Hospital electronic prescribing and medicines administration system implementation into a District General Hospital: a mixed method evaluation of discharge communication

Pamela Ruth Mills

A thesis submitted in partial fulfillment of the requirements of the Robert Gordon University for the degree of Doctorate of Professional Practice

This research programme was carried out in collaboration with NHS Ayrshire & Arran

January 2016

ABSTRACT

Hospital electronic prescribing and medicines administration (HEPMA) system implementation is advocated by national e-health strategies to produce patient safety benefits. No previous study has evaluated HEPMA implementation impacting discharge information communication or assessed discharge prescribing errors.

The aims were to assess HEPMA system implementation impact on medicines related discharge communication and prescribing errors, and to gain the perspective of hospital staff involved in the communication process.

Following a narrative literature review, a convergent parallel mixed methods was selected, consisting of interpretative phenomenology and experimental before and after study design. Face-to-face semi-structured interviews of a purposive sample of hospital staff involved in discharge information communication were undertaken using the Theoretical Domains Framework (TDF) as a theoretical lens. In addition a quasi experimental retrospective case notes review, both before and after implementation was completed.

Pre-implementation, staff described patient safety concerns with traditional discharge communication processes. They cited frequent prescribing errors, and associated adverse events and hospital readmissions. HEPMA implementation was anticipated to improve patient safety and create more efficient discharge communication.

Post-implementation staff articulated improved information quality highlighting fewer omitted medicines and improved patient safety. TDF findings of behaviour change highlighted behavioural alteration including adaption of processes to improve discharge quality.

Quantitative data collection (n=159 before and after) confirmed qualitative findings; increased compliance with discharge documentation, for example staff grade recorded increased from 40% to 100% ($p<0.001$). Prescribing error quantity and severity were reduced; errors reduced from 99% to 23% of patients ($p<0.001$); only 22% of identified errors likely to cause harm. Omitted medicines decreased from 42% to 11% of patients ($p<0.001$).

The findings contribute original knowledge concerning HEPMA implementation impacting discharge information communication and prescribing errors. The study demonstrated reduced prescribing errors and improved patient safety which potentially impacted health and wellbeing. Qualitative findings and quantitative results are transferable and applicable to other NHS organisations or similar healthcare settings.

KEY WORDS
HEPMA, discharge communication, prescribing errors, patient safety, theoretical domains framework, behavioural change

ACKNOWLEDGEMENTS

Completing this course has often felt like a solitary endeavour, with substantial hours spent secluded in my spare room. As I reflect over the last four and a bit years, I am amazed at how many people have contributed to this process in one way or another; some big, some small.

Therefore, I am indebted to the many people who have provided me with assistance on this journey.

I am forever grateful to my family and friends, especially my Mum and Dad, who saw less of me than normal, for their continual unfailing support, encouragement and belief in their daughter.

I owe a huge debt of thanks to Michele Caldwell, Director of Pharmacy, NHS Ayrshire & Arran, who immediately and unquestioningly supported my application for the DPP course. Michele also provided financial assistance for partial course fees from the pharmacy endowment fund. Regrettably, due to ill health, Michele is not currently at work to see the finished product of my endeavours. I would have been unable to complete the DPP without her invaluable support. Michele has devoted significant time and effort to achieve HEPMA implementation throughout NHS Ayrshire and Arran. I hope she will be delighted with this finished product.

Additional thanks to NHS Education for Scotland for further financial contribution towards the DPP course fees.

Within NHS Ayrshire and Arran I need to thank the following staff (in no particular order, as they say on a certain TV programme!):

- the HEPMA team (Lynn Carleton, Richard Cottrell, David McDonald and Neil Fallon) who answered numerous queries and promptly provided the requested information
- my interview guinea pigs, Julie Mardon and Aileen Dunleavey, who tested my interview skills and provided invaluable feedback
- thanks to the heads of service who assisted my request for their staff to be interviewed, (Crawford McGuffie, Mark McColl, Mahanth Manuel, Margaret Nicol, Roisin Kavanagh, Laura Maule and Barbara Cowley).

They were all extremely helpful in facilitating staff interviews, especially considering the prevailing service pressures.

- the interviewed staff who gave their time freely and answered my questions honestly and articulately
- Susan Nairn, Senior Pharmacy Technician for helping search for copies of discharge letters in the furthest reaches of the paper store (and braved the spiders too!)
- the Business Intelligence department for providing randomised samples
- Health Records staff especially June Whyte, Debbie Baird, and Matthew Quinn who efficiently obtained the requested notes
- Lynsay Lawless and Sarah McDonald for ensuring the accuracy of my case note data extraction
- Medicines Utilisation Unit staff who obtained GP IDL receipt information (Colette Kerr, Graeme Bryson, Fiona Sanderson, Douglas Whitehill and all the practice support pharmacists)
- Jacqueline Seenan for supporting my presentation at the RPS Conference
- the librarians at University Hospital Crosshouse for obtaining obscure journal articles
- Roisin Kavanagh for proof reading the final document

Additional thanks to the following staff of Robert Gordon University (again in no particular order)

- all lecturers involved in HMW001, HWM002 and HWM004
- Dr Rachel Knott and Dr Winifred Obeh who provided essential support as DPP course leaders
- Dr Katie MacLure for advice and encouragement and help with poster preparation when family health problems left me stranded abroad
- Dr Lesley Diack for stepping in as my temporary supervisor

My final thanks (last but by no means least!) are to my supervisory team of Prof Derek Stewart and Dr Anita Weidmann. The enthusiasm and encouragement that I have received was exceptional and I sincerely appreciate their efforts on my behalf. Whenever I faced a challenge they proffered a solution to guide me through the difficulties. Their advice and

support have improved exponentially the resultant end product. I am extremely grateful for their timely and helpful comments throughout. I couldn’t have wished for a better supervisory team.

OUTPUTS

PEER REVIEWED PUBLICATIONS

Mills PR, Weidmann AE, Stewart D (2015) Hospital discharge information communication and prescribing errors: a narrative literature overview. *European Journal of Hospital Pharmacy* doi:10.1136/ejhpharm-2015-000677

In preparation

Mills PR, Weidmann AE, Stewart D Hospital discharge communication: hospital staff opinion of a recently introduced hospital electronic prescribing and medicine administration system

Mills PR, Weidmann AE, Stewart D An investigation of hospital electronic prescribing system implementation impact discharge information communication and prescribing errors

CONFERENCE PRESENTATIONS

Oral presentation

Royal Pharmaceutical Society Conference 2013 (Birmingham)

Mills PR, Weidmann AE, Stewart D Gearing up for hospital electronic prescribing: hospital staff experiences of paper based prescribing systems and future expectations.

(Abstract) *International Journal of Pharmacy Practice*; 21(S2): 15-6

Poster Presentation

Royal Pharmaceutical Society Conference 2014 (Birmingham)

Mills PR, Weidmann AE, Stewart D Gearing up for electronic prescribing: baseline audit of content, prescribing errors and GP receipt of handwritten hospital immediate discharge letters. (Abstract) *International Journal of Pharmacy Practice*; 22 (S2): 47-8

European Society of Clinical Pharmacy Symposium 2014 (Copenhagen)

Mills PR, Weidmann AE, Stewart D Baseline audit of handwritten immediate discharge letters. (Abstract) *International Journal of Clinical Pharmacy*; 2015, 37:285

European Society of Clinical Pharmacy symposium 2015 (Lisbon)
Mills PR, Weidmann AE, Stewart D HEPMA implementation: hospital staff opinion of impact on discharge communication

Abstract *International Journal of Clinical Pharmacy* (in press)

INVITED PRESENTATIONS

Patient Safety Congress 2014 (Liverpool)
Mills PR Prescribing in a paperless NHS

INVITED WORKSHOP

Promoting patient safety through pharmacy practice technology and research 2016 (Doha)
Mills PR Workshop title to be confirmed

OTHERS

NHS Ayrshire and Arran, Safer Medicines Group 2015 (Presentation)
Mills PR, Weidmann AE, Stewart D HEPMA system implementation: a mixed method evaluation of discharge communication

NHS Scotland HEPMA business case evaluation 2015
Mills PR, Weidmann AE, Stewart D Summary of findings provided to aid evaluation and develop specification.

FOREWORD

My current role is as Principal Pharmacist – Redesign in NHS Ayrshire and Arran, which is an area post with innovation and service development as key components.

My current role includes the following:

- Developing and implementing procedures for new ways of working to ensure efficient practice, patient safety and improvements in patient journeys.
- Undertaking research and complex audits to evaluate service change.
- Providing leadership to multi-disciplinary healthcare staff.

I am an experienced clinical pharmacist and have worked in multiple specialities, especially medical wards. I maintain my clinical competency by participating in two clinical sessions per week in the Emergency Department.

Working as a clinical pharmacist in a hospital setting I have completed formal both clinical pharmacy qualifications and also undertaken quality improvement and audit work.

As a fellow of the Scottish Patient Safety Programme I received intensive coaching in improvement methodology and leadership and I am the lead pharmacist for Safer Medicines work within the hospital.

My reason for selecting this particular course rather than the traditional PhD was because as an experienced practitioner of clinical pharmacy, service redesign and quality improvement, I was keen to undertake more formal research. I wanted to ensure that my selected research would be relevant to my job as a hospital pharmacist and would impact on my local organisation as well as being relevant to national and international audiences.

ABBREVIATIONS

A&E	Accident and Emergency
ADTC	Area Drug and Therapeutics Committee
AHP	Allied health professional
AKI	Acute kidney injury
AMD	Associate medical director
ANP	Advanced nurse practitioner
ASSIA	Applied Social Sciences Index And Abstracts
BNF	British national formulary
CAMM	Clinical adoption meta-model
CDD	Core discharge document
CHI	Community hospital index
CINAHL	Cumulative Index to Nursing and Allied Health
DGH	District general hospital
DPP	Doctorate of professional practice
ED	Emergency department
EDD	Extended discharge document
e-prescribing	Electronic prescribing
EQUIP	Errors- Questioning Undergraduate Impact on Prescribing
FFL	First and final letter
FL	Final letter
FY1	Foundation year one doctor
FY2	Foundation year two doctor
GMC	General Medical Council
GP	General Practitioner
GPhC	General Pharmaceutical Council
HEPMA	Hospital electronic prescribing and medicine administration

HIS	Healthcare Improvement Scotland
HITS	Health information technology systems
ID	Identification
IDL	Immediate discharge letter
INR	International normalised ratio
IT	Information technology
JHO	Junior house officer
MHRA Agency	Medicines and Healthcare Products Regulatory
MR	Medicine reconciliation
NCCMERP	The National Co-Ordinating Council For Medication Error Reporting And Preventing
NHS	National Health Service
NIHR	National Institute for Health Research
NIP	Nurse independent prescriber
NKDA	Nil known drug allergies
NPT	Normalisation process theory
PI	Principal Investigator
PMS	Patient management system
PROTECT	Prevalence and causes of prescribing errors: The PRescribing Outcomes for Trainee Doctors Engaged in Clinical Training Study
PSD	Patient specific direction
RCT	Randomised control trial
RGU	Robert Gordon University
RPS	The Royal Pharmaceutical Society
SHO	Senior house officer
SIGN	Scottish Intercollegiate Guidelines Network
SPARS	Scottish prescription and administration record

SPICe	Scottish parliament information centre
SPSP	Scottish patient safety programme
SPSS	Statistical package for the social science
ST	Speciality training
TDF	Theoretical domains framework
UHA	University Hospital Ayr
UHC	University Hospital Crosshouse
UK	United Kingdom
USA	United States of America

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 GENERAL INTRODUCTION

CHAPTER INTRODUCTION

This chapter provides the introduction to the thesis, with specific focus on the communication of medicines information to general practitioners (GPs) following an in-patient stay.

The chapter commences with a description of the legal policies for prescribing of medicines in hospitals, with particular emphasis on the legislation relating to discharge information communication and medicine prescribing at the point of patients' hospital discharge following an inpatient stay.

Patient safety issues including medication and prescribing errors are described with consideration to discharge communication.

There is coverage of the local setting and context including the background to hospital electronic prescribing and medicines administration (HEPMA) systems implementation.

This is followed by evolution of prescribing systems over time to provide context to the implementation of HEPMA systems, and the political drivers and associated policy documentation relating to these systems.

A narrative, critical appraisal is provided of the limited literature available relating to HEPMA implementation and specifically discharges information communication.

The aims of the research are then stated.

PRESCRIBING IN NATIONAL HEALTH SERVICE (NHS) HOSPITALS

Prescribing of medicines in hospitals is legislated by the Medicines Act 1968 and associated statutes and regulations (*The Medicines Act* 1968).

The requirements for a prescription are detailed in the Prescribing Section of the Code of Practice for Medicines Governance of NHS Ayrshire and Arran (NHS Ayrshire and Arran). This code was developed under the auspices of a subgroup of the Area Drug and Therapeutics Committee (The Medicines Risk Protection Group) (NHS Ayrshire and Arran).

Prescribing is defined in the Code of Practice for Medicines Governance as "a written direction for the preparation, compounding and administration of a medicine".

The prescribing of medicines in hospital must be undertaken by suitably qualified prescribers. These include doctors, pharmacist independent and supplementary prescribers, nurse independent or supplementary prescribers and also allied health professionals who have completed an approved prescribing qualification. A patient specific direction (PSD) may be used for hospital inpatient prescribing as "directions to administer" as outlined in guidance produced by the Royal Pharmaceutical Society in Medicines and Ethics (Royal Pharmaceutical Society of Great Britain 2014). A PSD must refer to a specific named patient but does not need to comply with the specifications required for a prescription. The information on a PSD may be transcribed to create an order for discharge.

Transcribing of medicines is also defined in the Prescribing Section of Code of Practice for Medicine Governance. Transcribing is the "transfer of information from one direction to supply or administer to another form of direction to supply or administer. This includes transcribing medicines to discharge letters, writing transfer letters, copying illegible patient administration charts onto new charts, whether handwritten or computer generated."

Documentation for Hospital Inpatient Stay

The documentation used to record the prescribing and administration of medicines is an inpatient prescription chart. Local policies have been produced to provide clear advice for practitioners working within the Health Board area and documented in the Code of Practice for Medicines Governance (NHS Ayrshire and Arran). A copy of the traditional NHS Ayrshire and Arran inpatient prescription chart is included in Appendix 1.1, with a HEPMA version in Appendix 1.2.

Documentation at Hospital Discharge

A specific document is used to communicate discharge information to the patient's GP when discharged from hospital to home or onward place of care. This document is traditionally termed an Immediate Discharge Letter (IDL), which serves as both prescription and communication of information about the

inpatient stay to the GP. A copy of the traditional IDL is included in Appendix 1.3, with a HEPMA version in Appendix 1.4. This documentation should be sent to the patient's GP on the day of the discharge from hospital.

MEDICATION ERRORS AND PRESCRIBING ERRORS

This section provides an overview of medication errors, with emphasis on prescribing errors. These are described within the context of the patient journey during stay and specifically in relation to discharge.

Medicine related errors may occur during the process of prescribing medicines, dispensing of medicines or administration of medicines (MERP 2001). There is often a lack of clarity in the published studies on the array of terms around medicine related errors.

Reasons' model of accident causation for human error, which is the most widely used model to describe human error in complex organisations, describes several error causality factors (Reason 1990). Execution errors are slips or lapses which tend to occur during everyday tasks and may be detected by self-checking. Planning failures are actually mistakes which may either be rules based or knowledge based mistakes and are rarely detected by self-checking as the individual considers their actions to be correct.

Medication related error definitions

The National Co-ordinating Council for Medication Error Reporting and Preventing (NCCMERP) is an American independent body comprised of 27 American health care organisations with a vision that "no patient will be harmed by a medication error and a mission to maximise the safe use of medicines and to increase awareness of medicine errors" (The National Co-ordinating Council for Medication Error Reporting and Preventing 2014). The NCCMERP recommends the term, medication error, defined as "any preventable event that may cause or lead to inappropriate medicine use or patient harm while the medicine is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labelling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use."

Ferner et al define a medication error as "a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient" (Ferner and Aronson 2006). They further describe a classification based on Reason's classification of errors (Reason 1990). "Errors can be classified according to whether they are mistakes, slips or lapses. Mistakes are errors in the planning of the action. They can be knowledge based or rule based. Slips and lapses are errors in carrying out an action- a slip through an erroneous performance and a lapse through an erroneous memory." The distinction between different error types is important in influencing prevention efforts. Their medication error definition includes all stages in the process of medicines use and encompasses prescribing, transcribing, preparation, dispensing and administration of medicines as well as therapy monitoring.

Definition of medicine and medication

The Medicines and Healthcare Products Regulatory Agency (MHRA) is responsible for regulating medicines in the UK (Medicines and Healthcare Products Regulatory Agency 2014). The MHRA defines a medicine as "something used in disease, whether it is used to prevent, treat or diagnose it, in anaesthesia, investigating conditions or interfering with the normal operation of the body. It does not include such things as contact lens fluids, food supplements and cosmetics". The MHRA does not provide a definition for medication but frequently the terms medicine and medication are used interchangeably. The Oxford dictionary defines a medicine as "a drug or other preparation for the treatment or prevention of disease" (Oxford University Press 2014a). Whilst the definition of a medication is defined by the same publication as either "a drug or other form of medicine that is used to treat or prevent disease" or "treatment using drugs" (Oxford University Press 2014b).

Prescribing error definition

A definition of a prescribing error is provided by Dean et al, derived from a formal consensus approach as "a prescribing error occurs, when as a result of a prescribing decision or prescription writing process, there is an unintentional reduction in the probability of treatment being timely and effective or increase in the risk of harm" (Dean, Barber and Schachter 2000). This highlights two separate phases: the decision making about the prescription and the act of writing a prescription.

Whilst this doctoral research is focussed on discharge prescribing errors consideration must be given to inpatient prescribing errors as these errors may be transcribed onto discharge prescriptions, perpetuating the errors.

Inpatient prescribing errors

Review of the published literature for inpatient prescribing errors shows variation in error prevalence rates. There are two UK systematic reviews which demonstrate the scale of the issue and the breadth of the literature base. A systematic review published by Lewis PJ et al in 2009, conducted as part of the EQUIP study critically reviewed 63 studies and identified an error rate which ranged from 7.4% to 18.7% of prescriptions (Lewis et al. 2009). They identified that there was "no consistent pattern in the number or types of errors, or medicines associated with them." Furthermore they highlighted variation in study design and outcome measures, which may have contributed to the range of prevalence rates. Of note, they excluded papers of electronic prescribing systems and also discharge prescriptions.

A systematic review, published by Ross et al in 2009, assessed the prevalence of prescribing errors committed by junior doctors (Ross et al. 2009). They critically reviewed 24 papers, identifying an error prevalence rate in the studied countries (Europe, USA, Australia and New Zealand) which ranged from 2 to 514 per 1000 prescribed items or 4.2 to 82% of patients or reviewed charts. They also highlighted inconsistencies in error definition and methodologies in the reviewed papers.

Two large studies on prescribing errors in the hospital setting in the UK merit further consideration: the EQUIP and PROTECT studies.

EQUIP study

EQUIP is an acronym for Errors- Questioning Undergraduate Impact on Prescribing, commissioned by the UK General Medical Council (GMC). It was an " in depth investigation into causes of prescribing errors by foundation trainees in relation to their medical education", limited to two regions in England (Dornan et al. 2009). The study report was published in 2009 and comprises three components: systematic reviews, prevalence study and qualitative research.

The prevalence component studied the prescribing errors of junior doctors in the first year of practice, assessed in relation to their actual environment and education provision. Errors were detected in 4190 out of total 50,016 prescribed medicines with a mean error prevalence of 8.4%.

Greater than 50% of errors (using Dean's definition) were "errors due to the correct execution of an incorrect plan" and noted the need to differentiate between execution errors and planning errors. Qualitative interviews with a sample (n=30) identified that they were acutely aware of knowledge gaps at the point of prescribing and associated errors with busy workloads and tiredness.

A further article from the EQUIP study published in 2015, reported the prevalence of prescribing errors at hospital discharge as 6.3% per 100 prescribed items (Ashcroft et al. 2015). They also reported a reduction in prescribing error incidence with electronic systems (12% less likely) although described no association between prescribing system used and error severity (Ashcroft et al. 2015).

PROTECT study

PROTECT, Prevalence and Causes of Prescribing Errors: The PRescribing Outcomes for Trainee Doctors Engaged in Clinical Training Study consists of three phases conducted in eight different Scottish hospitals (Ryan et al. 2014). Phase one determined the prescribing error prevalence rates for junior doctors, phase two assessed their awareness of prescribing errors and experience of errors, whilst phase three assessed their perceived ability to prescribe accurately.

More errors were found at hospital admission (56.7%; n=1907) than at discharge (14.5%; n=489), although a much smaller sample size was used at discharge compared to admission. Results indicated that 60% of observed errors reached patients but with less than 1% of these errors resulting in patient harm (Ryan et al. 2014).

Specific issues relating to the creation of discharge communication by junior doctors due to pressures on hospital flow were identified as contributing to

prescribing errors (Ross et al. 2013). Junior doctors identified feeling the need to create discharge prescriptions under duress and at high speed.

Junior doctors were self-aware of their prescribing error rate but were unworried about potential or actual patient harm as a result of these errors and in fact were self-assured about their prescribing aptitude (Ryan et al. 2013).

Thus to reduce prescribing errors will need multiple solutions due to the complexity of the causative factors.

PATIENT SAFETY

The NHS in Scotland was the first country worldwide to introduce a national programme to improve patient safety.

Scottish Patient Safety Programme

The Scottish Patient Safety Programme (SPSP) was established by the Scottish Government in conjunction with Healthcare Improvement Scotland(HIS) in January 2008.The primary aim of the programme was "to reduce mortality by 15% and adverse events by 30% in acute hospitals by end of 2012". The SPSP programme was extended by the Scottish Government in June 2012 "with a more ambitious target of reducing hospital standardised mortality by 20% by end of 2015 "(Healthcare Improvement Scotland 2014b).The SPSP is described as "a unique national initiative that aims to improve the safety and reliability of healthcare and reduce avoidable harm." The initial work concentrated on acute hospitals with separate work streams targeting different components for example, medicines management, general ward, intensive care and peri-operative work. The medicine management work stream consists of specific improvement activities related to medicine safety to be undertaken in each acute hospital in Scotland. Recommended improvement areas included "accuracy of medicines at the interface" and "communication with primary care". The former is responsible for medicine reconciliation work whilst the latter includes the need "to develop a communication process with primary care". Improvements to the existing discharge information communication system and reduction of prescribing errors would therefore be important work to contribute to the SPSP medication safety effort.

NHS England Patient Safety Alert

NHS England published a patient safety alert in 2014, aimed at all NHS organisations, other providers of NHS care and social care sectors highlighting problems with essential information communication at patients' hospital discharge (NHS England 2014). They are currently collating information of possible solutions before publishing a resource to enable discharge information communication improvement.

STRATEGIES TO OVERCOME PRESCRIBING ERRORS

Various solutions have been proposed to reduce the incidence and patient harm associated with prescribing errors. These include alteration to the training of medical and non-medical prescribers, standardisation of prescribing documentation, and the use of IT systems including HEPMA (Dornan et al. 2009).

Training of medical and non-medical prescribers is beyond the scope of this DPP research. Consideration will be given to the other proposed solutions.

Standardisation of inpatient prescription chart

Studies reviewing inpatient prescribing errors have recommended standardisation of the inpatient chart as a strategy to reduce errors.

Dornan el al considered the design of hospital inpatient charts to have contributed to medication errors in the EQUIP study (Dornan et al. 2009). In the hope of overcoming some of these errors, a national paper inpatient chart has been prepared in Wales (Routledge 2012) but to date there is no published evidence on the impact of standardisation on prescribing error rates. The NHS in England has produced a guidance document stating the requirements for a safe inpatient prescription chart (Academy of Medical Royal Colleges 2008). In Scotland, a group led by the Royal College of Physicians of Edinburgh is devising an inpatient SPARS (Scottish Prescription and Administration Record) chart, which is in draft format and only applies to inpatient paper charts. HIS produced a Scottish good practice guide for HEPMA implementation which states that a standardised paper inpatient prescription chart may be used as a template for the HEPMA inpatient chart (Healthcare Improvement Scotland 2014a).

Tallentire et al in 2013 reviewed inpatient chart design in Scotland, noting that it may be hypothesised that knowledge of chart layout and design would reduce prescribing errors. Their study identified that faster prescribing speed was associated with increased error rates (Tallentire et al. 2013). A limitation of their study was that the design involved trainee doctors prescribing using different styles of inpatient charts, some of which were unfamiliar, which may have impacted their prescribing time and hence the study findings.

e-Prescribing impact on prescribing errors

Electronic prescribing (e-prescribing) is defined by NHS Connecting for Health in 2007 as "the utilisation of electronic systems to facilitate and enhance communication of a prescription or medicine order, aiding the choice, administration and supply of medicine through knowledge and decision support and providing a robust audit trail for the entire medicine use process" (NHS Connecting for Health 2007).

Two UK papers demonstrate the impact of e-prescribing on prescribing errors.

Data from Donyai et al highlighted a reduction in prescribing error frequency for inpatients following e-prescribing implementation (Donyai et al. 2008). They reviewed prescribing errors four weeks prior to and four weeks following e-prescribing implementation, with a reduction in clinical pharmacist interventions on one surgical ward (28 beds) from 3% of all prescribed items to 1.9% and prescribing errors reduced from 3.8% of prescribed items to 2%. The system implemented did not include an electronic discharge component.

The second study by Redwood et al explored the implementation of e-prescribing solutions on the nature of prescribing errors (Redwood et al. 2011). They analysed medicine related incident reports over a five month period in one UK hospital that had implemented an e-prescribing system. The study aimed primarily to detect if new error types, termed sociotechnical errors "occurring at the point where the system and the professional intersected and would not have occurred in the absence of the system" occurred. While they attributed 15% (n=73) of reported incidents as being sociotechnical, with almost half related to the failure to record electronic signatures. They acknowledged that a major limitation of their study was the known underreporting of medicine incidents.

The Health Foundation is an independent UK charity with the aim of improving the quality of healthcare to make lasting improvements. The two main priorities are patient safety and person centred-care. The Health Foundation produced an evidence scan in 2012 which focused on the reduction of prescribing errors (The Health Foundation 2012). While hospital electronic prescribing was identified as a key tool for reducing prescribing errors, they highlighted that change implementation may cause an initial drop in performance. Of note, incomplete communication of medicine information between care settings was identified as the highest cause of errors. They concluded that the implementation of e-prescribing systems with decision support could realise a 50% reduction in prescribing errors. One limitation of the evidence scan is that the majority of studies reviewed were based in the United States of America (USA) and hence not necessarily generalisable to UK systems and situations. Furthermore, no studies in this scan focused on discharge communication.

GOVERNMENT DIRECTION- STRATEGY AND E-STRATEGY

Both National Health Service (NHS) England and NHS Scotland have developed policies committing to HEPMA as a future e-health model in all secondary healthcare settings. In 2013, the Department of Health produced a £260 million investment plan to aim for the NHS in England to be paperless by 2018 (Department of Health 2013). The Scottish e-health strategy (2011 to 2017) produced by the Scottish Government and revised in 2012 recommends all Scottish health boards implement HEPMA (The Scottish Government 2012). They also recommend HEPMA connects to other IT clinical systems as outlined in Payne's SPICe Briefing in 2013(Payne and The National Health Service in Scotland. 2013). SPICe briefings are written by research specialists in the Scottish Parliament Information Centre (SPICe) and are used by Members of the Scottish Parliament to support parliamentary business. The e-health strategy for Scotland aims include "to maximise efficient working practices and to improve the safety of people taking medicines..." It states "the Scottish Parliament and Audit Scotland have urged the Scottish Government to roll out a HEPMA system across Scotland. HEPMA supports the prescribing, ordering, administration, reconciliation and supply of medicines, as well as supporting a robust audit trail."

E-prescribing toolkit

The NHS in England produced an e-prescribing toolkit in 2013 (NIHR Programme Grant for Applied Research 2013). The toolkit was created by a National Institute for Health Research (NIHR) funded e-prescribing research programme entitled" Investigating the implementation, adoption and effectiveness of e-prescribing systems in English hospitals: a mixed methods national evaluation". The study is "a multidisciplinary collaboration between the Universities of Edinburgh, Birmingham and Nottingham." The NIHR is funded through the Department of Health in England to "improve the health and wealth of the nation through research". The e-prescribing toolkit was "designed to support NHS hospitals in the planning implementation and use of e-prescribing and medicines administration systems, the toolkit offers you tools, resources and information to help you every step of the way". The toolkit consists of the following sections: planner; case study showcases; tools; interact; quick references; and news and documents.

The toolkit states that e-prescribing systems "can eliminate or reduce certain types of prescribing errors, and alerts users to potential dangers but they cannot replace sound clinical judgement. There is a need to understand that these systems can lead to the introduction of new errors..."

The research programme consists of four separate phases

1. Qualitative case studies of implementation and adoption
2. Quantitative assessment of prescribing safety before and after implementation
3. Health economic analyses of the implementation
4. Best practice recommendations and a toolkit for the NHS

This toolkit provides information about planning, system choice, business case creation and implementation advice but includes limited evaluation tools for organisations to use when undertaking system evaluation.

The e-prescribing toolkit website provides information in the form of PowerPoint presentations and published papers on error measurement, with a strong focus on safety culture. A document, prepared by NHS England,

outlines the assessment of benefits of system implementation in terms of quality/effectiveness, financial or efficiency with each benefit potentially fitting into more than one category (Slee 2014).

In relation to patient hospital discharge prescribing, benefits are stated as:

1. Reduction in prescribing errors due to removal of transcription process from inpatient to discharge prescription
2. Improvement in legibility and completeness
3. Improvement in process completion
4. Improvements in timeliness and accuracy of information communication to GPs
5. Improved communication as "integrate admission medication history into discharge summary"

Proposed measures to demonstrate these benefits are respectively:

1. Audit of transcription prescribing errors or near misses before and after implementation
2. Before and after audit of prescriptions
3. Number of complaints and compliance with Royal Pharmaceutical Society (RPS) standards (Picton and Wright2012)
4. Number of complaints/incidents before and after and compliance with RPS standards
5. Before and after user survey and compliance with RPS standards

A key limitation is the minimal attention placed on discharge.

HEPMA implementation good practice guide

Healthcare Improvement Scotland (HIS) published a good practice guide for HEPMA implementation in April 2014 (Healthcare Improvement Scotland 2014a). HIS is a national body which supports Scottish healthcare professionals obtain and use the best advances in medicines, technology and medical practice to improve the quality of healthcare. HIS works to support Scottish Government priorities and produces advice, guidance and standards. This Scottish good practice guide was commissioned by the Scottish Government to overcome identified inhibitors for HEPMA implementation including "clinical risks due to inadequate system or poor implementation".

The aim is "to support safe and consistent implementation and provide information and tools for implementation". It focuses on three specific areas: governance and risk management, leadership and organisational change and technology. This document articulates that HEPMA systems need to be at least as safe as the traditional paper systems and provides certain safety requirements with the goal of improving patient safety relating to medicine prescribing and administration.

This publication does not provide explicit evaluation guidance for assessing the impact of HEPMA implementation on discharge information communication.

DISCHARGE INFORMATION GUIDANCE

Guidance on hospital discharge documentation requirements are provided by two UK bodies which are applicable to the NHS in Scotland.

Royal Pharmaceutical Society Guidance

RPS published recommendations in June 2012 focusing on the accuracy of medicine information when patients move between different care settings (Picton and Wright 2012). These recommendations highlight the frequency of changes made to patients' medicines during hospital admissions. Data from the National Patient Safety Association are cited, with 30 to 70% of patients experiencing an error on hospital admission during the initial medicine reconciliation process (National Institute for Health and Clinical Excellence and National Patient Safety Association 2007). The RPS guidance proposes core content for medicine information communication on hospital discharge, which includes a mandatory requirement for information about any medicine changes during hospital inpatient stays to be recorded in electronic discharge communication.

SIGN Guideline 128

The Scottish Intercollegiate Guideline Network (SIGN) produced national guidance to define the ideal content of hospital discharge documentation (Scottish Intercollegiate Guidelines Network (SIGN) 2012). The current version is the third iteration of guidance relating to hospital discharge documentation. It provides additional recommendations to improve the quality of timely discharge information communication, taking into consideration

changes to electronic production and transmission of discharge letters and medicine reconciliation requirements.

The guidance applies to patients discharged from hospital after an inpatient stay of greater than 24 hours, excluding patients in mental health wards. It states the minimum requirements for essential information and, while it is intended primarily for healthcare professionals, a copy may be provided to patients and carers.

It also specifies a core discharge document (CDD) to replace the IDL which is mandatorily produced for every patient on their discharge day. The CDD alone will suffice for patients with straightforward hospital stays. More complicated patients will require an additional extended discharge document (EDD) which should ideally be communicated within seven days of patient's discharge and no later than 14 days post-discharge. The CDD and EDD should be produced by the multidisciplinary team, including pharmacy input. Where the CDD is the only discharge communication, the letter should be countersigned by the patient's hospital consultant or a locally designated senior doctor at time of discharge. In circumstances where senior doctors are not available at discharge point, a countersigned letter must be sent within seven days of patient's discharge.

The guidance provides a template with 29 required sections with notes provided to aid completion of the CDD.

A summary of the key points from SIGN 128 is included in Appendix 1.5.

Medicine reconciliation

A review of hospital discharge information communication would be incomplete without mention of medicine reconciliation.

Medicine reconciliation (MR) is a crucial component of the hospital discharge process. Medicine reconciliation is defined in NHS Scotland as "the process that the healthcare team undertakes to ensure that the list of medication, both prescribed and over-the-counter, that I am taking is exactly the same as the list that I or my carers, GP, community pharmacist and hospital team have. This is achieved in partnership with me through obtaining an up-to-date and accurate medication list that has been compared with the most recently

available information and has documented any discrepancies, changes, deletions or additions resulting in a complete list of medicines accurately communicated" (The Scottish Government 2013). Failure to complete MR on discharge may result in errors.

HEPMA implementation may facilitate the MR discharge process. If a medicine is discontinued during the inpatient stay the prescriber will be forced to document the reason for the discontinuation. This is achieved by mandatory completion of a dropdown box pre-populated with a list of discontinue choices. This information will be transferred onto the discharge letter and there is scope to add additional "free text" information if required. Appendices 1.6 and 1.7 provide screenshots to demonstrate the MR functionality provided by HEPMA for discharge communication.

Analysis of discharge MR is beyond the scope of the proposed DPP research.

HEPMA BACKGROUND

A report commissioned by NHS Connecting for Health in England states that "e-prescribing systems will change how people work" and indicates that some tasks are more rigid requiring complete compliance and limiting options (Cornford et al. 2009). They predict that HEPMA implementation will permit simple and direct discharge prescription production. It should be noted that they suggest that hospital staff will develop "work-rounds" to get work done quickly and simply which may be helpful or may actually compromise safety.

While there is a clear need for a multi-perspective research evaluation of HEPMA implementation, there is a lack of published formal evaluation which relates to UK hospitals.

A review of systematic reviews of all e-health solution implementations published between 1997 and 2010 was undertaken by Black et al (Black et al. 2011). They included 108 systematic reviews in total with 28 papers focusing on e-prescribing assessment. They highlighted that the available literature is of low quality in relation to methodology and outcomes and that often these systems are heralded as solutions with minimal or no data to support these claims. Whilst e-prescribing solutions are reviewed, they did not differentiate between systems in primary and secondary care or between systems in adult

or paediatric populations. Neither a fully integrated HEPMA system nor discharge communication was reviewed in any of the studies. The review highlighted system design as being crucial. The system should be easy to use with adequate training provided for users or unsafe workarounds and an increase in prescribing errors will result. They highlighted a concern that the amount of published evidence is low and expressed disquiet at the thought that negative findings may not be published due to the cost of implementing such systems.

A later systematic review by Motamedi et al, published in 2011 into the effectiveness of computer generated discharge summaries compared to handwritten letters advocated the need for further research of IT communication systems versus traditional systems. They advised that organisations implementing such systems should undertake formal evaluations of these systems (Motamedi et al. 2011).

HEPMA IMPLEMENTATION SURVEY OF NHS ENGLAND

McLeod et al conducted a postal questionnaire survey in 2011 to review progress with HEPMA implementation in all NHS Hospitals in England (McLeod et al. 2014). Results highlighted HEPMA implementation as being sporadic, with only 13% (n=100) of replying hospitals (response rate 61%) having completed HEPMA implementation in 'most' inpatient wards. These results are confirmed by 2012 survey by with results demonstrating low implementation rates, as only 7% (n=168) of replying English hospitals (response rate 79%) had implemented any e-prescribing solution (Cresswell et al. 2013). At publication time there were a further 20% (n=168) of hospitals completing some stage of implementation with a further 55% (n=168) in the planning or procuring process. Many hospitals were either implementing or considering implementation of systems falling short of full HEPMA implementation for example a separate discharge module which may be integrated into a full HEPMA system at a later stage.

Mozaffar et al in 2013 noted a marked variation in types of HEPMA systems in use in English NHS hospitals (Mozaffar et al. 2014). They highlighted the number (17) of available options for e-prescribing systems ranging from

commercially available to bespoke systems, and acknowledged low implementation in English Hospitals.

LOCAL SETTING AND CONTEXT

Ayrshire and Arran Health Board serves a population of 367,000 (7.3% of the Scottish population) and consists of two District General Hospitals (DGH), University Hospital Ayr (UHA) and University Hospital Crosshouse (UHC), with 318 General Practitioners (GPs) working in 57 different practices.

University Hospital Ayr is a 350 bedded DGH which has had a HEPMA system implemented gradually since 1995.

The doctoral research was conducted at University Hospital Crosshouse (UHC), a 560 bedded DGH (NHS Ayrshire and Arran). Services provided from UHC include general medicine, general surgery, orthopaedics, gynaecology, ear, nose and throat, oncology, mental health, maternity and paediatric inpatient wards. The initial implementation of HEPMA at UHC commenced in October 2013 into the Intensive Therapy Unit. The planned progression of implementation into surgical wards in November 2013 was delayed due to a significant information technology (IT) incident at NHS Greater Glasgow and Clyde in early October 2013.The local Stop Press information notice is provided in Appendix 1.8 (NHS Ayrshire and Arran 2013). The NHS Ayrshire and Arran Corporate Management Team decided to delay any planned implementation of IT systems until the cause of these problems was determined and resolved. The implementation resumed in March 2014, in surgical wards followed by medical wards being completed in September 2014.

HEPMA Implementation in NHS Ayrshire and Arran

The driver for HEPMA implementation in NHS Ayrshire and Arran (and indeed globally) is to improve patient safety.

The initial clinical sponsor for the HEPMA project was the then South Ayrshire NHS Trust Drug & Therapeutics Committee. Clinical ownership was considered an essential component of this project. The Clinical Champion was the Chief Pharmacist.

The main drivers for the implementation were:

- To achieve compliance with the standards for prescription writing.

(Repeated unpublished audits having highlighted a range of issues associated with poor prescription writing).

- To reduce prescribing non conformances and opportunity for misadventure
- To reduce administration non conformances and opportunity for misadventure
- To link prescribing and administration to dispensing and supply
- To provide a typed, legible and validated immediate discharge letter
- To support further clinical audit

Reducing prescribing errors was of key significance especially errors related to poor handwriting and cluttered and untidy prescription charts. Concerns had been raised by GPs about the quality, content, information accuracy and timeliness of receipt of discharge information.

The initial implementation of HEPMA into UHA offered the following functionalities:

- paperless electronic prescribing
- prescribing protocol management
- paperless nurse administration with full charting
- pre admission module
- generation of an immediate discharge letter compliant with the mandatory requirements and some desirable requirements of national guidelines
- automatic linkage to pharmacy dispensing and procurement
- clinical decision support (not switched on due to system immaturity)

The HEPMA system chosen for implementation into UHC is the same commercially available standalone system that has been refined since the initial implementation in UHA. The system consists of both inpatient and discharge e-prescribing documentation.

Notably, HEPMA includes allergy information with limited decision support (allergy information, drug-drug interactions and therapeutic duplications). There is still a requirement for paper prescribing charts for infusions and complex medicines, for example insulin.

The doctoral research focuses on HEPMA implementation in relation to aspects of the hospital discharge process. Prior to HEPMA implementation, there was a clear need to improve the quality of prescribing of medicines generally and specifically in relation to discharge. A recent audit conducted at UHC in September 2012 (unpublished data) reviewed one week of immediate discharge letters completed by Foundation Year 1 (FY1) junior doctors. The FY1 doctors had completed letters for 77 patients, prescribed 372 items with 1,134 identified errors by the investigating team of pharmacists and hospital consultants.

Pre HEPMA Implementation

The IDL traditionally used in Ayrshire and Arran prior to HEPMA implementation is included in Appendix 1.3.

This document consists of designated sections for diagnosis, investigations and medicines, providing both communication and a prescription. Frequently amendments are made to the IDL by pharmacists to allow for legal and dispensing requirements. The traditional IDL consists of multiple carbon copies therefore any changes made in pharmacy applies to all copies. Although an audit trail of change exists on the IDL, it may be difficult to identify individual practitioners due to poor documentation of prescribing or dispensing information. A copy of the IDL is held in pharmacy, the patient's notes and passed to the patient's GP, either via the patient or by post. This traditional version is not fully compliant with the SIGN guidelines standards (Scottish Intercollegiate Guidelines Network (SIGN) 2012).

HEPMA version

The HEPMA version of the discharge document is included in Appendix 1.4. To create the discharge document, the medicine information is pre-populated with each medicine currently prescribed on the inpatient chart. Thereafter, each medicine must be selected individually by the prescriber to ensure that the medicine is appropriate to be continued on discharge. The prescriber may alter the required duration of each medicine and must indicate if each individual medicine should be continued by the patient' GP after hospital discharge. Additional medicines may be also added at this stage.

PROCESSES FOR DISCHARGE COMMUNICATION

Local traditional process

The traditional method of discharge communication (which is not compliant with most recent SIGN guidelines) consists of two documents: the Immediate Discharge Letter (IDL) and the Final Typed Letter (FL).

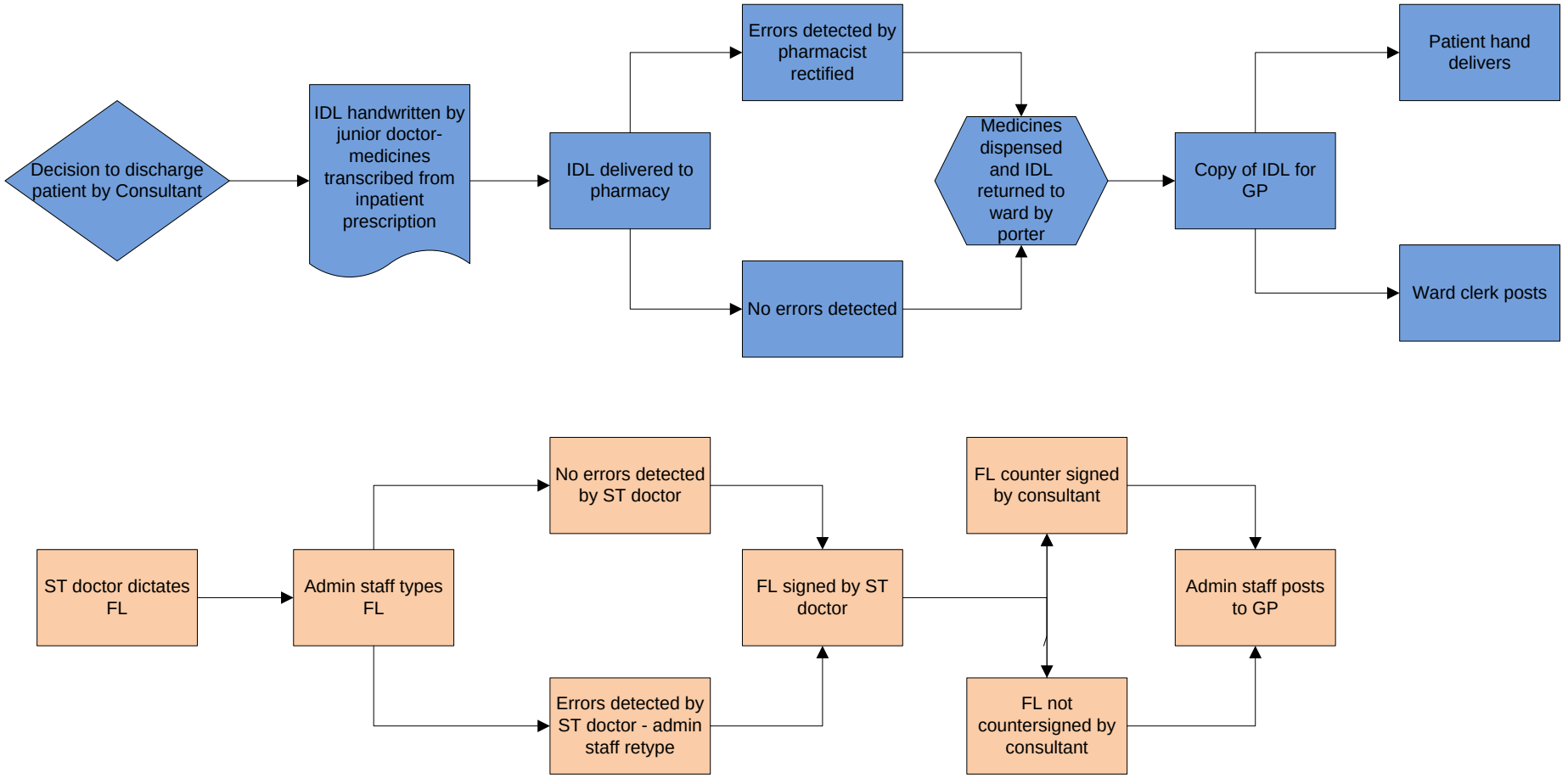
In NHS Ayrshire and Arran, pre-HEPMA implementation, the IDL is completed by a junior doctor who is completing postgraduate training (Foundation Year 1 or Foundation Year 2), without any input from senior colleagues. The IDL is a handwritten document as outlined in the template included in Appendix 1.3. The only exception to handwritten completion is for the patient demographic information which may be completed by adding a pre-printed label.

The IDL is followed by a more complete typed communication, the typed FL which provides detailed information about the patient's hospital stay and ideally should be sent within a week of the patient's discharge date (Scottish Intercollegiate Guidelines Network (SIGN) 2012). A more senior doctor i.e. completing specialist training (ST) grade or above (rarely hospital consultants) is usually responsible for completing the FL.

The process involves the doctor dictating the letter, being typed by administration staff, signing by the doctor, return to administration staff, countersigning by the consultant (or 'per procurationem' by administration staff), and then posted to the GP. It should be noted the local process for posting letters is not by Royal Mail delivery but by use of routine laboratory van deliveries. There may be delays at any or all parts of this process. Thus there may be time delays of several weeks or months for the FL to reach the patient's GP.

Local data (unpublished) for one clinical area gives median time from patient discharge to FL being posted of 11 days (range 2 to 41).

Figure 1.1 depicts the traditional discharge letter communication in NHS Ayrshire and Arran



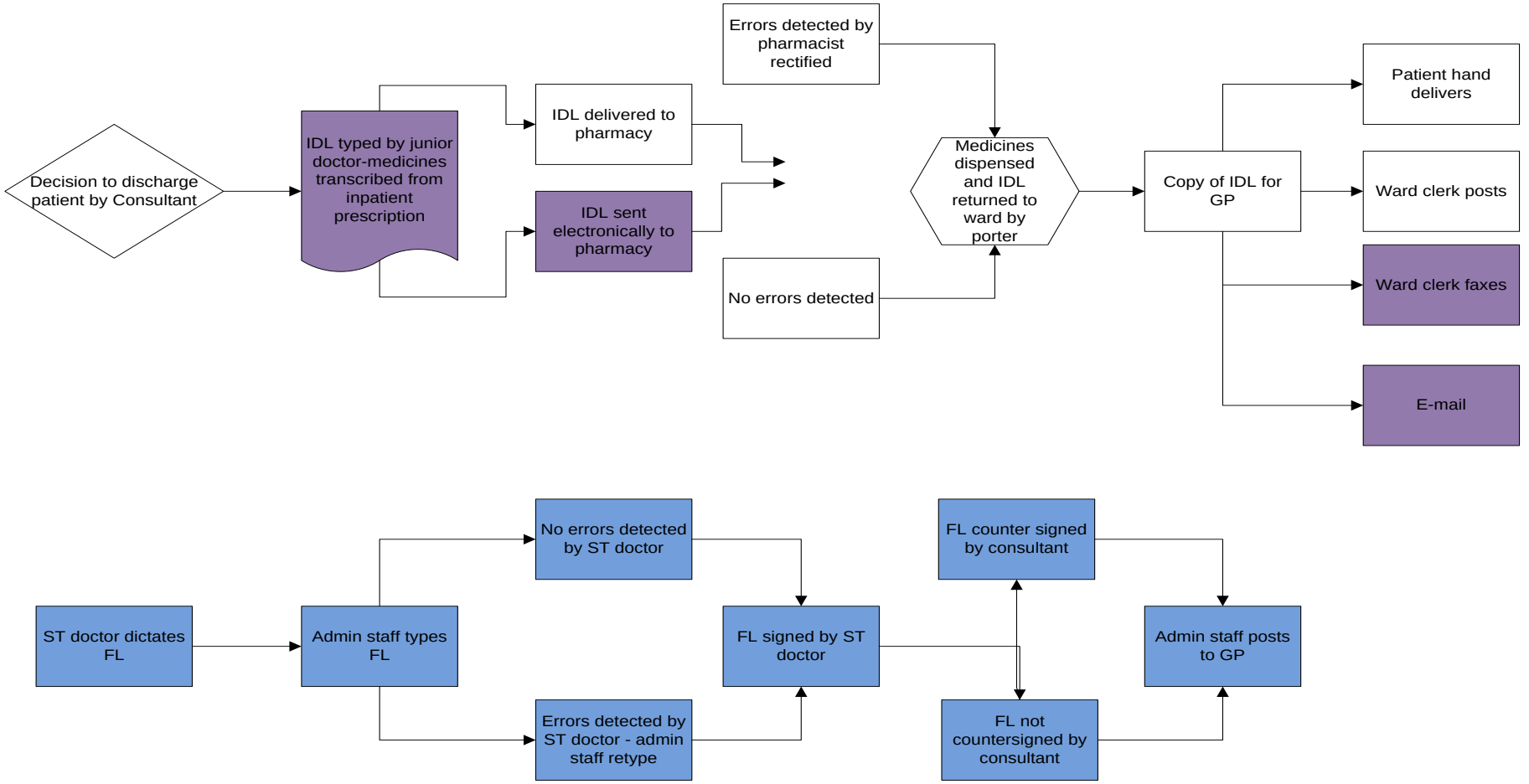
Blue- Immediate Discharge Letter Orange- Final Letter

Figure 1.1 Traditional (paper based handwritten) Local Process Map

Interim solutions

Advances in IT have permitted changes to this traditional method. Prescribing systems have evolved nationally and globally over time. Due to the complexity of implementing a fully integrated HEPMA system, some NHS organisations and international healthcare systems have made changes to both the inpatient and discharge prescription documentation. They have implemented various interim processes, harnessing electronic solutions that fall short of full HEPMA implementation. Several countries, including the UK, have produced electronic immediate discharge letters which still require information transcription from inpatient prescription charts. These electronic letters may be sent to GP by different methods including fax and e-mail as well as by the traditional methods of patient delivery or post (Chen, Brennan and Magrabi 2010, Scullard et al. 2007).

Other interim solutions have concentrated on electronic implementation of documentation on hospital admission for example medicine reconciliation documentation. This information is not used as part of the inpatient prescription chart but may be used to pre-populate the medicine component of the discharge letter. Figure 1.2 depicts interim electronic solutions.



White- Traditional; Purple – Electronic; Blue FL (may become redundant with some interim systems)

Figure 1.2 Process map of national and international interim solutions

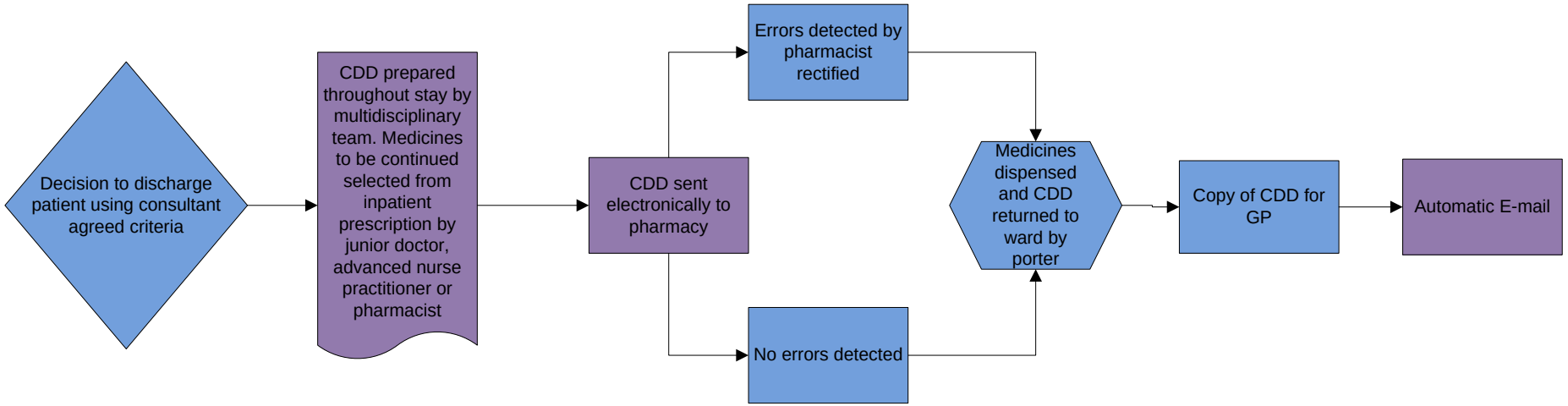
Proposed HEPMA plus electronic transmission solution

The implementation of HEPMA ensures electronic generation of IDLs, which may be electronically transmitted to GP surgeries by use of facsimile or secure e-mail. The IDL may be compiled throughout the patient's hospital stay, with the possibility of senior medical input during this process. The HEPMA system negates the need for medicine transcription from the inpatient prescription sheet to the IDL, a recognised cause of prescribing errors. The creation of the discharge document throughout the patient stay facilitates the change from the IDL followed by FL, to the CDD and negates the need for a further typed discharge letter, especially for patients with short hospital stays.

The HEPMA process is provided in Figure 1.3.

Other changes in healthcare systems have occurred simultaneously. This is especially related to changed roles for healthcare professionals as a result of changes due to modernising medical careers (Scottish Executive and Department of Health 2004). Whilst the consultant remains accountable for the care of their allocated patients, changes to the way doctors and other healthcare professionals are trained in the UK, has resulted in other members of the healthcare team assuming responsibility for tasks that would traditionally be associated with junior doctors for example non-medical prescribing.

Thus the change to the discharge process provided in Figure 1.3 also depicts the evolution in roles of the hospital multidisciplinary team as well as HEPMA implementation.



The purple box denotes use of HEPMA and IT

Figure 1.3 Process Map for full HEPMA system (NHS Ayrshire and Arran)

NARRATIVE LITERATURE REVIEW

A narrative review was undertaken of the literature on the communication of discharge information to GPs.

The search was conducted using the Knowledge Network of NHS Scotland electronic database which incorporates MEDLINE, EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Applied Social Sciences Index and Abstracts (ASSIA) databases. These provided coverage of: medical and healthcare topics; nursing midwifery and allied healthcare topics; and health and social sciences respectively. The search was supplemented by RPS and International Pharmacy Abstracts databases to encompass relevant pharmaceutical literature. The search terms used were: hospital discharge information communication; electronic hospital discharge letters; hospital electronic prescribing information communication; electronic discharge medicine information; integrated care information communication to GPs; seamless care information communication to GPs; and e-prescribing discharge information. Papers were included if they were published in the English language, from 2000 onwards, and reporting data from the UK, or countries with similar healthcare systems.

