not the case and instead some HCPs were continuously checking the electronic prescription chart to look for changes that could occur at any time, instead of getting on with their work (Section 4.5.3.1). This practice was also advocated in the NPSA document (4) stating that staff should be encouraged to interrogate systems for Stat doses.

Communicating the fact that an eStat medicine had been prescribed and required administration was never documented in the medical notes; this message would usually take place in the form of verbal communication, as the nurse would generally need to know instantly about Stat medications requiring administration.

5.3.1.2 Prescription Order Sets

An order set is a collection of clinically related medication orders grouped by purpose (5). Documentation review enabled the exploration of order sets that were utilised within the EPMA system, in relation to surgical specialities, see Figure 5-2 and Figure 5-3 for examples of prescription order sets in Hospitals A and B. The exploration highlighted patient safety issues with unclear and inaccurate written documentation of the order sets in the medical notes (Table 5-4). As well as the order set becoming a convenience (5) to facilitate efficiency, there were consequently patient safety issues: these included the possible duplication of medication or a failure to act on or highlight allergies or contra-indications to the medication within the pre-defined order sets.

Figure 5-2 Example of a prescription order set in Hospital A

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital A, EPMA system.

The use of order sets facilitated the prescribing of several drugs all at the same time, advocating an increased efficiency for HCPs, especially in the speciality of surgery (5). Conversely, the use of order sets contributed to unnecessary prescribing of medications, leading to the prescribing of excessive medications and reducing the clarity of the prescription as discussed below.

Figure 5-3 Example of a prescription order set in Hospital B

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital B, EPMA system.

Within Hospitals A and B, the number of *as required medications* newly prescribed in the surgical specialities appeared to increase compared to the district general Hospital C with paper prescribing in place. On further examination, this appeared to be, to some extent, due to the utilisation of order sets within the EPMA system. The actual number of newly prescribed *as required medications*

exceeded the number of regular medications prescribed in the same period; see Table 5-4 below.

Table 5-4 Prescribing of new medications on the surgical wards in Hospitals A, B and C with specific focus on order sets.

Hospital	A	B	C
No. of surgical patients	14	10	10
No. of new medications	90	51	65
No. of Stat medications	9	6	8
No. of Regular medications	38	22	44
No. of prn medications	43	23	13
No. of prn in order set	27	11	n/a
No. of order sets used	7 in 6 pts	4 in 3 pts	n/a

In Hospitals A and B, two similar patient case studies showed that each patient was prescribed an order set twice during their admission to the ward. On review of the two cases, each HCP prescribed a second order set that contained very similar medications to the first and then proceeded to cancel numerous prescriptions, rather than to prescribe individual medications that were required in the first place.

The use of order sets and whether they are effective or if they contribute to patient safety issues requires consideration. Specific protocols about the use of order sets are required to make HCPs aware of the risks of their use and to promote patient safety. The use of order sets may also de-skill the prescriber from creating individual prescriptions that they believe to be complicated. For example, the order sets prescribed for the patients at Hospital A included one for a naloxone infusion and a morphine infusion within the sets, see Figure 5-4.

Figure 5-4 View of a surgical prescription order set in Hospital A

The image originally presented here cannot be made freely available via LJMU Digital Collections because of copyright. The image was sourced from Hospital A, EPMA system.

In Hospital, B a morphine sulphate prescription was changed 14 times in total; a mixture of 4 Stat prescriptions and 10 “as required” or prn prescriptions were created. During review, it was realised that when the morphine Stat doses were prescribed, the nurses already had the option of administering as required morphine, and then because the “as required” prescription would have shown as duplication within the system it was discontinued. The other prescription changes occurred due to the wrong route of administration being selected and then further duplication of a morphine sulphate prescription occurred due to the prescribing of two separate order sets.

Again, the clarity of the prescription was further reduced by the use of order sets that include many *as required medications*. Thus, when a lot of *as required medications* are prescribed for a surgical patient and the prescriber uses order sets, the regular medications that are important, were pushed even further down the screen due to the way in which the regular medications were displayed.

5.3.1.3 Clinical indication on the prescription

Having a clinical indication on *as required* or *antibiotic* prescriptions adds to the purpose and clarity of that prescription. However, the quality of the prescription can be disputed if the clinical indication on the prescription is wrong or not completed.

All three hospitals within the study have policies in place, that state *antibiotic* therapy and *as required* medications must have a clinical indication specified on the prescription. The hospitals recorded the clinical Indication in different ways:

- In Hospital A, the EPMA system used mandatory fields to force the prescriber to document the clinical indication of the stipulated medications, by not allowing them to continue with the prescribing process unless the information was completed.
- In Hospital B, the clinical indication of stipulated medications was done by completing a “note” within the electronic prescription, this was not

compulsory and therefore the system did not enforce the prescriber to provide this information.

- In Hospital C, on the paper drug chart there was a specific box requiring the clinical indication to be completed, like the rest of the prescription, manually.

Because the three hospitals each had different ways of attaining the clinical indication of an *as required* medication or *antibiotic* on the prescription, it had led to different completion rates, see Table 5-5.

Table 5-5 Number and percentage of new prescriptions with a completed Clinical indication on the prescription.

Hospital	A	B	C
No. of Patients	32	29	28
No. of new antibiotic prescriptions	19	19	35
No. of new antibiotic prescriptions with a clinical indication	19 (100%)	8 (42%)	20 (57%)
No. of new antibiotic prescriptions with a MES of 1 or 2, to confirm accuracy of the clinical indication	9 (47%)	6 (75%)	7 (35%)
No. of new “as required” prescriptions	62	41	24
No. of new “as required” prescriptions with a clinical indication	62 (100%)	22 (54%)	16 (67%)

In Hospital A, 100% completion of the clinical indication was achieved because of the mandatory field within the EPMA system. However, the accuracy of the clinical indications on the prescription was reviewed, in order to see if mandatory fields could achieve an accurate entry. Approximately half of the antibiotic prescriptions, 47 % (n = 9/19) had clinical indication entries that correlated with written documentation in the notes (MES of 1 or 2). The remaining 10 did not have a detailed enough entry in the medical notes (MES 3, 4 or 5) to confirm accuracy.

Interestingly, the completion rate of the clinical indication in (paper drug chart) Hospital C was superior to that of Hospital B where the EPMA system did not force the prescriber into completing the information. However, the accuracy of the

clinical indication was also explored, showing that the clinical indication may be completed but that it is not necessarily accurate.

In Hospital B, where eight antibiotics had a clinical indication completed on the prescription, six (75%) had corresponding detailed entries in the medical notes to confirm that the clinical indication on the prescription was accurate, as it corresponded with the medical note entry (MES of 1 or 2). Of the 22 *as required* medications that had a clinical indication on the prescription, not one had a corresponding clinical indication documented in the notes (MES of 3, 4, or 5). The clinical indication in some *as required* cases was already populated within the electronic prescription, as it was part of an order set; this is discussed in the next section 5.3.2 when considering the medical entries within the notes.

In Hospital C, of the 20 antibiotics that had a clinical indication on the prescription, only seven (35%) had a detailed corresponding medical entry (MES 1 or 2) to confirm the accuracy of the clinical indication. The remaining 13 antibiotics had a MES of 3, 4 or 5. The general term “antibiotics prescribed” was used within the medical note entries on a number of occasions. Of the 16 *as required* medications that had a clinical indication on the prescription, only two had a MES of 2 confirming its accuracy. The remaining 14 *as required* medications had a MES of 4 or 5.

The limitations of this study, exploring the accuracy of the clinical indications, are apparent due to the lack of detailed medical entries in the medical notes. It does not mean that the clinical indication was conclusively wrong or inaccurate, if there is no corresponding medical entry. However, the researcher cannot decisively say if the clinical indication was 100% accurate, this also reflects a “real” world scenario.

5.3.2 The clarity and accuracy of medical note entry

Where the clarity of a prescription is impaired, it may cause misunderstanding for healthcare practitioners such as other doctors, nurses or

pharmacists, possibly to the point that the prescription cannot be acted on without first seeking clarification from the prescriber.

Medical entries are a contemporaneous log of information that may not clearly connect the required data. Decision-making is inferred or implied rather than implicit when connecting diagnosis and treatment. These entries were reviewed in order to explore the impact written communication can have on the quality of in-patient prescribing.

A total of 89 patients healthcare documents were reviewed with approximately 30 patients from each of the three hospitals. The medical note entries for newly initiated medications (effective prescribing) were explored. This involved confirming that the prescriber had made a clear connection between diagnosis and treatment, by documenting within the same note entry their intentions, showing consideration of relevant clinical findings and diagnosis of the patient and stating the plan of action including the medication to be prescribed (12). The correlation of information was also explored, by looking at the information that was documented in the HCPs' notes about a new medication and seeing if it matched the information provided on the prescription chart.

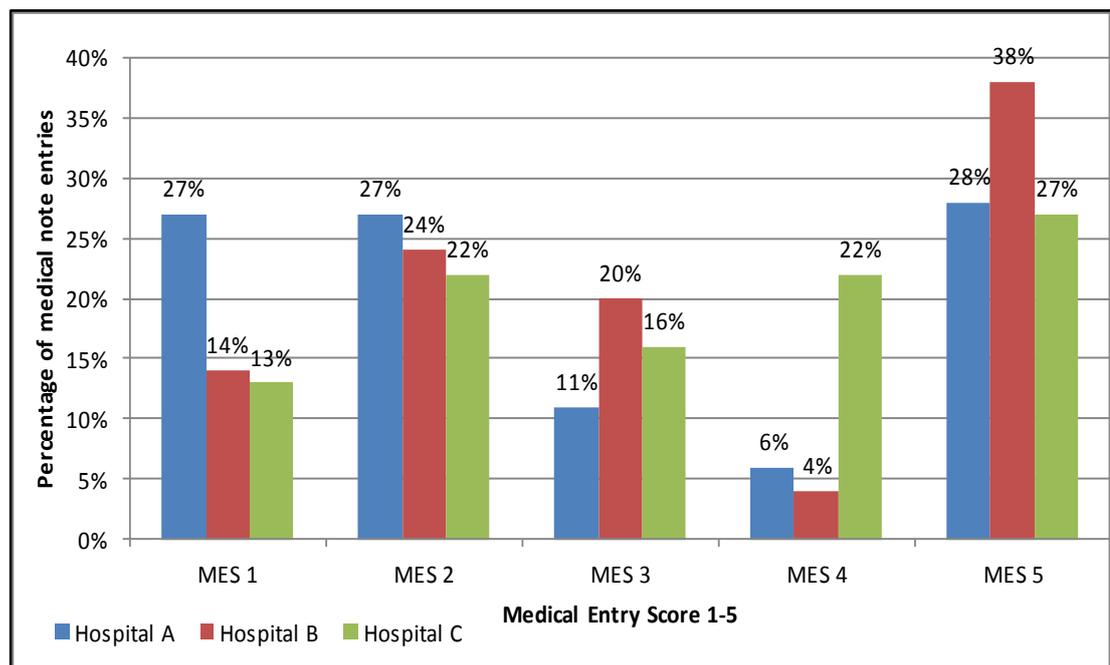
Using the rating scale (Section 5.2.2.1) based on the GMC standards (12), the documentation within the notes did not always fulfil the criteria for clear documentation and led to difficulties in exploring possible medication errors.

In all three hospitals, the MES of "1" was reached less than 30% of the time. This evidence suggests and reinforces previous research (38) that a direct connection of diagnosis and treatment, with a complete record of the new medication's name, dose and frequency in the medical notes rarely happens leading to patient safety issues and inefficiency for HCPs.

Medication errors occurring within the EPMA system are now possibly more convincing and harder to pick up compared to the paper prescribing system (Section 4.4.2). Therefore, written documentation in the medical notes is essential to confirm or pick up if a prescription error has occurred.

Documentation of new medications that took place on the medical wards was clearer, than notes made on the surgical wards; this can be seen in Figure 5-5 and 5-6. Medications that are prescribed for in-patients in the area of medicine, rather than surgery, tend to be more complex and involve a higher number of patients needing newly initiated medications on discharge from the hospital. This provides some understanding as to the quality of written communication that takes place between the specialities of medicine and surgery.

Figure 5-5 Medical Entry Scores for medical ward in-patients



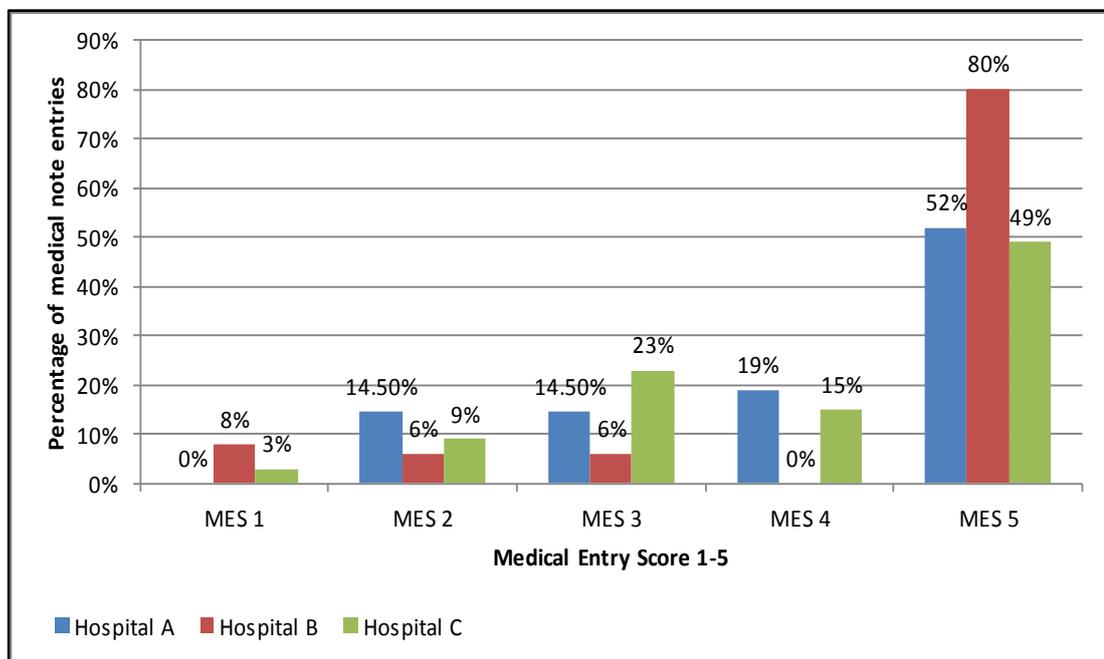
Refer to Table 5-1 for definitions of medical entry scores

Documentation of the new medications of surgical patients had no clear direction or connection to the diagnosis in at least 65% of the patients, with 80% of surgical patients having no mention whatsoever of the new medication in Hospital B. In Hospital B, whenever the order sets were used in surgery they were not documented within the notes; this raises concerns about the use of order sets and their clarification within the medical notes.

