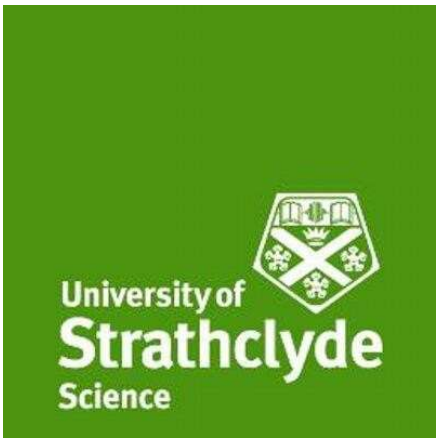

Medication Supply Process at Patient Discharge Across a Selection of Hospitals in Scotland

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Copyright declaration

Signed: 

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Thesis Abstract

A delayed discharge is defined as when a patient is clinically ready to be discharged from the hospital setting but continues to occupy a hospital bed (Public Health Scotland, 2021). Delayed discharges resulted in patients spending an additional 358,426 days in hospitals across Scotland in 2021 (Public Health Scotland, 2021). Delayed discharges can be multifactorial and have an impact on the patient, who is keen to return home, while also adding increased pressure to the flow of patients through the hospital. The most common patient reported reason for delayed discharge was “waiting for medicines” in the 2018 Scottish National Inpatient Experience Survey (Scottish Government, 2018). This research utilised a scoping review to investigate the existing knowledge base on medication supply at the point of hospital discharge. A second scoping review focused on the methodology to be used within this research by examining where process mapping has been used as a tool to identify areas for improvement within a hospital or community pharmacy setting. The scoping reviews informed the research with a mixed methodology approach, utilising process mapping and SHERPA task classification along with timing data analysis to examine the pathway of patient medication supply at the point of hospital discharge in a selection of six Scottish hospitals. The results from the research demonstrated that all the hospitals visited shared eight stages within the medication supply at discharge pathway, along with having a similar number of stages and steps within each pathway. The median time for completion of the patient medication supply at the point of discharge for 50 patients in each hospital varied from 309 minutes (5.1 hours) to 1709 minutes (28.4 hours). The process maps created in this research can be used as a starting to point to enable discussion on areas for improvement within the medication supply at discharge process and to give consideration for using other settings, such as community pharmacies, to supply patients with discharge medication.

Chapter 1: Introduction

1.1 Hospital Discharge

Patient discharge from hospital is a complex multifactorial system that occurs at the conclusion of a patient episode of care in the hospital setting (Waring et al., 2014). The discharge of a patient from hospital back to their own home or homely setting can be considered the point the patient's care transitions from the hospital back to the primary care team (Earl, Katapodis and Schneiderman, 2020). The World Health Organisation (WHO) recognises the risks posed to patient care at the transition of care settings and advocates 10 key actions that are likely to have the most impact on improving patient safety at the transition of care. These key actions include improving communications between care interfaces, improving the use of electronic tools to transfer information safely and securely between the interface points of patient care, and ensuring the involvement of patients and family members during the transition of care (Dawda and Russell, 2016).

The processes for supplying patients with medication at the time of hospital discharge vary across the world but can be split into two main categories. These categories can be defined as first, patients are supplied a written or electronic prescription medicines order at discharge that they collect from a pharmacy based in the community setting, or second, the patient is issued with discharge medication by the hospital pharmacy at the time of discharge. The practice of issuing patients with a written or electronic prescription medication order at discharge is common in countries that have health care systems with an emphasis on private health care, such as in the United States of America or some parts of Europe. The method of discharging the patient from hospital with a written or electronic prescription can be associated with challenges, including patient nonadherence to filling discharge medication prescriptions (Farris et al., 2018) and patient understanding of any new or changed medication regimens at discharge (Ziaeiani et al., 2012; Bulut et al., 2013, Al-Hashar et al., 2018,). The National Health Service (NHS) finances the drug reimbursement models in both primary and secondary care across the UK. In the UK the majority of hospital discharges are from NHS hospitals and a supply of medication is issued, free of charge to the patient, at the point of the patient's discharge from hospital (Bullock et al., 2016).

The NHS in Scotland works with a number of independent contractors to deliver ongoing patient care. In the primary care setting the general practitioner (GP) and community pharmacy (CP) are both separate independent contractors who perform duties for the NHS under nationally devolved contracts. These contracts are negotiated between the Scottish

Government and the appropriate representative bodies and form the detail of the roles required by the independent contractor along with the remuneration for providing services on behalf of the NHS (Scottish Government, 2020a).