Results of literature review

There is a lack of a published systematic review of the prevalence and causes of prescribing errors at the point of patient discharge from hospital. Kripalani et al completed a systematic review, published in 2007, which assessed communication gaps on any type of discharge information communication including handwritten and typed letters and/or summaries (Kripalani et al. 2007). They reviewed 213 articles in total, with 83 included for data extraction. The review mainly involved studies in American settings and did not focus on prescribing errors. They identified missing information including medicine information as problematic.

This section therefore describes primary studies of published literature.

Fifteen papers were identified and reviewed, none of which reported post-HEPMA implementation. Table 1.1 provides details of study, setting, aim design and key findings.

Table 1.1 Descriptions of studies

Authors Publication Year	Country	Setting	Aim	Design (Study type)	Outcome Measures	Sample size	Key Findings	Key Limitations
Sexton J, Ho YJ, Green CF, and Caldwell NA. 2000	UK	UK survey	To assess hospital pharmacy service provision for hospital discharge	Postal survey of UK Chief Pharmacists	Grade of staff preparing IDLs; communication method; format of communication	153/222 (73.4%)	Junior doctors prepared nearly all IDLs. Only 10% of hospitals electronically prepared IDLs. Only 9% of respondents communicated medicine changes on discharge.	Survey conducted in 1999 so information quite dated.
Wilson S, Ruscoe W, Chapman M, and Miller R. 2001	Australia	Medical, surgical, elderly, gynaecology and paediatric from one hospital	To assess information accuracy and GP receipt time of hospital IDLs, and GP opinion of the process	Retrospective audit; semi-structured GP interviews	Receipt time; information content; accuracy of medicine information; GP opinions	569 (5% sample) of patients 20 GPs	27% GPs received IDLs; IDLS assessed as 64% accurate; medicine information errors in 17.5% of IDLs included incorrect medicine, omitted medicines and inaccuracy of dose or frequency; GPs preferred faxed communication method	Includes paediatric patients who are prescribed fewer medicines than adults. Transcription errors not considered. Breakdown of medicine error types not reported. Patients mainly delivered IDLs which is not consistent with other studies. Small number of IDLs received by GPs which limits usefulness of GP opinion data Use of extrapolated data to determine percentage receipt by GP which may be inaccurate.
Foster DS, Paterson C and Fairfield G. 2002	Scotland	Patients discharged from hospital to 4 GP practices (35000 patients)	To assess information content of IDLs and receipt time of IDLs by GP surgeries	Retrospective audit SIGN 5 (Sign 5 superseded by SIGN 128)	Receipt time; information content	244 IDLs (28 days)	Basic information missing in 30% of letters. 93% contained medicine information. 60% received within 5 days of patients' hospital discharge.	SIGN criteria now superseded. Validity of all information not assessed; if data were present it was deemed sufficient. Neither accuracy assessment of medicine information nor consideration of transcription errors.
Pillai A, Thomas SS and Garg M. 2004	UK	GPs in one Scottish Health Board area	To assess GP opinion about quality and accuracy of electronic IDLs	Postal survey GPs	Information content; number of communications; GP opinions	28/40 (70%) receiving electronic version; 67/96 (70%) will receive electronic version in future	Accuracy and completeness of information was perceived most important to GPs(n=28). GPs tended not to rely solely on electronic immediate version and wanted final version too.	One health board area. Restricted to GPs using electronic systems- different survey for those not receiving electronic version. No evaluation of transcription errors as cause of errors on the electronic IDLs.

Author Publication Year	Country	Setting	Aim	Design (Study type)	Outcome Measures	Sample size	Key Findings	Key Limitations
McMillan TE, Allan W and Black PN 2006	New Zealand	Medical, surgical patients from one hospital	To assess medicine error frequency and type on IDLs	Retrospective audit	Accuracy of medicine information; potential patient harm	100 medical 100 surgical	0.81 errors per surgical IDL and 1.42 errors per medical IDL. 50% of errors were classified as minor with 13% classified as either potentially serious or likely to cause readmission.	Only assessed handwritten inpatient and discharge documentation. Small number of patients so lack of generalisability. Validated severity scoring tool not used.
Alderton M and Callen J. 2007	Australia	General medical, elderly wards, 75 bed hospital	To assess GP opinion regarding information quality and receipt time of electronic IDLs	GP survey	Receipt time; Information content; GP opinion	54/85 (64%)	93% preferred electronic to handwritten version. 83% of IDLs received within 2 weeks. 76% very satisfied with medicine information. Future preference for electronic communication.	Small hospital. Individual doctor variation in completing IDLs. Acknowledgment of transcription of medicine information but not assessed as potential error source. Electronic IDL not sent electronically but by post.
Scullard P, Iqbal N, White L, Olla E and Thomson GA. 2007	UK	Hospital type not stated	To assess information content of traditional handwritten IDLs and typed FLs with an electronic summary alone using SIGN guideline criteria	Retrospective audit; GP survey	Information content and accuracy; GP opinions	30 patients	The electronic summary met 82% of criteria versus 62% for traditional method. 83% of GPs preferred electronic version.	Small sample size of 30 patients selected randomly but no randomisation information provided so potential lack of generalisability. Transcription errors not considered. Accuracy of medicine information not assessed. Process for version control of IDLs not considered.
Callen JL, Alderton M McIntosh J. 2008	Australia	Unknown	To compare handwritten and electronic IDLs for information content and accuracy	Retrospective audit	Information content; Accuracy of medicine information	Control 94 (38%) Intervention 151(62%)	Electronic IDLs contained more errors or omissions than handwritten ones 87.4% of electronic IDLs were assessed as having accurate medicine information versus 93.6% of handwritten ones	Incorrect information discounted if documented in incorrect section. Completeness and accuracy of information only assessed for medicine information. Not calculation of sample size. No information about patient demographics or number of medicines.

Authors Publication Year	Country	Setting	Aim	Design (Study type)	Outcome Measures	Sample size	Key Findings	Key Limitations
Grimes T, Delaney T, Duggan C, Kelly JG, Graham IM 2008	Ireland	Cardiology patients in four medical wards in a teaching hospital	To assess the accuracy of medicine information on discharge documents and to correlate discrepancies with patient harm	Retrospective audit	Accuracy medicine information; potential patient harm	139 patients	65.5% of patients had at least one identified error on discharge documents. Errors in 10.8% prescribed items. Medicine omission most common error (21% of patients). No errors assessed with potential for severe patient harm; 53% moderate and 47% none or minor harm.	Only assessed handwritten inpatient and discharge documentation. Have a separate discharge prescription document and discharge summary document in Ireland. Small number of patients so lack of generalisability.
Witherington EMA, Pirzada OM, and Avery AJ. 2008	UK	Elderly patients, one district general hospital	To assess discharge information availability and content for patients readmitted to hospital within 28 days, and if lack of information or content contributed to readmission	Retrospective audit	Information content and availability; accuracy of medicine information; preventable readmissions	141 patients	96% of patient had IDLs available but 62% of patients were readmitted without FL being completed. 38% of readmissions were medicine related of which 61% were preventable. 18% of IDLs omitted medicines and only 71% had information about medicine changes.	Study only in patients aged 75 and over who were readmitted to hospital therefore potential lack of generalisability Accuracy of admission medicine information unknown and GP processes for IDL unknown. Multiple causes for hospital readmissions.
Abdel-Qader DH, Harper L, Cantrill JA, and Tully MP. 2010	UK	Medical and elderly care patients, one teaching hospital (904 beds)	To assess the number of prescribing errors on e-prescribing discharge prescriptions detected by pharmacists during usual validation practice and to determine error severity.	Retrospective observational interrupted time sequence	Number and type of pharmacist identified prescribing errors; error severity assessment	1038 patients 7290 prescribed items	Error rate 8.4% per prescribed item. Errors were medicine omission 31%; medicine choice 29.4%; dose error 18.1%. Error severity assessment: serious 2.9%; significant 76.3% and minor 20.8%. Sociotechnical errors 44.3% but lower error severity than non sociotechnical errors. Four prescribing errors occurred per hour. High risk medicines 33% of errors.	Short time duration (4 weeks). Error severity assessment by pharmacist alone and not multidisciplinary. Pharmacists aware of study so potential Hawthorne effect. Only medical and elderly care so a lack of generalisability to other populations.

Authors Publication Year	Country	Setting	Aim	Design (Study type)	Outcome Measures	Sample size	Key Findings	Key Limitations
Callen J, McIntosh J, and Li J. 2010	Australia	Elderly ward, 78 bed hospital	To compare transcription errors on handwritten and electronic IDLs and assess medicine information in relation to grade of staff preparing document	Retrospective audit	Accuracy of medicine information; potential patient harm	966 Handwritten 842 Electronic	Transcription errors common Medicine omissions most common error 12% handwritten and 11% electronic No statically significant error difference between doctor grade and errors	Only elderly patients who tend to be on more medicines than average population. Lack of generalisabiliy of study data to other populations and countries. No assessment of errors on patient outcome i.e. actual or potential patient harm.
Chen Y, Brennan N, and Magrabi F. 2010	Australia	Elderly ward, 300 bed teaching hospital	To assess effectiveness of IDL communication by different delivery methods	Blinded randomised controlled trial; GP survey	Receipt by GP practice within 7 days following hospital discharge; GP opinions	Control 63 RCT 168: email 40, fax 48, post 40, patient 40; GP n=52	Electronic delivery methods [fax (69.4%) or email(73.9%)] proved more effective than post (43.8%) or patient delivery (24.2%) GPs preferred fax	Small study in one ward in Australia so potential lack of generalisability. Study restricted to elderly patients so not directly comparable to general population. Not all GP surgeries had IT equipment available to receive secure e-mail communication.
Hammad EA Wright DJ Nunney I and Battacharya 2014	UK	Patients discharged from hospital to one English primary care area (91 GP practices)	To assess information content of IDLs against a recommended minimum dataset and assess compliance with medicine information	Retrospective review of IDLs	Full data set compliance; medicine information compliance; medicine change compliance; legibility	3444 IDLs from 12 hospitals audited by 84 GP practices	Total data set compliance: electronic 73.7% versus handwritten 67% Medicine information: electronic 67.2% compliant versus handwritten 54.8% Medicines changes: electronic 50.9% compliant versus handwritten 40.2% 47% handwritten legible.	Dataset applies to England so potential lack of generalisability. Assessment in primary care so would not have access to inpatient prescriptions. Accuracy of medicine information recorded as pass or fail so detail not assessed.
Yemm R, Bhattacharya D, Wright D, and Poland F. 2014	UK	600 bed district general hospital 43 GP practices (325,000 patients)	To assess opinion of hospital junior doctors and GPs in relation to discharge letter content	Survey	Ideal receipt time of IDLs; content accuracy assessed by GPs; importance of content and features of IDLs	36 junior doctors, 42 GPs	GPs wanted IDLs within 24 hours of patients discharge but 59% would wait longer for improved accuracy. 15% IDLs contained inaccuracies needing GP rectification. Information accuracy was top priority with both GPs (72%) and junior doctors (88%).	Small sample size GPs receive only electronic letters so results may not be applicable to handwritten or HEPMA systems. One area of UK so potential lack of generalisability.

Analysis of results
HEPMA systems were not being used in any of these studies.

Key findings and results are described under the following three headings:

1. Studies investigating the traditional paper handwritten system
2. Studies comparing electronic interim solutions to traditional paper handwritten system
3. Studies investigating solely electronic interim solutions

Traditional handwritten systems
Six studies investigated traditional communication methods (Sexton et al. 2000, Wilson et al. 2001, Foster, Paterson and Fairfield 2002, McMillan, Allan and Black 2006, Grimes et al. 2008, Witherington, Pirzada and Avery 2008). The majority were retrospective audits (Wilson et al. 2001, Foster, Paterson and Fairfield 2002, McMillan, Allan and Black 2006, Grimes et al. 2008, Witherington, Pirzada and Avery 2008), one survey(Sexton et al. 2000) and one using a qualitative approach of semi-structured interviews (Wilson et al. 2001). Details of key findings are provided in Table 1.2, clearly demonstrating the high prevalence of errors (medicine information assessed as 64-66% inaccurate) combined with delays in receipt of communication (60% received within 5 days and 66% assessed received in time for effective patient care). Furthermore, it is evident that few studies fully researched all aspects of communication with limited assessment of potential patient harm.

The following key findings and results were obtained from the studies:

Information Content and Accuracy
Information accuracy and completeness was not researched in all studies. Different methods and outcome measures related to the assessment of content and accuracy were adopted. Inadequate information (in terms of both content and accuracy) was found in all sections of both IDLs and FLs with an accuracy rate of 63.6% (Wilson et al. 2001).

Medicine Information Accuracy

Errors were common and included inaccurate medicines information with 10.8% errors per prescribed item or 66% of patients (Grimes et al. 2008), with omitted medicines (18-21%) (Wilson et al. 2001, Grimes et al. 2008, Witherington, Pirzada and Avery 2008) accounting for the most prevalent error type. The majority of patients (up to 86%) had medicine changes during inpatient stays (Witherington, Pirzada and Avery 2008), but these were not always communicated on hospital discharge (McMillan, Allan and Black 2006). More medicines changes occurred during medical than surgical stays (1.7 changes in medical patients and 0.59 changes in surgical patients), which may account for higher error rates detected (McMillan, Allan and Black 2006).

Legibility

There was high variability in the extent of communication deemed to be legible with up to 77% deemed as "mostly legible" (Wilson et al. 2001), with some authors noting that the measurement of legibility to be highly subjective.

Time to Receipt

Approaches to measurement varied from those subjective e.g. "timely as regards to effective patient management" with 66% success (Wilson et al. 2001) to more objective approaches e.g. being compared against a standard of five days for IDL (60%) and 28 days for FL (51%) (Foster, Paterson and Fairfield 2002). Results demonstrated inter-country differences, including differences in communication methods; in Australia delivery was mainly reliant on the patient whereas in the UK there was a combination of postal and patient delivery.

Patient Harm

Hospital readmissions due to medicine related problems were detected in 38% of patients but with uncertainty regarding the association between inaccurate communication and the potential to cause readmission (Witherington, Pirzada and Avery 2008). The population studied consisted of elderly patients who are more likely to be re-admitted due to significant co-morbidity, terminal illnesses and complex social problems irrespective of poor communication.

Table 1.2 Results of Studies of Traditional IDLs

Author Year	Country Population	Information content + accuracy	Medicine Information Accuracy	Receipt	Time to receipt	GP satisfaction	Number of Communications	Potential Patient Harm	Legibility	Communication Method	Grade of Staff
Sexton J, Ho YJ, Green CF, and Caldwell NA. 2000	UK	NA	NA	NA	NA	NA	NA	NA	NA	Only 9.9% electronic means, 19 different combinations	Junior doctors
Wilson S, Ruscoe W, Chapman M, and Miller R. 2001	Australia General	Errors all parts of document- 63.6% accuracy	36.4% med accuracy 21% no med info recorded	27.1%	66% for effective patient care	GP prefer fax	NA	NA	77% mostly legible or legible	NA	NA
Foster DS, Paterson C and Fairfield G. 2002	UK Unknown	20% no admission or discharge dates, 13% no diagnosis	NA	NA	60%IDL 5 days 51% FL 4 days	NA	NA	NA	39% legible signature	NA	NA
McMillan TE, Allan W and Black PN 2006	New Zealand Medical/ surgical	NA	More errors med(1.42) than surg (0.81) more changes	NA	NA	NA	NA	88% errors minor or potentially troublesome 1.8% may result readmission	NA	NA	NA
Grimes T, Delaney T, Duggan C, Kelly JG, Graham IM 2008	Ireland Cardiology	NA	Errors in 65.5% patients or in 10.8% per prescribed item	NA	NA	NA	NA	53% moderate harm; 47% none or minor harm.	NA	NA	NA
Witherington EMA, Pirzada OM, and Avery AJ. 2008	UK elderly	62% no FL on re-admission	Baseline 66% incomplete	NA	NA	NA	NA	⇔	NA	NA	NA

NA- not assessed; ⇔- communication error alone not responsible for patient harm

Comparison of traditional and interim electronic solutions

Four studies compared handwritten traditional methods with electronically prepared IDLs (Scullard et al. 2007, Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008, Hammad et al. 2014). All involved retrospective audits with one study including a survey of GPs (Scullard et al. 2007). Details of key findings and results are provided inTable1.3, which demonstrates variability in results among the studies especially in relation to errors and medicine information accuracy. Scullard et al and Hammad et al demonstrated an improvement in information accuracy using electronic systems with up to 82% completed accurately with electronic versus 62% with paper (Scullard et al. 2007, Hammad et al. 2014); whereas Callen, McIntosh et al showed no significance difference with an error rate of 12.1% with paper versus 13.3% for electronic although both systems required transcription (Callen J, McIntosh J and Li J 2010); and Callen, Alderton et al reported more errors with the electronic system with (13% versus 6% errors) with a free-format section being particularly problematic for errors (Callen, Alderton and McIntosh 2008).

The following key findings and results were obtained:

Information Content and Accuracy

Improved information content and accuracy was found when changing to a first and final electronic discharge letter (FFL) (Scullard et al. 2007, Hammad et al. 2014). On initial implementation a higher error rate was detected in the electronic version for all audited components which resolved with system integration (Callen, Alderton and McIntosh 2008). Scullard et al and Hammad et al demonstrated improved compliance of up to 82% with a minimum dataset when using electronic template (Scullard et al. 2007, Hammad et al. 2014).

Medicines Information Accuracy

There are inconsistent findings in relation to medicine accuracy. Studies found deterioration in accuracy from 6.4% handwritten prescribing errors to 12.6% with electronic version (Callen, Alderton and McIntosh 2008), no change in accuracy (13.3 % electronic medication errors versus 12.1% handwritten (Callen J, McIntosh J and Li J 2010) or improvement in accuracy from 54.8%

to 67.2% compliance (Scullard et al. 2007). Medicines omission was the commonest detected error type with an average error rate of 1.5 with paper versus 1.4 with electronic discharge letters with errors (Callen J, McIntosh J and Li J 2010).

GP Satisfaction

GPs preferred electronic versions of communication with standardised format and improved legibility cited as the main reasons (Callen, Alderton and McIntosh 2008, Hammad et al. 2014).

Number of Communications

Replacing the traditional documents (IDL followed by FL) with a FFL was acceptable and improved communication. This single communication was assessed as having sufficient information (Hammad et al. 2014).

Legibility

Changing to electronic discharge letters resulted in complete legibility (Hammad et al. 2014).

Grade of Staff

No significant difference was found in prescribing error rates for discharge letters being created by different grade of doctors although data not provided in the study to corroborate this claim (Hammad et al. 2014).

Table 1.3 Results of studies comparing handwritten and electronic IDLs

Author Year	Country Population	Information content + accuracy	Medicine Information Accuracy	Receipt	Time to receipt	GP satisfaction	Number of Communications	Potential Patient Harm	Legibility	Communication Method	Grade of Staff
Scullard P, Iqbal N, White L et al. 2007	UK unknown	electronic +	NA	NA	NA	electronic +	FFL alone +	NA	electronic +	NA	NA
Callen JL, Alderton M, McIntosh J. 2008	Australia unknown	electronic -	electronic -	NA	NA	electronic +	NA	NA	electronic +	NA	NA
Callen J, McIntosh J, and Li J. 2010	Australia Elderly	NA	⇔	NA	NA	NA	NA	NA	NA	NA	⇔
Hammad EA Wright DJ Nunney I and Battacharya 2014	UK General	electronic +	electronic +	NA	NA	NA	NA	NA	electronic +	NA	NA

NA- not assessed +- significantly improved - -significantly worse ⇔- no significance between groups

Results of studies of electronic immediate discharge letters

Five studies evaluated electronic immediate discharge letters, with the majority assessing delivery methods (Chen, Brennan and Magrabi 2010, Pillai, Thomas and Garg 2004, Alderton and Callen 2007, Abdel-Qader et al. 2010, Yemm et al. 2014). Four used survey approaches to gauge opinions (Chen, Brennan and Magrabi 2010, Pillai, Thomas and Garg 2004, Alderton and Callen 2007, Yemm et al. 2014), with one retrospective observational interrupted time sequence (Abdel-Qader et al. 2010); and one blinded randomised control trial (Chen, Brennan and Magrabi 2010). One study surveyed the requirements for IDLs from the perspectives of both GPs and hospital junior doctors (Yemm et al. 2014).

Details of key findings and results are provided in Table 1.4.

Information content and accuracy

Pillai et al found information accuracy and content to be at least as good as the previous system (Pillai, Thomas and Garg 2004); whilst Alderton et al identified that 93% of GPs surveyed noted enhancement with the electronic version (Alderton and Callen 2007). Accurate information was stated to be most important category on discharge communication for surveyed GPs (72%) and junior doctors (88%) (Yemm et al. 2014). This rated higher than comprehensiveness, timely receipt and grammatical accuracy.

Medication information

Prescribing errors were found to still occur with electronic systems, at an error rate of 8.4% per prescribed item. Errors categorised as sociotechnical errors (defined as an error unlikely to occur with handwritten charts) were associated with lower patient harm with 68% considered significant or serious versus 85% of non-sociotechnical errors (Abdel-Qader et al. 2010). Error severity was assessed using a five point scale as: potentially lethal; serious; significant; minor; or no error.

Receipt

Patient delivery, mail or electronic delivery methods failed to reach a target of 95% reliability for receipt within 1 week of hospital discharge. The slowest method was patient delivery with only 24% received within seven days (Chen, Brennan and Magrabi 2010).

Time to receipt

Electronic communication methods resulted in improvement in receipt times with 74% of emailed and 69% of faxed letters arriving within 7 days (Chen, Brennan and Magrabi 2010) and 80% of surveyed GPs stating that e-mailed letters had quicker receipt time (Pillai, Thomas and Garg 2004). GPs wanted IDLs within 24 hours of discharge but 59% would wait longer for improved accuracy (Yemm et al. 2014).

GP satisfaction

Electronic documentation resulted in improved satisfaction of GPs, with 93% reporting enhanced satisfaction compared to handwritten version (Alderton and Callen 2007).

Number of communications

Less than half (42%) of responding GPs agreed that an electronic FFL could replace the traditional process of the IDL followed by a typed FL (Pillai, Thomas and Garg 2004).

Communication methods

Almost all (83%) of responding GPs favoured electronic communication of IDLs rather than faxed receipt (Chen, Brennan and Magrabi 2010).

Table 1.4 Results of studies of electronic IDL

Author Year	Country Population	Information content + accuracy	Medicine Information Accuracy	Receipt	Time to receipt	GP satisfaction	Number of Communications	Potential Patient Harm	Legibility	Communication Method	Grade of Staff
Pillai A, Thomas SS and Garg M. 2004	UK General	⇔	NA	NA	electronic +	electronic +	electronic -/+ #	NA	NA	electronic +/- *	NA
Alderton M and Callen J. 2007	Australia General medical, elderly	electronic +	NA	NA	electronic +	electronic +	NA	NA	NA	NA	NA
Abdel-Qader DH, Harper L, Cantrill JA, and Tully MP. 2010	UK Medical, elderly care	NA	Electronic- still errors	NA	NA	NA	NA	+ Socio-technical errors less severe	NA	NA	NA
Chen Y, Brennan N, and Magrabi F. 2010	Australia Elderly	NA	NA	electronic +	electronic +	electronic +	NA	NA	NA	electronic +	NA
Yemm R, Bhattacharya D, Wright D, and Poland F. 2014	UK General	NA	Accuracy main concern (72%GPs and 88% junior doctors)	NA	NA	electronic +	NA	NA	NA	NA	NA

NA- not assessed +- significantly improved - -significantly worse ⇔- no significance between groups

58% actually receiving GPs disagreed with 78% potentially receiving agreeing

* status quo favoured by actually receiving GPs whilst potentially receiving favoured electronic version

Conclusion

Advantages ascribed to electronic solutions include improved legibility, information content accuracy, speed of transmission and GP satisfaction. The noted improvement in legibility does not necessarily concurrently improve information accuracy.

Previous studies have highlighted the importance of accurate communication of information including medicine information at patients' hospital discharge. None of the studies could equate patient harm with miscommunication and errors in discharge information.

GAPS IN LITERATURE

There is a paucity of literature regarding evaluation of HEPMA implementation. Policy documents and government strategies recommend systems implementation as solutions to reduce prescribing errors and improve communication, but with little evidence to support these claims. Seidling et al describe collaborative research in three European countries (Germany, Switzerland and Austria) and emphasise that IT solutions need to be infiltrated into existing working systems and people then need to modify behaviour accordingly (Seidling et al. 2013). A limited number of studies have reviewed the impact of such solutions on communication of discharge information and none have encompassed HEPMA implementation. Most of the published literature has focused on interim solutions which still require transcription from a paper inpatient chart to an electronic discharge document.

Concern has been expressed over the lack of publications relating to HEPMA implementation and that perhaps unfavourable data may be leading to a negative publication bias. There is therefore an urgent need for evaluative research to focus on the impact of HEPMA implementation, specifically relating to discharge communication.

The majority of survey studies have focused on the GP perspective although interestingly one recent study also considered hospital doctors perspectives. Research of the hospital perspective initially to ensure that prescribing systems are working well there and to assess staff satisfaction with the prescribing tools available would provide additional insight to this complex area.

This study will be important to identify the impact of HEPMA implementation either favourably or otherwise in relation to discharge information communication and prescribing errors.

OVERALL AIM OF DPP PROJECT AND AIM OF EACH PHASE

The overall aim of the project was to assess the impact of HEPMA system implementation on medicines related discharge communication and prescribing errors, and to gain the perspective of hospital staff involved in the communication process.

Phase 1

Interpretative phenomenology to fully describe and understand the opinions of staff groups involved in discharge communication using the traditional paper based system prior to HEPMA implementation.

Phase 2

Interpretative phenomenology to fully describe and understand the opinions of staff groups involved in discharge communication after HEPMA implementation.

Phase 3

Experimental study to quantify the impact of HEPMA implementation on discharge communication errors and receipt of discharge communication at GP surgeries.

Study design

The project used convergent parallel mixed methods design consisting of both qualitative and quantitative components.

Research Question Phase 1 (Qualitative research methods)

What are the opinions of staff involved in the prescribing and discharge communication process using traditional paper based prescribing system?

Aim

The aim was to describe and understand perspectives of key staff groups (i.e. consultant doctors, junior doctors, pharmacists and advanced nurse practitioners) relating to patient discharge communication via the traditional paper based system and prior to HEPMA implementation.

Objectives

1. To describe and understand staff views and experiences of the traditional paper based system
2. To explore expectations and likely behaviours in relation to HEPMA implementation
3. To highlight any differences in key themes identified amongst different professional staff groups

Research question Phase 2 (Qualitative research methods)
What impact did HEPMA implementation have on the experiences of hospital staff relating to prescribing and discharge communication and are these consistent with pre-implementation expectations of electronic prescribing?

Aim

The aim of this phase of the project was to describe and understand the perspectives of key staff groups (i.e. consultant doctors, junior doctors, pharmacists and advanced nurse practitioners) relating to patient discharge communication via the recently implemented HEPMA system.

Objectives

1. To describe and understand staff views and experiences of the HEPMA system
2. To explore behaviours and behavioural determinants in relation to HEPMA implementation
3. To highlight any differences in key themes identified amongst the different professional groups

Research questions Phase 3 (Quantitative research methods)

1. What impact does HEPMA implementation have on discharge information content, discharge information accuracy and number and severity of prescribing errors?
2. What impact does HEPMA implementation have on discharge letter receipt and time of receipt at GP surgery
3. What impact does HEPMA implementation have on patient re-admission rates?

Research question 1 is the primary question.

Aim

The aim of this phase of the DPP project was to determine if HEPMA implementation impacted discharge information.

Objectives

Pre-implementation objectives

- To determine the frequency and nature of prescribing errors on immediate discharge letters prepared using traditional handwritten processes
- To determine discharge letter receipt and time of receipt at GP practices

Post-implementation objectives

- To determine the frequency, nature and severity of prescribing errors on immediate discharge letters post HEPMA implementation
- To determine discharge letter receipt and time of receipt at GP practices

COMPARISON OBJECTIVES

Primary Objective

- To determine if HEPMA implementation impacted the frequency, nature and severity of prescribing errors on immediate discharge letters.

Secondary Objectives

- To determine if HEPMA implementation impacted discharge letter receipt and time of receipt by GP practices.
- To determine if HEPMA implementation impacted patient re-admission to same specialty at 7, 14, 28 and 90 days after initial discharge date.

Hypotheses

- the null hypothesis was that HEPMA implementation did not impact discharge letter quality, number and severity of prescribing errors
- the alternative hypothesis that HEPMA implementation impacted discharge letter quality, number and severity of prescribing errors

CHAPTER SUMMARY

This chapter has provided the introduction to the thesis, with specific focus on the communication of medicines information to GPs following an inpatient stay.

A description of the local context and setting has been provided including background information relating to HEPMA implementation.

The legal policies for prescribing of medicines in hospitals have been described, with particular emphasis on the legislation relating to discharge information communication and medicine prescribing at patients' hospital discharge following an inpatient stay.

Coverage of the evolution of prescribing systems over time has been provided to contextualise the implementation of HEPMA systems.

A narrative critical appraisal of the limited available literature relating to HEPMA implementation and specifically discharge information communication has been provided

The aims of the research have been described.

Thus the proposed project fills a gap in the available evidence.

CHAPTER 2 RESEARCH METHODOLOGIES

CHAPTER INTRODUCTION

This chapter provides a brief description of research philosophies, methodologies, approaches and methods. Selected research methodologies and methods are justified, accompanied by an overview of potential theoretical frameworks with a justification for the selected framework. Finally there is consideration of research governance issues.

GENERAL OVERVIEW OF RESEARCH PHILOSOPHIES

Research paradigms deal with philosophical scope, which includes assumptions and beliefs that affects researchers' behaviours, as outlined by Wahyuni, and Johnson et al (Wahyuni 2012, Johnson and Onwuegbuzie 2004). They espouse that ontology, epistemology and axiology are the three fundamental beliefs. Wahyuni and Durant-Law describe ontology as the researcher's view on the nature of reality, epistemology as the consideration of what is acceptable knowledge and axiology describes the researcher's values and ethics (Durant-Law). They claim that there are four distinct paradigms, which are positivism (naïve realism), postpositivism (critical realism), interpretivism (constructivism) and pragmatism, each described by different philosophical beliefs and summarised in Table 2.1.

Table 2.1 Summary of philosophical beliefs in research paradigms, adapted from work by Wahyuni (Wahyuni 2012)**.**

	Research Paradigms			
Philosophical belief	Positivism	Postpositivism	Interpretivism	Pragmatism
Ontology	Independent, hypothesis driven	Independent but interpreted through experience/ conditions	Subjective, multiple options	Multiple- use what is most appropriate to answer research question
Epistemology	Observable and measurable, cause and effect	Observable, explain data in context	Subjective- analysis of details and meanings of details	Observable and/or subjective, practice research- mixing different perspectives for data interpretation
Axiology	Independent, value-free and etic	Researcher bias, value-laden and etic	Researcher a part of what is being researched, value-bonded and emic	Both objective and subjective- values used to interpret data, value-bonded and etic-emic
Research Methodology	Quantitative	Qualitative or quantitative	Qualitative	Qualitative and quantitative (Mixed methods)

TYPES OF RESEARCH METHODOLOGY

Methodology is the approach the investigator uses to answer the specific research question. Methodology concerns the theory about the use of specific research methods and this theory is responsible for the selection of the appropriate research method. It explains why certain methods or tools are used.

There are three different methodologies for undertaking research: quantitative; qualitative and mixed methods research. There are strengths and weaknesses in all methodologies. Thus, it is important to select the appropriate methodology to answer the research question, which has the most strengths and minimal weaknesses. Creswell states that "when constructing a research plan it is vital to have a meaningful research question with an appropriate way to answer it" (Creswell 2013). It is therefore essential to consider the different types of methodologies and associated methods to ensure that the optimum methodologies are selected when constructing the research design to answer the required research question. Thus the selection of appropriate methods (research approach) will aid the research strategy and answering of the research question.

QUANTITATIVE RESEARCH

Quantitative research is described as "answering the questions of who, where, how many, how much, and what is the relationship between specific variables" (Schimmel 1996). Creswell notes that quantitative research is "deductive, objective and general" (Creswell 2013).

Quantitative research collects numerical data by using structured research instruments which are finalised prior to data collection. It tends to rely on sampling of a population to produce results that should be representative of that larger population and tends to be easily replicated because of its high reliability. Bowling claims quantitative research is "appropriate in situations in which there is pre-existing knowledge, which will permit the use of standardised data collection methods, and in which it is aimed to document prevalence or test hypotheses" (Bowling 2014). Creswell adds that quantitative research methodologies "mainly comprises surveys and experiments to test a theory which produces objective data from empirical

observations and measures necessitating validity and reliability to permit meaningful interpretation of data" (Creswell 2013). It may be used to generalise concepts, predict future results or determine causality. Table 2.2 provides an overview of quantitative research methodologies and is adapted from Creswell and Davies (Creswell 2013, Davies 2007).

Key issues of sampling, and data validity and reliability are explained later in the text.

Strengths of quantitative research include that it tends to be independent of the investigator, and is conducive to large sample sizes.

Limitations of quantitative research include the multiple biases which may exist (see later) and that it may not generate hypotheses but will merely confirm or reject an existing hypothesis.

While there is often confusion between methodologies and methods, methods have been described as "the tools to do the research" (Kinash 2006). Research methods are described by Bowling as "the practices and techniques used to collect, process and analyse the data" (Bowling 2014). Furthermore, Bowling claims that quantitative research methods are highly structured (Bowling 2014).

Table 2.2 Summary of Quantitative Methodologies, adapted from Creswell and Davies (Creswell 2013, Davies 2007)

Quantitative Methodologies		
Design	Survey Design	Experimental Design
Specific methodologies	Cross-sectional (one point in time) or longitudinal (repeated) surveys	Randomised controlled trials (RCTs), quasi-RCT, before and after studies, cohort studies, case control studies, case series studies
Description of general aims	To describe and investigate issues such as trends, attitudes or opinions of a population or sample of that population	Generally aim to determine if a specific treatment or intervention impacts the outcome. Treatment or intervention applied to one group and ideally another comparable group acts as a control. Random selection or random sampling or convenience sampling which makes a quasi-experiment.
Main methods of data collection	Questionnaires or structured interviews to collect objective data. Data may be collected at one point in time or over time.	Completion of research tools to collect objective data.
Approaches to sampling	May use the entire population (depending on size). If sampling, ideally a random sample but may be stratified, systematic, convenience or clustered.	May use the entire population (depending on size). If sampling, ideally a random sample but may be stratified, systematic, convenience or clustered.
Approaches to data analysis	Statistical analysis (descriptive and inferential), depending on the aim.	Statistical analysis (descriptive and inferential), depending on the aim.
Approaches to data interpretation	To describe the population (sample) and to make inferences about particular population characteristics. May test or generate hypotheses.	To accept or reject the null hypothesis.
Issues of validity and reliability	Need to demonstrate validity and reliability	Need to demonstrate validity and reliability.

Survey Designs

Survey design methodologies largely employ questionnaires and structured interviews as methods of data collection. Data may be collected via face-to-face, telephone, postal or internet based approaches (Davies 2007).

Experimental Designs

Bowling defines the experimental approach as "a situation in which the independent variable (also known as the exposure, the intervention, the experimental or predictor variable) is carefully manipulated by the investigator under known, tightly defined and controlled conditions, or by natural occurrence." Experimental designs are considered to have different levels of evidence. The quantitative hierarchy of evidence is described by the Scottish Intercollegiate Guidelines Network as shown in Table 2.3 (Scottish Intercollegiate Guidelines Network (SIGN) 2012). The ranking is from 1 with the highest evidence to 4 as the lowest. Randomised controlled trials (RCTs) are ranked top in the hierarchy of evidence. It may not always be possible to conduct RCTs for a variety of reasons so quasi-experiments would be an alternative design. Harris et al define a quasi-experiment as "a study that aims to evaluate interventions but that do not use randomisation. The aim is to demonstrate causality between an intervention and an outcome. Quasi – experimental studies can use both pre-intervention and post-intervention measurements as well as non-randomly selected control groups" (Harris et al. 2006).

Table 2.3 Levels of evidence obtained from SIGN (Scottish Intercollegiate Guidelines Network (SIGN) 2012)

Evidence Level	Study Design
1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies e.g. case reports, case series
4	Expert opinion

Experimental designs are divided into the following categories:

Randomised controlled trials (RCTs)

Bandolier defines an RCT as ”a group of patients is randomised into an experimental group and a control group. These groups are followed up for the variables/outcomes of interest. The point about using randomisation is that it avoids any possibility of selection bias in a trial. The test that randomisation has been successful is that different treatment groups have the same characteristics at baseline. For instance, there should be the same number of men and women, or older or younger people, or different degrees of disease severity” (Bandolier 2007).

Bowling defines a RCT as “a study involving the random allocation of participants (i.e. patients) between experimental group(s), whose members receive the treatment or other intervention, and control group(s), whose members receive a standard or placebo treatment. The outcome of the groups is compared” (Bowling 2014).

By the nature of its design, an RCT cannot be employed when randomisation is not possible. Harris et al provides four situations: because of ethical considerations; difficulty to randomise patients; difficult to randomise locations e.g. wards; or small available sample size (Harris et al. 2006). Harris et al claim for medical informatics implementation, which would include HEPMA implementation, it is impossible to randomise to individual patients as the system needs to be on or off and for numerous reasons it is not possible to have half the patients on a ward with one system and half with the other.

Quasi Experiment

Davies describes quasi –experiments as those which aim "to compare groups that cannot assume to be strictly equivalent" (Davies 2007). Harris et al provide a relative hierarchy of quasi-experimental designs which is depicted in Table 2.4 (Harris et al. 2006).The lowest design quality is A with the hierarchy increasing in quality as you move down the table thus A6 is a higher quality than A5. In general, studies in category C are a lower design quality than category D. Harris et al claim that "the intervention proceeds the measurement of the outcome but that statistical association does not necessarily imply causality" which means that it is possible that there may be alternative explanations for the apparent causal association (Harris et al. 2006).

Major threats to internal validity of quasi- experiments include that concurrent events caused the noted effect; natural progression may have caused effect; and the measured intervention impact may in fact be dependent on another concurrent intervention.

Table 2.4 The hierarchy of quasi-experimental design, adapted from Harris et al (Harris et al. 2006)**.**

Quasi-experimental Study Designs		**Design**
A	Designs without control groups	
1	One-group post-test only	I M1
2	One-group pre-test post-test	M1 I M2
3	One group pre-test post-test with a double pre-test	M1 M2 I M3
4	One-group pre-test post-test with a non-equivalent dependent variable	(M1a, M1b) I (M2a, M2b)
5	Removed treatment design	M1 I M2 M3 remove I M4
6	Repeated treatment design	M1 I M2 remove I M3 M4
B	Designs with control group but no pre-test	
1	Post-test only with non-equivalent groups	Intervention group: I M1 Control group: I M2
C	Designs with control groups and pre-tests	
1	Untreated control group with dependent pre-test and post-test samples	Intervention group: M1a I M2a Control group: M1b M2b
2	Untreated control group with dependent pre-test and post-test samples using a double pre-test	Intervention group: M1a M2a I M3a Control group: M1b M2b M3b
3	Untreated control group with dependent pre-test and post-test samples using switching replications	Intervention group: M1a I M2a M3a Control group: M1b M2b I M3b
D	Interrupted time series	
1	Multiple pre-test and post-test measurements at equal time intervals	M1 M2 M3 M4 M5 I M6 M7 M8 M9 M10

M= measurement, I = intervention Time moves from left to right

Before-and –after studies

Before and after studies are a subset of quasi- experiments in which observations are made before and after intervention implementation, both in the treatment and control groups (Bowling 2014).

Before and after studies are depicted in Table 2.4 as category A (2-4). These studies therefore fall into the lowest hierarchy of quasi-experiments (Bowling 2014).

Cohort studies

Cohort studies involve identification of a group of people sharing a common feature or characteristic and following them over a period of time to see how their exposures to a particular variable affect their outcomes (Bowling 2014).

Case control studies

This is a study involving people with a certain health problem "cases" and a similar group without "controls" to determine frequency of occurrence of factors in the case and control groups (Bowling 2014).

Case series studies

Case-series design involves the study of a series of cases of any particular condition. These cases suggest at best a hypothesis but as there is no comparison group, it is impossible to draw too many conclusions about the disease or the disease process.

Sampling

The majority of research design methods necessitate the use of a sample because the studied population is too large to be researched in its entirety. Therefore, both quantitative and qualitative (see later) research require sampling. The research design should describe whether the whole population will be studied or if sampling is required.

Sampling is defined by Kotzab et al as "the process of using a small number of items or parts of a larger population to make conclusions about the whole population" (Kotzab et al. 2006).

The sampling process consists of defining the population of interest, obtaining the population list (i.e. the sampling frame), determining the sampling method and the required sample size prior to recruitment and data collection or generation.

There are several different sampling methods that may be used and these are selected dependant on the research questions, methodology and methods. Sampling is generally classified as probability or non-probability sampling (Creswell 2013).

Sampling approaches used in quantitative research consist mainly of random sampling (probability). These approaches are outlined in Table 2.5. As the name suggests, in probability sampling there is a known probability for selection of a particular integer.

Irrespective of the selected sampling method, a clear record of how potential participants will be identified should be documented, which is usually presented as inclusion and exclusion criteria.

Table 2.5 Probability Samples adapted from Bowling, Creswell and Davies (Creswell 2013, Bowling 2014, Davies 2007)**.**

Type	**Cluster**	**Random**	**Stratified Random**	**Systematic**
Description	A large cluster of members of the population in proximity are selected	Each member of the population will have an equal chance of selection	Each member of the population will have an equal chance of selection based on a defined criteria	Every nth member of the population will be selected
Advantages	Economic	Easy	Smaller sample size with better accuracy and representative of population of interest	Simple
Disadvantages	Lower statistical efficiency	Need a list of the entire population, time consuming, larger sample, produces larger errors, high cost	Requires greater effort to design, and detailed advance knowledge required	Trends may cause bias, results may be skewed, medium cost

Sample size

In quantitative research, which usually seeks to ascertain a difference between two groups except in descriptive surveys, an adequate sample size is obtained by means of a calculation based on three factors, namely: "an estimate of effect, appropriate confidence interval and *P* value" (Whitley and Ball 2002). Whitley et al state that "the confidence interval indicates the likely range of values of the true effect in the population: while the *P* value determines how likely it is that the observed effect in the sample is due to chance." The statistical power of the study is also important and this is defined as "the probability of correctly identifying a difference between two groups in the study sample when one genuinely exists in the population from which the samples were drawn" (Whitley and Ball 2002). It is desirable to design a high power study as this correlates with a high chance of identifying a difference between studied groups if it exists. Study power is dependent on several factors; however a large sample size tends to produce a higher power.

Whitely et al claim that " the ultimate aim is to conduct a study that is large enough to ensure that an effect of the size expected, if it exists, is sufficiently likely to be identified" (Whitley and Ball 2002). In practice there are conventional choices for *P* values and power. The *P* value for significance is most commonly set at 0.05 and the power is usually between 80% and 95%. The size of the effect is usually based on either clinical judgement or from previous published studies. Tabulated values and formulae may then be used to calculate the required sample size (Whitley and Ball 2002).

Type I and Type II errors

The sample size needs to consider both statistical and practical components which necessitate taking into account two different error types.

Type I error is defined as "the error of rejecting a true null hypothesis that there is no difference" whereas a Type II error is defined as "the failure to reject the null hypothesis when it is actually false" (Bowling 2014).

Validity and reliability

Validity and reliability are considered at all stages of research design. *Validity is defined as* "the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform" (Biddix). Reliability

refers to consistent measurement of the data. Consistent measurement aids the replication of the study (Creswell 2013). A robust quantitative research study should be both valid and reliable (Creswell 2013).

Validity
There are two main types of validity: external and internal.

External Validity
External validity, also known as generalisability, is the degree to which the study result is true for other situations for example other people, places or times (Creswell 2013).

Internal Validity
Internal validity has been defined by Roberts et al as "addressing the reasons for the outcomes of the study, and helps to reduce other, often unanticipated, reasons for these outcomes" (Roberts and Priest 2006). Thus, internal validity is concerned with establishing a causal relationship between the independent and dependent variable and it is based on the measures used, the research setting, and the whole research design.

Roberts et al provides three approaches for internal validity: content, criterion-related and construct (Roberts and Priest 2006).

They describe content validity as the "weakest level of validity" and it is concerned with whether the study measures what it is intended to measure in relation to the research questions. Face validity may be included as a subset of content validity and is an assessment at "face value" of whether it measures what it is meant to measure or in other words "looks valid" (Roberts and Priest 2006).

Roberts et al claim that criterion-related is at a higher level of validity and is used when a tool can be compared to a similar validated tool (Roberts and Priest 2006).

Construct validity is defined as the "validity of a test or a measurement tool that is established by demonstrating its ability to identify or measure the variables or constructs that it proposes to identify or measure" (Anonymous 2009). It is concerned with whether items measure hypothetical constructs or

concepts and is particularly relevant to whether the measurement provides a practical benefit in the actual situation.

Additional aspects of validity less commonly applied in health service research as outlined by Bowling include precision; responsiveness to change; sensitivity; specificity; and sensitivity analysis, all of which are mainly related with internal validity (Bowling 2014).

Reliability

Reliability is the extent to which measurement gives consistent results (Bowling 2014). Bowling describes different types of reliability including test-retest, inter-rater reliability and internal consistency (Bowling 2014).

Test-retest

Test- retest reliability is defined by Trochim as "to assess the consistency of a measure from one time to another" (Trochim,W,M,K. 2006).

Inter-rater

"The degree to which different raters/observers give consistent estimates of the same phenomenon" is the definition provided by Trochim for inter-rater reliability (Trochim,W,M,K. 2006).

Internal consistency

Internal consistency is described by Trochim as being "used to assess the consistency of results across items within a test" (Trochim,W,M,K. 2006).

Bias

Bias is a key threat to both the validity and reliability of quantitative studies.

Types of bias in research

Bias is defined by Bennet as "unknown or unacknowledged error created during the design, measurement, sampling, procedure, or choice of problem studied" (Bennet). An alternative definition is provided in a medical dictionary as "any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that differ systematically from the truth; deviation of results or inferences from the truth, or processes leading to deviation" (Anonymous 2009).

Shuttleworth describes the main types of research bias as design; measurement; sampling; procedural; interviewer; response; and reporting (Shuttleworth 2009).

Bowling provides additional potential biases including the following: acquiescence response set ("yes-saying");assumption; bias in handling outliers; evaluation apprehension; mood bias; non-response bias; observer; publication; reactive effects (Hawthorne effect); recall (memory) bias; response style bias; and response set (Bowling 2014).

The different types of biases with a brief description are outlined in Table 2.6.

Table 2.6 Bias in research, adapted from Shuttleworth 2009 and Bowling 2014 (Bowling 2014, Shuttleworth 2009)**.**

Bias	Description
Acquiescence response set ("yes-saying")	More common for people to agree than refute statements
Assumption	Defective logic of investigator resulting in incorrect interpretation and conclusions
Bias in handling outliers	Not discounting unusual values in a small sample or not including unusual values which should be included
Design	Use of incorrect design, methods, sampling or analysis thus the observed value is not the true value
Evaluation apprehension	Anxiety caused by investigation results in people providing what they would expect the investigator would want to find rather than their actual opinion
Interviewer	Subconscious effect of investigator to bias response by perceived value stance or by asking leading questions
Measurement	Change over time in measurement process or use of faulty instruments
Mood bias	Depressed people may provide overly negative responses
Non-response bias	Effective sample size diminished due to people not responding
Observer	The perception of the observer is different from the reality
Procedural	Undue pressure applied to respondents to answer quickly
Publication	Published literature likely to contain only positive results and not negative studies
Reactive effects (Hawthorne effect)	The effect of study is altered by people knowing they are being investigated and thus altering their behaviour
Recall (memory) bias	Selectively remembering previous occurrences, experiences and conduct
Reporting	Failure to disclose requested information
Response	Respondent provides the answer either subconsciously or consciously that they think the investigator wants to hear
Response style	Respondent answers similarly to all questions irrespective of question
Sampling	Sampling method does not provide an equal opportunity for all of the population of interest to be included in the sample e.g. convenience samples or exclusion of ethnic minorities

Quantitative data analysis

Analysis of quantitative data usually involves statistical methods which may be either descriptive or inferential (Davies 2007). Descriptive analysis is used to describe what happened with the actual study participants, whereas inferential analysis permits generalising results to the wider population (Davies 2007). The actual analysis may be undertaken by a manual process or by using computer software for example Statistical Package for the Social Science (SPSS©) (IBM 2013).

Study design for quantitative component of DPP research

Quantitative research normally adheres to the positivist philosophical world view and aims to "identify and assess the causes that influence outcomes" (Wahyuni 2012). The positivist position involves testing a hypothesis based on known theory, with a specific focus on factual information.

An experimental design methodology was selected using a quasi-experimental before and after study method which is depicted in Table 2.4 as level A. The design study of the DPP project is classified as A2 which is a one group pre-test post-test design. Harris et al claim that this is a frequently used study design (Harris et al. 2006). The pre-test is acting as the control so that there is some information about discharge information communication prior to HEPMA implementation.

Bowling describes this study design as "before-after study with non-randomised control group" and she claims a major limitation of this design is that changes in the dependent variable may be attributed to several other occurrences (Bowling 2014). It should be recognised that non- randomised controlled studies have limitations as the observed change could have happened without the intervention therefore consideration of concurrent events is essential (Davies 2007).

This is one of the lowest levels in the design hierarchy. It would be impossible (and indeed inappropriate) to conduct a RCT when evaluating HEPMA implementation as a systematic ward by ward implementation approach was required. Hence, it was not feasible to randomly select individual patients with or without HEPMA prescribing. An alternative approach to increase the design hierarchy would be to use an interrupted time series design but this was also impossible as there was a definitive HEPMA implementation schedule which did

not allow sufficient time for completion of this study design. Therefore, a before and after study design was both feasible and practical for completion in the research setting.

The study design comprised a retrospective case note review, an assessment of discharge letter receipt at GP practice and calculation of patient re-admission rate. The focus of this part of the research was on discharge information content, discharge information accuracy and medication errors on discharge letters.

Case notes eligible for review was any patient greater than or equal to sixteen years of age discharged home from hospital after an inpatient stay of at least 24 hours from UHC during a defined three month period. Patients with shorter length of stays and/or not in the required time frame were excluded from the sample. In addition patients in mental health, maternity and paediatric wards were excluded from the study. A random sample list of eligible patients was obtained from the business intelligence department of NHS Ayrshire and Arran, who were provided with the inclusion and exclusion criteria information. This list was provided to the medical records department who accessed the case notes for review by the principal investigator (PI). The case note review patients were used for GP receipt time and re-admission rate calculation.

Sample Size

Identified error rates from the reviewed literature produced huge error rate variance ranging from 12.1% to 66% dependent on error category.

The sample size calculation used a correlation analysis with 0.05 level of significance selected. Therefore, to show a clinically important difference of 10% with a power of 80% (the study has an 80% chance of detecting if null hypothesis is not valid) i.e. a probability of 1 in 20 (Type 1 errors). Two different sample size calculators for determining differences in proportions were used to determine sample size (Casagrande 2013, Brant). The calculated size was 159 case notes before and 159 case notes after i.e. a total of 318 when using P1 (the traditional system) =0.15 and P2 (HEPMA)=0.05 with the first calculator or 141 case notes before and after i.e. a total of 282 using the second calculator (Casagrande 2013, Brant).

An initial 47 case note sample provided an actual error rate of 76.6%. It was originally planned to use the actual error rate to determine the final required sample size. As the actual error rate was higher than the initial literature review it would mean a much smaller sample size would be required with 30 case notes before and after being sufficient to show a 50% reduction in errors (Casagrande 2013). Therefore, it was decided to review the originally calculated 159 case notes before and after HEPMA implementation to ensure sufficient information could be obtained for the study.

Identified medication errors were severity scored using a validated scoring system. Documented GP receipt date of discharge letter was compared against recorded time of patient hospital discharge to determine actual receipt time of discharge letter. Patient re-admission rates were calculated from the hospital patient management system.

Promotion of validity and reliability

The case note review used a validated tool from SIGN 128 adapted for local use which enhanced external validity as the study result will be applicable to other healthcare organisation; face validity as the tool appears to measure what it should; and criterion validity as the tool used can be compared to a similar validated tool (Scottish Intercollegiate Guidelines Network (SIGN) 2012).

Reliability and minimising bias

A random sample of 10% of case notes was checked by an independent assessor for reliability which provides inter-rater and internal consistency reliability. Test-retest reliability has been designed into the study by undertaking a before and after study design which means that consistency of measurement over time will be determined.

Biases that have been possible to minimise were: measurement bias by the PI applying a consistent approach by using a validated tool; non-response and sampling biases by the using a random patient sample obtained from business intelligence and by systematic application of the sample by the PI.

QUALITATIVE RESEARCH

Qualitative research is best at answering "why and how questions" and is good for research examining processes (Schimmel 1996). Thus, qualitative

research is an exploratory process to discover thoughts, generate ideas and create hypotheses. Qualitative research has been defined as "inductive, subjective and contextual". It may be used to ascertain the success or otherwise of interventions and to discover the reason why, usually by means of interviews (Creswell 2013). Table 2.7 provides an overview of qualitative research methodologies and is adapted from Creswell (Creswell 2013).

Starks et al in a discussion of possible methodologies for qualitative research in healthcare settings propose three possible methodologies which are phenomenology; discourse analysis and grounded theory (Starks and Trinidad 2007). They claim phenomenology concerns the lived experience; discourse analysis focuses on the use of language; and grounded theory generates hypotheses around social interactions studied in situ. They advocate that the use of different approaches necessitates different types of research questions, sampling methods and data handling. Data collection usually consists of observations and interviews. In their opinion, semi-structured interviews are appropriate for all three types of studies (Starks and Trinidad 2007).

Creswell describes three further possible methodologies for qualitative research, namely: narrative, ethnography and case studies (Creswell 2013). Narrative research design is based on stories and storytelling and is described by Sandelowski as "the impulse to story life events into order and meaning" (Sandelowski 1991). Ethnography concerns observation and in-depth study of cultural groups in their own environment and tends to be over a lengthy time period (Creswell 2013). Yin claims that case study research "allows the investigators to focus on a "case" and retain a holistic and real-world perspective- such as investigating individual life cycles, small group behaviour, organisational and managerial processes, neighbourhood change, school performance, international relations and the maturation of industries" (Yin 2014). All of these designs use small sample sizes ranging from perhaps one person in case- studies to a cultural group for ethnographic studies.

Table 2.7 Summary of Qualitative Methodologies, adapted from Creswell (Creswell 2013)

Qualitative Methodology						
Design	Case Study	Discourse Analysis	Ethnography	Grounded theory	Narrative	Phenomenology
Description of general aims	Detailed long-term study of an individual case or cases	How language is used by individuals	Study of a particular group (actions, behaviour, speech) in the natural environment of the participants	Multiple data collection periods to obtain a general, abstract theory of a process, outcome or interaction from view of participants about lived experience	Studied life of individual(s) by obtaining life stories of participant(s)	Participants description of a phenomenon, usually obtained by conducting interviews
Main methods of data generation	Observations, interviews	Observations, interviews	Observations, interviews	Interviews, focus groups	Story collection	Interviews, focus groups
Approaches to data analysis	Non-statistical analysis using coding and indexing. Data analysis should be rigorous so that have demonstrated aspects of trustworthiness. Computer programmes may be used to aid management of analysis.					
Approaches to data interpretation	Patterns and themes categorised and described	Use of coding to prepare concepts	Patterns and themes to understand and explain them	Probability of concepts and relationship between concepts	Conceptual	Patterns and themes categorised and described
Trustworthiness	Achieved by data triangulation and peer review and by providing detailed description so may be repeated	Achieved by provision of text detail to explain concept and by providing detailed description so may be repeated	Achieved by confirmation from participants and by providing detailed description so may be repeated	Achieved by fit, relevance, workability and modifiability and by providing detailed description so may be repeated	Achieved by data triangulation and peer review and by providing detailed description so may be repeated	Achieved by data triangulation and peer review and by providing detailed description so may be repeated

Qualitative methods mainly comprise interviews, focus groups, observational studies, or in-depth investigation of one particular case or cases (Creswell 2013).