In Hospital A, if the surgical patients new medications within an order set were mentioned, not all the medications within the order set were documented, rather notes such as “pain relief” or “antiemetic”. The lack of clarity in written

documentation regarding order sets may be because not all of the medications within the “order set” were to be continued once the patient was discharged. However, this treatment was being provided to the patient whilst in hospital and therefore all HCPs involved in their care should know about the patient’s medications and the reasons why they were required in order for quality patient care to be provided by the multidisciplinary team. Documenting the order set name would define the medications that were prescribed and the reason why: for example, ANMINOR see Figure 5-2.

Figure 5-6 Medical Entry Score for surgical ward in-patients



Refer to Table 5-1 for definitions of medical entry scores

5.3.3 Timely documentation

The length of time it took to prescribe on the prescription chart and document in the medical notes was quantified. This was achieved by recording the time interval between making an entry in the medical notes and generating a prescription on the prescription chart. The working practices of HCPs were also taken into account, so whether the entry in the notes occurred before or after the prescription was created. The efficiency of HCPs is important to consider, as it

informs how quality care is being provided, possibly highlighting further delays in treating patients with a change in prescribing system. Therefore, the time it takes to create a prescription and how efficient HCPs are when new technology is implemented could expose further delays in treating patients.

The time a prescription is created and the time interval between entering the intended plan of action in the medical notes and prescribing was explored in Hospital A and B. The problems that HCPs now perceive with efficiency included remote prescribing, delayed access to the prescribing system and the ability to prescribe on ward rounds; these were discussed in the focus groups and considered during documentation review.

Unfortunately, because a time is only documented in the medical notes for each entry and not on the paper prescription chart, it was not possible to compare the data from Hospitals A and B with Hospital C and consider the impact on working practice between paper and ePrescribing. Further quantitative research within this area would be warranted.

A total of 88 out of 181 (49%) newly initiated medications in Hospital A had a time of documentation in the medical notes, as per the GMC standards, enabling the researcher to deduce the time taken to prescribe a medication on the prescription chart before or after it was documented in the medical notes. A total of 49 out of 130 (38%) newly initiated medications in Hospital B, also had a time of documentation in the medical notes.

Figure 5-7 and Figure 5-8 show the time interval between documenting in the medical notes and prescribing the medication on the prescription chart. The figures also depict whether the prescription, on the prescription chart, was created before or after an entry was made in the medical notes. The red bars show the percentage of prescriptions prescribed on the drug chart before an entry was made in the medical notes.

Figure 5-7 Distribution graph showing the time interval between documenting in the notes and prescribing in Hospital A.

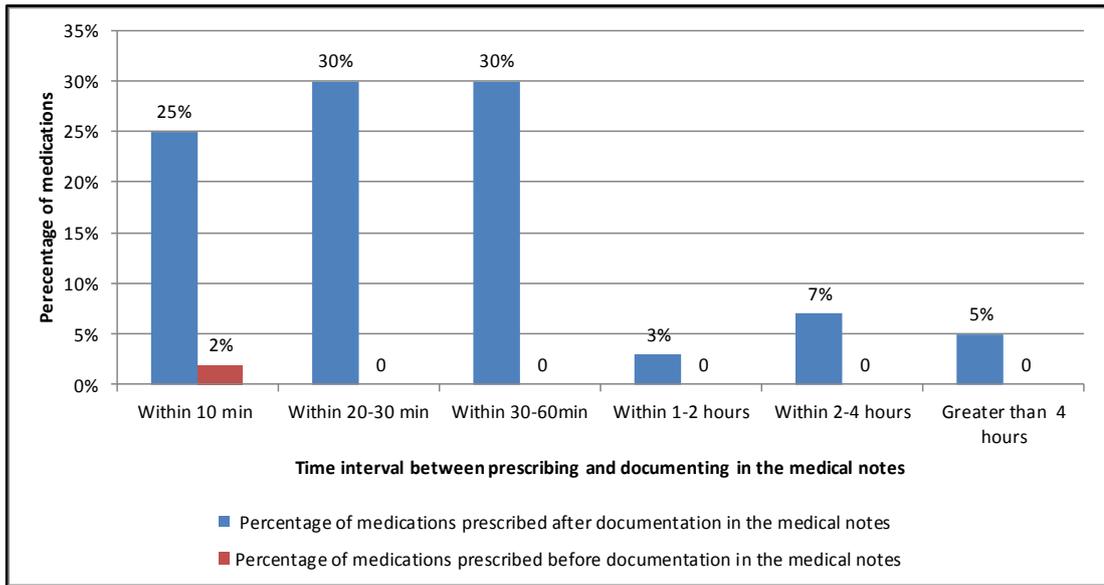
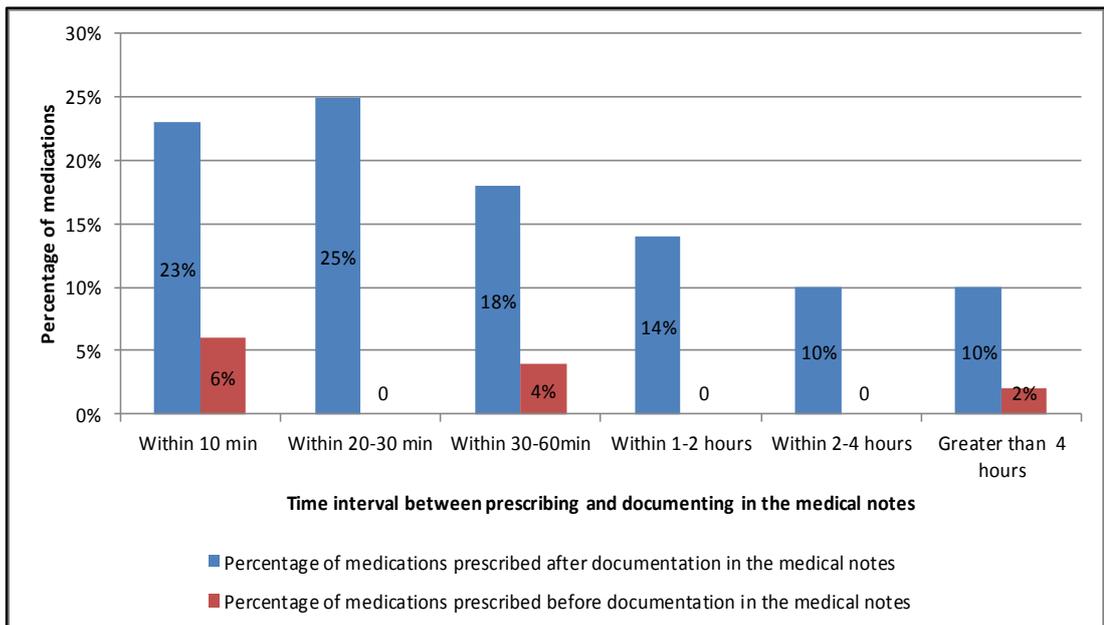


Figure 5-8 Distribution graph showing the time interval between documenting in the notes and prescribing in Hospital B.



Only 2% of the prescriptions were created before the medical note entry was made in Hospital A, showing that 98% of the time the medical note entry was completed first. Figure 5-7 informs how the HCPs carry out their work in Hospital A and provides insight into HCPs clinical workflow when using an EPMA system. In Hospital B, the majority (88%) of medical note entries were made before a prescription was created.

Prescribing the new medication did not always immediately happen after the intended plan of action had been entered in the medical notes (12). In the district general hospital A (Figure 5-7), 25% of the medications documented in the medical notes were prescribed within ten minutes of the documentation taking place; this occurred (Figure 5-8) 22% of the time at Hospital B. The longer time intervals may suggest that access to the EPMA system could have hindered the prescribing process from taking place promptly. The percentage of medications prescribed increased as the time interval increased, with the majority of medications (75% in Hospital A and 65% in Hospital B) being documented and prescribed within an hour of each other.

This interval of time between documenting in the medical notes and then creating a prescription has highlighted additional delays in the prescribing process. Previous research (4) has focused on delays by other HCPs in supplying and administering a medication, yet the periods involved in making an active clinical decision and actually prescribing the medication could be adding further efficiency concerns to the prescribing and administration process. This illustrates part of the clinical workflow processes that occur in practice. Yet it can only consider when the MDT or individual prescriber documented a clinical decision and not specifically when the clinical decision was made. It would not be unreasonable to assume that the speed at which ward rounds occur, as discussed in the focus groups, may have led to junior doctors documenting a prescribing decision in the notes and then prescribing after the ward round has ended. This raises questions about the clinical workflow of ward rounds and its timeliness and efficiency from a quality healthcare perspective.

5.3.4 Information given to patients (patient contact)

This Section explored HCPs' entries in the notes for confirmation that the HCP had discussed and provided information to patients or their carers about the new medications that they had been prescribed. The information documented in the HCPs' notes about discussing the new medications with the patient and providing them with advice was explored in order to deduce how often patients

were informed about their medications and included in the decision making process. Within all the hospitals, a similar number of verbal communications (Table 5-6) with the in-patient were documented during their stay.

Table 5-6 Information documented in the medical notes by HCPs, about discussions they have had with patients about their newly initiated medication.

Hospital	A	B	C
No. of patients	32	29	28
No. of medicines	181	130	144
No. of medicines discussed	13	14	13
% of medicines discussed	7%	11%	9%

Where written documentation was recorded in the notes, the communication lacked detail about the information given to the patient. At all three Hospitals A, B and C, each with a different prescribing system, the results show similar levels of documentation about new medications being discussed with the patient. Whether a patient received information about their newly initiated medications was independent of the prescribing system used.

5.4 Chapter Summary

This chapter has given an indication of what is happening in practice using a documentation review approach of prescribing systems. Documentation review was chosen to evaluate (138) the changes in clarity and accuracy of the prescription chart and medical records making comparisons between Hospitals A, B and C. Documentation review was considered important as it enabled the direct comparison, without bias, of equivalent documents that already existed, that were not created for the purpose of research.

Phase three indicated that changes in clarity occur with the prescription chart and medical entries in the notes, when moving from paper to ePrescribing systems. Documentation in the medical notes must improve, now that prescribing errors have become more convincing with the advent of ePrescribing. A clinically meaningful prescribing error can also occur, when the timely treatment of a patient is hindered. Documentation review has also shown how other quality components

such as efficiency and patient centred care can be influenced by a change in prescribing system.

The following chapter brings together all three phases of the programme of work to discuss the findings and consider their implications for practice when providing quality care to patients. The limitations of the programme of work are also deliberated, along with future research aspirations.

6 DISCUSSION AND IMPLICATIONS FOR PRACTICE

This chapter will discuss the data presented in Chapters 3-5 along with recommendations for practice, demonstrating that the impact prescribing systems have on healthcare quality is very complex. The data highlighted areas for critical consideration that are original or have previously been emphasised in research studies, providing more in depth detail as to why difficulties by frontline staff are encountered when using paper or EPMA systems and therefore the implications for practice.

As Lucian Leape explained

“Human beings make mistakes because the systems, tasks, and processes they work in are poorly designed”

This was acknowledged in the NHS document *Building a Safer NHS for Patients: Improving Medication Safety* (84), where it was explained that errors which occur when both human and system factors interact, in a chain of often complex events, result in an undesirable outcome. The need to review systems in order to minimise the risk of latent conditions is therefore essential.

While this programme of work was designed to explore the impact that different in-patient prescribing systems can have on healthcare quality, and how the change in prescribing system can impact on HCPs working practices, it did not seek to make statistical generalisations. Traditional statistical generalisations are based on sampling theory, where the ability to make extrapolations about a population is based on the representativeness of the sample selection. Within the programme of work analytical generalisation was used, whereby findings are generalised to theory, as proposed by Yin (139). The theory of STS (98) framework guided the final triangulation of the results to consider the prescribing systems as a whole. Understanding the issues where social and technical aspects interact in the prescribing system, emphasise where healthcare quality is impacted by a change in prescribing system.

6.1 Key Findings and Themes

- When comparing paper and ePrescribing systems, the difference in the clarity of the prescription changes quite considerably, a factor that relates to the ease with which the correct meaning of the prescription is interpreted. The clarity of the prescribing “story” has deteriorated with the introduction of ePrescribing, impacting on HCPs ability to provide quality healthcare.
- The accuracy of an electronic prescription is difficult to deduce, due to new types of prescribing error created by the design of the ePrescribing system and lack of detailed documentation in the notes of a prescribing decision.
- The use of a clinical indication within the ePrescribing system could provide a way of detecting the inherent risk of selection error.
- Further work reviewing EPMA design, is essential to progress the “*standards for the design of hospital in-patient prescription charts*” in relation to ePrescribing, along with optimising socio technical interaction and quality patient care.
- The variation in training between individual training sessions and between hospitals was significant.
- The change in clinical workflow and practices included very complex issues, such as eSTAT doses.
- Quantifying prescribing errors based on quality indicators born out of paper prescribing deficiencies, will always show that ePrescribing has improved patient safety. Newly created prescribing errors due to the ePrescribing system need to be robustly identified, to enable a fair comparison between the safety of paper and electronic prescribing systems. The harm caused by newly created ePrescribing errors needs further consideration.

6.1.1.1 Themes

How technology can impact upon the individual:

- Clarity of the prescription chart – Safe, Timely and Efficient
- Accuracy – Safety and Errors (new error types)
- Clinical Indication
- Regulation
- Accessibility and Reliability of the system

Social impact on technology

- Training and Education
- Clinical Workflow
- Location of the prescription chart – Patient Centred
- Change in HCPs' Working Practices

6.2 How technology can impact upon the individual

6.2.1 Clarity of the prescription chart – Safe, Timely and Efficient

A central focus of this programme of work, investigating the quality of care, is the clarity and accuracy of the prescription chart. Prescribing medicines is a key part of healthcare and so it is important that the prescription chart conveys clear and practical instructions to those reading them (12). The General Medical Council prescribing standards stated that doctors should “*keep clear, accurate and legible records*” (12), reinforcing the need for good communication amongst HCPs.

The legibility of the electronic prescription is no longer a specific concern as information is text rather than handwritten. It is acknowledged that typed text is readable (140), yet how the prescription is designed and easily “*viewed*” and interpreted is still open to human error (see Section 4.4.2). Members of the MDTs perceived this, as an improvement now that the prescription was “*legible*” using results from the focus groups (Section 4.4.2.1). However, the HCPs felt their ability to identify medication risks was reduced, as illegible handwriting could indicate prescriber uncertainty and would lead to more caution when reviewing and administering medicines, prompting HCPs to double check the information in the notes. With the move to ePrescribing, HCPs in the focus groups reflected that there were no subtle clues (as with paper prescribing) and the prescription was “*quite convincing*” (see Section 4.4.2.1), leading to greater, possibly false, confidence in the accuracy of the information than would have been the case with some hand-written prescriptions.