The transfer of care between secondary and primary care is recognised to be a high-risk time for patient pharmaceutical care, with an increased risk of medication errors occurring between care settings (Picton, 2012). In Scotland, at the time of discharge an immediate discharge letter (IDL) is created for each patient. The IDL contains a clinical information summary in relation to the patient's hospital stay along with a list of all the patient's current medication. A copy of the IDL is sent electronically to the patient's GP at the time of discharge. This is used in the GP practice to update the patient notes with any new medical conditions and to update the patient's current medication list that is prescribed in primary care. The patient can also be issued a hard copy of the IDL for them to take to their own community pharmacy. Community pharmacies in Scotland are independent contractors working within an NHS contract to deliver pharmaceutical care and dispense medications to NHS patients (Scottish Government, 2020a). Community pharmacies in Scotland are not routinely electronically advised if a patient is admitted to or discharged from hospital. Currently not all community pharmacies in Scotland have access to patient NHS records; however, all community pharmacies in Scotland have access to the patient's digital emergency care summary that contains a list of the patient's current medication (Tissier, 2023). A delayed discharge is defined in the NHS Scotland Delayed Discharge report (Public Health Scotland, 2021) as *"when a hospital patient who is clinically ready for discharge and inpatient hospital care continues to occupy a hospital bed beyond the date they are ready for discharge"*. The desired outcome of the patient discharge process is for the patient to transition care from the hospital setting back into the primary care setting. To enable the patient discharge with continued care, various different internal hospital departments can be involved, including the patient's ward team and the hospital pharmacy team.

In Scotland the number of delayed discharges is included in an annual NHS Scotland Delayed Discharge report (Public Health Scotland, 2021). Delayed discharges result in additional patient time being spent in the hospital setting. The delayed discharge report 2021 highlights that there were 358,426 additional days spent in hospital by patients across Scotland due to delayed discharges. These additional days spent in the hospital by delayed discharge patients add increased pressure to the hospital systems, both on the flow of patients through the

hospital (as fewer beds are available for incoming patients) and the additional staff time spent caring for the delayed discharge patients. Table 1.1 presents the number of delayed discharge bed days per health board across Scotland. The NHS in Scotland is subdivided into 14 health boards that are based on the geographic regions of the country.

Table 1.1. Delayed Discharge Bed Days Across Scotland 2020/21

Scotland NHS Board	Delayed discharge bed days 2020/21	Percentage of national delayed discharge bed days	Population size (2018)	Percentage of population size
NHS Ayrshire & Arran	27,264	7.61%	369,360	6.79%
NHS Borders	9,995	2.79%	115,510	2.12%
NHS Dumfries & Galloway	9,161	2.56%	148,860	2.74%
NHS Fife	29,088	8.12%	371,910	6.84%
NHS Forth Valley	24,701	6.89%	306,070	5.63%
NHS Grampian	18,821	5.25%	584,550	10.75%
NHS Greater Glasgow & Clyde	85,239	23.78%	1,174,980	21.61%
NHS Highland	31,869	8.89%	321,800	5.91%
NHS Lanarkshire	46,743	13.04%	659,200	12.12%
NHS Lothian	51,573	14.39%	897,770	16.51%
NHS Orkney	1,445	0.40%	21,190	0.39%
NHS Shetland	378	0.11%	22,990	0.42%
NHS Tayside	19,158	5.35%	416,080	7.65%
NHS Western Isles	2,991	0.83%	26,830	0.52%

Table 1.1 highlights that larger health boards such as NHS Greater Glasgow and Clyde and NHS Lothian have a higher percentage of the national delayed discharge bed days number; however, the information also shows that delayed discharge days occur across all health boards in Scotland.

Due to the complex, multifactorial system that occurs at the point of patient discharge, a wide range of factors can be the cause of the delayed discharge. These factors can range from complex delay reasons, such as patients awaiting a place at a specialist facility, to patients awaiting suitable transport to be discharged to their own home.

The Scottish NHS inpatient survey was last completed in 2018 (Scottish Government, 2018). The survey is sent to a random sample of people, aged 16 and over, who have had an

overnight stay in a hospital in Scotland between April and September 2017. The survey was completed by 20,809 patients. The questions in the survey covered a range of topics related to the patient's hospital stay, including the process of leaving hospital. One of the patient questions in the survey was "on the day you left hospital, were you delayed for any reason?" and 30% of patients expressed that they had experienced a delay on the day they left hospital. The report highlighted that 36% of patients who had experienced a delay on the day they left hospital reported waiting an additional two to four hours, while a further 20% reported waiting over four hours at the time of discharge. The main reason reported by patients for the delayed discharge was waiting for medications. This accounted for 69% of the patient reported delayed discharges.

Different models currently exist in Scottish hospitals to supply patients with discharge medication. These models can be split into two main categories: traditional hospital pharmacy dispensing, and patient's own drugs/medication augmented with dispensing new or changed medication at the patient's bedside. The traditional hospital pharmacy dispensing service involves the patient's discharge medication supply being dispensed from a hospital pharmacy dispensary and then sent to the patient's ward. The second model involves the patient bringing their own medication with them into hospital. This medication is stored in the patient's room and is used during their hospital stay. Any changes to the patient's medication that may occur during the patient's inpatient care are dispensed at the patient's bedside, from ward stock, into the patient's own medication supply. This ensures that the patient has a supply of their medication that includes any changes to their medication regimen with them in their room at all times during their stay as an inpatient. At discharge the medication that has been stored with the patient in their room is used for the discharge medication to be taken with the patient when leaving the hospital. In both instances a minimum supply of seven days of any new or changed medication is issued to the patient. Using patients' own medication, along with a bedside dispensing process, has been shown to reduce staff time involved in the medication supply at the point of hospital discharge (Lummis, Sketris and Veldhuyzen van Zanten, 2006; Houlind et al., 2018).