Interviews

There are several different types of interviews which are described as structured; semi-structured; or unstructured, and these may be conducted either face-to-face or by telephone (Bowling 2014). Davies describes six types of data that may be obtained through conducting interviews:" facts about the here and now; what the interviewee knows; facts about past events; feelings; attitudes or opinions; and beliefs" (Davies 2007). A comparison of the different interviews is provided in Table 2.8.

In structured interviews the questions are asked in a predetermined sequence; whereas unstructured interviews are usually conducted with a pre-prepared topic list but not consisting of detailed questions with the purpose of doing an "in-depth" investigation (Bowling 2014).

Semi-structured interviews aim to obtain more detailed information by the use of pre-determined open questions which then permit the interviewer to probe further to clarify and extract further information of interest (Bowling 2014).

Interviews are advantageous where participants may have poor literacy or are illiterate (Bowling 2014). Limitations of interviews include that they are restricted to the opinions of the interviewees, interviewer presence may bias replies, and interviewees perception and articulation may be wide ranging (Creswell 2013).

Table 2.8 Comparison of different interview types adapted from Bowling (Bowling 2014)**.**

Type	Structured	Semi-structured	Unstructured
Description	An interviewer asking an interviewee a list of pre-determined questions on a specific topic	An interviewer asking an interviewee a list of pre-determined questions with the ability for more in-depth questioning in light of provided responses	An interviewer searching for in-depth responses from interviewee about a particular topic perhaps about unknown information
Advantages	Interviewer determines questions and directs discussion, consistency of questioning, tends to be a formal situation	Able to obtain more in-depth information than with structured interview, reliability, comparability of data	Particularly suited to learn about individual interviewee experience about a specific topic and feelings about the experience; results may be used to prepare a more structured interview
Disadvantages	Lack of flexibility, interviewer must stick to pre-defined questions, limited depth of information obtained	May be time consuming, skill of interviewer may influence responses obtained, not as reliable as structured interviews	Lack of consistency in approach, questions and order of questions may vary among interviewees so lacks transferability of findings

Interview Format

Bowling claims that characteristics of a good interviewer include early establishment of rapport between the interviewer and the interviewee, development of effective listening skills without interrupting interviewee as well as being amiable and trustworthy (Bowling 2014). The aim is to minimise influence of the interviewer on the interview i.e. to reduce interviewer bias (Bowling 2014). Bowling describes other possible biases while conducting a personal interview as being due to "the characteristics, expectations and attitudes of the interviewer" and also the interviewer behaviour i.e. not following the script, "directive, non-neutral probing" and inaccurate recording of response". The last bias may be minimised by recording the interview and transcribing verbatim the response.

Good preparation is essential and a suitable location should be selected which is comfortable, free from interruption and mutually convenient (Bowling 2014).

Wahyuni advocates that prior to the interview, information should be provided to the participant by either e-mail, letter or direct communication (Wahyuni 2012). She asserts that the initial component of the interview should consist of outline of the purpose of the interview with explanation about confidentiality and anonymity and the right to withdraw from the study at any time (even after the interview completed). A consent form must be signed by both the interviewee and interviewer and content of interview audio recorded with participant consent. At the end of the interview, the participant is given the option to add any additional information not already covered (Wahyuni 2012).

Data collected should be securely stored in locked filing cabinet and password protected computer only accessible by the researcher (Wahyuni 2012).

Interview transcription

Transcribing has been proposed as the first part of analysis and enables the researcher to become immersed in the data. Transcription is time consuming and it is estimated that one hour of recorded data takes approximately between two and four hours to transcribe (Wahyuni 2012).

Focus groups

Focus groups involve detailed discussion of specific issue(s) by a number of individuals brought together by a facilitator (researcher) to create information (Bowling 2014).

Observational Studies

The observation of participants is undertaken by the researcher who may declare the purpose of the study to participants or they may be blinded hence unaware of the research activity. The researcher observes and documents observations with an annotation of observant comments where applicable to provide a more detailed analysis than that possible by interviews (Bowling 2014).

Case study

Bowling defines a case study as "a research method which focuses on the circumstances, dynamics, and complexity of a single case, or a small number of cases" and states that it is "a valuable method of study of complex social settings and is useful in exploratory, early stages of research, and for generating hypotheses" (Bowling 2014).

Sampling

Sampling has been described earlier in the quantitative research section. As stated previously, the majority of research design methods necessitate the use of a sample because the studied population is too large to be researched in its entirety. The research design should describe whether the whole population will be studied or if sampling is required. Non-probability sampling approaches are mainly used in qualitative research and details about the different approaches are provided in Table 2.9. In non-probability sampling, the population as a whole is unknown, but there is a shared characteristic (Davies 2007). Bowling claims that for qualitative research, sampling is normally undertaken using convenience, purposive, snowballing or theoretical sampling methods (Bowling 2014). Starks et al in a discussion of possible methodologies for qualitative research in healthcare settings suggest that irrespective of the selected approach that purposive sampling should be used to capture participants who have knowledge of the investigated experience (Starks and Trinidad 2007).

Table 2.9 Non-probability Samples adapted from Bowling 2014, Creswell 2013 and Davies 2007 (Creswell 2013, Bowling 2014, Davies 2007)**.**

Type	**Convenience**	**Purposive**	**Quota**	**Snowball**
Description	Selection based on ease of accessibility	Select individuals of a population with a particular goal or purpose in mind	Various sub groups represented by certain characteristics	Later respondents found from response of initial respondents (selected by probability)
Advantages	Cheap, easy	More accurate results as unsuitable cases eliminated, quick and relatively cheap	Trying to create a representative sample, quick and easy	Access to difficult to reach respondents, more time-consuming
Disadvantages	Least reliable	Open to researcher bias	Unable to determine sampling error, must be able to clearly divide into subgroups	Unable to determine sampling error, limits transferability

Sample Size

The determination of an adequate sample size in qualitative research is ultimately a matter of judgement and experience and depends on the selected qualitative design. Creswell claims that ”narrative research includes one or two participants; phenomenology to typically range from three to ten; grounded theory, twenty to thirty; ethnography to examine one single culture-sharing group; and case studies to include four to five cases” (Creswell 2013). Whereas Starks et al suggest that the required sample size for phenomenological studies is usually one to ten people; in discourse analysis, one person may suffice if there is sufficient depth of discussion or a greater number may be required if insufficient depth; grounded theory explores multiple dimensions of the investigated experience and therefore adds participants until data saturation has been achieved. Typical sample sizes range from 10 to 60 individuals (Starks and Trinidad 2007).

There continues to be a great deal of debate about what constitutes an adequate sample size. Baker et al asked both experienced (n=14) and novice (n=5) researchers how they decided how many interviews to conduct in their research (Baker and Edwards 2012). They concluded that the answer was that it depended on the research design and methods as well as practicalities and philosophical beliefs. It is important to ensure the sample size is adequate for the research purposes without being larger than needed as research funds and participants’ time are wasted (Francis et al. 2010).

Another conventional approach is to continue until “data saturation” is achieved. Data saturation is defined as “the point in data collection when no new additional data are found that develops aspects of a conceptual category” and Francis et al claim that it is essential to reach data saturation to ensure that content validity has been achieved for the sample (Francis et al. 2010). The principles should be agreed by the research team prior to starting the study so that consensus may be reached about when to stop (Francis et al. 2010). Francis et al propose an approach for achievement of data saturation (Francis et al. 2010). This is by agreeing the minimum number of interviews to be analysed first and then subsequently to state the number of further interviews to be completed without any new ideas being voiced. They claim

that this method may not be suitable for research using interviews with sub-groups but that a modified version may be applicable (Francis et al. 2010).

Trustworthiness and Reflexivity

There is debate around the appropriateness of the concepts of validity and reliability in qualitative research and therefore many subject experts recommend trustworthiness.

Trustworthiness and reflexivity must be considered when designing research methods for qualitative research methodology to minimise any bias of the investigating team.

Trustworthiness

Qualitative research should be conducted with a rigorous approach to ensure trustworthiness. Miles et al argue that the conclusion should be verified to prevent arriving at "incorrect" answers (Miles and Huberman 1994). Rigorous data analysis should be thorough and careful. Shenton states four criteria are necessary for ensuring trustworthiness in qualitative research studies (Shenton 2004).

These are "credibility, transferability, dependability and confirmability".

When planning the proposed research design, trustworthiness should be considered, to ensure the aims of the research are fully met without compromising the integrity of the findings.

Credibility can be achieved by ensuring essential components are included in research design. This consists of the selection of reputable research methods which have been effectively used in similar studies; appropriate sampling (here need to consider random sampling of population versus purposive); triangulation – in a mixed methods study this may be achieved by the integration of the data from the different research components; permitting interviewees the opportunity to refuse to participate in study; inclusion of probing questions to extract comprehensive information from the interviewees; frequent discussion with the full research team about emerging data; seeking out feedback from peers by presenting at conferences; and comparing results with existing work (unpublished) in studied organisation.

Can the results of the study be applied to other situations is important when considering transferability? As qualitative studies use a limited number of participants it is important to clearly define the study range and explicitly detail the participants, data collection methods, number and type of data collection and the time period of data collection.

Dependability is reliant on the actual research design being clearly articulated with sufficient provision of information about data collection and appropriate reflection and evaluation of study on completion.

Confirmability is achieved by ensuring that it is the true voice of the participants that is related and not the researchers' opinions by robust audit and use of triangulation (Shenton 2004).

Starks et al also consider trustworthiness of data due to the essential subjective nature of qualitative research (Starks and Trinidad 2007). A rigorous approach to data analysis may be facilitated by the use of established computer programmes for example N-Vivo© (QSR International).

Reflexivity

Another important consideration when undertaking qualitative methods of research, particularly when using interview design is reflexivity. Reflexivity is defined by Creswell as "the inquirer reflects about how their role in the study and their personal background, culture and experiences hold potential for shaping their interpretations, such as the themes they advance and the meaning they ascribe to data" (Creswell 2013). Thus, reflexivity involves researchers reflecting on their ability to be unbiased when conducting the research and to consider the effects of this on the study and any subjective bias that may be present.

Strengths of qualitative research include that it permits the detailed analysis of a small number of cases, facilitates complex description, allows individual perspective to be described and is usually concerned with local settings.

Limitations of qualitative research include the limited transferability due to the small study numbers used, time taken to collect and analyse data and the fact it is open to researcher interpretation bias.

Approaches to qualitative data analysis

Bowling described three possible methods of data analysis: thematic; framework; and content analysis (Bowling 2014). Analysis of qualitative data usually involves dividing the collated data according to themes. Creswell states that this is usually between five to seven key themes (Creswell 2013). The identification of themes may be facilitated by use of computer software to then enable interpretation and meaning to be deduced by the investigator.

Thematic analysis

Thematic analysis consists of deconstructing content, sorting by themes and arranging data into themes. This is the most traditional method of analysis for qualitative studies and traditionally was sorted manually which more recently has been superseded by the use of computer software packages (Bowling 2014).

Framework analysis

Bowling describes framework analysis as consisting of the following phases:

- familiarisation by reading interview transcripts to acquire a general impression- (This has also described as the researcher becoming immersed in the data (Pope, Ziebland and Mays 2000))
- identification of thematic framework (themes emerging from interviewees, themes included in interview schedule or themes emerging from repeated analyses
- systematic application of thematic framework by coding
- data rearranged to the identified themes
- mapping and interpretation (aggregating patterns, searching for structure, synthesising the findings)

Bowling claims that framework analysis is more informed by reasoning of existing knowledge than thematic analysis (Bowling 2014).

Content analysis

Bowling describes content analysis as consisting of collecting data, coding according to theme or category and then the coded data are analysed and presented (Bowling 2014).

Framework analysis

Smith et al describe the use of the framework approach in healthcare which they claim to be a systematic approach to data analysis (Smith and Firth 2011). They claim the benefit of use of the framework approach includes that it is "particularly suited to analysing cross-sectional descriptive data", transparency of analysis of interviewee descriptions, and facilitation of systematic data analysis. Srivastava et al claim that framework analysis is ideal for research with specific questions and with limited time (Srivastava and Thomson 2009) They claim benefits include fundamentally related to experience of interviewees, fluidity so alterations possible during research, systematic and comprehensive as well as transparent (Srivastava and Thomson 2009). Another advantage is the ability to perform both within-case or between case analysis and it is accessible to other researchers (Srivastava and Thomson 2009).

Study design for qualitative component of DPP research

Qualitative research normally adheres to the interpretivism philosophical world view and aims to "understand the participants' views of the situation being studied" (Wahyuni 2012, Creswell 2013). A phenomenology methodology has been selected using semi-structured interviews as the design method.

Face-to-face semi-structured interview design was selected because as described in Table 2.8 this permits more detailed information acquisition whilst promoting trustworthiness and data comparison. Focus groups would be a suitable alternative method however disadvantages of focus groups include a lack of confidentiality, the influence of some members of group may prevent all participants contributing freely to the discussion and the difficulty in scheduling the group when all participants are available to attend. The interview format was focused by use of an interview schedule, to allow the interviewee to provide their personal opinion of the process and the PI had key questions with associated probing to ensure important topics were covered during the interview but allowed for flexibility of discussion. Types of probing questions include a request for more detail about a specific item, clarification of actual meaning of statements and asking for specific examples (Bowling 2014).

The interviewed participants were members of staff groups involved in the discharge communication process between the hospital service and general practitioners (GP). These groups consist of consultant medical staff, junior medical staff, advanced nurse practitioners and pharmacists. Purposive sampling was used to interview a diverse group of people in relation to experience and demographics (sex, ethnicity, years worked at research setting). As outlined in Table 2.9 purposive sampling enabled the targeting of key individuals involved in the discharge process to enable accurate result generation. Service leads were asked by the PI to nominate five to six staff members and to minimise bias were asked to select staff with a broad demographic range in relation to sex, ethnicity and years worked at the hospital. Exclusion criteria in the pre-implementation phase included staff routinely using HEPMA system at University Hospital Ayr. The PI invited the nominees by either personal communication or by e-mail to participate in the study and followed the order provided by the service lead to recruit to interview until data saturation was achieved. It was anticipated interviewing a sample of five members of each professional group would achieve data saturation (Francis et al. 2010). Further or fewer participants were interviewed as required to achieve data saturation.

Interviews were audio recorded with participant consent. The recorded information was transcribed verbatim by the primary investigator immediately after the interview or as soon as possible after the interview. The transcription used a denaturalised style and names of participants were not included in the transcript (Oliver, Serovich and Mason 2005). The recorded information was deleted after transcription. All collected transcribed information was entered into NVivo 10© software by the PI (QSR International). Framework analysis has been selected as the data analysis method because of its previous use in healthcare research and it provides a systematic, structured approach to data analysis whilst permitting data transparency (Smith and Firth 2011). Pope et al claim that framework analysis is especially suited for qualitative research with pre-defined objectives (Pope, Ziebland and Mays 2000).This is therefore consistent with the DPP project design as the framework approach suits studies with pre-identified questions set in short time frames and related to

policies and procedures. Data was sorted by looking for principal themes from the interviews, evolving themes and issues of interest in relation to the objectives. Data analysis involved theme analysis, cataloguing of information, mapping and data interpretation.

Promotion of trustworthiness and reflexivity

The study design and conduct of the PI when undertaking the qualitative component of the DPP project aimed to promote trustworthiness and reflexivity. Credibility was achieved by the use of the following: selection of purposive sampling to ensure participants were actively engaged in the studied process; selection of the semi-structured interview method was consistent with published similar studies; interviewees were able to refuse to participate in study and this information was included in the participant information sheet which stated they could withdraw from the study at any time even after the interview was completed; by the use of probing questions to elicit information from interviewees; the PI had frequent discussions with university supervisors as the interviews were conducted and transcribed; and pre-implementation interview results were presented at a national conference which permitted comparison of results with other unpublished studies.

Transferability was achieved by providing a detailed description of the study design, including the number of interviews and type of interviewees.

Dependability was achieved by having content validation of the interview schedule by university supervisor review and regular reflection on the study by the PI with university supervisors.

Confirmability was achieved by having a sample of five transcripts and interview recordings reviewed and validated by the university supervisors to ensure that the PI was accurately transcribing the interviews and truly recording the participant voice.

Trustworthiness was also promoted by having a rigorous approach to data analysis by use of the framework approach within the NVivo© computer programme. Identified themes in the transcripts by the PI were confirmed by university supervisor review.

Reflexivity to minimise bias

The PI reflected on the ability to be unbiased when undertaking interviews and analysis of interviews. The role of the PI within the organisation may impact on the completion of the qualitative research and results obtained. Wherever possible biases were minimised but it was impossible to minimise all bias types. A review of a sample of transcripts and recordings and theme generation by university supervisors minimised assumption basis; whilst the use of an interview schedule meant the same questions were asked consistently so minimising interviewer bias.

Mixed methods research

Mixed methods is a recently evolved methodology which captures the benefits of the two previous systems by amalgamating the results and findings of each methodology to provide a fuller picture than that achieved by using either individual method alone and aims to minimise weakness by limiting occurrence of similar weaknesses in the study design. Mixed methods research has been defined by Johnson et al as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study "(Johnson and Onwuegbuzie 2004).This may be applicable to circumstances where either quantitative or qualitative methods alone would not suffice (Johnson and Onwuegbuzie 2004). The use of mixed methods allows the combination of stories from research participants to be combined with statistical analysis to create the actual picture of what is happening in relation to the research question. For certain research questions, if quantitative methods are used alone there is a some degree of understanding of the participants' situation; whereas if qualitative methods are used alone it is difficult to make wide recommendations because of the limited number of people included in the data analysis and also analysis is dependent on the interpretation of the researcher and may be open to bias. Johnson et al postulate that mixed methods utilisation produces higher quality research than use of a single method alone when answering certain research questions (Johnson and Onwuegbuzie 2004). The benefits of each type of research method can be combined to produce a synergistic effect which is particularly suited to practice research. Mixing of research methods provides maximum opportunity to

answer several research questions with consideration of experience and practical consequences. This may result in a greater knowledge of the situation and not merely confirmation of findings.

Study design should describe the timing of the qualitative and quantitative phases which may be either concurrent or sequential (Johnson and Onwuegbuzie 2004). Creswell provides detail recommendations about possible designs for conducting mixed methods research (Creswell 2013). Table 2.10 provides an overview of mixed methods research methodology and is adapted from Creswell (Creswell 2013).

Table 2.10 Summary of Mixed Methods Methodologies adapted from Creswell (Creswell 2013)

Mixed Methods Methodologies						
Design	Convergent Parallel	Explanatory sequential	Exploratory sequential	Embedded	Transformative	Multiphase
Description	Qualitative & quantitative data individually collected and analysed independently. Results are compared to see if are confirmatory.	Quantitative research completed initially with more detailed analysis of results using qualitative research	Qualitative research completed initially with more detailed analysis of results using quantitative research	Either qualitative or quantitative is primary research with the other answering a secondary question	Both qualitative and quantitative data which may be convergent or sequential	Concurrent or sequential methods used together over long timescale to enable evaluation of lengthy studies.
Measurement	Requirement for both qualitative and quantitative measures to be collected using a combination of approaches outlined in Tables 2.2 & 2.5.					
Data Collection and Generation	Both qualitative & quantitative at approximately same time	Quantitative data collected first followed by qualitative	Qualitative data collected first followed by quantitative	Both collected together but primary research guides secondary	Both collected simultaneously for convergent or sequentially for sequential	Both collected concurrently or sequentially
Data Analysis	Analysis of both data types concurrently	Quantitative data analysed first and used to prepare qualitative component which is then analysed later	Qualitative data analysed first and used to prepare quantitative component which is then analysed later	Primary research analysed first supported by secondary analysis of alternative method	Data analysed concurrently or sequentially	Data analysed concurrently or sequentially
Data Interpretation	Data integration using either: side by side comparison; data transformation; joint display of data.	Data integration using connecting data	Data integration using connecting data	Data integration by embedding data	Data integration using either: side by side comparison; data transformation; joint display of data.	Data integration using connecting data, side by side comparison or joint display of data.
Validation, trustworthiness procedures	Validity and trustworthiness should be demonstrated using appropriate procedures for the composite quantitative and qualitative components as outlined in Tables 2.2 & 2.7.					
Anticipated Outcomes	To demonstrate agreement or disagreement	Greater knowledge about quantitative research	Greater knowledge about qualitative research to aid better measurement	Greater depth of knowledge about participants' views	To create radical change	A decisive and collective assessment
Limitations	Complex research design, time and resources required and resolution of discrepancies between methods					

Data analysis

In mixed methods design the two components i.e. the quantitative and the qualitative should be analysed independently before being combined (Creswell 2013) .

Advanced mixed method design uses the addition of a framework for example an experiment, theory or philosophy.

Strengths of mixed method research include being able to answer more complex and detailed research questions and using the strengths of one methodology to surmount the limitations of the other methodology.

Limitations of mixed method research include the complexity of the research design, the amount of time and resources required to complete and the difficulty of resolution of discrepancies between the different data types.

Theory in research

Creswell states that a theory is "a scientific prediction or explanation for what the researcher expects to find" (Creswell 2013). Whereas Kerlinger defines a theory as "a set of interrelated constructs (variables), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining natural phenomena" (Kerlinger 1979). Reeves et al provides a further definition as "an organised, coherent, and systematic articulation of a set of issues that are communicated as a meaningful whole" and considers that "theories are used to help design a research question, guide selection of relevant data and propose explanations of underlying cause"(Reeves et al. 2008). "A theory may be included in research as an argument, a discussion, a figure or a rationale and it helps explain (or predict) phenomena that occurs in the world" (Creswell 2013). Creswell states that "in quantitative research theories are often tested; in qualitative research a theory may be generated or may be used to shape questions asked; and mixed methods may contain a theoretical framework within which both quantitative and qualitative data are collected" (Creswell 2013).

APPLICATION AND USE OF CHANGE THEORY AND THEORETICAL FRAMEWORKS IN DPP RESEARCH

Change theory guides the development of health interventions (Lewin 1947). Change theory is worthy of consideration when designing research methods as HEPMA implementation requires behaviour change in multiple professional groups within the hospital setting. Thus, the use of interventions based on evidence-based principles of behaviour change should be incorporated within the research proposal. Suggested methods include obtaining opinions of users by conducting interviews and assessing the effect of system implementation on specific factors including errors, patient safety and care quality. A prospective study method is recommended to aid assessment of the juxtaposition of the technology and the situational environment (Cresswell and Sheikh 2014). Evans et al advocate the use of theoretical framework when utilising mixed methods research methods as they claim this provides helpful organisation of what is a complex assessment (Evans, Coon and Ume 2011). Cresswell et al propose theoretical frameworks to be used when evaluating health information technology implementation such as HEPMA system implementation (Cresswell and Sheikh 2014). They stress the importance of consideration of not only the IT solution but how the human and organisational setting interacted when assessing the effects of implementation. Cognisance of changes that have occurred over time to make the system work in the actual setting should be discovered and assessed. Undertaking this robust and rigorous evaluation will allow the results to be considered in other contexts and not just in the implementation setting.

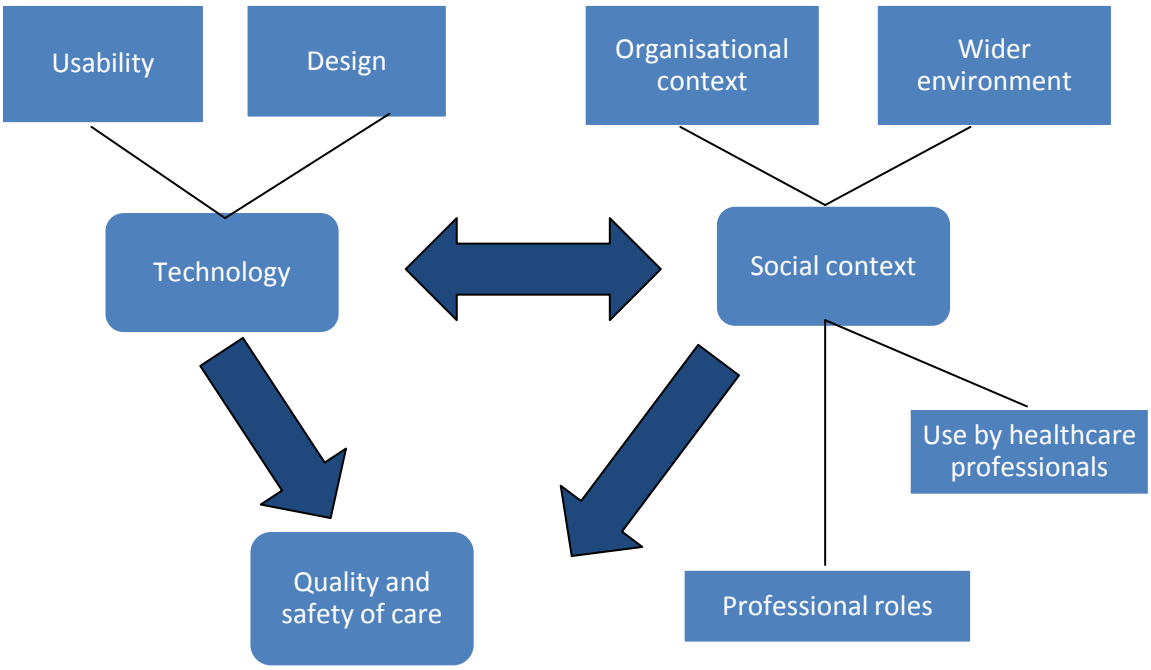


Figure 2.1 Dimensions commonly explored in sociotechnical evaluations of health information technologies. Reproduced from Cresswell et al (Cresswell and Sheikh 2014)

Figure 2.1 describes the various dimensions that may be evaluated for implementation of health information technologies. Sociotechnical perspective demonstrates an interdependency of both the technology and the social context with mutual influence. Therefore, sociotechnical evaluation entails assessment of the impact of technology on social processes, e.g. alteration in prescribing after HEPMA implementation and sequential alteration of technology by local customisation to make the technology work in the actual setting.

Cresswell et al propose five separate frameworks worthy of consideration as possible assessment tools when implementing health information technologies (Cresswell and Sheikh 2014). These are:

1. diffusions of innovation
2. normalization of process theory
3. social shaping of technology
4. HOT-fit
5. an evaluation framework.

Additional frameworks have been identified during an on-going literature review which are equally applicable to healthcare implementation (Michie et al. 2005, May 2013, Price and Lau 2014). IT related theories have been discounted for consideration in this particular study because HEPMA implementation is a specific healthcare IT system. Cresswell recommendations apply directly to healthcare settings and therefore HEPMA implementation is an applicable situation for use of these frameworks (Cresswell and Sheikh 2014). Thus, in total there were eight possible frameworks considered in devising the research questions, methods and aiding the analysis (Creswell 2013).

Table 2.11 provides an overview of the frameworks considered.

In conclusion, after the review in Table 2.11, there were five possible frameworks worthy of more in-depth consideration when evaluating the implementation of complex IT systems like HEPMA in healthcare settings.

Table 2.11 Theoretical Frameworks for Consideration

Theoretical Framework	Authors Publication year	Brief Description	Relevance to assessment of impact of HEPMA implementation
The Theory of the Diffusion of Innovation	Rogers E. 1983	Describes how innovation is spread into organisations and why this may or may not be successful.	Included in Theoretical Domains Framework therefore will not be considered in isolation
Evaluation framework	Cornford T, Doukidis G, Forster D. 1994	Provides an ordered evaluation for IT system implementation in developing countries.	Framework specifically devised for developing countries; HEPMA implemented into a developed country therefore excluded.
Social Shaping of Technology	Williams R, Edge D. 1996	Assesses how IT systems evolve in relation to the past, finance and cultural context.	Not relevant for assessment of the specific research question therefore excluded.
Theoretical Domains Framework	Michie S, Johnston M, Abraham C, Lawton R, Parker D, Walker A. 2005	Assessment of behaviour change in healthcare implementation intervention.	Needs consideration
Normalization Process Theory	May Carl 2006	Investigates how innovations are sustained in clinical situations over time and what promotes or hinders this.	Needs consideration
HOT-fit	Yosuf MM, Kuljis J, Papazafeiropoulou A, Stergioulas LK. 2008	Discovers the association among technology, human and organisational factors to assess successful implementation	Needs consideration
Implementation theory	May C. 2013	Assesses both outcome and process implementation in healthcare by identifying essential components.	Needs consideration
Clinical Adoption Meta-model	Price M, Lau F. 2014	Describes acceptance of implementation through time.	Needs consideration

POTENTIAL FRAMEWORKS FOR ASSESSMENT OF COMPLEX INTERVENTION IMPLEMENTATION INCLUDING HEALTH INFORMATION SYSTEMS

As outlined in Table 2.11 there were five theoretical frameworks that required to be considered for inclusion in the research design.

Theoretical Domains Framework

Michie et al undertook a consensus approach to identify the key domains required for successful implementation of interventions in healthcare which focused specifically on the behaviour change of healthcare staff (Michie et al. 2005). The result produced the Theoretical Domains Framework (TDF). Since its inception in 2005, the TDF has been content validated and refined by Cane et al to include 14 domains and 84 component constructs and captures 33 theories of behavioural change (Cane, O'Connor and Michie 2012). TDF has been used successfully in studies of interview and questionnaire design and has been used specifically to assess behaviour change in healthcare intervention implementation (Francis, O'Connor and Curran 2012, French et al. 2012). Lipworth et al also confirmed the applicability of TDF to quality improvement interventions (Lipworth, Taylor and Braithwaite 2013). TDF is established as an effective method to design interviews and questionnaires in healthcare. Duncan et al used semi-structured interviews based on TDF as part of the PROTECT study when interviewing junior doctors about prescribing errors (Duncan et al. 2012). Huijg et al used TDF to design questionnaires to determine implementation success in healthcare (Huijg et al. 2014). Patey et al used interviews based on TDF to assess behaviour change in doctors ordering tests (Patey et al. 2012). Therefore, the TDF would be appropriate to be adopted in the DPP project when designing an interview schedule.

Normalization of Process Theory

Normalization of Process Theory (NPT) investigates how innovations are sustained in clinical situations over time and what promotes or hinders this (May et al. 2009). May considers that the diffusion of innovations model does not provide a framework for assessing the conditions for practical implementation of complex interventions in healthcare. He advocates a need to assess not only if the system is functional but also if it has the ability to assimilate into the organisation and therefore suggests that NPT would be better as this examines "how complex interventions can become embedded in

clinical work" (May, Murray, et al. 2010). Normalization is defined as "the embedding of a technique, technology or organisational change as a routine and taken-for-granted element of clinical practice" (May, Murray, et al. 2010). This concentrates on the daily user and actual circumstances of use rather than on "special champions and early adopters". It takes into consideration that local adaptations may occur to allow systems to meet local requirements. "Normalization acknowledges that technological and organisational change in healthcare settings is often imposed". "NPT focuses on actions and processes" (May, Murray, et al. 2010). NPT requires looking at all the diverse people who use the system or are involved in making the system become routinely used and therefore concentrates on what people actually do rather than what they think. May states that" NPT can aid the creation of the research question and associated aims and objectives for qualitative research" (May, Murray, et al. 2010).

An internet toolkit is available to aid the use of NPT which provides an overview of how to use it and clear explanations for what it is intended (May, Murray, et al. 2010). NPT has been rejected as a theoretical framework because the DPP project is concerned with reviewing the outcomes of HEPMA system implementation specifically relating to discharge information communication and not system implementation evaluation per se.

HOT-fit Theory

An alternative framework for evaluation to determine if Health Information Technology Systems (HITS) are well implemented is described by Yusof et al and is called HOT-fit (Yusof et al. 2008). This examines the association among human, organisation and technology fit components. The authors claim that "culture and process changes are reported to be barriers to the wider use of health care systems" which includes changes to traditional models of working, organisational issues include hospital culture and risk adverse behaviours. They believe that human and organisational components are ranked equal with the technical functionality in what they call "fit". The human component considers individual HITS use i.e. how much and how often they use it; do they use it as intended; as well as user satisfaction. This includes satisfaction with particular aspects, the ease-of-use and general satisfaction with the system.

The organisation component concerns the managerial support and leadership including planning as well as environmental factors including politics and finance.

The technology component concerns the actual system with evaluation to include "system quality measures include ease of use, ease of learning, usefulness, availability, response time, system flexibility (adapt and fit in clinical setting) and security" (Yusof et al. 2008).

The impact of HITS implementation on organisational benefits is assessed by the impact on performance using both quantitative and qualitative measures. Measurement of clinical outcomes for example medication errors may be used as a quantitative measure whilst impact on communication and quality of care used as a qualitative measure.

The HOT-fit framework has been developed to evaluate HITS implementation in healthcare as a totality and thus it was beyond the scope of the planned DPP project.

Implementation theory

May initially developed NPT with colleagues. Subsequently he proposed a further theory called implementation theory which is described as an extension of NPT providing more detailed consideration of implementing and embedding an innovation or intervention into practice in healthcare (May 2013). May describes implementation as "a process-that is, as a continuous and interactive accomplishment- rather than as a final outcome" (May 2013). Implementation theory provides assessment of implementation of both outcomes and processes by identifying essential components: implementation; embedding; and integration. He defines implementation as "a deliberately initiated process, in which agents intend to bring into operation new or modified practices that are institutionally sanctioned, and are performed by themselves or other agents" (May 2013). He proposed four components to be studied "capacity, potential, capability and contribution" (May 2013). Capability concerns whether the innovation is workable in practice and if it can me subsumed into the local context. Capacity is dependent on individuals working together collectively to make implementation successful. Potential is dependent on individual's ability to implement or use the complex

intervention. Contribution is dependent on individuals continuing to engage and develop the complex intervention. There is a need to assess what individual attitudes and intentions are and also what it takes to make the system "business as usual" (May 2013). Do practitioners continually use the system? The evaluation should include personal accounts of practitioner's experience with the system to try to explain why what happened occurred. The implementation occurs in a complex environment with multiple practitioners facing time pressures and competing priorities. Are the individuals motivated both individually but also communally to make the new process work? Whilst these are essential questions that require to be asked when carrying out an assessment of the full HEPMA implementation, the focus of the DPP project was one component of the implementation. Also this framework concentrates specifically on the actual implementation rather than the outcomes of the implementation, so this framework was considered to be beyond the scope of the planned project.

Clinical Adoption Meta-Model

The clinical adoption meta-model (CAMM) as described by Price et al may be used to specifically evaluate implementation of health information systems (Price and Lau 2014). They define adoption as the process that "involves the multitude of activities, decisions and evaluations that encompass the broad effort to successfully integrate an innovation into the functional structure of a formal organisation" (Price and Lau 2014). They claim that CAMM describes acceptance through time. The use of CAMM ascertains how information systems are incorporated into routine situational working. It can be applied to a variety of system implementation and thus would be applicable to HEPMA implementation.

CAMM consists of four dimensions:

1. availability; describes the ability of required users to access the system
2. system use; describes how practitioners actually use the system for example the amount of use and includes practitioner know-how
3. clinical/health behaviour; describes customisation of system into the actual clinical setting and includes consideration of capacity

4. clinical outcomes; describes the impact of the system implementation which could be at different levels for example patients, costs etc The outcomes may be assessed over time e.g. initial outcomes and later outcomes.

CAMM may be used for evaluation although there is no evaluation format provided. They compare this model with other adoption models, for example diffusions of innovation and conclude that CAMM is superior because not only has it been contextualised to healthcare but it also assesses adoption in relation to clinical outcomes.

The results of CAMM are graphically depicted to show simultaneously the impact of all four dimensions necessitating data collection of at least some aspect of all dimensions. Thus, this method of assessment was beyond the scope of the DPP project.

Therefore, after consideration of these potential frameworks, the TDF was selected as the framework to use when undertaking the qualitative component of the DPP project. Notably, it is a validated framework that has been successfully used in similar research. TDF was used for analysis of semi-structured interview findings.

JUSTIFICATION OF SELECTION

The overall DPP project used a mixed methods methodology comprising of a quantitative quasi-experimental before and after study method and a qualitative interpretive phenomenology. Therefore, the overall DPP project adopted a pragmatic research approach.

Alignment to research methodologies

The alignment of philosophical belief, required research outcomes and research questions suggests mixed methods methodology is suitable to answer the research question. The rationale for selecting an overall pragmatic approach is because the researcher wants to use the most appropriate methodology to answer the research question which may be achieved by mixing different perspectives.

Johnson et al postulate that mixed methods utilisation produces higher quality research than use of a single method alone (Johnson and Onwuegbuzie 2004).

The benefits of each type of research method can be combined to produce a synergistic effect which is particularly suited to practice research. Mixing of research methods provides maximum opportunity to answer the research questions with consideration of experience and practical consequences.

It is important to ensure data integration from both methods to complete the expected study outcomes. When undertaking practice research, the study involves an examination in the actual context but using careful study design ensures that the results may be able to be generalized to a wider context. Furthermore, Cresswell et al advocate mixed methods research using both quantitative and qualitative components as being optimal for assessing implementation of complex systems like IT systems (Cresswell and Sheikh 2014). They also advocate using purposive sampling when completing the qualitative component so that the targeted individuals are familiar with the system and the investigating phenomenon (Cresswell and Sheikh 2014).

Thus, mixed methods methodology has been selected because the use of pragmatism (not being committed to any one epistemological or ontological position) will enable the research questions to be fully answered in the actual practice research setting. The mixed methods methodology permits measured assessment of the real situation with considered evaluation. The use of mixed methods allows the combination of stories from research participants to be combined with statistical analysis to create the actual picture of what is happening in relation to the research question. If quantitative methods are used alone there is some degree of understanding of the participants' situation; whereas if qualitative methods are used alone it is difficult to make wide recommendations because of the limited number of people included in the data analysis and also analysis is dependent on the interpretation of the researcher and may be open to bias.

Study Design

The required research aim was to assess the impact of HEPMA system implementation on medicines related discharge communication, from the perspective of the hospital staff involved in the communication process. Reviewing study design from identified literature has facilitated development of study methods. Careful consideration of research questions has also aided

study design. Study design should minimise the personal attitudes, values and beliefs of the PI. Thus by ensuring external validation and internal validation of data collection bias is minimised.

Therefore, multiphase mixed methods methodology was selected for the study design. The quantitative component consisted of an experimental study of quasi-experimental before and after study design to quantify the impact of HEPMA implementation on discharge communication prescribing errors and receipt of discharge communication at GP surgeries. The qualitative component consisted of interpretive phenomenology of semi-structured interviews so that the opinions of the staff groups involved in the discharge communication could be fully described and understood both before and after HEPMA implementation.

The use of theoretical domains framework (TDF) is established as an effective method to design questionnaires to determine implementation success in healthcare (Huijg et al. 2014). TDF was selected as the theoretical framework of choice when analysing the semi- structured interview findings. TDF has been established as an effective method to design interviews in healthcare (Duncan et al. 2012, Huijg et al. 2014, Patey et al. 2012).

Data integration is extremely important when conducting mixed methods research. A convergent method of data integration as outlined by Creswell was used to answer the research question (Creswell 2013).

It should be noted that throughout the DPP project, patients were excluded from the research focus. Whilst individual patients are the topic of the inpatient prescription chart and discharge communication, they are not directly involved in the prescribing of medicines and routinely do not have access to their prescription chart nor are involved in the communication process in either the traditional or newly implemented system.

RESEARCH GOVERNANCE

The project was registered with Robert Gordon University (RGU) using the Research Degree Registration (RDR) and Research Ethics: Student and Supervisor Appraisal (RESSA) forms. This ensured maintenance of appropriate governance and ethical principles.

The Research and Development department of NHS Ayrshire and Arran was notified of the project. Information received from the Research and Development department indicated that NHS ethical approval was not required for any phase of the project in compliance with the requirements of the NHS Research Ethics Committee (NHS Research Ethics Committee 2006). The project consisted of a service evaluation and did not directly impact on patients, staff or the investigators.

The data collected contained commercially sensitive information so were treated confidentially and stored on a secure "H" drive and compliance with NHS confidentiality procedures was maintained throughout (NHS Ayrshire and Arran Information Governance Team 2010). The "H" drive was only accessible by the PI and the laptop used for access was kept securely in the pharmacy department or on the person of the PI. Paper copies of consent forms were stored securely in the pharmacy department in a locked drawer only accessible by the PI. The data collected and stored were fully anonymised and names did not appear on any study documentation or reports. Compliance with Data Protection Act 1998 requirements (*Data Protection Act* 1998), the updated Caldicott Principles (Caldicott 2013) and the Common Law Duty of Confidentiality were also maintained. The National Research Ethics Service Defining Research paper indicates for projects designed to judge current care with a question of "What standard does this service achieve?", and only uses usual intervention with involvement of interviews without randomisation do not require Research Ethics Committee review (NHS Research Ethics Committee 2006).

PATIENT SAFETY IMPLICATIONS

The study included retrospective case note review which raised the potential for patient safety issues to be identified. The PI is a practising pharmacist registered with both the pharmacy regulatory body, the General Pharmaceutical Council (GPhC); and the pharmacy professional body, the Royal Pharmaceutical Society (RPS) and as such is bound by both professional and ethical considerations when working as a pharmacist especially in relation to actions of professional judgement. Both the GPhC and RPS provide ethical guidance for pharmacists (General Pharmaceutical Council 2012, Royal Pharmaceutical Society of Great Britain 2014). Both organisations cite "make

patients your first concern" (General Pharmaceutical Council 2012, Royal Pharmaceutical Society of Great Britain 2014). The GPhC further describes this as to "take action to protect the well-being of patients and the public" and "consider and act in the best interest of individual patients and the public" (General Pharmaceutical Council 2012). To mitigate problems in circumstances where issues were identified, the PI planned to discuss with a senior member of medical staff any details of concern. The PI planned to refer any issues considered of a serious and/or ongoing nature to the patient's general practitioner for consideration and appropriate action. No such issues were identified during the project.

CHAPTER SUMMARY

This chapter has provided a brief outline of research philosophies, methodologies and possible research approaches. The different types of research methods have been described with a justification of the selected methodology and methods. Details of potential theoretical frameworks to be used in study designs gave been discussed with a justification for the selected framework. Finally, the consideration of research governance issues has been described.

CHAPTER 3 PRE-IMPLEMENTATION INTERVIEW

CHAPTER INTRODUCTION

This chapter describes the aim and research questions for the pre-implementation qualitative interview phase of the DPP project. There is a brief description of methodology prior to detailed coverage of study methods, findings and discussion.

Contextualisation

Implementation into hospitals of innovative electronic solutions for discharge communication has been described in detail in Chapter 1. Previous studies investigating the implementation of these solutions have involved mainly quantitative studies which tended to include an assessment of specific aspects for example information content, accuracy and receipt time of discharge letters at GP surgeries (Pillai, Thomas and Garg 2004, Alderton and Callen 2007, Scullard et al. 2007, Callen, Alderton and McIntosh 2008, Abdel-Qader et al. 2010, Callen J, McIntosh J and Li J 2010, Chen, Brennan and Magrabi 2010, Hammad et al. 2014). Qualitative research was undertaken to a lesser extent, mainly ascertaining GPs' opinions regarding the discharge communication process but with little focus on the perspectives of hospital staff (Pillai, Thomas and Garg 2004, Alderton and Callen 2007, Scullard et al. 2007, Callen, Alderton and McIntosh 2008, Chen, Brennan and Magrabi 2010). The only study ascertaining opinions from hospital staff perspectives was reported by Yemm et al who invited (n=74) junior hospital doctors to prioritise the content of discharge letters in a questionnaire survey (Yemm et al. 2014). There is therefore a clear deficiency in the published literature relating to hospital staff perspectives of the systems prior to implementation of electronic innovations.

AIM

The aim of this phase of the project was to describe and understand perspectives of key staff groups (i.e. consultant doctors, junior doctors, pharmacists and advanced nurse practitioners) relating to patient discharge communication via the traditional paper based system and prior to HEPMA implementation.

OBJECTIVES

1. To describe and understand staff views and experiences of the traditional paper based system
2. To explore expectations and likely behaviours in relation to HEPMA implementation
3. To highlight any differences in key themes identified amongst different professional staff groups

QUALITATIVE STUDY DESIGN

As described in Chapter 2, the philosophical stance of the PI was pragmatism and thus the DPP project utilised multiple approaches appropriate to the research aim and objectives. The DPP project comprised mixed qualitative and quantitative research approaches.

This phase of the research employed a qualitative methodology, which described in Chapter 2 as best at answering "why and how questions" and most suitable for research examining processes (Schimmel 1996).

Methodology and method

The study design used interpretative phenomenology to fully describe and understand the perspectives of staff groups involved in discharge communication using the traditional paper based system prior to HEPMA implementation. As described in Chapter 2 phenomenology usually involves conducting interviews or focus groups. In this case, the selected study method was face-to-face semi-structured interviews. A literature review had identified that semi-structured interviews were previously used in a similar study and literature review indicated that this would be a suitable method to achieve this phase study objectives (Wilson et al. 2001). Semi-structured interviews permitted more detailed information acquisition whilst promoting trustworthiness and data comparison as described in Table 2.8.

Interview Format

The interview was guided by use of an interview schedule, to allow the interviewees to provide their personal views and experiences, which allowed the PI to ask core questions which were supplemented by probing questions. These probing questions included requests for further details of specific items, clarification of actual meaning of statements and asking for specific examples

(Bowling 2014). The interview format was developed in line with the criteria outlined in Chapter 2 so that the influence of the interviewer was minimised. At the end of the interview, the participant was given the option to add any additional information not already covered, as recommended by Wahyuni (Wahyuni 2012).

Interview Schedule

The interview schedule is provided in Appendix 3.1 The questions were developed after conclusion of a narrative literature review (Chapter 1), review of local incident reports concerning medicines and consideration of SIGN 128 guideline recommendations (Scottish Intercollegiate Guidelines Network (SIGN) 2012). As described in Chapter 1, SIGN guideline 128 is national Scottish guidance defining the ideal content of hospital discharge documentation. This guidance states the minimum requirements (comprising of 29 sections) of essential information to be communicated at hospital discharge to primary healthcare professionals. This information may also be provided to patients and carers.

The interview schedule required gathering information which included: the code number of the participant (rather than name to maintain anonymity); interview date; and start and stop time of interview (enabled calculation of interview duration). Demographic information was included in the initial section of the semi-structured interview schedule.

The schedule consisted of five main components: inpatient prescribing; discharge prescribing; discharge letter process; incident reports and significant adverse event reviews; and HEPMA implementation. Questions about both inpatient and discharge prescribing were included because any prescribing errors present on the inpatient prescription chart may be transferred to the discharge letter. Verification of the initial interview topic guide was achieved by review from a senior pharmacist involved in the education and training of junior doctors in NHS Ayrshire and Arran and also by the university supervisory team.

Interview Pilot

The verified interview schedule was pilot tested by the PI with a consultant doctor, allowing any identified deficiencies to be rectified before

commencement of the participant interviews. The pilot interview enabled the PI to ensure that the questions permitted the participant to speak freely and tested the ability of the investigator to formulate probing questions. Feedback from the pilot participant was positive and no amendments were made to the interview schedule. Furthermore, the pilot lasted 22 minutes, within the planned 20 to 30 minutes. The pilot interview was excluded from data analysis.

Sampling

Non-probability sampling approaches are mainly used in qualitative research and details about the different approaches have previously been outlined in Chapter 2. In non-probability sampling, the population as a whole is unknown, but there is a shared characteristic (Davies 2007). Bowling claims that for qualitative research, sampling is normally undertaken using convenience, purposive, snowballing or theoretical sampling methods (Bowling 2014). Starks et al, in a discussion of possible methodologies for qualitative research in healthcare settings, suggest that irrespective of the selected approach that purposive sampling should be used to capture interviewees who have knowledge of the investigated experience (Starks and Trinidad 2007).

In this instance purposive stratified sampling was used. As outlined in Table 2.9, purposive sampling enabled the targeting of key individuals involved in the discharge process to enable accurate result generation.

Inclusion and exclusion criteria

To be included in the sample, the individual had to be a member of the identified staff groups currently working at UHC and involved in the discharge communication process. The identified staff groups consisted of consultant medical staff, junior medical staff, advance nurse practitioners and pharmacists. Staff were excluded if they worked at University Hospital Ayr (UHA), at both UHA and UHC, or had routine experience of HEPMA systems which was assessed by asking about previous HEPMA use and frequency.

The aim was to recruit a diverse sample in terms of the following criteria: gender and years worked at research setting. The length of time an individual had worked in the organisation may impact on their perceptions of systems

and identified problems. More junior staff may be less aware of process and procedural problems.

The number of eligible members of each professional group currently employed at UHC is as follows: consultant medical staff 46; advance nurse practitioners 38; pharmacists 35; and junior doctors 64.

Sample size

The determination of an adequate sample size in qualitative research is ultimately a matter of judgement and experience and depends on the selected qualitative design. Creswell claims that, "phenomenology typically range from three to ten" (Creswell 2013), whereas Starks et al suggest that the required sample size for phenomenological studies is usually one to ten people (Starks and Trinidad 2007).

It is important to ensure the sample size is adequate for the research purposes without being larger than needed as research funds and interviewees' time are wasted (Francis et al. 2010).

Another conventional approach is to continue until "data saturation" is achieved. Data saturation is defined as "the point in data collection when no new additional data are found that develops aspects of a conceptual category" and Francis et al claim that it is essential to reach data saturation to ensure that content validity has been achieved for the sample (Francis et al. 2010). The principles should be agreed by the research team prior to starting the study so that consensus may be reached about when to stop (Francis et al. 2010). Francis et al propose an approach for achievement of data saturation (Francis et al. 2010). This is by agreeing the minimum number of interviews to be analysed first and then subsequently to state the number of further interviews to be completed without any new ideas being voiced. They claim that this method may not be suitable for research using interviews with sub-groups but that a modified version may be applicable (Francis et al. 2010).

Anticipated Sample Size

It was anticipated prior to starting the interviews that to achieve total population data saturation a sample of five to six members of each professional group would be sufficient. If necessary, this number could be

amended upwards or downwards to achieve overall data saturation and not necessarily for each individual professional group.

Recruitment

Service leads (who are managerially responsible for staff within their respective areas i.e. associate medical director, lead pharmacist, associate nurse director, and assistant director of medical education) were initially asked verbally by the PI to nominate individual staff members from their jurisdiction to participate in this service evaluation. This initial verbal communication was followed by an e-mail request. The service leads were each asked to nominate five to six staff members as this was thought to be a suitable number to achieve data saturation as described above. Sampling bias, as outlined in Chapter 2, was minimised by requesting the service leads to select staff with a broad demographic range in relation to gender and years worked at hospital. The PI then invited the nominees by e-mail to participate in the study. The e-mail invitation is provided in Appendix 3.2. All nominated staff responded positively to the request.

Participant Information and Informed Consent

All nominated staff were e-mailed a copy of the information sheet to their secure NHS email accounts (which are readily accessible) a week before the scheduled interview. Every interviewee was provided with a participant information sheet (Appendix 3.3) by the PI and asked to sign an informed consent form (Appendix 3.4) if they agreed to be included in the study. They were asked to confirm that they were still willing to proceed by e-mail reply. The investigator obtained a signed copy of the consent form on the day of interview. Staff kept a copy of both the participant information sheet and a signed copy of the informed consent form.

Interview Procedure

The PI conducted all face-to-face interviews at a location and time convenient to the interviewee. The interview locations were either the interviewee's private office or a private room located in the pharmacy department of UHC. No interviews were conducted in public spaces. The interviews were completed during February to August 2013.

The PI used a mixture of key questions and associated probing to ensure all relevant topics were covered, whilst permitting flexibility of discussion. The interview format allowed the interviewee to provide their personal opinion of the prescribing and discharge communication process. The interview schedule was developed iteratively as the interviews progressed. This required very little change to the content, merely an initial description of the interview structure was provided in the introduction and clarification of a minor aspect. The initial question of what, if any, impact will this (HEPMA implementation) have on your present role or profession was separated into two distinct questions.

Interviews were audio recorded with interviewee consent. The recorded information was transcribed verbatim by the PI immediately or as soon as possible after the interview. The transcription used a denaturalised style and names of interviewees were not included in the transcript (Oliver, Serovich and Mason 2005). A denaturalised approach was selected as the interview content rather than the delivery of the speech was of interest (Oliver, Serovich and Mason 2005). The recorded information was deleted from the recording device and computer after transcription and verification of transcription had been completed.

Theoretical Frameworks

The use of a theoretical framework is recommended by both Evans et al and Cresswell et al, as described in Chapter 2, because it provides helpful organisation of complex assessments (Evans, Coon and Ume 2011, Cresswell and Sheikh 2014).

Theoretical Domains Framework

The Theoretical Domains Framework (TDF) was developed to identify key domains for successful implementation of healthcare interventions with a specific focus on behavior change interventions, as described in Chapter 2.

TDF has been validated and refined by Cane et al to include 14 domains and 84 component constructs and captures 33 theories of behavioural change as described in Chapter 2 (Cane, O'Connor and Michie 2012). The use of theoretical domains framework (TDF) is established as an effective method to design questionnaires and semi-structured interviews and to determine

implementation success in healthcare (Cane, O'Connor and Michie 2012, Duncan et al. 2012, Huijg et al. 2014). Duncan et al used semi-structured interviews based on TDF as part of the PROTECT study when interviewing junior doctors about prescribing errors (Duncan et al. 2012). Patey et al used interviews based on TDF to assess behaviour change in doctors ordering tests (Patey et al. 2012). Furthermore, Fleming et al applied TDF to semi-structured interview findings regarding antibiotic prescribing (Fleming et al. 2014).

Application of the Theoretical Domains Framework

The Theoretical Domains Framework (TDF) was used in this research to aid analysis of results for behavioural aspects of the traditional prescribing processes. Once inductive coding had been completed, data were mapped to the domains of the TDF.

Table 3.1 is adapted from Cane et al and provides a list of the domains and associated constructs. The interview transcripts were mapped to the 14 domains of the theoretical domains framework (Cane, O'Connor and Michie 2012).

Table 3.1 Theoretical Domains Framework adapted from Cane et al (Cane, O'Connor and Michie 2012)

Domain	Domain Definition	Example Constructs
Knowledge	An awareness of the existence of something	Procedural Knowledge Knowledge of task environment
Skills	An ability or proficiency adapted through practice	Competence Practice
Social/professional role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	Professional role Professional confidence
Beliefs about capabilities	Acceptance of the truth, reliability or validity about an ability, talent or facility, that a person can put to constructive use	Self-confidence Perceived competence
Optimism	The confidence that things will happen for the best or that desired goals will be obtained	Optimism Unrealistic optimism
Beliefs about consequences	Acceptance of the truth, reliability or validity about outcomes of a behavior in a given circumstance	Outcome expectancies Consequences
Reinforcement	Increasing the probability of a response by arranging a dependent relationship or contingency between the response and the given contingency	Rewards Punishments
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions Stages of change model
Goals	Mental representation of outcomes or end states that an individual wants to achieve	Target setting Implementation intention
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Decision making Cognitive overload/tiredness
Environmental context and resources	Any circumstances of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Resources Critical incidents
Social influences	Those interpersonal processes that cause individuals to change their thoughts, feelings or behaviours	Social pressure Group conformity
Emotion	A complex reaction pattern, involving experiential behavioural, and physiological elements, by which the individual attempts to deal with a personally significant event or circumstances	Anxiety Stress
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring Action planning

Data Analysis

Data transcription has been proposed as the first part of analysis and enables the researcher to become immersed in the data. Transcription is time consuming and it is estimated that one hour of recorded data takes approximately between two and four hours to transcribe (Wahyuni 2012). Data immersion is also achieved by repeated reading of the interview transcripts. Verification of the transcribed data was achieved by university supervisor review of a random sample of 20% of the transcripts against the recordings.

All generated transcribed information was entered into NVivo 10© software by the PI (QSR International). NVivo© is computer software package which is designed for qualitative research and facilitates structured organisation and analysis of interviews and other qualitative research methods. The data included anonymised interviewee details including gender, years worked at UHC and professional group of interviewee.

Framework analysis was the selected data analysis method because of its previous use in healthcare research and because it provides a systematic, structured approach to data analysis whilst permitting data transparency (Smith and Firth 2011). Gale et al state that "the framework method is most commonly used for thematic analysis of semi-structured interview transcripts" (Gale et al. 2013). An advantage of thematic analysis is that the data tends to be a true reflection of the interviewee statement and it is usually presented as anecdotes or direct quotes.

