Understanding how HEPMA data can be utilised to improve medicines optimisation and support quality improvement in mental health services.

Nikki Gilluley

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Strathclyde Institute of Pharmacy and Biomedical Sciences
The University of Strathclyde,
Glasgow

Declaration of Authenticity and Author's Rights

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

Signed: Nikki Gilluley

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Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
AF	Aimee Ferguson
CDS	Clinical Decision Support
CMM	Careflow Medicines Management
DOI	Digital Object Identifier
DOJA	Directory of Open Access Journals
EMA	European Medicines Agency
ERD	Education, Research and Development
GDPR	General Data Protection Regulation
GF	Gareth Fullarton
HA	Hanan Abunimeh
HEPMA	Hospital Electronic Prescribing and Medicines Administration
HIS	Healthcare Improvement Scotland
MDT	Multi-disciplinary Team
NHS	National Health Service
PDSA	Plan-Do-Study-Act
PGD	Patient Group Direction
PhEW	Pharmacy Early Warning
PHS	Public Health Scotland
PICO	Population, Intervention, Comparison and Outcome
PIS	Participant Information Sheet
POMH-UK	Prescribing Observatory for Mental Health – United Kingdom
PRN	Pro re nata
PSC	Pharmacy Stock Control
QIT	Quality Improvement Team
R&D	Research and Development
RA	Rahaf Alkhlaifat
REH	Royal Edinburgh Hospital
RHCYP	Royal Hospital for Children and Young People
RIE	Royal Infirmary of Edinburgh
RPS	Royal Pharmaceutical Society
SIPBS	Strathclyde Institute of Pharmacy and Biomedical Sciences
SJH	St. John's Hospital
SPSP	Scottish Patient Safety Programme
SUD	Secondary Use of Data
UK	United Kingdom
ULM	Unlicensed Medicine
USA	United States of America
USD	United States Dollar
WGH	Western General Hospital
WHO	World Health Organization

Thesis Abstract

Introduction: There is potential to improve patient care through utilisation of data from Hospital Electronic Prescribing and Medicines Administration (HEPMA) systems. Effective utilisation of the data requires an understanding of users' needs. A systematic review concluded that medication errors occur frequently in mental health hospitals posing a risk to patient safety. Mental health was therefore identified as an area which could benefit from optimising the use of HEPMA data.

Methods: A scoping literature review was conducted to identify how prescribing and administration data have been utilised within mental health services. The search was conducted in MEDLINE, Embase, CINHAL and the Cochrane Library and included studies between 2012 and 2022. A topic guide was developed from the findings and used to conduct two multi-disciplinary focus groups to seek mental health specialists' views on how HEPMA data can be utilised to support quality improvement and medicines optimisation. Focus groups were audio-recorded, transcribed intelligent verbatim and thematically analysed.

Results: Twenty-two studies included in the scoping review provided a summary of how prescription data has been used across all sectors of mental health services. The overall uses of the data were broken down into two categories: data as a direct intervention and data to assess the success of a separate intervention. The review identified areas generally not reported on when utilising data including user requirements around data presentation and frequency.

The focus groups included a total of nine participants: 4 pharmacists, 3 doctors and 2 nurses. Seven themes were identified: experience of HEPMA data, barriers, proposed uses of HEPMA data, delivery of HEPMA data, governance, promotion and clinical user involvement in development. Proposed uses of HEPMA data included high-risk medicines, high dose antipsychotics and "when required" prescriptions.

Conclusions: High risk medicines, in particular clozapine, were identified as the highest priority area for utilising HEPMA data in mental health services. The ability to link HEPMA data with other data sets was identified as a key element to gain the most benefit from the data. Additional factors were outlined which will impact on how effectively the data can be utilised and should be taken into consideration by organisations utilising HEPMA data.

Researcher's Reflexivity

Whilst a part-time MPhil student, the researcher also worked full time as the Advanced Pharmacist HEPMA in NHS Lothian. Therefore, some of the knowledge relating to NHS Scotland and NHS Lothian HEPMA information and implementation was from the researcher's own knowledge and experience within their role in NHS Lothian.

As the researcher specialises in managing a HEPMA system, reflection was undertaken on the potential biases this could introduce. Biases could have been introduced where qualitative methodology was utilised in this thesis as it was in the researcher's interest to realise the benefits of HEPMA to improve patient care. The researcher tried to limit bias where possible by basing the content of the focus group topic guide on the literature and including independent thematic analysis by a researcher not working with HEPMA or within NHS Lothian. The themes identified included negative views on HEPMA which provides reassurance that the researcher was able to limit introducing bias based on their job role as much as possible to allow a balanced view to be sought. In addition, working relationships could have influenced participants responses however mental health is a clinical area where the researcher has never worked so although they were known to some participants, they did not have a close working relationship.

Chapter 1: Introduction

1.1 Global Medication Prescribing and Administration Challenges

The European Medicines Agency (EMA) defines a medication error as "an unintended failure in the drug treatment process that leads to, or has the potential to lead to, harm to the patient" (European Medicines Agency, 2023). The EMA outline that medication errors during prescribing, dispensing, storing, preparation and administration of a medicine are the most common preventable causes of undesired adverse events in medication practice and present a major burden to public health (European Medicines Agency, 2023).

Unintended harm resulting from medication errors remains a prevalent concern in healthcare around the world resulting in morbidity and mortality (Coleman, 2019). A systematic review concluded that globally medication errors at the point of prescribing are a common occurrence and identified the median error rate was 7% of prescriptions (Lewis, et al., 2009). From the studies included the four medication classes most associated with medication errors were identified as antimicrobials, drugs affecting the cardiovascular system, drugs affecting the central nervous system and gastrointestinal medications (Lewis, et al., 2009). Globally, the cost associated with medication errors is estimated to be $42 billion USD annually (World Health Organization, 2017). The third Patient Safety Challenge from the World Health Organization (WHO) identified this as an area for improvement and set out an aim to reduce severe avoidable medication related harm by 50% globally over 5 years (World Health Organization, 2017).

Despite global efforts to prevent medication errors, they still occur and result in patient harm (Mulac, et al., 2021). A study in Norwegian hospitals found that the majority of medication errors occurred during administration (68%) and prescribing (24%) (Mulac, et al., 2021). Mulac et al. also determined that the leading types of

medication errors were dosing errors (38%), omissions (32%) and the wrong drug (15%). Of the medication errors seen 62% were harmful and of these 5.2% resulted in severe harm with 0.8% being fatal (Mulac, et al., 2021).

Medication errors are a concern within mental health services. A systematic review concluded that medication errors occur frequently in mental health hospitals posing a risk to patient safety (Alshehri, et al., 2017). Three studies included in the review, determined that prescribing error rates ranged between 4.5-6.3% and across the eight studies assessing medication administration errors the most common administration errors were wrong administration time and drug omissions (Alshehri, et al., 2017). The prescribing error rate was comparable to another study conducted in mental health which showed a prescribing error rate of 6.3% (Keers, et al., 2014). A further study showed that the psychotropic categories most frequently involved in prescribing errors were antipsychotics, hypnotics and anxiolytics. This study stated that electronic prescribing would be a more effective way to prevent several of the errors they identified. This included the benefit of built in decision support and improvement of incomplete or illegible prescription related errors (Haw & Stubbs, 2003).

1.2 Hospital Electronic Prescribing and Medicines Administration (HEPMA)

Globally, there is substantial investment and interest in moving health care systems from paper-based to digital processes with the aim of improving patient safety and quality and efficiency of health care (Williams, et al., 2020). Hospital Electronic Prescribing and Medicines Administration (HEPMA) systems have the potential to restrict and prevent inappropriate prescription choices, alert prescribers to situations in which patients are at increased risk and facilitate cost-effective and evidence-based prescribing (Williams, et al., 2020).

There are many benefits, anticipated or already proven, from implementing HEPMA systems. The benefits will vary depending on the system in use, how sophisticated the system is and how well it has been implemented (Klein, et al., 2025). HEPMA systems can ensure 100% completeness of prescriptions (i.e. all necessary information is present) which one study showed the comparison for paper prescriptions was 47% completeness (Evans, et al., 1998) (Mitchell, et al., 2004). HEPMA systems also ensure legible prescriptions with a clear audit trail which has no variability unlike the variability seen with handwriting on paper prescriptions (Niazkhani, et al., 2009).

It has been demonstrated that medication errors, related to prescribing and administration, can be reduced with HEPMA systems with one United Kingdom (UK) study in intensive care demonstrating an error rate of 6.7% with paper prescriptions compared with a lower error rate of 4.8% with an electronic prescribing system (Shulman, et al., 2005). The study showed that there was a statistically significant ($p<0.001$) reduction in errors over time after the introduction of an electronic prescribing system (Shulman, et al., 2005). Another study in a general surgical ward in a UK hospital also showed statistically significant reductions in both prescribing (3.8% reduced to 2%) and administration errors (7% reduced to 4.3%) when a HEPMA system was introduced as part of a closed-loop electronic prescribing, dispensing and barcode patient identification system (Franklin, et al., 2007). In addition to a reduction in medication errors, a systematic review concluded that HEPMA systems reduce preventable adverse drug events by over 50% (Nuckols, et al., 2014). Following on from this work, the UK's largest study across a range of clinical settings was conducted to examine how changes implemented to optimise electronic prescribing systems affected error rates and error types. This study showed a reduction in the rates of some error types including dose and inappropriate-drug choice errors as well as a significant decrease in potential adverse drug events which the study attributed to system optimisation changes such as clinical decision support (Slight, et al., 2019).

As well as demonstrating a reduction in medication errors after implementation of a HEPMA system, a reduction in pharmacist clinical interventions has also been shown (Donyai, et al., 2007). Another review showed that ward clerk, nurse and pharmacist time relating to medication processes was reduced after HEPMA system implementation (Niazkhani, et al., 2009). This review also outlined clinicians had increased time to consult with patients after implementation of a HEPMA system (Niazkhani, et al., 2009).

Functionality within HEPMA systems allows permissions to be controlled at an individual level which can improve governance around aspects such as role specific prescribing of Patient Group Directions (PGDs). Furthermore, HEPMA systems have functionality to flag when medicines are out with the local formulary choice and have built in decision support in relation to allergies and interactions. It has been demonstrated that HEPMA systems can also improve adherence to guidelines (Eslami, et al., 2008). The ability to access information sources and decision support is reported in the literature as positive functionality of HEPMA systems as well as the display of information (Niazkhani, et al., 2009).

When patients move between different sectors of care it has been shown that there is an 18-60% discrepancy in their medication on admission to hospital and an 11% discrepancy when discharged from hospital (Healthcare Improvement Scotland (HIS), 2014). Medication safety at transitions of care has been identified as a key area to help achieve the WHO medication without harm challenge (HIS, 2021). Cottrell et al. demonstrated that communication is improved between primary and secondary care after implementation of a HEPMA system resulting in improved patient safety and efficiency (Cottrell & Carleton, 2019).

In 2022, the Royal Pharmaceutical Society (RPS) in the UK published Pharmacy 2030: a professional vision. This outlined the future of pharmacy and what the

underpinning factors are to achieve the vision. The RPS advised that the change to pharmacy will be driven by harnessing digital and technological innovation and using data to deliver high quality services (Royal Pharmaceutical Society, 2022). One of the RPS expectations is that by 2030 there will be full electronic prescribing and transfer of prescriptions across all care settings, negating the need for paper prescriptions. RPS also expect that clinical data can be used to target and support decisions. This vision highlights the importance of HEPMA systems to drive pharmacy forward as a profession to enable the provision of improved quality of care to patients.

Although there are many benefits of HEPMA systems, there are also potential unintended consequences when these systems are introduced. For example, new medication errors can occur as a result of prescribers selecting from a drop-down list (Ahmed, et al., 2016). Another well documented issue with HEPMA systems is alert fatigue which can result in overriding of important safety alerts (Ahmed, et al., 2016). The unintended consequences have been categorised into nine types (in order of decreasing frequency): increased or new work for clinicians; unfavourable workflow; “never ending system demands”; issues related to paper persistence (e.g. additional paper monitoring or prescription charts); untoward changes in communication patterns and practices; negative emotions; generation of new errors; unexpected changes in the power structure; and overdependence on the technology (Campbell, et al., 2006). Campbell et al. concluded that the introduction of clinical decision support features caused many of the unintended consequences (Campbell, et al., 2006). HEPMA system adoption results in significant changes to practice and therefore realisation of the benefits is dependent on successful implementation and utilisation (Ahmed, et al., 2016).

1.3 NHS Scotland

1.3.1 Background and Medication Safety Challenges

The National Health Service (NHS) is a publicly funded service which provides healthcare to residents of the UK through taxation. The NHS has separate systems for each of the four nations of the UK. NHS Scotland, with a population of approximately 5.48 million people, has one of the most highly developed health informatics systems in the world (National Records of Scotland, 2022) (NHS Research Scotland, 2023).

Within NHS Scotland, medication errors at the point of prescribing and administration are reflective of the challenges seen globally. The constant increasing range of medicines available on the market, including high risk medicines or those with complex treatment regimens, mean safe and effective prescribing and administration of medicines is a constant challenge faced by healthcare professionals (Healthcare Improvement Scotland (HIS), 2014). High dose antipsychotics and high-risk medicines such as clozapine and lithium are examples of pharmacological treatments used in mental health services which pose medication safety challenges when prescribing for this patient population (Khawagi, et al., 2019).

In 2014, the prospective observational PROTECT study which analysed 50,000 paper prescriptions across eight hospitals in NHS Scotland found an overall error rate of 7.5% (Ryan, et al., 2014). The study found that the highest rates of error were in teaching hospitals, surgical wards, and wards with a high patient turnover. The highest number of errors were seen at the point of admission to hospital and the most common type of error identified was medication omitted. Other error types included: incomplete prescription, omission of signature, illegible, duplication of therapy, incorrect formulation and patient allergy. These errors are areas in which

electronic prescribing can demonstrate a benefit over paper-based prescriptions. The Scottish Patient Safety Programme (SPSP) recognised that HEPMA systems are key to reducing the harm associated with high-risk medicines (HIS, 2021).

1.3.2 HEPMA Implementation

In the Scottish eHealth Strategy 2014-2017 the Scottish Government outlined the key aims and associated requirements to improve healthcare in Scotland (Scottish Government, 2015). One of the aims outlined was "to improve the safety of people taking medicines and their effective use". The strategy recommended that HEPMA systems are a key requirement to achieving this aim and that significant progress should be made in Scotland to adopt a HEPMA system to allow prescribing and administration of medicines to be available within the electronic patient record. It was recommended that by achieving this progress there would be a reduction of risks and increased benefits to quality of care for patients. These benefits are expected to be derived from the ability to use system intelligence for prescribing decisions and monitoring of administrations. This strategy signalled that nationally HEPMA is seen as a crucial tool to driving forward quality improvement in patient care.

Digital innovation is further supported and reinforced in the updated Digital Health and Care Strategy as well as the most recent 2024-25 delivery plan (Scottish Government, 2021) (Scottish Government, 2024). Priorities within the strategy include making better use of the data available and involving staff in the design of tools, technologies and services that support them, noting that that those that have been co-designed with users are more likely to deliver meaningful and lasting change that improves outcomes.

As of July 2025, based on the researcher's own knowledge, 12 of the 14 regional health boards in NHS Scotland have begun or completed implementation of a

HEPMA system: Ayrshire and Arran, Dumfries and Galloway, Greater Glasgow and Clyde, Forth Valley, Lanarkshire, Lothian, Tayside, Grampian, Highland, Shetland, Eileanan Siar (Western Isles) and Orkney. All 12 of these health boards have chosen Careflow Medicines Management (CMM) as the supplier of their HEPMA system. NHS Fife and NHS Borders, which cover a combined population size of 485,510 people, have not begun their implementation at this point (NHS Scotland, 2025) (NHS Borders, 2021). Therefore, the health boards where HEPMA has been implemented covers over 90% of the population of Scotland.

1.3.3 NHS Lothian

NHS Lothian is Scotland's second largest health board, serving a population of around 850,000 people across Edinburgh and the surrounding areas (NHS Lothian, 2025). Based on the researcher's specialist knowledge, NHS Lothian began implementation of the CMM HEPMA system in July 2020 in a pilot area at the Royal Edinburgh Hospital (REH). The REH is a specialist mental health hospital, and the complexity of beds ranges from acute receiving and intensive care beds to rehabilitation and long stay beds including forensic high security and long stay learning disabilities units. The REH therefore provides care for a range of mental health conditions with varying degrees of acuity.

After the success of the pilot area the implementation continued until March 2023 when all areas outlined in the business case were implemented. The areas with HEPMA currently implemented covers a total of nine hospital sites with an approximate total of 2,700 beds across 134 wards. The implemented areas are outlined in more detail in Table 1.

Table 1: NHS Lothian HEPMA Implementation Overview

Hospital	Approx. Number of Inpatient Beds on HEPMA	Implementation Commenced	Number of Wards Implemented	Implementation Duration (weeks)
Royal Edinburgh Hospital (REH)	330	July 2020	22	7
Western General Hospital (WGH)	598	February 2021	33 wards & inpatient theatres	13
St. John's Hospital (SJH)	383	September 2021	19 wards & inpatient theatres	7
Royal Infirmary of Edinburgh (RIE)	854	May 2022	32 wards & theatres	11
Women's Services (SJH and RIE)	142	November 2022	8 wards & theatres	2
Royal Hospital for Children and Young People (RHCYP) & SJH Children's Services	183	January 2023	7 wards & inpatient theatres	3
East Lothian Community Hospital	112	February 2023	5 wards	2
Princess Alexandra Eye Pavilion	14	March 2023	1 ward & inpatient theatres	1
Liberton Hospital	48	March 2023	3 wards	1
Astley Ainslie Hospital	42	March 2023	4 wards	1

Based on researcher's own experience of delivering HEPMA implementation in NHS Lothian

There are a wide range of specialities across the implemented sites including: mental health; acute medicine; general medicine; respiratory; gastroenterology; rheumatology; medicine of the elderly; cardiology; transplant; renal medicine; orthopaedics; ear, nose and throat (ENT); cancer; neurology; regional trauma centre and infectious diseases. NHS Lothian, therefore, has a large and varied data set available within HEPMA.

Access to the HEPMA data locally showed that between July 2020 and May 2025 there were a total of 8,672,337 orders prescribed and 40,002,516 administered doses on HEPMA in NHS Lothian. During this time, the number of areas using the system has gradually increased. These numbers highlight that there is already a large volume of data available to use within the HEPMA system and the size of the

data set is continually increasing. As mental health services were the first to implement HEPMA in NHS Lothian, HEPMA use and knowledge was established and there was over three years of data available for that clinical area at the time of starting this research. Therefore, the longevity of data available and experience with HEPMA was greatest in this area.

The data available for prescriptions within HEPMA is comprehensive and Table 2 summarises some of the data available relating to prescribing and administration.

Table 2: Overview of Available Prescription Data in HEPMA

Prescribing Data
Drug name
Drug formulation
Prescribed dose
Prescribed frequency
Course duration
Planned treatment interruptions e.g. prescription suspension
Prescription discontinuation information e.g. data, time, reason, prescriber details
Prescriber details including name and job role
Date and time of prescription
Conflict warnings and resulting actions undertaken based on the decision support
Allergy warnings and resulting actions undertaken based on the decision support
Administration Data
Time of administration
Administrator details
Non-administration reasons
Doses unaccounted for

Based on researcher's own knowledge as the Advanced Pharmacist HEPMA in NHS Lothian

1.4 Uses of HEPMA Data

A systematic review, published in December 2021, aimed to determine the types of interventions in the hospital setting based on the secondary use of data (SUD) from HEPMA systems (Chaudhry, et al., 2021). The systematic review identified nine studies which explored interventions based on the use of HEPMA system data to improve the quality and safety of medication use. Of these nine studies, six were from the United Kingdom (UK) and three were from the United States of America

(USA). One of the studies focused on HEPMA data use for patients with schizophrenia (Finnerty, et al., 2002). This study looked at the feasibility of using healthcare databases to support guideline implementation through automated clinical reports. Finnerty, et al. showed databases can be utilised to develop clinical decision support tools which have high physician acceptability (Finnerty, et al., 2002). This demonstrated that electronic prescribing data has already been successfully used within mental health services to support clinical practice.

From the identified studies the systematic review summarised that there are four categories of SUD interventions in the literature: feedback; incorporation of additional features into an electronic prescribing system; production of guidelines; and education. Chaudhry et al. concluded that the data interventions were effective at improving medication safety by improving prescribing and reducing missed doses as well as demonstrated improvements in administration errors (Chaudhry, et al., 2021). The results of this review help demonstrate that effective use of HEPMA data can be a key benefit of introducing HEPMA systems.