A number of design aspects influence the factors that limit the clarity and accuracy of EPMA prescriptions. The design aspects deliberated within the

multidisciplinary team focus groups (see Section 4.4.2.2), and reinforced with documentation review (Chapter 5). The design of the prescription chart (Section 4.4.2.2) affected the HCPs' working practices, changing their clinical workflow and their ability to provide quality care to their patients. The "*prescribing story*" and clarity of what medications a patient took were obtainable by a "*glance*" at the paper prescription chart. However, such an efficient, clear picture was perceived to be absent due to the layout and intricacies of the ePrescribing system.

The design of the ePrescribing system had affected the "*prescribing story*" and clarity because HCPs now needed to view different screens to get the information they require, as well as scroll through the screen: this made the "*prescribing story*" of what medications a patient had received, or would receive, harder to comprehend (Section 4.4.2.2) and detached.

In ePrescribing systems, HCPs are required to navigate different screens to see all medication details, and must remember to do so during busy periods. Consequently, the HCP may not obtain a comprehensive view of the currently prescribed medication leading to increased patient risk. Not being able to view different screens at the same time, had led to inefficiencies compared to the paper prescribing system. For example, it was impossible to view the patient's medications at the same time as creating the discharge letter. Cognitive load had also increased, as HCPs now have to remember information between screens leading to additional implications to patient safety and effective patient care (Section 4.5.3.3). The issue of navigating different screens leading to fragmentation of information concurs with previous studies (141).

The design of the ePrescribing system had affected the "*prescribing story*" and clarity because of different "*views*", depending on the HCPs' working practice and priorities. The EPMA systems provided a view of prescription items, without any administration details available with it, generally for prescribers and pharmacists. Alternatively, a separate administration view, called the Electronic Medication Administration Record (eMAR), is available for nurses or any other HCP administering medications on a drug round using the EPMA system. The ability to gain information about a patient's medication, and what they have taken becomes detached and the

prescribing “story” is impacted upon by having these separate views. Patient-centred care is hindered to a point, as specific patient administration details are disconnected and unclear.

The design of the ePrescribing system had affected the “*prescribing story*” and clarity because the individual prescription items in Hospital A and B appeared in a list. The prescription items were presented using one “line” within the EPMA system (Sections 2.3.1 and 2.3.2), unlike the paper prescription chart in Hospital C that had six lines for each regular and as required individual prescription, along with the administration details (Section 2.3.3). The use of only one line to display a prescription item on a prescription chart compared to six lines brings the display of medications closer together and forms a list perspective. The individual medications become less defined and harder to distinguish, especially when the HCP has to scroll up and down the list, navigating past Stat medications in Hospital A to review the regular medications. Scrolling through the list to view all the medications could be time consuming and inefficient.

The design of the ePrescribing system has affected the “*prescribing story*” and clarity because the ePrescribing system has different size displays depending on the electronic device used to view the prescription chart, compared to the paper prescription chart that has a large set viewing size that does not change. Small displays of text that never filled the computer’s visual display unit were a common occurrence on the desktop computers; it was like trying to “*run a hospital through a letter box*” (Section 4.4.2.2). The change in size and display can cause inefficiencies trying to decipher the prescription, possibly leading to patient safety risks. The lack of clarity and size of the prescription chart, whilst carrying out drug rounds, had led to HCPs having to concentrate a lot more on the computer screen rather than conversing with the patients.

The order in which individual prescription items appear within the EPMA list is dictated by the EPMA technology. The systems in both Hospitals A and B displayed the prescription items alphabetically or by BNF category, rather than chronologically as on a paper prescription chart. Not having the medicines chronologically arranged can make deciding when a medication started or stopped difficult to comprehend, leading

to greater patient safety risks, for example, the length of course of an antibiotic, or the monitoring of a patient's new medication. Whether a medication was taken before admission to hospital or newly initiated in the hospital setting was no longer as apparent in the EPMA system compared to the paper prescribing system. Previous studies have shown that the majority of prescribing errors occur early in the in-patient stay (1)(142). Knowing if a patient was taking a medication prior to coming into hospital (pre-admission medication) or that the medication started in hospital is important information. For example, being able to distinguish newly initiated medication facilitates communication with primary care, such as the GP, when the patient is ready for discharge from the hospital. When carrying out documentation review, the researcher had to document prescribed medications chronologically to understand what had happened retrospectively. The difference between a pre-admission medication and a medication newly initiated in the hospital was not clear within the EPMA system (Sections 4.6.1.1 and 5.3.1.3). This highlighted the change from reviewing medicines chronologically on a paper prescription chart to alphabetically within the EPMA system.

Each prescription item displayed in the EPMA system requires the addition of strength and formulation of the medication. This extra information of strength and formulation, is now required compared to the paper prescription, because the EPMA system may be linked into the pharmacy dispensing system. Therefore, the strength and formulation of the medication product needs selecting in order for the pharmacy department to be able to dispense the medication. However, the addition of strength and formulation data brought clarity issues. Some HCPs explained how easy it was to mix up the strength of the medication with the dose of the medication, and that when prescribing the medication it was *"not how prescribers think about medications"*. The change in working practice (Section 6.3.4) had therefore influenced selection issues and had increased the chance of prescribing errors due to choosing the wrong formulation. This was discussed in the telephone interviews (Section 3.3.2.3) and the focus group discussions (Section 4.4.4.1)

Additional prescription items, compared to a paper prescription chart, are required with the use of electronic prescription charts; these include eStat medications and order sets. The focus groups and documentation review highlighted how the

additional prescription items had caused further issues with prescription clarity. Even though supplementary paper prescription charts were, still in use for certain medications, the addition of eStat doses, and/or the use of order sets (Sections 5.3.1.1 and 5.3.1.2) to the prescription chart had thwarted the clarity of on-going medications for patients. Extra “*as required*” medications were being prescribed due to the use of order sets.

6.2.1.1 Recommendations for clarity

Issues encountered regarding the clarity of the prescription chart and its implications for practice are considered. To minimise the impact these issues have on working practices of HCPs, the following recommendations are proposed:

- Re-configure EPMA software to reduce the navigation of different screens in order to obtain important information. Alternatively, the use of two visual display units for one computer would avoid HCPs having to recall information between screens, so for example HCPs can view the prescription chart at the same time as creating the discharge letter.
- EPMA systems need to be re-configured to present the medications in chronological order, to enhance the prescribing story visually.
- A distinction between pre-admission medication and newly initiated medication would facilitate communication between primary and secondary care, along with enabling the use of a clinical indication on the prescription.
- A minimum viewing size for an electronic prescription chart, using any electronic device, needs stipulating in the “*standards for the design of hospital in-patient prescription charts*”(2). The use of smartphones to view a prescription should not be encouraged.
- A tick box incorporated within the EPMA system, as a prompt to prescribe an associated eStat medicine if the medication is not due within the next five hours. The prescriber would still make the final decision.
- An associated eStat medicine should not take up a completely new line on the prescription display, an asterisk would be sufficient.

- A different tab for each category of medicine so that they can be navigated easily and regular medicines viewed straight away without scrolling through Stat or as required medicines.
- Administration status displayed with the prescription to highlight omitted medicines to HCPs that do not view the administration screen.
- The use of order sets, for convenience, must be discouraged to ensure a specific protocol is followed.

6.2.2 Accuracy – Safety and Errors (new error types)

Due to the change in clarity of the prescription, the accuracy of the prescription and prescribing errors were difficult to deduce by the HCPs without using their clinical experience or referring to the medical notes. Previous research has shown that the design of the EPMA system could contribute to the creation of new errors (69)(136)(143).

The lack of documentation in the notes of a prescribing decision or of an indication for a new medication was noted in all three phases of this study. The issue of prescribing documentation in the hospital medical record, has been a matter of concern for some time, being cited as a specific reason for prescribing errors (38). The prominent error type identified from the telephone interviews with Chief Pharmacists, whose hospitals had implemented and were using ePrescribing and the focus groups with HCPs, was the introduction of selection errors within the prescribing system.

Doctor: It's not safer for me because I prescribe the majority of medications so....I don't write the wrong thing but I can click on the wrong thing and if I've written the wrong thing it's because I'm stupid, if I click on the wrong thing it's because I have made a mistake. A5

Selection error has been identified in previous studies (64–70)(64,144). The technology used in Hospital A to order microbiology services experienced (Section 4.4.4.1) similar selection error issues. This led the researcher to consider how these selection errors could be robustly identified within the ePrescribing system. As discussed previously in the “clarity of the prescription” (Section 4.4.2) identifying this new error type had proved difficult for HCPs and was putting greater demand on their time. In addition, perception of less patient contact and discussion about their medications was taking

place, due to the change in location of the prescription chart, decreasing the HCPs' chances of picking up the potential new types of selection error. However, written documentation of patient contact and discussions about medications was very similar between all three Trusts. The use of a clinical indication on the EPMA prescription could provide a solution, by requiring the prescriber to confirm the prescription with an indication; however, this would require further research.

The clarity and accuracy of the medical note entries were queried by the HCPs in phases one and two of this study and, therefore, reviewed in phase three. With the clarity of ePrescribing being affected by various design changes, the medical note entries were important for HCPs to be able to check that the prescription was correct. Entries in the medical record were legible but, like the prescription chart, the medical plan was not clear (Section 5.3.2) and therefore the accuracy of the electronic prescription chart could not be deduced in many cases (Section 5.3.1.3). However, this reflects the issues that HCPs face in everyday practice of not being able to confirm if a prescription is appropriate for the patient. The reasons why doctors do not write clinical decisions in the medical notes regarding patients' medications have also been studied: reasons included lack of time and colleagues' clinical judgement to fill in the gaps being cited (135). Such issues forcibly demonstrate that awareness of the new selection errors within computerised systems should be stressed within training and the need for a quality entry in the medical notes to be able to detect the error.

There is a conflict between providing efficient or safe healthcare, in order to identify new error types (10). The safety of the patient is paramount, so the time taken to try to identify the errors was perceived by pharmacy staff to have increased. Efficiency slowed due to the HCPs scrutinising the system and questioning its information, because human error was still a factor in providing the correct data (Section 4.4). Unclear medical note entries, as evidenced in Chapter 5, can also hinder HCPs' efficiency in detecting prescription errors.

The NPSA rapid response document (4), *"Reducing Harm from Omitted and Delayed Medicines in Hospital"*, recognised the risks that e-prescribing brings to the administration of medicines and also how it can magnify existing problems already seen with a paper prescription chart. The need for doctors to have an awareness of

what time of day it is, when prescribing within the EPMA system and ultimately situational awareness (Section 4.5.2) about new prescriptions arose in the focus groups. HCPs felt it had resulted in quite a change to their working practices, requiring extra work, responsibility, and that it was difficult to comprehend. Documentation review therefore reviewed the use of eStat doses and the time delay between documenting a prescribing decision and creating a prescription as this could contribute to medication delays (Section 5.3.3).

Hospital policies for the use of eStat medications need clarifying and reinforcing with HCPs. The use of eStat doses was included in training sessions provided by Hospitals A and B; nonetheless, the EPMA systems did not provide a reminder to the HCPs that an intermediate dose might be required, as proposed by the NPSA. It is not efficient for HCPs to check the EPMA system continually for any changes to prescribing, even though the NPSA proposed this as a solution. HCPs within the focus groups mentioned that they were constantly reviewing the information presented in the ePrescribing system, which had affected their clinical workflow in a negative way (Sections 4.4.1.1, 4.5.1.1 and 4.5.3.1). The extra task of prescribing the medication twice (eStat and a regular medication) had led to workarounds by staff, such as changing the system clock or borrowing doses from the next day. However, these solutions, although quicker for the HCP involved, had consequences for patient safety and were not officially documented within quality assurance protocols that should reflect actual practice within Hospitals A and B.

6.2.2.1 Recommendations for accuracy

Issues encountered regarding the accuracy of the prescription chart and its implications for practice were presented in the previous section. Proposed recommendations to try to minimise the impact these accuracy issues have on the working practice of HCPs include:

- To make HCPs fully aware in training that the EPMA system does not completely take away human variability and that human error can occur, resulting in errors being harder to pick up.

- To provide HCPs with common errors encountered, with each specific EPMA system, using errors reported within the Trust in relation to the EPMA system used.
- To make HCPs aware of selection errors within computerised systems and reinforce within training.
- To make HCPs aware that a quality entry in the medical notes could enable them to detect errors within computerised systems and confirm accuracy.
- To complete a clinical indication on the prescription chart, in order to confirm the appropriateness and accuracy of the prescription. This could be a possible solution but would require further research.
- To remind prescribers via the EPMA system, that an intermediate dose (eStat) may be required, as proposed by the NPSA guidelines.

6.2.3 Clinical Indication

One of the recommendations by the Royal Colleges (2) that had not previously been a routine design standard on in-patient prescription charts, was to include a space for *clinical indication* on all regular and as required medications. The addition of a clinical indication to the design of the prescription chart was examined throughout the programme of work, as it facilitated a comparison between the use of a paper and electronic prescription charts.

The use of an indication on the prescription varied across England with a variety of medications having an indication included (Section 3.3.1.2), the main group of medications being antimicrobial therapies followed by warfarin and as required medications. Very few hospitals required an indication on all of the prescribed medications. The overall response during the telephone interviews with chief pharmacists to the theory of including an indication on the prescription was positive; however, practical issues were raised as a reason for it not being routinely used. Staff at both paper and ePrescribing hospitals acknowledged that the inclusion of an indication on the prescription would make it clearer as to why the prescription was needed, facilitating HCPs' working practices and communication with patients, assuming the clinical indication was correct. The use of an indication on the

prescription was reinforced during the focus groups, when communication between prescribers was thought to be facilitated by the inclusion of a correct indication.

Chief pharmacists and frontline HCPs however all had reservations about the ability to include an indication on all regular and as required prescriptions. Concerns over completion rates and accuracy of the indication were discussed, and were the main driver for caution when using an indication on the prescription. The difference between a pre-admission medication and a newly initiated medication was defined and how the different medication categories influenced HCPs' abilities to complete the indication for the medication. Where an indication was included on a prescription in phase three, the indication was studied to see how accurate it was when included on the prescription. Confirmation of accuracy had its limitations, however, the accuracy of the non-mandatory field entries in the EPMA system were confirmed to be higher, compared to the accuracy of the mandatory field entries.

If we are moving towards electronically based systems, a clinical indication would be fundamental to resolving the issue of selection errors. This is important to ePrescribing systems, as ePrescribing is rolled out the use of a clinical indication needs to be part of standard workflow. This should not just be enforced, but actually become part of the medical, nursing and pharmacy education that people receive early on to understand the value of this piece of information in terms of identifying and minimising selection errors inherent in the ePrescribing system.

6.2.3.1 Recommendations for clinical indication

- Incorporating a clinical indication on the prescription would facilitate discussions with patients about their medications, before discharge from hospital.
- Incorporated on all electronic prescriptions to identify and minimise selection errors inherent in the ePrescribing system.
- GP surgeries need to supply the clinical indication of all patients' medications upon admission to hospital, enabling continuity of care and the ability to provide a clinical indication on pre-admission medications.