1.2 Healthcare Strategies in Scotland.

In 1999 devolution of healthcare responsibilities was established in the UK, with the Scottish Government taking over responsibility for all health care strategies in Scotland. These strategies underpin the delivery of patient care through NHS Scotland. An overview of the strategies that support the pharmaceutical care of patients in Scotland that are relevant to this thesis are summarised and described in Table 1.2.

Table 1.2. Summary of Scottish Healthcare Strategy Post Devolution.

Year of Publication	National Strategy	Key areas of interest for this research
2000	Our National Health: A Plan for Action, a Plan for Change	Emphasis on collaborative working with patients, healthcare providers and the NHS, to enable improvements within healthcare.
2002	The Right Medicine: A Strategy for Pharmaceutical Care in Scotland	Strengthen cross-sector partnership working with a focus on safer use of medication in all patient settings.
2010	The Healthcare Quality Strategy for NHS Scotland	Deliver person-centred, safe and effective care. Establishment of "Scottish Patient Safety Programme" including reducing medication harm across transition of care setting.
2013	Prescription for Excellence	Enable closer working between hospital and community pharmacy teams with a focus on patients' medication at discharge. Initial suggestions of community pharmacist reconciling patients' medication after discharge.
2014	Realistic Medicine: Chief Medical Officers Annual Report	One of the themes from this document was to ensure that our healthcare services should meet the demands and expectations of the patients that use the service.
2016	A National Clinical Strategy for Scotland	Highlighted "we need to ensure that patients experience timely discharge without delay"

Year of Publication	National Strategy	Key areas of interest for this research
2017	Achieving Excellence in Pharmaceutical Care: A Strategy for Scotland	One of the nine key aims is "transform hospital pharmacy services". This includes working with a patient's community pharmacy to ensure continued pharmaceutical care at discharge.
2021	NHS Recovery Plan	Commitment to establishing a new community pharmacy hospital discharge and medicines reconciliation service.

1.2.1 Our National Health: A Plan for Action, a Plan for Change (2000)

The first Scottish healthcare strategy published after the devolution of healthcare responsibilities was "Our National Health: A Plan for Action, a Plan for Change" (Scottish Government, 2000). The plan involved redesign of healthcare services, with patient involvement in the design of the services that they access. One of the key themes of the plan was partnership working between the NHS services and other stakeholders such as local authorities, independent providers including community pharmacies, and voluntary groups. The focus for pharmacy was for increased integration into NHS Information Technology (IT) with electronic prescription barcodes. Community pharmacies also improved patient pharmaceutical care through different NHS funded model schemes, including allowing community pharmacists to prescribe a broader range of medicines under patient group directives and conduct medication reviews with patients.

1.2.2 The Right Medicine: A strategy for Pharmaceutical Care in Scotland (2002)

"The Right Medicine: A Strategy for Pharmaceutical Care in Scotland 2002" (Scottish Government, 2002) further developed the "Our National Health: A Plan for Action, a Plan for Change" (Scottish Government, 2000) into a plan for pharmacy. The main aim was to strengthen partnership working with pharmacists, other professionals and patients, to ensure the most appropriate and safest use of medicines in all care settings. This strategy also included a redesign of hospital pharmacy services with the aim for all hospital patients

to receive care from a clinical pharmacist, including pharmacist prescribers. It was highlighted in the strategy that effective communications between hospitals and community pharmacies are required to provide seamless care to patients. This strategy was also the catalyst for changes to the community pharmacy contractual payments. These were realigned with a shift from payment based primarily on dispensing volumes to the inclusion of payments for national service provisions.

1.2.3 The Healthcare Quality Strategy for NHS Scotland (2010)

"The Healthcare Quality Strategy for NHS Scotland" (Scottish Government, 2010) was the first major update to "Our National Health: A Plan for Action, a Plan for Change" (Scottish Government, 2000). The strategy was aimed at supporting the delivery of the highest quality healthcare service to patients in Scotland by providing person-centred, safe and effective healthcare. The three quality ambitions are shown in Table 1.3.

Table 1.3. The Quality Ambitions of The Healthcare Quality Strategy for NHS Scotland (2010)

Key Driver	Quality Ambitions
Person-centred	"Mutually beneficial partnerships between patients, their families and those delivering healthcare services which respect individual needs and values and which demonstrate compassion, continuity, clear communication and shared decision making."
Safe	"There will be no avoidable injury or harm to people from healthcare they receive, and an appropriate clean and safe environment will be provided for the delivery of healthcare services at all times."
Effective	"The most appropriate treatments, interventions, support and services will be provided at the right time to everyone who will benefit, and wasteful or harmful variation will be eradicated."