Nationally across NHS Scotland HEPMA data is already being used to improve care. Public Health Scotland receive a regular feed, at least weekly although in most cases nightly, of HEPMA data from health boards in Scotland. This national HEPMA data resource supports a range of clinical studies including point prevalence studies (Mueller, et al., 2023). The initial focus of this national data resource was utilisation of the data to support planning and delivery of care during the COVID-19 pandemic. The data was used in a number of ways including: identifying vulnerable patients at risk of developing COVID-19; characterising patients who tested positive for COVID-19; medications used in the treatment of COVID-19 and the outcomes associated with these treatments; and to review changing patterns of medicines use through the pandemic (Tibble, et al., 2023) (Mueller, et al., 2022).

NHS Ayrshire and Arran who first started implementing HEPMA in 1997 have already shown many benefits from HEPMA data use. Examples of work developed include: prompts when Parkinson's medicines are due for administration (Cottrell & Bryden, 2020); controlled drug ordering and stock monitoring (Dewar & Cottrell, 2022); and the Pharmacy Early Warning (PhEW) tool (Cottrell , et al., 2014).

HEPMA systems offer many advantages over paper-based prescriptions when it comes to utilisation of data including: completeness and legibility of the data; near real-time data enabling faster surveillance and intervention; and scalability as datasets can be aggregated nationally on a routine basis. However, due to the legal requirements of prescriptions, paper-based prescription data and HEPMA prescription data should hold the same minimum prescription information. In addition, many of the ways paper prescription data has been used to improve patient care including audits, monitoring, policy review, and review of prescribing trends are also possible with HEPMA data. Therefore, learning from paper-based approaches could also be useful to identify further ways to utilise and realise the potential benefits of HEPMA data in the future.

1.5 Identified Need for this Research

This chapter has so far outlined the potential benefits of implementing HEPMA systems including the ability to utilise the data available within these systems to improve patient care. However, there are barriers and factors which influence the effective use of the data which present an area for improvement to allow the full potential of HEPMA data to be utilised to support medicines optimisation and quality improvement.

The literature outlines that the needs of different stakeholders in relation to the effective reuse of data to improve the safety, quality and efficiency of care are not

well known (Cresswell, et al., 2016). This study identified factors which will affect the ability to derive maximum benefits from HEPMA systems which included usability of systems to fit in with user workflows, intuitive user interfaces and motivating users around the usefulness of the system data for service and clinical improvement (Cresswell, et al., 2016). The systematic review conducted by Chaudhry et al. outlined that the knowledge and skills of users of data will influence the secondary use of data process (Chaudhry, et al., 2021). This review concluded that improvement is required in five areas (organisation, technology, users, policy, and process) to enable HEPMA data to be utilised effectively to improve medication safety and quality (Chaudhry, et al., 2021). Suggested areas for improvement across these five areas included: clear purpose for the data being used; better stakeholder engagement and managerial support; the need to promote HEPMA data awareness; increase transparency of HEPMA data; address questions around HEPMA data; users' knowledge of the available data; users' knowledge of data analysis and interpretation to ensure they have the right skills to use the data; and knowledge of the audience the data is being presented to (Chaudhry, et al., 2021). Although these suggested improvements were split across the five areas, many of the improvements were interlinked with users of the data. In addition, as previously mentioned priorities in the Digital Health and Care Strategy include making better use of the data available and involving staff in the design of tools, technologies and services that support them, noting that those that have been co-designed with users are more likely to deliver meaningful and lasting change that improves outcomes (Scottish Government, 2021). Finally, within NHS Lothian there is a strong quality improvement culture within mental health services and there was a desire and enthusiasm from clinical staff within mental health services to have greater involvement in harnessing the benefits of HEPMA data to improve patient safety.

Users of the data will therefore be the focus of this thesis to help enable effective utilisation of HEPMA data. In particular, this thesis will focus on engaging with users

and improving understanding of user requirements as these were two areas for improvement identified in the literature.

The decision was taken to focus initially on a single clinical area as this enables views across different professions within the multi-disciplinary team (MDT) to be explored. Mental health services were deemed a suitable area to undertake the initial research for several reasons.

In addition to the medication errors and high-risk medicines already described which pose challenges in mental health, increases in polypharmacy of psychotropic medicines (Mojtabai & Olfson, 2010) and unlicensed prescribing seen in mental health are also a medicines safety risk (Baldwin & Kosky, 2007). In addition to these medication safety challenges, within NHS Scotland there are also health inequalities relating to mental health with adults in the most deprived areas being approximately twice as likely to have a mental health disorder than those in the least deprived areas (Public Health Scotland, 2021). Improving mental health within the population of Scotland is a national priority (Public Health Scotland, 2021).

Furthermore, there are added pressures on mental health services. Mental health prevalence has increased substantially in recent years with the WHO highlighting that in the first year of the COVID-19 pandemic there was a 25% increase in the global prevalence of anxiety and depression (WHO, 2022). In addition, patient contact with secondary mental health services in England increased by 43% between 2019 and 2024 (Care Quality Commission, 2025). Approximately 1 in 4 people will experience a mental health disorder in their lifetime with 1 in 6 people having a mental health disorder at any one time (Public Health Scotland, 2021). Mental health can shorten life expectancy by up to 20 years and can have a substantial economic impact (Public Health Scotland, 2021). Finally, as described mental health services in NHS Lothian had the greatest longevity of HEPMA data availability and experience with HEPMA. Therefore, taking all these factors into

consideration, mental health was chosen as the focus of this improvement research.

Chapter 2: Thesis Aims and Objectives

2.1 Research Question

How can hospital electronic prescribing and medicines administration (HEPMA) data be utilised to improve medicines optimisation and support quality improvement in mental health services?

2.2 Aims

To determine how prescription data has been utilised previously to improve medicines optimisation and support quality improvement in mental health services.
To understand how healthcare professionals want HEPMA data to be utilised to improve medicines optimisation and support quality improvement in mental health services.

2.3 Objectives

2.3.1 To conduct a scoping literature review to identify how prescribing and administration data has been used in mental health services to improve medicines optimisation and support quality improvement and to provide a baseline for discussion with the MDT.

2.3.2 To seek the views of healthcare professionals working within mental health services and identify common themes that emerge for how HEPMA data can be utilised to improve medicines optimisation and support quality improvement.

Chapter 3: Identifying Reported Uses of Prescribing and Administration Data in Mental Health Services to Improve Medicines Optimisation or Support Quality Improvement Work: A Scoping Literature Review

3.1 Introduction

Scoping literature reviews are a way of mapping key concepts underpinning a research area and provide value in examining a broad area to identify gaps in the research knowledge base, clarify key concepts and report on the types of evidence that inform and address practice in the field (Peters, et al., 2015). Scoping reviews can be undertaken to determine the scope of literature in an area and give a clear indication of the volume and focus of the literature available (Munn, et al., 2018).

The aim of this scoping review was to identify the reported uses of prescribing and administration data, both paper and electronic, in mental health services to support quality improvement work or medicines optimisation. Whilst HEPMA systems offer many advantages over paper-based prescriptions it was felt appropriate to keep the scoping review broad and include all prescribing and administration data sources as due to the legal requirements of prescriptions, paper-based prescription data and electronic prescription data should hold the same minimum prescription information. In addition, many of the ways paper prescription data has been used to improve patient care including audits, monitoring, policy review, and review of prescribing trends are also possible with HEPMA data. Therefore, learning from paper-based approaches could be useful to identify further ways to utilise and realise the potential benefits of HEPMA data.

Quality improvement has many definitions but for the purpose of this review the definition used was: “making a difference to patients by improving safety,

effectiveness, and experience of care by using understanding of our complex healthcare environment, applying a systematic approach, and designing, testing, and implementing changes using real time measurement for improvement" (British Medical Journal (BMJ), 2019). Medicines optimisation has been defined as: "a person-centred approach to safe and effective medicines use, to ensure people obtain the best possible outcomes from their medicines. Medicines optimisation applies to people who may or may not take their medicines effectively" (NICE, 2015).

The results of the scoping review are expected to provide a background summary of uses of data to date which will provide a baseline to inform, focus and stimulate the subsequent discussions with the multi-disciplinary team (MDT) in the qualitative fieldwork within this thesis. A scoping review was therefore chosen to summarise the type of evidence currently reported in this field and to use this to help inform the next stage of this research.

3.2 Methods

3.2.1 Search Strategy

It is recommended best practice to search at least two online databases when conducting a scoping review (Joanna Briggs Institute, 2024). The databases searched were MEDLINE, Embase, CINHAL and the Cochrane Library. MEDLINE is the United States National Library of Medicine database covering worldwide medical literature and Embase is a major health, pharmacological and biomedical literature database covering journals from 110 countries and with a strong coverage of European journals. These databases were therefore chosen because of their focus on medical literature and their global coverage. The Cochrane Library was chosen as it also has a global focus on high-quality health information. CINHAL was

chosen particularly because its focus includes nursing and allied health professionals. The databases chosen were reviewed by an experienced librarian to confirm they were appropriate for the search. Furthermore, these databases were used in several systematic reviews conducted on related topics including the systematic review detailed in Chapter 1, which provided some of the background evidence for the work undertaken in this thesis (Chaudhry, et al., 2021).

The search strategy was based on the PICO model of population, intervention, comparison, and outcome (University Libraries Health Sciences Library, 2022). The PICO model is widely used to define search strategies in evidence-based health care and has been used in reviews in similar topic areas (Cochrane Library, 2025) (Chaudhry, et al., 2021). No comparison group was included in this search resulting in three facets of the search which related to population, intervention, and outcome. Subject terms (MeSH, EMTREE or CINAHL headings) were identified in each database for each facet and keywords with truncations were developed from these. The keywords were searched within the titles and abstracts of papers within the databases. The search terms used in each database are outlined in Table 3. The search terms were tested multiple times and refined each time. During the development of the search terms, subject terms for individual mental health conditions were removed. The aim of the scoping review was not specific to particular mental health conditions, but rather looking at mental health services in general, which led to the decision to only include the broader subject terms in the final search.

Table 3: Database Search Terms

MEDLINE (Ovid)	Embase (Ovid)	CINAHL (EBSCO)	Cochrane Library
Facet 1: Mental Health			
Mental Health (MeSH Term)	Mental health (EMTREE term)	Mental Health (CINAHL Heading)	Mental Health (MeSH Term)
Mental Disorders (MeSH Term)	Mental disease (EMTREE term)	Mental Disorders (CINAHL Heading)	Mental Disorders (MeSH Term)
Mental health.tw.	Mental health.tw.	Mental health	(Mental health):ti,ab,kw
mental disorder*.tw.	mental disorder*.tw.	mental disorder*	(mental disorder):ti,ab,kw
mental disease*.tw.	mental disease*.tw.	mental disease*	(mental disease):ti,ab,kw
Facet 2: Prescription/ Administration Data			
Drug Prescriptions (MeSH Term)	Prescription (EMTREE term)	Prescriptions, Drug (CINAHL Heading)	Drug Prescriptions (MeSH Term)
prescri* data.tw.	prescri* data.tw.	prescri* data	(prescri* data):ti,ab,kw
admin* data.tw.	admin* data.tw.	admin* data	(admin* data):ti,ab,kw
Facet 3: Quality Improvement			
Quality of Health Care (MeSH Term)	Health care quality (EMTREE term)	Quality of Health Care (CINAHL Heading)	Quality of Health Care (MeSH Term)
Evidence-Based Practice (MeSH Term)	Evidence based practice (EMTREE term)	Medical Practice, Evidence-Based (CINAHL Heading)	Evidence-Based Practice (MeSH Term)
Outcome Assessment, Health Care (MeSH Term)	Outcome assessment (EMTREE term)	Nursing Practice, Evidence-Based (CINAHL Heading)	Outcome Assessment, Health Care (MeSH Term)
		Outcomes (Health Care) (CINAHL Heading)	
Quality health care.tw.	Quality health care.tw.	Quality health care	(Quality health care):ti,ab,kw

MEDLINE (Ovid)	Embase (Ovid)	CINAHL (EBSCO)	Cochrane Library
guideline adherence.tw.	guideline adherence.tw.	guideline adherence	(guideline adherence):ti,ab,kw
quality assurance.tw.	quality assurance.tw.	quality assurance	(quality assurance):ti,ab,kw
quality improve*.tw.	quality improve*.tw.	quality improve*	(quality improve*):ti,ab,kw
quality indicat*.tw.	quality indicat*.tw.	quality indicat*	(quality indicat*):ti,ab,kw
medic* optimi*.tw.	medic* optimi*.tw.	medic* optimi*	(medic* optimi*):ti,ab,kw
evidence based medic*.tw.	evidence based medic*.tw.	evidence based medic*	(evidence based medic*):ti,ab,kw
outcome* assess*.tw.	outcome* assess*.tw.	outcome* assess*	(outcome* assess*):ti,ab,kw
health outcome*.tw.	health outcome*.tw.	health outcome*	(health outcome*):ti,ab,kw
health care outcome*.tw.	health care outcome*.tw.	health care outcome*	(health care outcome*):ti,ab,kw
clinical audit.tw.	clinical audit.tw.	clinical audit	(clinical audit):ti,ab,kw
professional standard*.tw.	professional standard*.tw.	professional standard*	(professional standard*):ti,ab,kw
clinical standard*.tw.	clinical standard*.tw.	clinical standard*	(clinical standard*):ti,ab,kw
quality control.tw.	quality control.tw.	quality control	(quality control):ti,ab,kw

The subject terms and keywords were combined with OR for each facet and then the results of each of the three facets were combined with AND to give the final search result. The search strategies were independently reviewed by an experienced librarian, established researchers and PhD students before the search was conducted. The full search strategies for each database are outlined in Appendices 1-4. All publication dates were initially included from the beginning of

the databases to the date the searches were conducted. The searches in Embase and MEDLINE were conducted on the 12th December 2022 and the searches in the Cochrane Library and CINAHL were conducted on the 13th December 2022. The results from the electronic databases were imported into the reference management software, EndNote 20™.

3.2.2 Inclusion and Exclusion Criteria

Studies undertaken in mental health services within any sector of care were included if mental health was the main focus, the patient was under the care of mental health services, and prescribed medication was involved. Quality improvement work across all sectors of mental health care were considered to be potentially relevant in helping identify and define how best to use prescription data. Studies on quality improvement or medicines optimisation involving prescribing or administration of prescription medicines were included. The source of the data was not restricted and therefore all data related to prescribing or administration of medicines was included regardless of whether it was from a paper or electronic source. As outlined earlier there is potential learning to be derived from paper-based prescribing data that could be useful for HEPMA data. In addition, it was deemed important not to limit this aspect of the search and include all data sources to ensure no relevant studies were missed if the data source was not clearly outlined or if a study utilised multiple data sources. Due to capacity only studies written in or translated into English language were included. There were no restrictions on geographical locations of the studies included. At full text review the decision was made to limit the date of publication to within the last 10 years (2012-2022) to ensure the most relevant and current studies within the current healthcare landscape were included. Limiting by date and language is common practice for scoping reviews (Tricco, et al., 2016). A full outline of the inclusion and exclusion criteria is detailed in Table 4.

Table 4: Study Selection Eligibility Criteria

	Inclusion criteria	Exclusion criteria
Population & Healthcare setting	Mental health services in any sector of care. Any mental health condition will be included as long as it is the main focus of the study, and the patient is under the care of mental health services.	Mental health conditions being looked at secondary to other diseases and conditions will not be included. For example, studies looking at depression in cancer patients will not be included.
Intervention – Prescribing & Administration Data	Quality improvement, service improvement or medicines optimisation work that involves prescribing or administration of prescribed medication.	Studies which do not involve or focus on prescribing or administration of prescribed medication. Illicit drug reviews will not be included, only prescription medication. Research on patient or staff satisfaction of services or surveys which do not include prescription data.
Outcomes	Studies that focus on quality improvement, improvement of health outcomes or medicines optimisation. Interventional studies implementing improvement/change.	Studies which were not looking at quality improvement in terms of prescribing or administration of prescription medicines as their main outcome. Studies lacking an intervention directly related to prescribing or administration.
Geography	All geographical locations will be included.	No geographical locations will be excluded.
Types of methods employed	The following study types will be included as long as they present empirical data. • Qualitative • Quantitative • Mixed methods	No patient or staff satisfaction surveys will be included. Posters, commentaries, opinion pieces and reviews will not be included.
Language	Studies that are written or been translated into English language.	Studies that are in a language other than English.

3.2.3 Study Selection

Once duplicates were manually removed in EndNote 20™, titles and abstracts were screened in EndNote 20™ against the defined inclusion and exclusion criteria.

Duplicate independent screening of titles and abstracts was undertaken by two reviewers (NG and RA, PhD student) for 10% of the studies. The level of agreement was calculated and categorised against pre-defined cut-offs: poor <70%; fair 70–79%; good 80–89%; and excellent > 90% (Cicchetti , 2001). After 10% of the screening had been validated, the remainder of the titles and abstracts were screened by the primary reviewer (NG) as the initial validation resulted in a level of agreement above the cut off considered good which provided assurance that screening could continue with one researcher.

Full text articles were then retrieved for studies considered for inclusion and duplicate independent screening was undertaken by two reviewers (NG and HA, PhD student) for 10% of the studies. The initial validation resulted in a level of agreement above the cut off considered good which gave assurance that screening could continue with one researcher. The remaining studies were therefore screened by the primary reviewer (NG) against the defined inclusion and exclusion criteria. Advice was sought from a librarian at the University of Strathclyde on full texts which couldn't be located or couldn't be accessed for free. The Directory of Open Access Journals (DOJA), inter-library loan service and direct contact with the authors were all utilised to attempt to retrieve full text articles.

3.2.4 Data Extraction

A data extraction template was pre-defined and developed within Microsoft® Excel®. The template was reviewed by PhD students and research associates and changes were implemented based on feedback before piloting the template. A pilot of a minimum of 10% of articles was undertaken by two reviewers (NG and DC, MPhil student). The independently charted extraction data was reviewed for consistency and discussed. The reviewers agreed on all charted data and no further changes were therefore required to the template. Data extraction for all remaining

full text articles was completed by the primary reviewer (NG). The extracted data included article details (e.g. publication year, first author, DOI, title, aim, country, study setting, study design, population), source and type of prescription data, intervention, quality improvement methodology, outcome measure(s), conclusion, recommendations and limitations.

The purpose of this scoping review was to support the discussions in the qualitative field work of this research rather than extensively searching the literature to identify gaps in the evidence base. It was therefore not felt necessary to continue to update the search after the initial extraction and summary of the available literature.

3.2.5 Data Analysis

Methodological quality of the included studies was not formally assessed as scoping reviews are designed to outline the current evidence base, regardless of the quality (Peters, et al., 2015). This is consistent with guidance on conducting scoping reviews and with published scoping reviews (Tricco, et al., 2016). The results of the data analysis were presented using a mixture of tabular and descriptive forms that responded to the scoping review question. A narrative summary was undertaken to summarise the literature.

Data analysis was conducted by one researcher (NG) and was not independently validated by another researcher. The researcher systematically organised the data from the included studies. As the researcher became familiar with the data, they identified similarities with the interventions described in each of the included studies and grouped the studies based on the interventions utilised. Through this grouping the researcher identified two distinct categories which reflected the role of data in the intervention: direct intervention and assessment of an intervention. The researcher defined direct intervention as a quality improvement or medicines

optimisation intervention that relied on utilisation of prescription data. The researcher defined assessment of an intervention as a quality improvement or medicines optimisation intervention which did not involve the use of prescription data. In this category, studies utilised prescription data to assess the effectiveness of the intervention employed against the study outcome measures. Additionally, there were studies which utilised data for both categories which led to a third category (dual purpose).

The following data collated during data extraction were presented into tabular form: publication year, first author, aim, country, care setting, population, data source, type of prescription data, intervention, improvement methodology and outcome measure(s). The three categories for data purpose identified during data analysis were then added to the table and studies were colour coded based on this category.

3.3 Results

3.3.1 Study Selection

A total of 2309 records were identified with the following breakdown from each database: Embase n= 1623; MEDLINE n= 189; Cochrane Library n=335; CINAHL n=162. A total of 269 duplicates were manually identified and removed before screening. Twenty-two studies were included from the remaining studies (Figure 1).