- The use of a clinical indication on the prescription for newly initiated medications within the hospital and not pre-admission medications could increase the probability of a complete and accurate clinical indication.
- Hospital Trusts must promote and reward good quality written documentation in the medical notes. The use of a clinical indication on the prescription chart could facilitate HCPs in providing efficient care as documentation of an indication in the medical notes is rarely clear.

6.2.4 Regulation

Regulation, control, feedback, and audit are important factors to monitor and improve quality healthcare, with the advent of new error types occurring with the EPMA system (65)(66)(64)(144). These were emphasised in all three phases of this study, noting the change a different prescribing system can bring to the area of regulation.

Leaving gaps on a paper prescription chart, which could be considered a workaround, leads to issues of clarity and accuracy and from an audit point of view considered detrimental to quality patient care. The introduction of Mandatory fields within the EPMA system, as deliberated in phase one (Section 3.3.2.1) has enabled “regulators” to track and reinforce policies and guidelines. Conversely, mandatory fields have potentially provoked the ingenuity of hard-pressed staff, to create further workarounds to avoid being slowed down by the system (Section 4.4.4.2). The accuracy of the information provided is then questionable. For example, the EPMA system in Hospital A provides prescribers with a list of possible entries for mandatory fields, when prescribing. Therefore, if uncertain about specific information that is required, there could be a greater tendency to guess or complete the mandatory field with the wrong information (Sections 3.3.2.3 and 4.4.2.1) leading to administration errors and ultimately harm to the patient.

Mandatory fields are appropriate for core prescribing information, but the expansion of their use needs consideration, taking into account the length of time it may add to a HCP’s clinical workflow, and the possible safety compromises the use of such fields could precipitate. As mentioned in Chapter 3, it is a balance between audit, workflow, and safety data (Section 3.3.2.2).

Obtaining specific information available in the ePrescribing system compared to the paper prescribing system had become a lot quicker and more efficient (Section 3.3.2.2). This was a very positive aspect of the technology in phase one when chief pharmacists thought of the advantages of EPMA systems (Section 3.3.2.1). The ePrescribing system had enabled them to view a lot of information remotely and could now be utilised by the Pharmacy Department to improve care. For example, pharmacy staffs were able to locate patients on a specific medication that had been recalled and action the response quickly.

The issue of being able to change a paper prescription, with no audit trail back to the HCP who had changed the prescription, raised concern with the HCPs (Section 4.6.3). With the introduction of ePrescribing, the ability to audit prescription changes back to the HCP, that made the change, was an area that had improved. Although explanations, in the focus groups, of how audit and accountability in the EPMA system still had limitations, the ability to deceive the electronic audit system had become a lot tougher, minimising the occurrence of accountability weaknesses.

6.2.4.1 Recommendations for regulation

Considering what can be done, to minimise the negative aspects that regulations can have on the working practice of HCPs, the following recommendations are proposed:

- The use of mandatory fields should be limited to essential prescription information.
- The accuracy of mandatory field information needs auditing once in place to review the overall effectiveness of mandatory fields.
- Further research to explore the use of mandatory fields and their impact on quality prescribing is warranted.

6.2.5 Accessibility and Reliability of the system

Without an accessible and reliable prescribing system, HCPs cannot provide quality care to their patients. Information stored within the system must be available at all times, quickly and efficiently to support HCPs clinical workflow.

The main issues noted in the focus groups with the paper prescription chart was that it could go missing, as it could be easily moved from the patient bedside on the ward and was an integral part of many processes, thereby making it susceptible to loss (Section 4.4.1.1). Other reliability issues with the paper prescription chart included; the prescription chart could fall apart after being in use for some time, due to high usage, and that it required re-writing as it could only hold a limited amount of prescription data (Section 4.4.1.1).

The electronic prescription chart, on the other hand, had very different issues to contend-with, such as lack of available computers (Section 4.6.2.3). This was further compromised by hardware problems like broken keyboards, flat batteries, and Wi-Fi interruptions affecting drug and ward rounds. The response time and lack of IT efficiency in attending to these issues was apparent in both Hospitals A and B with queuing systems via the phone to report issues and then poor response times once an issue had been reported (Sections 4.4.1.1 and 4.6.2.3). Downtime (when the complete ePrescribing system is not available) was not explicitly discussed in the focus groups; however, downtime was mentioned as a potential worry by all focus groups. The advent of more electronic based documentation, such as electronic medical notes, was a concern, as computers would become integral to the HCPs' clinical workflow and therefore the availability and reliability of the system would become crucial in providing quality care.

Disruption of computer access and ultimately the electronic prescription chart, due to lack of computer availability caused by hardware issues needs correcting quickly and efficiently by the organisation. Delays in patient care due to hindered prescribing or missed doses all impact on the quality of care that is provided. These situations are due to technical issues that are beyond the HCP's control. Nevertheless, hindrance of HCP's clinical workflow occurs and an extra task of trying to find a solution follows. The HCP at the frontline is seen as the person not providing a quality service to patients and so these obstructions to providing care can cause frustration amongst HCPs.

6.2.6 Recommendations for accessibility and reliability of the system

- Mapping the peak times of computer use and carrying out a clinical workflow review of all staff using the computers at peak times is required to see if more computers would solve the accessibility issues.
- Provide a competent, designated IT staff member on the wards to take responsibility for keeping hardware functional and operational in all locations of the hospital, providing HCPs with easy access to the IT team if required.

6.3 Social impact on technology

From a social perspective, the staff involved in managing the different prescribing systems have taken on a more complex and time-consuming project that requires more effort and input to facilitate its use and ensure quality care is not compromised. Key HCPs, who have to learn and know how to operate and use the prescribing system, have had to change how they carry out their work (clinical workflow) in order to incorporate the new technology into their everyday working lives (Sections 3.3.2.2 , 4.4 , and 5.3).

During the telephone interviews, from a social perspective, a chief pharmacist explained how the implementation of ePrescribing within the hospital had been a good quality initiative in itself (Section 3.3.2.2). This initiative brought together representatives of all the professional groups that would be using the system and gaining their viewpoints, along with specific training. The chief pharmacist believed that if the same process was used when implementing a paper prescribing system, with the same “buy in”, the quality of prescribing using the paper prescription chart might also have been better as HCPs may have complied a little more.

6.3.1 Training and Education

The training of staff to use any prescribing system is very important to provide quality patient care (Section 4.4.3.1). HCPs perceived that the paper prescription chart was self-explanatory and therefore minimal training was required compared to the ePrescribing system and that they could figure out what needed to be done in order to create a prescription (Section 4.4.3.1). The paper system did not require computer-

literate staff and enabled agency staff to carry out their work without affecting other colleagues. However, it is confounded by the EQUIP study that looked at the prescribing error rate, with paper prescribing, in hospitals and recommended the need for a standardised paper prescription chart to facilitate prescriber training, in an attempt to improve the quality of prescribing (145)(45) on a paper chart. The theories for a standardised prescription chart anecdotally make a lot of sense, but the possibilities of a standardised EPMA system across England are not realistic when taking into account all the influential factors such as politics, Trust finances, existing software interfaces within the hospital etc. that influence the choice of system by Trust Management.

A major finding from the focus groups was the variation in training provided between each individual training session and between Hospitals A and B. This wide variation in training was unexpected due to all the policies and procedures in place within such a complex, high risk, healthcare system. This variation might be due to the inexperience of the hospitals implementing the new prescribing system or the cost of employing staff competent enough to provide quality training on the systems. Having HCPs teaching other staff members is beneficial as they will be aware of the pitfalls, however HCPs do not necessarily have any teaching qualifications in order to provide an engaging and productive teaching session. How training was delivered was discussed at length in the focus groups, with improvements to training being suggested. HCPs agreed that a productive training session was essential but having an intuitive ePrescribing system was also important (Section 4.4.2.2); HCPs described how a more user-friendly system would enable them to work more efficiently. However, they acknowledged the dangers of trying to use any electronic system without the appropriate training (Section 4.4.3.1) or having not used the system on a regular basis.

Documentation review in phase three (Chapter 5) revealed an “*out of hours*” doctor user guide in Hospital B, that provided a username and password for a limited amount of time. This showed that doctors were permitted to use the ePrescribing system without any detailed training and would be self-certified. It also enabled generic access to doctors, possibly affecting the audit trail for a short time within the Trust.

Different training packages were provided for nurses, doctors, and pharmacists (Section 4.4.3.1). The ePrescribing team trained some HCPs themselves; others received training from fellow colleagues on the job, potentially passing on workarounds or bad habits between staff. The diversity in training and time permitted would potentially create different standards of users and ultimately have an impact on the quality of patient care. Some HCPs felt that training was “*painful*” and rushed or did not focus on the important points.

Each profession had its own specific training within each Trust that focused on parts of the system they used the most. It was debated within the focus groups that each profession should know and understand the whole system in order to have an awareness of how their actions can affect the whole system and fellow colleagues within the multidisciplinary team. Pharmacists in Hospital B explained how they did not have a training “*package*” yet the doctors and nurses did. Pharmacists felt they use the system most of the time, yet their training was a combination of the training received by doctors and nurses. The fact that pharmacists had also become unofficial IT support on the wards reinforced the need for thorough training and an overall view of the system (Section 4.4.3.1).

The use of different functionalities within the ePrescribing system, such as clinical decision support, mandatory fields etc. requires standardisation and a lot of consideration from management to facilitate training. What may seem like a good patient safety initiative could also backfire if not used properly. This again reinforces the need for good training and that experienced staff is essential to providing quality patient care. It is important that training be provided by a competent ePrescribing team made up from each profession (MDT) who have an understanding of the issues that arise when using the system in relation to each professional’s job.

6.3.1.1 Recommendations for training

- Further research in the area of education and training on the EPMA system is required in order to provide the best training for new HCPs in the time allocated by each hospital Trust.
- Follow up training should be available to all staff members, at any time, if they feel they are not confident in using the system to the best of their ability.

- Extra training and/or support should be readily available for staff that are not computer literate or do not use the system on a daily basis.
- A compulsory review or mini-test, for example every two years put in place by the Trust to ensure the quality of their EPMA users.
- An EPMA “users group” with HCPs actively using the prescribing system on a regular basis would be beneficial to highlight workarounds and general EPMA system issues.
- Explanations about situational awareness and the functionalities in use within the system, such as automatic stops for antibiotics, must be discussed in training and routinely emphasised based on a patient safety perspective.
- A multidisciplinary team approach to training could provide opportunity for situational awareness of using the system and enhance inter-professional learning.

6.3.2 Clinical Workflow - Timeliness

The time taken to prescribe an individual prescription item using the electronic system compared to the paper system was perceived to take much longer (Section 3.3.2.2). This was noted by chief pharmacists during the telephone interviews and frontline staff in the focus groups (Section 4.4.4.2), who were using the ePrescribing system on a regular basis.

A chief pharmacist explained how you “*could make it half an hour to prescribe something*” (one prescription item) in the ePrescribing system. This provided insight into how important it was to consider the balance between getting accurate audit information, safeguarding patients by using mandatory fields and warnings but not slowing clinical workflow down to the extent that it could have a rebound effect on the original quest for quality patient care. For example, having too many mandatory fields, and the number of safety warnings that appear, in the end could have a negative effect on the HCPs’ ultimate goal of providing patient care as the time taken to complete a prescription could take so long that they do not have time to see physically the patient.

The increase in time taken to prescribe medication using the ePrescribing system can be a driver for HCPs to create workarounds. For example, the ingenuity of staff to avoid completing the mandatory fields, by putting a “*full stop*” rather than the

required information (for example a clinical indication) as an entry in the mandatory field. Each individual item prescribed within the electronic system requires the strength and formulation of medications unlike the paper system (Section 2.3). This ultimately leads to the prescription becoming more time consuming to create and requires the prescriber to have knowledge about specific formulations.

The lack of computer availability in both Hospitals A and B were slowing HCPs' clinical workflow (Sections 4.4.1.1 and 4.6.2.3). Even when the HCPs had obtained a computer they still had to log onto the system: an even harder task was to keep access to that computer. Some HCPs had resorted to carrying the computer with them "*not wanting to let it go*", possibly leading to a shortage of available computers. Lack of computer availability on the wards was also resulting in the promotion of remote review and prescribing. HCPs described how they had to leave the ward to obtain access to a computer and then go back to the ward in order to check the patients' notes and discuss things with the patient.

The time difference between, documenting the decision to prescribe a new medication in the medical notes and then creating a prescription in the prescribing system was reviewed in phase three (Section 5.3.3). This provided an understanding of the prescribing HCPs' clinical workflow and the time it takes to create a prescription once it is decided to prescribe a new medication. It was deduced in phase three that 90% of new medications are documented in the notes before being prescribed.

6.3.2.1 Recommendations for clinical workflow

- Hospital Trust management responsible for EPMA must ensure a balance between audit information, safeguarding patients and clinical workflow is achieved. Further research to consider the optimal balance is required.
- Management need to facilitate feedback about inefficiencies in the system and provide a prompt action plan to minimise wherever possible the use of "unofficial" workarounds.
- Management must ensure that a prompt connection to the EPMA system is possible and computer facilitates are available at the patient bedside and remotely to facilitate clinical workflow.

- The EPMA system should have the facility to log out automatically on one computer terminal, if a HCP tried to log onto the system at a different computer terminal.
- Any changes to the prescription will require a password or fingerprint to provide an audit trail, but this process must also be efficient and rapid.
- Consultants need to consider their juniors when ward rounds are taking place, providing sufficient time to prescribe before moving to the next patient. Training should reinforce how important the balance of efficiency and safety is within the complex healthcare environment.

6.3.3 Location of the prescription chart – Patient centred

With the recommendations of the Francis and Berwick reports (8)(146) to ensure patients are central to their own care, the change in location of the prescription chart, away from the patient bedside, becomes a concern. The adjustment in prescribing system has had a considerable impact on HCP's working practices and the amount of patient contact they have. In phases one (Section 3.3.2.2) and two (Section 4.4.1.2) it was acknowledged by chief pharmacists and HCPs that the change from paper to ePrescribing systems had promoted less patient contact due to the advent of remote prescribing or remote access. This issue has also been raised in other EPMA implementation studies (20)(114), yet the best solution is not straight forward. The use of handheld devices (i.e. tablets) at the patient bedside has been suggested (20), to bring the HCP closer to the patient, but the size of the prescription chart is then compromised.