Pope et al claim that framework analysis is especially suited for qualitative research with pre-defined objectives (Pope, Ziebland and Mays 2000).This is therefore consistent with the DPP project design as the framework approach suits studies with pre-identified questions (or objectives) set in short time frames and related to policies and procedures. Data were sorted by looking for principal themes from the interviews, evolving themes and issues of interest in relation to the objectives. This reflects an inductive approach as outlined by Gale et al when "themes are generated from the data through open (unrestricted) coding, followed by refinement of themes" (Gale et al. 2013).

Coding of Key Themes

Nodes were created for each identified concept in the interview transcripts. A node is defined as "a representation of an idea, theme or category" (QSR International). This is the coding method used in NVivo 10© (QSR International). FrameWork© has been integrated into NVivo 10© which assisted with data analysis. Data analysis consisted of deconstructing the content, sorting by themes and arranging data into themes. Gale et al outline seven stages in the process of data analysis using the framework approach (Gale et al. 2013). The stages and actions taken are provided in Table 3.2.

In NVivo 10©, a free node is defined as "a node not connected to anything else and represents ideas, concepts and themes in the dataset." Further review of the data identified that certain nodes were connected or expressed similar ideas so that a tree map was additionally created. The tree structure aided the organisation and classification of concepts. An example of a tree map is provided in Figure 3.2.

Table 3.2 Data Analysis Stages as described by Gale et al and project specific actions (Gale et al. 2013)**.**

Stage	Actions undertaken
Transcription	Audio recorded interviews were transcribed verbatim using denaturalised style by the PI. The interview content was more important than the speech nuance.
Interview familiarisation	The PI listened to the audio recordings repeatedly and also read the transcripts several times to aid with identification of developing themes in the interviews.
Coding	The PI completed coding by highlighting certain sections of the transcripts using an inductive method. The codes generated were topics repeatedly raised during the interviews. A sample of interview transcripts was independently coded by university supervisor. In addition TDF constructs were applied to identify behavioural components of the interviewees.
Framework development	After code agreement between the PI and the university supervisor the agreed codes and the TDF constructs were applied to all transcripts to create a framework.
Application of framework	Codes entered into computer software package NVivo 10© by PI to aid data analysis.
Data charting to framework	Development of framework matrix by using the computer software package which included a direct link to the original transcript so that the original text could be viewed in the context of the interview.
Data interpretation	Data interpretation using the original inductive codes and also deductive coding using the TDF to describe and understand interviewees' views and behaviours associated with the themes and also allow the exploration of relationships amongst themes.

PROMOTING QUALITY

Trustworthiness

Consideration of the four criteria for trustworthiness, as outlined in Chapter 2, was applied in conducting this qualitative research.

Credibility was promoted by selecting a semi-structured interview method which has been used in similar studies and therefore was an appropriate research method. The purposive sampling approach ensured that the interviewees interviewed were representative of the staff familiar with using the traditional handwritten discharge communication systems. Staff were able to refuse to participate in the study and were informed of the possibility of withdrawal from the study even after completion of the interview. The PI held frequent discussions with the university supervisory team throughout this phase of the DPP project and an oral communication of the early results of this study were presented at The Royal Pharmaceutical Society Conference in September 2013 and therefore allowed discussion amongst peers and academics about the research and permitted feedback to be obtained.

Transferability of results is possible as a clear description of the methods used has been provided along with an in-depth description of the setting and interviewees.

Dependability was achieved by provision of full details of the research design and data collection methods.

Confirmability has been achieved by use of robust audit trail including transcript and thematic review by the university supervisory team. However, it is impossible to discount that the role of the PI in the organisation may have impacted the interviewees' response during the semi-structured interviews. The role of the PI aided access to staff for interviews and all potential interviewees contacted agreed to partake in the interviews. This response may not have been achieved if a researcher external to the organisation had been undertaking the interviews. The PI attempted to minimise bias stance concerning the traditional prescribing systems and the perceived benefits of HEPMA implementation. One of the biggest challenges the PI faced when conducting the interviews was being directly questioned by the interviewee about HEPMA implementation and HEPMA benefits. The skill of the PI at

deflecting these questions was iteratively developed during the course of completing the pre-implementation interviews.

Finally, a rigorous approach to data analysis was applied by the use of framework analysis in the established NVivo 10© computer programme to maximise trustworthiness.

Research Governance

The study did not require NHS Ethics approval as the work was considered a "service evaluation" as outlined in Department of Health Guidance (Department of Health 2013). The communication from UHC Research and Development Department is provided in Appendix 3.5. The research was approved by the ethical review panel of the School of Pharmacy and Life Sciences, Robert Gordon University (RGU). The communication from RGU is provided in Appendix 3.6.The audio recorded interviews were anonymous and likewise identities were excluded from interview transcripts and all documentation. Once transcription was completed the audio recordings were deleted. The completed consent forms were securely stored in a locked filing cabinet in the secure environment of the pharmacy department. The generated data were securely stored in a locked filing cabinet and password protected computer only accessible by the principal researcher. Data Protection Act 1998 requirements, the Caldicott Principles and the Common Law Duty of Confidentiality were adhered to throughout the study (Act 1998, Caldicott 2013).

FINDINGS

Interviewed Staff

A total of 19 staff members were interviewed from the 22 that agreed to be interviewed. Three staff were not interviewed: one ANP and two junior doctors. No staff refused to participate in the interviews. One of the consultant interviews needed to be rescheduled due to service pressures. One of the ANPs interview could not proceed as the individual had been working at UHA for the previous six months. Demographic details of the interviewees are provided in Table 3.3. The PI experienced the greatest difficulty in scheduling interviews for junior medical staff. This was resolved by certain doctors coming in early before their shift commenced to participate in the interview.

The interview length ranged from 14 minutes to 42 minutes; with a median of 26 minutes. All interviewees were familiar with and regularly used the traditional paper based inpatient prescribing, discharge prescribing and communication processes. The interview phase was completed when total population data saturation was achieved which accounts for the difference in numbers interviewed amongst the professional groups.

Table 3.3 Interviewee demographics

Advanced Nurse Practitioner	**Gender**	**Years worked at UHC**	**Any prior electronic system use**
1	F	15-16	Yes
2	F	27	Yes
3	F	13	Yes
4	F	15	Yes
Consultant Medical	**Gender**	**Years worked at UHC**	**Any prior electronic system use**
1	M	11	Yes
2	M	9	Yes
3	M	15	No
4	F	5	Yes
5	M	5.5	No
6	M	8	Yes
Junior Medical	**Gender**	**Years worked at UHC**	**Any prior electronic system use**
1	F	< 1 year	Yes
2	F	< 1 year	Yes
3	F	< 1 year	Yes
Pharmacist	**Gender**	**Years worked at UHC**	**Any prior electronic system use**
1	M	2	Yes
2	M	7	Yes
3	F	13	No
4	F	5	Yes
5	F	4	Yes
6	F	26	Yes

Prior Exposure to HEPMA

Table 3.3 shows that the majority of interviewees had some previous exposure to electronic discharge systems, however no one individual had routine prior HEPMA experience. All the ANPs had minimal experience with HEPMA at UHA; the maximum number of HEPMA system usage that any individual acknowledged was up to four times. In the pharmacist staff group, one pharmacist had witnessed HEPMA as a pharmacy student at UHA; another was familiar with the system from previous work at UHA limited to the dispensary; and three other pharmacists had used electronic discharge systems in other hospitals in different Health Board areas in Scotland. One of the consultants had used a discharge module of HEPMA as a pilot at UHC; one had used an electronic discharge system in a different Scottish Health Board area; another had used a bar-coded system in England; whilst another had experience of an electronic prescribing system in Australia. None of the junior medical staff had prior HEPMA exposure but all had experience of using an electronic discharge module in a different Scottish Health Board area.

Framework Analysis Results

Initially 28 free nodes (as defined on page 11) were created including experiences with the inpatient charts, immediate discharge letters and the discharge letter process.

Staff Experience

The interviewees described their experiences with the traditional prescribing systems and discussed difficulties at all patient journey stages.

One particular issue during the inpatient stay was the difficulty of knowing whether a medicine had been administered as the traditional system relies on alpha/numerical code and the same medicine may be associated with different letters/numbers if it has been rewritten. As described by one junior doctor,

'*it's on a different sheet and I think sometimes it's confusing when there's a few kardexes and it's A1 or A2'* [JD1]

This was reinforced by a pharmacist,

'It's not quite clear what has and hasn't been given' [Ph4]

The structure of the IDL was discussed and a lack of space and not having specific sections were highlighted. As one ANP stated,

'There isn't anywhere to record the patients' drug allergy status.' [ANP1]

Likewise a pharmacist described the recording of compliance device information as,

'*There's no specific part on the prescription again for that* (compliance device information)' [Ph 5]

The experience of the existing discharge process was described as leading to significant delays, as discussed by one consultant,

'*so three to four month delay in getting them (final typed letter) done, 30% of discharge letters are never done'* [C1]

Staff behavioural determinants

The TDF was used to explore behavioural determinants of the interviewees in relation to the traditional prescribing and discharge communication processes.

Six of the 14 domains of the TDF were applicable to discussion topics identified during review of the interview transcripts. The relevant domains and associated constructs are depicted in Figure 3.1. While there is a difference in terminology with TDF referring to constructs and NVivo© to nodes, these are now described as themes.

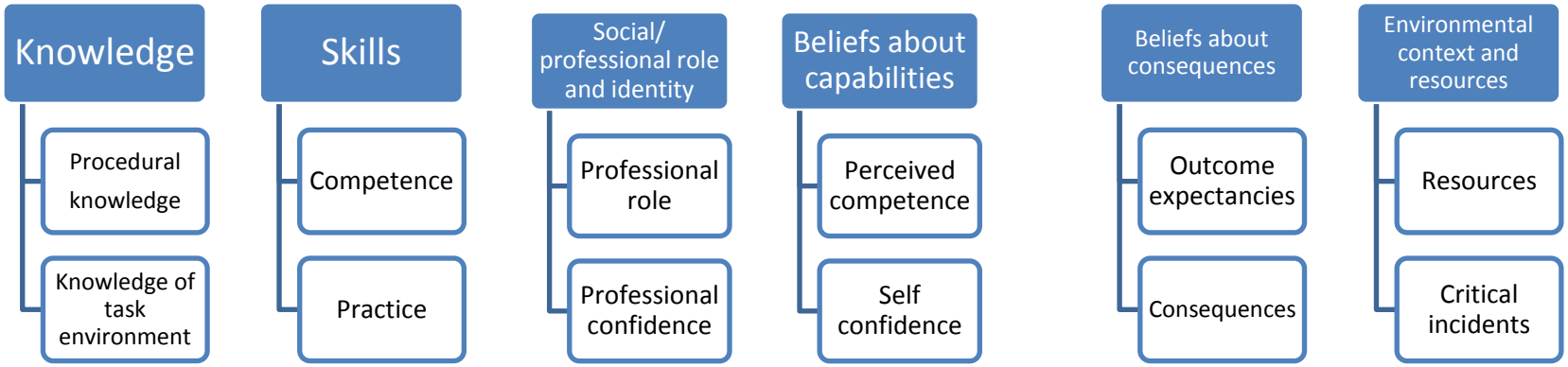


Figure 3.1 TDF Domains and associated constructs mapped to interview findings

THEORETICAL DOMAINS

Knowledge Domain

All interviewees (i.e. ANPs, consultants, junior doctors and pharmacists) described knowing what to do and how to do it in association with the traditional documentation. The process of completing a handwritten immediate discharge letter followed by a typed formal discharge letter was understood and followed, although deficiencies in the process were acknowledged especially with delays in process completion. As one ANP described,

'I like the sheet that's there, I think it is easy enough to read through, I think it is easy enough to see what drug has been prescribed and when the patient is to get it. I've worked with it for over a decade as a qualified nurse and very much used to that system of prescribing –I don't have any issues with that.' [ANP1]

However, another ANP described limitations of the traditional discharge documentation,

'*There is not much room to prescribe – I think there is only about six boxes to actually prescribe drugs so again you have to use about two or three different sheets for some patients that are on lots of polypharmacy*.'[ANP 4]

One consultant articulated the failure of the paper immediate discharge letter to meet the national standards described in the SIGN discharge document (Scottish Intercollegiate Guidelines Network (SIGN) 2012),

'*Our current drug charts do not easily lend themselves to meeting SIGN requirements for discharge letters, so it's not easily apparent to see which drugs have been discontinued purposefully, which have been crossed off maybe with the intention being re-commence but weren't recommenced* ' [C2]

The delivery method for the IDL to reach the patients GP was described by one interviewee whilst acknowledging limitations in the letter content as,

'*Patients are quite well informed about handing the letter to their GP as soon as possible but I think communication in relation from prescribers what is on the letter is something to be desired.'* [ANP3]

The description of the traditional prescribing documentation layout and of the discharge letter process was outlined by interviewees who articulated their opinions regarding the design of the documentation.

One pharmacist described problems with the inpatient chart as,

'You know if it is maybe azithromycin three times a week or something like that or if you want to give a diuretic on alternate days it's not the easiest thing to do using the particular paper kardex that we have.' [Ph 2]

Whilst the immediate discharge letter was viewed more favourably as,

'What works well on the immediate discharge letter is that there is space on it to write the accurate diagnosis, what tests and investigations have been done and because you are able to write that, that should correlate with what is prescribed. '[ANP4]

Although a pharmacist highlighted difficulties when controlled drugs need to be prescribed,

'Because it doesn't lead the prescriber to provide the legal requirements- it's a generic chart intended for any medicine and it doesn't prompt for example the words and figures requirement under the Misuse of Drugs Act.' [Ph6]

Several interviewees explained familiarity with the documentation was important to them. This ensured that the staff knew what to do when they were prescribing medicines and completing the discharge process. One consultant described,

'Ok well the positive side is familiarity with the concept in terms of what we've always done so people understand particularly the permanent staff how the kardex works, how it's written out, how it's administered ' [C1]

Interviewees describing how to use the current documentation, explained how they individually completed it and also described systems they had developed to improve information accuracy on the prescribing documentation. A junior doctor described their personalised process as,

'I've just finished working in haematology/oncology and as patients maybe became more palliative there was maybe screeds… a couple of pages of kardexes when one would have done. I personally if I've got the time do try and re-write kardexes to try and make it easier because some of them are very confusing if you've got a list of ten or twelve medications and most of them have been crossed off apart from maybe one amongst there – it can get lost quite easily.' [JD1]

Whilst a consultant described their actions to improve safety as,

'If the drug chart is not reviewed and I will review them at least twice a week on my ward rounds. I make a point of looking at every drug chart for my patients as part of consultant review...so we always try to at least act to make sure that everything is re-charted on a single chart wherever possible' [C5]

However, inconsistencies in the application of processes were described by some interviewees.

'How consistent we are in documenting it on the form I think again it's very variable with inconsistency.' [C6]

Skills Domain

The interviewees discussed their skill to prescribe and practice within the existing traditional system. Ease of access was cited as a positive factor by one pharmacist,

'I think that what works well is obviously that it is easy to hand, the doctors are used to the system- they don't have to learn how to do anything they just have to write out the doses and things like that' [Ph6]

And this was reinforced by an ANP,

'The current system is accessible so if a patient takes unwell you can quickly prescribe there and then what has to be administered' [ANP 4]

The traditional documentation is not conducive to enabling prescribing in accordance with accepted standards which is exemplified by the comments of one consultant.

'In a number of cases it can be unsatisfactory if the junior doctor doesn't prescribe it in a clear manner. If the dose is not specified clearly you know sometimes it is difficult to give micrograms, milligrams or these kind of abbreviations that can be sometimes mixed up. Sometimes also about slow release tablets if it has not been written as a slow release that can sometimes cause problems'. [C3]

A pharmacist provides an additional example specifically related to the IDL as,

'Quite often the regular medicines are omitted from the paper prescriptions for discharge and they are only prescribed the acute medicines antibiotics, nebules whatever and they are only prescribed new medicines and quite often … they just write below "no changes to regular medications" which isn't the best for GPs to understand what the patient's taking. Again quite often it's omitted whether or not a patient's medicine has been stopped' [Ph2]

The interviewees did not claim a lack of training or deficiency in prescribing skills as an individual consideration. The one skill that was repeatedly highlighted as an issue was handwriting; with legibility a specific concern for both inpatient and discharge documentation.

'Quite often it is illegible.' [C6]

It (IDL) is usually done in a hurry, usually the writing is very difficult to read once the medication has been written and there have been some mistakes of course because of missing tablets and writing the wrong duration or wrong frequency. So this is definitely not satisfactory. [C3]

Social /professional role and identity domain

A change to prescribing legislation in the UK in 2006 enabled nurses and pharmacists to practice as independent prescribers. The newer prescribing professions (nurses and pharmacists) focused on the professional aspect of prescribing and their professional confidence about prescribing during the interviews. One ANP described as,

'If I'm asked to prescribe something I've never prescribed before I won't do it unless I go and look up the BNF but if there is a doctor there that is willing to prescribe it..' [ANP4]

Whilst a pharmacist considers the changes that HEPMA will bring in relation to ability to prescribe as,

'Prescribing medicines myself as a pharmacist with HEPMA will be fine, it will be straightforward.' [Ph2]

The SIGN discharge document recommends consultant review and sign-off wherever possible of the immediate discharge letter (Scottish Intercollegiate Guidelines Network (SIGN) 2012). Difference in the opinions amongst the professional groups was evident. All professional groups except consultant medical staff reported consultant counter signing never occurred as exemplified by the comments below

'None of them (the consultants) have ever signed.' [ANP 2]

'I don't think it ever is- I've never seen that done.' [JD2]

'Never absolutely, I have never seen a consultant sign off a discharge letter.' [Ph3]

It should be acknowledged that the consultants reported infrequent signing of the document themselves.

'Rarely, I would say if I guess 1 in 30, 1 in 40 maybe if a consultant sees or I do it myself very occasionally – maybe 1 in 100 I think so that's about it.' [C6]

Beliefs about capabilities domain

Some staff described anxiety when currently prescribing using the systems available to them as described by one ANP as,

'From a prescriber sometimes I don't feel very secure.' [ANP 3]

Whilst others described how they had changed their practice to improve competence as highlighted by one junior doctor,

'I was guilty of just writing "No changes to meds" because when I was doing surgical admissions and if you've get ten discharge scripts to do to write everybody's medicines and if all their antihypertensives have stayed the same it seems a bit excessive……. and I do write even though they take longer.' [JD1]

Consultant medical staff expressed concern about the abilities of junior doctors when completing certain tasks as,

'...it is written by juniors and they take the information from what they understand happened and quite often they might not have a full understanding. It depends very much on the person who writes it, when they write, how legible they write it and of course, everyone is different so there's no set standard to that process – it's just pure luck really.' [C6]

Variability was also cited as an issue by another consultant.

'Not everybody prescribes in block capitals, not everybody puts a diagnosis, not everybody details what's been stopped- so very variable.' [C4]

Apprehension was expressed when changing to HEPMA and its potential impact on prescribing competence. Interviewees described how the current system means they need to check doses and become familiar with routinely prescribed medicines which may disappear with HEPMA.

You probably have to be quite careful if you were starting someone on something that it could come up with a whole range of different doses for somebody or amitriptyline you might want to give someone a small dose for it but say you type in and it's giving you a range of doses you might want to be careful to pick the right dose which I think could easily go wrong- so many options you accidentally click the wrong one. [JD1]

I think there is a worry that people will become complacent or not be so responsible for their own prescribing practice. I think if you put any system in place where the system does it all for you, you just come complacent, stop thinking and you just let the system guide you and I think there is a danger in that and I would like to be able to think that I am on top of my responsibilities as a prescriber. [ANP1]

Beliefs about consequences domain

Interviewees described patient safety concerns and discussed issues with inadequate information provision on discharge as exemplified by one consultant.

'There are deep concerns about the safety around about using the paper kardex, legibility, frequency, recording of administrations, start and finish times and reasons for drugs?.....There are significant delays on the system. It is pressurised, tends to be batched and held in a holding pattern and often there's big delays to it getting done. That it does lead to medication errors across the boundary into primary care and it also leads to readmissions.' [C1]

Almost all interviewed staff reported receiving GP queries about the information content of handwritten immediate discharge letters. They reported the majority of queries related to missing or inaccurate information with a need to clarify certain information as described by one consultant as,

'Always just about please tell me why they are no longer on x,y,z, what have you done with their antihypertensives? Am I meant to be continuing this- it is just lack of clarity on the immediate discharge letter.' [C4]

And reiterated by a pharmacist as,

'A few doctors have phoned in and said they can't read the discharge prescription and you've to go over it.' [Ph1]

In relation to GP query resolution, interviewees were mostly able to successfully provide the required information although they conceded that it usually took time as they frequently needed to access the patient's case notes to answer queries as described by one consultant as,

'Yes- but it usually involves getting notes out and spending time doing it.' [C4]

Whilst pharmacists stated they may be required to pass enquiries to medical staff.

'Sometimes – I would say probably about 70% or 80% of the time we can resolve it. They may then come back with a further question which may be more appropriately answered by the medical staff in which case they are passed in that direction.' [Ph6]

Environmental context and resources domain

The interviewees described the current documentation and processes required for prescribing and completing the required information on the discharge letters. They frequently expressed experienced constraints due to the existing documentation design, and the necessary processes to be completed for patient discharge information communication and provide examples of problems associated with these systems with delay in information provision to GPs highlighted as a specific issue.

'At the moment there is a very significant delay between the immediate handwritten letter and the final discharge letter and that's just pressure of work...often by the time the final discharge letter is dictated, things are different again -the person has perhaps come back in, the GP has maybe changed things so the two things are not always the same.' [C4]

'there was changes made at the very last minute to discharge medicines and the doctor came down and made several annotations but the yellow copy didn't go into the notes...and so the final discharge letter was from the kardex and there were several changes and I noticed that when the patient got re-admitted when I compared what we had dispensed here (in pharmacy) to the kardex. [Ph3]

An area of concern highlighted by interviewees was pressure to complete discharge documentation quickly to hasten patient discharge which may lead to prescribing errors.

'It's often filled out by a passing doctor trying to facilitate a discharge in a pressurised system.' [C1]

Individual patients requiring several pages of immediate discharge letter documentation were mentioned by interviewees as a potential source of error and they described instances where pages had been mislaid or become mixed

up with another patient's documentation and cited the number of pages as problematic.

'We're in the era of polypharmacy now so there's more and more of these multiple pages and what very much annoys me if I'm having to dictate some summaries and somebody has just written the new medications that they've been on and it's therefore not immediately apparent to me which of the old ones were continued – I might have to go back and look at the drug kardex and see what their meant to be on and the general practitioner has no way of doing that so that's a big problem' [C2]

'The only thing I will say about the number of pages is that obviously things can go missing – it's easier for it to go missing if it's a two or three page long prescription and there's controlled drugs with it etc things like that.' [Ph2]

The formal documentation of incident reports in relation to prescribing documentation was only completed by the pharmacist professional group. The pharmacist interviewees provided examples of reported incidents for example,

'One and it was for when the wrong patient label was put on a discharge prescription for a patient the only reason that was caught was because there was a problem and I had to phone up the ward to speak to a nurse to ask the nurse looking after the patient and went through the medicines and they said "Well they are not on any of that" and it came to that it was actually the patient in the next bed – so that's the only one I've ever datixed.'[Ph1] (Datix is the hospital incident reporting system)

They also highlighted the infrequency with which they formally document errors due to the preponderance of errors detected during their routine work.

'I will have done about the discharge letter – things like wrong stickies going on to the discharge letters ... but other wrong doses and things like that I don't tend to datix them to be honest because sometimes you can have lots in one patient. [Ph4] (Stickies is the colloquialism for patient identification stickers).

Future aspirations with HEPMA

The pre-implementation interviews also consisted of exploring staff expectations of HEPMA implementation hence TDF was less relevant at this stage. A tree map has been used to convey staff opinions and expectations about HEPMA implementation. The tree map is provided in Figure 3.2. HEPMA implementation was viewed as a solution with expectations of improved legibility, clarity, decision support and discharge communication.

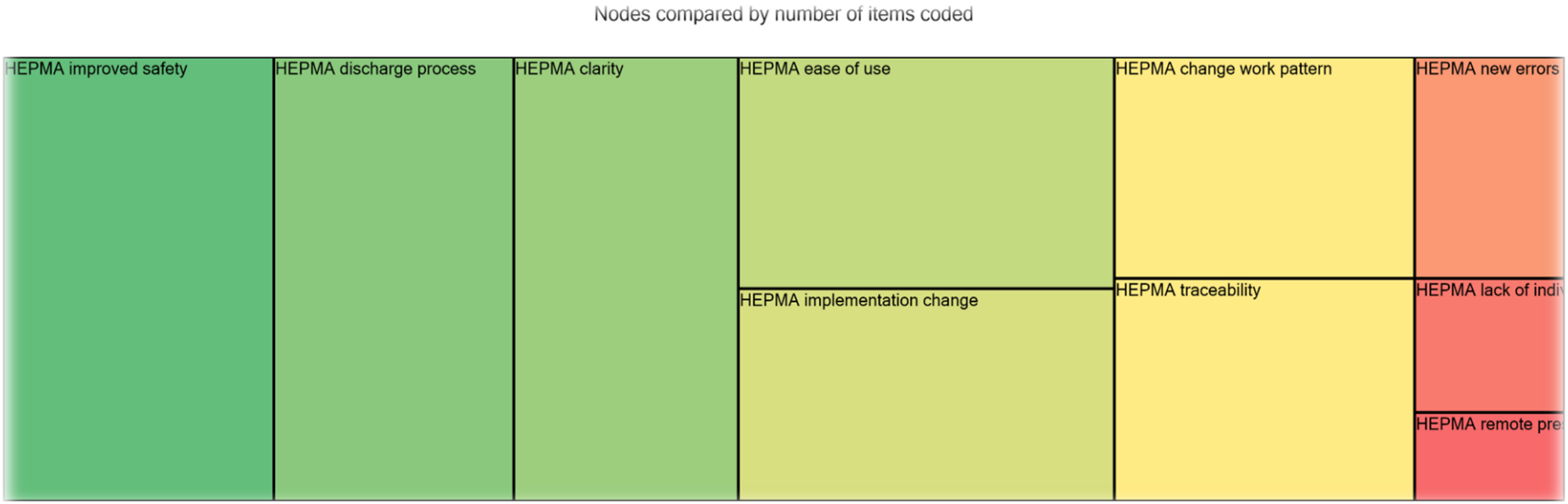


Figure 3.1 Tree map of nodes of future aspirations for HEPMA from all interviewees (source NVivo 10©)

The greater the size of the rectangles, the greater the number of interviewees raised this concept with the colour of the rectangle depicting the number of nodes coding the sources also with dark green the most comments to red the fewest.

The majority of comments about HEPMA implementation were positive as demonstrated in Figure 3.2. Improved safety was the most frequently voiced hope with aspirations for discharge process system improvement.

The comments below illustrate the similar thoughts amongst the different professional groups in relation to HEPMA implementation.

'I think it (HEPMA) *will be safer, I think it will be more accurate.'* [ANP4]

'I think it (HEPMA) *will make us safer and it will improve communication between primary and secondary care.'* [C4]

'I think it (HEPMA) *would be a much more efficient system and safer and probably a lot easier to use and save probably both people on the wards and in the pharmacy quite a lot of time.'* [JD2]

'I think it (HEPMA) *will be much safer for the patient and much safer for us...if you do become a prescriber it will be a much safer system as well*.' [Ph4]

The ability to prescribe remotely was not viewed favourably by the ANP staff, which was the only professional group to raise this point as exemplified by,

'They (nursing ward staff) can get a bit annoyed that you're not going to prescribe from wherever you are, for what they deem a simple thing: analgesia, antiemetic, things that people think are simple but are not always simple...I think you can get a bit pressurised to hurry up and prescribe.' [ANP2]

Another highlighted concern was about the perceived lack of individual thought process that might occur as outlined by,

'I think sometimes because it is very available, because of the dosages and things are there, sometimes it makes you a bit lazy so you are not really thinking about dosages and you are just choosing a dose within what is offered to you as opposed to actually you know having that knowledge in your head is that reasonable, is this the right drug or the wrong drug.' [ANP2]

'You probably have to be quite careful if you were starting someone on something that it (HEPMA) *could come up with a whole range of different doses for somebody...you might want to be careful to pick the right dose...so many options you accidentally click the wrong one.'* [JD1]

An additional expressed issue concerned adequate availability of computers to enable prompt access to HEPMA as described by a junior doctor,

'I don't know what kind of access you would have to it whether or not it would be some sort of tablet at the end of everybody's bed or it would be a computer per ward or a computer per bay because access could maybe be a bit tricky...if you had limited access to the electronic... then things might get missed because you might think oh that's busy I'll do that later and you never get round to doing it.' [JD1]

This was supported by an ANP,

'It should work fairly well and as long as people have got accessibility to laptops and computers.' [ANP3]

Several interviewees identified potential teething problems during HEPMA implementation although this was considered necessary to achieve the long-term perceived benefits.

'I think initially it will be time consuming because it's a new system that you have to get familiar with and again that's going to take time but I think certainly once it is up and running I think it will save time in the long run with regards to doing the discharge scripts.' [ANP4]

'The transition period is always difficult, people will be unhappy not liking it, need to get used to it, slow down things initially but like anything else after three, four months it will run smoothly and the whole process will be much smoother and safer.' [C6]

'I think everyone is quite looking forward to having electronic prescribing...but it's not perfect and we will probably have problems when we first use it but hopefully as we get used to the system everyone will be quite happy how it goes and it will lead to better care for the patients.' [Ph5]

A summary of the findings from each construct within a domain is provided in Table 3.4 to illustrate the applicability of the TDF to the findings.

Table 3.4 Summary of Findings from TDF

Domain	Construct	Summary of Findings
Knowledge	Procedural knowledge	Staff knew what to do and familiarity described as important
	Knowledge of task environment	Limitations of documentation and processes described
Skills	Competence	Staff mainly felt competent and ease of access cited as a positive factor, although illegibility described as problematic
	Practice	Limitations in practice described especially omitted medicines
Social/ professional role and identity	Professional role	Non – medical prescribers described professional aspect of prescribing
	Professional confidence	All groups positive
Beliefs about capabilities	Perceived competence	Anxiety described due to existing documentation and processes and concern expressed by consultants about junior doctors' capabilities
	Self confidence	Changes in individual practice to increase confidence described
Beliefs about consequences	Outcome expectancies	Patient safety a major concern with prescribing errors reported by numerous interviewees
	Consequences	Queries from GPs regarding missing or incomplete information frequently related to medicines were reported
Environmental context and resource	Resources	Constraints due to documentation design and time pressures were described
	Critical incidents	Incident reports only completed by pharmacist professional group

DIFFERENCES IN KEY THEMES AMONGST PROFESSIONAL GROUPS

The themes expressed by the different professional groups were on the whole consistent. Differences emerged amongst the professions in the following themes:

Documentation

The design of the existing documentation appeared to be viewed more favourably by the ANP staff who all had worked in the hospital for more than

10 years; whereas all junior doctors who had worked in the organisation for less than two years articulated a preference for different documentation.

Professional Prescribing Aspects

The non-medical prescribers (ANPs and pharmacists) articulated aspects of professional prescribing practice which were not discussed by the traditional prescribing groups (junior and consultant doctors).

Remote prescribing

ANPs were the only staff group to raise concerns about the ability to remote prescribe once HEPMA was implemented. Concern was expressed that they may feel pressurised by ward nurses to prescribe without prior patient review.

Completion of incident reports

All staff groups described problems and patient safety issues with the traditional paper based prescribing documentation. Pharmacists were the only professional group to report completion of incident reports.

Discharge process

The hospital consultants provided most detail regarding issues with the current discharge process.

DISCUSSION OF KEY FINDINGS

This phase of the DPP project provided an insight into the perspectives of hospital staff regarding the traditional paper based inpatient prescribing and discharge communication documentation and processes.

The findings contribute original knowledge about the perceived benefits and difficulties of the traditional system as described by the various staff groups. The complexity of the prescribing and discharges communication process has been described from the users' perspectives. The interviewees articulated a perceived complexity when prescribing and administering medicines using the current documentation. They also expressed challenges with the traditional discharge information communication processes. This research detected multi factorial contributors to adverse outcomes including legibility, documentation design, polypharmacy, high patient turnover and communication delays.

The interviewees provided multiple examples of system deficiency including individual instances of adverse outcomes with patient hospital readmission

identified as a consequence of inadequate discharge information communication. In fact, the traditional discharge information communication process was described as an anachronism and insight has been gained into the diverse challenges faced by the varying staff groups when using these systems. Furthermore, contributing organisational issues were identified including patient flow pressures, time restrictions for task completion, and inconsistencies of approach despite the availability of guidelines and policies.

Framework analysis identified initial themes whilst the application of specific domains of the TDF aided data analysis in relation to staff experience and behavioural aspects of the prescribing and discharge communication process.

Utilisation of TDF enabled systematic identification of behavioural determinants to be explored. Six domains were pertinent to topics discussed during the interviews (knowledge, skills, social professional role and identity, beliefs about capabilities, beliefs about consequences, and environmental context and resources) and influenced the behaviour of staff working with the traditional prescribing and discharge communication processes.

An exploration of hospital staff aspirations for HEPMA implementation revealed general optimism about the implementation benefits; with an improvement in patient safety the most frequently quoted expectation. Although initial implementation problems were expected by the majority of interviewed staff, the consensus was that the ultimate benefits would exceed the initial disruption. Remote prescribing and overreliance on the electronic prescribing system were cited as the main concerns regarding HEPMA implementation.

The difference amongst the composition of the staff groups in relation to length of time that they had worked in the hospital may have influenced their responses. All of the junior doctors and one pharmacist had worked in the organisation for less than two years; whereas all advanced nurse practitioners (ANP) had worked in the organisation for greater than ten years. These results reflect what would be expected. Junior doctors by the nature of their role will have limited hospital work experience. Whereas, the role of an advanced nurse practitioner is a relatively new position and the staff recruited to these positions tend to have several years general nursing experience prior to assuming an extended role.

The main differences in themes described by the various professional groups included familiarity with traditional documentation, detailed knowledge of the discharge process, completion of incident reports and concern about remote prescribing. The difference in the majority of these themes may be attributed to the different roles of the various professional groups and the length of experience associated with the different professional groups. For example hospital consultants described issues with the discharge process not discussed by other participants which is perhaps explained by a lack of direct involvement by the other professional groups with the final typed document. Also pharmacists were the only professional group to complete incident reports, however under reporting of medicine incidents is a recognised phenomenon in the published literature (Hartnell et al. 2012). Finally, the ANPs thoughts about future HEPMA implementation were different from the other staff groups. This was perhaps because they were more informed about HEPMA due to discussions with ANP colleagues familiar with HEPMA use at UHA and because of limited personal HEPMA exposure. They were the only staff group to express concerns about remote prescribing and feeling pressurised to prescribe in an unsafe manner due to the availability of technology.

Patient safety was the primary concern for all staff groups with traditional paper based systems. The interviewees were knowledgeable about existing documentation; did not claim lack of training as an issue and described individual processes devised to overcome identified challenges. GP queries regarding discharge communication occurred frequently and query resolution took time. Pharmacists uniquely reported formal incidents relating to medicine prescribing systems with lack of time cited as an inhibitor to further reporting. HEPMA implementation was viewed favourably with an improvement in patient safety the most anticipated outcome.

Strengths and weaknesses

The strength of this research included adoption of a rigorous approach in relation to study design to minimise design bias. A rigorous approach was utilised as described previously to ensure trustworthiness for this qualitative study. Additional bias was minimised by adopting the principles recommended by Shuttleworth and Bowling as outlined in Chapter 2 (Bowling 2014,

Shuttleworth 2009). Sampling bias was minimised by using stratified purposive sampling which is a recognised sampling method for this study type as described earlier.

The role of the PI (interviewer bias) may have influenced interviewees' responses (response bias) but the consistency in replies throughout the study would suggest that staff felt comfortable to answer honestly. The interviews were audio recorded and transcribed verbatim to minimise reporter bias in relation to recorded information accuracy.

The PI was a novice at conducting semi-structured interviews and completing framework qualitative analysis. Therefore there was a possibility of introducing researcher interpretation bias. This was minimised by verification of analysis by the university supervisors who were external to the hospital.

Weaknesses include the relatively small sample of staff interviewed which limits the applicability of these results to other organisations. Additionally, the difference in experience of the varying professional groups may have coloured their knowledge and hence responses about certain aspects of the studied processes.

Interpretation of the data

Key findings identified in the narrative literature review (Chapter 1) in studies solely investigating traditional communication methods were information content and accuracy, medicine information accuracy, legibility, time to GP receipt and patient harm.

Deficiencies in information on the IDL were described by interviewees which was identified by Wilson et al and Foster et al (Wilson et al. 2001, Foster, Paterson and Fairfield 2002). Information accuracy was also described as problematic which is consistent with published literature of Wilson et al, Grimes et al and Witherington et al (Wilson et al. 2001, Grimes et al. 2011, Witherington, Pirzada and Avery 2008).

Missing medicine information was highlighted as a concern; especially only new medicines prescribed on the discharge letter which is consistent with Wilson et al stating that 21% of letters had no medicines information recorded (Wilson et al. 2001). Receipt of GP queries by the majority of interviewees

confirmed information accuracy problems as highlighted by Wilson et al, Foster et al and Witherington et al (Wilson et al. 2001, Foster, Paterson and Fairfield 2002, Witherington, Pirzada and Avery 2008).

Several interviewees cited legibility as a problem which was described by both Wilson et al and Foster et al (Wilson et al. 2001, Foster, Paterson and Fairfield 2002).

Interviewees opined that final discharge letter preparation may be delayed by several months which is consistent with Foster et al, who identified delays in preparation of the FL (Foster, Paterson and Fairfield 2002); whilst Witherington et al stated that 62% of FL were not completed on patients hospital readmission (Witherington, Pirzada and Avery 2008).

Hospital readmissions due to deficiencies in information communication were described by interviewees and this is supported by McMillan et al who identified a rate of 1.8% of readmissions due to this problem (McMillan, Allan and Black 2006).

Interviewees intimated that HEPMA implementation may result in different error types which are supported by Abdel-Qader et al who identified sociotechnical errors related to the electronic system (Abdel-Qader et al. 2010).

Unique findings

This study uniquely obtained hospital staff opinion about the existing prescribing and discharge communication systems prior to HEPMA implementation and explored their future aspirations for its implementation. Patient safety improvement was the major aspiration for HEPMA implementation. Despite this, some interviewees identified potential patient safety problems with HEPMA implementation including sociotechnical errors which were described by Abdel-Qader et al (Abdel-Qader et al. 2010). Therefore, these findings support the requirement to complete the planned post- HEPMA implementation evaluation and especially its impact on patient safety.

The mixed methods methodology of this DPP project permitted comparison of these findings with results obtained from the quantitative project component. This will be discussed in a later chapter.

Clinical Governance

The reported findings are consistent with known incidents reported through the health board incident reporting system. No additional clinical governance issues were raised that required action by the PI.

Further work

A later phase of the DPP project re-examined staff views and opinions in context with the identified behavioural aspects of the TDF six months post HEPMA implementation and is provided in Chapter 4.

CHAPTER SUMMARY

This chapter described the aim and research questions for the pre-implementation interview phase of the DPP project. A description of the methods used was provided with a particular focus on findings and discussion of findings.

CHAPTER 4 POST-IMPLEMENTATION INTERVIEWS

CHAPTER INTRODUCTION

This chapter describes the aim and research questions for the post-implementation qualitative interview phase of the DPP, and provides the findings and discussion of findings.

AIM

The aim of this phase of the project was to describe and understand the perspectives of key staff groups (i.e. consultant doctors, junior doctors, pharmacists and advanced nurse practitioners) relating to patient discharge communication via the recently implemented HEPMA system.

OBJECTIVES

1. To describe and understand staff views and experiences of the HEPMA system
2. To explore behaviours and behavioural determinants in relation to HEPMA implementation
3. To highlight any differences in key themes identified amongst the different professional groups

QUALITATIVE STUDY DESIGN

This phase of research employed a qualitative methodology, as outlined in Chapter 3.

Methodology and method

This phase used interpretative phenomenology to fully describe and understand the perspective of staff groups involved in discharge communication using the HEPMA system. As outlined in Chapter 3, the selected method was semi-structured face to face interviews which were planned to be undertaken six months after completion of HEPMA implementation.

Interviews conducted following this time interval to provide focus on the actual performance of the new prescribing and administration system and not on the immediate implementation with incipient change factor issues.

The change process involves creating the change, implementation and sustainment of change. Lewin's seminal work on action research described this stepped process ("unfreeze, change, refreeze") as essential to ensure a

permanent change (Lewin 1947). Furthermore, the change curve developed from Kubler- Ross's grief model depicts how performance is impacted by the change over time (Kubler-Ross 1970). An illustration of the change curve is provided in Figure 4.1. This clearly illustrates the importance of leaving sufficient time for the intervention to be accepted into practice before any meaningful measurement may be assessed.

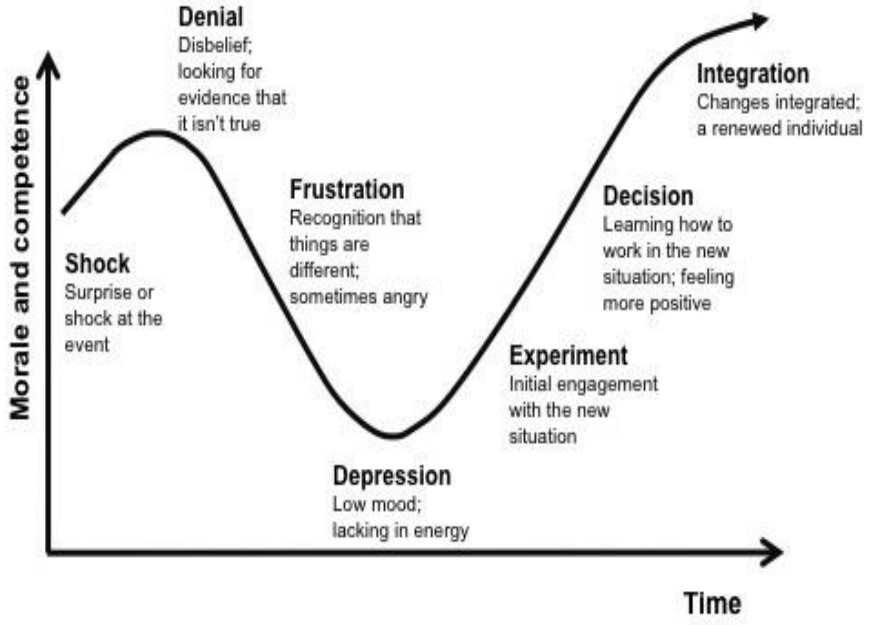


Figure 4.1 Change curve adapted from Kubler-Ross grief curve

Interview format

The interview was guided by the use of a semi-structured interview schedule, as described in Chapter 3.

Interview schedule

The interview schedule is provided in Appendix 4.1. The questions were developed after completion of the pre-implementation interviews. The interview schedule was similar in layout to the schedule described in Chapter 3 and required gathering information which included: the code number of the participant (rather than name to maintain anonymity); interview date; and start and stop time of interview (enabled calculation of interview duration). Demographic information was included in the initial section of the semi-structured interview schedule.

The schedule consisted of five main components: inpatient prescribing; discharge prescribing; discharge letter process; incident reports and significant

adverse event reviews; and general opinion about HEPMA. Questions about both inpatient and discharge prescribing were included because any prescribing errors present on the inpatient prescription chart may be transferred to the discharge letter. Confirmation of the initial interview topic guide was achieved by review from the university supervisory team.

Interview Pilot

The confirmed interview schedule was pilot tested by the PI (PI) with a senior pharmacist, allowing any identified deficiencies to be rectified before commencement of the participant interviews. The pilot interview enabled the PI to ensure that the questions permitted the participant to speak freely and tested the ability of the investigator to formulate probing questions. Feedback from the pilot participant was positive and no amendments were made to the interview schedule. Furthermore, the pilot lasted just under 22 minutes, within the planned 20 to 30 minutes. The pilot interview was excluded from data analysis.

Sampling

The sampling approach was consistent with the purposive stratified sampling approach as described in Chapter 3.

Inclusion and exclusion criteria

To be included in the sample, the individual had to be a member of the identified staff groups currently working at UHC and involved in the discharge communication process. The identified staff groups consisted of consultant medical staff, junior medical staff, advance nurse practitioners and pharmacists. Staff were excluded if currently working at UHA. It was aimed to recruit a diverse sample in terms of the criteria outlined in Chapter 3 and the number of eligible members of each professional group is provided in Chapter 3. Wherever possible, staff interviewed in the pre-implementation phase were re-interviewed which was included in the pre-implementation consent procedure. Inevitably it was impossible to re-interview all staff due to turnover; either staff leaving the organisation or on special leave.

Sample Size

To achieve total population data saturation, as described in Chapter 3, it was anticipated prior to starting the interviews that a sample of five to six members of each professional group would be sufficient. Likewise, fewer or

additional interviews would be conducted to achieve overall data saturation as described in Chapter 3.

Recruitment

Service leads were again contacted as described in Chapter 3 to nominate individual staff members from their jurisdiction. The PI invited the nominees by e-mail to participate in the study. The e-mail invitation is provided in Appendix 4.2. One ANP declined to participate because she was not involved in discharge communication.

Participant Information and Informed Consent

Participant information and informed consent was identical to the process in Chapter 3. Every interviewee was provided with a participant information sheet (Appendix 4.3) by the PI and asked to sign an informed consent form (Appendix 4.4) if agreed to be included in the study. The investigator obtained a signed copy of the consent form on the day of interview.

Interview Procedure

The interview procedure was as outlined in Chapter 3. The interviews were planned to commence six months after final completion of HEPMA implementation. Once again, the PI conducted all face-to-face interviews at a location and time convenient to the interviewee. The interview locations were either the interviewee's private office or a private room located in the pharmacy department of UHC. No interviews were conducted in public spaces. The interviews were completed during April to June 2015.

Data Analysis

Data analysis was as described in Chapter 3 and utilised the framework approach and application of TDF behavioural determinants.

FINDINGS

Interviewed Staff

A total of 19 staff members were interviewed from the 24 that agreed to be interviewed. Five staff were not interviewed: three ANPs and two junior doctors as total population data saturation had been achieved. A few interviews needed to be rescheduled due to service pressures; one consultant, one junior doctor and one pharmacist. One of the nominated ANPs was ineligible for interview as was not involved in discharge communication.

Demographic details of the interviewees are provided in Table 4.2. The PI experienced the greatest difficulty in scheduling interviews for ANPs. The hospital was experiencing high patient volumes and service pressures which resulted in difficulty freeing up staff time. This was resolved by re-contacting the ANP service lead to ask for assistance. The interview length ranged from 10 minutes to 45 minutes; with a median of 19 minutes. All interviewees were familiar with and regularly "used" the HEPMA system. The interview phase was completed when total population data saturation was achieved which accounts for the difference in numbers interviewed amongst the professional groups.

Table 4.1 Interviewee demographics

Advanced Nurse Practitioner	Gender	Years worked at UHC
1	F	23
2	F	15
3	F	6
Consultant Medical	**Gender**	**Years worked at UHC**
1	M	2
2	M	2.5
3	M	12
4	M	17
5	F	7
6	M	10
Junior Medical	**Gender**	**Years worked at UHC**
1	F	< 1 year
2	F	< 1 year
3	M	< 1 year
4	F	<1 year
Pharmacist	**Gender**	**Years worked at UHC**
1	M	4.5
2	F	6.5
3	F	10
4	F	6
5	M	8
6	F	12

Framework Analysis Results

Initially 14 free nodes (as defined in Chapter3) were created including experiences with HEPMA electronic inpatient charts, immediate discharge letters, the discharge letter process, patient safety and incidents and adverse events.

Staff Experience

The interviewees described their experiences with the newly implemented HEPMA system. Mainly positive experiences were articulated with suggestions for minor system improvement as outlined by one pharmacist as,

'I am a big fan of the system. I think it is really good and I do think it improves like prescribing and administration of drugs for the patients. It's not a perfect system there are things that we would like to tweak…' [PH4]

Whilst a consultant summarised the benefits as,

'I think there are lots of advantages in term of efficiency, in terms of access, in terms of safer prescribing…I think it is a fantastic innovation for Crosshouse' [C6]

Positive thoughts included predictive functionality when prescribing. As one consultant stated,

'I think it is quicker and it's easier to fill out a HEPMA chart than it is to write the kardex, particularly once you are used to the system with the kind of predictive element of the prescribing' [C1]

Availability to additional information was also viewed favourably,

'I like you can get the information about the medication on the system as well I think yeah from a prescribing point of view, I think it works really well' [JD2]

A positive HEPMA prescribing experience was discussed by a junior doctor as,

'I think it works rather well – really basic things like it helps with spelling a lot of the drugs. It gives you baseline doses…..in terms of prescribing yeah I think it's very good yeah' [JD1]

Viewing the inpatient chart was described as improved especially the ability to easily read the prescribed medicines as discussed by one consultant as,

'*So first of all it's amazing compared to paper prescription charts because it's legible. There's no problem like reading the actual medications...it's all on one sheet even if there are 30 medication you might have to scroll down a little bit rather than turning 10 pages'* [C2]

The ability to suspend medicines was mentioned positively by all professional groups, as outlined by one junior doctor,

'in terms of suspending medications.....it's just quite clear which medicines are suspended and which aren't. You can be confident if you suspend something electronically that it is not going to be given inadvertently which is good.' [JD3]

IDL improvement was remarked upon by the majority of interviewees,

'*It's just the quality of the letters that are coming out now, is far better than what we had before with the handwritten prescriptions particularly the clinical information, much more detailed and will be much better for the GP.'* [C1]

Working practice changes to facilitate improvements to this communication were outlined by one consultant as,

'We've worked very hard with the juniors to try and populate it properly so that it is actually a complete record of what has happened, and then obviously try to use that as a first and final discharge letter.' [C5]

Pharmacists described inputting additional information to IDLs which would have been virtually impossible with the paper version,

'*It's got a section for pharmacy...today I was doing someone's discharge and I wrote to the GP to say digoxin and the bisoprolol were stopped because they were bradycardic on admission, heart rate currently is ok so it's not been restarted...there was no space on the previous system to write all that information you could try and squeeze it in...I can write in a bit more depth and he or she knows it coming from the pharmacist'* [PH2]

There was a stated expectation that electronic systems for prescribing would currently be available in healthcare as a junior doctor said,

'I think that it's reasonable to assume that we are going to have an electronic system for prescribing, like we are definitely at that time.' [JD1]

Nevertheless, interviewees recognised HEPMA limitations, with allergy recording an especially highlighted issue as described by this comment,

'Difficult, hugely difficult trying to type quickly enough to get the drug in and knowing which column to put it in….the recorded what kind of allergy it is then you don't always have the right option or even anything close to it…it's very un.. user unfriendly' [PH4]

Unsurprisingly staff described initial problems using the system which were resolved with familiarisation as described by one ANP as,

'*it took a while to get the used to the system but now that I've become a lot more familiar with it I think definitely prescribing, inputting the data is certainly a lot quicker and a lot clearer'* [ANP2]

Staff behavioural determinants

The TDF was used to identify behavioural determinants of the interviewees in relation to HEPMA use post implementation. In the pre-implementation phase only six of the 14 domains of the TDF were applicable to discussion topics identified during review of the interview transcripts. A further two domains were applicable to discussion topics raised during the post-implementation interviews. The relevant domains and associated constructs are depicted in Figure 4.2. While there is a difference in terminology with TDF referring to constructs and NVivo to nodes, these are now described as themes. The initial domains are depicted in blue with the new domains in green.