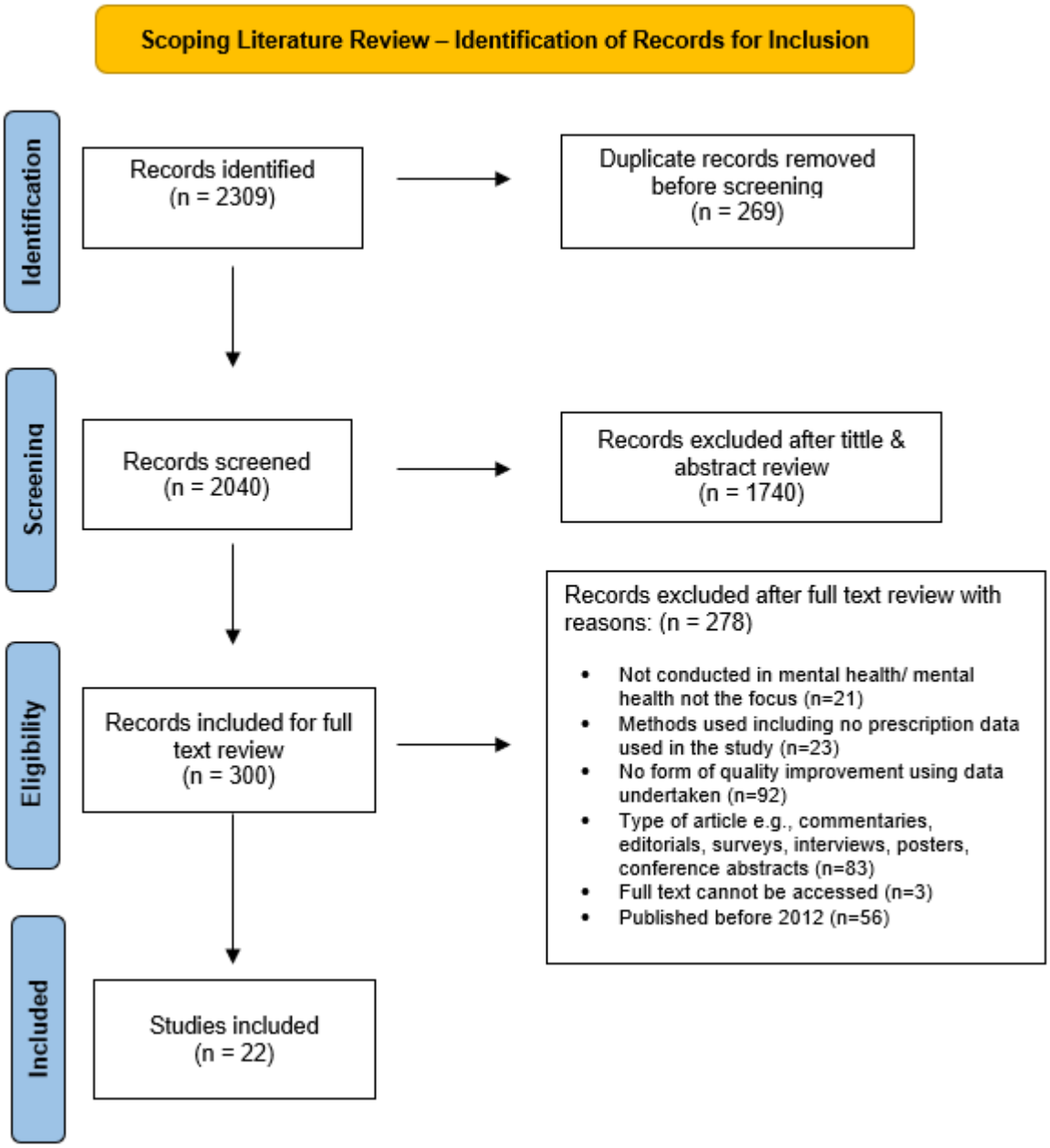

Figure 1: Scoping Review - summary of number of studies identified, screened, and included.

The initial agreement of the titles and abstracts independently screened was 81% which was considered good based on the pre-defined cut-offs. After discussion, all disagreements were resolved resulting in 100% agreement between the two independent screeners. For the full texts, the initial agreement was 87% which was

considered good based on the pre-defined cut-offs. After discussion, all disagreements were resolved resulting in 100% agreement.

3.3.2 Study Characteristics

Of the final 22 studies that were included for analysis, the majority (n=13, 59%) were published in the last five years (2018-2022). The studies were conducted in seven countries; United Kingdom (UK) and the Republic of Ireland (n=9); the United States of America (USA) (n=7); Australia (n=1); Italy (n=2); Germany (n=2) and Netherlands (n=1). Nine studies stated their data information source was electronic while only one study stated their data information source was paper based. For the remaining twelve studies the data sources were either a combination of paper and electronic (n=5) or not stated (n=7).

Ten of the studies included patients treated in the secondary care hospital inpatient setting. The remaining studies were conducted across community, outpatient, primary care or residential care settings. One study focussed on improving the quality of care related to the administration of medications (Kaplan, et al., 2013) whilst all other studies focussed on aspects relating to prescribing. Half of the studies (n=11) focussed specifically on antipsychotics whilst the remaining 11 studies focussed on: any type of psychotropic medication (n=2); antidepressants (n=1); benzodiazepines or sedative-hypnotic medications (n=3); lithium (n=1); opioid antagonists (n=1); stimulants (n=1); and studies which did not clearly state the class of medication (n=2).

3.3.3 Summary of Included Studies

Table 5: Description of included studies (n=22).

Lines are colour coded based on Data Purpose column. Coding: blue = direct intervention; orange = assessment of an intervention; green = dual purpose

Year, Author(s) & Country	Care Setting	Aim	Population	Data Source	Prescription Data Included	Intervention *(Improvement Methodology)*	Data Purpose	Outcome Measure(s)
2022 Barnes et. al UK	Mixed	Not stated.	Patients prescribed clozapine & under the care of adult mental health services	Not stated	Included when clozapine was initiated, and antipsychotic medication regimen prescribed immediately before clozapine treatment was started	Customised reports were provided to each trust after the baseline audit which showed their local performance data benchmarked against the performance of other participating mental health services and the total sample. *(Audit)*	Direct intervention	Off-label clozapine prescribing, antipsychotic regimen before starting clozapine, change in smoking status on clozapine prescribing and the accuracy of the summary care record.
2022 Lora et. al Italy	Community	To evaluate the quality of mental health care delivered to patients with schizophrenia and related disorders taken-in-care by mental health services in four Italian regions (Lombardy, Emilia-Romagna, Lazio, Sicily).	Patients with schizophrenia and related disorders	Electronic	Outpatient drug prescriptions. Prescriptions of antipsychotics and duration of each prescription was calculated.	Quality indicators were developed for: measuring quality of care: allowing benchmarking; establishing priorities for QI and supporting accountability. *(Quality indicators & benchmarking)*	Direct intervention	31 quality indicators split into groups: accessibility and appropriateness; continuity; and safety.
2022 Moses et. al USA	Outpatient clinic	Determine whether Second Chance (SC) patients' retention and opioid use is related to physical or mental health conditions, non-opioid substance use, or treatment features	Patients with opioid use disorder.	Electronic	Methadone dosing variables included entry dose, minimum and maximum dose, modal and average dose, days until reaching modal dose, number and percent of treatment days on modal dose, and cumulative methadone dose.	A "Second Chance" pilot program, founded to explore the effectiveness of enabling patients to remain in methadone treatment despite ongoing substance use. This included different approaches to management of methadone treatment. *(Service development and evaluation)*	Assessment of an intervention	Methadone variables and drug use and retention.
2022 Mueller et. al Germany	Primary care	To compare the health-service-utilisation of patients with ADHD enrolled in a GPcentred-paediatric-primary-care-programme with usual care in terms of disease-related hospitalisation, pharmacotherapy and psychotherapy	3- to 18-year-old patients with attention deficit hyperactivity disorder (ADHD)	Not stated	Claims data	GP centred paediatric primary healthcare which includes extended preventive paediatric check-ups and innovative services such as advanced screening for diseases in children and adolescents, as well as hearing and vision tests. *(Comparison of service delivery models using intervention and control groups)*	Assessment of an intervention	Main outcomes were disease related hospitalisation, pharmacotherapy, and psychotherapy.
2021 Agrawal et. al USA	Outpatient clinics	To monitor the trend of benzodiazepine prescription control in community mental health clinics (CMHC).	Adult outpatients in community mental health clinics	Electronic	Kentucky All Schedule Prescription Electronic Reporting (KASPER) prescribing reports showing prescription data.	Removal of benzodiazepines from the formulary and implementation of a "No Benzodiazepine" policy (supported by education) followed by a quarterly KASPER prescriber's report to see the trend. *(Practice-based interventions implementing harm reduction strategies)*	Assessment of an intervention	Reduction in benzodiazepine prescriptions.
2020 Veereschild et. al Netherlands	Long-term residential care	To determine whether DITSMI affected changes over time regarding diagnoses, pharmacological treatment,	Long-term residential psychiatric patients	Electronic	Medication changes. The numbers of prescriptions for clozapine, olanzapine, lorazepam and oxazepam.	Introduction of the Diagnose, Indicate, and Treat Severe Mental Illness" (DITSMI) model, a pharmacological protocol.	Assessment of an intervention	How medication use, general functioning, and hospital bed utilization were affected by changes in diagnosis or appropriate treatment.

Year, Author(s) & Country	Care Setting	Aim	Population	Data Source	Prescription Data Included	Intervention *(Improvement Methodology)*	Data Purpose	Outcome Measure(s)
		psychosocial functioning, and bed utilization.				*(Test of change of a new protocol introduction as part of a longitudinal cohort study)*		
2020 Johnson et. al UK	Community and primary care	To improve psychotropic prescription reconciliation accuracy at the community mental health team (CMHT) - general practice interface.	Patient's attending the community mental health team (CMHT)	Some aspects were electronic	Psychotropic prescribing information - drug, form, dose, dose instructions and indication.	Individualised prescriber patient-level feedback and reflection using routine individual patient-level data. *(Quality improvement run charts)*	Assessment of an intervention	Proportion of CMHT patients who have their psychotropic prescriptions accurately reconciled and recorded within their regular CMHT review letters to ≥80% by January 2017.
2019 Baum et. al USA	Primary care	To increase mental health-related office visits and PPCC prescribing for anxiety, depression, and ADHD and reduce PPCC prescribing of second-generation antipsychotic medications.	Paediatric patients with mental health conditions	Electronic	Pharmacy claims data. Medicaid claims data to assess monthly prescribing practices.	The Ohio Building Mental Wellness (BMW) learning collaborative. *(Plan-Do-Study-Act (PDSA) cycles)*	Assessment of an intervention	Clinician confidence (measured pre- and post-intervention). Medicaid claims data were used to estimate the intervention's effects on identification of mental health conditions and prescribing practices.
2018 Raynsford et. al UK	Primary care	To explore the gaps in service provision relating to medicines and determine whether a specialist pharmacy team could provide useful input for patients on the severe mental illness (SMI) register.	Patients on the severe mental illness (SMI) register	Not stated	Information was collected on high-dose and multiple antipsychotic prescribing. Medicines reconciliation was also carried out by comparing primary and secondary care patient records, with particular attention paid to patients on clozapine and depot antipsychotics. A list of patients receiving depots from the practice nurse was obtained and patients who did not regularly attend were identified.	A pharmacist and pharmacy technician were each allocated half a day per week per surgery. *(Audit)*	Assessment of an intervention	Pharmacist interventions were assessed and graded using a validated scale.
2018 Ross et. al UK	Secondary care	To improve the rates of physical health monitoring on an inpatient psychiatry unit through implementation of an electronic standardized order set.	Patients aged 18 to 100 years, admitted to the inpatient psychiatric service, and prescribed a regularly scheduled antipsychotic medication for 3 or more days	Mixture	Information was collected on antipsychotic medications prescribed in hospital for 3 or more days.	Developed and implemented a standard electronic admission order set and provided training to inpatient clinical staff. *(Audit)*	Assessment of an intervention	Physical health monitoring rates of thyroid-stimulating hormone, blood pressure, blood glucose, fasting lipids, electrocardiogram and height/weight. Intervention rates for abnormal results.
2018 Shayegani et. al USA	Outpatient clinics	To determine if passive clinical pharmacist involvement would reduce combination opioid and BZD therapy, we developed a quality improvement activity (QIA) that incorporated a single pharmacist without the need for additional resources or dedicated office visits.	Patients within a small Department of Veteran Affairs (VA) healthcare system receiving long term (>=90 days in 3 consecutive months or longer) combination opioid and benzodiazepine prescriptions from 1 of the 5 outpatient clinics	Electronic	The database used for this project generated a list of patents who were actively receiving an opioid prescription for chronic noncancer pain and were co-prescribed a benzodiazepine for at least 90 days.	A psychiatric pharmacist submitted a 1-time chart review note for each patient, which briefly outlined patient-specific considerations and recommendations for alternatives to benzodiazepine treatment. *(PDSA cycle type design)*	Assessment of an intervention	The number of providers who (1) acknowledged the chart review notes by providing their additional signature and (2) committed to the recommended interventions by initiating tapering schedules.
2018 Thackeray et. al	Mixed	A Medicaid statewide quality improvement (QI) collaborative was developed	Medicaid-enrolled children ages 2 through 17 who	Not stated	Not stated.	Developed evidence supported antipsychotic treatment algorithms and online modules, fact sheets, and shared	Dual purpose – direct	The objective of Ohio Minds Matter was to achieve a 25% reduction in three indicators of antipsychotic overprescribing to children while

Year, Author(s) & Country	Care Setting	Aim	Population	Data Source	Prescription Data Included	Intervention *(Improvement Methodology)*	Data Purpose	Outcome Measure(s)
USA		to improve antipsychotic prescribing practices for children.	received psychotropic medications			decision-making tools for prescribers, school and agency personnel, parents, and youths. *(PDSA cycles)*	intervention and assessment on an intervention	avoiding adverse clinical outcomes: antipsychotics prescribed to children under age six, prescription of two or more concomitant antipsychotics for longer than two months, and receipt of four or more psychotropic medications at any point.
2018 Avdagic et. al USA	Community	To describe the effect of a multimodal intervention targeting chronic benzodiazepine and sedative-hypnotic prescriptions in a large behavioural health system.	All active adult patients (≥ 18 years of age) with diagnosed mental illness who had billed services in the community behavioural health services (CBHS) electronic health record during the preintervention and assessment periods	Electronic	Calculated the data on chronic sedative-hypnotic prescribing percentages (number of patients with sedative-hypnotic prescriptions for ≥ 60 days in a 90-day quarter divided by number of patients with a mental health service billed within a 90-day quarter). Alternative medications (antidepressants, diphenhydramine, hydroxyzine, buspirone, gabapentin, and melatonin agonists).	The multimodal intervention consisted of provider education, coordination of care with all providers involved in patient care, and guideline development and implementation for safe prescribing of sedative-hypnotics. *(Multi-modal intervention analysed preintervention, 12 months post intervention and 24 months post intervention)*	Assessment of an intervention	The primary was change in frequency of chronic (≥ 60 days) sedative-hypnotic prescriptions received before and after the multimodal intervention. The secondary outcome included the change in prescription rates in priori-defined cohorts: patients on methadone maintenance therapy and patients ≥ 60 years of age.
2017 McMillan et. al Australia	Secondary care	To review antipsychotic polytherapy alone, high-dose therapy alone, polytherapy and high dose prescribing patterns in adults discharged from an inpatient mental health unit at two time-points, and the alignment of this prescribing with clinical guideline recommendations.	Adults discharged with at least one antipsychotic	Electronic	Clozapine trial, Antipsychotic name, Form, Dose, Other medication, Adverse drug reactions.	Preliminary findings and education sessions were provided to physicians between Cohorts. *(Audit)*	Assessment of an intervention	Polytherapy alone, high-dose therapy alone, polytherapy and high-dose therapy.
2017 Prajapati et. al UK	Secondary care	Our objective was to reduce high-dose antipsychotic therapy (HDAT) and antipsychotic combinations (AC) prescribing in Norfolk and Suffolk NHS Foundation Trust (NSFT) by around 10% from baseline in 12–18 months to bring it in line with the national average.	Acute adult inpatients prescribed antipsychotics	Mixture	Not clearly stated. Clinical pharmacists collected data from prescription charts to measure the overall high dose antipsychotic therapy (HDAT) and antipsychotic combination (AC) prescribing pattern in the acute adult service.	Guideline development, guideline implementation, communication and education and training. *(Audit)*	Assessment of an intervention	High-dose antipsychotic therapy and antipsychotic combination prescribing.
2016 Lora et. al Italy	Mixed	To assess the quality of mental healthcare provided to patients with schizophrenic disorders in the Italian region of Lombardy.	Patients with schizophrenic disorders that were under the care of Lombardy mental health services in 2009	Electronic	All prescriptions of antipsychotic medications that were dispensed to patients during 2009 were identified. The duration of each prescription was calculated. Adherence to antipsychotic treatment was determined as being the proportion of patients taking the drug consecutively out of the total number of patients included in the analysis.	Forty-one clinical indicators were applied to Lombardy's healthcare databases containing data on mental health treatments, hospital admissions, somatic health treatments and pharmaceutical prescriptions. *(Audit)*	Direct intervention	The forty-one clinical indicators.
2015 Mace et. al	Secondary care	To assess the impact of a 6-year quality improvement	Patients prescribed an antipsychotic on	Not stated	Names and doses of any regular and 'as required' antipsychotics were	Three QI programmes and interventions. 1. Restrictions and guidance on the use of 'as	Dual purpose –	Proportion of patients prescribed an antipsychotic high-dose and combination.

Year, Author(s) & Country	Care Setting	Aim	Population	Data Source	Prescription Data Included	Intervention *(Improvement Methodology)*	Data Purpose	Outcome Measure(s)
UK		programme aimed at reducing the rates of prescribing high-dose antipsychotics and polypharmacy on South London and Maudsley NHS Foundation Trust (SLAM) inpatients and psychiatric intensive care units.	SLAM inpatient and psychiatric intensive care units (PICUs)		noted from prescription charts. For 'as required' antipsychotics the maximum prescribed dose for the previous 24 h was recorded.	required' medications were implemented on inpatient units. Rates of prescribing high-dose antipsychotics and combinations were compared across the trust. 2. Practice was compared for wards with a similar patient demographic. Results were reported to the relevant staff. 3. Pharmacy, through the trust's Executive Performance Management Review process, agreed a target with all trust services to reduce the rates of prescribing high doses and combinations of antipsychotics. Prescriptions were examined on units with disproportionately high rates of prescription of either high doses or combinations of antipsychotics. Trust inpatient prescriptions were updated to include a warning that all 'as required' medications must be reviewed at least once a week. *(Audit)*	direct intervention and assessment on an intervention	
2015 van Dijk et. al Netherlands	Outpatient	To examine the effect of implementing anxiety disorders guidelines on guideline adherence and patient outcomes in specialized mental health care.	Outpatients aged 18 through 65 years who were (i) diagnosed with the Composite Interview Diagnostic Instrument CIDI) with one of the following DSM-IV anxiety disorders as primary diagnosis: panic disorder with or without agoraphobia, social phobia or generalized anxiety disorder (GAD)	Not stated	The adequacy of pharmacological treatment steps was assessed by (i) the prescription of the correct category and type of drug; (ii) prescription of the correct dosage; and (iii) the correct minimum duration of the medication before evaluation.	Anxiety disorder guidelines were implemented. *(Controlled intervention comparison)*	Assessment of an intervention	Adherence to the anxiety disorders guidelines by professionals. The effect on the presence and severity of anxiety and depressive symptoms in patients. Patient Outcomes: The primary outcome measure was the mean difference from baseline of the Beck Anxiety Inventory (BAI) total score]. Secondary outcome measures were (i) the percentage of patients responding and achieving remission on the BAI according to the criteria of Jacobson and Truax after 1-year and 2-year follow-ups.(ii) presence and severity of phobic avoidance behaviour, measured with the Fear Questionnaire (FQ); and (iii) co-morbid depressive symptoms, measured with the Inventory of Depressive Symptoms (IDS).
2015 Wilson et. al Republic of Ireland	Secondary care	The aim of this study was to improve the quality of prescription writing in a long-term psychogeriatric inpatient unit by a combination of serial audits and interventions designed to address the identified deficiencies.	Elderly patient's receiving continuing care with severe and enduring mental illness and dementia.	Paper	Documentation of patient identification details, regular medication and 'as required' medication was noted. The numbers of prescriptions per patients was also recorded. The prescription sheets were reviewed against the pre-defined criteria.	Based on the findings of the first audit a set of prescribing guidelines was implemented into the ward. Following the second audit a new prescription sheet was developed. The format of the new prescription sheet was designed to account for the needs of the unit and to adhere to Irish and UK best practise guidelines. *(Audit)*	Assessment of an intervention	Adherence with the guideline criteria recorded under data used.
2014 Kelly et. al	Secondary care	To examine the impact of a change in local prescribing policy on the adherence to	Adult inpatients prescribed antipsychotic(s)	Not stated	Antipsychotic prescribed, dose prescribed and documented indications for prescribing were	A hospital-wide clinical policy titled 'Prescribing and monitoring of	Assessment of an intervention	1. The total daily prescribed doses of antipsychotic drugs are within British National Formulary (BNF)/Summary of Product

Year, Author(s) & Country	Care Setting	Aim	Population	Data Source	Prescription Data Included	Intervention *(Improvement Methodology)*	Data Purpose	Outcome Measure(s)
Republic of Ireland		evidence-based prescribing guidelines for antipsychotic medication in a general adult psychiatric hospital			recorded, frequency and generation of antipsychotic. If multiple and/or high dose antipsychotics were prescribed any reasons documented for this prescribing were recorded. The maximum prescribed dose that could be administered over a 24-hour period was recorded, for both regular and PRN prescriptions, irrespective of whether they were administered or not.	antipsychotic medication, including high dose antipsychotic medication'. *(Audit)*		Characteristics limits. High dose is defined as a total daily dose, exceeding 100% of the maximum recommended daily dose. 2. Individuals should be prescribed only one antipsychotic at a time with the exception of cross titration during switching from one antipsychotic to another and those requiring augmentation of clozapine. 3. First (typical) and second-generation (atypical) antipsychotic drugs (SGAs) should not be prescribed concurrently, except during switching from one generation to another.
2013 Paton et. al UK	Mixed	The study was designed to test an audit-based quality improvement programme (QIP) addressing lithium prescribing and monitoring in UK mental health services.	Patients prescribed lithium	Mixture	Co-prescribed medication—both psychotropic and drugs with a known potential for pharmacokinetic interactions with lithium) data were collected for every patient. For the subsample of patients who had started lithium treatment in the previous year, data were collected related to the documentation of pre-treatment tests of renal and thyroid function, and evidence that the patient had been informed of the potential side effects of lithium treatment, the risk factors for lithium toxicity and signs and symptoms of toxicity. For the subsample of patients who had been prescribed lithium for more than a year, data related to the frequency of biochemical monitoring (renal and thyroid function and serum lithium levels) were collected.	Benchmarking of performance against clinical standards and customized change interventions. *(Audit)*	Direct intervention	1. Before treatment with lithium is initiated, the results of renal function tests and thyroid function tests should be available. Renal function tests should include creatinine or creatinine clearance or estimated glomerular filtration rate (e-GFR), the last of these being recommended for routine reporting in the UK. 2. During maintenance treatment, serum lithium should be measured every three months, while renal function tests, including e-GFR or another measure of creatinine clearance, and thyroid function tests should be conducted every six months.
2013 Kaplan et. al USA	Community	High-quality patient-clinician communication is associated with better medication adherence, but the specific language components associated with adherence are poorly understood. We examined how patient and clinician language may influence adherence.	Adults who screened positive for probable major depression and prescribed an antidepressant medication	Mixture	For all dispensing's, the initial and refill dates, strength, formulation, instructions for use, days' supply, and prescriber's identifier were recorded. Determined whether prescriptions were obtained by examining pharmacy fill records.	Training on motivational interviewing (MI). *(Randomised controlled trial)*	Assessment of an intervention	Primary Adherence and Proportion of Days Covered. Primary adherence was defined as an initial prescription being filled within 30 days of the index order. Proportion of days covered (PDC) was calculated by dividing the total days' supplied in the observation period by 180 days. T

3.3.4 Uses of Prescription Data for Quality Improvement

Twelve of the studies stated that some form of electronic prescription data was used. The only study which specifically stated that the data was exclusively from paper sources was from 2015 (Wilson, et al., 2015) and therefore one of the earlier studies included.