Characteristically in a hospital with paper prescribing, the prescription chart is kept at the bedside, with the patients' observation charts; this was standard practice in Hospital C (Section 2.3.3). Having the paper prescription chart at the bedside provides opportunity for the HCP to discuss medications with the patient and clarify any queries. It also provides a physical prompt as to when a new medication is prescribed for a specific patient. EPrescribing has enabled HCPs to access, review, and prescribe from anywhere, on or off the ward that the patient is staying on; this has taken the action of prescribing away from the patient. Hospitals, when implementing ePrescribing as in Hospitals A and B, have computers on wheels that can be pushed to

the patient bedside or laptops available for the HCPs to use. In reality, as discussed in the Focus groups (Section 4.4.1.2), the physical effort to take the computer to the patient bedside tends to hinder patient contact from occurring. The use of computers on wheels does not always facilitate HCPs' working practices, especially during surgical ward rounds, when patients are distributed across numerous wards.

When HCPs were "On Call" remote access to the prescribing system enabled efficiency and timeliness, by facilitating review of more than one patient's prescription chart, from a single location. All HCPs were able to check advice was followed and carried out as instructed, therefore aiding a double check and helping patient safety aspects. On the other hand, if a prescription is created remotely to the patient (Section 4.4.1.3), the HCPs need to ensure that they have examined the patient and that they are happy that the prescription is appropriate. The GMC advises *only prescribe when you have adequate knowledge of the patient's health*; this becomes difficult to comply with when working remotely to the patients and their medical notes (12). Documentation in the medical notes becomes a concern, as the medical notes are not routinely available when remote access to create a prescription or review a prescription takes place. This may change with the introduction of electronic patient records (EPR). However, the patient may become even more detached from the prescribing process, with more documentation going electronic, resulting in less patient-centred care. With no immediate access to supplementary prescription charts or medical notes, the complete patient "story" is not available to the prescriber. In addition, the actions taken by the HCP to prescribe or review a patient's medication cannot be documented in the notes at the same time.

Considering the changes in potential patient contact, discussed in the focus groups, the situation was explored during documentation review (Section 5.3.4). Documentation of patient discussions about their new medications only occurred approximately 10% of the time in all three hospitals (Table 5-6). These results were independent of the prescribing system, though limitations due to lack of written documentation rather than communication with the patient could be deduced. Such a low percentage, even with documentation issues, highlights the fact that patients may not be involved in the decision making process as much as they should. Patients need

to be informed about new medications whilst taking them as an in-patient in hospital, even if the medications are not going to continue once the patient is discharged.

The review in phase three explored the quality of documentation in the medical notes and the time difference between documenting in the notes and creating a prescription. As discussed in phase three the lack of detailed written communication in the notes was worse than previously suspected, with 80% of new medications on the surgical ward in Hospital B not being documented (see Figure 5-6). The prescriptions not documented may have been created remotely to the patient and medical notes. However, further quantitative work in this area is required to deduce how often remote prescribing is taking place and how patient safety is fairing.

Doctors also felt that more junior prescribers may find themselves being put under pressure by other staff members to prescribe remotely for a patient without examining them first (Section 4.6.3.1). Therefore, prescribers must safeguard against remote prescribing. Some HCPs commented on how examination of the patient had changed their mind. HCPs must consider the balance between safety, saving time and working more efficiently. As Reason (10) explained the balance in any system between output and safety must be considered.

6.3.3.1 Recommendations for patient-centred care

- A computer with a minimal size visual display unit that will provide a full view of the electronic prescription chart at every patient's bedside is required.
- The position of the visual display unit must be unobtrusive and adjustable, to facilitate patient discussion with the HCP and ensure its position is user friendly.
- A checklist should be implemented to facilitate documentation of patient counselling regarding new medications and any concerns raised by the patient.
- Management must promote a patient safety culture, safeguarding against remote prescribing "pressures" from staff to prescribe without examining the patient first.

6.3.4 Change in HCPs' Working Practices

One of the main changes in working practices for all HCPs was how they now communicated with each other and the patient. The use of physical prompts, such as seeing the prescriber physically write a prescription at the patient's bedside, was no longer possible. Alternative means of communication were required, such as "*jobs books*" rather than "*post it notes*" for written communication. The amount of verbal communication was perceived to have increased after implementation of EPMA (Section 4.5.3). This was also concluded in another study that looked specifically at the experiences and perceptions of hospital pharmacists (114). In Hospitals A and B there was an awareness by all HCPs in the focus groups that changes in communication had occurred but that no one was really quite sure what official process should be used between the multidisciplinary members (Section 4.5.3.3). Specific communication changes were discussed within the focus groups, but exact solutions and official ways of communicating, since the implementation of EPMA, were not clear to the HCPs. For example pharmacists, on some occasions, were documenting important queries they had for prescribers in the pharmacy care plan, jobs book and medical notes along with bleeping the prescriber to inform them verbally (Section 4.5.3.3) leading to duplication of work and inefficiencies.

The most time consuming practice that has been adopted into clinical workflow is the need for HCPs, specifically nurses and pharmacists, to constantly check the EPMA system for newly prescribed, changed or discontinued medications (Section 4.5.3.1) which is not a two way process of communication. The practice of constantly checking the system was adopted as a check for lack of verbal or written communication from the prescriber because, unless someone is checking the computer, new prescriptions may not be picked up in time.

It is not clear which HCP is responsible for delays in treatment when a change in medication occurs and is not actioned. Therefore, lack of guidance has led to HCPs becoming obsessed with checking the EPMA system. Until prescribers take responsibility for informing their fellow HCPs verbally of any necessary changes in prescribing, the practice of checking every patient's prescription chart, just in case a change is made, will remain and add to HCPs' inefficiency and workload. Continuous

access to the system and the need to check “*constantly*” may distract from other clinical practices leading to some HCPs feeling “*a bit of a slave to the computer*”. The NPSA (4) suggested the need for HCPs to check the system as a way of picking up potentially delayed doses. However, a more robust two-way communication solution is required to enable HCPs to work more efficiently. This prompts the question whether there is a greater need for verbal communication between HCPs now, compared to the paper prescribing system. However, from the data obtained, this increase in verbal communication cannot be quantified by the methods used.

Nurses can no longer modify prescriptions, as previously done with the paper prescribing system, to facilitate the doctors’ working practices, such as altering administration times or formulations. Therefore, the ePrescribing system had enabled a more robust audit trail, yet it had increased prescribers’ workload forcing them to consider new situations, leading to a change in working practice (Section 4.5.2). For example, prescribers now have to consider the time of day they create a prescription (situational awareness) and what exact formulation they require of a medication, that with a paper prescribing system would not be routinely considered.

The pharmacists’ review of the prescription chart, and therefore their clinical working practice, has changed becoming more time consuming due to the alteration in clarity of the prescription chart and the items prescribed. Pharmacists’ review now includes a more “*technical*” check, as well as a “*clinical check*” scrutinising the system to ensure the “*new*” potential prescribing errors are not missed (Section 4.5.1.1). However, pharmacists could now prioritise any changes made to the prescription from one location, making them more efficient. Nevertheless focusing on changes to the prescription chart may lead to overlooking patients whose condition has declined and require Pharmacy intervention. The way to prioritise patients for pharmacy review needs discussion within the MDT and a procedure put in place within the pharmacy department so that pharmacists have a framework to prioritise.

The natural inclination of HCPs to ask their pharmacy colleagues about how the EPMA system worked and how to navigate difficulties was happening (Section 4.4.3.1). Pharmacists are more accessible than the IT department, and they tend to have experience that is more practical with the EPMA system. Either way within the focus

groups, most HCPs would ask their pharmacist about an issue with EPMA first before contacting the IT department. This has highlighted a potential change in practice for pharmacists, trying to support their colleagues when using the EPMA system even when HCPs have all had the same training.

6.3.4.1 Recommendations for HCPs' working practices

- Hospital management need to ensure there are clear and official avenues of communication between HCPs, with the implementation of EPMA. Taking into consideration how HCPs work as part of a MDT and that inter-professional communication is essential to facilitate quality patient care. Without clear routes of communication, responsibility is ambiguous which can lead to miscommunication and ultimately patient harm.
- The EPMA technology could inform all HCPs of changes made to their patient prescriptions, in order to minimise HCPs constantly checking the computer system for any changes.

It is likely that the findings presented in this chapter after theoretical abstractions from the data were not due to the researcher, or participants that were recruited from a typical case sample, but the fact that they were uncovered was due to the three methods used and triangulation of the data and methods.

6.3.5 Reflexivity

Working as a Pharmacist in the NHS hospital sector prior to undertaking the PhD was an area that needed consideration. The researcher had experience of working with different electronic and paper systems, which may have brought with it preconceptions. However, the researcher had not specifically worked with an EPMA system. This enabled the researcher to take advantage of the “insider” knowledge and experience for example in gaining access to research sights and designing the study whilst remaining an outsider in terms of exposure to EPMA systems, therefore reducing the risk of pre-conceptions.

Being reflexive is a massive challenge when you have a clinical focus. It is difficult to separate roles between researcher and clinical pharmacist. The researcher's identity as a pharmacist was made explicit to the participants in all hospitals. Reasons for this

were that the researcher was known in one of the study hospitals, as well as previous hospitals they had worked in. Therefore, it was felt likely that if not revealed at the outset, the fact that the researcher was a pharmacist would emerge. Furthermore, the researchers' inside knowledge would become apparent to participants over time due to the terminology or phrases used. Although the researcher's background as a clinical pharmacist was revealed, their role as a student and researcher was highlighted. To help establish this, the researcher during casual conversation with chief pharmacists or employees within the study hospitals would freely discuss information relating to her experiences both as a researcher and as a pharmacist. It is important to build a good rapport with participants in the study and other individuals within the setting in order to help individuals to feel comfortable with the researcher and enhance the depth and quality of data collected.

During the telephone-interviews with chief pharmacists answers to some open questions were lengthy and included terminology used specifically in pharmacy to explain the intricacies of the prescribing systems. Having worked within the subject area the researcher did not have to interrupt the flow of conversation to clarify too many issues. However, the term "you know what I mean" was used by chief pharmacists during the telephone interviews, if the researcher did not know what they meant, it was clarified at the time.

When facilitating the focus groups with the MDTs in each of the three hospitals, it was essential to remain impartial. However, as the members of the MDTs were aware of the researcher's background as a clinical pharmacist, they were able to use medical terminology and phrases that would only be understood by someone whom had previously worked within the subject area.

When carrying out documentation analysis, the researcher's background initially slowed the process when reviewing notes for clarity and accuracy, as clinical context was distracting. However, piloting the documentation analysis process and constructing a simple guide to gain the correct information kept the researcher on track and facilitated the process. On the other hand, having "insider" knowledge of navigating different sections of the patient's notes and familiarity of documentation construction in healthcare improved the process.

This chapter has discussed the implications for quality healthcare practice from across all three phases of the programme of work and provided recommendations. Reflexivity of the methods has also been taken into account. The final chapter will conclude the programme of work by, providing limitations and key recommendations for the future along with further research aspirations.

7 CONCLUSIONS

The final Chapter of this thesis focuses upon the significant areas from the previous chapters. In Chapter 1, the background literature regarding prescribing systems was presented, with an overview of the programme of work specified in Chapter 2. The findings from the three phases of the programme of work are described in Chapters 3, 4, and 5. Chapter 6 has discussed and highlighted the implications for practice that different prescribing systems can have on quality healthcare. This chapter presents limitations, personal reflections and finally the conclusions that explain what is required in future development of the EPMA system in order to facilitate quality healthcare and further research.

7.1 Methodological Limitations for the programme of work

During the telephone interviews in phase one; it became apparent that personal assistants were, to different extents, answering the phones for the Chief Pharmacist and trying to make decisions, in some cases, on their behalf. The researcher explained to the personal assistants that it was NHS research being carried out. To overcome this scenario the researcher reassured the personal assistants about the research and offered to e-mail them a copy of the research information directly and then ring back. Explaining the research and taking the time to build a rapport with the personal assistant facilitated further interviews taking place. The time of year, just after Christmas, meant that some potential participants were on annual leave initially; therefore, to overcome this, the data collection period was extended from 4 weeks to 6 weeks. Different regional responses to the telephone interviews were noted; however, the purposive stratified sampling used enabled the researcher to take into account the region and size of hospital across England.

Whilst conducting focus groups within phase two the researcher was aware of potential scenarios that could arise during each focus group session, such as group dynamics including dominant participants or quieter individuals. Having researched known limitations of focus group methodology and carrying out a pilot study the researcher was able to pre-empt possible situations and facilitate the group ensuring each participant spoke within the discussion. It is important to be aware that focus

group discussions provided multidisciplinary team perceptions, and not necessarily reality. Considering the perceptions gained from phase two, phase three minimised the use of perceptions by reviewing actual written documentation created by the same multidisciplinary team members.

The availability and retrieval of the medical notes / documents in phase three to review written documentation created by the multidisciplinary teams presented a limitation that informed “real” world research. The researcher within each study hospital had to rely, to a point, upon administrative staff to obtain the relevant medical documentation for the study. The researcher, wherever possible, facilitated the process; any notes that could not be located due to different scenarios were documented and the researcher followed up to see if any of the patients had passed away. This was not the case for any of the unavailable notes. The number of unavailable notes was higher within the hospitals that had EPMA in place, compared to the hospital with paper prescribing.

The researcher did not review any completely illegible entries in the medical notes, the researcher used their clinical experience to decipher difficult to read passages but did not have to disregard any entries due to illegibility.

Having to obtain patient consent in phase three at one hospital, limited diversity of the patient notes accessed. The impact of a patient’s condition or treatment, when considering the change in prescribing system, may affect the structure of content within the written documentation and therefore could influence the results.

The range of prescribing systems included in the programme of work attempted to capture the diversity of in-patient prescribing systems in use across England and gain peoples’ experiences. Therefore, the three hospitals (A, B, and C) in phases two and three were selected as each had their own prescribing systems in place. However, specific issues in relation to prescribing systems not represented within this programme of work have not been identified. Whilst this is a limitation to the programme of work, the inclusion of more hospitals with different prescribing systems would not have been possible with the available resources.

Phase three documentation analyses of the medical notes, exposed medical entries did not constantly comply with documentation standards. Consequently, medical notes did not always have times documented for entries or mention new medications being initiated, and therefore could not be associated with the new prescription. In order to deduce how often the newly initiated medication prescribed was warranted, the new medication needed to be documented in the notes. This proved to be very difficult as the extent of clear written communication within the medical notes was limited. Therefore, it was not possible to determine if the correct medication, dose, and frequency was prescribed or whether a prescribing error had taken place. The situation reflects clinical practice and highlights an area for concern regarding patient safety.

Phase three began the development of the “*medical entry score*” tool used in documentation analysis to deduce whether the entry in the medical notes made by the prescriber was specifically linked with the initiation of a new medication. Judgement on clinical content was required to deduce the Medical Entry Score (MES) from entries in the medical notes; subjective decision-making was a limitation inherent in the analysis. However, the data were purely descriptive and no attempt was made to assess the clinical significance of the data. The use of the MES rating scale would be a valuable asset to medical note audit in the future; this area of research requires much needed investigation.