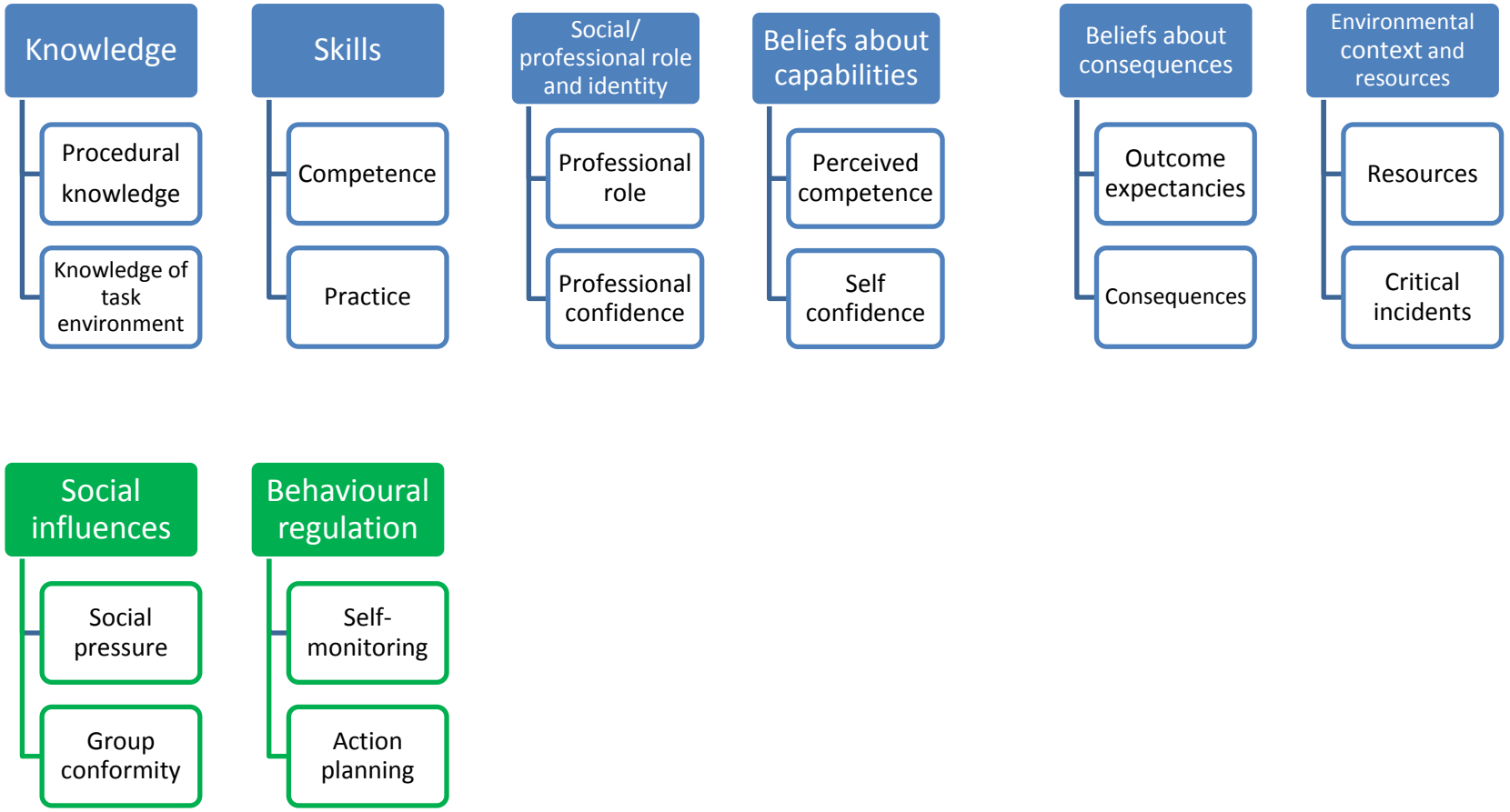


Figure 4.2 TDF Domains and associated constructs mapped to interview finding

Theoretical Domains

Knowledge domain

All interviewees described HEPMA knowledge and processes for inpatient prescribing. One consultant described the requirement of completion of allergy information prior to prescribing medicines and ability to view allergy information as,

'*…when you are trying to prescribe medication it won't allow you to go any further until you've prescribed the allergy…or you've mentioned the allergy status and obviously when you are trying to prescribe your new medication obviously allergy status is at the top of your prescriptions and it's quite legible and clear.'* [C2]

Another consultant described how the system facilitated prescribing of medicines with the available menu choices as,

'*Yeah I think the kind of drop down options…you usually find everything that you want...to input the individual times that seems fairly straight forward even if you need to do that for Parkinson's medicines or anything'* [C1]

Whilst a further consultant highlighted the ability to know what had happened with a particular medicine,

'*If you have the drug prescribed you can follow them up through the admission- so you know what was stopped, what was withheld...I can actually track any medication when it was stopped and who stopped it.'* [C4]

The ability to view additional medicine related information via the system was described as,

'*You have linked with the prescribing any potential contra-indications, allergies the patient might have to the drugs. You can obtain information about side-effects relatively quickly…it is a much more efficient system of prescribing and provision of information...you can all do it on-line'* [C6]

The viewing of the medicine administration records was described by a pharmacist as,

'it's a simple process…you can just look up charting or administration then to see whether or not the patient's had their medication you can actually just look to see for a prn it tells you whether they have had some doses or none at all...or the reason that they didn't have it.' [PH5]

The creation and information on the IDL was described by interviewees as,

'you have plenty of space to write down all the information for the GP so not just about the diagnosis …you can update clinical information…if you've had to make any changes to their medication, they can see it listed down below and they can see when you've changed it and why you've changed it…' [ANP1]

'it gives the option for the doctors to write exactly what's happened throughout the patient journey in hospital…medications that have been stopped again it gives you the allergy status it gives you all these things it tells you whether or not if patients got their own medication all these things if GPs should continue it or not so again it's very clear.' [PH5]

The interviewees described more sophisticated system use learned over time as described by,

'It's only more recently that I've known you can look back to see what meds patients are discharged on if they have been in an admission before…I've learned how to look on the admin charts and things and I use that quite frequently especially when it comes to things like pain relief meds to see how much pain relief someone is requiring' [JD1]

'It's very useful…to have things like details of Blister Packs, details of level 3 MAR that kind of transfer from one admission to the next so you're not constantly hunting for that information.' [PH3]

Interviewees confirmed sufficient training prior to system use as described by a junior doctor as,

'I thought the training was good…' [JD4]

Skills domain

Interviewees tended to express themselves as skillful HEPMA system users. A junior doctor described their general prescribing ability as,

'Yeah no I think that I can do it (prescribe on HEPMA) quite well- I don't have any issues' [JD1]

Whereas, a pharmacist articulated in-depth skills and described sophisticated system use,

'I feel I can use it quite well, the system, I know how to like modify things, and can suspend things and resume them...I am probably better at using HEPMA than the doctors are and I know more of the functions, I'm like oh you can do this, and I can tell them information' [PH2]

One ANP highlighted how to communicated information using the system,

'So you can put a note in and also things like high dose dalteparin until their INR is therapeutic and things like that you can put all that information in' [ANP1]

Junior doctors, pharmacists and ANPs mostly claimed to be skillful system users as described by this junior doctor,

'Yeah I find that (prescribing medicines) quite simple, quite straight forward' [JD3]

Whereas consultant doctors described varying abilities with some describing routine skills for inpatient prescribing,

'Yeah I mean it is quite easy so it gives you the choices or whatever. So when you type the name it gives you the doses for the administration so it's quite straight forward' [C4]

And discharge prescribing,

'on the discharge letter is quite easy all you do is tick the boxes which takes it on to the discharge prescription' [C2]

Whilst another stated he didn't use the system for prescribing at all,

'My skills are probably limited because I don't do it.' [C3]

Social/professional role and identity domain

HEPMA implementation was reported to have impacted professional roles to a varying degree, as described by certain individuals feeling more confident in their professional role. Increased job satisfaction and changes in role that had occurred as a result of HEPMA implementation were apparent,

'Certainly it's made me feel like I'm doing a better job, so I get more job satisfaction…it does allow you to have that kind of slightly different level of you know professional status' [ANP1]

'I'm still fulfilling the same role, probably just better than we were before yeah' [JD3]

'I think probably I'm writing much more on the discharge letters than maybe I would have done previously, maybe prescribing a bit more than previously. I don't know if that's the system or just the confidence...I think it has had a positive impact on the pharmacy profession' [PH6]

'I think I spend less time on formal discharge summaries I think that it allows us as a team to get much better information into the GP earlier...' [C1]

Although one consultant considered HEPMA implementation to have a negative impact on the medical profession,

'It has increased the administrative time for prescribing on the medical profession, particularly those at foundation level' [C3]

Despite described changes to the discharge letter process there was still no progress to consultants signing off and reviewing the IDL but more consultant input to IDL was mentioned,

'…generating this document is also an integral part of the ward round now, where previously that was done by the junior medical staff at the end of an admission without our input at all, so we have some input into the generation of this document collaboratively with the junior staff and potentially with allied healthcare professionals so that makes it much more real and actually at the time when the patient case you are dealing with is still very fresh in your mind. So it is pretty real time way of generating a document.' [C6]

When asked if the consultants have changed their processes to input into the creation the IDL, one junior doctor replied,

'One of our consultant does, the other two don't bother' [JD2]

Furthermore, some consultant teams had not changed their processes at all as described by one ANP,

'The consultants are doing exactly the same process. I mean they've been in with the bricks and mortar. They are not going to change anything with the electronic system.' [ANP1]

Improvements to clinical governance by having a clear audit trail were also highlighted as advantageous as mentioned by one consultant,

'I mean I guess just in terms of governance knowing who has prescribed what and when is good to know.' [C5]

Beliefs about capability domain

Feeling competent at inpatient prescribing and discharge communication was outlined by this range of interviewees,

'Yeah absolutely confident I don't have any issues with most of the stuff' [ANP1]

'Yeah for prescribing things no problem.....Yeah I'm pretty confident now' [JD1]

'I would say that I was reasonably skillful...very competent' [PH5]

An increase in confidence in prescribing by use of the HEPMA system was mentioned by several interviewees

'Probably I think my confidence has improved to prescribing and I think that is because I know there is a bit of a safety back up with it' [ANP1]

The exception was consultant medical staff who tended to have more limited use and therefore described themselves as being less competent. As one consultant stated,

'My skills are in the early stages I would say, as I rely very much on the junior staff. So we do it together you know, the juniors, you know, staff does it because they are so much quicker and slicker than I am, so my skills are in the early stages I would say.' [C6]

Beliefs about consequences domain

This theme produced the greatest number of comments and therefore to aid communication of the findings, sub-themes have been included in this section.

Patient safety

Prior to HEPMA implementation, patient safety improvement was the biggest aspiration and this was articulated by interviewees from all professions,

'Compared to what we did with paper it's just night and day for patient safety' [ANP1]

'it's definitely safer than the paper prescription chart' *[C2]*

'I think it's definitely made a huge difference, a huge improvement in patient safety.' [PH6]

'In terms of adverse events once people have gone home it might well have had an impact on reducing them because of better information' [JD3]

IDL quality

Improvements to the quality of the IDL were frequently cited as a consequence of HEPMA implementation as mentioned,

'the quality of the discharge prescription has improved because the doctors now use it as a letter to the GP and they start it off by writing dear doctor this patient was admitted with blah blah blah and it's much, much better as opposed to just the one word lines that they were putting in on the handwritten discharge letter so I think GPs are getting a lot more information. It's much easier for the doctors to put in all the medicines that the patient came in on so they are more complete now' [PH4]

First and final communication

The move to making the IDL the first and final discharge was also described as a consequence of HEPMA implementation as articulated by one consultant,

'the move to having the IDL as the principal discharge document, whereas I felt before that it was the final discharge summary that contained most of the important information and now the final letter is just you know yeah nothing more to add you know kind of just to ensure the GP is aware that we have chased up appropriate investigations…' [C1]

GP information

The quicker availability of more detailed discharge information for GPs was thought to be positive,

'the GP is getting a copy of the discharge letter much quicker and they don't have to wait for the final discharge letter so it allows for a good seamless process in terms of patient care' [PH5]

HEPMA engagement

An apparent failure by certain consultant medical staff to engage with HEPMA was described and this behavior influenced the junior doctor's perceived pressure when prescribing medicines,

'Well some consultants don't even use it all – some consultants won't touch it because they don't understand how it works – they don't like it...it leaves a lot of responsibility for the junior members of staff to sort out the medications and it is reliant on just verbal communication from senior doctors telling them to adjust things' [JD1]

GP queries

The impact on GP queries was variably described as either having no impact or causing a decrease in calls,

'It is not any more than the previous system, so about some medication that was missed' [C4]

'I've had probably one or two queries in the entire time it's been up and that would be all because you are able to put so much more information down. We used to have frequently so maybe 2 or 3 phone calls per week from GPs about things.' [ANP1]

Remote prescribing

Remote access to the system was also seen as a positive consequence,

'anyone dealing with a patient can access the prescription chart...wherever they are in the hospital which I think again is a big advantage to check a prescription if you are in a clinic or elsewhere make sure it's correct or change it if need be...'[C6]

HEPMA new error types

New error types were suggested to have occurred due to HEPMA implementation as described by these interviewees,

'The drop down boxes it's very easy for them to pick the first one that comes up when they choose a drug and they don't actually scroll down to find the correct form for the drug…so it's a different type of error' [PH3]

'it's quite easy to type, if you are working quite quickly on a ward round for example it's quite easy to type an incorrect drug, to type the drug name and get an incorrect concentration, or incorrect tablet' [JD3]

Prescriber identification
An identified concern was failure to update the prescriber identification for completion of the discharge document when different staff added information as outlined,

'Sometimes you phone up the doctor whose name is on the bottom of the prescription to ask about a query...and they don't know...I think when one doctor starts to formulate it and they don't complete it and another doctor comes and adds in to it there's not really anyway of identifying... '[PH1]

Discontinue/suspend information
Reasons for stopping or suspending medicines were not considered to be fully adequate as described by a pharmacist as,

'Sometimes the reason for withholding them (medicines) doesn't just fall into the reasons that are there' [PH4]

Electronic limitations
Interviewees described frustrations due to the electronic nature of the system,

'The nurses can't give medications because they've missed it by a minute and then you need to…prescribe a stat dose because it's not the right time whereas I suppose if it was a paper kardex they could just give it…' [JD2]

Insufficient section space
The clinical progress section of the IDL was highlighted as having insufficient space as described by one junior doctor as,

'the character limit we have at the moment is quite limiting often...you would actually want to write more but you are limited as to what you can write by the character limit' [JD3]

Electronic transmission
Whilst a failure to move to a completely electronic IDL system with electronic transmission to pharmacy was described as annoying by one consultant as,

'…why some wards have to print it out, it goes in a dooket to get somebody to take it down to pharmacy…when we are trying to get people home from hospital earlier in the day' [C3]

Educational impact

A junior doctor expressed concern that HEPMA implementation may impact on their education as,

'*As a junior, I think that will probably, will definitely impinge on my learning so if that I have an electronic system taken away from me at a later stage then I may not know the doses of some basic drugs just because I become so used to it telling me automatically*' [JD1]

Rotation to non- electronic prescribing area

Whilst another expressed anxiety having to revert to paper prescribing systems in their next work placement,

'I'm going to work in (place name obscured) next year and I'm a bit apprehensive about going back to using a kardex.' [JD2]

Dispensing process impact

Pharmacists indicated that changes to the IDL dispensing processes impacted workload and time as these pharmacists describe,

'very time consuming for validation…then you have to print 3 copies off again make sure it's (IDL) got its watermark on it' [PH2]

'You have to go in and do all the verification on the computer and then print it (IDL) off – it definitely slows you down- it almost doubles your time to do a prescription from a validation point of view.' [PH1]

Improvement suggestions

Examples of some suggestions for HEPMA improvement as recommended by the interviewees are provided.

System integration would be welcomed as described,

'I think HEPMA requires to have the ability to pull in primary care prescribing data...it would reduce transcribing errors. It would allow people to temporarily

suspend and hopefully comment on why they had suspended medications and it would just cut risk being more time efficient.' [C3]

'I would really like to see everything integrated that would be ideal to open up a system and click that button you get drugs, click that button you get blood results and you don't have to log in and out of everything- so that would be my dream.' [C5]

Possible improvements to the creation of the discharge letter were articulated,

'*when you are going into Patient's own, so if there is a whole host of medicines it is quite time consuming to go through them all and click which one's the patient has and doesn't have and I think it would be quite useful to have a little chart that you could select all and then deselect the ones that are the new prescriptions to start.*' [JD4]

'*If they had like something easier, like if you put someone's Blister Pack like it automatically put on 7 days and we don't then have to change the quantity of everything ourselves'* [PH2]

The ability to electronically transmit the IDL would also be welcomed,

'I find very difficult to know whether or not it's (the IDL) gone because there is no way of knowing if it was handed to the patient, put in the post you've got no way of knowing or not whether the GP has got it so we're assuming the GPs have these things but maybe they don't. Maybe we could move to an electronic delivery of those so we would know it's gone and you would have a record' [C5]

Environmental context and resources domain

The design and layout of both the HEPMA inpatient and discharge sections was commonly viewed favourably,

'*you can see what the patient is on and what has been discontinued'* [C4]

'The layout is very good and I like the box at the bottom of the discharge where it gives you the discontinued drugs and why they have been discontinued' [PH3]

Although the ability to alter the medication according to the prescribed route would be a suggested enhancement as outlined by a junior doctor,

'I don't think it is very clear when you are looking at the drug chart of everything that patient is on as to which drugs are oral, which drugs are intravenous and sometimes I've seen myself miss the route and assume that an antibiotic for example was intravenous and then it turns out actually it's oral.' [JD4]

General computer login was described as slow and additional ward computer equipment would be welcomed, although pharmacists were provided with laptops.

'invariably it should only take you 10 or 20 seconds they say to log in but invariably it takes longer than three or four minutes and it's quite frustrating' [ANP1]

'There's certain wards there's a lack of computers and it can take a while to log in and then that adds time to the process…and I think that is peoples major frustration with it – not the system itself but access to it' [C1]

'well, I've got my own laptop so it makes it easier…there are laptops spread throughout the wards but quite often they are getting used by nursing and medical staff so it can make it more difficult to get on to it' [PH5]

'sometimes when the nurses are all doing their drugs and stuff it can be difficult to get access to a computer or access to the medications because they're on them as well' [JD2]

Multiple user access to the same patient file is system prevented which was described as beneficial by a pharmacist as,

'it's good that only one person can be in it at a time because if we're on the ward round and change stuff and the nurses are trying to administer it then we might be changing it when they are administering it so obviously from a safety point that's good' [PH4]

Whilst other interviewees described failure to gain access as problematic,

'A big disadvantage is that it's not on every desktop...it can take a while to log in...when you are on the ward round and when you quickly need to access a patient's current drug history again logging in and out the system...in a cardiac arrest situation when you want a quick access someone has to run and get a laptop and then if it hasn't been charged...' [ANP2]

Poor battery life of laptops described as,

'the laptops especially run out of battery and you're right in the middle of a patient entry you've got to wait 15 minutes for it to log you out automatically before you can access the patient information again and get back in' [ANP1]

Also issues in relation to printers and malfunction of printers was highlighted as described by a junior doctor as,

'As long as your printer is working it's fine but I've had quite a lot of times when the printers not been working and you can't get it printed anywhere. It's actually probably more of a printer issue than an e-prescribing issue – printers seem to break all the time.' [JD2]

Integration of the different organisational computer systems was identified as problematic by several interviewees as described by one junior doctor,

'one of the things that's annoying about it is that the nurses... sometimes people go home and they take them off the system before you've actually done the letter and I now know how to put them back on but I didn't used to before and it was a big hassle' [JD2]

Whilst another doctor described the difficulty of patient flow exacerbated by the technology interplay as,

'having to admit patients into A&E waiting areas before they come up here – it seems more time consuming whereas if you were doing a paper copy downstairs it would come up with the patient….I find it difficult and I think it would be better if there was better access to it (HEPMA) in all departments' [JD4]

None of the interviewees had completed a formal incident report regarding HEPMA since implementation and the consensus was that incidents and adverse events were reduced. Formal evidence to support this claim could not be provided as described by one consultant as,

'I would guess and I can't back it up with any figures that it actually has improved the number of incidents and adverse events' [C6]

Social influences domain

Social pressures to change working practices were described although group conformity was not achieved as described by these doctors,

'Yeah I know other consultants are less comfortable with it, but having used it before…it took me a week or two and then I was back up to speed with it.' [C1]

'*I will ask my junior staff to do it. The role of a consultant is to produce oversight...so I would tend to defer the prescribing to the junior member of staff who is with us.'* [C3]

'Probably a lot less consultant prescribing because they don't know how to work it .... no not all of them, the younger ones can deal with it but a lot of the older ones.. so you will get called on an on-call shift to say doctor such and such has been to see this patient and he's suggested these medications but he can't work the prescribing so can you come and put them on...' [JD2]

Variability in how different teams working within the hospital was articulated,

'I think it varies a lot between different departments. Certainly, I think a lot of the departments in medicine are gearing more towards the IDL being the main discharge letter...' [JD1]

Pressure on ANPs and junior doctors to complete sufficient IDL information was considered to be an issue,

'I think it is more time consuming for the junior doctors and that is one drawback and there are a number of demands on their time and everything is a priority….so I think that's a barrier to producing good letters even though the system allows you to produce much better letters and I think sometimes the juniors feel under a bit of pressure to get them done in good time but also have the degree of information we're looking for on them.' [C1]

'We are using the HEPMA IDL as a first and final discharge letter. It's very time consuming for us...some days...you are discharging ten patients at a time so theoretically you really need somebody purely on scripts the full day because some of our patients have been in for six weeks and to try and summarise that adequately' [ANP2]

'it actually probably delays the discharges a bit from our team because it obviously takes us a longer amount of time to go through the notes and write all that down whereas...when I started you could kind of quickly... jot it down on the ward round and get it in the box to go down…I think it is more difficult to do when you are on ward rounds because the consultant will be asking to look at the bloods, you've got the prescribing open trying to do the discharge letter so it might be that more discharges are in the afternoon because of the amount of detail but the GP gets more information quicker' [JD2]

Behavioural regulation domain

The potential for HEPMA system errors to occur was raised by several interviewees and they described actions to avert these.

'I think as with any kind of prescribing and checking of anything you've got to get into your own system of checking things and if I prescribe I go back and double check it straight after and yeah I do find the occasional mistake when I've put in the wrong strength or put in the wrong frequency but I'll go and change that right there and then' [PH3]

'Usually as a kind of safety thing I will write on the discharge letter to the GP that we have made no changes to the patient's routine medicines so that... the GP can see that they maybe haven't had the drug because we didn't know about it and that we haven't made any changes to routine medicines so they understand ' [ANP1]

'I check more often now... I always try to look at the PDF version to look through and scan that I've done the patients' own correct, because I feel like that's easily done incorrectly sometimes so you do accidentally tick the wrong thing or you don't tick one or you've thought you've ticked it and maybe unticked it again I think that's an issue sometimes' [PH2]

Table 4.2 describes a summary of the findings from the TDF after HEPMA implementation.

Table 4.2 Summary of Findings from TDF

Domain	Construct	Summary of Findings
Knowledge	Procedural knowledge	Staff provided detailed descriptions of HEPMA processes
	Knowledge of task environment	Staff described how to complete tasks using HEPMA
Skills	Competence	ANPs, junior doctors and pharmacists rated themselves as skilful HEPMA users; consultant doctors had varying skill levels
	Practice	All staff used HEPMA regularly
Social/ professional role and identity	Professional role	Positive impact on professional role
	Professional confidence	An increase in confidence described by ANPs and pharmacists
Beliefs about capabilities	Perceived competence	ANPs, junior doctors and pharmacists all perceived competent; variability with consultant doctors
	Self confidence	ANPs, junior doctors and pharmacists all highly self confident; variability with consultant doctors
Beliefs about consequences	Outcome expectancies	Improvement in patient safety, quality of IDL and number of first and final discharge letters
	Consequences	Lack of engagement by some consultant doctors and introduction of new error types
Environmental context and resource	Resources	IT equipment problematic due to speed of access, availability and condition of equipment
	Critical incidents	No documentation of a formal incident about HEPMA
Social influences	Social pressure	Pressure to provide detailed IDLs with limited time
	Group conformity	Variability evident amongst different specialties
Behavioural regulation	Self-monitoring	Process for self-checking developed by some staff
	Action planning	Additional actions documented on IDL to prevent inadvertent errors

Differences in key themes amongst professional groups

Consistency in themes expressed by the different professional groups was apparent. Areas of difference included the following themes:

Professional prescribing aspects

Non–medical prescribers (pharmacists and ANPs) claimed that HEPMA implementation had increased their prescribing confidence and identified potential skill enhancement due to the system. Consultant doctors prescribing self-confidence varied and one voiced the opinion that the consultant role consisted of decision making and not the task of prescribing.

Junior doctor issues

One junior doctor thought their educational experience may be impacted by HEPMA implementation and another was anxious about returning to paper based systems in other hospitals.

Pharmacist processes

Pharmacists raised time concerns for the completion of the discharge prescription process including clinical checking (validation) and printing multiple copies of IDLs.

Discussion

This phase of the DPP project provided an insight into the perspectives of hospital staff regarding the recently implemented HEPMA inpatient prescribing and discharge communication documentation and processes. The findings contribute original knowledge about the perceived benefits and limitations as described by the various staff groups as well as providing insight into behaviour changes adopted by the various professional groups. All interviewees were regular system users either being “hands on” users or viewing HEPMA on computer screens.

It should be noted that for several months prior to and during the period of the interviews, the hospital service had experienced significant pressures with increased patient numbers leading to patient flow challenges. Despite these difficulties, HEPMA implementation was generally described in positive terms and was considered a successful hospital innovation. Framework analysis was used to identify initial themes with TDF used to analyse behavioural changes.

The study findings highlight the complexity of prescribing medicines for hospital inpatients and communication of discharge information using a HEPMA system from the users' perspective. There was staff expectation that electronic prescribing systems would be available because of widespread IT system accessibility in most facets of modern life. Medicine prescribing with HEPMA was reported to be quicker although delays to system access could occur due to computer logon and availability. Clarity of viewing the inpatient prescription chart and administration was highly rated and complete legibility was stated to have been achieved for both inpatient and discharge components. This is consistent with published literature by Hammad et al with electronic discharge letters providing full legibility (Hammad et al. 2014)). Access to additional electronic medicine information for example the British National Formulary was described as a positive feature with decision support also mentioned as helpful in reducing prescribing errors. Vast quality improvements to the IDL were frequently quoted with increased clinical and medication information documentation including medicine change information which is consistent with publications demonstrating electronic systems increased dataset compliance (Hammad et al. 2014, Scullard et al. 2007), and also fulfils a requirement of SIGN guideline 128 to provide medicine change information (Scottish Intercollegiate Guidelines Network (SIGN) 2012). The quick GP receipt of necessary patient information was cited as contributing to enhancements in seamless patient care with potential prevention of adverse outcomes. Interviewees reported either unchanged or markedly reduced phone calls from GPs regarding IDL content which is in keeping with increased quality of information provision and Alderton et al's study demonstrating information enhancement with electronic letters (Alderton and Callen 2007). Received GP queries mostly enquired about medicine changes which may reflect failure to complete medicine reconciliation on hospital admission rather than poor prescribing or use of HEPMA. Patient safety improvements were claimed to have occurred because of complete legibility of prescribed medicines, accurate documentation of medicine administration, decision support information availability and use of force functions to ensure completion of allergy information documentation for every patient. The literature review had indicated the creation of a new error type (sociotechnical error) and interviewees described instances of this error, although with no reports of

actual patient harm which also is in keeping with the study by Abdel-Qader et al which indicated that sociotechnical errors were associated with lower patient harm (Abdel-Qader et al. 2010). Allergy recording was highlighted as a specific difficulty with HEPMA use. A system upgrade on 6th May 2015 provided an improvement to allergy documentation. Additional areas for development were proposed which were fed back to the HEPMA team by the PI and were used to formulate a list of requirements for system enhancements.

Adoption of TDF permitted analysis of behaviour change amongst the various professional groups as a consequence of HEPMA implementation. Although some different individuals were interviewed before and after implementation there was consistency in findings irrespective of previous interview. In the pre-implementation phase six domains had been relevant; whereas an additional two domains (social influences and behavioural regulation) were applicable to discussed topics. The beliefs about consequences domain had the greatest quantity of applicable subthemes which is unsurprising with a complex IT implementation such as HEPMA. The use of TDF highlighted differences in professional group interplay and this study provides knowledge about behavioural alteration amongst these groups. Consultant medical staff behaviour was reported as the most varied of the studied professional groups; with some consultants refusing to engage with the electronic system, whilst others described sophisticated system use. The implementation of an electronic system may have highlighted an existing disparity in hospital prescribing. Research by Ross et al indicated that hospital consultants were only responsible for 3.4% of inpatient prescribing activity with several possible causes postulated including availability and culture (Ross et al. 2012). The majority of staff deemed themselves as skilful system users after resolution of initial teething problems. An increase in prescribing confidence with HEPMA was articulated especially by ANPs and pharmacists. Interviewees described adoption of behaviours to ensure GPs received good quality information in the IDLs and resultant process development adopted to achieve this. The associated changes in working systems were instigated as a direct consequence of HEPMA implementation with some consultant teams moving to first and final discharge letters with descriptions of modified processes to achieve this outcome which enables compliance with SIGN 128 vision of

changing from IDL to CDD (Scottish Intercollegiate Guidelines Network (SIGN) 2012). Staff described behavioural alteration to overcome the new system errors with use of self-checking and adoption of additional actions to prevent miscommunication.

All interviewed staff asserted receiving sufficient training prior to system use which is compliant with the recommendation by Black et al (Black et al. 2011). Furthermore, several staff described learning new skills or achieving optimal system use after "playing around" or advice from other system users.

Staff provided suggestions for improvement including accessing and pulling medicine information from patients' GP records into HEPMA. This is not technically possible currently due to the differences in IT systems and prescribing methods in primary and secondary care. Other suggested enhancements included greater spread of HEPMA into all departments because the use of different IT systems within the organisation leads to problems. This issue was particularly problematic in the Emergency Department (ED) which doesn't use the same patient management system (PMS) as the rest of the hospital. The hospital PMS is used to create patient files and feeds patient demographic information into HEPMA. The hospital e-health team is tasked with resolving this issue. Furthermore, integration of HEPMA with other hospital systems including blood results is being progressed. Electronic transmission of IDLs to GP surgeries has been tested and is under review by the hospital e-health team. There are several challenges regarding automatic sending of this information both technical and procedural which are currently being actioned.

Governance issues

Serious issues raised by staff during the interviews required action by the PI as they involved staff wellbeing and/or patient safety concerns.

The PI escalated concerns to the Director of Pharmacy whilst maintaining interviewee anonymity. Lack of HEPMA engagement by certain consultant doctors perceived as pressurising junior doctors' prescribing was further escalated to the Medical Director and relevant Associate Medical Directors (AMD). A new process to evaluate HEPMA use during routine professional

development assessments of hospital consultants was adopted as a result of this intervention.

Likewise, concerns about changes to the discharge letter process whereby ANPs and junior doctors were completing first and final discharge letters without any senior doctor input was escalated. SIGN 128 recommends multidisciplinary team input for CDD creation with consultant input essential (Scottish Intercollegiate Guidelines Network (SIGN) 2012). Currently, an AMD is responsible for review of the hospital discharge letter process.

Strengths and weaknesses

The study design adopted a similar robust and rigorous approach with bias minimisation as described in Chapter 3. The weaknesses outlined in Chapter 3 are equally applicable to this study phase.

Comparison with pre-implementation phase

Remote prescribing

Remote prescribing was viewed favourably and none of the interviewees identified feeling pressurised to prescribe remotely. This was previously raised as a pre-implementation concern.

Incident reports

There was a reduction in completion of incident reports as none had been completed by the post-implementation interviewees. The general consensus was that incidents and adverse events had been reduced.

Discharge process

Distinct differences in the discharge letter process had emerged as a consequence of HEPMA implementation although this was not universally implemented. Certain consultant teams had moved to using the IDL as a first and final letter and were no longer sending additional final typed letters which was described as an efficiency improvement.

Further work

Electronic transmission of discharge letters to GPs and community pharmacies is a crucial development that is being progressed by the HEPMA and hospital e-health teams. On completion of successful implementation, future work should assess staff views and opinions of this development to see whether the anticipated benefits have been achieved.

CHAPTER SUMMARY

This chapter described the aim and research questions for the post-implementation interview phase of the DPP project. A description of the methods used was provided with a particular focus on findings and discussion of findings.

CHAPTER 5 AUDIT PHASE

CHAPTER INTRODUCTION

This chapter describes the aim and research questions for the quantitative component of the DPP research, conducted before and after HEPMA implementation. There is a brief description of methodology prior to detailed coverage of study method, results and discussion.

CONTEXTUALISATION

Implementation into hospitals of innovative electronic solutions for discharge communication has been described in detail in Chapter 1. The literature review identified that quantitative methods proliferated; predominately questionnaires based studies and retrospective audits. Seven studies comprised retrospective case note audits investigating some component of the discharge process (Alderton and Callen 2007, Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008, Foster, Paterson and Fairfield 2002, McMillan, Allan and Black 2006, Scullard et al. 2007, Sexton et al. 2000). Six studies employed questionnaire based approaches, either postal or by electronic means (Alderton and Callen 2007, Scullard et al. 2007, Sexton et al. 2000, Pillai, Thomas and Garg 2004, Chen, Brennan and Magrabi 2010, Yemm et al. 2014). A variety of outcome measures were utilised with inconsistency in approach amongst the studies, as previously described. A deficiency identified in the reviewed literature was the lack of studies involving HEPMA systems.

AIM

The aim of this phase of the DPP project was to determine if HEPMA implementation impacted discharge information.

OBJECTIVES

Pre-implementation objectives

- To determine the frequency and nature of prescribing errors on immediate discharge letters prepared using traditional handwritten processes
- To determine discharge letter receipt and time of receipt at GP practices

Post-implementation objectives

- To determine the frequency, nature and severity of prescribing errors on immediate discharge letters post HEPMA implementation

- To determine discharge letter receipt and time of receipt at GP practices

COMPARISON OBJECTIVES

Primary Objective

- To determine if HEPMA implementation impacted the frequency, nature and severity of prescribing errors on immediate discharge letters.

Secondary Objectives

- To determine if HEPMA implementation impacted discharge letter receipt and time of receipt by GP practices.
- To determine if HEPMA implementation impacted patient re-admission to same specialty at 7, 14, 28 and 90 days after initial discharge date.

Hypotheses

- the null hypothesis was that HEPMA implementation did not impact discharge letter quality, number and severity of prescribing errors.
- the alternative hypothesis that HEPMA implementation impacted discharge letter quality, number and severity of prescribing errors.

QUANTITATIVE STUDY DESIGN

As described in Chapter 2, the philosophical stance of the PI was pragmatism and thus the DPP project utilised multiple approaches appropriate to the research aims and objectives. As previously outlined, the DPP project comprised mixed qualitative and quantitative approaches. This phase of the research employed a quantitative methodology, which as described in Chapter 2 is best at answering "the questions of who, where, how many, how much, and what is the relationship between specific variables" (Schimmel 1996).

Methodology and method

The study design used an experimental design methodology to test the hypothesis that HEPMA implementation impacted the outcome measures related to the primary objective (i.e. prescribing error frequency, nature and severity). As described in Chapter 2, a quasi experimental before and after study based design was adopted. This comprised a retrospective case note review, an assessment of discharge letter receipt at GP practices and calculation of patient re-admission rates.

Retrospective Case Note Review

A modified version of the Scottish Intercollegiate Guidelines Network (SIGN) discharge document template was used as a data collection tool to collate information obtained from the patients' case note review (Scottish Intercollegiate Guidelines Network (SIGN) 2012). The data collection tool is provided in Appendix 5.1. It includes an explanation and justification for each item of information to be collected and a brief description of exclusion criteria. Information about the criteria included in SIGN guideline 128 with an indication of whether each individual criterion was included in the DPP project is provided in Table 5.1. The retrospective review involved assessment of patients' clinical notes, inpatient prescription charts and immediate discharge letters (IDLs). The review was completed retrospectively to allow sufficient time to elapse after the patient's hospital discharge to enable full access to the patient's clinical notes. The time period of patient discharge was April to June 2013 in the pre-implementation phase and February to April 2015 in the post-implementation phase. The case note review was completed by the PI in October to December 2013 for the pilot notes and January to March 2014 for the remainder of the pre-implementation notes. The post-implementation review was from June to August 2015. The case notes were supplied by the medical records department to the dedicated audit room at UHC, where the PI undertook all case note reviews. It took approximately 20 to 30 minutes per patient to review the documentation and record the required information in the data collection tool. The availability of case notes for review was the rate limiting step in the completion of the case note review phase. The data were extracted from the patients' notes by the PI. The documented information of primary diagnosis, secondary diagnosis and significant operations/procedures was not assessed for accuracy by the PI, merely recorded as present or absent in the allocated section on the IDL which is consistent with the approach adopted by Callen et al (Callen, Alderton and McIntosh 2008)). Thus, if the information was recorded in the incorrect section, it was considered to be absent. The communication method of IDL to GP practice was assumed to be post. Patients may be requested to deliver the IDL to their GP practice but this information is not formally documented. Normality tests were applied to the data to determine data distribution.

A pilot of 50 case notes was reviewed to test the suitability of the data collection tool and the ability of the PI to extract the required information during the review. A random 10% sample was checked for reliability by an independent assessor who was a senior pharmacist responsible for prescribing development and education.

Table 5.1 Criteria included in SIGN Guideline 128 (Scottish Intercollegiate Guidelines Network (SIGN) 2012)

Criteria	SIGN Guideline Items	Included in Study?	Exclusion Reason
1	Name of Hospital	Yes	
2	Patient ID	Yes	
3	GP ID	Yes	
4	Consultant ID	Yes	
5	Ward/Department	Yes	
6	Ward/ Dept Telephone Number	No	Not in either template
7	Date of admission	Yes	
8	Date of discharge	Yes	
9	Primary Diagnosis	Yes	
10	Secondary Diagnosis	Yes	
11	Presenting Complaint	No	Assessment required
12	Mode of Admission	No	Beyond scope
13	Source of referral	No	Beyond scope
14	Significant operations/procedures	Yes	
15	Clinical progress	No	Assessment required
16	Results awaited?	No	Assessment required
17	Investigations pending?	No	Assessment required
18	Allergies	Yes	
19	Stopped medicines	Yes	
20	New medicines	Yes	
21	Continuing medicine	Yes	
22	Follow up arrangements	No	Assessment required
23	Copy to community pharmacy	No	Not in either template
24	Copy to patient	No	Not in either template
25	Copy to carer/relative	No	Not in either template
26	Extended discharge to follow	Yes	
27	Other information	No	Beyond scope
28	Consultant sign-off	No	Not in either template
29	Signature, name and position	Yes	

Sampling

Random sampling (probability) approaches are mainly used in quantitative research and details about the different approaches were outlined in Chapter 2. In random sampling, "each member of the population has an equal probability of being selected", as described by Cresswell (Creswell 2013). Furthermore, a simple random sample was defined by Davies as "every possible combination of individuals from within the 'population' is equally likely" and states that you must be able to obtain an exact list of the population (Davies 2007). Simple random sampling was selected for the DPP project as it was possible to obtain information of the whole population of interest from the Business Intelligence Department of NHS Ayrshire and Arran. As outlined in Table 2.5, random sampling has the advantage of being easy to conduct and was not time consuming as the information was readily available within the organisation.

Eligibility

Case notes eligible for review were according to the following patient inclusion criteria:

- greater than or equal to sixteen years of age
- discharged from hospital after an inpatient stay of at least 24 hours
- discharged from University Hospital Crosshouse
- discharged during the defined three month period

Patient exclusion criteria consisted of the following:

- in mental health, maternity and paediatric wards as HEPMA was not implemented or previously implemented
- confirmed prescribed no medicines at discharge
- inter hospital transfer

Therefore a random sample of patients fulfilling the eligibility criteria was required for the project. The PI provided the Business Intelligence department of NHS Ayrshire and Arran with the inclusion and exclusion criteria information and they e-mailed the sample list of patients to the PI. The patient list was forwarded by the PI to the medical records department to obtain the relevant

patients' case notes for review. The case note review patients were also used for GP receipt time and re-admission rate assessment.

Sample Size

The required sample size was calculated based on the primary objective of reducing prescribing errors. Error rates identified from the reviewed literature ranged from 12.1% to 66%, dependent on error category. Previous studies had used a random 5% sample of summaries produced per defined period (Wilson et al. 2001), selected a number of patients (100) without explanation (McMillan, Allan and Black 2006), or looked at all patients in a defined time period ranging from three months to a year (Callen J, McIntosh J and Li J 2010, Foster, Paterson and Fairfield 2002). None of these methods are statistically robust. Consequently, to enable estimation of sample size the following parameters were used:

- p value of 0.05
- power of 80%
- baseline error rate of 15%
- clinically important difference of 10%

Two different sample size calculators for determining differences in proportions were used to determine sample size (Casagrande 2013, Brant). The calculated size was 159 case notes before and 159 case notes after i.e. a total of 318 when using the first calculator (Casagrande 2013). Use of the second calculator produced a somewhat smaller 141 case notes before and after i.e. a total of 282 (Brant). There is an acceptance that the calculated sample size has insufficient power in relation to impact on the secondary objectives.

Pilot Sample Error Rate

A pilot sample of 47 case notes was reviewed to calculate the actual error rate. This was predicted to enable an accurate calculation of final sample size based on actual error rate and minimise the risk of type I and type II errors as described in Chapter 2.The pilot audit detected that 76.6% of patients had at least one prescribing error if Nil Known Drug Allergies (NKDA) not documented on IDL was excluded. If NKDA was included as a prescribing error then 99.4% of patients had at least one detected error.

The sample size calculation was completed as described previously based on an initial error rate of 76%. If the aim was to reduce errors by half to 38% then a total of 60 case notes (30 before and after) were required. If the aim was to reduce errors from 76% to 60% this would require a total of 120 case notes (60 before and after). As the calculated sample size based on the actual error rate was much smaller than the initial projected sample size, it was decided to proceed with the original sample of 318 patients in total to ensure sufficient data were obtained for the DPP project. The pilot data were included in the full sample data as no changes were made to the nature of data collected.

DATA COLLECTION

The PI extracted data from patients' clinical records and documented information in the data collection tool. The PI reviewed a copy of the patients' IDL (either paper or electronic) and noted the documented information, the number of medicines prescribed on the IDL and information about who had completed the IDL. The medicines prescribed on the IDL were compared to those prescribed on the corresponding inpatient chart to identify any discrepancies. Medicines not expected to be included in IDLs for example intravenous morphine sulphate injection as required would not be considered an omission. Medicines that a patient had received either on the day of discharge or the preceding day would be considered still to be an active current prescription and would therefore be expected to be included in the IDL, except if there was an explanatory entry in the patient's case notes.

Medication and prescribing errors

The DPP project involved retrospective case note review of existing prescriptions and patients' clinical records. Therefore, it was appropriate to adopt Dean et al's definition of a prescribing error as "a prescribing error occurs, when as a result of a prescribing decision or prescription writing process, there is an unintentional reduction in the probability of treatment being timely and effective or increase in the risk of harm"(Dean, Barber and Schachter 2000). The PI classified prescribing errors in the pre-implementation group as:

- omissions
- commissions

- incorrect dose
- incorrect frequency
- incorrect duration
- drug interactions
- therapeutic duplications
- missing allergy
- inaccurate allergy

An explanation for the error type classification is provided in Table 5.2.

Table 5.2 Error type classification

Error type	Description	Exclusion
Omission	Medicine omitted from IDL currently prescribed on inpatient chart. Medicine administered preceding/discharge day. For example documentation of "no changes to routine medicines".	Medicine not usually required on discharge for example antiemetic injection.
Commission	Medicine prescribed on IDL not on pre admission list. Medicine not administered preceding/discharge day e.g. cyclizine (anti-emetic) prescribed as a precaution but never administered.	Explanatory note documented for medicine requirement.
Incorrect dose	Discrepancy between dose on inpatient chart and IDL or nil documented e.g. carvedilol noted as 19mg instead of 18.75mg	Explanatory note documented regarding dose change.
Incorrect frequency	Discrepancy between frequency documented on inpatient chart and IDL or none documented. For example, as required medicines prescribed without specified time interval.	Explanatory note documented regarding frequency change.
Incorrect duration	Discrepancy between duration documented on inpatient chart and IDL or no documented duration provided.	Explanatory note documented regarding duration change.
Drug Interaction	A drug interaction recorded as a serious interaction in current edition of BNF.	Appropriate to co-prescribe with suitable monitoring.
Therapeutic Duplication	More than one medicine prescribed from same therapeutic group. Co-codamol and tramadol co-prescribed.	Protocol exists to evidence prescribing action.
Missing allergy	Allergy documented on inpatient chart and/or patients' case notes but not on IDL. NKDA missing from IDL.	Explanatory note documented regarding allergy information.
Inaccurate allergy	Discrepancy between allergy documented on inpatient chart and/or patients' case notes and IDL.	Explanatory note documented in case note regarding allergy information change.
Sociotechnical (post HEPMA)	Error caused by HEPMA system e.g. prednisolone soluble tablets instead of plain.	Error unlikely to be caused by HEPMA.

This was expanded further to include sociotechnical errors in the post-implementation group as previously described in Chapter 1 as "occurring at the point where the system and the professional intersected and would not have occurred in the absence of the system" (Redwood et al. 2011).

Error severity assessment

Identified prescribing errors were severity scored using a validated scoring system. The NCC MERP medication errors categorisation consists of nine severity ratings ranging from potential for error to occur (category A) to error occurrence which contributed to or resulted in patient death (category I) (MERP 2001). A study using a modified version of this scale assessed errors during the medicine reconciliation process with condensed scorings categorised to three severity levels (Gleason et al. 2010). A different error classification system was used to assess safety of two fully integrated hospital electronic prescribing systems in inpatient prescribing with an initial review to identify for procedural or clinical errors with further review for applicability of sociotechnical error (Westbrook et al. 2013). Sociotechnical errors were defined as "errors arising from the use and functionality of the electronic prescribing system which would be unlikely or unable to occur in paper-based medication ordering systems" (Westbrook et al. 2013).

Gleason et al's modified version was selected with severity ratings of:

(1) no potential harm

(2) monitoring or intervention potentially required to preclude harm

(3) potential harm (Gleason et al. 2010)

Literature review indicated varying methods to achieve error severity consensus. Options included independent practitioner review with meetings to agree consensus (Westbrook et al. 2013, Forster et al. 2003), reliability testing of error categorisation (Gleason et al. 2010) or alternatively validation panels may be used for error severity assessment. The chosen method of error severity scoring for the DPP project was a validation panel comprising one consultant doctor, one advanced nurse practitioner and one clinical pharmacist. This is consistent with the method and staff groups involved in local global trigger tool and hospital standardised mortality reviews (Bates et

al. 1999). If panel consensus was not achieved, the error was referred to another senior doctor for final assessment. Prescribing errors were scrutinised independent of patients' factors as previous studies indicated that focus should be on the prescribing systems and not individual patient risk. Reason suggested the need to look at the organisational level to prevent errors and not at the individual practitioners (Reason 2000). The implementation of HEPMA is an organisational level intervention which would be anticipated to effect prescribing error causality. After completion of all case note reviews the PI convened an error severity scoring panel. The PI personally approached a medical consultant, a consultant nurse (ANP) and a principal pharmacist to invite them to be part of the panel. All approached staff agreed to be involved. The PI followed up with an e-mail communication confirming the date, time and venue of the panel. The panel was convened on 11th September 2015. The panel discussion was held in a private room in the pharmacy department at UHC. The PI provided every panel member with a copy of each unique identified error and severity scoring guidance. The panel discussed each error in turn and assigned an individual severity score which was documented by the PI on a data collection sheet provided in Appendix 5.3. The duration of panel discussion was 37 minutes and 18 seconds. The PI collated the totals for each individual severity score after the panel had concluded.

Discharge Letter Receipt at GP practice

Partially anonymised patient details, including date of discharge recorded on the IDL, were collated onto a data collection form provided in Appendix 5.2. The patient was identified by Community Hospital Index (CHI) number which is a unique patient identification number and with patients' initials. Thus patient confidentiality was maintained as much as possible, whilst permitting confirmation of correct patient details by GP practices. The patients were then grouped according to their registered GP practice. This information was used to obtain the date of receipt of the IDL at the patient's registered GP practice.

The information for GP practices within NHS Ayrshire and Arran was obtained via the prescribing support pharmacy team who contacted their allocated GP practices. The requested information was: did the GP surgery receive the IDL: and if so, what was the documented receipt date? There were inconsistent approaches to receipt information documentation by the varying GP practices;

some recorded the actual receipt date whilst others recorded the date they had actioned the information. Therefore, the date the IDL was entered into the electronic healthcare data management system was used a proxy for IDL receipt. This was compared to the date of patient's hospital discharge as recorded on the hospital patient management system to calculate the number of days between patient discharge and GP information receipt.

The PI obtained GP receipt information for patients with GP practices out with NHS Ayrshire and Arran. This was achieved by telephone call to the relevant practice and requesting the receptionist to provide the required information. The PI confirmed sufficient time was available to respond or offered to phone back at a more convenient time.

Documented GP receipt date of discharge letter was compared against recorded date of patient hospital discharge to determine the time interval between patient hospital discharge and GP information receipt.

Patient Readmission

The patient readmission data was obtained via the Business Intelligence department of NHS Ayrshire and Arran. Readmission data were requested for seven, 14, 28 and 90 days after the patients' original hospital discharge date. The patient management system used by NHS Ayrshire and Arran provides real time data on patient movement through the hospital including admission and discharge dates.

PROMOTION OF VALIDITY AND RELIABILITY

The case note review used a validated tool from SIGN 128 adapted for local use which enhanced external validity as the study results will be applicable to other healthcare organisations; face validity as the tool appears to measure what it should; and criterion validity as the tool used can be compared to a similar validated tool (Scottish Intercollegiate Guidelines Network (SIGN) 2012).

A random sample of 10% of case notes was checked by an independent assessor for reliability which provided inter-rater and internal consistency reliability. Test-retest reliability has been designed into the study by undertaking a before and after study design which means that consistency of measurement over time will be determined.

MINIMISING BIAS

Biases that have been possible to minimise were: measurement bias by the PI applying a consistent approach by using a validated tool; non-response and sampling biases by the using a random patient sample obtained from business intelligence and by systematic application of the sample by the PI.

DATA ANALYSIS

The published literature reviewed in Chapter 1 described different statistical analysis ranging from descriptive statistics to inferential statistics using a variety of tests including the Mann Whitney U test, Chi-square analysis, 2x2 tables for odds ratio with Chi-square analysis (Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008, Chen, Brennan and Magrabi 2010, Witherington, Pirzada and Avery 2008). However, some studies did not describe statistical analysis (McMillan, Allan and Black 2006, Scullard et al. 2007).

The DPP project consisted of two independent (i.e. not paired) samples and the choice of appropriate statistical test is dependent on the data type. Data types may be categorical or quantitative (Campbell and Swinscow 2011). The quantitative data may either be measured or counted whilst the categorical data may either be ordered (ordinal) or unordered (nominal) (Campbell and Swinscow 2011). For continuous (measured) data, it is important to define if the data are parametric or non-parametric which may be determined by testing for normality. If the data are normally distributed it is parametric and if not it is non-parametric.

The variables collected in the DPP project included a mixture of data types. Categorical, nominal data included sex, discharge diagnosis, number of patients with a prescribing error and number of patients with specific types of prescribing errors. Quantitative discrete variables included age and number of medicines. An appropriate statistical test for categorical variables is the Chi-square test for data greater than zero and Fisher's exact test for data including a count of zero. Internet programmes were used to calculate Chi- square and Fisher exact test (Preacher 2012, QuickCalcs 2015).

Data were collected using the tool provided in Appendix 5.1, and were then input by the PI into Statistical Product and Service Solutions (SPSS©) software

version 21.0. This software aided statistical analysis including calculation of descriptive statistics, tests of normality and inferential statistics (IBM 2013). A mixture of descriptive and inferential statistics was used for data analysis.

Tests of normality

Calculation of the mode, the mean and the median allows determination of distribution. These will be identical if data are normally distributed (Casagrande 2013). Alternatively, a test for normality can be run using SPSS (IBM 2013). Normal data are required for parametric testing. A Shapiro-Wilk test of normality was used rather than the Kolmogorov-Smirnov test as Shapiro-Wilk is more appropriate for small samples of less than 50 but is also appropriate for samples as large as 2000 (Casagrande 2013). If $p < 0.05$ then the data are not normally distributed.

The patients being studied were different in the before and after study so an unpaired t test would be selected as an appropriate statistical test if the data were parametric and a Mann Whitney U test if the data were non-parametric (Driscoll, Lecky and Crosby 2000a, Driscoll, Lecky and Crosby 2000b).

Patient re-admission rates were recorded as number of patients re-admitted with comparison of pre-and post-implementation groups.

RESULTS

PRE-IMPLEMENTATION RESULTS

Patient demographic information for the pre-implementation group of patients is shown in Table 5.3

Table 5.3 Pre-implementation patient demographic information

Variable	Result/range	Mean	SD
Gender	57% female (n=91)		
Age at discharge (years)	18 to 102	60	19.8
Length of stay (days)	1 to 33	4	4.1

The most frequent length of stay for patients was two days; with Tuesdays (20%, n=32) and Thursdays (20%, n=32) the most frequent discharge day; Sunday (8%, n=13) was the least frequent. Only 19% (n=30) patients were weekend discharges. The majority of patients, 81% (n=129) were discharged from medical and surgical wards; 19% (n=30) were discharged from either orthopaedic or gynaecology wards.

Information documented on IDL

The results of the information documented on the IDL for pre-implementation patients are shown in Table 5.4.

Table 5.4 Results of information documented on IDL (N=159)

Required information	Documented % (n)
Patient's GP details	56(89) Name only 44(70) Name & address 12(19)
Hospital consultant	97 (154)
Diagnosis	96 (153)
Relevant secondary diagnosis	30 (48)
Procedures/operations	62 (99)
Allergy information	7 (11)
Signature	100 (159)
Full name printed	99 (157)
Grade of staff	40 (61)
Contact information	45 (71)
Further information to follow?	1 (1)

The GP full name and address was recorded in only 12% (n=19) patients. Hospital consultant information was missing in 3% (n=5) patients with no diagnostic information recorded in 4% (n= 6) patients.

Number of medicines on discharge

Patients were documented as being discharged home on between zero and 25 medicines as depicted in Figure 5.1. The mean number of medicines was 5.5 with a standard deviation of 4.1. (This number excludes medicines identified as omitted from the IDL.) The total number of medicines prescribed on IDLs pre- implementation was 872.

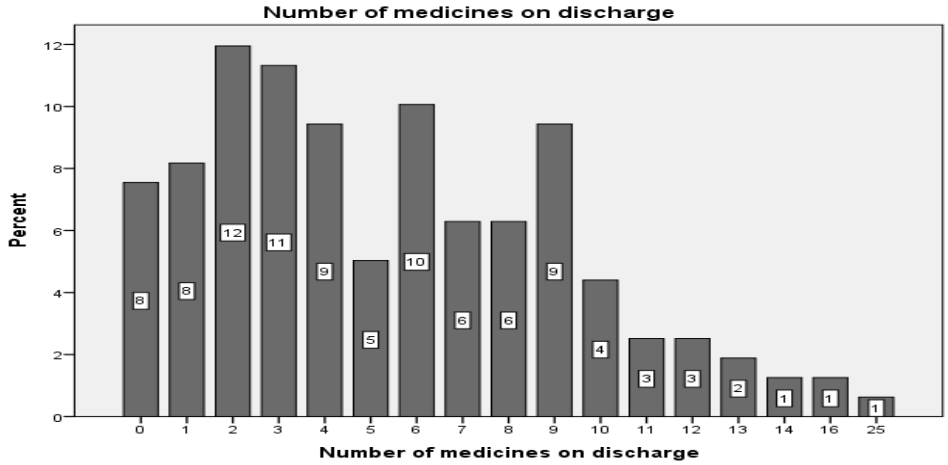


Figure 5.1 Number of discharge medicines (pre-implementation)

Two patients were lost to follow up for GP receipt information as they were recorded as unknown GP practice. GPs received 71% (n=113) IDL, with 6% (n=16) receipt failure as shown in Figure 5.2. A further 22% (n=35) patients were lost to follow up for the following reasons: patient left practice (n=10), patient deceased (n=14), patient not registered at practice (n=2), and one practice declined to provide information (n=9).

Figure 5.2 GP receipt information (pre-implementation)

The time delay between documented date of patient discharge and receipt of IDL at GP practice is depicted in Figure 5.3. The mean delay was five days; standard deviation of 6.3, with a range varying from zero to 42 days. Patients were registered at 34 different GP practices in the NHS Ayrshire and Arran Health Board area (n=151) with six patients registered at GPs out with local area, all at different practices

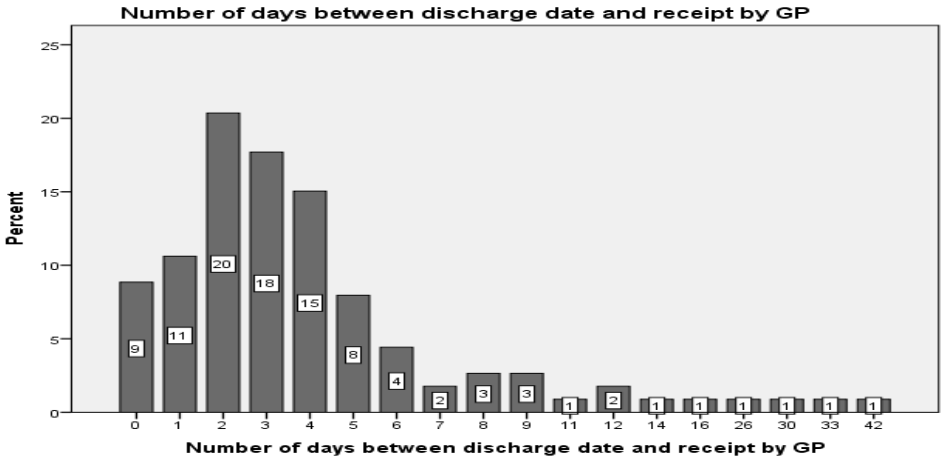


Figure 5.3 Days between discharge and GP receipt (pre-implementation)

The PI detected 726 errors in total in the pre-implementation IDLs. Figure 5.4 shows the number of patients associated with each specific error types.

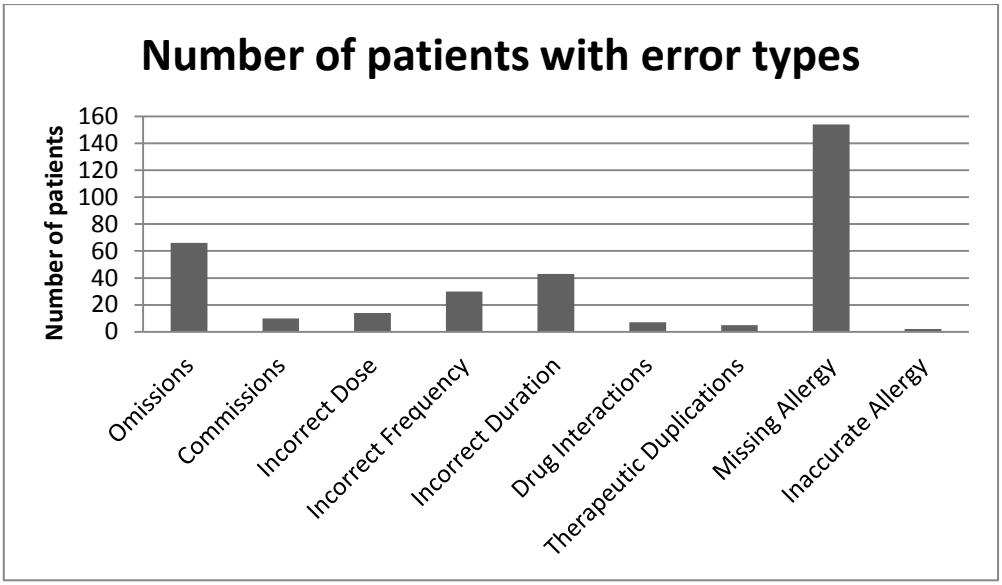


Figure 5.4 Number of patients with various error types on IDL (pre-implementation)

Omission of at least one medicine from the IDL was detected in 42% patients (n=66) using traditional handwritten systems as shown in Figure 5.5. A total of 237 medicines were omitted from IDLs. Types of omitted medicines varied considerably: routine medicines were not prescribed at all (for example recorded as "no changes to usual medicines"); individual medicines were omitted in error which ranged in seriousness from potential patient harm e.g. oxycodone to unlikely to cause harm e.g. lactulose.