The use of prescription data in the studies identified fell into two categories: prescription data used as a direct intervention and prescription data used to assess the success of a separate intervention. The use of prescription data solely as an assessment of other interventions was identified in 16 of the included studies and deemed the most common use. Prescription data solely as an intervention was identified in four of the included studies with the remaining two studies deemed to have used the data for both purposes.

Prescription Data as a Direct Intervention (n=4, colour coded blue in Table 5)

Two studies used prescription data as an intervention with customised reports which allowed performances to be benchmarked. The reports produced allowed the areas to benchmark their local prescribing practice against defined clinical standards and guidelines whilst also comparing their performance with other areas (Barnes, et al., 2022) (Paton, et al., 2013). Another use of prescription data as a quality improvement intervention was the development and use of quality indicators. These studies developed quality indicators which prescribing data was used to review performance against. Dashboards which could present the prescribing data for the agreed quality indicators were developed and recommended (Lora, et al., 2022) (Lora, et al., 2016).

The use of prescription data as an intervention had four common steps across the different studies as outlined in Figure 2.

Figure 2: Process of Using Prescription Data as an Intervention

During step one of the process outlined in Figure 2, a variety of methods were utilised to develop and agree the criteria to be used. In general, published sources of information such as published guidelines or online databases of published literature were used to identify the initial criteria. The initial criteria were then reviewed by experts to refine and agree the final criteria which involved the use of consensus methods such as a Delphi survey. During step two, some of the studies utilised data from more than one electronic source. In step three, processing of the data was required firstly to harmonise the data for extraction if the data was coming from multiple sources and secondly to merge data for individual patients that was retrieved from multiple sources. The final step of presenting the data was generally in three formats: bespoke reports which allowed benchmarking; quality indicators outlining and measuring performance (with potential for dashboards); and individual data driven feedback as outlined in the examples detailed.

Prescription Data as an Assessment of an Intervention (n=16, colour coded orange in Table 5)

For the studies where prescription data was used as an assessment of the quality improvement intervention employed this involved using the prescription data as a measure of a pre-defined outcome (n=16). This is shown in Table 5 where the prescription data used is in line with the outcome measures being investigated. An example was a quality improvement initiative to reduce benzodiazepine prescribing

through implementation of a new policy and a change to the prescribing formulary. The effectiveness of these interventions was monitored through prescription data on volume of benzodiazepine prescribing to determine if the target had been achieved after the intervention (Agrawal, et al., 2021). Another example was an intervention employed to improve medication adherence which looked at dispensing data to determine if the prescription had been dispensed within 30 days of the order (Kaplan, et al., 2013). This was also the only study of the 22 studies included that looked at aspects of medication administration.

Prescription Data for Dual Purposes (n=2, colour coded green in Table 5)

One study which involved multiple audit cycles utilised prescription data as both an intervention and an assessment of other interventions (Mace & Taylor, 2015). Mace and Taylor implemented prescribing restrictions and guidance as part of the initial quality improvement programme and reviewed prescription data at the re-audit to determine if the intervention had been effective in achieving the standards set. For the second quality improvement programme the prescription data collected as part of the audit was used as the intervention by comparing rates of prescribing across the Trust and reporting these to local staff.

The second study using prescription data for both purposes used data as a direct intervention by providing data-driven feedback to individual clinicians on their performance against recommended practice to help drive improvement (Thackery, et al., 2018). The study also used data as an assessment of other interventions. The interventions implemented and assessed using data included antipsychotic treatment algorithms, fact sheets, shared decision-making tools and online modules (Thackery, et al., 2018).

Involvement of Users in Data Intervention Development

The involvement of users of the data was reviewed, focusing on the studies which used data as a direct intervention (n=4) and for dual purposes which included use as a direct intervention (n=2).

Table 6: Involvement of Users of the Data in Studies Using Data as an Intervention (including studies using data for dual purposes)

Author(s) & Year	Summary of Study	Target Users	Clinical Staff Involved in Intervention Development	Methods & Consensus Tools Used to Determine Data Required by Users	Medium Used to Present Data to Users	Frequency of Data Presentation to Users
Barnes et. al 2022	Identifying quality improvement issues related to clozapine across all sectors of care in the United Kingdom.	Healthcare Trusts	Not detailed	Not detailed	Customised report showing Trust's local performance data benchmarked against the performance of other participating mental health services and the total sample.	Provided after each audit cycle. Two years between the audit cycles (2019 & 2021).
Lora et. al 2022	Evaluating the quality of mental health care delivered to patients with schizophrenia and related disorders by mental health services in four Italian regions (Lombardy, Emilia-Romagna, Lazio, Sicily).	Not outlined	Two multidisciplinary groups jointly designed the quality indicators.	Indicators were designed starting from evidence-based recommendations tailored to community care goals produced with the agreement of the Italian Ministry of Health and regional governments, and considering the guidelines developed by the American Psychiatric Association and the National Institute for Clinical Excellence (NICE) as a milestone for the treatment of schizophrenia spectrum disorders.	For the study write up this was presented in tabular form broken down by region and given as the whole sample for all 31 indicators.	This was a one-off test of using real world data with quality indicators. A 'dashboard' with software for calculating these indicators has been developed and proposed for implementation with the aim of routinely assessing the quality of clinical pathways and providing benchmarking at national and regional level.
Thackery et. al 2018	A Medicaid state-wide quality improvement (QI) collaborative was developed to improve antipsychotic prescribing practices for children.	Prescribers	An advisory panel of behavioural health experts.	Not detailed	Feedback provided on individual prescriber claims data compared with recommended prescribing practice.	Monthly
Lora et. al 2016	Assessment of the quality of mental healthcare provided to patients with schizophrenic disorders in the Italian region of Lombardy.	Not outlined	Experts from the Italian Society of Psychiatric Epidemiology were involved in developing the indicators.	An initial set of indicators were defined from the literature then a three-round Delphi survey, involving experts from the Italian Society of Psychiatric Epidemiology, reduced the number of indicators and enhanced their validity and feasibility.	For the study write up this was in tabular form presented as a list of indicators with a percentage of patients outlined against each.	One off use for this study.
Mace and Taylor 2015	Assessing the impact of a 6-year quality improvement programme aimed at reducing the rates of	Mainly prescribers	Pharmacy worked with trust clinicians to implement quality	Not detailed	Rates of prescribing high dose antipsychotics and combinations were compared across the trust.	After two quality improvement programmes in 2007 and 2009.

Author(s) & Year	Summary of Study	Target Users	Clinical Staff Involved in Intervention Development	Methods & Consensus Tools Used to Determine Data Required by Users	Medium Used to Present Data to Users	Frequency of Data Presentation to Users
	prescribing high-dose antipsychotics and polypharmacy on South London and Maudsley NHS Foundation Trust (SLAM) inpatients and psychiatric intensive care units.		improvement measures.			
Paton et. al 2013	The study was designed to test an audit-based quality improvement programme (QIP) addressing lithium prescribing and monitoring in UK mental health services.	Made available to each participating Trust and used by clinical teams.	Audit standards were derived from a NICE guideline and agreed by a multi-professional expert group.	Not detailed	An individualized benchmarked report.	The reports were presented after each audit – 2008, 2010 and 2011.

Colour coding as per Table 5: blue = studies using data as a direct intervention; green = studies using data for dual purposes (as a direct intervention and as an assessment of an intervention)

Only two of the studies (33%) detailed in Table 6 explicitly outlined the target user group that their data intervention was focussing on. Two of the six studies did not outline at all who the target users were of the data intervention. The remaining two studies outlined that the data intervention was for Healthcare Trusts but did not give detail on exactly who within the Trust the data intervention was aimed at such as management, prescribers, nurses or pharmacists.

Most of the studies (n=5, 83%) did involve clinical teams in the development of the data intervention although it was not always clear if those involved were the intended users of the data intervention. For three of the studies this involved the development of clinical quality indicators. However, the detail around how clinical teams helped develop the data intervention including consensus methods used was lacking with only two of the studies (33%) outlining this.

Only one study had an ongoing data intervention which was provided to users monthly. All other studies used the data intervention either as a one-off trial or on two or three occasions generally years apart.

3.4 Discussion

3.4.1 Main Findings

This scoping review aimed to identify the reported uses of prescribing and administration data, both paper and electronic, in mental health services to support quality improvement or medicines optimisation. The review adds to the literature by providing a summary of different ways to improve practice in mental health services through utilisation of prescription data. The findings demonstrated that prescription data has been used for quality improvement initiatives across all sectors of mental health services and across a range of conditions including schizophrenia, ADHD, substance misuse, anxiety, depression, and mood disorders. Furthermore, there were a range of pharmacological treatments across the

included studies including antipsychotics, antidepressants, benzodiazepines, sedative-hypnotic medications, lithium, opioid antagonists, and stimulants. This suggests there is a wide range of areas within mental health that can potentially benefit from the use of prescribing and administration data. Uses identified included: service development and improvement; prescribing practice improvement including monitoring requirements, assessment of service delivery quality; guideline implementation; and medication adherence. There were a range of different methodologies seen including audit, plan-do-study-act (PDSA) cycles and benchmarking which suggests that prescription data is versatile and can support a range of quality improvement initiatives.

The majority of studies were from the United Kingdom and the Republic of Ireland which may be due to the large quality improvement initiative within mental health services as part of the Prescribing Observatory for Mental Health (POMH-UK) (Royal College of Psychiatrists, 2023). Across the included studies there was limited focus on quality improvement specifically relating to administration of medication which was only identified in one study (Kaplan, et al., 2013). This could perhaps be attributed to the type of data that was available in some of the studies (e.g. pharmacy data and claims data) which wouldn't contain information on medication administration. Another factor could be the sectors of care where some of the studies were undertaken as less than half of the included studies were from secondary care. Therefore, in a large proportion of the studies, patients would mainly have been responsible for medication administration which may mean that administration data was less readily available than it would have been in an inpatient environment where medication administration is undertaken and recorded by healthcare professionals.

Nearly a third of studies (n=7) did not outline whether the prescription data utilised was derived from paper or electronic systems and therefore this lack of clarity is a notable limitation in the existing literature. As outlined already, paper records have

limited potential for scaling whilst electronic datasets offer timely access to structured data which can be automated and reproducible. Therefore, better reporting of data sources would improve the understanding of the potential for scalability and spread across healthcare settings.

The overall use of the data was broken down into two categories; data used a direct intervention (n=4), and data used to assess an intervention (n=16). There were also studies which used data for both purposes (n=2). Data being used to assess an intervention was seen most frequently and this involved using data to determine if a pre-defined outcome had been achieved post-intervention. This included review of prescribing rates to determine if an intervention employed had successfully reduced prescribing incidence. For the studies which used data as a direct intervention there were in general four steps required in the process: develop and agree standards or indicators; identify and retrieve the data; process the data; and present the data. However, in terms of the information relating particularly to the first and last steps of the process there was a lack of detail across the studies. In general, the studies did not clearly outline what software they used to create the format of data presentation or how they distributed this to the intended users. It is therefore not clear if user needs around data distribution were considered during development or if users were consulted. This could therefore be an area to address with users of the data in future to understand if they perceive distribution of data as key to effective usage and engagement with the data.

Where data was used as a direct intervention the involvement of the intended users was not something that was focussed on across many of the studies. This is in line with previous literature which outlined that the needs of different stakeholders in relation to the effective reuse of data to improve the safety, quality and efficiency of care are not well known (Cresswell, et al., 2016). The systematic review by Chaudhry et al. also concluded that improvements need to be made around users of the data to improve the benefits that can be obtained from prescription data

(Chaudhry, et al., 2021). Areas for improvement relating to users included: the need to promote data awareness and increase transparency of data while addressing any questions around data; users knowledge and awareness of the available data; and knowledge of the audience the data is being presented to (Chaudhry, et al., 2021). It was not clear in several of the studies who the intended users of the data intervention were which could suggest that their needs were not considered as part of the data intervention design. While most of the studies using data as an intervention did involve clinical teams in identifying the data to be used, it was not clear if these were the same clinical teams that the intervention was intended to be delivered to. This is a key area for improvement as data resources that are co-designed with users will be more likely to deliver meaningful and lasting change that improves outcomes (Scottish Government, 2021).

From what was identified in this scoping review there are several factors that were not generally reported on when trying to harness the benefits of prescription data as an intervention. These factors include determining user perceptions of the best medium to distribute the data intervention and the required frequency of access to the data intervention. Concerns relating to governance and confidentiality issues have been identified as considerations during the secondary use of clinical data (Scott, et al., 2017). Therefore, future consideration and improved understanding around aspects relating to data distribution are key to ensure appropriate data governance and confidentiality.

3.4.2 Strengths and Limitations

The search strategy was considered a strength as the search was conducted across four databases increasing the number of studies identified. The search strategy was reviewed by a range of research experts and refined based on feedback before being implemented. It was also a strength to have validation at each stage of screening and during extraction however it could have been improved if there had been capacity to have the entire process undertaken by two reviewers.

Furthermore, data analysis was conducted by a single researcher which represents a potential methodological limitation. Independent validation would have enhanced the reliability of the analysis and mitigated the potential for researcher bias.

Only studies available in English language were included which was a limitation as relevant studies could have been missed. However, this is common practice and of the final included studies (n=22) there were five studies which were conducted across countries where English is not the main language (Tricco, et al., 2016). The search terms did not outline all quality improvement methodology terms such as plan-do-study-act (PDSA) cycles. The decision was made not to include an exhaustive list as any studies that use these methodologies would be expected to use quality improvement as a terminology which was included as a search term. However, this could still be seen as a limitation of the search as relevant studies could have been missed and this could also have potentially introduced a bias towards inclusion of studies which utilised particular improvement methodologies (e.g. audit). A formal protocol was not registered which does not comply with the PRISMA-ScR statement for scoping reviews and is considered to be a limitation as this can lead to a lack of transparency and reproducibility (Tricco, et al., 2018).

Finally, the Cochrane Library includes randomised controlled trials and systematic reviews and therefore upon reflection, inclusion of the Cochrane Library in the search strategy was potentially unnecessary as no comparator was included in the search and reviews were excluded. No studies identified through the Cochrane Library were included for analysis which on reflection was to be expected based on the final inclusion and exclusion criteria.

3.4.3 Implications for Future Work

The broad range of data utilised within mental health services suggests there is benefit to be derived from using the data in the most effective way possible. It was clear from this scoping review, as outlined in previous work, that involvement of

users is lacking when using data as a direct intervention. Future work should focus on working with users to better understand how this gap can be addressed to ensure users are actively involved in the process to prevent any barriers to effective data use. This should include addressing questions around the areas of practice that users would like to be a focus for data interventions and how to deliver a data intervention to users including how often and through what medium.

3.5 Conclusion

This scoping review showed that prescription data can be utilised within mental health services for a variety of quality improvement initiatives across all sectors of care and across a range of therapeutic interventions. The data used was either as an assessment of an intervention or directly as an intervention, and in some cases both. The results of this scoping review allowed a clear pathway for using data as a direct intervention to be identified however there was detail lacking around user involvement. This knowledge should be used to identify how to better engage users of HEPMA data and understand their knowledge and awareness in relation to the data. This knowledge should also be used to better understand how to promote awareness of the available data and how best to present the data in the most meaningful way to users.

Chapter 4: Utilising HEPMA Data to Improve Medicines Optimisation and Support Quality Improvement in Mental Health Services: Multi-disciplinary Team Perspectives

4.1 Introduction

Users of HEPMA data will influence the intended uses of the data and the knowledge of the users and how the data is presented to them could pose potential barriers to maximising the effectiveness of the data (Chaudhry, et al., 2021). Chaudhry et. al identified areas for improvement when harnessing the benefits of data and this included better engagement with users to understand their requirements. The next stage of this thesis will therefore engage with clinical users to explore their perceptions and requirements in relation to the use of HEPMA data.

The scoping literature review conducted as outlined in Chapter 3, provided a background summary of uses of data to date in mental health services to provide a baseline to inform, focus and stimulate the discussions in this study. From what was identified in the scoping literature review there were several factors generally not reported on when trying to harness the benefits of prescription data. These factors included determining user perceptions of the best medium to distribute the data and the required frequency of access to the data. It was not always clear who the intended users of the data were and how involved they were in outlining the data requirements. These gaps identified in the literature were determined to be areas of focus for this study to help improve knowledge and understanding in this area.

4.2 Aim and Objectives

The aim of this study was to understand how healthcare professionals want HEPMA data to be utilised to improve medicines optimisation and support quality improvement in mental health services.

The study had the following objectives:

- To use the findings of the scoping literature review, outlined in Chapter 3, to develop a topic guide for focus groups involving healthcare professionals working within mental health services.
- To seek the views of healthcare professionals working within mental health services and identify common themes that emerge for how HEPMA data can be utilised to improve medicines optimisation and support quality improvement.

4.3 Methods

4.3.1 Study Design

A qualitative approach was used for this study design in the form of focus group interviews. A focus group is a type of group interview which uses communication between participants to generate data and is an effective technique to establish the needs and attitudes of healthcare staff (Kitzinger, 1995). Focus groups were chosen over one-to-one interviews to harness the power of group interactions to generate ideas and discussions based on participants' individual knowledge and experience to enrich the data collected. The topic area was not considered controversial or sensitive therefore there were no concerns identified around participants discussing their views on this topic in a group setting.

The focus group interviews were semi-structured and multi-disciplinary. A semi-structured approach was chosen to allow the required questions to be asked with flexibility utilising open-ended questioning techniques. Literature recommends a focus group size of between four to eight participants (Kitzinger, 1995). Therefore, the aim was to include eight to twelve participants across two separate focus groups (4-6 participants in each group) with at least two participants in each focus group representing each of the three professions included (doctors, nurses and

pharmacists) where possible. The study was reported in line with the COnsolidated criteria for REporting Qualitative research (COREQ) checklist (Appendix 5).

4.3.2 Study Approvals

The Head of Research Governance at NHS Lothian ACCORD provided confirmation that NHS Research & Development (R&D) approval and sponsorship was not required. NHS approval was granted by the NHS Lothian Pharmacy Quality Improvement Team (QIT) in February 2024. Review of the University of Strathclyde Code of Practice on Investigations Involving Human Beings (University of Strathclyde, 2017) confirmed that Strathclyde University Ethics Committee review was not required. Approval was obtained from the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) Department Ethics Committee in December 2023.