The programme of work-entailed exploration of how different prescribing systems affected HCPs’ working practices and so included doctors, nurses, and pharmacists. Additional groups, for example patients, pharmacy technicians, and IT specialists might have given different perspectives on the topic; however, their opinions fell outside the remit of the PhD. The value of other groups’ opinions is acknowledged, providing an opportunity for future research.

7.2 Personal reflections

Deciding to take on a PhD in pharmacy practice was influenced by my experience as a hospital pharmacist, specialising in Oncology and a constant need to learn. Central tasks as a clinical pharmacist in Oncology would involve using my initiative and thinking

of novel solutions to a problem. I found this stimulating and exciting, once the desired outcome was achieved; discovering this is where my potential lay.

Organising the work involved for a PhD takes good time management and requires organisation with a lot of attention to detail; I have certainly learnt that planning, determination, endurance, and motivation are all essential in order to complete a PhD to the best of your ability. However, too much planning can sometimes hinder the process, for example the moments where I procrastinated about the process so much, that it hindered me actually progressing with the work. Being able to discuss the research with my peers and family encouraged my thoughts on the topic and facilitated the whole PhD process. I have learnt that in order for me to consolidate thoughts and connect ideas it requires conversations with friends or a relaxed thinking environment with no interruptions.

Recruiting Chief Pharmacists for the telephone interviews and gaining a rapport with them was a task at first, but it did provide countless inter-personal skills. It helped me consider all the different personalities that we encounter in life and how to adapt my approach depending on their mood. Recruiting three hospitals to take part in my research also enhanced my networking skills and demonstrated my ability to develop and maintain connections with external providers.

The PhD has been rewarding seeing the outcomes of all the hard work along the way, but also challenging at times, providing me with diverse skills in order to achieve a high standard of research in the area of pharmacy practice. Because of undertaking a PhD, I have gained skills in submitting ethics applications, using different research methodologies, qualitative data analysis, preparing abstracts and posters and presenting research findings orally at conferences. The determination required and self-motivation to continue the PhD has come from my passion for the research subject and how this research can inform and improve prescribing systems and ultimately patient care in the future. I hope to continue research in the field of electronic prescribing and develop both the evidence base and my own expertise.

7.3 Conclusion

This programme of work has successfully explored and provided a greater understanding of the effect different prescribing systems can have on healthcare quality and how the changes from paper to ePrescribing systems influences HCPs' working practices. When comparing paper and ePrescribing systems, the difference in the clarity of the prescription changes quite considerably, a factor that relates to the ease with which the correct meaning of the prescription is interpreted. This research has established that the change from paper to ePrescribing systems does not necessarily improve the ease with which the prescription information is communicated. Instead, the clarity of the prescription varies in different ways. It has been acknowledged that ePrescribing has created new types of prescribing errors (38)(144). This programme of work has confirmed that ePrescribing has new types of clarity and accuracy issues compared to the paper prescribing system.

The clarity of a prescription with paper prescribing systems may be influenced by a number of aspects such as legibility, the use of unapproved abbreviations, the omission of essential medication details and prescriber identification. These aspects have been used as indicators of prescribing quality, all of which have been actioned to some extent by the implementation of EPMA. As such, the quality indicators have been used to review the quality of ePrescribing, highlighting and showing how ePrescribing has improved these quality indicators and quality care. However, these indicators, derived from paper prescription issues, are no longer as relevant. The perceived improvements of an EPMA system are that it can provide a complete and legible prescription. Yet with the introduction of ePrescribing systems, new comparisons and considerations arise when looking at the ease with which the correct meaning of a prescription is interpreted. The legibility of a prescription is no longer a specific concern, yet how the prescription is viewed and interpreted is still open to human error or individual opinion.

When comparing the two prescribing systems (paper vs electronic), using the standards that paper prescribing has not met, of course, the electronic system is going to achieve a higher standard as was seen in *Reducing prescribing errors: can a well-designed electronic system help?* (28). However, the programme of work has shown

that with ePrescribing systems, other aspects compared to paper prescribing influence the clarity of a prescription. These include the number of screens needed to navigate, the ability to follow the prescribing “story” as the data is not presented chronologically, distinguishing pre-admission or initiated in-hospital medications, active and inactive prescriptions, eStat medications, order sets, staff training and the accuracy of the data presented in the system i.e. formulations or selection errors. Therefore, new impediments with electronic systems to the clarity of the prescription have replaced the old impediments experienced with paper prescription charts.

Further work reviewing EPMA design, is essential to progress the “*standards for the design of hospital in-patient prescription charts*” in relation to ePrescribing, along with optimising socio technical interaction and quality patient care. The published standards for the design of hospital in-patient prescription charts did not specifically review ePrescribing systems, when reviewing the design of prescription charts, limiting their relevance to EPMA design, yet were indicated as being applicable to ePrescribing systems. These standards must be revisited to ensure they truly reflect the standards required for ePrescribing systems. Regular review of the standards would be pertinent, in order to keep up with the ever changing advances of technology and updates that are required.

The aim of the “*standards*” was to produce a national prescription chart across England, with the backing of the Royal Colleges, therefore supporting a standard training package for all HCP students. However, the introduction of so many different EPMA systems has delayed the plan. With different designs and functionalities incorporated into EPMA systems, a set training package would not be possible. Standards for topics for inclusion within the training for all HCPs would provide structure to training that is essential for HCPs to use the system properly and provide quality care. A national EPMA system could enhance the quality of care in the future, connecting primary and secondary care. This would require initially a pilot study of a small initiative, connecting one hospital with its primary care counterparts such as GP surgeries and community Pharmacies, allowing development prior to any roll out across the country. Unfortunately, some HCPs have lost faith in the ability to enhance quality of care in the future due to the current issues they already face (Section 4.6.1) and experiences from the failure of National Programme for IT (NPFIT)(147). However,

numerous factors such as implementation periods, structure etc. led to the failure of the NPfIT, that should not detract from the benefits of IT in the NHS.

The use of a clinical indication on the prescription chart was proposed by the *Standards for the design of hospital in-patient prescription charts (2)*. The research has raised the question as to whether the use of a clinical indication on the paper prescription chart is of benefit. However, the use of a clinical indication within the ePrescribing system could provide a way of detecting the inherent risk of selection error. Further research is required to appreciate if a clinical indication should only be provided in the hospital setting for newly initiated medication, due to the opinion provided by HCPs during the programme of work. The proposed requirement for a clinical indication on the prescription chart was addressed in all three phases of the programme of work and uncovered different perspectives and working practices. It would therefore be beneficial to investigate further the use of a clinical indication on the prescription chart as well as in the medical notes.

Overall, written communication via medical entries within the notes for newly initiated medications did not clearly connect diagnosis and treatment. Clear and accurate written communication is even more essential now that possible prescribing errors are “quite convincing” and harder to pick up. Without clear and accurate documentation in the medical notes connecting diagnosis and treatment, new types of prescribing errors may not be discovered in time for the patient.

The findings of this programme of work have raised further research questions. Existing research has focused on the implementation of ePrescribing systems and the difficulties encountered (20)(32)(80). This research has considered how different perspectives regarding the impact that a prescribing system design, whether paper or electronic, changes the clarity and accuracy of the prescription chart and the HCPs ability to provide quality healthcare. The design of EPMA systems still needs development, to maximise clarity and therefore facilitate HCPs’ working practices to provide quality healthcare to the patient.

Due to the aim of the NHS to go “paperless” by 2018, paper prescription charts cannot be the future in the long term; however, we must not forget how paper prescription charts have stood the test of time, facilitating communication amongst its

users. Paper prescription charts have provided a good starting point for designing electronic prescription charts, some aspects that have let the quality of prescribing down on the paper prescription chart have been addressed when designing EPMA technology. Nevertheless, the good design features of paper prescribing need integrating into the next generation of ePrescribing prescription chart design, in order to facilitate HCPs' working practices, quality patient care, and safety in terms of future development.

Some think that the cultural change required to ensure effective implementation of ePrescribing is a much greater challenge than finding the right system (148). This programme of work has showed that the design of the system and therefore the right system would enable HCPs and MDTs to embrace the technology and support effective implementation in order to provide quality healthcare.

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9 APPENDIX

9.1 Telephone Interview

9.1.1 Ethics approval

By email

Dear Katherine,

With reference to your application for Ethical approval:

A telephone based interview to explore prescribing and reporting systems in secondary care across England and Wales

Liverpool John Moores University Research Ethics Committee (REC) has reviewed the above application at the meeting held on 1st December 2011. I am happy to inform you that the Committee are content to give a favourable ethical opinion and recruitment to the study can now commence.

Approval is given on the understanding that:

- any adverse reactions/events which take place during the course of the project will be reported to the Committee immediately;
- any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately;
- any substantive amendments to the protocol will be reported to the Committee immediately.
- The LJMU logo is used for all documentation relating to participant recruitment and participation e.g. poster, information sheets, consent forms, questionnaires. The JMU logo can be accessed at <http://www.ljmu.ac.uk/corporatecommunications/60486.htm>

For details on how to report adverse events or amendments please refer to the information provided at http://www.ljmu.ac.uk/RGSO/RGSO_Docs/EC8Adverse.pdf

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be 1st December 2016. An application for extension of approval must be submitted if the project continues after this date.

Yours sincerely

PP:



Professor Andrew Young

Chair of the LJMU REC

9.1.2 Invitation letter for telephone interview

Countess of Chester Hospital 
NHS Foundation Trust



Research pharmacist
Martindale House
Countess of Chester Hospital NHS FT
Liverpool Road
Chester CH2 1UL

kate.shemilt@nhs.net
Phone: 01244 362008
Date:

RE: A telephone based interview to explore prescribing and reporting systems in secondary care across England and Wales.

Dear,

I am undertaking a research project as part of my PhD about different prescribing systems. Given your experience and expertise in this area I would like to interview you, at a mutually convenient time. The interview should take a maximum of 15 minutes.

Your participation will contribute to the knowledge and understanding of paper and electronic based prescribing systems used in NHS hospitals, and inform future development of approaches to different prescribing systems.

Further details of the study are outlined in the enclosed participant information sheet. I would be very grateful if you could take a moment to peruse this and I will call you in the next few days to see if you are agreeable to taking part in the study. If you are happy to take part, I will arrange a mutually convenient time for an interview when I call.

I hope that you will be able to help me with my research. If you have any queries concerning the nature of the research, please contact me.

Finally, thank you for taking the time to consider my request.

Kind Regards

Kate Shemilt MPharm Clin pharm Dip PG Cert
Research pharmacist

Phone: 01244 362008 or via email at kate.shemilt@nhs.net

Letter vs. 1 10/11/2011

9.1.3 Participant information sheet for telephone interview

Countess of Chester Hospital 
NHS Foundation Trust



PARTICIPANT INFORMATION SHEET

Title of Project: A telephone based interview to explore prescribing and reporting systems in secondary care across England and Wales.

Name of Researcher: Kate Shemilt – Faculty of Science, Pharmacy and Biomolecular Sciences

We would like to invite you to take part in our research study. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please take time to read the following information. Please ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

A number of paper and electronic prescribing systems are used for inpatient prescribing in hospitals across England & Wales. Individual hospitals also have different systems in place for reporting errors including those associated with prescribing. The purpose of the study is to ascertain the nature of these systems by eliciting the views of Acute Trust or Local Health Board Chief Pharmacists, across England and Wales.

Why have I been invited?

You have been invited because you have specific knowledge about prescribing within your Acute Trust. The Chief Pharmacists in a number of secondary care trusts across England and Wales have also been invited to take part.

Do I have to take part?

No, it is up to you to decide whether or not to take part. You can withdraw at any time without giving a reason.

If I do take part, what will I be asked to do?

In the next few days the researcher will make contact by telephone to find out if you are happy to take part in the telephone interview and if you do agree, you will be asked to agree a mutually convenient time to be interviewed by the researcher. The interview will take place over the telephone and will be audio recorded. It should take a maximum of 15 minutes to complete. You will be asked to give verbal consent for the interview by agreeing to each of a number of statements.

What are the risks of taking part?

There are no identified risks to taking part in the study.

What are the benefits of taking part?

Your participation will contribute to the knowledge and understanding of paper and electronic based prescribing systems used in NHS hospitals, and inform future development of approaches to different prescribing systems.

Will anyone know that I've taken part?

Responses to the interviews are strictly confidential. I will not tell anyone who, or which hospital took part. Your personal data will be held in accordance with the Data Protection Act 1998. It will not be possible to identify any of the participants from the findings published.

Who should I contact if I want to know more about the study??

If you need to know more about any aspect of this study, you should speak to Kate Shemilt the researcher who will do their best to answer your questions. Telephone 01244 362008 or via e-mail at Kate.Shemilt@nhs.net

What if there is a problem?

If you are unhappy with the way that this research has been conducted, you should contact Professor James Ford, Director, School of Pharmacy and Biomolecular Sciences, Byrom Street, Liverpool, L3 3AF

9.1.4 Interview schedule for telephone interview (1-4)

Interview Schedule

Note: Check recorder is running.

Researcher introduces themselves:

Hi MY NAME IS KATE SHEMILT; I'M CALLING FROM THE COUNTESS OF CHESTER HOSPITAL REGARDING RESEARCH THAT I AM UNDERTAKING AS PART OF A PHD. I'M HOPING THAT YOU RECENTLY RECEIVED A LETTER WHICH GAVE AN OVERVIEW OF THE STUDY?

WOULD YOU TAKE PART IN AN INTERVIEW AT A TIME CONVENIENT TO YOU AS PART OF THAT RESEARCH? IT SHOULD TAKE A MAXIMUM OF 15 MINUTES.

Too busy – SORRY TO HAVE CAUGHT YOU AT A BAD TIME. I WOULD BE HAPPY TO CALL BACK. WHEN WOULD BE A GOOD TIME TO CALL IN THE NEXT DAY OR TWO?

Now – THAT'S GOOD, ARE YOU OKAY WITH THE INTERVIEW BEEN AUDIO RECORDED?

Depending on the response continue with the interview or organise a call-back

Obtain informed consent.

Can I just check that you have read and understood the participant information sheet for the study that was supplied in the letter you hopefully received? Have you got any questions about the study?
Yes No

You understand that participation is voluntary and you can withdraw at any time, without giving a reason.
Yes No

That any personal information collected during the study will be anonymised and remain confidential.
Yes No

Are you happy with the interview been digitally recorded and that this recording will be transcribed
Yes No

Some quotes could be taken from the recording of our conversation and may be used in publications and reports, but these will be anonymised and not traceable to you.
Yes No

Finally do you agree to take part in the study?
Yes No

Interview schedule 1 – Kate Shemilt vs. 2 27/10/2011

Section A: About the Acute Trust

FIRST I WOULD LIKE TO START BY ASKING YOU SOME GENERAL QUESTIONS ABOUT THE ACUTE TRUST (AT) or LHB

1. How many sites are in your trust? Acute Elective
2. What is the name of the main acute hospital site in your trust?

PLEASE CONSIDER THE MAIN ACUTE HOSPITAL SITE IN YOUR TRUST WHEN ANSWERING THE FOLLOWING QUESTIONS

Section B: Prescribing system

MOVING ON TO THE PRESCRIBING SYSTEM.....