One of the key mechanisms the strategy highlighted to achieve the quality aims was partnership working. This included not only partnership working between the NHS and patients, but also extended to partnership working between NHS Scotland and independent contractors, such as community pharmacists. One of the major changes that was accelerated

by this strategy was the roll out of the Scottish Patient Safety Programme (SPSP). One of the key focus points for the Scottish Patient Safety Programme was to reduce medicines harm across transitions, including pharmaceutical care when a patient is discharged from hospital back into the primary care setting. SPSP worked collaboratively with acute care, community pharmacists and GPs to develop a medicines reconciliation care bundle that was released in 2016 (Health Improvement Scotland, 2016) as a best practice guide for medicines reconciliation at the transition of care.

1.2.4 Prescription for Excellence (2013)

The "Healthcare Quality Strategy for NHS Scotland" (Scottish Government, 2010) was further developed into a vision and action plan for the pharmacy profession in the 2013 strategy document Prescription for Excellence (Scottish Goverment, 2013a). Prescription for Excellence was based upon a report by Wilson and Barber that was commissioned by the Cabinet Secretary for Health (Scottish Government, 2013b), to review the appropriateness of NHS Scotland pharmaceutical services. Prescription for Excellence aimed to integrate pharmaceutical care and set out a route map to align with the Scottish Government's "The Healthcare Quality Strategy for NHS Scotland" (Scottish Government, 2010). Some of the areas that Prescription for Excellence targeted to work alongside the 2010 Healthcare Quality Strategy included patient centred care, primary care and integrated care for patients.

One of the main themes from Prescription for Excellence was to encourage closer working between healthcare teams in hospitals and communities to support patient's pharmaceutical care at the transition between primary and secondary care settings. The document also highlighted and identified the roles that community-based pharmacists could undertake, including medicines reconciliation to support patient pharmaceutical care when moving between different settings.

1.2.5 Realistic Medicine: Chief Medical Officers Annual Report (2014)

The wide-ranging publication from Dr Catherine Calderwood, then Chief Medical Officer for Scotland (Realistic Medicine: Chief Medical Officers Annual Report, Scottish Government

2014) was the first introduction of the principles of realistic medicine to the Scottish healthcare system. The main themes from this document included shared decision making between the clinician and the patient, along with changing our practices to support improvement. Hospital discharge processes are not directly mentioned in the document, but the principles of improvement in systems to support patients can also be applied to the process of patient medication supply at hospital discharge.

1.2.6 A National Clinical Strategy for Scotland (2016)

The publication "A National Clinical Strategy for Scotland" (Scottish Government, 2016) was a strategic plan described as "offering a high-level vision, based on the best research evidence available, of what change is needed" within the NHS in Scotland. One of the key areas for change highlighted in the document is the "need to ensure that patients experience timely discharge without delay". It is emphasised that patients should be discharged from hospital as soon possible, with support from both primary and community colleagues.

1.2.7 Achieving Excellence in Pharmaceutical Care: A Strategy for Scotland (2017)

The strategy "Achieving Excellence in Pharmaceutical Care: A Strategy for Scotland" (Scottish Government, 2017) was published following the appointment of Professor Rose Marie Parr as the Chief Pharmaceutical officer in 2015. This strategy was an update to Prescription for Excellence (Scottish Goverment, 2013), and sought "to build on the impetus for change on the content, quality and ways in which NHS pharmaceutical care is delivered in Scotland." The priorities aligned two key areas: improving NHS pharmaceutical care and enabling NHS pharmaceutical care transformation. Figure 1.1 shows the nine key commitments.

Figure 1.1 The nine commitments of Achieving Excellence in Pharmaceutical Care: A Strategy for Scotland (2017)

One of the main actions underpinning the commitment to transform hospital pharmacy services was a review of the hospital discharge process. The strategy highlights the "well documented challenges with regards delays at discharge". The strategy committed to commission work to improve all pharmacy related aspects of the discharge process. This included roles for community pharmacy teams, such as discharge medication supply and supporting patient pharmaceutical care during the transition of care settings from hospital to home.

1.2.8 NHS Recovery Plan (2021)

In August 2021 the Scottish Government produced the NHS 2021-2026 Recovery Plan (Scottish Government, 2021). This wide-ranging strategy was delivered to support NHS Scotland into recovery and growth of services following the previous two years focusing on the COVID-19 pandemic. The strategy established a National Centre for Sustainable Delivery for Health and Social Care (CfSD). This centre has a remit to pioneer and deliver more

sustainable and better services for patients, including enhanced delivery of services in the community setting and transforming hospital pharmacy services.