4.3.3 Development of Materials

4.3.3.1 Participant Information Sheet and Consent Form

A participant information sheet (PIS) and consent form (Appendix 6) was developed to provide participants with information about the study and enable them to give informed written consent before participation. University of Strathclyde templates were adapted to develop these materials.

4.3.3.2 Basic Demographic Questionnaire

A basic demographic questionnaire (Appendix 7) was developed to confirm participants met the inclusion criteria and ensure a balanced representation across the professional groups in each focus group. The questionnaire was also used to ensure staff grading within professional groups was similarly matched to prevent differences in levels of authority impacting on individuals' confidence to participate. The basic demographic questionnaire collected information on participants' job role, length of experience in their current role and within mental health services overall and their specialist area of practice.

4.3.3.3 Topic Guide

The results of the scoping literature review, outlined in Chapter 3, were used to develop a semi-structured topic guide with prompts included to elicit further information from participants where required (Appendix 8). The scoping literature review recommended future work should focus on understanding, from a user perspective, how to actively involve users in the process of using HEPMA data to prevent any barriers to effective data use. This should include addressing questions around the areas of practice that users would like to be a focus for data interventions and how to deliver a data intervention to users including how often and through what medium. The focus groups consisted of two parts:

Part 1 Experience with HEPMA Data

This part focussed on participants' experiences of HEPMA data to date to understand the perceived usefulness of the data provided and identify what areas are working well and areas for improvement. This involved one question with prompts:

Questions	Prompts
Tell me about any experiences you have of using HEPMA data.	• Can you describe what went well? • Can you describe how it could have been improved? • What were your thoughts on how useful the data provided was for the intended purpose? • If you haven't used HEPMA data previously are there reasons for this?

Part 2 Ideas for Effectively Using HEPMA Data

This part focused on participants' ideas around effective use of HEPMA data and involved three questions with prompts:

Questions	Prompts
To be able to effectively use HEPMA data to support quality improvement and medicines optimisation we need to identify the requirements of users. Tell me about your ideas for how HEPMA data could be used to support clinical practice?	• What are your ideas on the areas of practice that should be focussed on? • How can we identify and prioritise the areas where data will have the most impact? • How would you prioritise data for use in clinical practice versus quality improvement work? • What are your ideas on the local governance processes that should be in place to identify and agree the data users want?
Following on, how do you think awareness of the HEPMA data available could be promoted?	• What are your ideas around communication strategies? • What are your thoughts on how best to engage with clinical staff?
Tell me about your thoughts on how to deliver HEPMA data to users to maximise its effectiveness.	• What are your thoughts on how involved users should be in the development of reports? • What stages of development is user involvement critical to the effectiveness and why? • What are your ideas on the best medium for presenting the data? Does this vary depending on the purpose and intended audience? • What are your thoughts on frequency requirements when accessing available data?

The topic guide underwent face validity testing in January 2024 with the Lead Pharmacist for Mental Health Services in NHS Lothian who met all the inclusion criteria to be a participant in the study. Face validity testing is a subjective assessment of whether, “at face value”, the instrument measures what it intends to. This test can provide an assessment of the grammar, flow and appropriateness of questions (DeVon, et al., 2007). The face validity test confirmed the topic guide questions were clear and interpreted as expected and no changes were required.

4.3.4 Setting and Participants

Purposeful sampling was used to identify individuals who were representative of the multi-disciplinary team within mental health services (Kitzinger, 1995). The Lead Clinical Pharmacist Mental Health, the Associate Medical Director Mental Health, the Medicines Management Nurse Mental Health, and the Mental Health Quality

Improvement Network in NHS Lothian were all asked to identify at least four individuals who met the following inclusion criteria:

- A healthcare professional working within mental health services in NHS Lothian.
- From one of the following professions: doctor, nurse, or pharmacist.
- Involved in the use of medications (prescribing, administration or verification) within mental health services.
- A minimum of 12 months experience working within mental health services.
- Familiar with the CMM HEPMA system.

Potential participants identified were sent a recruitment email which included the PIS and consent form (Appendix 6), explaining each participant's role and rights, along with the basic demographic questionnaire (Appendix 7). No selection method was required as all individuals who provided written informed consent and met all the inclusion criteria, participated in one of the focus groups. This study did not stipulate that data saturation must be met before the study could end due to pragmatic constraints, including participant access, limited time and resources. Instead, the number of focus groups was determined by the recommendations in the literature and the feasibility of recruitment and analytic manageability of the data. This approach aligns with the exploratory purpose of this research, where the goal was to capture a range of perspectives amongst healthcare professionals and generate insights rather than exhaustively capture all possible themes.

4.3.5 Data Collection

Two multi-disciplinary focus groups were conducted by the researcher (NG) with support from a second researcher (GF, Specialist Pharmacist HEPMA, NHS Lothian). The focus groups were conducted in person at the Royal Edinburgh Hospital in NHS Lothian between February and April 2024 and were audio recorded. The focus groups were undertaken following the steps outlined in Table 7.

Table 7: Steps Taken During the Focus Groups

Step	Description
Step 1	The researcher introduced the study then confirmed all participants understood the participant information sheet, had signed the consent form and completed their basic demographic information, and were happy to proceed. Participants were reminded that at the end of the focus group it would not be possible to withdraw any individual participant's data, but everyone would remain anonymous. Participants were given the opportunity to ask any questions before the audio recording was started.
Step 2	The recording commenced. Participants were asked to introduce themselves to the group and for the purposes of identifying each voice on the recordings when analysing the recording data. The focus group was conducted by the researcher as per the topic guide. Notes were taken where required and prompts utilised to elicit further information.
Step 3	Participants were asked if they had anything further to add and were invited to ask any questions before the conclusion of the focus group. Participants were then thanked for their involvement.
Step 4	The recording was stopped.

4.3.6 Data Management

The data collected were stored on the NHS Lothian Education, Research & Development (ERD) shared drive, in line with information governance requirements. The shared drive was on a password protected network and access to the shared drive was restricted to those directly involved in undertaking or supervising the study. Participants were pseudo-anonymised so that they were not identifiable. Both Dictaphones were stored securely whilst data were held on the device. Once a recording had been successfully obtained and stored on the shared drive from one Dictaphone, the data on the backup Dictaphone were erased. Once all data had been analysed and verified, the data on the remaining Dictaphone were erased.

Olympus dictation software was used to transfer audio files from the Dictaphone to a laptop. This software enabled the audio to be slowed down to aid transcription. Transcription was completed in Microsoft Word by the researcher (NG) using intelligent verbatim where the following types of data were not transcribed; sounds

such as “eh” and “umm”, stutters, stammers and false starts. The researcher (NG) then carefully removed all identifiable information from the transcript. Participants were given a code which could be used by the researcher to identify them whilst keeping the transcript anonymised. After transcription, 50% of the data was independently validated by a second researcher (GF) to ensure transcription was accurate. There were no discrepancies identified between the two independent transcriptions and therefore with 100% agreement on the content, the transcript was considered accurate. No transcripts were returned to participants for comment and/or correction.

4.3.7 Data Analysis

Thematic analysis is a widely used method for identifying, analysing and reporting patterns (themes) within a data set (Braun & Clarke, 2006). Thematic analysis was chosen as the data analysis method as it is considered a flexible and useful research tool which can provide detailed and rich accounts of data (Braun & Clarke, 2006). Furthermore, thematic analysis has the advantage of generating unanticipated insights (Braun & Clarke, 2006). Thematic analysis was performed on the data following six steps outlined in the literature (Kiger & Varpio, 2020) (Braun & Clarke, 2006). Firstly, the researcher familiarised themselves with the data. Transcribing the data themselves allowed the researcher to improve their familiarity of the data. The transcript data was then read in-depth multiple times to become more familiar with the content and initial ideas were noted down during this familiarisation. As the researcher became acquainted with the data, initial codes were generated by identifying specific text segments and coding these for further analysis. This was done in a systematic way across the transcript and each data item was given equal attention during the coding process to ensure the process was thorough, inclusive and comprehensive. The text segments were colour coded on the transcript in Microsoft Word to allow data relevant to each code to be collated. Themes were then searched for by grouping together the codes that had been generated into

potential themes and sub-themes. All identified data was organised accordingly using Microsoft Excel and the themes were reviewed to check that they worked in relation to the coded extracts and the entire data set. Once all the identified data had been grouped the themes were reviewed to define and name them.

Thematic analysis was independently undertaken by two researchers (NG and AF, PhD student, University of Strathclyde) for the first transcript (Matheson, et al., 2016). Both researchers identified and coded the same text segments under similarly named themes. Although each researcher had named some individual themes and subthemes slightly differently, the concept of the themes and subthemes were similar and together the researchers agreed the final naming. Therefore, there were no discrepancies identified that suggested significant divergence between the two independent thematic analyses. Using the results of this validation, thematic analysis was performed by one researcher (NG) on the second transcript. The results of the analysis of the second transcript were reviewed by AF and themes were agreed and finalised.

4.3.8 The Research Team and Reflexivity (as per COREQ checklist)

The research team comprised of an MPhil student (NG) as well as three supervisors (MB, AK, AW) who had extensive experience in qualitative research methods in healthcare. As this study was part of their MPhil, the female MPhil student was the sole researcher and conducted both focus groups with administrative support (GF). The researcher was qualified to MSc level in research and had experience of conducting qualitative research methods. The researcher was known to five of the focus group participants through their NHS role as Advanced Pharmacist HEPMA which could have affected participants' behaviour in response to the questions. Participants were made aware before the focus group that the research was being conducted as part of the researcher's MPhil and this included outlining the broader goals of conducting the research.

4.4 Results

4.4.1 Demographics

A total of nine members of the multi-disciplinary team participated in the focus groups. The first focus group had four participants and lasted 58 minutes. The participants consisted of two pharmacists, one doctor and one nurse. The second focus group had five participants and lasted 47 minutes. Of the five participants, there were two pharmacists, two doctors and one nurse. Participant demographics are detailed in Table 8. Participants were required to opt in to the study therefore refusing to participate was not relevant. There were no participants who failed to attend their scheduled focus group.

Table 8: Participant Demographics (n=9)

Demographic		n (%)
Job Role	Pharmacist (Prescriber)	3 (33%)
	Pharmacist (Non-prescriber)	1 (11%)
	Consultant	1 (11%)
	Speciality Doctor	1 (11%)
	Junior Doctor (all training grades)	1 (11%)
	Nurse (Prescriber)	0
	Nurse (Non-prescriber)	2 (22%)
Time in Current Role	0-2 years	3 (33%)
	>2-5 years	4 (44%)
	>5-10 years	1 (11%)
	>10 years	1 (11%)
Experience in Mental Health Services	>2-5 years	2 (22%)
	>5-10 years	5 (56%)
	>10-20 years	0
	>20 years	2 (22%)
Specialist Area of Practice	Acute adult general psychiatry	6 (67%)
	Dementia	1 (11%)
	Substance misuse	1 (11%)
	Acute complex discharge	1 (11%)

4.4.2 Summary of all Themes and Subthemes

A total of seven themes were identified and within these there were a total of 12 sub-themes identified. All themes and subthemes are summarised in Table 9.

Table 9: Summary of Themes & Subthemes

Theme	Subtheme
Theme 1 Experience of HEPMA Data	• Limited experience using HEPMA data or limited knowledge of HEPMA data • Knowledge and/or experience of HEPMA data
Theme 2 Barriers	• Training • Expectations • Usability • Data Limitations
Theme 3 Proposed Uses of HEPMA Data	• Clinical Uses • Triggered Prompts and Alerts • Medicines Management • Prioritisation of Proposed Uses of Data
Theme 4 Delivery of HEPMA Data	• Presentation • Frequency
Theme 5 Governance	
Theme 6 Promotion	
Theme 7 Clinical User Involvement in Development	

4.4.3 Theme 1 Experience of HEPMA Data

Participants were asked about their experience and knowledge of HEPMA data at the beginning of the focus groups and the results of these discussions formed the first theme. Participants generally fitted into one of two categories which resulted in the two sub-themes identified: (i) those with very limited to no experience and/or knowledge of HEPMA data and (ii) those who had knowledge and/or direct experience of using HEPMA data.

(i) Sub-theme: Limited experience using HEPMA data or limited knowledge of HEPMA data

When asked about their experience and knowledge of HEPMA data, four (44%) participants expressed they had limited or no experience of utilising HEPMA data. All three of the doctor participants were in this category. One participant expressed *"I don't know how to do it, so I've never done it personally" (Doctor 2).* Another participant advised *"I can't say that I've ever really used it beyond…prescribing and looking what people have been prescribed…so I don't know a huge amount about the use of data outside of that." (Doctor 1).*

There was also a lack of awareness and knowledge around the available data amongst participants in this category. Participants advised they weren't aware what was available and *"I don't know how to look into it myself, I've never been taught or shown how to do that" (Doctor 2).* It was also described that "*we've all probably…gotten into the mindset of thinking of HEPMA as just a digital Kardex and forget there's probably huge amounts of data that we could correlate…to make use of…I don't really know how that currently works." (Doctor 1).*

(ii) Sub-theme: Knowledge and/or experience of HEPMA data

The remaining five (56%) participants expressed that they did have prior knowledge or experience with HEPMA data. All four of the pharmacists recruited were in this category. There were four areas of previous experience with HEPMA data that were described: controlled drug monitoring; patient identification; individual patient monitoring; and medication history reviews.

<u>Controlled Drug Monitoring</u>

Some participants had previously utilised HEPMA data presented as a report which compared controlled drug administrations against the stock supplied to the wards.

This report was being used frequently by one of the participants who advised *"we use it quite a lot if we have a discrepancy with the controlled drugs… we're able to go back and maybe look and see ones that haven't been written in our paper book that have been charted on HEPMA and fill them in and hopefully find that there's actually not any tablets missing it's just that we haven't filled it in correctly" (Nurse 2).*

When asked about the usefulness of the data from this experience the feedback was positive from the participants who had used it advising *"I think it was pretty good" (Pharmacist 1)* and *"it is quite easily accessible the data" (Nurse 2).* The report was also felt to have time saving benefits.

Patient Identification

Another experience of HEPMA data use was in relation to quick identification of patients who met certain criteria to support project work:

"…we pulled out data for sodium valproate prescriptions…to see if the pregnancy prevention paperwork was in place…they used that to pull out names and then they could go on Trak [electronic patient record system] to then look and see" (Pharmacist 1)

Individual Patient Monitoring

The third example of HEPMA data use was related to individual patient monitoring to guide treatment decisions:

"We've pulled out data before from HEPMA on how much benzodiazepine someone was given in a month's time to guide us whether we need to titrate it down. Basically, what was the total dose that they've been having each day so it can be helpful." (Pharmacist 2).

Medication History Reviews

The final area of experience with HEPMA data was related to medication history reviews within the mental health context. With this use of the data there were mixed views on the usefulness of the data. One participant explained that the data solution did not work for their needs when transferring information from the data report to their master record for the patient:

"I gave up using it because the way the data was presented, I couldn't cut and paste it." (Pharmacist 4).

This view was in contrast with another participant who advised *"I did think that it was useful having very specific dates and…I thought it was quite good having it compiled" (Pharmacist 3).*

4.4.4 Theme 2 Barriers

It was further explored why some participants had never used HEPMA data before. Additionally, those who had prior experience of using data from HEPMA were able to elaborate on barriers to being able to use the data more effectively and efficiently. These barriers identified, formed the second theme. Four sub-themes were identified: training; expectations; usability; and limitations of the data.

(i) Sub-theme: Training

On further exploring why some participants had never used HEPMA data before participants agreed that training was a barrier advising that they hadn't had any training relating to the data:

"I don't think there's the knowledge base there among nurses beyond the fact that we administer and that there is data. We probably don't even know what it is and what could be used" (Nurse 1).

This view on training being a barrier was expressed by several participants, with one participant saying, *"it doesn't matter how much data is there if ward-based staff, pharmacists, nurses, doctors aren't adequately trained." (Pharmacist 4).* As well as training being a barrier it was felt that training must be tailored to the needs of different professions:

"…everybody on this table is going to need to use it differently…So the training needs to show people these good things they can use…and you need to be able to access the training to show you what is useful for your role. (Pharmacist 4).

(ii) Sub-theme: Expectations

Amongst the participants there was a feeling that staff expectations are a barrier as they do not expect to be allowed access to all the available data:
"I'm not expecting to be allowed to use some of the things [data] but maybe I will…it is an expectation thing…but knowing what level…of involvement we're likely to have, what level of data we could request, would be really helpful." (Nurse 1).

As well as the participants having low expectations on the level of access to data they would be permitted, there was also unrealistic expectations of the system and the data within it which cannot be met. This can lead to a negative view of the system and reduced engagement if expectations are not appropriately managed:

"You think you could just search say haloperidol and it gave you everything about that drug. You'd expect in an electronic system you could do that, but it doesn't seem to be able to facilitate it." (Pharmacist 4).

(iii) Sub-theme: Usability

Participants felt that when data is not easily accessible it creates a barrier. It was the experience of some participants that *"it's really hard to pull that data*

out…that's often the case in HEPMA there's a huge amount of information there and it's often quite difficult to access it" (Doctor 1)

Another factor affecting the usability was the time required to review and access the data. It was described that if the data can be accessed quickly in "a matter of minutes" then this would be more usable. The time available in clinical practice was highlighted as a barrier:

"We don't have enough clinical time…we don't have extra time to run reports…so if it's being done it needs to be done in a helpful way for us." (Pharmacist 4).

The final area of usability was the way the data is delivered and presented. Participants had opposing views on what delivery and presentation would be their preference. As an example, one participant said, *"I don't want to be running reports, I want somebody to give me the outcome of that." (Doctor 3)*. However, another participant had an opposing opinion advising *"…whereas I would…it would be helpful for me to have that access so that… I could just run a report, it would take me much less time." (Nurse 2).*
An example was described where the delivery of the data can affect the usability:

"a daily e-mail that was only helpful once in a blue moon would probably start getting ignored" (Doctor 2).

When referring to data delivered in the form of triggered emails or regular reports it was felt that if the trigger for the data is *"…oversensitive then you would end up deleting them all because most of the time you'll start realising they're not making any changes to your clinical practice, but…if it was something more serious, maybe you would pay attention to it." (Doctor 3).*

(iv) Sub-theme: Limitations of the Data

The limitations of the data itself was another barrier described by participants as this can impact on the quality of the data and the intended purpose. The biggest limitation of the data that was discussed by participants was due to HEPMA only being available for inpatients currently and not easily linked with data from other care settings:

"Pharmacist 3: …if HEPMA had some sort of outpatient prescribing programme whereby it was prescribed by outpatients it would be quite good to be able to go through that as well.

Doctor 3: I agree and being able to match up anything that's happened in the Community."

4.4.5 Theme 3 Proposed Uses of HEPMA Data

Participants discussed many areas of their clinical practice which could benefit from HEPMA data. These proposed uses of HEPMA data formed four main sub-themes: clinical uses; triggered prompts and alerts; medicines management; and prioritising uses of HEPMA data.

(i) Sub-theme: Clinical Uses

The proposed uses identified within this sub-theme are all related to HEPMA data which could be provided as standalone reports or live dashboards and could be either regularly scheduled data or ad hoc requests. There were several areas of clinical practice discussed where it was felt that HEPMA data used in this way could be beneficial and these are visualised in Figure 3.

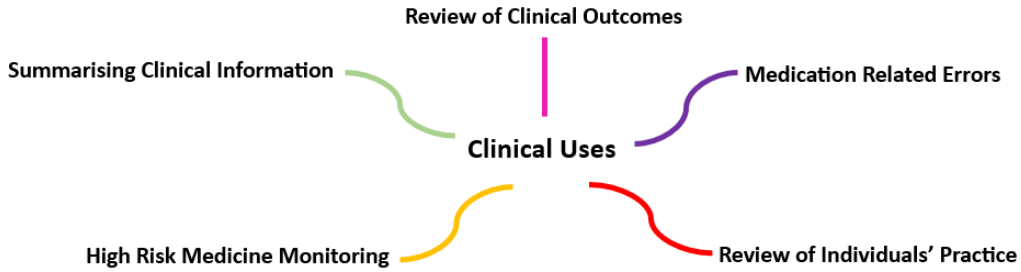

Figure 3 Summary of Proposed Clinical Uses of HEPMA Data

Review of Clinical Outcomes

It was described that HEPMA data could be utilised to enable large scale reviews, for example, to identify prescribing patterns which are resulting in positive clinical outcomes:

"look…on a wider scale of…what medicines are keeping people out of hospital…are certain teams using more of a particular drug and finding they're having less readmissions because of it…that would be really useful." (Doctor 1).

One specific example given was *"…looking en masse at all the treatment resistant patients in the hospital and what has caused a successful outcome versus an unsuccessful outcome." (Doctor 1).*

It was also suggested that by reviewing the data around what medicines patients have been prescribed but not required could help rationalise prescribing for individual patients:

"…if you could get…your patients on the ward have had X number of doses…that they haven't taken…then that could be super helpful around deprescribing." (Doctor 3).