1. What type of inpatient prescribing system is used within your AT or LHB?
 - a) Paper.....→SKIP TO Q 8
 - b) Electronic If electronic who is your provider.....?
 - c) A mixture..... What wards are excluded..... and why?.....
2. How long has the current inpatient prescribing system been in place?
3. Does the Electronic Prescribing inpatient system use functionalities such as:

a. Dose checking	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't know <input type="checkbox"/>	
b. Dose calculations	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
c. Free text prescribing or drug not on system	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't know <input type="checkbox"/>	
d. Drug interaction alerts	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
e. Multi level control for prescribers	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
f. Drop down menu for drug selection	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
g. Access to drug management information	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
h. Allergy checker	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
i. Discharge/transfer summaries	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't Know <input type="checkbox"/>	
j. Other.....				
4. Do you think that these are effective at improving prescribing quality compared to paper prescribing? Why?

	Yes	No	Don't Know
a			
b			
c			
d			
e			
f			
g			
h			
i			
j			

Interview schedule 1 – Kate Shemilt vs. 2 27/10/2011

5. Do you have any supplementary drug charts?
Yes No Don't Know Skip to Q 7 if No

6. Which drugs are prescribed on a supplementary paper drug chart?

a. Continuous IVs	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Don't Know	<input type="checkbox"/>
b. Insulin	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Don't Know	<input type="checkbox"/>
c. Warfarin	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Don't Know	<input type="checkbox"/>
d. Tapering doses	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Don't Know	<input type="checkbox"/>
e. Other (please specify)	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Don't Know	<input type="checkbox"/>
f. None of them	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Don't Know	<input type="checkbox"/>

7. Have you encountered any unpredicted benefits or problems with eP?

8. Are you aware of any plans in the future to change the prescribing system?
Yes No Don't Know
a) If so which one..... and why.....?

NOW I AM GOING TO ASK SOME QUESTIONS ABOUT THE CLINICAL INDICATION OF A DRUG.....

9. Is the clinical indication of a medication required for any prescribed medication within your AT? →

All meds Reg meds Prn meds Abx Warfarin Other None

10. Do you think that the clinical indication is completed all the time, most of the time, undecided, rarely or never.

All the Time Most of the time Undecided rarely Never

a. Why do you think the Trust enacted the policy of having a clinical indication?

11. What are your views on having a clinical indication for a prescribed medication on the prescription?

- Do you think it has an effect on prescribers' clinical workflow?
- Do you think it has an effect on patient safety?

IF LHB SKIP TO SEC C

12. Has your trust considered the use of "standards for the design of hospital in-patient prescription charts"?

Yes No don't know

a) If so, what did the discussion find?

Interview schedule 1 – Kate Shemilt vs. 2 27/10/2011

Section C: Prescribing error reporting system

WE ARE ALMOST FINISHED WITH THE INTERVIEW, I JUST HAVE A FEW QUESTIONS ABOUT THE PRESCRIBING ERROR REPORT SYSTEM.....

13. Can you tell me what predominant system is in place within your AT or LHB to report prescribing errors?

Datix Paper Other None Don't know

14. How long has the prescribing error reporting system(s) been in place?

15. Do you know if there are any plans in the future to change the prescribing errors reporting system?

Yes No Don't Know

a. If so which one..... and why.....?

16. What do you think of the current prescribing error reporting system?

a) Do you think that the error reporting system is easily accessible?

Yes No Not Sure

b) Do you think that the error reporting system is user friendly?

Yes No Not Sure

c) Do you think that staffs are motivated to use the error reporting system?

Yes No Not Sure

17. Do you have any other comments to make regarding prescribing quality and prescribing systems in place within your AT or LHB?

THIS COMPLETES OUR INTERVIEW. THANK YOU FOR TAKING THE TIME TO ANSWER QUESTIONS.

WE ARE PLANNING FURTHER RESEARCH AROUND PRESCRIBING SYSTEMS AND HOW THEY ARE CENTRAL TO THE PRESCRIBING PROCESS. WOULD YOU BE INTERESTED IN KNOWING MORE ABOUT THE RESEARCH?

If YES what next ... GREAT, THAT IS GOOD NEWS. HOW WOULD YOU LIKE TO BE CONTACTED?

If NO what next OKAY, SORRY TO HEAR THAT,

THE INFORMATION YOU HAVE PROVIDED HAS BEEN EXTREMELY VALUABLE TO THE RESEARCH. WOULD YOU LIKE AN E-MAIL WITH A SUMMARY OF THE FINDINGS? Yes No

E-mail address

THANK YOU FOR TAKING THE TIME TO PARTICIPATE.....

Interview schedule 1 – Kate Shemilt vs. 2 27/10/2011

9.2 Focus Group Discussion

9.2.1 Ethics approval

Dear Katherine,

With reference to your application for Ethical approval:

Minute No.:	12.75.14
Project:	12/PBS/002, Katherine Shemilt, P/G Research, An exploration of health care quality surrounding prescribing systems in secondary care (Dr Charles Morecroft).
Decision:	<i>Application approved without further information being required following submission of application of signature sheet.</i>

Liverpool John Moores University Research Ethics Committee (REC) has reviewed the above application at the meeting held on Thursday 12th July 2012. I am pleased to inform you that ethical approval has been granted and the study can now commence.

Approval is given on the understanding that:

- any adverse reactions/events which take place during the course of the project are reported to the Committee immediately;
- any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately;
- the LJMU logo is used for all documentation relating to participant recruitment and participation eg poster, information sheets, consent forms, questionnaires. The LJMU logo can be accessed at <http://www.ljmu.ac.uk/corporatecommunications/60486.htm>

Where any substantive amendments are proposed to the protocol or study procedures further ethical approval must be sought.

Applicants should note that where relevant appropriate gatekeeper / management permission must be obtained prior to the study commencing at the study site concerned.

For details on how to report adverse events or request ethical approval of major amendments please refer to the information provided at http://www.ljmu.ac.uk/RGSO/RGSO_Docs/EC8Adverse.pdf

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be 12th July 2017. An application for extension of approval must be submitted if the project continues after this date.

Yours sincerely **PP:**



Professor Andrew Young
Chair of the LJMU REC

9.2.2 Trust gatekeeper invitation letter/e-mail for focus group discussion

Countess of Chester Hospital 
NHS Foundation Trust



Research pharmacist
Martindale House
Countess of Chester Hospital NHS FT
Liverpool Road
Chester CH2 1UL

kate.shemilt@nhs.net

Phone: 01244 362008

Date:

RE: An exploration of health care quality surrounding prescribing systems in secondary care

Dear xxxxxx (Chief Pharmacist)

We would like to invite your department and Acute Trust to take part in a research study about different prescribing systems.

Health care professionals (HCPs) within your hospital will be asked to take part in a focus group or face-to-face interview. It will provide the HCPs with an opportunity to share their experiences and opinions on the use of the prescribing system. I am hoping that the clinical ward pharmacists will be able to help recruit HCP colleagues that use the prescribing system on a regular basis and work in similar clinical areas.

Further details of the study are outlined in the attached Trust gatekeeper information sheet and participant information sheet. I would be very grateful if you could take a moment to read this to see if you are agreeable to taking part in the study. If you are happy to take part please could you e-mail me back on the e-mail address provided at the top of this e-mail.

I hope that you will be able to help me with my research. If you have any queries concerning the nature of the research, please feel free to contact me at the contact details above

Finally, thank you for taking the time to consider my request.

Kind Regards

Kate Shemilt MPharm Clin pharm Dip PG Cert

Kate Shemilt - 25th June 2012 – Trust Gatekeeper Invitation Email (TGIE – 001)

9.2.3 Trust gatekeeper information sheet for focus group discussion

Countess of Chester Hospital 
NHS Foundation Trust



TRUST GATEKEEPER INFORMATION SHEET

Title of Project: An exploration of health care quality surrounding prescribing systems in secondary care

Name of Researcher: Kate Shemilt – Faculty of Science, Pharmacy and Biomolecular Sciences

We would like to invite you to take part in our research study. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please take time to read the following information. Please ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

A number of paper and electronic prescribing systems are used for inpatient prescribing in hospitals across England. The purpose of the study is to explore the opinions and experiences of healthcare professionals using the different prescribing systems about the impact they have on clinical workflow and multidisciplinary teams communication.

Why have I been invited?

You have been invited because you have specific contact with clinical ward pharmacists using the prescribing system as part of a multidisciplinary team on their ward within your Acute Trust.

Do I have to take part?

No, it is up to you to decide whether or not to take part.

If I do take part, what will I be asked to do?

If you agree to take part, you will be asked to introduce the researcher to clinical ward pharmacists within the pharmacy department at your Acute Trust because the clinical ward pharmacists have specific contact with healthcare professionals using the prescribing system. You will also be asked to sign a consent form.

What are the risks of taking part?

There are no identified risks to taking part in the study.

What are the benefits of taking part?

Your participation will facilitate the recruitment of multidisciplinary teams and thus contribute to the knowledge and understanding of paper and electronic based prescribing systems used in NHS hospitals, and inform future development of approaches to different prescribing systems.

Who should I contact if I want to know more about the study??

If you need to know more about any aspect of this study, you should speak to Kate Shemilt the researcher who will do their best to answer your questions. Telephone 01244 362008 or via e-mail at Kate.Shemilt@nhs.net

What if there is a problem?

If you are unhappy with the way that this research has been conducted, you should contact Professor James Ford, Director, School of Pharmacy and Biomolecular Sciences, Byrom Street, Liverpool, L3 3AF

Kate Shemilt – 25th June 2012 – Trust Gatekeeper Information Sheet (TGIS – 002)

9.2.4 Trust gatekeeper consent form for focus group discussion

 	
TRUST GATEKEEPER CONSENT FORM	
An exploration of health care quality surrounding prescribing systems in secondary care	
I confirm that I have read and understand the information sheet dated 25 th June 2012 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	Initial Here
I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason and that this will not affect my legal rights	Initial Here
I am happy for the ward pharmacists in my trust to help recruit their health professional colleagues for focus groups or interviews for the above study.	Initial Here
Name of Trust Gatekeeper (Print) _____	
Signature _____	Date _____
Name of Researcher (Print) _____	
Signature _____	Date _____
Kate Shemilt – 25 th June 2012 – Trust Gatekeeper Consent Form (TGCF – 003)	

9.2.5 Ward gatekeeper information sheet for focus group discussion

WARD GATEKEEPER INFORMATION SHEET

Title of Project: An exploration of health care quality surrounding prescribing systems in secondary care

Name of Researcher: Kate Shemilt – Faculty of Science, Pharmacy and Biomolecular Sciences

We would like to invite you to take part in our research study. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please take time to read the following information. Please ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

A number of paper and electronic prescribing systems are used for inpatient prescribing in hospitals across England. The purpose of the study is to explore the opinions and experiences of healthcare professionals using the different prescribing systems about the impact they have on clinical workflow and multidisciplinary teams communication.

Why have I been invited?

You have been invited because you have specific contact with healthcare professionals using the prescribing system as part of a multidisciplinary team on your ward within your Acute Trust. Your chief pharmacist has agreed to you undertaking this recruitment activity.

Do I have to take part?

No, it is up to you to decide whether or not to take part.

If I do take part, what will I be asked to do?

If you agree to take part, you will be asked to hand out a study recruitment pack and invite fellow healthcare professionals within your multidisciplinary team to take part in a focus group discussion or face to face interview. If you agree to take part, you will be asked to sign a consent form. You may also wish to participate directly in the study.

What are the risks of taking part?

There are no identified risks to taking part in the study.

What are the benefits of taking part?

Your participation will help facilitate the recruitment of multidisciplinary teams and thus contribute to the knowledge and understanding of paper and electronic based prescribing systems used in NHS hospitals, and inform future development of approaches to different prescribing systems.

Who should I contact if I want to know more about the study??

If you need to know more about any aspect of this study, you should speak to Kate Shemilt the researcher who will do their best to answer your questions. Telephone 01244 362008 or via e-mail at Kate.Shemilt@nhs.net

What if there is a problem?

If you are unhappy with the way that this research has been conducted, you should contact Professor James Ford, Director, School of Pharmacy and Biomolecular Sciences, Byrom Street, Liverpool, L3 3AF

Kate Shemilt – 25th June 2012 – Ward Gatekeeper Information Sheet (WGIF – 004)

9.2.6 Ward gatekeeper consent form for focus group discussion



WARD GATEKEEPER CONSENT FORM

An exploration of health care quality surrounding prescribing systems in secondary care

I confirm that I have read and understand the information sheet dated 25th June 2012 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

Initial Here

I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason and that this will not affect my legal rights

Initial Here

I agree to distribute recruitment materials to my doctor, nurse and pharmacist colleagues working on the wards I am responsible

Initial Here

I agree to respect the confidentiality of participants.

Initial Here

Name of Ward Gatekeeper (Print)

Signature

Date

Name of Researcher (Print)

Signature

Date

Kate Shemilt – 25th June 2012 – Ward Gatekeeper Consent Form - 005

9.2.7 Health care professional invitation letter to focus group discussion

Countess of Chester Hospital 
NHS Foundation Trust



Research pharmacist
Martindale House
Countess of Chester Hospital NHS FT
Liverpool Road
Chester CH2 1UL

kate.shemilt@nhs.net

Phone: 01244 362008

Date:

RE: An exploration of health care quality surrounding prescribing systems in secondary care

I am undertaking a research project as part of my PhD about different prescribing systems. Given your experience and expertise in this area I would like to invite you to take part in a focus group or face-to-face interview. We anticipate the focus group discussions and face to face interviews will last 45 minutes however if you have a lot to say it may take longer. It will provide you with an opportunity to share your experiences and opinions on the use of the prescribing system.

Your participation will contribute to the knowledge and understanding of paper and electronic based prescribing systems used in NHS hospitals, and inform future development of approaches to different prescribing systems.

Further details of the study are outlined in the enclosed participant information sheet. I would be very grateful if you could take a moment to read this to see if you are agreeable to taking part in the study. If you are happy to take part, please could you complete the expression of interest. I will arrange a time for the focus groups or face to face interviews to take place at a mutually convenient time between 9am and 4pm here at the hospital.

I hope that you will be able to help me with my research. If you have any queries concerning the nature of the research, please feel free to contact me at the contact details above

Finally, thank you for taking the time to consider my request.