The NHS Recovery Plan (Scottish Government, 2021) also committed to establishing a new community pharmacy hospital discharge and medicines reconciliation service. This service was envisaged to help decrease the time it takes for patients to be discharged from hospital back into the community setting.

1.3 Community Pharmacy Hospital Discharge and Medicines Reconciliation Service Pilot

In 2020, during the COVID-19 pandemic, the NHS established Nightingale hospitals in response to increased patient hospitalisation. Within the NHS Greater Glasgow and Clyde health board, the NHS Louisa Jordan was set up in the Scottish Exhibition and Conference Centre (SEC) (Scottish Government, 2020b). The conversion of the SEC into a temporary hospital posed significant challenges, including for the hospital pharmacy department, as its size and location within the building meant it was unable to supply any discharge medication to patients who attended the hospital. The NHS Louisa Jordan hospital never received any patients during COVID-19 pandemic, however the challenges with the size and location of the pharmacy department within the hospital prompted the initial discussion around supply of patient discharge medications from alternative sources.

NHS Greater Glasgow and Clyde health board, in conjunction with Community Pharmacy Scotland, developed a pilot with support from the Glasgow Royal Infirmary to supply patients with discharge medication from the patient's regular community pharmacy. The pilot was conducted from a small number of wards in the Glasgow Royal Infirmary as a feasibility study to evaluate if a similar discharge medication supply model would be possible, if required, from the NHS Louisa Jordan hospital. The pilot used pandemic legislation (UK Government, 2020) that allowed pharmaceutical services to be delivered to a patient in the event of a pandemic, including dispensing of medication. The study was undertaken from June to November 2020 across three Plan-Do-Study-Act cycles. The patient advised the hospital pharmacy team of their regular community pharmacy and consented for them to be informed of their hospital discharge. The hospital pharmacy team then contacted the community pharmacy and advised them of any medication required by the patient at the

time of discharge, excluded medication included controlled drugs. The community pharmacy then accessed the patient's immediate discharge letter on a shared electronic record. The community pharmacy prepared the patient required discharge medication and this was subsequently collected by the patient or their representative after discharge from hospital. The pilot demonstrated that it was feasible for the patient's regular community pharmacy to supply discharge medication if the request to supply was highlighted on the IDL during a pandemic. The pilot also demonstrated that patients discharged to collect medication from their regular community pharmacy were able to leave the hospital before patients not on this discharge pathway in the same wards, 154 minutes (interquartile range (IQR) 82–272) for patients on the community pharmacy discharge pathway vs 296 minutes for patients on the usual practice discharge pathway (IQR 197–1281) (Tait et al., 2023).

1.4 Thesis Rationale

The number of delayed discharges (Public Health Scotland, 2021) indicates that delayed discharges are an issue across all health boards in Scotland. The patient experience survey, sent to a random sample of patients aged 16 and over that experienced a hospital stay between April and September 2017, indicated that patients reported waiting on medication to be a key factor in delayed discharges (Scottish Government, 2018). This demonstrates that medication supply at discharge could be a potential area for improvement. The Achieving Excellence in Pharmaceutical Care Strategy for Scotland (Scottish Government, 2017) includes a main theme for closer working between primary and secondary care pharmacy teams to improve patient pharmaceutical care at the point of hospital discharge. The feasibility study conducted in Greater Glasgow and Clyde (Tait et al., 2023) demonstrated that, on a small scale, utilising community pharmacy in the discharge medication process could result in a timesaving on the patients discharge time.

Prior to proposing any changes to the well-established medication supply at discharge process in hospitals in Scotland, it is important to investigate the current evidence base for different discharge models used both across the UK and further afield (Chapter 2). It is also important to understand the current discharge process in a selection of hospitals across Scotland (Chapter 3) with an aim to identify any similarities and differences in both the current models utilised and the time taken for each discharge model. Completion of this

research will enable a discussion of the context of the results (Chapter 3.10) and to identify potential areas for future research (Chapter 3.12). The key findings from this research project will be summarised in the conclusions within Chapter 4.

Chapter 2: Medication Supply at the Point of Hospital Discharge – Literature Scoping Review

2.1 Introduction

As outlined in section 1.4, it is important to gain a better understanding of the existing knowledge base on the subject of medication supply at the point of hospital discharge in Scotland and further afield. This understanding ensures that new research will add to the existing evidence base, and also provides the detail required to identify areas for potential improvements. It is also important to ascertain if the methodology of process mapping would be valid to use within any new research on the medication supply process at patient discharge in a selection of hospitals in Scotland. As the literature review was planned to investigate the current body of work within Scotland and further afield along with identifying any gaps in a Scottish content of the medication supply at discharge - rather than attempt to collate and comment on the existing evidence base - a scoping review was considered most appropriate for the review methodology (Munn et al., 2018).