Medication Related Errors

Participants felt that review of reported errors could highlight areas where HEPMA data could be used as a mitigation to prevent similar errors occurring. It was suggested that themes identified through the error reporting system, Datix, could identify these areas where HEPMA data could be beneficial to promote safe practice:

"that could all come from incidents, Datixes, if there ever comes a need where there's a theme you could do that for wards as part of addressing that theme. It doesn't need to be forever it could just be for a period of time and simultaneously it helps highlight the fact that this data can be obtained." (Pharmacist 1).

Participants felt that clinical staff, for example charge nurses, would benefit from having regular access to HEPMA data identified for this purpose.

Review of Individuals' Practice

A participant highlighted that HEPMA data would be helpful for being able to review your own practice. They advised *"you can identify your own bias…if you look at your own prescribing, if you request a report on yourself" (Pharmacist 2)* as this would allow you to review and reflect on your own prescribing habits and practice. They also highlighted prescribing data could be helpful to review prescribing patterns across prescribers and identify any potential areas for improvement such as identifying training needs for individual prescribers.

Participants felt that HEPMA data would also be useful for identifying behavioural patterns of clinical staff. One example was related to administration of when required medications, pro re nata, commonly referred to as "PRNs". It was explained that by looking at practice through HEPMA administration data it could help identify areas where there is variance between staff. An example described was different nurses utilising PRN medication to different extents for the same

patient. It was described that identifying this variance in administration patterns through review of HEPMA data might highlight that the prescription, including the intended indication, is unclear leading to this inconsistency in practice:

"…there's probably some interesting behavioural stuff there as well for nursing practice. I can think of specific patients that I'll give PRNs to that other nurses won't…Do we need to change the message coming from ward round about why they [the patient] are getting it?" (Nurse 1)

It was felt that behavioural patterns would also be helpful from a prescribing perspective to identify and review variation in practice:

"…if you looked at the prescribing habits of different consultant teams in terms of who follows what protocols, in terms of what meds they go for, you know, what do you try before you get to clozapine? How long would you give it?" (Doctor 1).

Summarising Clinical Information

It was felt that some information in HEPMA is too complicated and not concise enough and therefore access to data that summarised and presented the clinical information in a more user-friendly way would be beneficial:

"you go on the discontinued list of medications and if someone's been in hospital for a while…if they've been titrated onto clozapine, you get every single dose change…if there could be another thing that said they started on clozapine on this day, took them this amount of weeks to get up to a reasonable maintenance dose and since then they've gone up to this dose…some sort of simplification or condensation I think would be really helpful." (Doctor 2).

This was described as something that would also be beneficial for depot medicines and when required medicines. In addition, pharmacist participants suggested that

summarised information they would find beneficial is *"when a new prescription's put on HEPMA…if there was a way of flagging that or even priority drugs so that when you come in in the morning you can see…this patient's had a new prescription for this drug." (Pharmacist 1).* It was described that this would help ensure prompt pharmaceutical interventions where required for new medicines commenced.

High Risk Medicine Monitoring

The group discussed a data report currently in use in other areas in NHS Lothian for gentamicin, a high-risk antibiotic. This report for gentamicin combines HEPMA data with data from the electronic patient record and laboratory results data which are separate electronic systems to HEPMA. It was described that the equivalent to that report in mental health would be medicines such as clozapine, lithium and valproate. There was a lot of discussion around the benefits of data in supporting the safe use and monitoring of high-risk medicines in mental health:

"…there could be a report for the hospital that would say ok all these patients are on clozapine, this is the date of their last blood test, this is their blood level…lithium similarly, this is their lithium level, this is when they last had bloods done, this is when they last had the monitoring done." (Doctor 3).

It was described that reports for high-risk medicines, and in particular clozapine, would be *"super helpful"* which was agreed by several participants. It was felt that data showing information on when monitoring bloods were due, recent blood monitoring levels and if these are out of range alongside the prescription information *"would be really helpful…and be useful to lots of people because lots of people are running around looking for that data just now." (Pharmacist 4).* It was suggested this would be wanted on a regular ongoing basis for example on a weekly basis.

This example was agreed amongst participants as something they would find beneficial to their clinical practice. It was described that this would be a helpful way for phlebotomists to identify patients requiring bloods to be done and for clinical staff including doctors and pharmacists to be prompted to review prescriptions and levels to ensure patient safety and prevent any delays to treatment.

(ii) Sub-theme: Triggered Prompts and Alerts

Participants discussed several other areas of their practice which could benefit from HEPMA data in the form of triggered prompts and alerts. The ideas within this sub-theme would likely rely on utilising HEPMA data to enhance the functionality within the system to respond to certain criteria, development of which would require to be driven by the HEPMA system vendor. Alternatively, some of the ideas could potentially be realised through utilisation of triggered emails to staff. The participants discussed several areas where they felt HEPMA data could really benefit their practice in this way, and these are summarised in Figure 4. It was explained that the triggered prompts and alerts developed from the available data would be helpful as *"there's a lot of stuff that's relying on one person remembering to tell another person about something" (Doctor 1).*

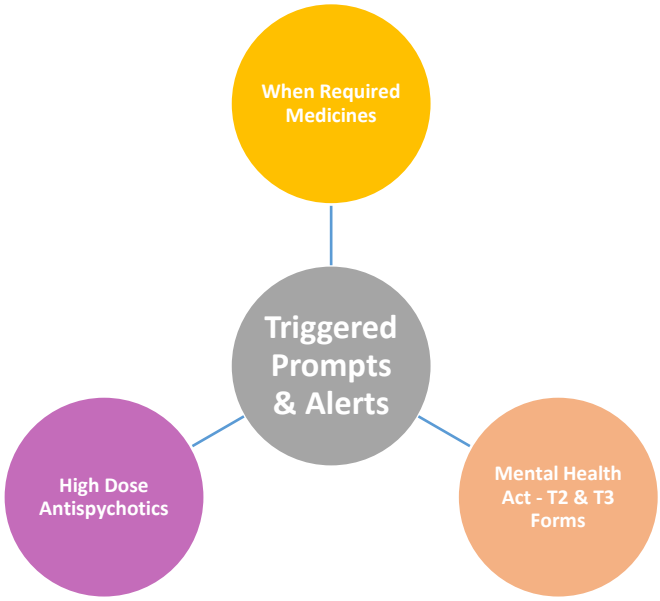

Figure 4 Summary of Proposed Triggered Prompts and Alerts from HEPMA Data

One example given was a triggered email from the data when a patient reaches their maximum dose of an “as required” medication. The suggestion was the data would trigger an email alert to the appropriate members of staff when the patient reaches this defined threshold to prompt a review of the patient’s requirements and whether their current dose is appropriate.

Another suggestion was utilising the data to identify when the high dose antipsychotic threshold is reached. The expectation was that this would allow the HEPMA data to alert that high dose monitoring is required for the patient.

The final area discussed where a triggered alert from the data would be beneficial was related to treatment forms (e.g. T2 and T3 forms) used in connection with patients detained under the Mental Health (Care and Treatment) (Scotland) Act 2003, who are in receipt of treatment for a mental health disorder. A T2 treatment form is a certificate of the consent to treatment and a T3 treatment form is a certificate of a second opinion when a patient is unable or unwilling to consent to treatment. Both T2 and T3 forms outline the treatments which are authorised to be used for the patient. It was suggested that HEPMA data could be used to trigger when treatment is out with the plan agreed within the T2 or T3 form:

“…if there was a function on HEPMA whereby HEPMA knew what was on the T2 or T3 form and if we prescribed an extra drug for example and it alerts you to say this needs to be updated because it's not on the form or it tells you that you maybe need to stop something because it's not on the form.” (Pharmacist 3).

It was highlighted that prescribing within the context of these forms is a legal requirement across Scotland and therefore this could give more traction to develop what is required from the data available as the benefit could be Scotland wide. Currently there are standalone templates within HEPMA for T2 and T3 forms but the content of these is not correct for legislation requirements within Scotland.

Furthermore, the built in HEPMA forms do not currently have any functionality linked to them. There is also currently no ability to extract data entered into these forms to be able to create a data tool that could compare the data entered into the form with the current inpatient prescription on HEPMA.

(iii) Sub-theme: Medicines Management

The final area where proposed uses of HEPMA data were discussed was around medicines management processes. This area would involve linking HEPMA data and pharmacy stock control (PSC) data. Data from both are contained within the same database as they are two components of the same system. A proposed example was utilising data on medication usage to identify medicines which have not been administered in an area and if it would be appropriate within local medicines governance policies to then return these to pharmacy:

"I have gone round to seven acute wards counting every single medication that's expiring in the next six months…if I could just get flagged or a pharmacy technician could be flagged that something…hasn't been administered in six months, then it gets…returned to pharmacy" (Nurse 1).

Participants felt that in addition to reducing wastage this sort of data could be timesaving and help ensure critical medicines were available promptly if clinical staff were allowed access to data relating to ward stock holdings and usage. This was described as particularly helpful in an on-call situation. Additionally, it was highlighted that this type of data could be helpful for reviewing and updating stock lists by comparing administration data from HEPMA against stock ordering and issuing data within PSC.

The final example relating to medicines management processes was monitoring of unlicensed medicines (ULM) and utilising HEPMA data to identify these prescriptions:

"…some of the descriptions on HEPMA…have ULM next to it…that's other data that would be handy…to look through for medicines management processes to see if things have been followed as they should…like part of an audit…Unlicensed medicines are very specific groups of medicines so would be useful tools to have." (Pharmacist 1).

(iv) Sub-theme: Prioritisation of Proposed Uses of HEPMA Data

There were a lot of proposed uses described, and participants were therefore invited to give their thoughts on how development of HEPMA data resources should be prioritised so that the available capacity for development is utilised in the most effective way. It was summarised by one of the participants that the best place to focus initially would be an area *"that lots of people would find helpful and that has real impact on patient care." (Doctor 3).*

Clinical requirements were felt to be the priority amongst several participants:

"*clinical…ought to be priority because obviously quality improvement is really important and we all need to be doing it, but at the end of the day if somebody's sick in front of you…that's the bit you…have to prioritise." (Doctor 1).*

This was further expanded on to suggest how clinical resources could also be prioritised:

"…you should start with the risky drugs that need attention across a service. So that would be clozapine, lithium and valproate. And probably clozapine top of the list" (Doctor 3).

In addition to data which directly supports the clinical care of a patient, it was also suggested that any data uses which have time-saving benefits should be a priority as this would release time to care for patients.

In terms of who should make the decision around the prioritisation it was felt amongst several participants that there should be local clinical input to this. It was suggested the best place for this would be the clinical area's Drug and Therapeutics Committee which would ensure representation from more than one professional group.

4.4.6 Theme 4 Delivery of HEPMA Data

Participants discussed the delivery of HEPMA data and within this theme there were two sub-themes identified: presentation and frequency.

(i) Sub- theme: Presentation

Participants described different aspects of data presentation that would help enable clinical users to utilise HEPMA data. One participant advised that *"the most important part is…how user friendly it will be. Because if it's not, it will never be used." (Pharmacist 2).*

Participants felt that having live data presented for example, on an electronic dashboard, would be beneficial for clinical users. It was suggested that clinical users would want the ability to control and filter the data they are presented with and to have the ability to change these preferences for different patients. It was felt this would help prevent information overload:

"You can also completely get information fatigue…where you just get so many alerts…that you just stop really paying attention to them." (Doctor 1).

In addition to being able to modify the content and volume of data presented on an individual basis it was also described that an ability to change the presentation format would be helpful:

"…creating things like…toggles so if you wanted to see it in table form you can see it in table form, if you wanted to see it in graph form it's easy, there's not different reports each time…to get the same data." (Pharmacist 1).

The ability to change the presentation format to be able to see the data as a "visual timeline" was also described as something that would be beneficial to clinical staff. Participants felt that the presentation would depend on the intended use and who the target audience was. It was therefore felt that having this flexibility for users to change the presentation could enable one data resource to be utilised for many different purposes. It was also highlighted that report requests should not be considered in isolation and that when any data resource is being created the presentation of this should be considered for the requested purpose but also on a broader scale to widen the usefulness of the data.

It was also highlighted that the presentation of the report should be jargon free to ensure it is clear for all users.

(ii) Sub- theme: Frequency

Participants expressed that the frequency of access to the data, like the presentation of the data, *"would vary on what you were using it for" (Doctor 1).* This was felt by several participants to be the case, and it was described that clinical uses of data for a patient in your care would often require immediate access to the data whereas uses of data to support audits as an example would have variable frequency requirements:

"95% of what we'd look for would be we want to look at it now, it's patient specific." (Nurse 1).

However, it was expressed that despite the majority of clinical data uses potentially necessitating instant access to live up-to-date data, there were other clinical examples described where the data would be suited to delivery at a regular set frequency:

"…a weekly report of who's on a high dose of antipsychotic would be really useful in terms of helping junior doctors plan who needs to get bloods done." (Doctor 1).

Participants also felt that some HEPMA data uses would require a continuous frequency of delivery while others would only be required for a short period of time to perhaps address a short-term issue:

"You might have a ward-based thing where…medications go missing. You want that report for a relatively short period of time, just until you get on top of the problem…there's going to be…stuff that you just want running and then other bespoke things to look at specific issues." (Doctor 3).

4.4.7 Theme 5 Governance

The governance surrounding the use of data was discussed amongst participants. There was a lack of knowledge amongst participants on current governance processes relating to HEPMA data as well as data from other sources, but it was felt that governance for all data requests should be aligned:

"I don't really know how that currently works…we did an audit…and we spoke to some of the Quality Improvement team and they found that data…But I don't know who has to…approve that…whatever way we currently do for the other data, probably ought to be the same way we do it for HEPMA so we have some kind of consistency with it." (Doctor 1)

Participants felt that there should be local oversight as part of this governance if this is not already in place. As well as governance around granting access to the data participants were very clear that they would want assurance that there would be an audit trail to show who accessed what data. Participants also highlighted the need to consider confidentiality aspects and when patient consent would be required for access to patient identifiable data.

With regards to approving access to HEPMA data it was suggested that it might be helpful if some data requests could be approved for a group of staff to access rather than at an individual level:

"…if certain requests are regular, making them all auto approved for certain users to cut down on the amount of requests…for example…you auto approve that for band fives [staff nurse grade] in acute wards…and I start showing people within the ward that we can use this data and they don't have to go and wait on a request to be approved cause it's data that's appropriate…it's not going to be sharing information that people wouldn't regularly have." (Nurse 1)

Communication of governance relating to HEPMA data was discussed amongst participants. Participants expressed the importance of ensuring the governance process to request access to data is clear and well communicated.

4.4.8 Theme 6 Promotion

Participants were invited to share their thoughts on how the available data could be promoted to clinical staff to improve engagement. The ideas for promotion of HEPMA data are summarised in Figure 5.

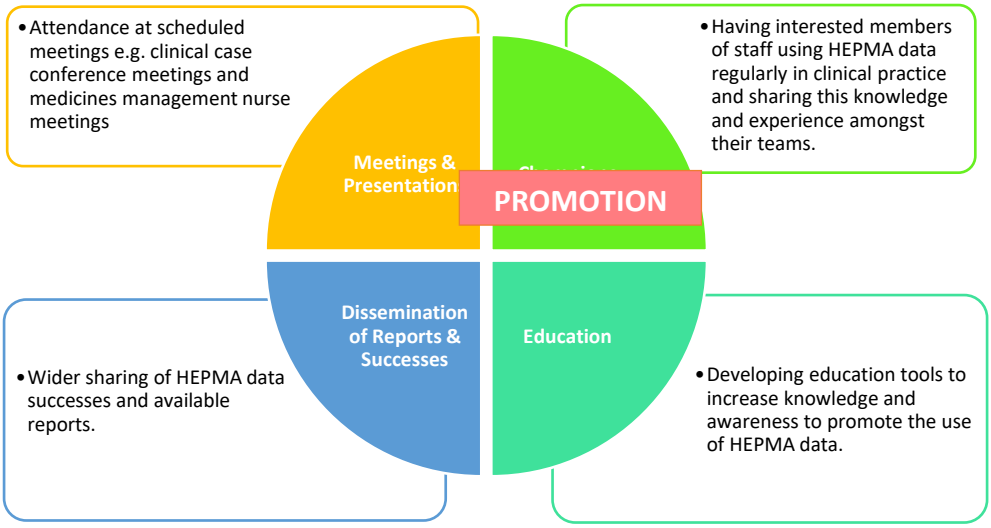

Figure 5: Summary of Ideas to Promote HEPMA Data (Theme 6)

It was suggested that attending scheduled meetings to inform staff and present on the data that is available from HEPMA could help with promotion:

"…sometimes people come to case conference…and give…a talk to doctors about particular systems or changes that are happening, and I think making people aware of what's available and how you access it would probably make a massive difference." (Doctor 1).

For nursing it was suggested that a local medicines management nursing group which meets every two months would be a good place to promote HEPMA data.

Another suggestion to help promote the available data was to have "Champions". It was described that clinical staff with a particular interest in utilising HEPMA data could promote this by spreading awareness amongst their colleagues and using opportunities like ward rounds to highlight where HEPMA data could be beneficial. It was also felt that in the case of Champions, *"having somebody using them [reports] and showing their colleagues this is what's…available you might get a lot more users requesting to use them." (Nurse 2).*

The third suggestion was around educating staff on the data related tools that already exist. It was felt that if staff were educated on HEPMA data it would raise awareness and promote interest amongst staff to access and utilise the data. An example suggested was a new e-learning module in addition to the mandatory modules required to gain access to the HEPMA system:

"…it would need to be here's the basic training so you've got access to HEPMA…and then an option to do…enhanced training which is how you pull this data and actually may be specific to certain areas or if you can give kind of suggestions about how you would use the data and you can be shown how to use it." (Pharmacist 3).

The importance of making key members of the clinical team aware of a training module was expressed as important to aid promotion:

"Getting charge nurses…because they identify people who are interested you know they might not have time to go and watch something like that, but they might go…you're interested in this, there's something on this go and find it and watch." (Nurse 2).

The final area suggested to support promotion was utilising existing communication pathways such as "all staff" email communications to promote examples of how HEPMA data has supported practice. It was felt that communicating what can be done with the data to a wider audience would help with promotion of the data. As well as sharing success stories, it was also suggested that wider distribution of the HEPMA data being used would help raise awareness and promote staff to start to think of other similar uses that could benefit their practice:

"…sending regular reports, even to charge nurses, on particular medications that are prescribed so they can review the patterns…and think OK it's useful for this drug why don't we use it for another drug." (Pharmacist 2).

4.4.9 Theme 7 Clinical User Involvement in Development

Participants were invited to provide their thoughts on clinical user involvement in the development of HEPMA data resources. The participants agreed that clinical staff should be involved in the development of data resources:
"You need to be involved at the beginning to know what the limitations are…but you'll need to be involved again at the end to see how they're going to present the data…so to me it would be the two things." (Pharmacist 4).

As well as involvement at the two critical stages described it was also highlighted that you need to ensure you have the *"right people involved in a small group…that were willing to commit the time to it…it's better to…do that and get something really useful at the end of it." (Doctor 3).*

As well as clinical user involvement in the development being expressed as a crucial aspect to getting the most out of HEPMA data it was also highlighted that feedback from the clinical users is essential. It was felt that staff need to have an easy way to provide feedback, and the suggestion was to have this linked in directly with the report resource:

"…if you want to give feedback…it would just be better if on the page where the reports are there's a…feedback option and you just send it off without opening up Outlook." (Pharmacist 1)

4.5 Discussion

4.5.1 Summary of Key Findings

This study sought to explore and synthesise views of healthcare professionals in relation to HEPMA data with the aim of determining how HEPMA data can be utilised in the most effective way to improve medicines optimisation and support quality improvement in mental health services. It is outlined in the literature that better engagement with users to understand their requirements would improve the ability to harness the benefits of data (Chaudhry, et al., 2021). In addition, the scoping literature review in Chapter 3 identified several factors generally not reported on when trying to harness the benefits of prescription data. These factors included determining user perceptions of the best medium to distribute the data and the required frequency of access to the data. It was also not always clear who the intended users of the data were and how involved they were in outlining the data requirements. The scoping literature review recommended future work should address questions around the areas of practice that users would like to be a focus for data interventions and how to deliver a data intervention to users including how often and through what medium.

A total of nine participants (four pharmacists, three doctors and two nurses) from the multi-disciplinary team working within mental health services participated in one of the two focus groups conducted in February and April 2024. The data were categorised into seven themes using thematic analysis as summarised in Table 9: experience of HEPMA data (Theme 1); barriers (Theme 2); proposed uses of HEPMA data (Theme 3); delivery of HEPMA data (Theme 4); governance (Theme 5); promotion (Theme 6); and clinical user involvement in development (Theme 7).