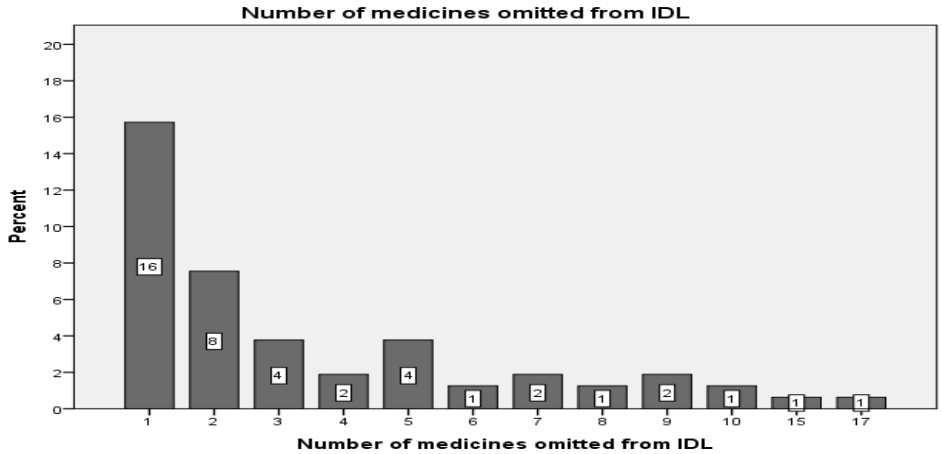


Figure 5.5 Frequency of omitted medicines (pre-implementation)

The number of medicine commissions is shown in Figure 5.6 with a total of 13 detected in 6% (n=10) patients. An example of a commission was cyclizine

(an anti-emetic) prescribed and supplied on the IDL despite not being administered during the inpatient stay.

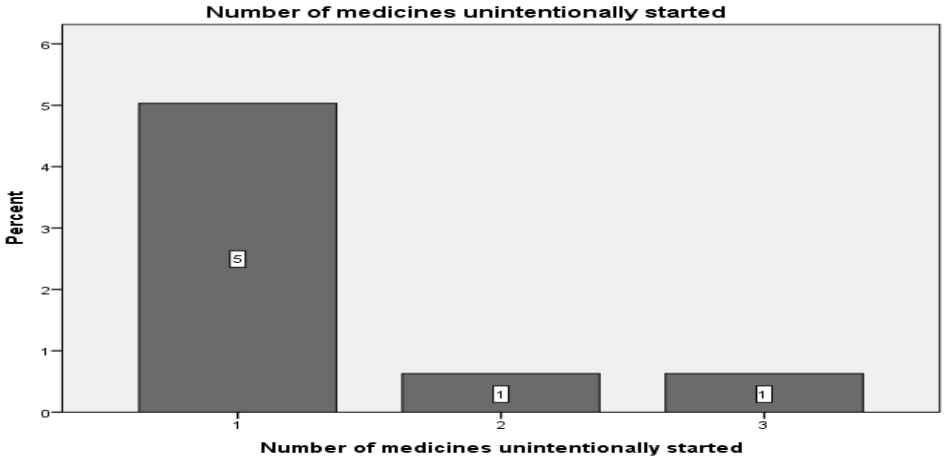


Figure 5.6 Number of medicine commissions (pre-implementation)

Incorrect doses were present in 17 prescribed medicines on the IDL (2% of all medicines) and in 14 patients (9% of all patient) pre-implementation. Categories of incorrect doses were transcription errors (for example trandolapril documented as 20mg instead of 2mg); illegibility (diazepam dose indecipherable could have been 20mg or 210mg but should have been 2mg); and omission of dosing information (for example no specification of inhaler dosages and warfarin documented as charted).

Incorrect frequencies were present in 49 IDL prescribed medicines (6% of all medicines) and in 30 patients (19% of all patient) pre-implementation. Incorrect frequencies were categorised as omitted information (for example as required medicines with no dose interval information) and incorrect transcription (for example ramipril transcribed onto IDL as 1.25mg once daily when prescribed twice daily on the inpatient chart).

Figure 5.7 shows that 27% patients (n=43) had at least one medicine documented with an incorrect duration, with 225 medicines (26% of all prescribed medicines) having incorrect documented duration. These were categorised as incorrect information documented on IDL (for example antibiotics marked as to be continued by GP rather than a defined course); and no duration information provided, which was a frequent occurrence.

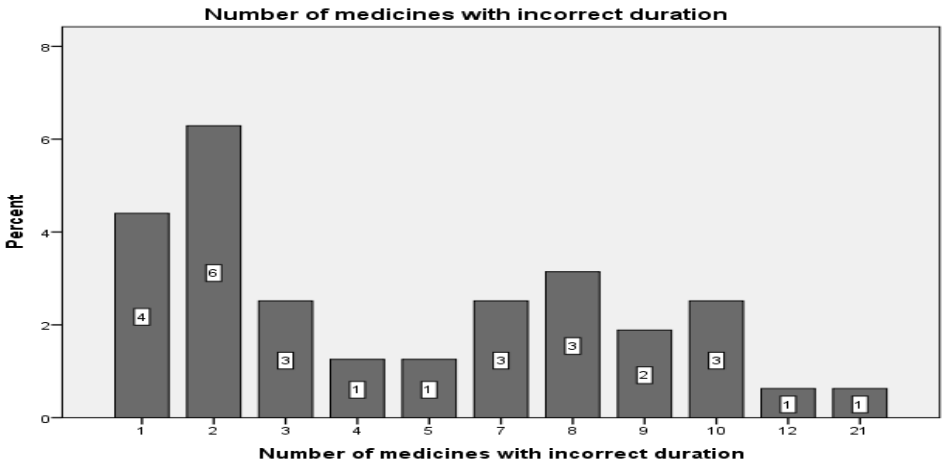


Figure 5.7 Number of medicines with incorrect duration (pre-implementation)

Drug interactions classified as a serious drug interaction in BNF were detected in 4% (n=7) patients. Examples included a patient discharged home on both clopidogrel and omeprazole which may result in decreased effectiveness of clopidogrel; warfarin missed from an IDL, when the patient was also on penicillin v which may potentiate the patient's INR so the patient should have more frequent INR checks to prevent harm from warfarin exceeding the desired target INR range e.g. bleeding and a patient on amlodipine and simvastatin prescribed at a dose of 40mg when the maximum dose should be 20mg with concomitant use of amlodipine (British Medical Journal and Royal Pharmaceutical Society of Great Britain 2015). Therapeutic duplications were detected in 3% (n=5) patients. For example a patient discharged home on both Laxido ® and lactulose which should be rationalised to either alone (The Scottish Government 2012).There were 172 omitted allergies in 97% (n=154) patients mainly due to failure to document NKDA. Figure 5.8 illustrates that 8% (n=13) patients had multiple allergies not documented on the IDL.

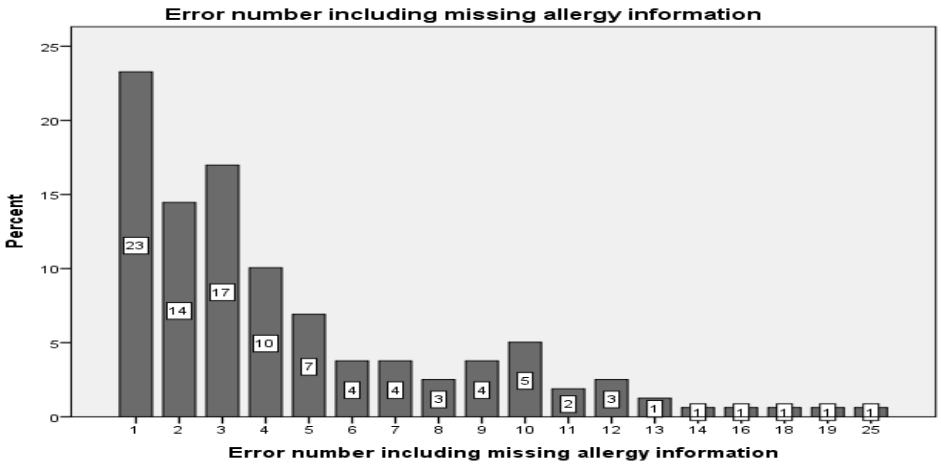


Figure 5.8 Total errors including missing allergies (pre-implementation)

Patients could have multiple error types or multiple instances of the same errors on the IDL. Figure 5.9 shows the wide variation in error percentages in pre-implementation patients ranging from one to 25 errors. A frequently occurring error was the failure to document NKDA on the IDL (n=105).

Allergy discrepancies were detected in 1% (n=2) patients. This consisted of the allergy being incorrectly documented as uric acid and not uric acid metabolites and NKDA documented although the patient was allergic to paracetamol. If the error total is calculated excluding the failure to document NKDA the revised totals are illustrated in Figure 5.9. This demonstrates that 84% (n=134) of patients had detected errors.

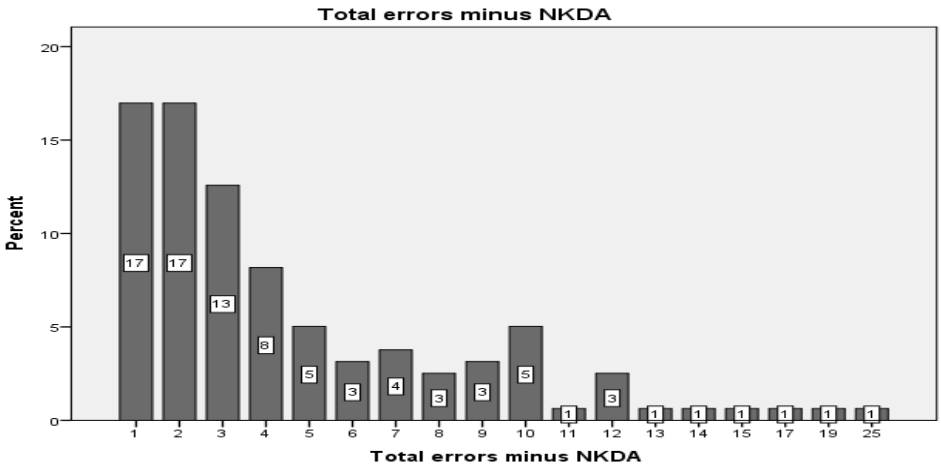


Figure 5.9 Error total excluding nil known allergy (pre-implementation)

The documentation of grade of staff completing the IDL was relatively poor, as only 40% IDLs had prescriber grade recorded. None were documented as being completed by consultant medical staff in the pre-implementation

patients. It would appear that FY1s (26%) and NIPs (9%) were more likely to record this information.

Pre-implementation findings

The IDL serves as both a prescription and communication about the patients' hospital stay. A fundamental requirement of accurate information communication is to document the individual patient's GP practice information. The failure to record essential information necessitates other healthcare staff, particularly medical records staff, to retrieve and record this information so that the letter may be successfully sent to the patient's GP. A lack of crucial information on the IDL results in information gaps for ongoing care and highlights communication issues with the traditional system. Missing allergy information was the commonest error type, followed by medicine omission. A major cause of omitted medicines was failure to transcribe the medicines and document "no changes to regular medicines". This is not compliant with the SIGN guideline requirements (Scottish Intercollegiate Guidelines Network (SIGN) 2012). Pharmacists when completing the initial clinical check would be unaware of existing medicines and may miss drug interactions and therapeutic duplications which may result in patient harm.

POST-IMPLEMENTATION RESULTS

Patient demographic information for the post-implementation group of patients is shown in Table 5.5

Table 5.5 Post-implementation patient demographic information

Variable	Result/range	Mean	SD
Gender	57% female		
Age at discharge (years)	17 to 93	55	20.8
Length of stay (days)	1-25	4	4.2

The most frequent length of stay was two days. Patients were most frequently discharged on a Friday (21%, n=33); with Thursday (9%, n=14) the least frequent discharge day. Nearly a quarter of patients (24%, n= 38) were discharged at the weekend. The majority of patients were discharged from medical and surgical wards; 22% (n=35) were discharged from orthopaedic and gynaecology wards.

Documented information on HEPMA IDL

The results of information documented on post-implementation IDLs are shown in Table 5.6.

Table 5.6 Results of information documented on HEPMA IDL (N=159)

Required information	Documented HEPMA % (n)
Patient's GP details	99 (157) unknown GP Scotland 1(2)
Hospital consultant	100 (159)
Diagnosis	72 (116)
Relevant secondary diagnosis	31 (49)
Procedures/operations	39 (62)
Allergy information	100 (159)
Signature*	100 (159)
Full name printed	100 (159)
Grade of staff	100 (159)
Contact information	0 (0)
Further information to follow?	0 (0)

*full name considered to be electronic signature

Table 5.6 provides details of the information completed for the post-implementation patients. As before, the information was not assessed for accuracy by the PI, merely recorded as documented or absent in the relevant section of the IDL. The HEPMA IDL has 11 different heading tabs which may be completed when creating an IDL as shown in Appendix 5.4. These are namely; diagnoses, secondary diagnoses, investigations, operation/procedure, clinical progress, results awaited, social/nursing/AHP, GP follow up, hospital follow up, subspecialty notes and medicines/pharmacy. The PI identified that some prescribers ignored the individual headings and put all the information in the clinical progress section. Thus whilst the diagnosis was not documented in diagnosis section, it was often included in the clinical progress segment.

Number of medicines on discharge

Patients were documented as being discharged home on between zero and 18 medicines as shown in Figure 5.10. The mean number of medicines was six with a standard deviation of 3.9. (This number excludes medicines identified as omitted from the IDL). The total number of medicines prescribed on IDLs post-HEPMA implementation was 1018.

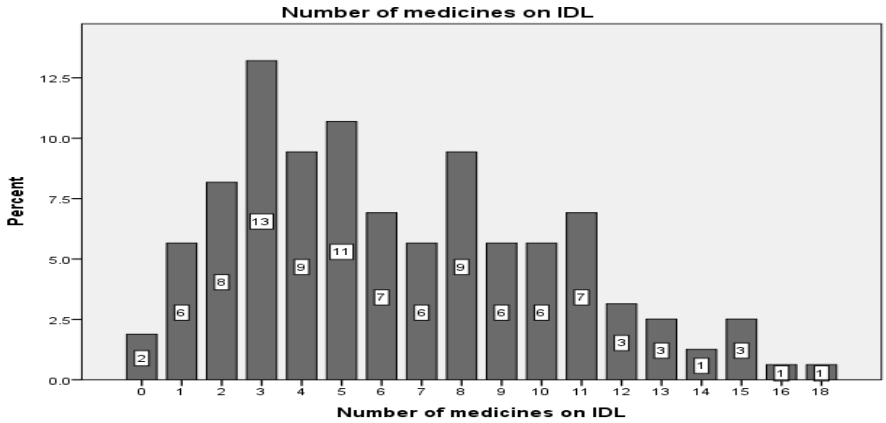


Figure 5.10 Number of medicines on IDL (post-implementation)

The grade of prescriber was recorded on all IDLs post-implementation. The traditional description of medical staff grade was recorded by HEPMA at this time although it is now amended to current terminology of FY1, FY2 etc. JHO (FY1s) were responsible for the greatest number of IDLs (45%, n=71) with consultants only completing 2% (n=3) of IDLs. HEPMA implementation permitted alteration to the conventional process of producing an IDL followed by a typed FL. The results show a gradual move to first and final discharge letters which were used in 21% of patients (n=34).

GP receipt information was not obtained for the post-implementation patient because the electronic transmission of IDLs to GP practices had not been implemented.

Errors post HEPMA implementation

The PI detected 75 errors in total in the post-implementation IDLs. Figure 5.11 shows the number of patients associated with each specific error types. Medicine omission was the most frequently detected error type (n=18).

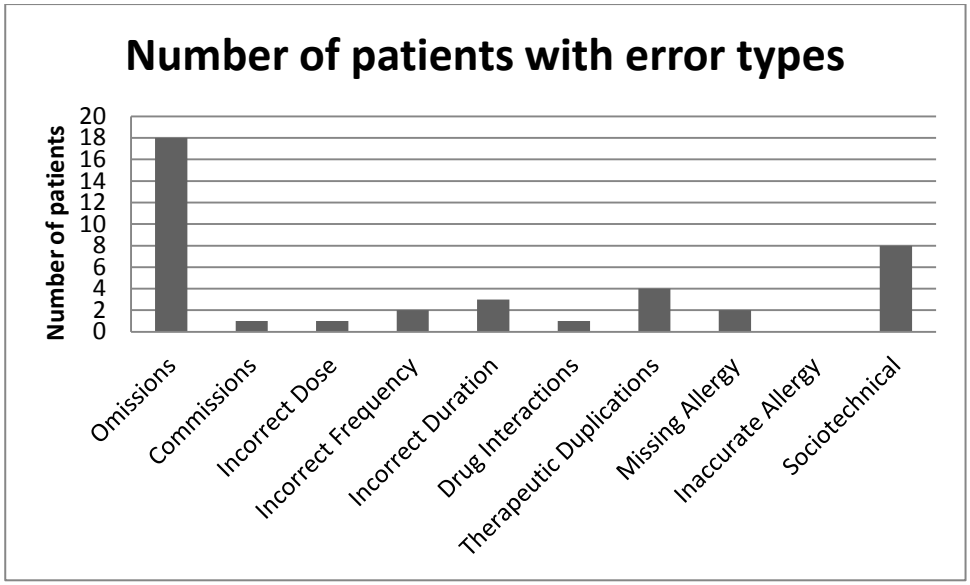


Figure 5.11 Number of patients with errors on IDL (post-implementation)

The PI detected errors in only 23% patients (n=37) post-implementation. Figure 5.28 illustrates that the majority of patients with errors had only one error (n=26).

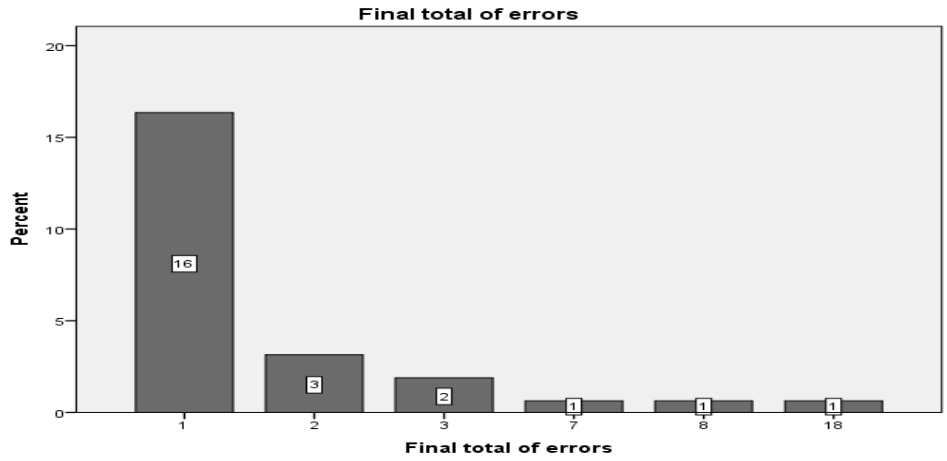


Figure 5.12 Percentage of patients with number of errors (post-implementation)

Examples of specific error types are depicted in Figures 5.13 and 5.14. The most frequent error type was omitted medicines which was present in 11% patients (n=18) with 51 medicines omitted. Figure 5.13 illustrates that the most frequent number of medicine omitted post HEPMA implementation was one medicine.

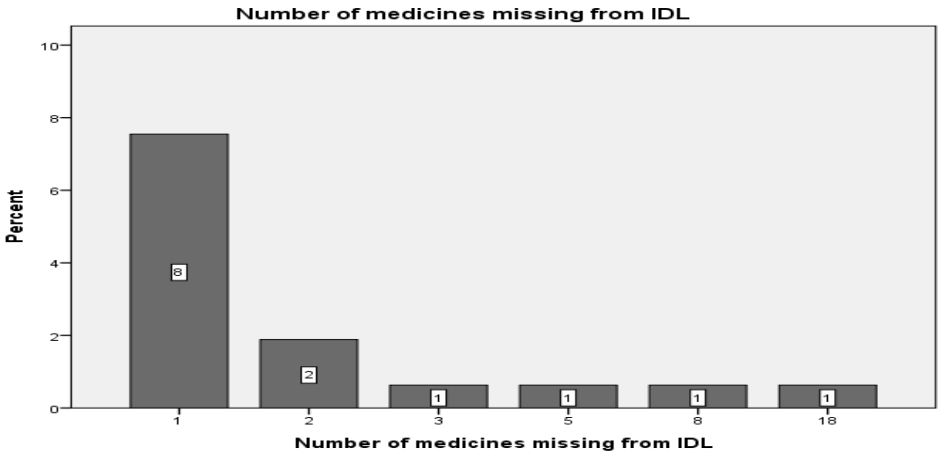


Figure 5.13 Number of omitted medicines from IDL (post-implementation)

Incorrect dosages (1 medicine in 1 patient), incorrect frequencies (3 medicines in 2 patients) and drug interactions (1 medicine in 1 patient) accounted for less than 1% of errors respectively; with 2% of errors attributable to incorrect durations (4 medicines in 3 patients). Therapeutic duplications were detected in 4 patients (2.5%) with two patients prescribed identical duplicate medicines.

Sociotechnical errors which are errors that occur as a result of the technology were identified in 5% patients (n=8) for 10 medicines and are shown in Figure 5.14. Examples of sociotechnical errors include incorrect selection of medicine formulation (diclofenac soluble tablets selected instead of tablets as the computer lists in alphabetical order and soluble tablets appears prior to tablets), eye drops defaulting to choose route and the prescriber failed to select the appropriate eye or both eyes as relevant.

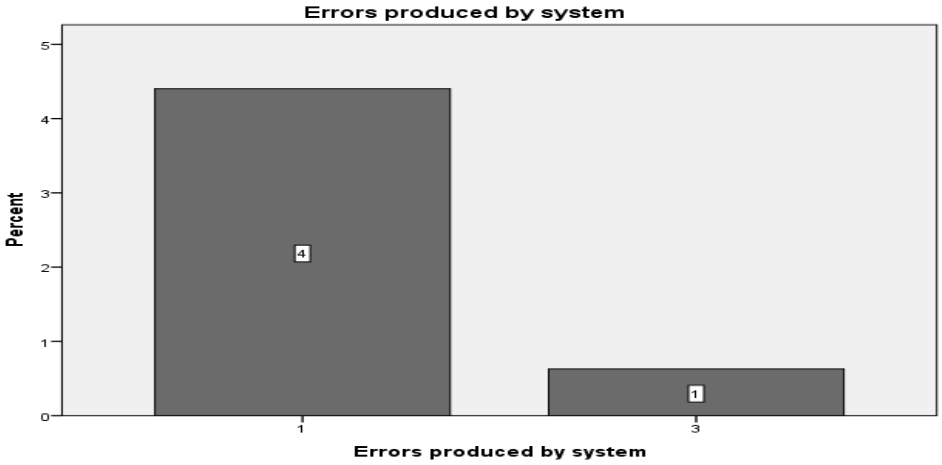


Figure 5.14 Sociotechnical errors (post-implementation)

Post implementation findings

Prescribing errors were still detected post-implementation. Medicine omission was the most frequent prescribing error type. Socio-technical errors were detected as a consequence of the HEPMA system. Information documentation was not completely compliant in all sections of the IDL. There was total absence of contact information and further information to follow. HEPMA IDLs are exempt for the requirement of handwritten signatures as the electronic signature will suffice as described in Statutory Instrument 2008 (The Secretary of State for Health 2008). Therefore, although the SIGN guideline states signature the inclusion of the prescriber's name documented as an electronic signature suffices for both signature and name (Scottish Intercollegiate Guidelines Network (SIGN) 2012).

COMPARISON OF PRE AND POST-IMPLEMENTATION RESULTS

The pre and post implementation results were compared to assess if HEPMA implementation had impacted on the objectives. A normality test was applied to the results which demonstrated that the data were non-parametric.

The results in Table 5.7 show there was no statistically significant difference in patient demographics between the two groups. Apparent differences included discharge day: in the pre-implementation group the most common discharge days were Tuesday and Thursday but this had altered to Friday post-implementation with more discharges also occurring on a Sunday. This is probably reflective of changes in the hospital moving to a seven day discharge culture as demonstrated by an increase in weekend discharges from 19% to 24%. Also more medicines were prescribed on IDLs post HEPMA with 1018 in total in contrast to 872 medicines pre-implementation.

The results in Table 5.8 demonstrate that there was a statistically significant improvement in certain aspects of documentation; no impact on others; whilst certain sections were associated with reduced information documentation.

Table 5.7 Comparison of pre and post-implementation results

Variable	Pre-Implementation	Post-Implementation	Statistical Test Mann Whitney U	Significance P value
Mean patient age (years)	60	55	0.000	0.317
Mean number of discharge medicines	5.5	4	0.000	0.317
Most frequent discharge day	Tuesday 20% Thursday 20%	Friday 21%	0.000	0.317
Gender	57% female	57% female	N/A	
Age range (years)	18-102 Mean 58	17-93 Mean 59	11974.5	0.416
Length of stay (days)	1 -25 Mode 2	1-33 Mode 2	11884.0	0.232
Discharge specialty	Medical 47% Surgical 33%	Medical 47% Surgical 30%	12334.5	0.688
Total number of IDL prescribed medicines	872	1018	10787.5	0.023

Table 5.8 Comparison of documented information on IDL

Comparison of number and percentage of patients with required information	**Pre- HEPMA** (n=159)	**Post-HEPMA** (n=159)	**Chi-square**	**p value**
Patient's GP details	89 (56%)	157 (98.7%)	83.019	<0.001
Hospital consultant	154 (96.9%)	159 (100%)	Fisher exact	0.0605
Diagnosis	153 (96.2%)	116 (73%)	33.028	<0.001
Relevant secondary diagnosis	48 (30.2%)	49 (30.8%)	0.015	0.902
Procedures/ operations	99 (62.3%)	62 (39%)	17.223	<0.001
Allergy information	11 (6.9%)	159 (100%)	Fisher exact	<0.0001
Signature	159 (100%)	159 (100%)	Fisher exact	1.0000
Full name printed	157 (98.7%)	159 (100%)	Fisher exact	0.4984
Grade of staff	64 (40.2%)	159 (100%)	Fisher exact	<0.0001
Contact information	72 (45.3%)	0 (0%)	Fisher exact	<0.0001
Further information to follow?	2 (1.3%)	0 (0%)	Fisher exact	0.4984

Fisher exact test used a two tail P value

Prescribing errors were compared pre and post HEPMA implementation as illustrated in Table 5.9. There was a statistically significant reduction in the number of patients with a prescribing error post HEPMA implementation, with a reduction from 158 to 37 ($p<0.001$.) Furthermore, there was a statistically significant reduction in all types of prescribing errors post HEPMA implementation except for three categories as shown in Table 5.9. Therapeutic duplications and incorrect allergies showed no statistical difference; although these had small patient numbers in both subsets. The new error type (sociotechnical) showed an increase in occurrence from zero to eight patients.

Multiple error types were detected in 41.5% (n=66) pre-implementation patients. Multiple instances of the same error occurred in 56% (n=89) patients in particular multiple omitted medicines or no duration of information. Whereas, in the post-implementation cohort, multiple error types were detected in only 2% (n=3) patients and multiple instances of the same error in 7% (n=11).

Table 5.9 Comparison of prescribing errors

Comparison of number and percentage of patients with prescribing errors	**Pre- HEPMA** n=159	**Post-HEPMA** n=159	**Chi-square**	**p value**
Patients with errors	158 (99.4%)	37 (23.3%)	194.115	<0.001
Patients with errors excluding NKDA	134 (84.3%)	37 (23.3%)	119.03	<0.001
Omitted medicines	66 (41.5%)	18 (11.3%)	37.275	<0.001
Medicine commissions	10 (6.3%)	1 (0.6%)	7.627	0.006
Incorrect Doses	14 (8.8%)	1 (0.6%)	11.824	<0.001
Incorrect frequencies	30 (18.9%)	2 (1.3%)	27.241	<0.001
Incorrect durations	43 (27.0%)	3 (1.9%)	40.665	<0.001
Drug Interactions	7 (4.40%)	1 (0.6%)	4.616	0.032
Therapeutic duplications	5 (3.1%)	4 (2.5%)	0.114	0.736
Missing allergies	154 (96.9%)	2 (1.3%)	290.72	<0.001
Incorrect allergies	2 (1.3%)	0 (0%)	Fisher exact	0.498
Sociotechnical error	0 (0%)	8 (5.0%)	Fisher exact	0.007

Error Severity Scoring

Error severity scoring was arranged with a panel comprising a consultant doctor, pharmacist and ANP. The ANP failed to attend the scheduled appointment and therefore the panel proceeded with only a consultant doctor and pharmacist. The results of the severity scoring are shown in Figure 5.15. HEPMA implementation resulted in 22% (n=8) patients with errors assessed as likely to cause potential patient harm. It should be noted that patients could have errors in more than one severity category.

There were 40 distinct errors that were assessed for severity. The same error may have occurred in multiple patients for example therapeutic duplication of lactulose and Laxido© and selection of prednisolone soluble tables instead of plain which both occurred in two patients. Table 5.6 provides a description of the error with associated score

The doctor and pharmacist were in agreement with the severity scoring for all errors and therefore no errors required further review.

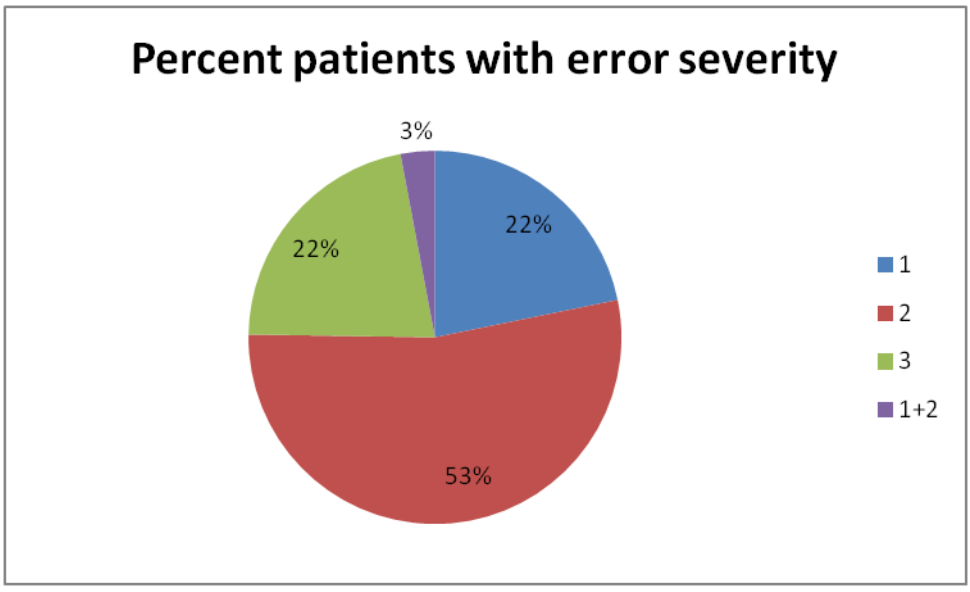


Figure 5.15 Percentage of patients with error severity levels

1= no potential harm; 2= monitoring or intervention potentially required to preclude harm; 3=potential harm

*1+2 Patients could have errors in more than one severity category

Hypothesis acceptance or rejection

The null hypothesis was rejected and therefore HEPMA implementation impacted positively the discharge letter quality, number and severity of prescribing errors.

Table 5.10 Post HEPMA error severity scoring

Error Description	Error type	Severity Score
Eye drops prescribed on IDL with choose route.	Sociotechnical	1
Both Laxido® and lactulose prescribed on IDL.	Therapeutic duplication	2
Admitted on hyoscine butylbromide 20mg 4x prn, prescribed and administered as inpatient but missing from IDL.	Omission	3
Zopiclone as required for night sedation missed from IDL. The patient had doses the two nights prior to discharge and was admitted on zopiclone.	Omission	2
Cilest® suspended on admission due to vaginal bleeding but not transferred to IDL and no information documented regarding when to restart.	Omission	2
No medicines added to IDL but patient had 18 medicines prescribed and administered as inpatient which should be continued on discharge.	Omission	3
Esomeprazole 40mg 1x prescribed as inpatient but omitted from IDL.	Omission	2
Wrong formulation of phenoxymethylpenicillin selected; syrup instead of tablets.	Sociotechnical	1
Bisoprolol 7.5mg prescribed as inpatient but only 5mg on IDL (medicines transferred across on 10/03 but dose increased after that and patient discharged on 20/03) Bisoprolol started to treat atrial fibrillation.	Sociotechnical	2
Senna missed from IDL despite increased dose of co-codamol from 15/500 to 30/500.	Omission	2
Movicol® paediatric plain selected instead of adult.	Sociotechnical	1
Lantus® and Humulin S® on IDL with no frequency documented. Marked as charted but the insulin chart would not be sent to the patient's GP.	Incorrect frequency	1
Glyceryl trinitrate spray omitted from IDL although was prescribed on inpatient prescription.	Omission	2
Prednisolone soluble tablets selected instead of plain.	Sociotechnical	1
Simvastatin withheld during inpatient stay as also prescribed clarithromycin. Information documented on IDL to restart simvastatin once antibiotics completed. Simvastatin and clarithromycin both prescribed on IDL and both dispensed.	Drug Interaction	2

Error Description	Error type	Severity Score
Five day supply of cyclizine requested on IDL but this was not administered during inpatient stay.	Commission	1
Clomipramine prescribed in morning but should be at night as per admission medicine reconciliation. (HEPMA defaults to 10pm time).	Incorrect frequency	2
Methocarbomol missing from IDL although prescribed as inpatient.	Omission	2
Amiodarone 200mg tablets selected for 100mg dose (100mg tablets available).	Sociotechnical	2
Diclofenac dispersible tablets selected but all other medicines are solid oral forms and patient was taking enteric coated tablets prior to admission.	Sociotechnical	1
Commenced on zopiclone for night sedation but developed a skin rash so stopped. Information not documented on IDL nor allergy status updated.	Omitted allergy	3
Omeprazole started for gastro-intestinal protection whilst on steroids for 14 days. Therefore omeprazole should not be long-term but 28 days requested of omeprazole requested on IDL and marked as to continue by GP.	Incorrect duration	3
Alendronic acid once weekly on a Sunday missing from IDL but prescribed on inpatient chart.	Omission	2
Palliative care recommended codeine and sevredol for pain as tramadol no longer effective but all three on IDL plus dihydrocodeine.	Therapeutic duplication	3
Ramipril withheld on admission due to acute kidney injury (AKI) but not restarted on IDL despite information stating AKI resolved.	Omission	2
NovoRapid® missing from IDL. Only lantus® prescribed on IDL although both prescribed on inpatient prescription.	Omission	2
Laxido® sachets missing from IDL. The patient is prescribed high dose morphine (Zomorph® 40mg 2x).	Omission	2
Omitted breakthrough morphine (morphine sulphate solution) from IDL. Patient prescribed Zomorph® 40mg 2x.	Omission	2
Salbutamol metered dose inhaler 2 puffs as required prescribed as inpatient but not prescribed on IDL.	Omission	2
Prescribed and administered ibuprofen 400mg 3x as inpatient for several days prior to discharge but not added to IDL.	Omission	2

Error Description	Error type	Severity Score
Nicotinell® 30 patch prescribed as inpatient but missing from IDL (Patient started 2 weeks prior to admission).	Omission	2
Eight routine medicines prescribed as inpatient but not documented on IDL.	Omission	3
Meloxicam, azathioprine and sulfasalazine should be restarted at normal doses one week post discharge but none prescribed on IDL and not mentioned on IDL.	Omission	3
Five medicines prescribed on inpatient prescription but not on IDL.	Omission	3
Tranexamic acid should be continued until clinic appointment but marked as 28 days with GP to continue.	Incorrect duration	2
Omeprazole prescribed as gastrointestinal cover whilst on diclofenac but this information not communicated to GP so potential that this could be continued.	Incorrect duration	3
Allergy information recorded as other (see medical notes). There was a note documented in inpatient HEPMA as sodium benzoate causes mouth ulcers but this note not added to the IDL.	Missing allergy	2
Patient prescribed both Fluoxetine and Amitriptyline on IDL (only taking Amitriptyline prior to admission).	Therapeutic duplication	2
Mometasone cream and Doublebase® gel prescribed as inpatient but missing from IDL.	Omission	2
Doxycycline and prednisolone marked as 28 day supply on IDL but should only be 7 day course.	Incorrect duration	3

1= no potential harm; 2= monitoring or intervention potentially required to preclude harm; 3=potential harm

Patient readmission data

The patient re-admission data is shown in Table 5.7 for seven, 14, 28 and 90 days to assess whether prescribing errors and the quality of discharge communication had an impact on patient readmission episodes.

Table 5.11 Patient readmission data

Comparison of patient readmission numbers (percentages)	**Pre-HEPMA** (n=159)	**Post-HEPMA** (n=159)	**Chi-square**	**p value**
7 day total	3 (1.9%)	3 (1.9%)	0	1
14 day total	5 (3.1%)	4 (2.5%)	0.114	0.736
28 day total	8 (5.0%)	6 (3.8%)	0.299	0.585
90 day total	17 (10.7%)	12 (7.5%)	0.949	0.330
7 day same specialty	2 (1.3%)	1 (0.6%)	0.337	0.562
14 day same specialty	4 (2.5%)	1 (0.6%)	1.829	0.176
28 day same specialty	7 (4.4%)	5 (3.1%)	0.346	0.556
90 day same specialty	12 (7.5%)	8 (5.0%)	0.854	0.355

There were a total of 23 re-admission episodes for 17 patients in the pre-implementation group in comparison to 16 readmission episodes for 12 patients in the post-implementation group. Table 5.7 shows that there was no statistically difference between the pre and post patients. Therefore, there was no association between patient readmission and HEPMA implementation.

DISCUSSION

This phase of the DPP project quantified the impact of HEPMA implementation in relation to information documentation and prescribing errors. While accepting the limitations of the pre-post design compared to the ideal randomised controlled trial, the findings contribute original knowledge about the alteration in number, type and severity of prescribing errors on IDLs as a consequence of HEPMA implementation.

Information content of IDL

HEPMA implementation resulted in information content and accuracy improvement, although certain information was recorded in incorrect sections of the IDL and therefore classified as missing. A similar finding was reported by Callen et al (Callen, Alderton and McIntosh 2008). Previous studies had reported inconsistent results regarding discharge information content and accuracy when moving to electronic systems: either improved, unchanged or worse (Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008, Scullard et al. 2007, Hammad et al. 2014).An unanswered question remains regarding the importance of information recorded in incorrect locations on the IDL, for example, all diagnostic and stay information typed in the clinical progress section. It remains to be established if this is acceptable to GPs, or if the information is more accessible when recorded in the designated sections.

Compliance with SIGN guideline

An improvement for almost all assessed SIGN guideline criteria was detected as a consequence of HEPMA implementation. Notable exceptions were the documentation of "extended discharge to follow?" and contact information. Currently, there is no defined space to record this information on the HEPMA IDL, and therefore a free text entry would be required which may account for the low compliance with these criteria.

Number of prescribing errors

HEPMA implementation reduced significantly the number of prescribing errors. Allergy information documentation especially improved, although noticeably it impacted less on therapeutic duplications. The incidence of this error type remained consistent despite the addition of decision support information (currently only those conflicts graded as level 4 classified as "do not combine" are active. The grading is assessed by a group of First databank pharmacists and pharmacologists). The HEPMA system logs every incidence of decision support information displayed to prescribers. Conflict information was provided for two of the identified errors (simvastatin and clarithromycin drug interaction and therapeutic duplication of amitriptyline and fluoxetine). The prescriber may override the warning, which accounts for the persistence of error occurrence. HEPMA implementation confers automatic import of information from the

inpatient chart to the IDL which is consistent with a recommendation by Kriplalani et al that "hospitals should use information technology to extract information into discharge summaries to ensure accuracy (e.g. medication names and doses) and to facilitate rapid completion of summaries" (Kripalani et al. 2007). HEPMA implementation eradicates medicine transcription for IDLs which was predicted to reduce prescribing errors (Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008). Grimes et al reported medicine discrepancies in 66% patients (Grimes et al. 2008). HEPMA implementation reduced prescribing errors from 99% to 23% patients. The most frequent prescribing error type was omitted medicines which is consistent with published studies (Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008, Witherington, Pirzada and Avery 2008, Abdel-Qader et al. 2010). Sociotechnical errors accounted for 10 (13%) of post-implementation errors and therefore the HEPMA system prevented more errors than it created. This is consistent with an inpatient error study using an electronic system (Westbrook et al. 2013). Errors occurring as a consequence of making changes to inpatient chart after preparation of discharge letter had been previously reported (Callen J, McIntosh J and Li J 2010). A similar error was detected post HEPMA, despite a system alert to indicate that medicines previously added to the IDL. HEPMA implementation has not completely eliminated prescribing errors. The majority of detected prescribing errors were classified as execution errors in Reason's model (slips or lapses) which generally occur due to human fallibility (Reason 2000). Evidence of planning failures remained where practitioners considered their actions correct. Therefore, system design has diminished but not eradicated errors.

Severity of prescribing errors

HEPMA prescribing errors were categorised as potentially associated with harm in 22% (n=8) patients. Comparison with published studies indicates that error severity is lower with HEPMA compared to traditional handwritten processes. Published error severity varied and a range of severity scoring assessments were utilised. Grimes et al reported error severity rates in handwritten IDLs as 47% no harm or minor potential harm; with 53% as moderate potential patient harm (Grimes et al. 2008). McMillan et al assessed 88% of errors as minor or

potentially troublesome (McMillan, Allan and Black 2006). Abdel-Qader et al categorised errors as serious 2.9%; significant 76.3% and minor 20.8% (Abdel-Qader et al. 2010). Sociotechnical errors (n=10) were rated at either error severity level 1 or 2 which is consistent with previous literature which claimed this error type was associated with lower levels of harm than other prescribing errors (Abdel-Qader et al. 2010).

GP receipt time

Lengthy time delays for GP receipt of IDLs were identified in the pre-implementation patients. This highlighted a potential patient safety issue with a mean delay of five days and 6% IDLs not reaching the GP. Thus GPs may not have access to essential accurate information after patients' hospital discharge which may result in potential patient harm. Furthermore it highlights inefficiencies in the system requiring GP to contact hospital to obtain necessary information. The planned electronic transmission of IDLs was not successfully implemented prior to completion of post HEPMA evaluation. A previous study demonstrated electronic communication methods resulted in improved receipt times with 74% or emailed letters received within 7 days (Chen, Brennan and Magrabi 2010).

Patient re-admission rates

HEPMA implementation was not associated with a statistically significant impact on patient readmission rates. The sample size was calculated based on prescribing error rate reduction and it is likely that the sample was too small to detect this difference. This result is consistent with a systematic review where only one study demonstrated patient readmission reduction at 12 months (Motamedi et al. 2011). Patient readmissions as a consequence of inaccurate medicine information communication were described in the interview phase so it was decided to include this assessment because HEPMA implementation may have resulted in vastly different patient readmission rates.

Interplay between technology and humans

HEPMA significantly reduced errors especially when the system extracted information from the hospital patient management system e.g. GP information and when data from the inpatient chart was automatically pre-populated onto the IDL, for example allergy information. Errors occurred irrespective of HEPMA,

when human decision making was required e.g. decisions about which medicines to prescribe on discharge. Consideration of human factors would therefore be proposed in order to further reduce errors.

Additional identified communication issues

Whilst completing the case note review, the PI identified some additional communication issues and errors. Failure to accurately complete MR on admission was detected which may consist of medicines completely missed from the MR document or medicines ticked to be continued but not prescribed on HEPMA. Incorrect documentation of medicines on IDL as patients' own supply despite alterations in frequency or dose. Failure to communicate some essential information to GPs was noted e.g. specification of the required duration of the antiplatelet ticagrelor i.e. three or six months. Reasons selected for discontinuing medicines was not always accurate e.g. course complete selected for Ramipril when high serum potassium was the rationale. Essential dispensing information may be missed especially if the IDL not sent to pharmacy, like requirement for Blister Pack omitted. Information documentation was variable, sometimes all information included in "Clinical Progress" or "Primary Diagnosis" section and not inserted into various sections in IDL and inaccuracies between information documented on IDL and FL.

Governance

The PI obtained Caldicott guardian approval to access patient confidential information as shown in Appendix 5.5. The PI did not detect any prescribing errors that necessitated intervention during the case note reviews. None of the level 3 errors warranted any intervention at the detected stage as several months had passed since patient discharge and review.

Strengths and weaknesses

The study strengths include the consistent approach applied by the use of an adapted validated tool and appropriate study design to minimise bias.

Limitations of the study included the study design. The ideal would be to conduct a RCT but this was impossible due to the nature of HEPMA implementation which required to be implemented per ward and therefore patient randomisation could not be completed. The patients included in the two phases were different

although the demographic information demonstrated that the populations were very similar. Prescribing errors were not attributed to individual practitioners. Severity score assessment is subjective and as the ANP failed to attend the severity scoring panel the ANP perspective was absent. Therefore a panel comprising different members could reach different conclusions. Co-existing changes may have occurred during the 20 month time gap between pre and post assessment. Staff turnover in all professions occurred during that time period which meant that there were different prescribers in the two phases. There was a failure to complete GP receipt information post-HEPMA implementation. Finally, determination of actual patient harm in relation to detected errors was not undertaken.

Further work

Implementation of electronic transmission of IDL was delayed due to procedural and technical difficulties. Therefore, there was no merit in completing GP receipt and time to receipt assessment post- implementation. It is planned to complete this assessment once successful electronic transmission of IDLs is achieved. Additional work to obtain GP opinion regarding the HEPMA IDL is being undertaken by pharmacy colleagues.

CONCLUSION

HEPMA implementation was associated with a statistically significant reduction in prescribing errors and severity of prescribing errors with a concurrent improvement in discharge information content. There was no correlation between HEPMA implementation and patient readmission rates. It remains to be determined if HEPMA implementation will impact discharge letter receipt and time of receipt by GP practices.

CHAPTER SUMMARY

This chapter described the aim and research questions for the quantitative component of the DPP research, conducted before and after HEPMA implementation. There was a brief description of methodology prior to detailed coverage of study method, results and discussion.

CHAPTER 6 GENERAL DISCUSSION

CHAPTER INTRODUCTION

This chapter provides a brief overview of the project aims and description of the different project phases. The key findings and results are provided with more detailed discussion of the project findings and results especially relating to project impact. There is also consideration of future research relating to the project.

AIM

The overall aims of the project were to assess the impact of HEPMA system implementation on medicines related discharge communication and prescribing errors, and to gain the perspective of hospital staff involved in the communication process.

A convergent parallel mixed methods design was used consisting of both qualitative and quantitative components. The project comprised three separate phases.

Phase 1 Qualitative pre-implementation

The aim was to describe and understand perspectives of key staff groups (i.e. consultant doctors, junior doctors, pharmacists and ANPs) relating to patient discharge communication via the traditional paper based system and prior to HEPMA implementation.

Interpretative phenomenology was used to achieve this aim with the key findings of:

- challenges described with traditional discharge information communication processes, including documentation design
- patient safety concerns highlighted
- frequent prescribing errors, associated adverse events and hospital readmissions
- information clarification by GPs common, frequently about medicines
- HEPMA implementation anticipated to improve patient safety and more efficient discharge communication
- application of TDF to findings to identify potential behavioural change

Phase 2 Qualitative post-implementation

The aim was to describe and understand the perspectives of key staff groups (i.e. consultant doctors, junior doctors, pharmacists and ANPs) relating to patient discharge communication via the recently implemented HEPMA system. Interpretative phenomenology used to achieve this aim and produced the following key findings:

- improved IDL quality including complete legibility
- documentation design facilitated information completeness
- fewer omitted medicines
- identification of sociotechnical prescribing errors
- improved patient safety
- TDF applied to findings to identify behavioural change due to HEPMA implementation
  - ✓ process changes to improve prescribing and discharge communication
  - ✓ inconsistencies between and among specialties
  - ✓ consultant doctor engagement variable
  - ✓ GP queries reduced or unchanged
  - ✓ staff knowledgeable about HEPMA
  - ✓ HEPMA competence and confidence variable amongst professions
  - ✓ development of behavioural regulation to prevent errors

Phase 3 Quantitative

The aim was to determine if HEPMA implementation impacted discharge information.

An experimental, before and after study design was used to achieve this aim and produced the following key results:

- enhanced information content and accuracy
- improved compliance with SIGN guidelines
- patients with prescribing errors reduced from 99% to 23% ($p<0.001$)
- reduced incorrect doses [8.8% to 0.6% ($p<0.001$)]
- reduced incorrect frequencies [19% to 1% ($p<0.001$)]
- reduced incorrect durations [27% to 2% ($p<0.001$)]

- omitted medicines most prevalent error type
- error severity reduced

DISCUSSION OF FINDINGS

Policy documents and government strategies have recommended HEPMA implementation into NHS hospitals throughout the UK. Previous studies demonstrated that e-prescribing systems reduced inpatient prescribing error frequency. This study aimed to fill gaps in existing published literature highlighted in Chapter 1, especially the paucity of literature relating to HEPMA communication of discharge information to GPs. Previous studies of prescribing errors and discharge information communication were restricted to review of traditional handwritten systems, comparison of traditional systems with electronic interim solutions, or investigated solely electronic interim solutions (Sexton et al. 2000, Wilson et al. 2001, Foster, Paterson and Fairfield 2002, McMillan, Allan and Black 2006, Grimes et al. 2008, Witherington, Pirzada and Avery 2008, Scullard et al. 2007, Callen J, McIntosh J and Li J 2010, Callen, Alderton and McIntosh 2008, Hammad et al. 2014, Chen, Brennan and Magrabi 2010, Pillai, Thomas and Garg 2004, Alderton and Callen 2007, Abdel-Qader et al. 2010, Yemm et al. 2014). No previously published study had compared HEPMA implementation impact on discharge information communication to the traditional paper system it was replacing. Similarly, several of the previously published studies had ascertained GP opinion (Wilson et al. 2001, Scullard et al. 2007, Chen, Brennan and Magrabi 2010, Pillai, Thomas and Garg 2004, Alderton and Callen 2007, Yemm et al. 2014), but only one had considered the perspectives of hospital doctors (Yemm et al. 2014).Therefore, the findings of this project contribute original knowledge concerning the impact of HEPMA implementation on discharge information communication and prescribing errors. The viewpoints of key staff groups involved in the discharge communication process also provide a novel contribution to the HEPMA evidence base.

The findings of this study confirmed HEPMA implementation achieved the Scottish e-health strategy aims of improved working practice efficiencies and safety of people taking medicines (The Scottish Government 2012). The study result of 76% reduction in prescribing errors exceeds the 50% reduction reported by the Health Foundation (The Health Foundation 2012). HEPMA

implementation eliminated information transcription at discharge which reduced but did not eradicate prescribing errors. Two error types accounted for the majority of errors post-implementation: omissions and sociotechnical errors. The most prevalent prescribing error post-implementation was omitted medicines (11% patients). When a discharge letter is created, the user is provided with a list of the currently prescribed medicines. The prescriber is ultimately responsible to transfer each individual clinically appropriate medicine to the IDL. Therefore, the incidence of omitted medicines is a direct reflection of failure to adequately complete medicine reconciliation on discharge. Sociotechnical errors are caused by human interaction with the system and warrant exploration of human factors for potential solutions.

The combined results of the qualitative and quantitative components of the project demonstrate that staff aspirations of HEPMA implementation benefit have been realised. The primary aspiration prior to implementation was to improve patient safety. Staff articulated clearly patient safety improvements including complete legibility of prescriptions and IDLs. The statistically significant reduction in the quantity of patients with prescribing errors post implementation confirms staff beliefs of improved patient safety ($p<0.001$). Likewise, the reduction in error severity post-implementation contributes to increased patient safety. The claim of fewer omitted medicines on the IDL, as all relevant prescribed medicines are transferred to the IDL, was demonstrated similarly with a reduction in the number of patients with omitted medicines after HEPMA implementation ($p<0.001$).

Staff described more detailed information being included in IDLs and case note review data verified statistically significant improvements for certain aspects; GP details ($p<0.001$), allergy information ($p<0.0001$) and grade of staff completing IDL ($p<0.0001$). Certain information was documented in incorrect sections of the IDL, which was classified as missing information in the post-implementation study.

Prior to HEPMA implementation, interviewees expressed concern that sociotechnical errors, directly related to the HEPMA system may occur. This study confirmed the existence of sociotechnical errors which were identified in eight patients. Sociotechnical errors were associated with low error severity, which is consistent with previous literature (Abdel-Qader et al. 2010).

The DPP results indicate that future process change for discharge information communication should concentrate on the application of a consistent approach amongst the various clinical teams in the production of discharge letters. In addition, improvement activity should focus on senior medical input into discharge letter creation. It is anticipated this would reduce the pressure described by less experienced team members when feeling responsible for compilation of accurate information with associated time restrictions.
The results indicate the minimum HIS requirement that HEPMA systems should be at least as safe as the systems they replace has been exceeded and that patient safety improvements have been demonstrated (Healthcare Improvement Scotland 2014).
This study was unable to demonstrate improvement to timeliness of GP discharge information receipt because electronic transmission of IDLs had not been completed. Furthermore, the study could not correlate the reduction in prescribing errors with reduced patient hospital readmissions.

Theoretical framework application
Qualitative thematic analysis included application of TDF which enabled behavioural change aspects of HEPMA implementation to be explored. Pre-implementation six TDF domains were pertinent to study findings with an additional two domains post implementation. Behavioural alteration amongst the different professional groups was evident as a direct consequence of HEPMA implementation. Staff described alterations in their prescribing behaviours including adoption of self-checking to minimise errors and described improved prescribing confidence. Process change also evolved to enable high quality discharge communication to be produced with description of multidisciplinary and consultant input to increase information accuracy. Variability in behaviours was most prevalent within consultant doctor professional group with other professions describing greater conformity. TDF may be used in future interventions to aid questionnaire design for example when assessing GP and community pharmacist satisfaction with HEPMA.

TDF explores individual behaviour changes in response to a clinical intervention. NPT permits consideration of the organisational response to HEPMA so there may

be merit in consideration of this additional theory to reflect on organisational implementation impact.

HEPMA implementation into a NHS hospital involved the introduction of a complex system, for complex process use (prescribing and administration), in a complex environment. Normalization process theory (NPT) is a sociological model with a specific focus on intervention implementation with an aim of achieving sustainable interventions. NPT is pertinent to explain integration of a healthcare intervention into an organisation and is particularly relevant to organisations like the NHS (May 2006). May defines normalization as "the embedding of a technique, technology or organisational change as a routine and taken-for-granted element of clinical practice". NPT concentrates on acceptance of interventions into routine practice and is particularly relevant to "imposed interventions" such as HEPMA. NPT may be used to consider the" interpretation and impact of research findings" and "how new research findings are sustained in practice" (May 2006).

The four components of the NPT specifically contextualised to HEPMA are:

- coherence (meaning and sense making of HEPMA by users)
- cognitive participation (commitment and engagement to HEPMA by users)
- collective action (the work the users do to make HEPMA function)
- reflexive monitoring (users reflect or appraise HEPMA)

An advantage of using NPT for analysis of findings is because it "acknowledges that healthcare is a collective activity requiring a multitude of interactions between professionals, patients, managers and others" and consequently is particularly relevant to the appraisal of this practice research concerning complex implementation in a NHS hospital.

NPT analysis of DPP project findings indicates that normalization has occurred for this complex intervention according to expressed opinions of different professional groups of front line staff engaging with HEPMA. There was demonstration of staff acceptance of HEPMA into regular use. Staff described routine system use in their professional practice and case note review confirmed their assertions. Furthermore, staff articulated clearly perceived advantages and

disadvantages according to their specialism. They described adoption of different working practices when undertaking their clinical roles as a consequence of HEPMA implementation. This indicates sustainability of the implemented HEPMA system. Communication of HEPMA impact of immediate benefits to patient and practice will enhance sustainability. Longer –term benefits should also be communicated to promote continued sustainability. The TDF findings indicate certain behavioural enablers and inhibitors contributed to HEPMA implementation for example system design aided efficient prescribing but time pressures adversely affected prescribers' perceived abilities. The organisation should further explore these to ensure HEPMA implementation sustainability and when implementing additional services in the future.

Potential generalisability

Although this work was completed in a NHS District General Hospital in Scotland the work would be potentially generalisable to similar NHS organisations within the UK and also to other countries which have similar healthcare systems for example Australia, New Zealand, Canada and Ireland. The generalisability may be limited dependant on the implemented HEPMA system functionality.