To understand the current medication supply at a selection of Scottish hospitals, it had been proposed by the researcher to complete process mapping of the current medication supply at discharge pathways. Process mapping is a technique used to investigate the steps and stages of a process, to gain understanding of how a process is completed (Kirwan and Ainsworth, 1992). To ensure the process mapping methodology was an approriate technique to use to understand and identify areas for improvement within a hospital or community pharmacy setting, a second scoping review was completed. A scoping review was selected as it is an established methodology to both investigate a body of literature and clarify the concepts/methodology used in the research (Munn et al., 2018). To these ends, literature scoping reviews were carried out in order to address these two areas of significance.

2.2 Methods and Study selection

Both scoping reviews were carried out following the methodology described by Arksey and O'Malley (2005). The scoping reviews were completed using the Embase, Medline and Cochrane library databases. The searches were completed on 7th December 2022. The key search terms used in both searches are detailed in table 2.1 and the complete structure for searches used in both scoping reviews, along with the number of results, are presented in Appendix 1.

Table 2.1. Search Terms Used in Each Embase, Medline and Cochrane Databases

Embase (via Ovid)	Medline (Via Ovid)	Cochrane
Process Mapping		
Process adj1 map*. ti,ab,kw	Process adj1 map*. ti,ab,kw	(process map*): title, abstract, keyword
Exp model		
"model of care". Kw		
Hospital Discharge		
Exp hospital discharge/	Exp Patient Discharge/	Patient Discharge – MeSH term
Prescription		
Exp prescription/	Exp prescription/	Prescription – MeSH term
Pharmacy Setting		
Pharmacy.kw	Exp Pharmacy/	Pharmacy.kw
Exp "pharmacy (shop)"/	Exp Pharmacies/	Community Pharmacy – MeSH term
Community pharmacy. ti.ab.kw	Pharmacy.mp	Pharmacy service, Hospital – MeSH term
	Community pharmacy. ti.ab.kw	
Medication Supply		
Exp prescription/	Exp prescription/	medication adj1 sup*(title, abstract, keyword)
Medication adj1 sup*. ti,ab,kw.	Medication adj1 sup*. ti,ab,kw.	

Adj1= finds two terms next to each other in any order, ti=title, ab=abstract, kw=keyword, Exp= Explosion (inclusion of the selected subject plus all of the more specific subjects within the hierarchy) MeSH= Medical subject headings as produced by the National Library of Medicines, mp=multipurpose (will search for word within fields including title, abstract keyword heading and unique identifier).

Both scoping reviews followed a two-step eligibility process. Initially papers were screened from reading the title and abstract of the published paper. Where this was found to meet the inclusion criteria, the paper was then moved into the full text review, where the inclusion and exclusion criteria were again applied.

The main reviewer (DJ) completed the initial title and abstract screening. A 20% randomly selected subset of the initial title and abstract screen was completed by a second reviewer (MM). Any papers that did not have consensus between the two reviewers were discussed and a consensus reached as to whether to include them in the literature review. This process was again completed for the full paper review. The Cohen's kappa coefficient was used to measure the inter-rater reliability of the 20% of randomly selected subsets (McHugh, 2012). Strength of agreement related to the Cohen's kappa statistic was ascertained using the benchmarks suggest by Landis and Koch in 1977 (Landis and Koch, 1977). The online software Covidence (Innovation, 2022) was used to complete the screening by both the main reviewer and the second reviewer.

2.3 First Scoping Review: Knowledge Base on Medication Supply at Hospital Discharge

As mentioned in the introduction, it is important to understand the existing knowledge base around the medication supply at the point of hospital discharge to ensure any new research will add to the existing knowledge base. The first scoping review focused on the question of what is the existing knowledge base on medication supply at the point of hospital discharge from the hospital pharmacy or community pharmacy setting?

The key search terms used in first review to identify the existing knowledge base were: hospital discharge, medication supply, models of care and pharmacy. The structure of the searches is presented in Appendix 1, and the key search terms in Table 2.1 within the Methods and Study Selection in Chapter 2.2.

As highlighted in the Methods and Study Selection (Section 2.2), initially papers were screened from reading the abstract of the published paper. Where this was found to meet

the inclusion criteria, the paper was then moved into the full text review, where the inclusion and exclusion criteria were again applied. The inclusion and exclusion criteria, along with the rationale for the criteria are presented in Table 2.2.

Table 2.2. Inclusion and Exclusion Criteria for First Scoping Review

Inclusion Criteria	**Rationale**
Paper focusing on hospital discharge process that includes patient medication supply	Ensure the literature reviewed included the process of supplying medication to patients at the point of discharge.
Paper focusing on medication supply at the time of hospital discharge from either hospital pharmacy or community pharmacy.	Ensures the literature review extends to cover any novel models of medication supply to patients from various settings at the time of discharge.
Exclusion Criteria	**Rationale**
Full paper not available in English.	No translation service was be available as part of this research.
Paper with focus on medicines reconciliation.	Medicines reconciliation was not be the focus of any planned research.
Papers with focus on patient medication counselling as part of the discharge process.	The mechanisms and staff involved in the patient medication counselling was not be a focus of any planned research.