Themes 1 and 2 focussed on participants' prior experiences with HEPMA data and over half the participants (n=5) had previous knowledge and/or experience of HEPMA data. An understanding of how these experiences could have been

improved was identified along with barriers that were preventing other participants from utilising the available data. Areas for improvement identified included training tailored to different professional groups' needs as well as improving understanding of what data is available and who can access it. It was also highlighted that the speed of accessing data and individual access needs must be factored in when utilising data.

Themes 3 and 4 addressed the research question of how HEPMA data can be utilised to improve medicines optimisation and support quality improvement in mental health services. The clinical uses of data identified were all related to data which could be provided as reports or live dashboards which are separate to the HEPMA system. Overall, these suggestions focused on improving practice through summarising and collating data in a more efficient and usable way as well as looking at cohorts of patient data to identify themes and trends in practice. The triggered prompts and alerts subtheme focussed on areas where practice could be improved by utilising the data to enhance the functionality within the HEPMA system to respond to certain criteria or through utilisation of triggered emails to alert staff. With many proposed uses identified participants felt that prioritising the order of development should have local clinical oversight from a local committee which has multi-disciplinary representation. In terms of effective delivery of HEPMA data the two key aspects identified were presentation and frequency. It was determined that clinical users desire an ability to filter and control the data they are presented with as well as an ability to change the presentation format including displaying as a graph or visual timeline depending on the use. The frequency of delivery was felt to be variable depending on the intended purpose.

The final themes (Themes 5, 6 and 7) were focussed on the organisational aspects which could impact on effective use of HEPMA data. There was a lack of knowledge amongst participants of current governance processes and concerns around confidentiality and data access rights. Promotion ideas were suggested which

participants felt could help address some of the barriers identified in Theme 2. Finally, the importance of organisations involving clinical users in the development of any HEPMA data resource was outlined.

Theme 1 Experience of HEPMA Data

Over half of the participants (56%, n= 5) had previous knowledge and/or experience of HEPMA data compared with those participants who had limited to no experience or knowledge. A clear split was identified between the medical and pharmacy professions regarding their experience with HEPMA data. All four pharmacist participants had previous experience with HEPMA data whilst all three doctor participants had no previous experience and/or knowledge of HEPMA data use. The HEPMA system in use where the participants work is part of the same system used for pharmacy stock control purposes. Based on the researcher's specialist knowledge, the pharmacy stock control part of the system has been implemented since 2014 and on average there are 20-30 reports used from this part of the system by pharmacy staff each day. There is therefore already a familiarity and established use within pharmacy teams utilising data from other aspects of the system that HEPMA is part of which may be a reason why the pharmacist participants had already sought data from HEPMA. There may also be barriers to accessing the data for professions out with pharmacy as pharmacy staff already have a higher level of access to the system that HEPMA is part of. Furthermore, the HEPMA system is delivered by a team of mainly pharmacy staff. Perhaps this has resulted in closer links with the wider pharmacy profession and led to the greater knowledge and uptake amongst pharmacy teams. This is consistent with what was seen in a previous United Kingdom (UK) study of 187 hospital organisations which determined that for organisations which reused data, 100% of them had pharmacists as users of the data (Chaudhry, et al., 2024). Uptake of the other groups was lower in the organisations included with 63% and 45% having doctors and nurses, respectively, as users of the data (Chaudhry, et al., 2024). In addition, a

significant difference was shown between organisations using data if they had an electronic prescribing pharmacist or not (Chaudhry, et al., 2024).

The previous uses described by participants in this theme were consistent with the literature. A previous UK wide study identified purposes for data reuse including audit, quality improvement projects, improving the safety of medication use, medicines reconciliation and evaluating interventions (Chaudhry, et al., 2024). Data for the purpose of audits and quality improvement projects was described by participants in the work in this thesis with an example given of a project on sodium valproate and associated pregnancy prevention paperwork. Participants also described using data to improve medication use and evaluate treatment with an example given of utilising data to guide treatment decisions around titration of benzodiazepines. In addition, participants described utilising data for medicines reconciliation purposes although the perceived effectiveness of the data for this purpose was variable. There were other purposes identified by Chaudhry et al. which were not currently being utilised by participants in this study but were identified as areas of interest under the proposed uses of HEPMA data theme which will be discussed later. There were further areas identified by Chaudhry et al. that were not discussed by focus group participants in this study which included board reporting and data to drive policy change (Chaudhry, et al., 2024). These uses are generally at a more strategic management level, and this is perhaps why these were not discussed amongst participants as they were being asked to focus on using data for their clinical practice.

Theme 2: Barriers

Barriers identified in this study were training, expectations, usability, and limitations of the data. The literature divides the reasons clinical information is not reused into four categories: information is not available when or where it is needed; information is present but usage of the existing source is prohibited; information is present but not routinely used in its available form; and the information is present

but the information is insufficiently reliable or of inadequate relevance (Galster, 2012). Within these categories it was identified that data is not used for technical reasons such as limited interoperability between information systems. This was described by focus group participants in this study as a limitation of the data as the information between community and outpatient systems is not currently linked with the inpatient data from the HEPMA system. The areas that the data extends to was felt to be a limitation as it means the patient's full treatment history cannot be seen through HEPMA data alone and instead necessitates review of data from multiple electronic systems to see a full treatment history across all sectors of care. Focus group participants in this study described issues with access to data as a barrier related to the usability of the data which the literature has also described as a factor which will prevent clinical information from being reused (Galster, 2012).

With regards to training being a barrier to effective use of HEPMA data this is also consistent with the literature. It has been highlighted previously that best practice with regards to secondary uses of data is to educate and train staff so that they have the right skillset and knowledge in relation to the data (Chaudhry, et al., 2021). In addition, participants in this study provided insight into how they want training to be provided with the focus being on training tailored to different professional roles.

Theme 3 Proposed Uses of HEPMA Data

The proposed uses of data were split into four subthemes: clinical uses; triggered prompts and alerts; medicines management; and prioritising uses of HEPMA data.

As mentioned under Theme 1 the proposed uses of HEPMA data identified in this thesis are consistent with what has been presented in the literature. The UK wide study described in Theme 1, which is the first research to explore secondary uses of data in survey format, outlined current uses including error analysis, performance, evaluating interventions, medication use and quality improvement (Chaudhry, et

al., 2024). The proposed clinical uses identified through the focus groups in this study could be grouped into these broad categories outlined in the literature. However, the focus groups enabled more detail to be gathered to understand exactly how clinical staff want to utilise data in mental health services, providing a user driven focus on how to best to utilise the data. The need to understand the intended audience better was an area of improvement outlined in the literature and this research has shown that engagement with users provides the focus and detail required to identify target areas to develop data resources.

The triggered prompts and alerts outlined by focus group participants are also consistent with the literature as they all relate to medication use and were in line with the top five incentives for secondary use of data identified in the literature which included improving medication safety and providing timely feedback (Chaudhry, et al., 2024). The focus groups had the benefit of identifying specific areas within mental health services (e.g. high dose antipsychotics and “when required” medicines) that clinical staff want to be a focus for improvement through data driven triggered prompts and alerts. The knowledge gained through this study will enable future work to be driven by the confirmed needs of the target audience.

The different uses of HEPMA data outlined in this study included individual patient level data applications as well as aggregate level data applications. Individual patient level data uses described could support direct clinical decision-making and patient safety whilst aggregate data uses could support population-level monitoring and quality improvement. This highlights that HEPMA data has the potential to support both personalised clinical care and broader quality improvement initiatives and there is a desire from users to utilise HEPMA data for both. User requirements would therefore determine which level of data is required.

Most of the proposed uses described by participants could potentially be developed by HEPMA specialists and data analysts within NHS Scotland to effectively reuse the

data available within HEPMA. Based on the researcher's specialist experience, being able to utilise current reporting tools and solutions to develop resources to support the proposed uses would be beneficial. Proposed uses requiring software enhancements built into the HEPMA system would require development by the HEPMA system supplier which would then require a system version upgrade to achieve the functionality as well as the timeline for the availability of this version being out with NHS Scotland's control. In addition, participants perception was that a benefit of HEPMA data would come from linking this to data from other electronic systems as this would provide a more complete picture in a more efficient way. An independent review of the UK health data landscape also concluded that datasets are most powerful when they are linked together and that using data from multiple sources is essential to improve patient care (Sudlow, 2024). Within NHS Lothian data from multiple electronic systems, including HEPMA, has already been successfully combined in a daily report for clinical staff in surgical wards. This available report includes prescription data from HEPMA, laboratory data including urea and electrolytes and full blood count results as well as data from the electronic patient record including patient weight.

A key finding from this study was that participants felt the priority area should be high-risk medicines with clozapine being their highest priority. In 2013 the Scottish Government published the Mental Health Strategy 2012-15 (Scottish Government, 2012). This strategy outlined that care and treatment of people with mental health illnesses such as schizophrenia is a national priority in Scotland and that premature mortality is seen among people with schizophrenia which is a health inequality that needs to be addressed. Clozapine is prescribed to the most ill and vulnerable people with schizophrenia and side effects are common (Scottish Government, 2012). Although clozapine licensing requires regular blood monitoring there is also a need to monitor physical health. The monitoring standards outlined in the strategy include the following parameters and tests: full blood count, body mass index, fasting plasma glucose, blood lipids, blood pressure, pulse, electrocardiogram, urea

and electrolytes, liver function tests, smoking status, pregnancy/contraceptive status, and side effects such as constipation (Scottish Government, 2012).

In addition, out of the 22 studies that were included in the scoping literature review in Chapter 3 of this thesis, nearly a third of these focused on improving care for patients with schizophrenia and/or patients prescribed clozapine suggesting this is a focus area for quality improvement work within mental health services.

Theme 4 Delivery of HEPMA Data

The key finding from this theme was the desire from clinical staff to have flexibility and control over the display of the data and the frequency of receiving or accessing the data. Participants felt that having flexibility and control would potentially allow one data resource to work for multiple different clinical users' needs and different clinical scenarios. Therefore, when developing any data resources in the future it is recommended that this should be considered, and the potential options explored with the intended users.

NHS England produced a guide to support clinical decisions with health information technology which identifies "the 5 Rights" that need to be considered to ensure systems developed can be used effectively. These five key aspects are: right information; right person; right format; right channel; and right time (NHS England, 2023). This guide focuses on implementation of clinical decision support (CDS) systems which harness the knowledge gained through data. Although this thesis is looking more broadly than CDS, these key aspects identified align with what participants in this study identified as crucial elements to facilitate effective use of data in clinical practice and ensure clinical staff engagement. In terms of the right format, NHS England outline that the information must be presented to clinical staff in a way that complements workflow which could include alerts or visual dashboards which was described by participants in this study. The right channel and

right time aspects also focus on user experience, context of use and preventing disruption to workflows.

The scoping review detailed in Chapter 3 highlighted that decisions on the delivery of data were not detailed in most of the studies analysed therefore it was not clear if user engagement had been undertaken to scope and consider their requirements. This was identified as an area to address with focus group participants to understand if they perceive distribution of data as key to using data effectively. As outlined, this study was able to address this and confirm that user involvement with decisions relating to delivery of the data is key. The findings from this study therefore demonstrate the importance of understanding the needs of the intended users and creating flexible solutions to improve engagement and uptake.

Theme 5 Governance

This study identified a gap in clinical staffs' knowledge around current HEPMA data governance processes highlighting there is a need to clearly outline these processes and ensure they are well communicated and easy to follow. In addition, it was proposed that the governance process should be in line with current processes for other data sources to ensure consistency and simplicity for staff following these processes.

It was also highlighted that when creating any resources consideration must be given to who will be authorised to use this for example if they can be made available for certain grades or professions or if access needs to be granted on an individual basis. The level of access may impact on the level of detail within the data resource. Appropriate local governance around access would need to be in place for any future resources developed.

Participants in the focus groups were clear they would want assurance that appropriate confidentiality and consent arrangements are in place when utilising

HEPMA data. The UK government have produced guidance on creating the right framework to realise the benefits for patients and the NHS where data underpins innovation and one of the principles within this outlines that NHS organisations must adhere to all national legal, regulatory and security obligations including the Common Law Duty of Confidentiality and General Data Protection Regulation (GDPR) (Department of Health & Social Care, 2019). All NHS organisations should ensure they are adhering to this which should provide assurance both to clinical users and patients that all necessary governance surrounding data use is in place.

Theme 6 Promotion

Participants described four ways that organisations could promote HEPMA data to clinical staff within mental health services: attendance at meetings and presentations; HEPMA Champions; education; and wider dissemination of reports and successes. These suggestions are evidenced by the literature giving confidence that what was suggested would be successful if implemented and that it would be applicable to all clinical areas and not solely mental health services. The use of local champions has been shown to be a key element to support and persuade peers that technology interventions are effective, safe and professionally appropriate (Greenhalgh, et al., 2017). In addition, a systematic review identified education as an important element of engagement with digital health interventions (O'Connor, et al., 2016). Furthermore, promotion strategies were shown to be more beneficial when they could be personalised to the recipient (O'Connor, et al., 2016).

Participants expressed that a variety of approaches would be most effective in promoting HEPMA data to clinical staff. It is recommended that these promotion ideas should be taken on board and implemented by organisations aiming to harness the benefits of HEPMA data.

Theme 7 Clinical User Involvement in Development

This theme highlighted the importance of involving clinical users in any future developments. There were two critical stages of development where participants felt that clinical user input is essential. The first stage was at the start when the requirements of the data resource are being scoped to outline what the inclusion requirements are and to understand the limitations of the data and the delivery methods available. The second stage was once the final resource is available to be involved in reviewing the presentation and delivery method as part of user acceptability testing. The scoping literature review in Chapter 3 identified these same two stages of the process as areas of focus for future work as the studies included in the review lacked detail on these stages and it was therefore not clear if user needs were considered during development or if users were consulted. It is therefore recommended that organisations aiming to effectively utilise HEPMA data ensure that clinical user involvement at the stages outlined is part of their development process.

Participants in this study had conflicting opinions which demonstrated the importance of knowing who the target users are when utilising HEPMA data and ensuring consultation with the intended users as part of the development process to understand their requirements as these may differ between users. This is consistent with the literature which recommends that best practice when using clinical data is to engage with the recipients of the data to maximise the impact of the data intervention and promote a positive outcome (Chaudhry, et al., 2021).

In addition, the importance of seeking feedback from clinical users on any resources developed was highlighted and when developing any data resource a feedback mechanism directly linked to the resource should be considered, where possible, to aid ease of communication.

4.5.2 Strengths and Limitations

To the best of the researcher's knowledge this is the first study seeking the views of clinical users to determine how HEPMA data can be utilised in the most effective way to support quality improvement and medicines optimisation in mental health services. The study was multi-disciplinary which is seen as a strength as this enriches the quality of the results as HEPMA is a multi-disciplinary system. In addition to having a range of professions included there was also a range of experience, including prior experience working in other NHS Boards, and different areas of practice within mental health services. This was felt to be a strength as it allowed views across mental health services to be obtained and helped ensure a balanced view.

The topic guide only underwent face validity which could be seen as a limitation of the study as this type of validity is considered the weakest form of validity due to the subjectivity of the assessment. Face validity does not indicate if the tool measures the construct of interest, but it does provide insight into how potential participants might interpret the items included (DeVon, et al., 2007).

The aim was to have two participants from each profession at each focus group, but this was only possible for pharmacists. It was more difficult to recruit nurses and doctors resulting in lower representation across these two professions which could be seen as a weakness of the study. However, the number of participants recruited met the overall numbers the study aimed to recruit based on the recommendations in the literature (Kitzinger, 1995). In addition, the themes were consistent across the two focus groups with no new themes generated in the second focus group. This suggested the study may have reached data saturation which the literature shows is possible with small samples sizes in qualitative research (Hennink & Kaiser, 2022). The consistent themes across both focus groups provided reassurance that the number and range of participants recruited was appropriate. The selection

process relied on selected individuals nominating participants which could have potentially introduced selection bias.

When conducting the focus groups, the researcher observed some confusion around the terminology being used around HEPMA data. The researcher therefore reflected that this should have been made clearer in the information given to participants ahead of participation and explained clearly at the start of the focus group. However, this was able to be taken on board for the second focus group and clarified prior to starting the focus group discussion which helped focus the discussion from the start.

The validation in the study was felt to be a strength as both validation stages had complete agreement between the independent researchers which gave confidence in the quality of the analysis that was being undertaken.

4.5.3 Future Work

The results of this study have highlighted areas that need to be considered when developing data resources for clinical users. For any future data resources being developed, the intended clinical users should be engaged with during the development. At a minimum this engagement should happen at the very start and end of the development process. The results of this study highlighted the importance of understanding clinical user requirements when it comes to the delivery of the data when developing any future data resources.

This study highlighted the need to address the barriers that were identified as this will help enable effective use of HEPMA data. Work should be undertaken to identify the training competency requirements for clinical users to enable them to effectively use HEPMA data and training resources developed to support these competencies. Additionally, work should be undertaken to manage user

expectations when it comes to utilising HEPMA data when promoting the data available through the promotion methods outlined.

There were several proposed uses of HEPMA data identified which clinical users would find beneficial. These proposals should be further explored and scoped out as these are areas of priority and focus for clinical users. Users described uses of data at both an individual patient level as well as larger aggregated data sets. It would therefore be important to consider both options in any future work with user requirements determining which levels of data are most appropriate for the intended purpose. Of the suggestions proposed, clinical uses which directly benefit patient care were felt to be the priority with high-risk medicines, and in particular, clozapine being identified as the highest priority area amongst participants. A data resource for clozapine would therefore be recommended as the first area to focus future data resource development work.

4.6 Conclusion

This study sought to determine how HEPMA data can be utilised in the most effective way for healthcare professionals to improve medicines optimisation and support quality improvement in mental health services. Through thematic analysis key themes were identified to enable more effective use of HEPMA data. This included when to engage with clinical users, requirements to factor in with regards to the delivery of the data, and how to promote the available data to ensure better engagement and uptake amongst clinical staff. In addition, barriers were identified which future work should focus on addressing. Furthermore, the results also identified gaps in participants' knowledge in relation to the current governance structures that need to be addressed to ensure appropriate information governance is followed to enable the data to be effectively used. The results also identified many potential new uses of HEPMA data that clinical staff would benefit from with a data resource for clozapine identified as the highest priority. Future work should

focus on scoping the requirements of the proposed data uses further to guide development of these resources.

Chapter 5: General Discussion and Implications of Findings

5.1 Summary of Key Findings

Implementation of HEPMA systems provides access to a wealth of electronic data which has the potential to be utilised to improve patient care. Users of the data will impact how effectively data can be utilised and better engagement with users was identified as a key area for improvement (Chaudhry, et al., 2021). A scoping literature review was conducted to identify how prescribing and administration data has been used in mental health services. Focus groups, informed by the results of the scoping literature review, were then conducted to seek the views of healthcare professionals working within mental health services to determine how HEPMA data can be utilised to improve medicines optimisation and support quality improvement.

Scoping Literature Review

A scoping literature review was conducted with the aim of identifying reported uses of prescribing and administration data, both paper and electronic, in mental health services to improve medicines optimisation or support quality improvement work. The results of the scoping review provided a baseline to inform the subsequent qualitative fieldwork.

The findings from the 22 studies included in the review demonstrated prescription data can be utilised within mental health services for a variety of quality improvement initiatives across all sectors of care and across a range of conditions and pharmacological treatments. This suggested there are a wide range of areas within mental health services which could benefit from the use of prescribing and administration data available from HEPMA. Uses identified included: service development and improvement; prescribing practice improvement including monitoring requirements; assessment of service delivery quality; guideline

implementation; and medication adherence. Nearly a third of the included studies focused on improving care for patients with schizophrenia and/or patients prescribed clozapine suggesting this is a focus area for quality improvement work within mental health services.

The overall uses of the data identified were broken down into two categories; data used as a direct intervention (n=4) and data used to assess the success of a separate intervention (n=16). There were also studies which used data for both purposes (n=2). Data being used to assess an intervention was seen most frequently and this involved using data to determine if a pre-defined outcome had been achieved post-intervention. This included review of prescribing rates to determine if an intervention employed had successfully reduced prescribing incidence. For the studies which used data as a direct intervention, four steps were identified to be required in the process: develop and agree standards or indicators; identify and retrieve the data; process the data; and present the data. However, in terms of the information relating particularly to the first and last steps of the process there was a lack of detail across the studies. It was therefore not clear if user needs around data distribution were considered during development or if users were consulted. This was identified as an area to address with users of the data in future to understand if they perceive distribution of data as key to effective usage and engagement with the data. The involvement of the intended users in general was not something that was focussed on across many of the studies. This is in line with what was identified in the systematic review by Chaudhry et al. who concluded that improvements need to be made in relation to engaging with users of the data to improve the benefits that can be obtained from prescription data (Chaudhry, et al., 2021).

This scoping review adds to the literature by providing a summary of different ways to improve practice in mental health services through utilisation of prescription data. It also provides an outline of the steps required in the process of using data as a direct intervention. It was recommended that future work through engagement

with users should focus on addressing the following areas: the areas of practice users would like to be a focus for data interventions; how to deliver a data intervention to users including how often and through what medium; and how to promote awareness of the available data.