Kind Regards

Kate Shemilt MPharm Clin pharm Dip PG Cert

Kate Shemilt – 25th June 2012 – Participant Invitation Letter (PIL – 006)

9.2.8 Participant information sheet for focus group discussion

<p>Countess of Chester Hospital  NHS Foundation Trust</p> <p></p> <p>PARTICIPANT FOCUS GROUP INFORMATION SHEET</p> <p>Title of Project: An exploration of health care quality surrounding prescribing systems in secondary care Name of Researcher: Kate Shemilt – Faculty of Science, Pharmacy and Biomolecular Sciences</p> <p>We would like to invite you to take part in our research study. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please take time to read the following information. Please ask us if there is anything that is not clear or if you would like more information.</p> <p>What is the purpose of the study? A number of paper and electronic prescribing systems are used for inpatient prescribing in hospitals across England. The purpose of the study is to explore the opinions and experiences of healthcare professionals using the different prescribing systems about the impact they have on clinical workflow and multidisciplinary teams communication.</p> <p>Why have I been invited? You have been invited because you have specific knowledge about the prescribing system within your Acute Trust.</p> <p>Do I have to take part? No, it is up to you to decide whether or not to take part. You can withdraw at any time without giving a reason.</p> <p>If I do take part, what will I be asked to do? If you agree to take part, you will be invited to take part in a focus group discussion. This will involve being asked questions about your experiences and opinions with different prescribing systems. We anticipate the focus group will take 45 minutes however if you have a lot to say it may take longer. The conversation will be recorded and subsequently transcribed. If you agree to take part, you will be asked to sign a consent form</p> <p>What are the benefits of taking part? Your participation will contribute to the knowledge and understanding of paper and electronic based prescribing systems used in NHS hospitals, and inform future development of approaches to different prescribing systems.</p> <p>Will anyone know that I've taken part? We will respect your right to confidentiality at all times and will not share your details with anyone outside the research team. Any data presented in publications will be anonymised such that no one would be able to identify you. However, in the unlikely event that gross misconduct were identified through something you say in this research, the researcher, as a registered health professional, would be ethically bound to raise this with the appropriate organisation(s). Confidentiality of the focus group discussions cannot be guaranteed for those participating in each focus group as other participants will know what has been said and by whom, however, focus group members will be asked to respect the confidentiality of other members of the group.</p> <p>Who should I contact if I want to know more about the study?? If you need to know more about any aspect of this study, you should speak to Kate Shemilt the researcher who will do their best to answer your questions. Telephone 01244 362008 or via e-mail at Kate.Shemilt@nhs.net</p> <p>What if there is a problem? If you are unhappy with the way that this research has been conducted, you should contact Professor James Ford, Director, School of Pharmacy and Biomolecular Sciences, Byrom Street, Liverpool, L3 3AF</p> <p>Kate Shemilt- 25th June 2012 – Participant Focus Group Information Sheet (PIS – 007)</p>

9.2.9 Participant consent form for focus group discussion

PARTICIPANT FOCUS GROUP CONSENT FORM

An exploration of health care quality surrounding prescribing systems in secondary care

I confirm that I have read and understand the information sheet dated 25th June 2012 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

Initial
Here

I understand that the focus group will be digitally audio recorded and that this recording will be transcribed verbatim. Any identifiable information will be removed during the transcription stage.

Initial
Here

I understand that my participation is voluntary and that I am free to withdraw at any time before or during the focus group without giving a reason and that this will not affect my legal rights

Initial
Here

I agree to respect the confidentiality and opinions of other participants participating in the focus group.

Initial
Here

I understand that verbatim quotes taken from the recording of our conversation may be used in publications and reports, but that these will be anonymised and not traceable to me.

Initial
Here

I agree to take part in the focus group conversation

Initial
Here

Name of Participant (Print)

Signature

Date

Name of Researcher (Print)

Signature

Date

9.2.10 Participant expression of interest for focus group discussion



EXPRESSION OF INTEREST

An exploration of health care quality surrounding prescribing systems in secondary care

If you are interested in taking part in the above study or would like more information please complete your contact details below and the researcher will get in touch in due course. There is a freepost envelope provided in order to return the expression of interest alternatively you can e-mail the researcher on kate.shemilt@nhs.net or telephone 01244 362008 and leave a message.

Name:

Profession:

Email:

Phone Number:

Thank you in anticipation.

Kate Shemilt MPharm Clin pharm Dip PG Cert

FOCUS GROUP SCRIPT

An exploration of health care quality surrounding prescribing systems in secondary care

Good morning/afternoon. Thank you for coming along today to participate in this focus group. I am Kate (depends on who is present) and this focus group is being undertaken as part of my research for my PhD.

During the course of the next 45 minutes or so I would like to get your experiences and opinions on the prescribing systems you have used within this hospital. What I need to record today is your opinions – There are no right or wrong answers. You can agree and or disagree with each other, and you can change your mind. I would like you to feel comfortable saying what you really think and how you really feel.

The session will be recorded and transcribed. All recorded information is confidential and will be anonymised, and will be used only for the purpose of the research.

No one will know who said what. I want this to be a group discussion, so feel free to respond to me and to other members in the group without waiting to be called on. However, I would appreciate it if only one person did talk at a time, you respect the opinions and confidentiality of others and that all discussions are kept confidential within this group.

The discussion will last approximately 45 minutes. There is a lot I want to discuss, so at times I may move us along a bit. Your participation is completely voluntary and you can stop taking part in the focus group at any time however, any information that you have given prior to your withdrawal will be used in the study.

Questions

1. Can you tell me about your experiences of the prescribing systems?
Probes: How have you given feedback about it?
2. Have you noticed any change in how people do their work since moving to electronic prescribing (ep)? Or Do you think moving to electronic prescribing would change how people do their work?
3. Have you seen new patient safety issues with ep? Do you think there would be new safety issues with eP?

4. Have you seen any alterations in communication patterns because of Electronic prescribing? Do you think there would be any alterations in communication if ep were implemented?

Probes: Written, verbal, interruptions, less or more with different HCPs.

5. How easy is it to use the paper/electronic prescribing system?

Probes: What would make it easier to use?

What makes it difficult to use....

What differences did you find in how you go about using the ep system compared to the paper-based system? In what ways?

What have you found to be the biggest difference?

What has the impact of this/these been?

6. How did you find the transition from the paper-based prescribing system to the electronic prescribing system?

Probes: What resources do you use to help you?

What additional support/ resources do you feel would have been useful?

Closure

Though there were many different opinions about _____, it appears that _____. Does anyone see it differently? It seems most of you agree _____, but some think that _____. Does anyone want to add or clarify an opinion on this?

Is there any other information regarding your experience with the prescribing systems that you think would be useful for me to know?

Thank you so much it has been very interesting listening to your comments and discussion. This information will be very valuable for my study and to help develop prescribing systems in the future.

9.3 Documentation review

9.3.1 Service Evaluation Approval

 Health Research Authority National Research Ethics Service								
NRES Committee North West - Cheshire HRA NRES Centre North West Barlow House 3rd Floor 4 Minshull Street Manchester M1 3DZ Telephone: 0161 625 7818 Facsimile: 0161 625 7299								
18 September 2012								
Ms K Shemilt (kate.shemilt@net.net) Research Pharmacist Martindale House Countess of Chester Hospital NHS Foundation Trust								
Dear Ms Shemilt								
Title of project:	Prospective review of health care professionals' (HCP) written communication							
Thank you for seeking advice from the HRA on whether the above project should be classified as research requiring review by a Research Ethics Committee (REC), or as some other type of activity, such as audit or service evaluation.								
Review by a REC is required only for research as specified within the Department of Health's <i>Governance Arrangements for Research Ethics Committees</i> (available from the Department of Health's website www.dh.gov.uk) or under legislation, such as the Clinical Trials Regulations, Human Tissue Act and Mental Capacity Act.								
You provided the following document for consideration:								
<table border="1"><thead><tr><th>Document</th><th>Version</th><th>Date</th></tr></thead><tbody><tr><td>Overview of project</td><td></td><td>03 September 2012</td></tr></tbody></table>	Document	Version	Date	Overview of project		03 September 2012		
Document	Version	Date						
Overview of project		03 September 2012						
This document has been considered by the Chair.								
Our leaflet " <i>Defining Research</i> " explains how we differentiate research from other activities and is published on the NRES website under Applications is your project research? Based on the information you have provided, our advice is that the project is not considered to be research according to this guidance. It would appear to be service evaluation, and therefore it does not require ethical review by a Research Ethics Committee.								
It is ultimately the responsibility of the sponsor to decide if a project is research or not. You must therefore contact the sponsor/funder/care organisation where the work will be undertaken to ensure that they agree with this advice.								
If you, your sponsor/funder or any care organisation feels that the project should be managed as research and/or that ethical review by a REC is essential, please write setting out your reasons and we will be pleased to consider further.								
You should also check with the Countess of Chester Hospital NHS Foundation Trust what other review arrangements or sources of advice apply to projects of this type. Guidance may be available from the clinical governance office.								
A Research Ethics Committee established by the Health Research Authority								

Although ethical review by a REC is not considered necessary in this case, all types of study involving human participants should be conducted in accordance with basic ethical principles such as informed consent and respect for the confidentiality of participants. When processing personal information there are also legal requirements under the Data Protection Act 2000. When undertaking an audit or service/therapy evaluation, the investigator and his/her team are responsible for considering the ethics of their project with advice from within their organisation. University projects may require approval by the university ethics committee.

This letter should not be interpreted as giving a form of ethical approval or any endorsement of the project, but it may be provided to a journal or other body as evidence that ethical approval is not required under the Department of Health's Research Governance Framework for Health and Social Care.

Where care organisations have clarified that a project is not to be managed as research, the Research Governance Framework states that it should not be presented as research within the NHS.

Yours sincerely



Miss Diane Catterall
Committee Co-ordinator

E-mail: diane.catterall@northwest.nhs.uk

Copy to: Countess of Chester Hospital NHS Foundation Trust (mary.fisher-morris@coch.nhs.uk)

9.3.2 Ethics Approval

Dear Katherine,

Proportionate Review – Full Ethical Approval: Application for Ethical Approval No.: 13/PBS/003 - Exploring written communication around prescribing

Dr Sue Spiers & Dr Chris Wall have considered the application on behalf of Liverpool John Moores University Research Ethics Committee (REC). I am pleased to inform you that ethical approval has been granted and the study can now commence.

Approval is given on the understanding that:

- any adverse reactions/events which take place during the course of the project are reported to the Committee immediately;
- any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately;
- the LJMU logo is used for all documentation relating to participant recruitment and participation eg poster, information sheets, consent forms, questionnaires. The LJMU logo can be accessed at <http://www.ljmu.ac.uk/corporatecommunications/60486.htm>

Where any substantive amendments are proposed to the protocol or study procedures further ethical approval must be sought.

Applicants should note that where relevant appropriate gatekeeper / management permission must be obtained prior to the study commencing at the study site concerned.

For details on how to report adverse events or request ethical approval of major amendments please refer to the information provided at http://www.ljmu.ac.uk/RGSO/RGSO_Docs/EC8Adverse.pdf

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be 7th May 2018. An application for extension of approval must be submitted if the project continues after this date.

Yours sincerely

PP:



PATIENT INFORMATION LEAFLET
Exploring written communication around prescribing

We would like to invite you to take part in our research study. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please take time to read the following information and ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study? The purpose of the study is to explore how different hospital systems for prescribing impact on the quality of written communication around prescribed medications between health professionals involved in patient care. The aim of the study is not related to your individual care; it is purely an academic study about written communication between healthcare professionals.

Why have I been invited? You have been invited because you are an inpatient on this ward.

Do I have to take part? No, it is up to you to decide whether or not to take part. If you decide not to take part this will not affect you or the quality of care you receive from the hospital or staff in any way.

If I do take part, what would happen? If you agree to take part, you will be given this information sheet to keep and be asked to sign a consent form. You would not have to do anything else. The researcher will then review your hospital records, relating to your current admission. The information extracted will include; gender, age, length of stay, pre-admission medication, newly prescribed medication and the written communication specifically about medicines whilst you are an inpatient on this ward.

What are the risks of taking part? We have not identified any risks or disadvantages to taking part.

What are the benefits of taking part? You will not personally benefit from taking part. Your participation will contribute to our understanding of written communication around prescribing and help us to understand how different systems may affect this. We hope that better understanding about this issue will help people to plan better systems in the future.

Will anyone know that I've taken part? We will only collect anonymous information – things that can't be linked back to you. Once the data collection has finished, it will not be possible for anyone to find out that you took part in this study. All information looked at during the course of this research study will be kept strictly confidential.

What will happen to the results of the research study? A written report of this study will be forwarded to the hospital and used to improve the written communication between health care professionals. In addition, the findings of the study will be presented to hospital staff, at professional conferences and submitted to professional journals.

Contact for Further Information – If you would like any further information or have concerns about the content or procedures of this study please contact any of the following;

1. Nurse-in-charge of the ward you have been admitted to.
2. Kate Shemilt the researcher who will do their best to answer your questions.
Telephone 01244 362008 or via e-mail at Kate.Shemilt@nhs.net
3. Alternatively academic supervisor Dr Charles Morecroft, School of Pharmacy and Biomolecular Sciences, Byrom Street, Liverpool, L3 3AF Tel - 0151 231 2296 Email - c.w.morecroft@ljmu.ac.uk

What should I do now? – If you are happy to take part in this study, please complete and sign the consent form and hand it back to the researcher. If you do not want to take part, tell the researcher when she returns.

Thank you for considering taking part in this study

9.4 Dissemination of thesis

9.4.1 Conferences Attended

Patient Safety Congress - International Conference Centre, Birmingham, July 2011.

Health Service Research and Pharmacy Practice (HSRPP) Conference, University College Cork (UCC), Ireland, Apr. 2012.

United Kingdom Clinical Pharmacist Association (UKCPA) Autumn Symposium, Crowne Plaza, Chester, Nov. 2012.

United Kingdom Clinical Pharmacist Association (UKCPA) Autumn Symposium, Crowne Plaza, Chester, Nov. 2013.

Royal Pharmaceutical Society (RPS) Annual Conference – International Conference Centre, Birmingham, Sept. 2014.

9.4.1.1 Poster Presentations

Shemilt K, Morecroft C, Green C, Mackridge A, Ford J. Chief Pharmacists' perceptions of using clinical indication on in-patient prescription charts. *United Kingdom Clinical Pharmacist Association (UKCPA) Autumn Symposium*. Crowne Plaza, Chester. 2012.

Shemilt K, Morecroft C, Green C, Mackridge A, Ford J. The impact of prescribing systems on health care professionals' working practices. *United Kingdom Clinical Pharmacist Association (UKCPA) Autumn Symposium*. Crowne Plaza, Chester. 2013.

9.4.1.2 Oral Presentations

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Shemilt K. The impact of prescribing systems on health care professionals' working practices. *Research Café*. Liverpool John Moores University. May 2014.

Shemilt K, Morecroft C, Green C, Mackridge A, Ford J. Is clarity and accuracy being compromised by the way electronic prescriptions are designed?. *Royal Pharmaceutical Society Annual Conference*, ICC Birmingham. Sept 2014.

9.4.2 Publications

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