2.4 Results of First Scoping Review

The first scoping review looked at the existing knowledge base on medication supply at the point of hospital discharge. Overall, 208 records were identified from three databases, after removal of 55 duplicates, 153 papers were screened by reviewing title and abstract. A further 88 papers were excluded as not relevant to the topic and 65 papers taken forward to full review. Full paper review excluded a total of 49 papers, using the inclusion and exclusion criteria previously discussed. 16 papers were included in the scoping review. This information is presented in the PRISMA diagram, Figure 2.1.

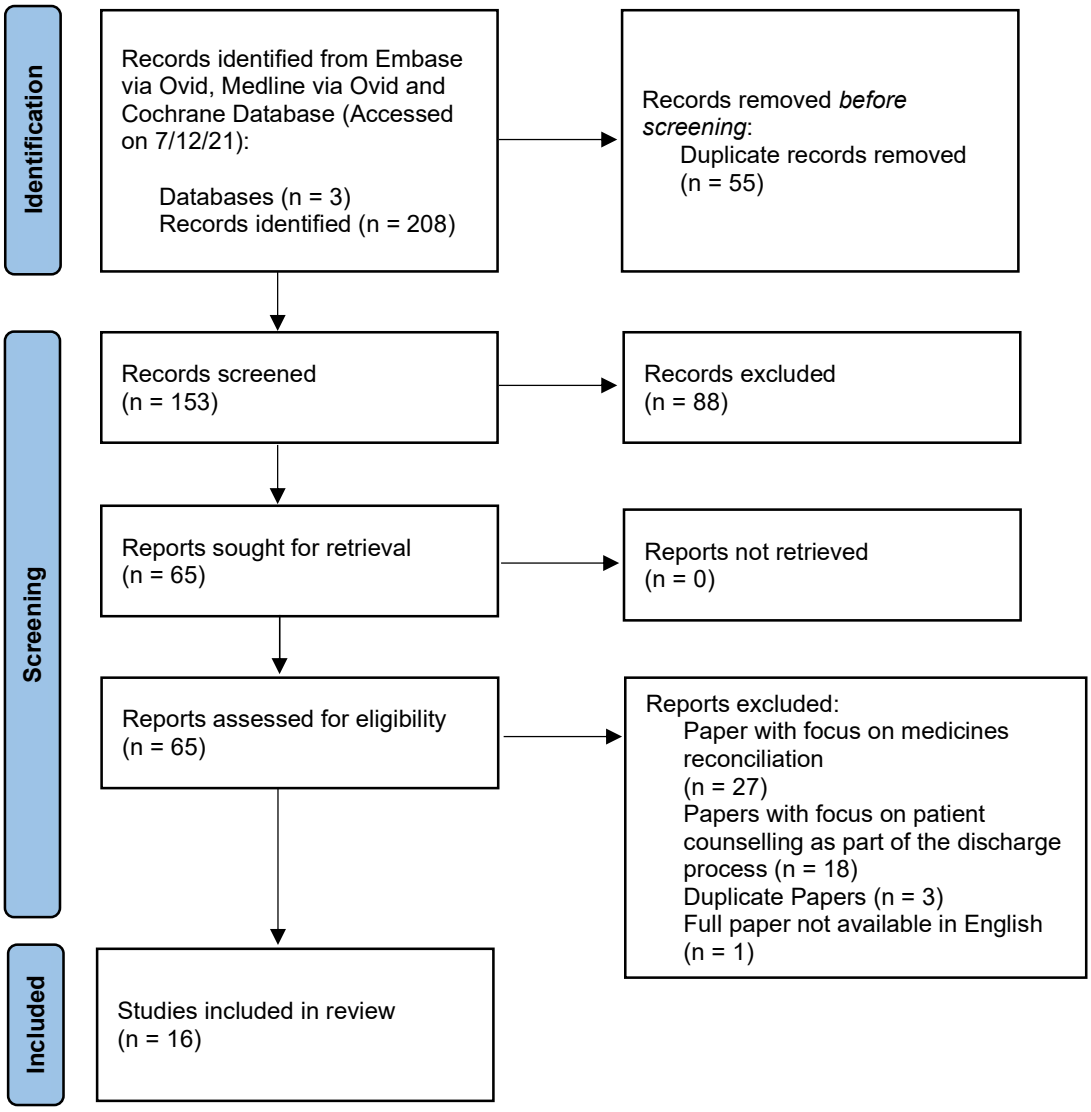


Figure 2.1. PRISMA Flow Chart of Screening Process for Medication Supply at the Point of Hospital Discharge

Table 2.3 shows the percentage of agreement, the Cohens K value and the level of agreement that was reached for the 20% randomly selected subsets at each stage of the screening process for the first scoping review.