Qualitative Fieldwork

Multi-disciplinary focus groups were conducted to seek the views of healthcare professionals working within mental health services to understand how HEPMA data can be utilised to improve medicines optimisation and support quality improvement. Two focus groups were conducted between February and April 2024 with a total of nine participants (four pharmacists, three doctors and two nurses). The focus group topic guide was developed based on the recommendations of the scoping literature review. The seven themes and twelve subthemes identified through thematic analysis are summarised in Table 9 (section 4.4.2).

Proposed uses of HEPMA data (Theme 3) were identified which helped answer the research question by outlining the different ways clinical staff want HEPMA data to be utilised within mental health services to improve medicines optimisation and support quality improvement. The proposed uses generally fit into the broad categories outlined in the literature. However, this study allowed specific areas to be identified as a key focus within mental health services. The clinical uses subtheme (Figure 3), identified uses for HEPMA data that could be provided as reports or live dashboards, not integrated within the HEPMA system. Overall, the proposed clinical uses focused on improving practice through summarising and collating data in a more efficient and usable way as well as looking at cohorts of patient data to identify themes and trends in practice. The triggered prompts and alerts subtheme (Figure 4), focussed on areas where practice could be improved by utilising the data to enhance the functionality within the HEPMA system to respond to certain criteria or through utilisation of triggered emails to alert staff. A key finding from the prioritisation of proposed uses of HEPMA data subtheme, was the

multi-disciplinary view that uses of data which directly benefit patient care should be the priority with the highest priority being high risk medicines and in particular clozapine. The findings of this theme provide detail for the focus of work going forward which can be used to drive innovation and improve patient care using HEPMA data.

In terms of effective delivery of HEPMA data (Theme 4) the two subthemes identified were presentation and frequency. The knowledge gained from this theme helped address the gaps that were identified in the scoping review in Chapter 3 as key areas of focus for future work. It was determined that clinical users desire an ability to filter and control the data they are presented with as well as an ability to change the presentation format including displaying as a graph or visual timeline depending on the use. The frequency of delivery was felt to be variable depending on the intended purpose. NHS England produced a guide to support clinical decisions with health information technology which aligns with what participants in this study identified as crucial elements to facilitate effective use of data in clinical practice (NHS England, 2023).

The aim of the qualitative research was to understand how healthcare professionals want HEPMA data to be utilised to improve medicines optimisation and support quality improvement in mental health services which Theme 3 and Theme 4 directly addressed. In addition, this study also identified factors which would improve how effectively the data could be utilised. These factors included barriers to be addressed (Theme 2), governance aspects to be considered (Theme 5), promotion methods to be implemented (Theme 6) and finally the importance of organisations involving clinical users in the development of any HEPMA data resources (Theme 7).

5.2 Strengths and Limitations

Through engagement with a range of clinical staff in mental health services it was determined how clinical users want to utilise HEPMA data and additional factors which need to be considered. This addressed an area of improvement outlined previously in the literature and is therefore seen as a strength of this work. It is expected that the knowledge gained through this engagement can support effective utilisation of HEPMA data across mental health services going forward.

The scoping literature review informed the qualitative fieldwork in this thesis which is seen as a strength. The scoping literature review provided an evidence base to develop the focus group topic guide which ensured the discussions were focussed on the current knowledge gaps identified in the literature. However, there were some limitations identified for the scoping review. Only studies available in English language were included which was a limitation however this is common practice and of the final included studies (n=22) there were five studies which were conducted in countries where English is not the main language (Tricco, et al., 2016). The search terms didn't outline all quality improvement methodology terms such as plan-do-study-act (PDSA) cycles. The decision was made to not include an exhaustive list as any studies that use these methodologies would be expected to use quality improvement as a terminology which was included as a search term, but this could still be seen as a limitation of the search.

The use of qualitative methodology was seen as a strength as it facilitates an in-depth understanding of participants' perspectives. However, the subjective nature of qualitative research means there is a potential that researchers' opinions can influence data analysis. The potential for researcher bias was mitigated by validation processes at each stage of the analysis.

The focus groups were multi-disciplinary which is seen as a strength as this enriches the quality of the results as HEPMA is a multi-disciplinary system. In addition to

having a range of professions included there was a range of experience, including prior experience in different NHS Boards, and different areas of practice within mental health services. This was felt to be a strength as it allowed views across mental health services to be obtained and helped ensure a balanced view. The range of experience is felt to give a reflective view of the target audience within mental health services which would potentially mean the results of this study are transferable across other NHS Scotland Boards and potentially wider. However, further work would need to be done to confirm national agreement and validation of the results.

The selection process relied on selected individuals nominating participants which could have potentially introduced selection bias which could be seen as a limitation. Although it was more difficult to recruit nurses and doctors resulting in lower representation across these two professions which could also be seen as a limitation, the overall number of participants recruited met the overall number that the study aimed to recruit based on recommendations in the literature (Kitzinger, 1995). In addition, the themes were consistent across the two focus groups with no new themes generated in the second focus group which provided reassurance that the number and range of participants recruited was appropriate (Hennink & Kaiser, 2022).

5.3 Future Work Implications and Recommendations

Nationally across Scotland, all NHS Boards utilising a HEPMA system have implemented the same system provided by CMM. Therefore, from a technical perspective any data resource developed from HEPMA data in one Board has the potential to be transferrable across NHS Scotland. However, further work should be undertaken first to determine the generalisability of the results in this study to validate that the priority areas identified by the local audience are reflective of the national audiences' priorities.

A key focus of future work should be addressing the priority area identified in this study which is to utilise HEPMA data to support management of high-risk medicines and in particular clozapine. Clinical staff would like data to be utilised in a way which summarises clinical information relevant to the management of clozapine and potentially highlight and/or prioritise information based on the criteria outlined by clinical users. If validated that this is a priority area nationally, it is recommended that future work scoping the details of this resource should be undertaken nationally to create a resource that can be utilised across NHS Scotland. Participants outlined a benefit of using HEPMA data would come from the ability to link HEPMA data with data from other electronic systems e.g. laboratory data and this is reflected in the literature (Sudlow, 2024). Therefore, linking of electronic data sets should be considered when scoping out the details of this resource with clinical users during development. Limitations of the data were identified as a barrier as HEPMA is mainly available in inpatient areas and further implementation of HEPMA to additional areas will improve this as more of the patient journey will be contained in the same data set. However, in terms of clozapine data the dispensing information for all patients in NHS Lothian is held in the CMM system that HEPMA is part of and therefore prescription related data would be available for all sectors of care. In addition, both inpatient services and community mental health teams use the same Electronic Patient Record (EPR) as well as the same system for laboratory results. Therefore, if linking HEPMA data to these additional electronic data sets, clinical data relating to clozapine would be available for the whole patient journey.

A lack of available training was identified as a barrier to clinical staff being able to effectively utilise HEPMA data. Furthermore, the availability of training was felt to also be an effective way to promote engagement with HEPMA data. Participants felt that training should be tailored to different professions. It is therefore recommended that work should be undertaken to scope the competency requirements of training related to HEPMA data for different professions to enable appropriate training to be developed.

5.4 Final Conclusion

Globally there is a drive to improve patient care through implementation of HEPMA systems. A benefit of HEPMA systems is the ability to utilise the data available to improve care through quality improvement and medicines optimisation. To be able to effectively harness the benefits of HEPMA data it is essential that clinical users are engaged with to ensure their needs are understood. Through engagement with the multi-disciplinary team, supported by the findings of a scoping literature review, potential uses of HEPMA data were determined which future work should focus on developing. The highest priority area for future work was determined to be high risk medicines, and in particular clozapine. In addition to the multiple proposed uses identified, factors were outlined which will impact on how effectively the data can be utilised. These included barriers to be addressed, governance aspects to be considered, promotion methods to be implemented and the importance of organisations involving clinical users in the development of any HEPMA data resources.

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Appendices

Appendix 1: MEDLINE Search Strategy

1	Mental Health/
2	Mental Disorders/
3	Mental health.tw.
4	mental disorder*.tw.
5	mental disease*.tw.
6	1 or 2 or 3 or 4 or 5
7	Drug Prescriptions/
8	prescri* data.tw.
9	admin* data.tw.
10	7 or 8 or 9
11	"Quality of Health Care"/
12	Evidence-Based Practice/
13	Outcome Assessment, Health Care/
14	Quality health care.tw.
15	guideline adherence.tw.
16	quality assurance.tw.
17	quality improve*.tw.
18	quality indicat*.tw.
19	medic* optimi*.tw.
20	evidence based medic*.tw.
21	outcome* assess*.tw.
22	health outcome*.tw.
23	health care outcome*.tw.
24	clinical audit.tw.
25	professional standard*.tw.
26	clinical standard*.tw.

27 quality control.tw.

28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27

29 6 and 14 and 32

30 limit 33 to english language

Appendix 2: EMBASE Search Strategy

1 mental health/

2 mental disease/

3 mental health.tw.

4 mental disorder*.tw.

5 mental disease*.tw.

6 1 or 2 or 3 or 4 or 5

7 prescription/

8 prescri* data.tw.

9 admin* data.tw.

10 7 or 8 or 9

11 health care quality/

12 evidence based practice/

13 outcome assessment/

14 quality health care.tw.

15 guideline adherence.tw.

16 quality assurance.tw.

17 quality improve*.tw.

18 quality indicat*.tw.

19 medic* optimi*.tw.

20 evidence based medic*.tw.

21 outcome* assess*.tw.

22 health outcome*.tw.

23 clinical audit.tw.

24 professional standard*.tw.

25 clinical standard*.tw.

26 quality control.tw.

27 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25

or 26

28 6 and 10 and 27

29 limit 28 to english language

Appendix 3: CINAHL Search Strategy

1 (MH "Mental Health") OR (MH "Mental Disorders") OR "mental health" OR "mental disorder*" OR "mental disease*"

2 (MH "Prescriptions, Drug") OR "prescri* data" OR "admin* data"

3 (MH "Quality of Health Care") OR (MH "Medical Practice, Evidence-Based") OR (MH "Nursing Practice, Evidence-Based") OR (MH "Outcomes (Health Care)") OR "quality health care" OR "guideline adherence" OR "quality assurance" OR "quality improve*" OR "quality indicat*" OR "medic* optimi*" OR "evidence based medic*" OR "outcome* assess*" OR "health outcome*" OR "health care outcome*" OR "clinical audit" OR "professional standard" OR "clinical standard*" OR "quality control"

4 1 AND 2 AND 3

Appendix 4: Cochrane Library Search Strategy

1	(mental health):ti,ab,kw
2	(mental disorder*):ti,ab,kw
3	(mental disease*):ti,ab,kw
4	MeSH descriptor: [Mental Health]
5	MeSH descriptor: [Mental Disorders]
6	#1 OR #2 OR #3 OR #4 OR #5
7	MeSH descriptor: [Drug Prescriptions]
8	(prescrip* data):ti,ab,kw
9	(admin* data):ti,ab,kw
10	#7 OR #8 OR #9
11	MeSH descriptor: [Quality of Health Care]
12	MeSH descriptor: [Evidence-Based Practice]
13	MeSH descriptor: [Outcome Assessment, Health Care]
14	(Quality health care):ti,ab,kw
15	(guideline adherence):ti,ab,kw
16	(quality assurance):ti,ab,kw
17	(quality improve*):ti,ab,kw
18	(quality indicat*):ti,ab,kw
19	(medic* optimi*):ti,ab,kw
20	(evidence based medic*):ti,ab,kw
21	(outcome* assess*):ti,ab,kw
22	(health outcome*):ti,ab,kw
23	(health care outcome*):ti,ab,kw
24	(clinical audit):ti,ab,kw
25	(professional standard*):ti,ab,kw
26	(clinical standard*):ti,ab,kw
27	(quality control):ti,ab,kw

28 #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21
OR #22 OR #23 OR #24 OR #25 OR #26 OR #27

29 #6 AND #10 AND #28

Appendix 5: COnsolidated criteria for REporting Qualitative studies (COREQ) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Item No.	Topic	Guide Questions/ Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal Characteristics			
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	62 and 65
2.	Credentials	What were the researcher's credentials? E.g. PhD, MD	65
3.	Occupation	What was their occupation at the time of the study?	11 & 65
4.	Gender	Was the researcher male or female?	65
5.	Experience and training	What experience or training did the researcher have?	65
Relationship with participants			
6.	Relationship established	Was a relationship established prior to study commencement?	11 & 65
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	65
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	65
Domain 2: Study Design			
Theoretical framework			
9	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	64
Participant selection			
10	Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	61
11	Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	62
12	Sample size	How many participants were in the study?	66
13	Non-participation	How many people refused to participate or dropped out? Reasons?	66
Setting			
14	Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	62
15	Presence of non-participants	Was anyone else present besides the participants and researchers?	N/A
16	Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	66

Data collection			
17	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	60-61
18	Repeat interviews	Were repeat interviews carried out? If yes, how many?	N/A
19	Audio/visual recording	Did the research use audio or visual recording to collect the data?	62
20	Field notes	Were field notes made during and/or after the interview or focus group?	63
21	Duration	What was the duration of the inter views or focus group?	66
22	Data saturation	Was data saturation discussed?	62 & 100
23	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	64
Domain 3: analysis and findings			
Data analysis			
24	Number of data coders	How many data coders coded the data?	63-64
25	Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26	Derivation of themes	Were themes identified in advance or derived from the data?	64-65
27	Software	What software, if applicable, was used to manage the data?	53-65
28	Participant checking	Did participants provide feedback on the findings?	N/A
Reporting			
29	Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	67-88
30	Data and findings consistent	Was there consistency between the data presented and the findings?	67-88
31	Clarity of major themes	Were major themes clearly presented in the findings?	67
32	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	67-88

Appendix 6: Participant Information Sheet and Consent Form

Participant Information Sheet for Focus Group

Name of department: HEPMA Clinical Team

Title of the study: Exploring the views of clinical staff to understand how HEPMA data can be utilised to improve to improve medicines optimisation and support quality improvement.

Introduction
I am currently undertaking this project as part of a post-graduate MPhil degree. I can be contacted via my NHS and University emails; nikki.gilluley@nhslothian.scot.nhs.uk and nikki.gilluley@strath.ac.uk.

What is the purpose of this research?
The aim of this project is to determine how HEPMA data can be utilised to improve medicines optimisation and support quality improvement in mental health services by seeking the views of the MDT.

Do you have to take part?
It is your decision to take part in this research; participation is completely voluntary. Deciding not to participate or withdrawing participation at any point is completely within your rights and will not have any adverse effects on the way you are treated. Please be aware that after participating in the focus group a participant cannot withdraw their data from the focus group as that would negate the whole focus group.

What will you do in the project?
If you consent to take part in this research you will be asked to attend a focus group at the Royal Edinburgh Hospital. This is a face-to-face qualitative methodology involving a small group who have been purposefully sampled. During the focus group you will be expected to provide your thoughts and opinions on the areas being discussed around uses of prescribing and administration data within mental health services.

Why have you been invited to take part?
Purposeful sampling has been used to identify potential participants to take part in this research. You have been chosen to take part as you meet one of the following criteria: a prescriber (medical or non-medical) with experience of prescribing within mental health services; a nurse with experience working within mental health services; or a pharmacist with experience working within mental health services.

What are the potential benefits to taking part?
The results of this project will be used to help realise the benefits of HEPMA data to support quality improvement and medicines optimisation.

What are the potential risks to you in taking part?
There are no risks involved with taking part in this study however you should be aware that you will be required to dedicate time to attend the focus group. It is expected that this process will take no longer than 1-2 hours.

What information is being collected in the project?
Basic demographic information will be collected for all participants in this study which you will be asked to complete yourself. Any information which you do not wish to provide can be omitted. This will include basic information such as job role, length of time in current role and in mental health services and specialist area of practice. The information generated in the focus group will be qualitative with themes identified from the discussions. Direct quotes may be reported but this will be non-identifiable.

Who will have access to the information?
All personal information will be kept confidential and anonymous.

Where will the information be stored and how long will it be kept for?
Consent forms will be kept for three years within NHS Lothian as per local policy. Any personal identifiable information will be destroyed once the project is complete, and the project has been submitted to the University of Strathclyde (approximately January 2023).

What happens next?
If you would like to find out more about the project or you would be happy to participate, please contact Nikki Gilluley on nikki.gilluley@nhslothian.scot.nhs.uk. If you are happy to participate you will be asked to sign a consent form prior to your participation in the focus group. Once the project is complete you will be provided with a copy of the final results if you are interested.
If you do not wish to participate in this research, thank you for your attention and for taking the time to read this information sheet and consider the option of taking part.

Lead Researcher contact details:
Nikki Gilluley
nikki.gilluley@nhslothian.scot.nhs.uk

Chief Investigator contact details:
Marion Bennie
marion.bennie@strath.ac.uk

This research was granted ethical approval by the SIPBS Ethics Committee.
If you have any questions/concerns, during or after the project, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

Secretary to the University Ethics Committee
Research & Knowledge Exchange Services
University of Strathclyde
Graham Hills Building
50 George Street
Glasgow
G1 1QE
Telephone: 0141 548 3707
Email: ethics@strath.ac.uk

Consent Form for Focus Group

Name of department: HEPMA Clinical Team

Title of the study: Exploring the views of clinical staff to understand how HEPMA data can be utilised to improve medicines optimisation and support quality improvement.

	Initials
▪ I confirm that I have read and understood the Participant Information Sheet for the above project and the researcher has answered any queries to my satisfaction.	
▪ I confirm that I have read and understood the Privacy Notice for Participants in Research Projects and understand how my personal information will be used and what will happen to it (i.e. how it will be stored and for how long).	
▪ I understand that my participation is voluntary and that I am free to withdraw from the project at any time, up to the point of participating in the focus group, without having to give a reason and without any consequences.	
▪ I understand that I can request the withdrawal from the study of some personal information and that whenever possible researchers will comply with my request. This includes the following personal data: ○ my personal information from basic demographic information collected.	
▪ I understand that anonymised data (i.e. data that do not identify me personally) cannot be withdrawn once they have been included in the study.	
▪ I understand that any information recorded in the project will remain confidential and no information that identifies me will be made publicly available.	
▪ I consent to being a participant in the project.	

(PRINT NAME)	
Signature of Participant:	Date:
Signature of Researcher Verifying Consent:	Date:

Appendix 7: Basic Demographic Questionnaire

Basic Demographic Questionnaire

1. **What is your job role?** (Please select one)
    - Consultant
    - Junior doctor (includes all training grades)
    - Nurse (non-prescriber)
    - Nurse (prescriber)
    - Pharmacist (non-prescriber)
    - Pharmacist (prescriber)

2. **How long have you been in your current job role?** _____

3. **How many years have you worked in mental health services?**
   _____

4. **What specialist area of mental health do you work in?**
   _____

Appendix 8: Focus Group Topic Guide

Focus Group Topic Guide

This focus group aims to understand your knowledge around the data available from the hospital electronic prescribing and medicines administration (HEPMA) system and your ideas around how best this could be utilised for quality improvement and medicines optimisation. Please note from now on we will refer to hospital electronic prescribing and medicines administration as HEPMA.

Researcher to confirm all consent forms and basic demographic information has been completed.

Thank you all for agreeing to be a part of this focus group today and providing consent to take part. Please be aware that at the end of the focus group we will be unable to withdraw any individual participants data, but everyone will remain anonymous.

Can I please confirm that you are all still happy to proceed?

The focus group will be audio recorded. Does anyone have any questions before we begin the audio?

Questions	Prompts	Notes
Introductions		
In turn, starting from my left, can each participant please introduce themselves and let the group know your name, where you work and your role.		
Experience with HEPMA Data Firstly, we would like to discuss your experience with HEPMA data to date.		
Tell me about any experiences you have of using HEPMA data.	• Can you describe what went well? • Can you describe how it could have been improved? • What were your thoughts on how useful the data provided was for the intended purpose? • If you haven't used HEPMA data previously are there reasons for this?	
Ideas for Effectively Using HEPMA Data		
To be able to effectively use HEPMA data to support quality improvement and medicines optimisation we need to identify the requirements of users. Tell me about your ideas for how HEPMA data could be used to support clinical practice?	• What are your ideas on the areas of practice that should be focussed on? • How can we identify and prioritise the areas where data will have the most impact? • How would you prioritise data for use in clinical practice versus quality improvement work? • What are your ideas on the local governance processes that should be in place to identify and agree the data users want?	

Following on, how do you think awareness of the HEPMA data available could be promoted?	• What are your ideas around communication strategies? • What are your thoughts on how best to engage with clinical staff?	
Tell me about your thoughts on how to deliver HEPMA data to users to maximise its effectiveness.	• What are your thoughts on how involved users should be in the development of reports? • What stages of development is user involvement critical to the effectiveness and why? • What are your ideas on the best medium for presenting the data? Does this vary depending on the purpose and intended audience? • What are your thoughts on frequency requirements when accessing available data?	