Overall strengths and limitations

The strengths of the DPP project include the adoption of a rigorous study design approach to minimise design bias and to ensure trustworthiness for the qualitative research component. The quantitative component applied a consistent approach by use of an adapted validated tool and appropriate study design to minimise bias. Bias was minimised wherever possible in the qualitative research including sampling, interviewer, response and research interpreter biases as described previously.

The limitations of the DPP project include the relatively small sample size of interviewed staff which may limit applicability of results to other organisations and the variety of experience amongst the different professional groups may have impacted their responses relating to discharge communication processes. The study design was a limitation of the quantitative research as the ideal would be to conduct an RCT which was impossible due to the nature of HEPMA implementation. The patients included in the before and after sample were different, although the demographic information demonstrated very similar

patient populations. Prescribing errors were not attributed to individual practitioners. The subjective nature of severity scoring is a limitation further exacerbated by failure of ANP to attend the panel therefore a panel comprising different members may conclude differently. Furthermore, co-existing changes may have occurred during the 20 month time gap between pre and post assessment. Staff turnover in all professions occurred therefore there were different prescribers in the two phases. Determination of actual patient harm in relation to detected errors was not assessed.

IMPACT

Impact has been defined as "a marked effect or influence" (Oxford University Press 2014). In terms of research, it is important to ensure that research has demonstrable benefits which may be wide ranging, including organisational and societal benefits.

The Research Councils UK diagram for pathways to impact focuses on various impact points concentrating on academic and economic significance. A copy of the diagram is provided in Figure 6.1 (Research Councils UK 2014). The DPP project mainly impacted the pathways of "enhancing the effectiveness and sustainability of organisations including public services and businesses" and "improving health and wellbeing". Post-implementation the discharge communication process was more efficient with fewer prescribing errors which improved patient safety.

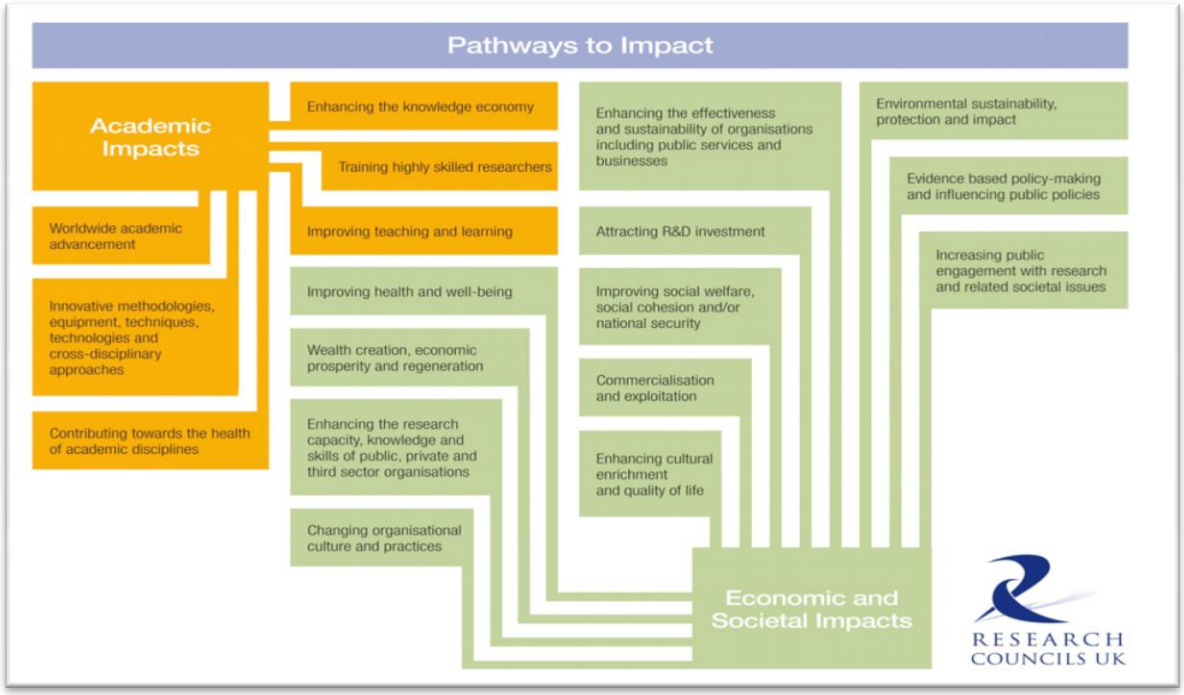


Figure 6.1 Pathways to impact by Research Councils UK

Alternatively, impact may be described by consideration of knowledge, people, economic and societal factors. These factors are considered below in relation to the DPP project.

Knowledge

The advancement of knowledge has been achieved as described:

Scientific advances

- New knowledge of HEPMA impact to improve discharge information communication and reduce prescribing errors
- Unique assessment of hospital staff opinion regarding HEPMA

Publications

- Oral and poster presentations and journal article publication as described in output section

Conference attendance

The PI attended the following conferences which provided networking opportunities:

- RPS annual conference 2013 and 2014
- European Society of Clinical Pharmacy 2014 and 2015
- Patient Safety Congress 2014

Transfer of knowledge

- Results shared with HEPMA full business case project board
- Presentations of results to NHS Ayrshire & Arran pharmacy and hospital staff
- Presentation of results to NHS Ayrshire & Arran Safer Medicines Group
- Presentations and publications as described in output section

People

The impact of the DPP on people included skills development by the PI and engagement of other people in research activities as outlined below:

Skills development

The PI developed the following skills:

- Qualitative research skills including face-to-face interviews and interview transcribing
- Use of electronic analysis software – NVivo© and SPSS
- Use of electronic reference management system i.e. Refworks©
- Enhancement of time management skills
- Development of writing skills including conference abstracts

- Development of oral and poster presentation skills

Outreach

- Multiple staff exposed to research as a direct consequence of interview participation, review of data extraction, or information retrieval

Economy

The DPP project impacted on economy by:

Products and procedures

- HEPMA system development as a consequence of sharing interview participants' suggestions for improvement to the HEPMA development team and national HEPMA full business case project board

Society

The societal impacts of the DPP project are described by the following points:

Quality of life

- Improved discharge information communication assists with seamless transfer of care between secondary and primary care which consequently prevents potential patient harm
- Staff satisfaction with HEPMA is high with described improvements to professional confidence and prescribing competence

Policies

- HEPMA implementation is recommended by the Scottish government and the DPP results support the HEPMA benefits in the e-health strategy
- HEPMA implementation resulted in improved compliance with SIGN guideline
- HEPMA implementation assessed as being safer than the traditional prescribing system it replaced and therefore complies with HIS recommendation to be at least as safe as existing system

Health

- Improved patient safety as HEPMA implementation resulted in reduced prescribing error quantity and severity
- Improved patient safety as increased quality of IDL communications

FURTHER RESEARCH SPECIFIC TO DPP PROJECT

Three further research areas specific to the DPP project require to be completed.

GP receipt and receipt time

The planned assessment of IDL GP receipt and receipt time for the DPP project was not completed after HEPMA implementation due to technical difficulties with electronic IDL transmission. This is a current organisational priority. Therefore, the PI will complete the proposed research to establish the consequences of electronic transmission.

Research question

Did electronic transmission of HEPMA IDLs alter GP IDL receipt and time to receipt?

Methodology

Quantitative experimental design

Method

Quasi experimental before and after study design (before phase already completed)

Key outcome measures

1. GP receipt
2. Time difference between GP receipt and patient hospital discharge

Likely impact pathways

Changing organisational culture and practice as new process for IDL communication will be developed.
Improving health and well being as GPs should receive IDL information more quickly which will facilitate future GP consultations with discharged patients.

GP opinion

GP opinion regarding HEPMA IDLs and electronic communication of IDLs to patients' GP should be obtained when successful transmission has been achieved.

Research question

What are GP perceptions of HEPMA IDLs and electronic transmission of IDLs from UHC?

Methodology

Quantitative survey design

Method

Questionnaire

Key outcome measures

1. GP satisfaction with document design and information completion
2. Availability of discharge information when required by GP

Likely impact pathways

Improving health and well being as GPs should receive IDL information more quickly which will facilitate future GP consultations with discharged patients.

Community pharmacist opinion

Community pharmacist opinion regarding electronic communication of IDLs to patients' nominated community pharmacy should be obtained when successful transmission has been achieved.

Research question

What is the perception of community pharmacists about the impact of electronic transmission of IDLs on pharmaceutical care provision?

Methodology

Quantitative survey design

Method

Questionnaire

Key outcome measures

1. Pharmacist satisfaction
2. Pharmaceutical care provision alteration

Likely impact pathways

Improving health and well-being as pharmaceutical care provision should be better tailored for individual patients.

Changing organisational culture and practices as a new process for transmission of IDL to patients' nominated community pharmacist will be developed.

FURTHER HEPMA RESEARCH

HEPMA implementation is a complex intervention into a complex environment and there are multiple future research areas which should be considered by NHS Scotland and other areas implementing HEPMA. Additional research could focus on the impact of HEPMA on inpatient prescribing errors; the alteration of clinical pharmacist work by use of an electronic screening tool which prioritise patients according to predefined criteria including patient factors and prescribed medicines; and alteration of staff working as a consequence of HEPMA implementation.

FURTHER PI RESEARCH AMBITIONS

The PI aims to continue utilising and developing the skills honed during the DPP course and plans to conduct further pharmacy practice research. Innovation is a core component of the current role of the PI, which creates an ideal opportunity to conduct practice research. The PI aims to share research findings by conference abstract submissions and publication of completed work in peer reviewed journals. Furthermore, the PI aspires to develop research capability within the local pharmacy profession and encourage other pharmacists, especially junior pharmacists to become involved in research and to likewise share research findings either by conference attendances and journal publications. The PI would also like to collaborate with other individuals or organisations completing comparable research with the ultimate aim of enhancing patient care through embedding research in pharmacy practice.

CONCLUSION

The key findings of the DPP project indicate that HEPMA implementation resulted in statistically significant improvements to the content and quality of discharge information with an associated statistically significant reduction in prescribing errors. Confirmation of a new error type (sociotechnical), related to the system was achieved. A reduction in prescribing error severity was demonstrated and sociotechnical errors were associated with low error severity. Prescribing errors occur due to multiple causative factors and this

study indicates that HEPMA implementation will reduce but not eradicate prescribing errors.

Hospital staff described perceived benefits of improved patient safety and reduced adverse events as a consequence of enhanced discharge information communication. The study provided unique insight about behavioural changes adopted by staff to facilitate the normalization of this complex intervention into routine organisational work. It highlighted differences in professional group interplay with consultant medical staff exhibiting the most variable behaviour. Staff described process changes adopted as a direct consequence of HEPMA implementation to further improve discharge information communication. Thus, the advantages ascribed to electronic prescribing solutions of improved legibility, information content accuracy and reduced errors have been verified in relation to discharge information communication. The impact of electronic IDL transmission remains to be ascertained. These results will be relevant to other Scottish, UK and national organisations with similar healthcare services. The Scottish e-health policy advocates HEPMA implementation for all secondary care settings. Significant resource investment is required for HEPMA implementation. Thus the demonstrated benefits of prescribing error reduction, increased information quality and high staff acceptance provides reassurance for organisations in the process of, or planning HEPMA implementation.

CHAPTER SUMMARY

This chapter provided a brief overview of the project aims with description of the different project phases. The key findings and results were provided with more detailed discussion of the project findings and results especially related to project impact. Future research plans were discussed.

REFERENCES

Mosby's medical dictionary. 2009. [online] Elsevier. Available from: http://medical-dictionary.thefreedictionary.com/construct+validity [Accessed 11/16 2014]

ABDEL-QADER, D.H. et al., 2010. Pharmacists' interventions in prescribing errors at hospital discharge. *Drug Safety,* 33(11), pp. 1027-1044

ACADEMY OF MEDICAL ROYAL COLLEGES, 2008. *A clinician's guide to record standards- part 2:Standards for the structure and content of medical records and communications when patients are admitted to hospital* [online] Royal College of Physicians. Available from: http://www.rcplondon.ac.uk/resources/clinician's-guide-record-standards-––part-2-standards-structure-and-content-medical-record [Accessed 01/16 2012]

ALDERTON, M. and CALLEN, J., 2007. Are general practitioners satisfied with electronic discharge summaries? *Health Information Management Journal, 36(1), pp. 7-12*

ASHCROFT, D.M. et al., 2015. Prevalence, nature, severity and risk factors for prescribing errors in hospital inpatients: prospective study in 20 UK hospitals. *Drug Safety,* 38(9), pp. 833-843

BAKER, S.E. and EDWARDS, R., 2012. How many qualitative interviews is enough. [online] National Centre for Research Methods Review Paper. Available from http://eprints.ncrm.ac.uk/2273/4/how_many_interviews.pdf [Accessed 04/30 2013]

BANDOLIER, 2007. *Evidence based thinking about healthcare.* [online] Oxford University Press. Available from: http://www.medicine.ox.ac.uk/bandolier/booth/glossary/RCT.html [Accessed 01/12 2015]

BATES, D.W. et al., 1999. Patient risk factors for adverse drug events in hospitalized patients. *Archives of Internal Medicine,* 159(21), pp. 2553

BENNET, L.W., *Research bias.* [online] University if Illinois at Chicago. Available from: http://tigger.uic.edu/~lwbenn/jacswcourses/socw360/week14.htm [Accessed 12/19 2014]

BIDDIX, J.,P., *Research rundowns.* [online] WorldPress.com. Available from: http://researchrundowns.wordpress.com/quantitative-methods/instrument-validity-reliability/ [Accessed 01/12 2015]

BLACK, A.D. et al., 2011. The impact of eHealth on the quality and safety of health care: a systematic overview. *PLoS medicine,* 8(1), pp. e1000387

BMJ GROUP AND ROYAL PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 2015. *British National Formulary 69.* Royal Pharmaceutical Society.

BOWLING, A., 2014. *Research methods in health Investigating health and health services.* 4th ed. Maidenhead, England: McGraw Hill Education Open University Press.

BRANT, R., *Inference for proportions: Comparing two independant samples.* [online] University of British Columbia. Available from: http://www.stat.ubc.ca/~rollin/stats/ssize/b2.html [Accessed 05/08 2013]

CALDICOTT, F., 2013. Information: To share or not to share. Information Governance Review. [online] Available from: http://eprints.bucks.ac.uk/1475/2/Information%20Governance%20Review.pdf .txt [Accessed 08/09 2014]

CALLEN J, MCINTOSH J and LI J, 2010. Accuracy of medication documentation in hospital discharge summaries: A retrospective analysis of medication transcription errors in manual and electronic discharge summaries. *International Journal of Medical Informatics,* 79 (1), pp. 58-64

CALLEN, J.L., ALDERTON, M. and MCINTOSH, J., 2008. Evaluation of electronic discharge summaries: a comparison of documentation in electronic and handwritten discharge summaries. *International Journal of Medical Informatics,* 77(9), pp. 613-620

CAMPBELL, M.J. and SWINSCOW, T.D.V., 2011. *Statistics at square one.* John Wiley & Sons. BMJ Books, West Sussex, UK.

CANE, J., O'CONNOR, D. and MICHIE, S., 2012. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science,* 7(1), pp. 37

CASAGRANDE, P.A.S., 2013. *Casagrande pike and smith sample size calculator: Compare two proportions.* [online] Available from: http://www.cct.cuhk.edu.hk/stat/proportion/Casagrande.htm [Accessed 05/08 2013]

CHEN, Y., BRENNAN, N. and MAGRABI, F., 2010. Is email an effective method for hospital discharge communication? A randomized controlled trial to examine delivery of computer-generated discharge summaries by email, fax, post and patient hand delivery. *International Journal of Medical Informatics,* 79(3), pp. 167-172

CRESSWELL, K. et al., 2013. Investigating and learning lessons from early experiences of implementing ePrescribing systems into NHS hospitals: a questionnaire study. *PloS one,* 8(1), pp. e53369

CRESSWELL, K.M. and SHEIKH, A., 2014. Undertaking sociotechnical evaluations of health information technologies. *Informatics in Primary Care,* 21(2), pp. 78-83

CRESWELL, J.W., 2013. *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage. University of Nebraska, Lincoln. USA.

CORNFORD, T. et al., 2009. Electronic prescribing in hospitals-challenges and lessons learned. NHS Connecting for Health. [online] Available from eprints.pharmacy.sc.uk [Accessed 05/08 2013]

DAVIES, M.B., 2007. *Doing a successful research project: Using qualitative or quantitative methods.* Palgrave Macmillan New York.

DEAN, B., BARBER, N. and SCHACHTER, M., 2000. What is a prescribing error? *Quality in Health Care,* 9(4), pp. 232-237

DEPARTMENT OF HEALTH, 2013. *Information to share or not to share? the information governance review.* [online] Department of Health. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/192572/2900774_InfoGovernance_accv2.pdf [Accessed 04/24 2013]

DEPARTMENT OF HEALTH, 2013. *£260 million invested in patient safety plan.* [online] Department of Health. Available from: https:///www.gov.uk/government/news/260-million-invested-in-patient-safety-plans [Accessed 05/28 2013]

DONYAI, P. et al., 2008. The effects of electronic prescribing on the quality of prescribing. *British Journal of Clinical Pharmacology,* 65(2), pp. 230-237

DORNAN, T. et al., 2009. An in depth investigation into causes of prescribing errors by foundation trainees in relation to their medical education—EQUIP study. *London: General Medical Council,* pp. 1-215

DRISCOLL, P., LECKY, F. and CROSBY, M., 2000a. An introduction to everyday statistics—1. *Journal of Accident & Emergency Medicine,* 17(3), pp. 205-211

DRISCOLL, P., LECKY, F. and CROSBY, M., 2000b. An introduction to everyday statistics—2. *Journal of Accident & Emergency Medicine,* 17(4), pp. 274-281

DUNCAN, E.M. et al., 2012. Learning curves, taking instructions, and patient safety: using a theoretical domains framework in an interview study to investigate prescribing errors among trainee doctors. *Implementation Science,* 7(1), pp. 86

DURANT-LAW, G., *Research paradigms, the philosophical trinity, and methodology.* [online] Available from: http://www.durantlaw.info/sites/durantlaw.info/files/Research%20Paradigms,%20the%20Philosophical%20Trinity%20and%20Methodology.pdf [Accessed 04/24 2013]

EVANS, B.C., COON, D.W. and UME, E., 2011. Use of theoretical frameworks as a pragmatic guide for mixed methods studies: A methodological necessity? *Journal of Mixed Methods Research,* 5(4), pp. 276-292

FERNER, R.E. and ARONSON, J.K., 2006. Clarification of terminology in medication errors. *Drug Safety,* 29(11), pp. 1011-1022

FLEMING, A. et al., 2014. Antibiotic prescribing in long-term care facilities: a qualitative, multidisciplinary investigation. *BMJ Open,* 4(11), pp. e006442-2014-006442

FORSTER, A.J. et al., 2003. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Annals of Internal Medicine,* 138(3), pp. 161-167

FOSTER, D., PATERSON, C. and FAIRFIELD, G., 2002. Evaluation of immediate discharge documents--room for improvement? *Scottish Medical Journal,* 47(4), pp. 77-79

FRANCIS, J.J. et al., 2010. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychology and Health,* 25(10), pp. 1229-1245

FRANCIS, J.J., O'CONNOR, D. and CURRAN, J., 2012. Theories of behaviour change synthesised into a set of theoretical groupings: introducing a thematic series on the theoretical domains framework. *Implementation Science,* 7(1), pp. 35

FRENCH, S.D. et al., 2012. Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implementation Science,* 7(1), pp. 38

GENERAL PHARMACEUTICAL COUNCIL, 2012. *Standards of conduct, ethics and performance.* 2nd ed. London, England: General Pharmaceutical Council.

GALE, N. et al., 2013. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology,* 13, pp. 117

GLEASON, K.M. et al., 2010. Results of the Medications at Transitions and Clinical Handoffs (MATCH) study: an analysis of medication reconciliation errors and risk factors at hospital admission. *Journal of General Internal Medicine,* 25(5), pp. 441-447

GRIMES, T.C. et al., 2011. Medication details documented on hospital discharge: cross-sectional observational study of factors associated with medication non-reconciliation. *British Journal of Clinical Pharmacology,* 71(3), pp. 449-457

GRIMES, T. et al., 2008. Survey of medication documentation at hospital discharge: implications for patient safety and continuity of care. *Irish Journal of Medical Science,* 177(2), pp. 93-97

HAMMAD, E.A. et al., 2014. Adherence to UK national guidance for discharge information: an audit in primary care. *British Journal of Clinical Pharmacology,* 78(6), pp. 1453-1464

HARRIS, A.D. et al., 2006. The use and interpretation of quasi-experimental studies in medical informatics. *Journal of the American Medical Informatics Association,* 13(1), pp. 16-23

HARTNELL, N. et al., 2012. Identifying, understanding and overcoming barriers to medication error reporting in hospitals: a focus group study. *BMJ Quality & Safety,* 21(5), pp. 361-368

HEALTHCARE IMPROVEMENT SCOTLAND, 2014a. *Implementing an electronic prescribing and medicines administration system: A good practice guide.* [online] Edinburgh Scotland: NHS Scotland. Available from: http://www.healthcareimprovementscotland.org/our_work/technologies_and_

medicines/electronic_prescribing/good_practice_guide.aspx [Accessed 06/10 2014]

HEALTHCARE IMPROVEMENT SCOTLAND, 2014b. *The Scottish patient safety programme.* [online] Healthcare Improvement Scotland. Available from: http://www.scottishpatientsafetyprogramme.scot.nhs.uk/ [Accessed 09/12 2014]

HUIJG, J.M. et al., 2014. Measuring determinants of implementation behavior: psychometric properties of a questionnaire based on the theoretical domains framework. *Implementation Science,* 9(33) pp. 9-23

IBM, 2013. *SPSS software version 21.* [online] IBM. Available from: http://www-01.ibm.com/software/uk/analytics/spss/ [Accessed 09/11 2012]

JOHNSON, R.B. and ONWUEGBUZIE, A.J., 2004. Mixed methods research: A research paradigm whose time has come. *Educational Researcher,* 33(7), pp. 14-26

KERLINGER, F.N., 1979. *Behavioral research: A conceptual approach.* Holt, Rinehart and Winston New York.

KINASH, S., 2006. Paradigms, Methodology & Methods. *Bond University Australia,*

KOTZAB, H. et al., 2006. *Research methodologies in supply chain management.* Springer New York

KRIPALANI, S. et al., 2007. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *Journal of the American Medical Association,* 297(8), pp. 831-841

KUBLER-ROSS, E., 1970. On death and dying. Scribner. New York

LEWIN, K., 1947. Frontiers in Group Dynamics II. Channels of group life; social planning and action research. *Human Relations,* 1(2), pp. 143-153

LEWIS, P.J. et al., 2009. Prevalence, incidence and nature of prescribing errors in hospital inpatients. *Drug Safety,* 32(5), pp. 379-389

LIPWORTH, W., TAYLOR, N. and BRAITHWAITE, J., 2013. Can the theoretical domains framework account for the implementation of clinical quality interventions?: a qualitative synthesis and mapping experiment. *BMC Health Services Research,* 13(1), pp. 530

MAY, C., MURRAY, E., FINCH, T., MAIR, F., TREWEEK, S., BALLINI, L., MACFARLANE, A. AND RAPLEY, T., 2010. *Normalization process theory on-line users' manual and toolkit.* [online] Economic and social research council. Available from: http://www.normalizationprocess.org [Accessed 06/02 2014]

MAY, C.R. et al., 2009. Development of a theory of implementation and integration: Normalization Process Theory. *Implementation Science,* 4(29), pp. 29-37

MAY, C., 2006. A rational model for assessing and evaluating complex interventions in health care. *BMC Health Services Research,* 6(1), pp. 86-96

MAY, C., 2013. Towards a general theory of implementation. *Implementation Science* 8 (18), pp. 8-21

MCLEOD, M. et al., 2014. A national survey of inpatient medication systems in English NHS hospitals. *BMC Health Services Research,* 14(1), pp. 93-103

MCMILLAN, T., ALLAN, W. and BLACK, P., 2006. Accuracy of information on medicines in hospital discharge summaries. *Internal Medicine Journal,* 36(4), pp. 221-225

MEDICINES AND HEALTHCARE PRODUCTS REGULATORY AGENCY, 2014. *What we regulate.* [online] Medicines and Healthcare Products Regulatory Agency. Available from: http://www.mhra.gov.uk/Aboutus/Whatweregulate/ [Accessed 09/25 2014]

MERP, N., 2001. National Coordinating Council for Medication Error Reporting and Prevention. *Taxonomy of Medication Errors* [online] Available from: http://www. nccmerp. org/pdf/taxo2001-07-31.pdf [Accessed 03/17 2014]

MICHIE, S. et al., 2005. Making psychological theory useful for implementing evidence based practice: a consensus approach. *Quality and Safety in Health Care,* 14(1), pp. 26-33

MILES, M.B. and HUBERMAN, A.M., 1994. *Qualitative data analysis: An expanded sourcebook.* Sage. Beverley Hills

MOTAMEDI, S.M. et al., 2011. The efficacy of computer-enabled discharge communication interventions: a systematic review. *BMJ Quality & Safety,* 20(5), pp. 403-415

MOZAFFAR, H. et al., 2014. Product Diversity and Spectrum of Choice in Hospital ePrescribing Systems in England. *PloS one,* 9(4), pp. e92516

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE AND NATIONAL PATIENT SAFETY ASSOCIATION, 2007. *Technical patient safety solutions for medicines reconciliation on admission of adults to hospital.* [online] National Institute for Health and Clinical Excellence. Available from: http://www.nice.org.uk/guidance/psg001/resources/full-guidance-pdf2 [Accessed 07/31 2014]

NHS AYRSHIRE AND ARRAN, *NHS Ayrshire and Arran.* [online] Available from: https://www.nhsaaa.net/ [Accessed 06/10 2013]

NHS AYRSHIRE AND ARRAN INFORMATION GOVERNANCE TEAM, 2010. *Information governance and IT guidance for researchers.* [online] NHS Ayrshire and Arran. Available from: http://athena/kmeh/igs/Documents/IGResearch.doc [Accessed 04/10 2013]

NHS AYRSHIRE AND ARRAN, 2013. *Stop press significant IT incident at NHS Greater Glasgow and Clyde.* [online] Available from: http://www.nhsaaa.net/media/231133/sp091013.pdf [Accessed 09/12 2014]

NHS CONNECTING FOR HEALTH, 2007. *ePrescribing baseline functional specifications for NHS trusts.* [online] Department of Health. Available from: http://www.connectingforhealth.nhs.uk/systemsandservices/eprescribing/baselinefunctspec.pdf/view [Accessed 07/13 2014]

NHS ENGLAND, 2014. *Patient safety alert stage one: Warning risks arising from breakdown and failure to act on communication during handover at the time of discharge from secondary care.* [online] NHS England. Available from: http://www.england.nhs.uk/2014/08/29/psa-communication/ [Accessed 09/02 2014]

NHS RESEARCH ETHICS COMMITTEE, 2006. *Differentiating audit, service evaluation and research.* [online] NHS Health Research Authority. Available from: http://www.nres.nhs.uk/applications/guidance/research-guidance/?entryid62=66988 [Accessed 04/10 2013]

NIHR PROGRAMME GRANT FOR APPLIED RESEARCH, 2013. e-Prescribing Toolkit for NHS Hospitals. [online] Available from: http://www.eprescribingtoolkit.com/ [Accessed 09/10 2014]

OLIVER, D.G., SEROVICH, J.M. and MASON, T.L., 2005. Constraints and opportunities with interview transcription: Towards reflection in qualitative research. *Social Forces,* 84(2), pp. 1273-1289

OXFORD UNIVERSITY PRESS, 2014a. *Definition of medicine.* [online] Oxford University Press. Available from: http://www.oxforddictionaries.com/definition/english/medicine [Accessed 09/10 2014]

OXFORD UNIVERSITY PRESS, 2014b. *Oxford dictionaries.* [online] Oxford University Press. Available from: http://www.oxforddictionaries.com/definition/english/medication [Accessed 09/10 2014]

PATEY, A.M. et al., 2012. Anesthesiologists' and surgeons' perceptions about routine pre-operative testing in low-risk patients: application of the Theoretical Domains Framework (TDF) to identify factors that influence physicians' decisions to order pre-operative tests. *Implementation Science,* 7(1), pp. 52

PAYNE, J. and THE NATIONAL HEALTH SERVICE IN SCOTLAND., 2013. *SPICe briefing 13/10 eHealth in Scotland.* [online] Available from: http://www.scottish.parliament.uk/ResearchBriefingsAndFactsheets/S4/SB_13-10.pdf [Accessed 05/06 2013]

PICTON, C. and WRIGHT, H., 2012. *Keeping patients safe when they transfer between care providers- getting the medicine right Final Report.* London: Royal Pharmaceutical Society.

PILLAI, A., THOMAS, S.S. and GARG, M., 2004. The electronic immediate discharge document: experience from the South West of Scotland. *Informatics in Primary Care,* 12(2), pp. 67-73

POPE, C., ZIEBLAND, S. and MAYS, N., 2000. Qualitative research in health care. Analysing qualitative data. *British Medical Journal (Clinical research ed.),* 320(7227), pp. 114-116

PREACHER, K., 2012. *Calculation for the chi-square test: an interactive calculation tool for chi-square tests of goodness of fit and independence [computer software].Kristopher J Preacher; 2001 [cited June 23, 2011],*

PRICE, M. and LAU, F., 2014. The clinical adoption meta-model: a temporal meta-model describing the clinical adoption of health information systems. *BMC Medical Informatics and Decision Making,* 14(1), pp. 43-52

QUICKCALCS, G., 2015. [online] GraphPad Software, Inc. Available from: http://graphpad.com/quickcalcs/contingency1.cfm [Accessed 09/22 2015]

QSR INTERNATIONAL, *NVivo software.* [online] Available from: http://www.qsrinternational.com/ [Accessed 09/11 2012]

REASON, J., 1990. *Human error.* Cambridge University Press. New York

REASON, J., 2000. Human error: models and management. *British Medical Journal (Clinical research ed.),* 320(7237), pp. 768-770

REDWOOD, S. et al., 2011. Does the implementation of an electronic prescribing system create unintended medication errors? A study of the sociotechnical context through the analysis of reported medication incidents. *BMC Medical Informatics and Decision Making,* 11(1), pp. 29-39

REEVES, S. et al., 2008. Qualitative Research: Why Use Theories in Qualitative Research? *BMJ: British Medical Journal, 337*, pp. 631-634

RESEARCH COUNCILS UK, 2014. *Pathways to impact.* [online] Research Councils UK. Available from: http://www.rcuk.ac.uk/innovation/impacts/ [Accessed 11/18 2015]

ROBERTS, P. and PRIEST, H., 2006. Reliability and validity in research. *Nursing Standard (Royal College of Nursing (Great Britain) : 1987,* 20(44), pp. 41-45

ROSS, S. et al., 2009. What is the scale of prescribing errors committed by junior doctors? A systematic review. *British Journal of Clinical Pharmacology,* 67(6), pp. 629-640

ROSS, S. et al., 2012. Who makes prescribing decisions in hospital inpatients? An observational study. *Postgraduate Medical Journal,* 88(1043), pp. 507-510

ROSS, S. et al., 2013. Perceived causes of prescribing errors by junior doctors in hospital inpatients: a study from the PROTECT programme. *British Medical Journal Quality & Safety,* 22(2), pp. 97-102

ROUTLEDGE, P.A., 2012. A national in-patient prescription chart: the experience in Wales 2004–2012. *British Journal of Clinical Pharmacology,* 74(4), pp. 561-565

ROYAL PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 2014. *Medicines, Ethics and Practice: The Professional Guide for Pharmacists.* 38th ed. London, England: Pharmaceutical Press.

RYAN, C. et al., 2013. Junior doctors' perceptions of their self-efficacy in prescribing, their prescribing errors and the possible causes of errors. *British Journal of Clinical Pharmacology,* 76(6), pp. 980-987

RYAN, C. et al., 2014. Prevalence and Causes of Prescribing Errors: The PRescribing Outcomes for Trainee Doctors Engaged in Clinical Training (PROTECT) Study. *PloS one,* 9(1), pp. e79802

SANDELOWSKI, M., 1991. Telling stories: Narrative approaches in qualitative research. *Image: the Journal of Nursing Scholarship,* 23(3), pp. 161-166

SCHIMMEL, D., 1996. *Research That Makes a Difference: Complementary Methods for Examining Legal Issues in Education. NOLPE Monograph Series No. 56.* ERIC. SCOTTISH EXECUTIVE AND DEPARTMENT OF HEALTH, 2004. *Modernising medical careers- the next steps.* [online] Department of Health. Available from: http://www.sehd.scot.nhs.uk/publications/TheNextSteps_Published.pdf [Accessed 01/05 2012]

SCOTTISH INTERCOLLEGIATE GUIDELINES NETWORK (SIGN), 2012. 128 The SIGN Discharge Document. [online] Available from: www.sign.ac.uk [Accessed 04/12 2014]

SCULLARD, P. et al., 2007. Improved communication between hospital and general practice using online patient discharge summaries. *Journal of Telemedicine and Telecare, 13 (S1), pp. 56-58*

SEIDLING, H. et al., 2013. Medication safety through e-health technology: can we close the gaps? *British Journal of Clinical Pharmacology,* 76(S1), pp. i-iv

SEXTON, J. et al., 2000. Ensuring seamless care at hospital discharge: a national survey. Journal of Clinical Pharmacy & Therapeutics, 25(5), pp. 385-93

SHENTON, A.K., 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information,* 22(2), pp. 63-75

SHUTTLEWORTH, M., 2009. *Research bias.* [online] Explorable.com. Available from: https://explorable.com/research-bias [Accessed 12/09 2014]

THE SECRETARY OF STATE FOR HEALTH., 2008. *The Medicines for Human Use (Prescribing by EEA Practitioners) Regulations, Statutory Instrument, UK*

SLEE, A., 2014. *Benefits realisation guidance for ePrescribing projects.* [online] NHS England. Available from: http://www.eprescribingtoolkit.com/wp content/uploads/2013/11/Benefits-realisation-eP-guidance-v1.0.pdf [Accessed 12/09 2014]

SMITH, J. and FIRTH, J., 2011. Qualitative data analysis: the framework approach. *Nurse Researcher,* 18(2), pp. 52-62

SRIVASTAVA, A. and THOMSON, S.B., 2009. Framework analysis: a qualitative methodology for applied policy research. *JOAAG,* 4(2), pp. 72-79

STARKS, H. and TRINIDAD, S.B., 2007. Choose your method: A comparison of phenomenology, discourse analysis, and grounded theory. *Qualitative health research,* 17(10), pp. 1372-1380

THE DATA PROTECTION ACT, 1998. [online] Available from: https://www.gov.uk/data-protection/the-data-protection-act [Accessed 12/30 2012]

THE HEALTH FOUNDATION, 2012. Evidence Scan: Reducing prescribing errors. [online] Available from: http://www.health.org.uk/publications/reducing-prescribing-errors/ [Accessed 12/30 2012]

THE SCOTTISH GOVERNMENT, 2012. *eHealth strategy 2011-2017 (revised July 2012 to include a sixth strategic aim).* [online] Edinburgh: The Scottish Government. Available from: http://www.scotland.gov.uk/Publications/2012/11/7663/0 [Accessed 12/30 2012]

THE SCOTTISH GOVERNMENT, 2012. *Polypharmacy guidance.* [online] Edinburgh: The Scottish Government. Available from: http://www.central.knowledge.scot.nhs.uk/upload/Polypharmacy%20full%20guidance%20v2.pdf [Accessed 07/30 2015]

TROCHIM,W,M,K., 2006. *Research methods knowledge base.* [online] Web Center for Social Research Methods. Available from: http://www.socialresearchmethods.net/ [Accessed 01/12 2015]

WAHYUNI, D., 2012. The Research Design Maze: Understanding Paradigms, Cases, Methods and Methodologies. *Journal of Applied Management Accounting Research,* 10(1), pp. 69-80

WESTBROOK, J.I. et al., 2013. The safety of electronic prescribing: manifestations, mechanisms, and rates of system-related errors associated with two commercial systems in hospitals. *Journal of the American Medical Informatics Association,* 20 (6), pp.1159-1167

WHITLEY, E. and BALL, J., 2002. Statistics review 4: sample size calculations. *Critical Care,* 6(4), pp. 335

WILSON, S. et al., 2001. General practitioner–hospital communications: a review of discharge summaries. *Journal of Quality in Clinical Practice,* 21(4), pp. 104-108

WITHERINGTON, E., PIRZADA, O. and AVERY, A., 2008. Communication gaps and readmissions to hospital for patients aged 75 years and older: observational study. *Quality and Safety in Health Care,* 17(1), pp. 71-75

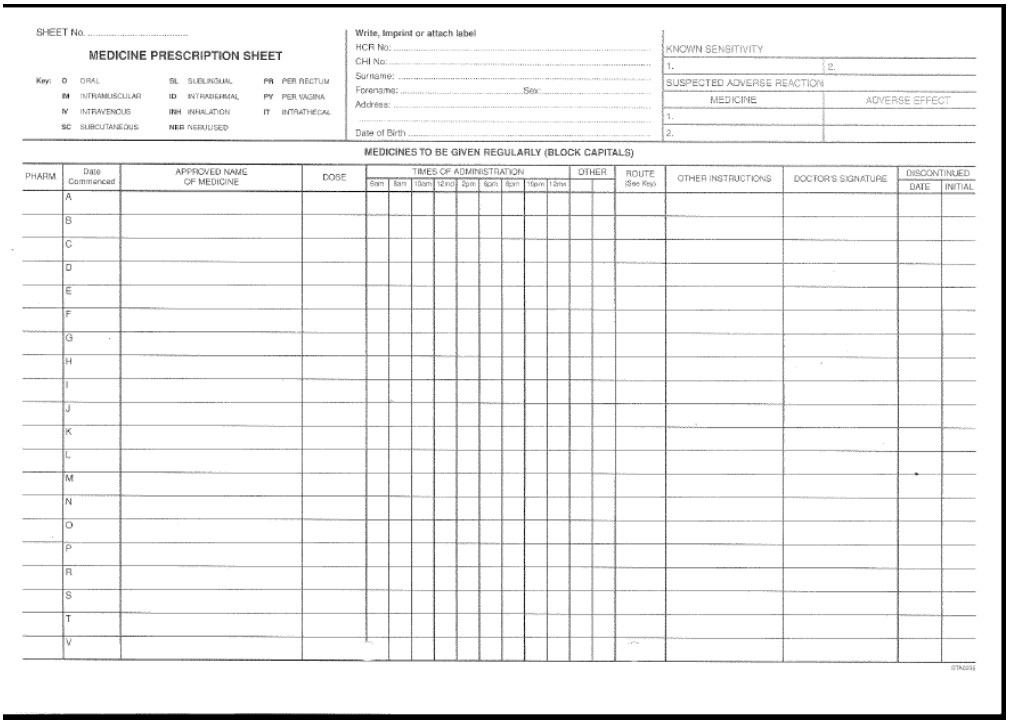
YEMM, R. et al., 2014. What constitutes a high quality discharge summary? A comparison between the views of secondary and primary care doctors. *International Journal of Medical Education,* 5, pp. 125-131

YIN, R.K., 2014. *Case study research: Design and methods.* Sage publications. California

YUSOF, M.M. et al., 2008. An evaluation framework for Health Information Systems: human, organization and technology-fit factors (HOT-fit). *International Journal of Medical Informatics,* 77(6), pp. 386-398

APPENDIXES

APPENDIX 1.1 PRE-IMPLEMENTATION INPATIENT PRESCRIPTION CHART



SHEET No. .....

MEDICINE PRESCRIPTION SHEET

Key: O ORAL SL SUBLINGUAL PR PER RECTUM
IM INTRAMUSCULAR ID INTRADERMAL PV PER VAGINA
IV INTRAVENOUS INH INHALATION IT INTRATHECAL
SC SUBCUTANEOUS NEB NEBULISED

Write, Imprint or attach label
HCR No: .....
CHI No: .....
Surname: .....
Forename: ..... Sex: .....
Address: .....
Date of Birth .....

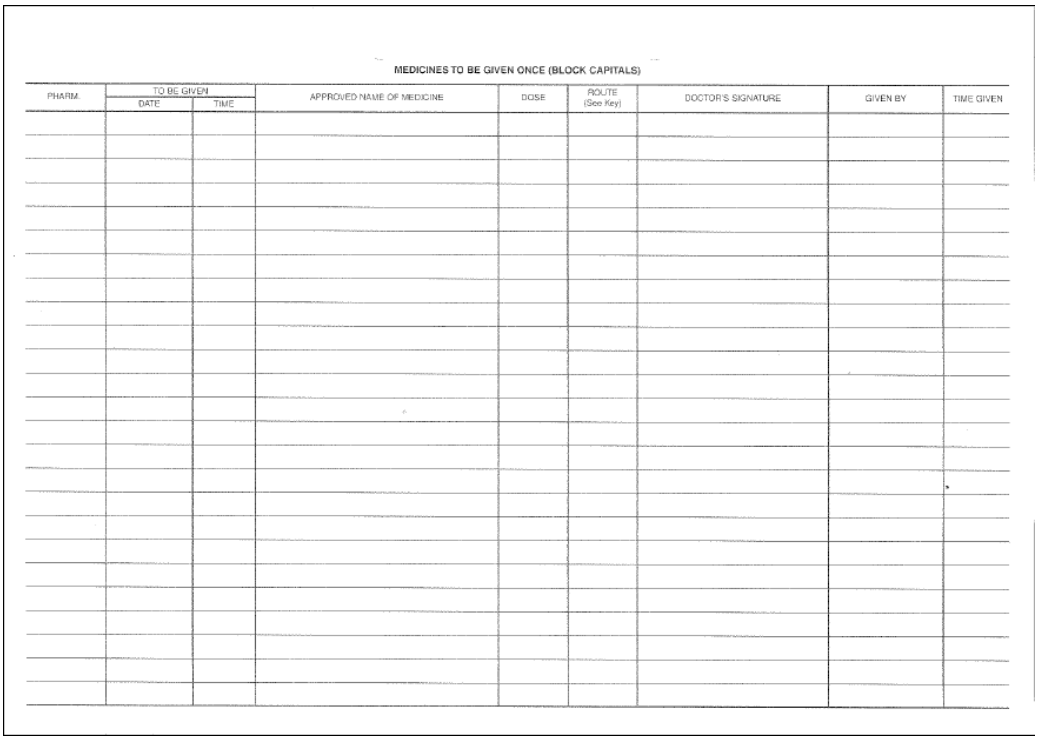
KNOWN SENSITIVITY
1. 2.
SUSPECTED ADVERSE REACTION

MEDICINE	ADVERSE EFFECT
1.	
2.	

MEDICINES TO BE GIVEN REGULARLY (BLOCK CAPITALS)

PHARM.	Date Commenced	APPROVED NAME OF MEDICINE	DOSE	TIMES OF ADMINISTRATION: 6am	8am	10am	12mid	2pm	6pm	8pm	10pm	12mn	OTHER		ROUTE (See Key)	OTHER INSTRUCTIONS	DOCTOR'S SIGNATURE	DISCONTINUED DATE	DISCONTINUED INITIAL
	A																		
	B																		
	C																		
	D																		
	E																		
	F																		
	G																		
	H																		
	I																		
	J																		
	K																		
	L																		
	M																		
	N																		
	O																		
	P																		
	R																		
	S																		
	T																		
	V																		

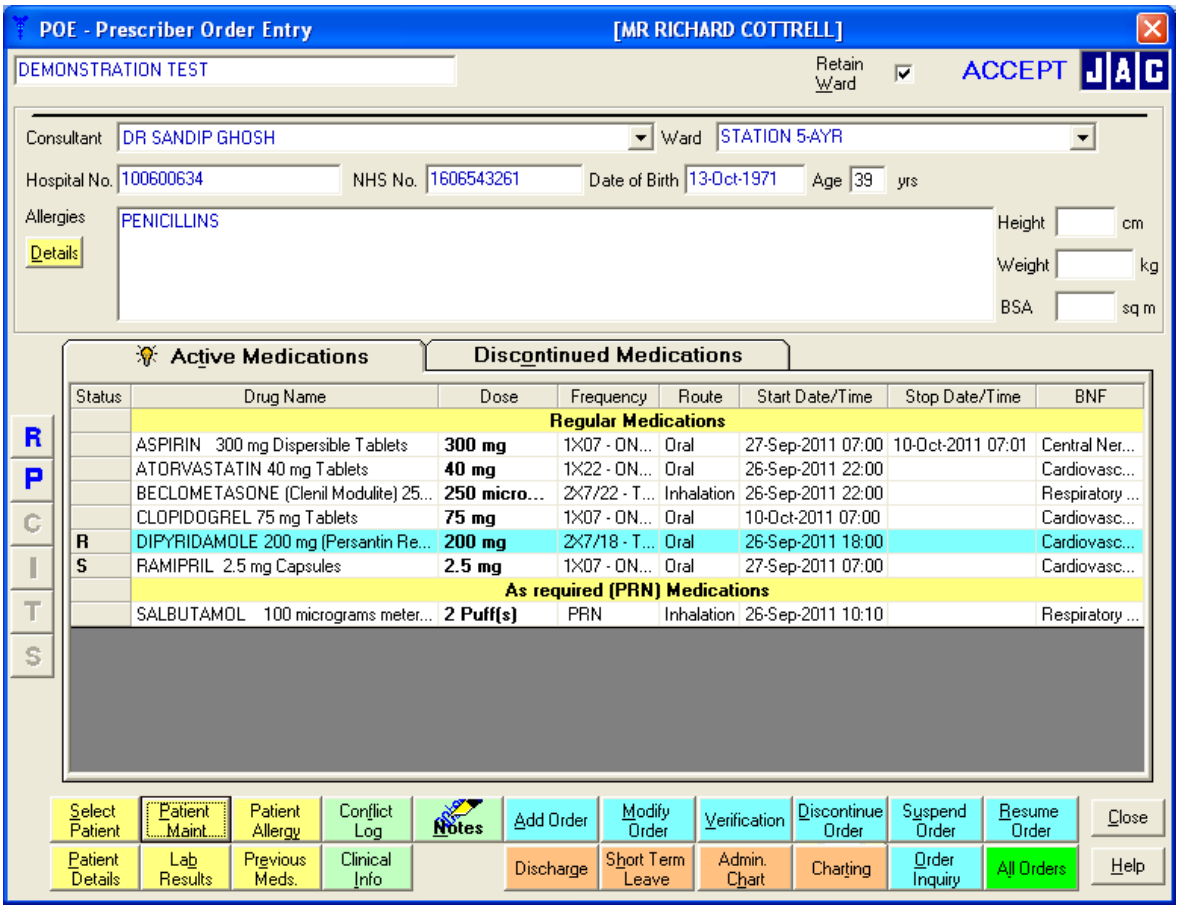
STA2015



MEDICINES TO BE GIVEN ONCE (BLOCK CAPITALS)

PHARM.	TO BE GIVEN DATE	TO BE GIVEN TIME	APPROVED NAME OF MEDICINE	DOSE	ROUTE (See Key)	DOCTOR'S SIGNATURE	GIVEN BY	TIME GIVEN

APPENDIX 1.2 SCREENSHOT OF HEPMA INPATIENT PRESCRIPTION CHART



APPENDIX 1.3 PRE-IMPLEMENTATION IMMEDIATE DISCHARGE LETTER

STA0849

NHS AYRSHIRE & ARRAN

Crosshouse Hospital Discharge 380749

G.P.

* PLEASE PRINT HEAVILY USING BALL POINT PEN

Write or attach label

HCR No: .....
CHI No: .....
Surname: .....
Forename: .....Sex: .....
Address: .....
.....
Date of Birth .....

Ward:
Consultant:

Date of Admission:
Date of Discharge:
(or date of death)
Clinic Appointment:

Services Arranged: ☐ Home help ___ times week ☐ Meals on wheels ☐ District Nurse ☐ Other
Discharged to: ☐ Home ☐ Stay with relatives ☐ Other hospital ☐ Nursing home ☐ Other ☐ Died

Discharge Diagnosis (if admitted due to an injury, include place of accident & site of injury)	If multiple Day Case admission, list dates of admission
1	
2	
3	
4	
5	

Operations / Procedures
1
2
3
4

Discharge Medication (7 days supply will be dispensed unless otherwise stated by doctor)

For Pharmacy use

Drug Name and formulation	Dose	Frequency	Route	Duration (cont/stop)	Quantity and strength	Notes
				pharmacy date	dispensed by	checked by

Additional Information (e.g. awaiting histology or other results, patients progress)

A finished consultant episode letter will follow.

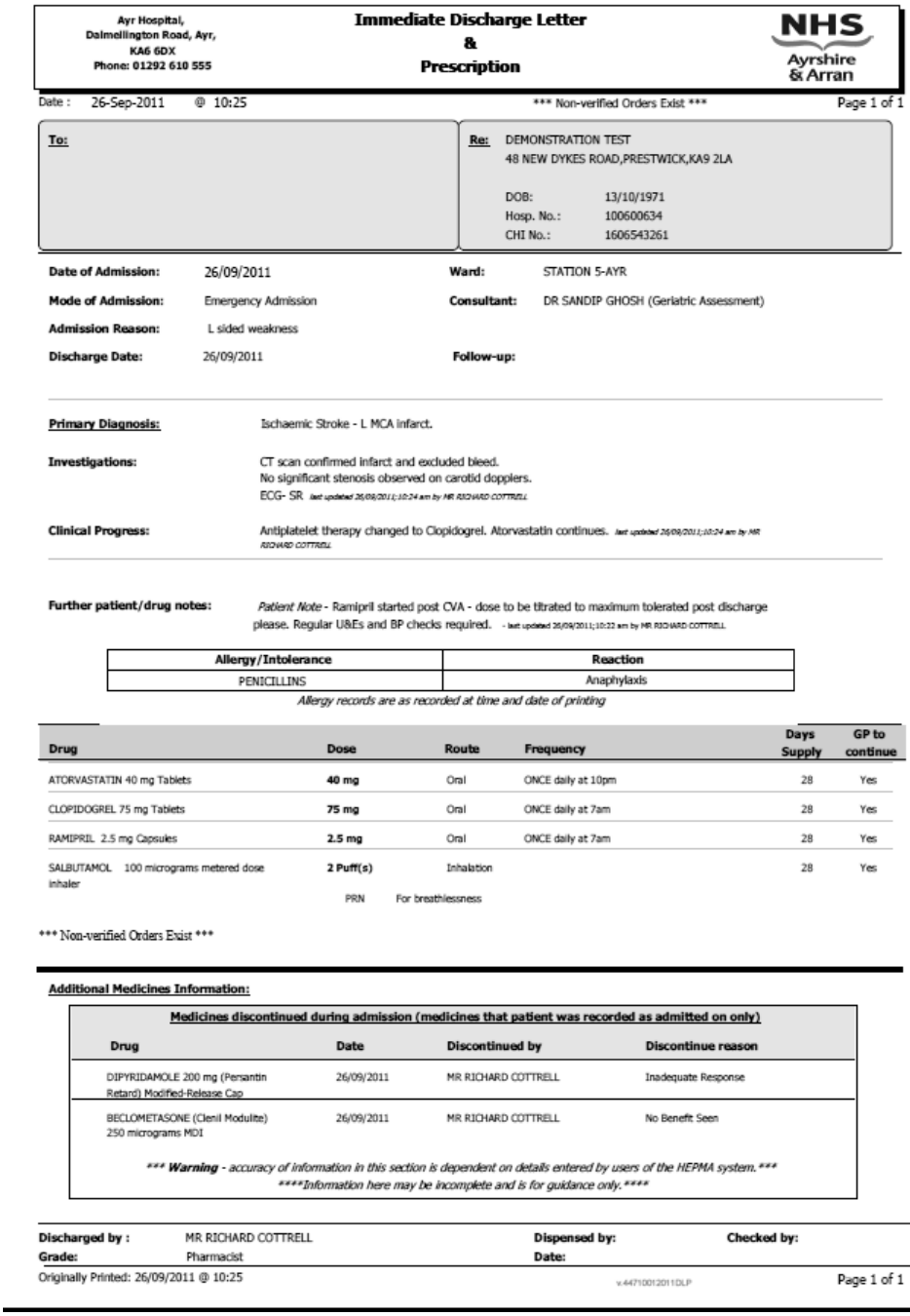
Signature _____

PRINT NAME _____ Date / 20

N.B. DISCHARGE MEDICATION IS FOR INFORMATION ONLY. FAXED COPY HAS NOT BEEN CHECKED BY DOCTOR. ON RECEIPT OF HARD COPY, FAXED COPY CAN BE DESTROYED.

Ward Clerkess : _____ / Dictated : _____ / Typed : _____ / Signed : _____ / Mailed : _____

APPENDIX 1.4 SCREENSHOT OF HEPMA IMMEDIATE DISCHARGE LETTER



Ayr Hospital,
Dalmellington Road, Ayr,
KA6 6DX
Phone: 01292 610 555

Immediate Discharge Letter
&
Prescription

NHS Ayrshire & Arran

Date : 26-Sep-2011 @ 10:25 *** Non-verified Orders Exist *** Page 1 of 1

To:

Re: DEMONSTRATION TEST
48 NEW DYKES ROAD,PRESTWICK,KA9 2LA

DOB: 13/10/1971
Hosp. No.: 100600634
CHI No.: 1606543261

Date of Admission: 26/09/2011 **Ward:** STATION 5-AYR
Mode of Admission: Emergency Admission **Consultant:** DR SANDIP GHOSH (Geriatric Assessment)
Admission Reason: L sided weakness
Discharge Date: 26/09/2011 **Follow-up:**

Primary Diagnosis: Ischaemic Stroke - L MCA infarct.

Investigations: CT scan confirmed infarct and excluded bleed.
No significant stenosis observed on carotid dopplers.
ECG- SR *last updated 26/09/2011;10:24 am by MR RICHARD COTTRELL*

Clinical Progress: Antiplatelet therapy changed to Clopidogrel. Atorvastatin continues. *last updated 26/09/2011;10:24 am by MR RICHARD COTTRELL*

Further patient/drug notes: *Patient Note* - Ramipril started post CVA - dose to be titrated to maximum tolerated post discharge please. Regular U&Es and BP checks required. *- last updated 26/09/2011;10:22 am by MR RICHARD COTTRELL*

Allergy/Intolerance	Reaction
PENICILLINS	Anaphylaxis

Allergy records are as recorded at time and date of printing

Drug	Dose	Route	Frequency	Days Supply	GP to continue
ATORVASTATIN 40 mg Tablets	**40 mg**	Oral	ONCE daily at 10pm	28	Yes
CLOPIDOGREL 75 mg Tablets	**75 mg**	Oral	ONCE daily at 7am	28	Yes
RAMIPRIL 2.5 mg Capsules	**2.5 mg**	Oral	ONCE daily at 7am	28	Yes
SALBUTAMOL 100 micrograms metered dose inhaler	**2 Puff(s)** PRN	Inhalation For breathlessness		28	Yes

*** Non-verified Orders Exist ***

Additional Medicines Information:

Medicines discontinued during admission (medicines that patient was recorded as admitted on only)

Drug	Date	Discontinued by	Discontinue reason
DIPYRIDAMOLE 200 mg (Persantin Retard) Modified-Release Cap	26/09/2011	MR RICHARD COTTRELL	Inadequate Response
BECLOMETASONE (Clenil Modulite) 250 micrograms MDI	26/09/2011	MR RICHARD COTTRELL	No Benefit Seen

**** **Warning** - accuracy of information in this section is dependent on details entered by users of the HEPMA system.****
*****Information here may be incomplete and is for guidance only.*****

Discharged by : MR RICHARD COTTRELL **Dispensed by:** **Checked by:**
Grade: Pharmacist **Date:**

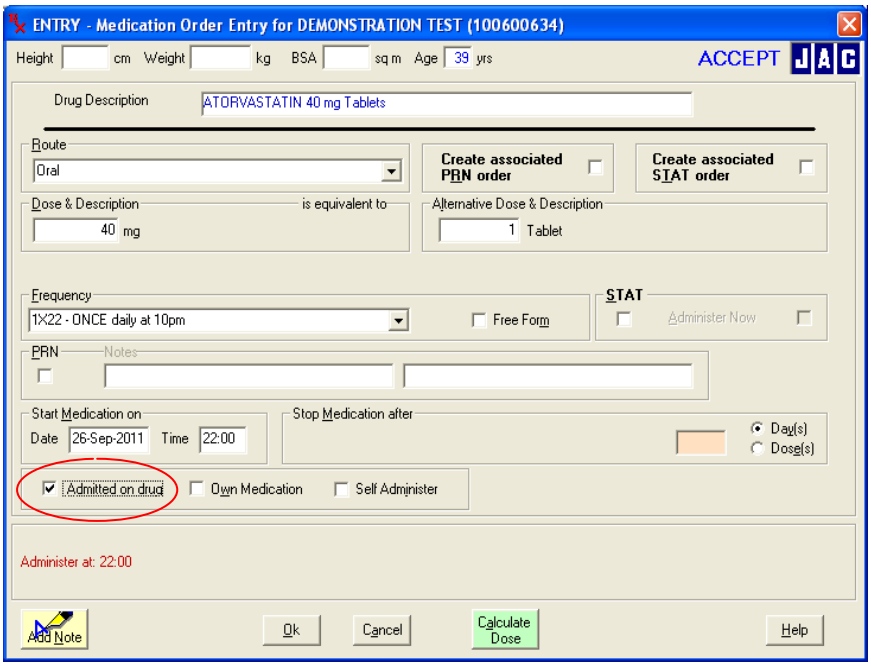
Originally Printed: 26/09/2011 @ 10:25 v.44710012011DLP Page 1 of 1

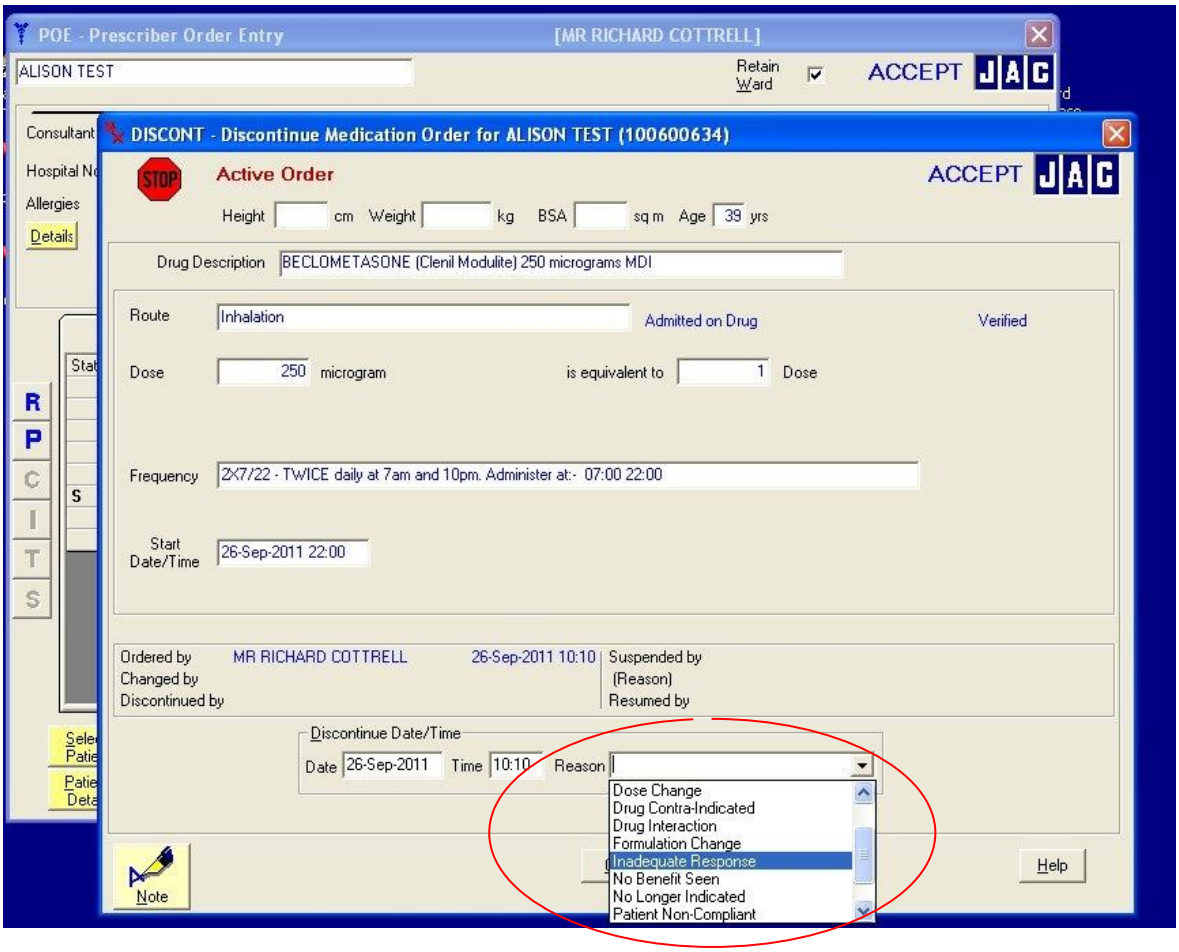
APPENDIX 1.5 SUMMARY OF KEY POINTS FROM SCOTTISH INTERCOLLEGIATE GUIDELINES NETWORK GUIDELINE 128 THE SIGN DISCHARGE DOCUMENT

The template states information requirements for both the CDD and the EDD although this is not provided in an actual discharge letter format. The information in the table below depicts the different mandatory headings with an explanation.

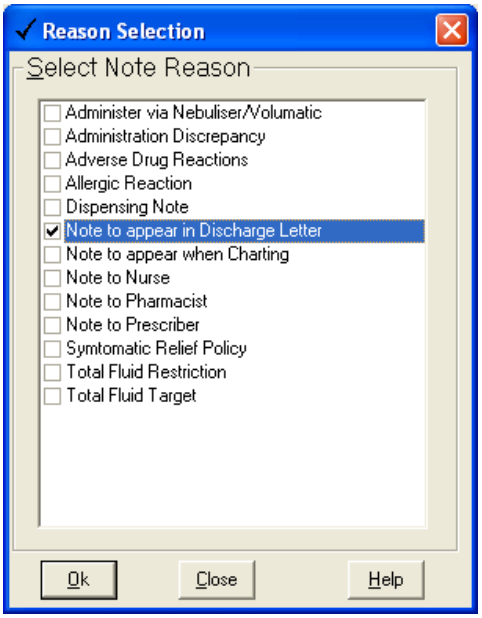
Information required	**Explanation**
Hospital name	Name of discharging hospital
Patient Identification	Full name, address, date of birth and identification number
GP identification	Registered GP
Consultant identification	Consultant at discharge
Ward/department	Ward patient discharged from
Contact information	Phone number
Date of admission	Date admitted to this hospital
Date of discharge	Date of actual discharge
Primary discharge diagnosis	Record if definite or interim
Secondary discharge diagnosis	Record if definite or interim
Presenting Complaint	Reason patient came to hospital
Admission type	Arranged, emergency or transfer
Referral source	GP, self-referral, ambulance etc
Significant operations/procedures	Dates to provided and abbreviations avoided
Clinical progress	What happened during stay
Results awaited	Any outstanding results
Investigations pending	Any pending investigations
Allergies	All known allergies
Medicines stopped	Medicines stopped during this episode
New medicines	New medicines started
Continuing medicines	Medicines continuing
Follow-up arrangements	Specify what, when and by whom
Copy to community pharmacy	Was a copy of CDD sent to community pharmacy
Copy to patient	Was a copy of CDD given to patient
Copy to carer/relative	Was a copy of CDD given to carer/relative
Extended document to follow?	Only required for more complicated patients
Other information	Any other relevant information
Consultant sign-off and comment	Consultant responsible for patient at discharge
Signature, name and position	Signature, name, job title and contact number

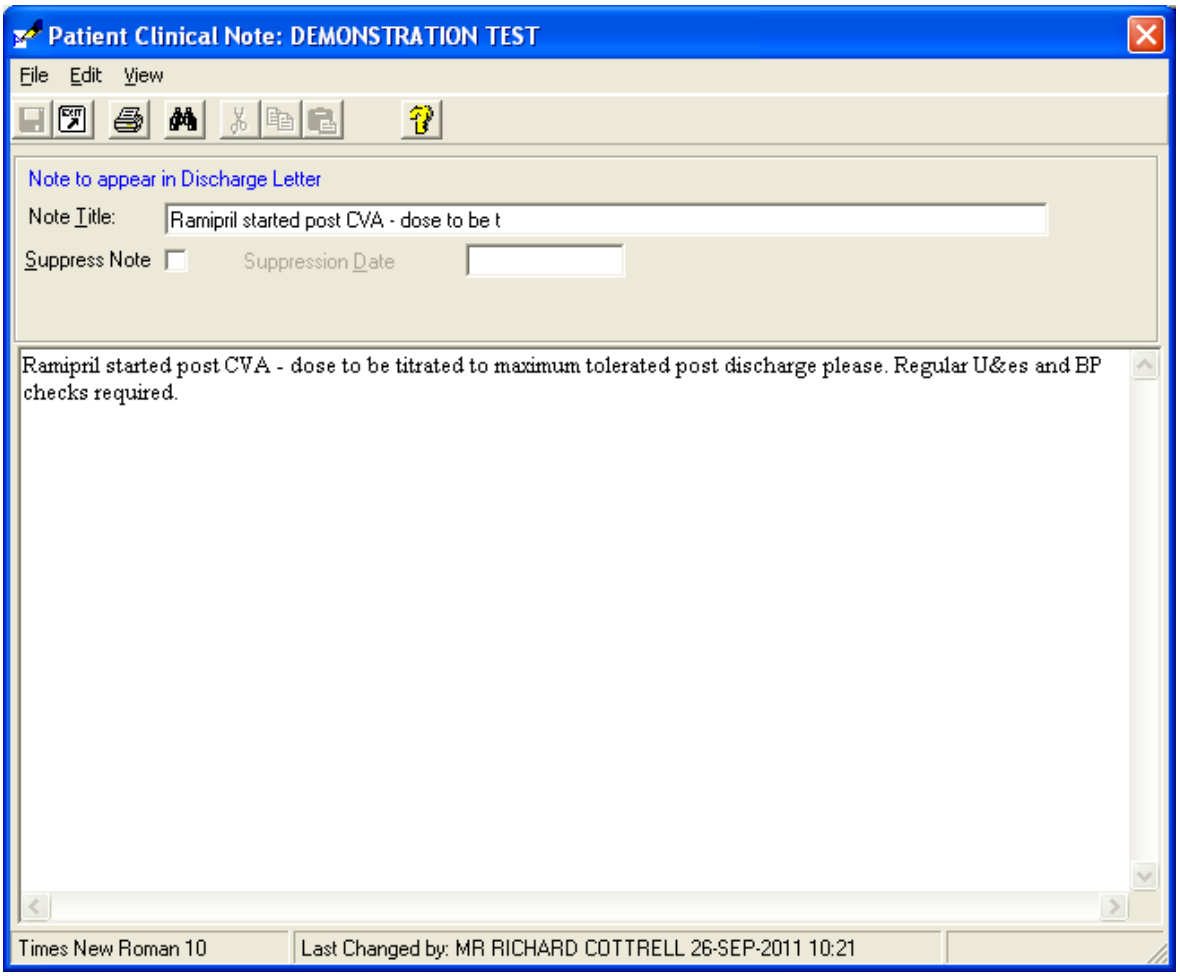
APPENDIX 1.6 DISCHARGE MEDICINE RECONCILIATION HEPMA ASSISTANCE MEDICINE DISCONTINUED



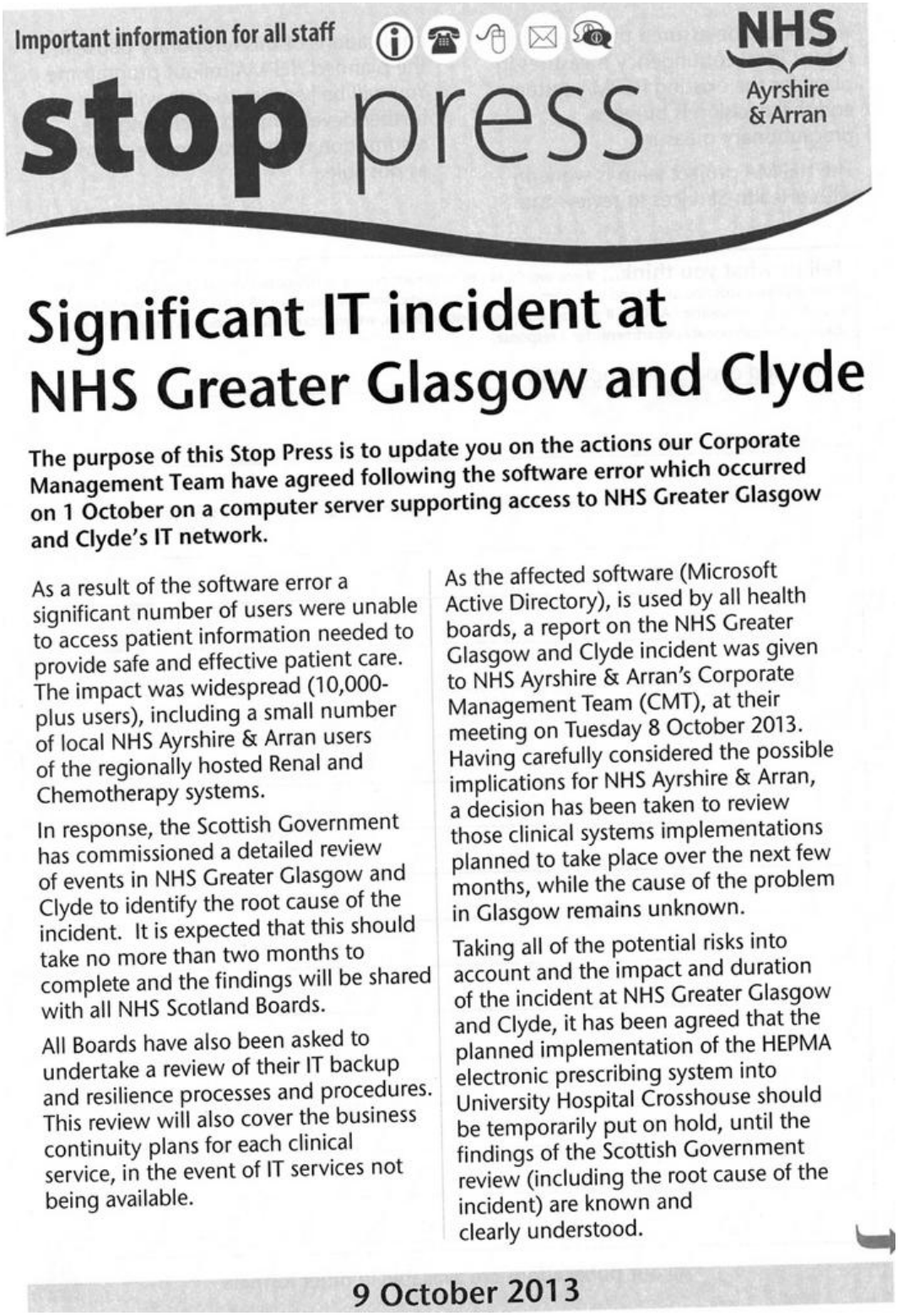


APPENDIX 1.7 DISCHARGE MEDICINE RECONCILIATION HEPMA ASSISTANCE NEW MEDICINE INFORMATION





APPENDIX 1.8 NHS AYRSHIRE AND ARRAN STOP PRESS



Important information for all staff

stop press

NHS Ayrshire & Arran

Significant IT incident at NHS Greater Glasgow and Clyde

The purpose of this Stop Press is to update you on the actions our Corporate Management Team have agreed following the software error which occurred on 1 October on a computer server supporting access to NHS Greater Glasgow and Clyde's IT network.

As a result of the software error a significant number of users were unable to access patient information needed to provide safe and effective patient care. The impact was widespread (10,000-plus users), including a small number of local NHS Ayrshire & Arran users of the regionally hosted Renal and Chemotherapy systems.

In response, the Scottish Government has commissioned a detailed review of events in NHS Greater Glasgow and Clyde to identify the root cause of the incident. It is expected that this should take no more than two months to complete and the findings will be shared with all NHS Scotland Boards.

All Boards have also been asked to undertake a review of their IT backup and resilience processes and procedures. This review will also cover the business continuity plans for each clinical service, in the event of IT services not being available.

As the affected software (Microsoft Active Directory), is used by all health boards, a report on the NHS Greater Glasgow and Clyde incident was given to NHS Ayrshire & Arran's Corporate Management Team (CMT), at their meeting on Tuesday 8 October 2013. Having carefully considered the possible implications for NHS Ayrshire & Arran, a decision has been taken to review those clinical systems implementations planned to take place over the next few months, while the cause of the problem in Glasgow remains unknown.

Taking all of the potential risks into account and the impact and duration of the incident at NHS Greater Glasgow and Clyde, it has been agreed that the planned implementation of the HEPMA electronic prescribing system into University Hospital Crosshouse should be temporarily put on hold, until the findings of the Scottish Government review (including the root cause of the incident) are known and clearly understood.

9 October 2013

APPENDIX 3.1 SEMI-STRUCTURED INTERVIEW SCHEDULE (PRE-IMPLEMENTATION)

*"*Does hospital electronic prescribing impact on discharge communication- staff views and experiences of the traditional system"

Participant Number	Date	Start time
	/ /	:

A. Introduction

Hello, thanks for agreeing to be interviewed for this project. Please, can I check you have read the participant information sheet.

If not, here is a copy to read before we begin.

The main purpose of this interview is to find out your views and experiences about the current prescribing and discharge communication system.

The organisation is intending to implement a Hospital Electronic Prescribing and Medicines Administration (HEPMA) system in this hospital in the near future.

I would also like to ask you about how you think this new system might impact on prescribing and discharge communication.

Your participation is voluntary and you may withdraw at any point.

If you do not want to answer a specific question, then please let me know.

There are no right or wrong answers and I am interested in your personal opinion.

The identities of all participants will remain strictly confidential and it will not be possible to identify individuals from the study results.

The interview should take approximately 20 to 30 minutes, are you ok to go ahead?

IF NO: That's okay. When would be more convenient? Thanks I'll see you on day/date/time at .....location. Bye.	Write the new day/date/time here and in diary chart:

IF YES continue: That's great, thank you.

B. Housekeeping

As you are aware from the information sheet and consent form, this conversation is being audio recorded but I would emphasise that it is confidential.

Please do not use names of patients or hospital staff during this interview. It is ok to refer to "a patient", "another doctor", " a nurse", "a GP" etc

Are you still OK with that?

IF NO: That's fine. I'll need a bit more time to write down notes as we go through the sections and I may ask you to repeat some answers so I don't miss anything.	Reminders • Take time to write detailed notes • If in doubt, ask the interviewee for clarification before you move on to the next section

If you decide after the interview you no longer wish to be a part of the research, please let me know. The contact details are on the information sheet.

Do you have any questions before we begin?

Technical problem? Keep calm! Explain, apologise and rearrange interview day/date/time

C. Background Information

"I would like to ask you some background information"

What is your professional group: Consultant Medical/Junior Medical/Advanced Nurse Practitioner/ Pharmacist

Sex: Male/Female

How many years have you worked in this hospital?……years

How many other organisations have you worked in the last 10 years? ……

Have you used electronic systems for prescribing and discharge previously? Y/N

If Yes, please prescribe a description of what this involved e.g. full HEPMA system, stand alone electronic discharge letter……..

If No, go to Section D

D. Inpatient prescribing

I would like to ask you about the current inpatient prescription chart- what works well, what doesn't work well, any experiences you would like to share, any thoughts? Please use your experience of patient care as illustrative examples

Allow free comment and then ask if not covered: Comments about prescribing/transcribing daily medicines? What about medicines of unusual frequencies e.g. Parkinson's medicines, alternate day, or once weekly? What about insulin, warfarin, non-formulary medicines? Comments about recording/knowing if a patient was admitted on a medicine? Comments about recording allergy information? Comments about documenting withheld medicines? Comments about documenting medicines to be continued on discharge? Comments about viewing the inpatient chart? What about the number of pages per patient? What about re-writing prescription charts? Comments about knowing if a medicine has been administered? Comments about documenting/knowing if a patient uses a compliance device/MAR chart? How have your experiences of..... impacted on your views? What about contribution to patient care and risk? Anything you would like to add about why you have made these comments.....	Note answers here for backup and reference

E. Discharge prescribing

I would like to ask you about the current immediate discharge letter (IDL) -what works well, what doesn't work well, any experiences you would like to share, any thoughts? Please use your experience of patient care as illustrative examples

Allow free comment and then ask if not covered: Do you have any comments about recording/knowing diagnosis on IDL? What about clinical progress, follow up information? Do you have any comments about prescribing daily medicines? What about medicines of unusual frequencies e.g. Parkinson's medicines or alternate days/ once weekly What about insulin, warfarin, non-formulary medicines? Do you have any comments about recording/knowing if a patient was admitted on a medicine? What about recording/knowing allergy information, documenting/knowing medicine stopped during hospital admission, documenting/knowing if a medicine is to be continued by GP on discharge, documenting/knowing an indication for newly started medicine? Comments about the number of pages per patient? Comments about documenting/knowing that a patient needs a compliance device/MAR chart on discharge? Comments about how often is IDL reviewed and signed off by a consultant? How have your experiences of..... impacted on your views? What about contribution to patient care and risk? Anything you would like to add about why you have made these comments.....	Note answers here for backup and reference

F. Incident Reports and Significant Adverse Event Reviews

I would like to ask you about Datix reporting/ reviewing or SAER in relation to current prescribing and discharge communication system?

Allow free comment and if No go to Section G **or then ask if not covered:**	**Note answers here for backup and reference**
- Have you recorded any Datix incidents regarding the current prescribing and discharge communication system? If Yes, what was the problem, did it result in harm, what would prevent this happening again? - Have you responded to any Datix incidents regarding the current prescribing and discharge communication system If Yes, what was the problem, did it result in harm, what would prevent this happening again? - Have you been involved in any Significant Adverse Event Reviews (SAER) involving the prescribing and discharge communication system? If Yes, what was the problem, did it result in harm, what would prevent this happening again?	

G. Hospital Electronic Prescribing and Medicines Administration (HEPMA) Implementation

I would like to ask about your understanding and views about the proposed HEPMA implementation

Allow free comment and then ask if not covered: - What, if any, impact do you think this will have on your present role? - Why do you think this? - What, if any, impact do you think this will have on your profession? - Why do you think this? - What, if any, impact do you think this will have on inpatient prescribing - Why do you think this? - What, if any impact do you think this will have on discharge prescribing and communication? - Why do you think this? - What, if any impact do you think this will have on incidents and adverse events? - Why do you think this? - What, if any, impact do you think this will have on patient safety? - Why do you think this? - What, if any, impact do you think this will have on the hospital service? - Why do you think this?	**Note answers here for backup and reference**

H. Other

Is there anything else you would like to add? Note answers here for backup and reference	
Well that's all of my questions. You've been very helpful and I appreciate you taking the time to speak to me. If you think of anything else you would like to add, please get in touch. If you would like to see a copy of the transcript from the interview, please let me know and I will arrange for this to be supplied to you. Thank you very much.	**Transcript Y/N** **Interview concluded at:** **:**

APPENDIX 3.2 E-MAIL PARTICIPANT INVITATION

Dear

I would like to invite you to participate in a short interview to evaluate our current prescribing system prior to Hospital Electronic Prescribing and Medicines Administration (HEPMA) implementation.
The study has been approved by Robert Gordon University Ethics Review Panel and has been assessed by NHS Ayrshire and Arran Research and Development as a service evaluation project and thus does not require NHS Ethics review.

The interviews will be recorded with your agreement. All information will be treated confidentially and no names will be used in any analysis or publications.

I hope you will agree to participate and if so I will arrange a date for the interview to be held at a mutually convenient time. Ideally I would like the interviews to be in January or February 2013.
The interviews may be held in the pharmacy in a private room or another identified room of your choosing that would allow the meeting to remain confidential.
I enclose a copy of the participant information sheet and consent form for your information.
If you have any queries, please do not hesitate to contact me.
Thanking you in anticipation.

Pamela

Pamela Mills
Principal Pharmacist- Redesign
Pharmacy Department
University Hospital Crosshouse
Kilmarnock
KA2 0BE

01563 521133 Bleep 3178

APPENDIX 3.3 PARTICIPANT INFORMATION SHEET

Title of Project: Does hospital electronic prescribing impact on discharge communication-staff views and experiences of the traditional system?

You are being invited to take part in a research study. Before you decide if you wish to take part it is important for you to understand why the research is being undertaken and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish.

Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

The purpose of the study is to investigate if implementing a Hospital Electronic Prescribing and Medicines Administration (HEPMA) system has improved discharge communication. Currently, there have been problems with inaccurate and incomplete information or delayed information being sent to patients' GPs. These problems may result in either potential or actual patient harm especially in relation to information about medicines.

Study aim

The aim of this study is to investigate the impact of implementing a HEPMA system into a district general hospital (DGH) specifically in relation to discharge information communication to patients' general practitioners after an inpatient hospital stay of adult patients (16 years and over).

The study will be carried out by a pharmacist working within NHS Ayrshire and Arran. This work will form part of a submission towards a Doctorate of Professional Practice qualification from Robert Gordon University.

Why have I been chosen?

You have been chosen because you belong to one of the staff groups involved with prescribing medicines and discharge information communication and you are familiar with the current hospital prescribing and medicine administration system.

Do I have to take part?

No. It is up to you to decide whether or not to take part. If you do, you will be given this information sheet to keep and be asked to sign an informed consent form. You are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect any way your employment with NHS Ayrshire and Arran.

What will happen to me if I take part?

If you decide to take part in this study, you will be asked to take part in an interview of approximately twenty to thirty minutes with the researcher at either a private room in the pharmacy department or your office, whichever is more convenient. You will be asked to provide your views and opinions relating to the current prescribing and medicine administration system. The interview will be audio recorded with your permission. The recording will be transcribed into a qualitative data software system to aid analysis. You will be provided with a transcript of the audio recording if requested and allowed to make any required amendments to the transcript.

Any information provided during the interview will be anonymous and confidential. Your name will not appear on the transcript or any report of the research. This information may be used anonymously in any publication or presentation of the study results.

Several months after the implementation of the hospital electronic prescribing and medicines administration system you will be contacted to participate in another interview with the researcher to enable to gain your opinion of the impact of the new system. You will be asked for your consent again before participating in the second interview.

What do I have to do?

If you decide to take part in the study, you will be asked to sign an informed consent form and to take part in the interview as described above.

What are the possible benefits of taking part?

There are no direct benefits to you by taking part in the study. There may be benefits to the organisation in evaluating any benefits of the newly implemented HEPMA system.

What if there is a problem?

Any complaint about the way you have been dealt with during the study will be addressed. If you have any complaints or would like further information about the study please contact:

Pamela Mills

Principal Pharmacist – Redesign

Pharmacy Department

University Hospital of Crosshouse

Kilmarnock

KA2 0BE

Telephone: 01563 826066

If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from Crosshouse or Ayr Hospital.

Will my taking part in the study be kept confidential?

Yes. All the information about your participation in this study will be kept confidential. Any data relating to your participation will be stored securely at all times and can only be accessed by the researcher.

You will be given a copy of the information sheet and a signed consent form to keep.

Thank you for taking time to read the information sheet and for considering taking part in this study.

APPENDIX 3.4 CONSENT FORM

Does hospital electronic prescribing impact on discharge communication- staff views and experiences of the traditional system?

Researcher

Pamela Mills

Principal Pharmacist- Redesign

Pharmacy Department

University Hospital of Crosshouse

Ext: 26066 Bleep: 3178 E-mail: pamela.mills@aaaht.scot.nhs.uk

Participant Study Number.....

Please INITIAL box

I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.	☐
I agree to take part in the above study.	☐
I agree to the interview being audio recorded.	☐
I agree to the use of anonymised quotes in publications.	☐

Name of Participant	Date	Signature
Name of Interviewer	Date	Signature

APPENDIX 3.5 NHS ETHICS (PHASE 1)

NHS
Ayrshire
& Arran

Healthcare Quality, Governance & Standards Unit
Research, Development & Evaluation Office
58 Lister Street
Crosshouse Hospital
Kilmarnock
KA2 0BB

Ms Pamela Mills
Principal Pharmacist- Redesign
Pharmacy Department
Crosshouse Hospital
Kilmarnock
KA2 0BE

Date 14 November 2012
Your Ref
Our Ref KLB/AMK

Enquiries to Karen Bell
Extension 25850
Direct line 01563 825850
Fax 01563 825806
Email Karen.bell@aaaht.scot.nhs.uk

Dear Ms Mills

Does hospital electronic prescribing impact on discharge communication – staff opinion of traditional system

I have reviewed your proposal and have determined that it is not appropriate to classify it as Research according the guidance issued by the NHS National Research Ethics Service (NRES).

The NRES guidance is outlined in a summary leaflet which can be accessed via their website at: http://www.nres.npsa.nhs.uk/EasySiteWeb/GatewayLink.aspx?alId=355.

The leaflet contains a helpful summary table, a portion of which I have reproduced at the end of this letter for your reference.

As the project is not research, it does not require to be reviewed by an NHS Ethics Committee, and does not require formal R&D Management Approval to be undertaken within NHS Ayrshire & Arran.

I would, however, like to highlight a number of issues that you should consider when carrying out your project:

- As your project has not been defined as Research, it will not be managed as such, nor will it be subject to regular review or monitoring by the R&D Department. Furthermore, you should avoid referring to it as research in any paper or presentation.

- You will be required to submit a progress report midway through the project and a final report at the end of the project.

- You should ensure that you have agreement of appropriate senior staff to carry out

your project in their area (e.g. Senior Nurse, Service Manager etc., as applicable).

- You should be aware of any potential ethical issues, discuss these with colleagues and advisors, if necessary, and ensure patient safety as your first priority.
- You should comply with all relevant Health and Safety and Data Protection legislation and guidance, and avoid using patient identifiable information unless it is essential – seek guidance from the Information Governance department if required.
- You should ensure that all confidential information is maintained in secure storage.
- You should maintain a well organised project file at all times, including copies of any agreements, protocols questionnaires etc.
- You should seek to publish the results of your work as widely as possible.

Good luck with your project.

Yours sincerely

Dr Karen L Bell
Head of Research, Development & Evaluation

RESEARCH	SERVICE EVALUATION*	CLINICAL AUDIT
The attempt to derive generalizable new knowledge including studies that aim to generate hypotheses as well as studies that aim to test them.	Designed and conducted solely to define or judge current care.	Designed and conducted to produce information to inform delivery of best care.
Quantitative research – designed to test a hypothesis. Qualitative research – identifies/explores themes following established methodology.	Designed to answer: "What standard does this service achieve?"	Designed to answer: "Does this service reach a predetermined standard?"
Addresses clearly defined questions, aims and objectives.	Measures current service without reference to a standard.	Measures against a standard.
Quantitative research – may involve evaluating or comparing interventions, particularly new ones. Qualitative research – usually involves studying how interventions and relationships are experienced.	Involves an intervention in use only. The choice of treatment is that of the clinician and patient according to guidance, professional standards and/or patient preference.	Involves an intervention in use only. The choice of treatment is that of the clinician and patient according to guidance, professional standards and/or patient preference.
Usually involves collecting data that are additional to those for routine care but may include data collected routinely. May involve treatments, samples or investigations additional to routine care.	Usually involves analysis of existing data but may include administration of interview or questionnaire.	Usually involves analysis of existing data but may include administration of simple interview or questionnaire.
Quantitative research – study design may involve allocating patients to intervention groups. Qualitative research – uses a clearly defined sampling framework underpinned by conceptual or theoretical justifications.	No allocation to intervention: the health professional and patient have chosen intervention before service evaluation.	No allocation to intervention: the health professional and patient have chosen intervention before audit.
May involve randomisation.	No randomisation.	No randomisation.
Normally requires REC review. Refer to www.nres.npsa.nhs.uk/applications/apply/ for more information.	Does not require REC review.	Does not require REC review.

* Service development and quality improvement may fall into this category.

APPENDIX 3.6 RGU ETHICS REVIEW PANEL (PHASE 1)

ROBERT GORDON UNIVERSITY•ABERDEEN

COMPLETED

Does hospital electronic prescribing impact on discharge communication- staff views and experiences of the traditional system.

14/12/12

Dear Pamela

We have reviewed your ethics application and it has been approved with no changes. The panel recommends that it is of sufficient standard for you to proceed. However the panel would prefer that no interviews were stored on pen drives (either encrypted or not) as they are not a safe form of storage for potentially sensitive material.

We do not need you to comment on the above but just to consider this and make any changes to your RESA and protocol that you feel are needed in discussion with your supervisors.

If there are any questions on our response to the ethics submission please do not hesitate to get in touch.

Regards

Dr Lesley Diack
Chair of the School Ethics Review Panel

APPENDIX 4.1 PARTICIPANT INFORMATION SHEET

PARTICIPANT INFORMATION SHEET – Post-implementation

Title of Project: Does hospital electronic prescribing impact on discharge communication- staff views and experiences of the HEPMA system?

You are being invited to take part in a research study. Before you decide if you wish to take part it is important for you to understand why the research is being undertaken and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish.

Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

The purpose of the study is to investigate if implementing a Hospital Electronic Prescribing and Medicines Administration (HEPMA) system has impacted on discharge communication. Traditionally, there have been problems with inaccurate and incomplete information or delayed information being sent to patients' GPs. These problems may result in either potential or actual patient harm especially in relation to information about medicines.

Study aim

The aim of this study is to investigate the impact of implementing a HEPMA system into a district general hospital (DGH) specifically in relation to discharge information communication to patients' general practitioners after an inpatient hospital stay of adult patients (16 years and over).

The study will be carried out by a pharmacist working within NHS Ayrshire and Arran. This work will form part of a submission towards a Doctorate of Professional Practice qualification from Robert Gordon University.

Why have I been chosen?

You have been chosen because you belong to one of the staff groups involved with prescribing medicines and discharge information communication and you are familiar with the newly implemented hospital electronic prescribing and medicines administration system.

Do I have to take part?

No. It is up to you to decide whether or not to take part. If you do, you will be given this information sheet to keep and be asked to sign an informed consent form. You are still free to withdraw at any time and without giving a

reason. A decision to withdraw at any time, or a decision not to take part, will not affect any way your employment with NHS Ayrshire and Arran.

What will happen to me if I take part?

If you decide to take part in this study, you will be asked to take part in an interview of approximately twenty to thirty minutes with the researcher at either a private room in the pharmacy department or your office, whichever is more convenient. You will be asked to provide your views and opinions relating to the newly implemented electronic prescribing and medicine administration system. The interview will be audio recorded with your permission. The recording will be transcribed into a qualitative data software system to aid analysis. You will be provided with a transcript of the audio recording if requested and allowed to make any required amendments to the transcript.

Any information provided during the interview will be anonymous and confidential. Your name will not appear on the transcript or any report of the research. This information may be used anonymously in any publication or presentation of the study results.

What do I have to do?

If you decide to take part in the study, you will be asked to sign an informed consent form and to take part in the interview as described above.

What are the possible benefits of taking part?

There are no direct benefits to you by taking part in the study. There may be benefits to the organisation in evaluating any benefits of the newly implemented HEPMA system.

What if there is a problem?

Any complaint about the way you have been dealt with during the study will be addressed. If you have any complaints or would like further information about the study please contact:

Pamela Mills

Principal Pharmacist – Redesign

Pharmacy Department

University Hospital Crosshouse

Kilmarnock

KA2 0BE

Telephone: 01563 826066

If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from University Hospital Crosshouse or University Hospital Ayr.

Will my taking part in the study be kept confidential?

Yes. All the information about your participation in this study will be kept confidential. Any data relating to your participation will be stored securely at all times and can only be accessed by the researcher.

You will be given a copy of the information sheet and a signed consent form to keep.

Thank you for taking time to read the information sheet and for considering taking part in this study.

APPENDIX 4.2 CONSENT FORM

Does hospital electronic prescribing impact on discharge communication- staff views and experiences of the newly implemented HEPMA system?

Researcher

Pamela Mills

Principal Pharmacist- Redesign

Pharmacy Department

University Hospital of Crosshouse

Ext: 26066 Bleep: 3178 E-mail: pamela.mills@aaaht.scot.nhs.uk

Participant Study Number.....

Please INITIAL box

I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.	☐
I agree to take part in the above study.	☐
I agree to the interview being audio recorded.	☐
I agree to the use of anonymised quotes in publications.	☐

_____	_____	_____
Name of Participant Signature		Date
_____	_____	_____
Name of Interviewer Signature		Date

APPENDIX 4.3 SEMI-STRUCTURED INTERVIEW SCHEDULE

Participant Number	Date / /	Start time :

A. Introduction

Hello, thanks for agreeing to be interviewed for this project. Please, can I check you have read the participant information sheet.

If not, here is a copy to read before we begin.

The main purpose of this interview is to find out your views and experiences about the electronic prescribing and discharge communication system. The focus is specifically on the systems and how people interact with the systems.

The organisation recently implemented a Hospital Electronic Prescribing and Medicines Administration (HEPMA) system in this hospital. Whilst the intervention was electronic, it is people that will use the system so I am interested in your experience and opinions.

The interview will be divided into 5 different sections and this will cover some background information, 1) inpatient prescribing looking at the electronic system, 2) discharge prescribing looking at the electronic version, 3) the discharge process 4) incident reports and significant adverse event reviews and 5) opinion about HEPMA implementation

Your participation is voluntary and you may withdraw at any point.

If you do not want to answer a specific question, then please let me know.

There are no right or wrong answers and I am interested in your personal opinion.

The identities of all participants will remain strictly confidential and it will not be possible to identify individuals from the study results.

The interview should take approximately 20 to 30 minutes, are you ok to go ahead?

IF NO: That's okay. When would be more convenient? Thanks I'll see you on day/date/time at .....location. Bye.	Write the new day/date/time here and in diary chart:

IF YES continue: That's great, thank you.

B. Housekeeping

As you are aware from the information sheet and consent form, this conversation is being audio recorded but I would emphasise that it is confidential.

Please do not use names of patients or hospital staff during this interview. It is ok to refer to "a patient", "another doctor", " a nurse", "a GP" etc

Are you still OK with that?

IF NO: That's fine. I'll need a bit more time to write down notes as we go through the sections and I may ask you to repeat some answers so I don't miss anything.	Reminders Take time to write detailed notes If in doubt, ask the interviewee for clarification before you move on to the next section

If you decide after the interview you no longer wish to be a part of the evaluation, please let me know. The contact details are on the information sheet.

Do you have any questions before we begin?

Technical problem? Keep calm! Explain, apologise and rearrange interview day/date/time

C. Background Information

"I would like to ask you some background information"

What is your professional group: Consultant Medical/Junior Medical/Advanced Nurse Practitioner/ Pharmacist

Sex: Male/Female

How would you describe your ethnic origin: White/ Mixed Race/ Asian/ African, Caribbean, Black/Arab/Other

How many years have you worked in this hospital?……years

How many other organisations have you worked in the last 10 years? ……

Have you used electronic systems for prescribing and discharge in previous organisations? Y/N

If Yes, please prescribe a description of what this involved e.g. full HEPMA system, stand alone electronic discharge letter……..

If No, go to Section D

D. Inpatient prescribing

1. I would like to ask you about the electronic inpatient prescription chart- what works well, what doesn't work well, any experience Allow free comment and then ask if not covered:	
Comments about prescribing/transcribing daily medicines? – What about medicines that are of unusual frequencies e.g. Parkinson's medicines, alternate day, or once weekly? Comments about recording/knowing if a patient was admitted on a medicine? Comments about recording allergy information? Comments about documenting withheld medicines? Comments about documenting continuing medicines on discharge? Comments about viewing the inpatient chart? Comments about knowing if a medicine has been administered? Comments about documenting/knowing if a patient uses a compliance device/MAR chart? How have your experiences of……impacted on your views? What about contribution to patient care and risk? Anything you would like to add about why you have made	Note answers here for backup and reference

E. Discharge prescribing I would like to ask you about the electronic discharge letter -what works well, what doesn't work well, any experiences you would like to share, any thoughts? Allow free comment and then ask if not covered:

Do you have any comments about recording/knowing diagnosis on DL? What about clinical progress, follow up information? Do you have any comments about prescribing daily medicines? What about medicines that are of unusual frequencies e.g. Parkinson's medicines or alternate days/ once weekly Do you have any comments about recording/knowing if a patient was admitted on a medicine? What about recording/knowing allergy information, documenting/knowing medicine stopped during hospital admission, documenting/knowing if a medicine is to be continued by GP on discharge, documenting/knowing an indication for newly started medicine? Comments about the number of pages per patient? Comments about documenting/knowing that a patient needs a compliance device/MAR chart on discharge? Comments about consultant IDL reviewed and sign off	Note answers here for backup and reference

3. I would like to ask you about the electronic discharge letter process- what works well, what doesn't work well, any experiences you would like to share, any thoughts? Please use your experience of patient care as illustrative examples	
Allow free comment and then ask if not covered: Has HEPMA implementation altered this process? If Yes, please explain Comments about the completion of this process? What do you think facilitates this process? What barriers do you think impede this process? Comments about the time taken to complete this process? What are the main problems, if any you experience with this process Have you had any queries from GPs regarding the content of the electronic discharge letters? If Yes, what and why Do you have any comments about the ability to resolve these queries How have your experiences of……impacted on your views?	Note answers here for backup and reference

F. Incident Reports and Significant Adverse Event Reviews

4. I would like to ask you about Datix reporting/ reviewing or SAER in relation to newly implemented HEPMA system?	
Allow free comment and if No go to Section 5 or then ask if not covered: Have you recorded any Datix incidents regarding the HEPMA system? If Yes, what was the problem, did it result in harm, what would prevent this happening again? Have you responded to any Datix incidents regarding the HEPMA system? If Yes, what was the problem, did it result in harm, what would prevent this happening again? Have you been involved in any Significant Adverse Event Reviews (SAER) after HEPMA implementation? If Yes, what was the problem, did it result in harm, what would prevent this happening again?	Note answers here for backup and reference

G. Hospital Electronic Prescribing and Medicines Administration (HEPMA) Implementation

5. I would like to ask about your personal thoughts and opinions about HEPMA implementation	
Allow free comment and then ask if not covered: What, if any, impact has this had on your present role? Why do you think this? What, if any, impact has this had on your profession? Why do you think this? What, if any impact has this had on incidents and adverse events? Why do you think this? What, if any, impact has this had on patient safety? Why do you think this? What, if any, impact has this had on the hospital service? Why do you think this?	Note answers here for backup and reference

H. Other

6. Is there anything else you would like to add? Note answers here for backup and reference	
Well that's all of my questions. You've been very helpful and I appreciate you taking the time to speak to me. If you think of anything else you would like to add, please get in touch. If you would like to see a copy of the transcript from the interview, please let me know and I will arrange for this to be supplied to you. Thank you very much.	Transcript Y/N Interview concluded at: :

APPENDIX 4.4 NHS ETHICS (PHASES 2&3)

NHS
Ayrshire
& Arran

Research & Development
58 Lister Street
Crosshouse Hospital
Kilmarnock
KA2 0BB

Pamela Mills
Principal Pharmacist - Redesign
Pharmacy Department
Crosshouse Hospital
Kilmarnock
KA2 0BE

Date	6 August 2013
Your Ref	
Our Ref	KLB/NM
Enquiries to	Karen Bell
Extension	25850
Direct line	01563 825850
Fax	01563 825806
Email	Karen.bell@aaaht.scot.nhs.uk

Dear Ms Mills

Hospital Electronic Prescribing and Medicine Administration System Implementation: A Mixed Methods Study Assessing Impact on Discharge Communication (Phases 2 and 3)

I have reviewed your proposal and have determined that it is not appropriate to classify it as Research according the guidance issued by the NHS National Research Ethics Service (NRES).

The NRES guidance is outlined in a summary leaflet which can be accessed via their website at: http://www.nres.nhs.uk/search/?q=service+evaluation.

The leaflet contains a helpful summary table, a portion of which I have reproduced at the end of this letter for your reference.

As the project is not research, it does not require to be reviewed by an NHS Ethics Committee, and does not require formal R&D Management Approval to be undertaken within NHS Ayrshire & Arran.

I would, however, like to highlight a number of issues that you should consider when carrying out your project:

- **You must apply for Caldicott Guardian approval. Once you have received this approval you will then be able to access patient case notes.**

- As your project has not been defined as Research, it will not be managed as such, nor will it be subject to regular review or monitoring by the R&D Department. Furthermore, you should avoid referring to it as research in any paper or presentation.

- You will be required to submit a progress report midway through the project and a final report at the end of the project.

- You should ensure that you have agreement of appropriate senior staff to carry out your project in their area (e.g. Senior Nurse, Service Manager etc., as applicable).

- You should be aware of any potential ethical issues, discuss these with colleagues and advisors, if necessary, and ensure patient safety as your first priority.

- You should comply with all relevant Health and Safety and Data Protection legislation and guidance, and avoid using patient identifiable information unless it is essential – seek guidance from the Information Governance department if required (informationgovernance@aapct.scot.nhs.uk).

- You should ensure that all confidential information is maintained in secure storage.

- You should maintain a well organised project file at all times, including copies of any agreements, protocols questionnaires etc.

- You should seek to publish the results of your work as widely as possible.

- If you make changes to the protocol in the future, please resubmit the paperwork to Research and Development for review, as this might change the status of the project.

Good luck with your project and if you require any assistance in the future please don't hesitate to contact us.

Yours sincerely

Karen L Bell

Dr Karen L Bell
Head of Research & Development

c.c. Wallis Riddell, Information Governance, NHS Ayrshire and Arran

APPENDIX 4.5 RGU ETHICS REVIEW PANEL (PHASES 2&3)

ROBERT GORDON UNIVERSITY ABERDEEN

School of Pharmacy and Life Sciences Research Ethics Committee

COMPLETED **19 September 2013**

Hospital Electronic Prescribing and Medicine Administration System Implementation: A Mixed Methods Study Assessing Impact on Discharge Communication.

Dear Pamela
We have reviewed your ethics application (Title above) and it has been approved with no changes. The panel recommends that it is of sufficient standard for you to proceed.

If there are any questions please do not hesitate to get in touch.

Regards

Dr Lesley Diack
Chair of the School Ethics Review Panel

APPENDIX 4.6 CALDICOTT GUARDIAN APPROVAL

Mills, Pamela

From: White, Craig Prof.
Sent: 10 September 2013 11:08
To: Mills, Pamela
Cc: Caldwell, Michele; Graham, Alison (Medical Director); MacDonald, Kate
Subject: Hospital Electronic Prescribing and Medicine Administration System Implementation: A Mixed Methods Study Assessing Impact on Discharge Communication.

Dear Pamela

I am pleased to confirm that I have now reviewed this, considered advice from Information Governance and R&D Team colleagues, and can confirm that this evaluation proposal has Caldicott approval.

Best wishes for this important work,

Craig

PROFESSOR CRAIG A. WHITE
Assistant Director (Healthcare Governance and Assurance) & Caldicott Guardian
NHS Ayrshire and Arran
Eglinton House, Ailsa Hospital, Dalmellington Road, Ayr, KA6 6AB.

Tel: 01292 513607
Email: craig.white@aapct.scot.nhs.uk
PA: Mrs Kate MacDonald

1

APPENDIX 5.1 QUANTITATIVE DATA COLLECTION TOOL

Data	Explanation	Exclusion Criteria	Data Collection Reason
Name of Hospital	Hospital discharged from	Not Crosshouse	Ensure only study hospital
Patient Name	Name as documented on case notes	Nil	Required to contact GP for information
Patient CHI number	Unique identifier	Outside Scotland	Required to contact GP for information
Patient's age	Age at discharge	Nil	Demographic comparison
Patient's sex	Male or Female	Nil	Demographic comparison
General Practitioner (GP) ID	What is documented	n/a if patient has no GP	Required to contact GP for information
Consultant ID	What is documented	Nil	To determine discharge speciality/ demographic comparison
Ward/ Department	What is documented	Nil	Demographic comparison
Discharge specialty	Specialty of consultant at discharge	Nil	Demographic comparison
Date and time of admission	Data from patient management system	Nil	To enable calculation of length of stay
Date and time of discharge	Data from patient management system	Nil	To enable calculation of stay length and time to receipt
Patient – length of stay	Days as inpatient	Nil	Longer stay more potential for errors and discrepancies
Discharge day of week	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday	Nil	Do errors rates differ depending on discharge day
Primary Diagnosis	What is documented	Accuracy not assessed	Completeness of information
Secondary Diagnosis	What is documented	Accuracy not assessed	Completeness of information
Significant operations/procedures	What is documented	Accuracy not assessed	Completeness of information
Allergies	What is documented on IDL versus what is documented on inpatient prescription	Nil- if nothing documented this should be recorded	To assess completeness and accuracy of information communicated
Number of admission medicines	Number recorded on medicine reconciliation, GP referral letter or clerk-in. Also check pharmacist care plan for discrepancies	More than one dose e.g. warfarin	The greater the number of medicines the greater potential for errors
Number of medicines on discharge	Number recorded on discharge letter	More than one dose e.g. warfarin	The greater the number of medicines the greater potential for error
Number of medication changes during stay	Number changed from admission to discharge	Nil	The greater the number of medication changes the greater potential for error
Stopped medicines	Number of admission medicines stopped during stay	Temporary discontinuations	The greater the number of medication changes the greater potential for error
New medicines	Number of new medicines discharged home	Temporary administrations	The greater the number of medication changes the greater potential for error
Continuing medicine	Number of medicines unchanged from admission to discharge	Dose changes	The greater the number of medicines the greater potential for error
Signature, name and position	What has been documented	Nil	Required legal information for prescribing and to enable person completing document to be contacted
Grade of staff	NIP, FY1, FY2 etc	Nil	Is there a difference in error rate between different staff groups

Data	Explanation	Exclusion Criteria	Data Collection Reason
Extended discharge to follow	What has been documented	Nil	The more communication the greater potential for discrepancies and delay in information receipt Has HEPMA implementation changed practice to first and final discharge letter
Method discharge communication	Post or e-mail	Nil	Is there a difference in receipt or receipt time by different communication methods Has HEPMA implementation changed practice of discharge communication method
Receipt ?	Did GP surgery receive- Yes/no/n/a	n/a if patient has no GP	Is there a difference in receipt or receipt time by different communication methods
Date and time of receipt at GP	Date and time as recorded on GP system	n/a if patient has no GP	Is there a difference in receipt or receipt time by different communication methods
Number of additional discharge communication(s) to GP	Typed final letters, additional results etc	Telephone or verbal communication	The more communication the greater potential for discrepancies and delay in receipt of information Has HEPMA implementation changed practice to first and final discharge communication
Error – omission (from inpatient to discharge prescription)	Number of medicines omitted	Nil	To quantify different types of prescribing errors
Error- commission (from inpatient to discharge prescription)	Number of medicines unintentionally started	Nil	To quantify different types of prescribing errors
Error-incorrect dose (from inpatient to discharge prescription)	Number of medicines with wrong dose	Nil	To quantify different types of prescribing errors
Error- incorrect frequency (from inpatient to discharge prescription)	Number of medicines with incorrect frequency	Nil	To quantify different types of prescribing errors
Error-incorrect duration	Number of medicines with incorrect duration	Nil	To quantify different types of prescribing errors
Error- drug interaction	Number of detected drug interactions	Nil	To quantify different types of prescribing errors
Error-therapeutic duplication	Number of detected therapeutic duplications	Nil	To quantify different types of prescribing errors
Error-omitted allergy (from inpatient to discharge prescription)	Number of omitted allergies	Nil	To quantify different types of prescribing errors
Error- incorrect allergy (from inpatient to discharge prescription)	Number of allergy discrepancies	Nil	To quantify different types of prescribing errors

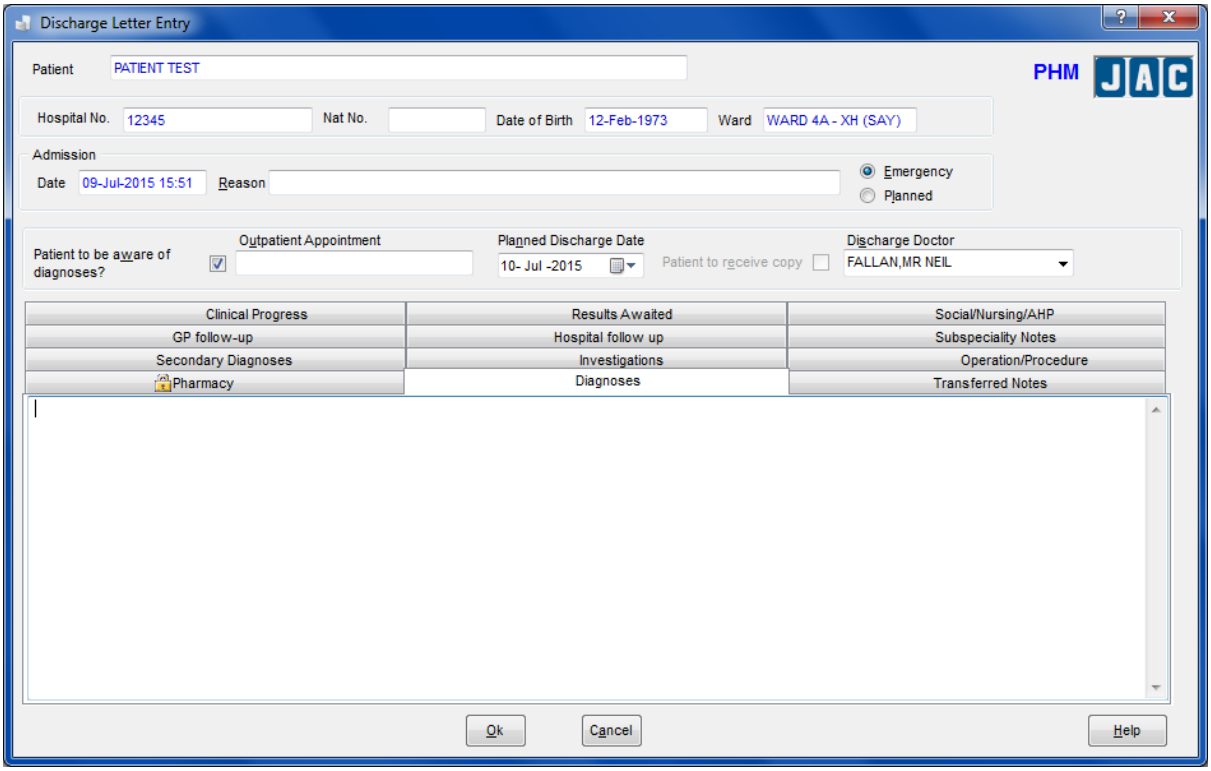
APPENDIX 5.2 GP RECEIPT INFORMATION DATA COLLECTION TOOL

Patient CHI	Patient Initials	Discharge Date	GP Name	GP Surgery	Date of Receipt

APPENDIX 5.3 ERROR SEVERITY DATA COLLECTION TOOL

Error Description	Error type	Severity Score

APPENDIX 5.4 HEADING TABS IN HEPMA IDL



APPENDIX 5.5 CALDICOTT GUARDIAN APPROVAL

Mills, Pamela

From: White, Craig Prof.
Sent: 10 September 2013 11:08
To: Mills, Pamela
Cc: Caldwell, Michele; Graham, Alison (Medical Director); MacDonald, Kate
Subject: Hospital Electronic Prescribing and Medicine Administration System Implementation: A Mixed Methods Study Assessing Impact on Discharge Communication.

Dear Pamela

I am pleased to confirm that I have now reviewed this, considered advice from Information Governance and R&D Team colleagues, and can confirm that this evaluation proposal has Caldicott approval.

Best wishes for this important work,

Craig

PROFESSOR CRAIG A. WHITE
Assistant Director (Healthcare Governance and Assurance) & Caldicott Guardian
NHS Ayrshire and Arran
Eglinton House, Ailsa Hospital, Dalmellington Road, Ayr, KA6 6AB.

Tel: 01292 513607
Email: craig.white@aapct.scot.nhs.uk
PA: Mrs Kate MacDonald