Table 2.3. Summary of agreement by reviewers for first scoping review

What is the existing knowledge base on medication supply at the point of hospital discharge from either the hospital pharmacy or community pharmacy setting?		
Title and Abstract Screening	83% agreement (Cohen's K = 0.615)	Substantial agreement
Full text review	85% agreement (Cohen's K = 0.649)	Substantial agreement

From the first scoping review, 16 papers were identified and reviewed on the subject of "the existing knowledge base on medication supply at the point of hospital discharge from either the hospital pharmacy or community pharmacy". This scoping review established the lack of current research in this area within a UK hospital context, with only three UK studies identified which explored medication supply at the point of patient discharge from hospital (Bullock et al., 2016; Wright et al., 2017; 2019), and no papers having yet focused on this within NHS hospitals in Scotland.

The Table 2.4 provides a summary of the key points identified from the papers identified as described in the PRISM flow diagram in Figure 2.1. This table follows the charting the data framework for scoping review as set out by Arksey and O'Malley (2005).

Table 2.4 Summary of the Key Findings from Papers Reviewed on the Subject of the Existing Knowledge Base on Medication Supply at the Point of Hospital Discharge from Either the Hospital Pharmacy or Community Pharmacy (n=16)

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Pharmacist linkage in care transitions: from academic medical centre to community	Bloodworth, J., et al., 2019, USA	**Intervention type**: Pharmacist linkage in care transitions **Comparator**: Patients receiving usual care at discharge **Duration**: 6 months.	**Carer Group**: Hospital pharmacists, community pharmacists **Care Recipient Group**: 69 adult patients.	Improve the care of patients discharged, reducing preventable hospital readmissions and inform future care transition collaborations with community pharmacies.	Randomised controlled trial.	Medication therapy management discussions to identify drug therapy problem and patient readmission rates.	169 drug therapy problems identified and corrected during the study. Positive but not statistically significant reduction in readmission rates.
Patients' perspectives on medication management at hospital discharge: A qualitative study	Boeni, F., et al., 2019, Switzerland	**Intervention type**: Qualitative study on patients' perspectives. **Comparator**: No comparator. **Duration**: interview conducted at discharge with patients over a 2-month period.	**Carer Group**: Hospital discharge planners and pharmacists. **Care Recipient Group**: 15 adult patients	To understand patients' perspectives on medication management at hospital discharge.	Qualitative interviews with patients.	Themes identified from patient interviews.	Patients' highlighted medication supply at discharge and coordination between healthcare professionals as areas of concern.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Medication supply problems after hospital discharge and patients' and physicians' suggestions for optimisation	Brühwiler, L., et al., 2017, Switzerland	**Intervention type**: Study on medication supply problems and suggestions. **Comparator**: None **Duration**: Structured telephone interviews patients up to 6 days after discharge.	**Carer Group**: Patients and physicians. **Care Recipient Group**: 100 patients discharged from hospital.	To investigate the causes of medication supply issues after discharge and suggest improvements.	Structured and semi structured interviews.	Number of discharge prescriptions filled by patients. Themes identified from interviews	77% of patients filled their discharge prescriptions. Better links suggested between hospital and community pharmacy.
A RCT evaluating a pragmatic in-hospital service to increase the quality of discharge prescriptions	Brühwiler, L., et al., 2019, Switzerland	**Intervention type**: In-hospital service for improving discharge prescriptions **Comparator**: Standard discharge procedures. **Duration**: Patients recruited over a 13-week period.	**Carer Group**: Hospital and community pharmacists. **Care Recipient Group**: 76 patients scheduled for discharge.	Increase quality of discharge prescription measured by a reduction in pharmaceutical interventions by community pharmacists.	RCT with pre- and post-intervention comparisons.	Prescription quality, via number of community pharmacy interventions. Patient readmission rate.	The intervention improved the quality of discharge prescriptions, reducing need for community pharmacist to make clinically significant interventions.
Hospital patient discharge process: An evaluation	Bullock, K., et al., 2016, England	**Intervention type**: Semi structured interview to understand the medication issue at patient discharge. **Comparator**: None **Duration**: Interviews conducted over a 4-month period.	**Carer Group**: 13 chief pharmacists **Care Recipient Group**: None	To evaluate the hospital patient discharge process.	Semi structured interviews and thematic analysis.	Generalised discharge process model identified across the interviews.	Lack of patient involvement in discharge process and poor communication between hospital and community pharmacies.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Implementation and evaluation of a new pharmacy discharge service: The impact on discharge time, costs and views of healthcare professionals	Chand, S., et al., 2012, England	**Intervention type**: New pharmacy discharge service at a single hospital. Utilising patients own drugs and one stop dispensing **Comparator**: Previous discharge process. **Duration**: Retrospective data collection over a one-month time period and staff/patient questionaries.	**Carer Group**: Hospital ward health care professionals **Care Recipient Group**: Patients receiving pharmacy discharge service.	To assess the impact of a new pharmacy discharge service on discharge time, costs, and patient views.	Quantitative study with outcome measures pre- and post-intervention. (330 item pre and 273 items post implementation).	Discharge time, healthcare costs, professional satisfaction.	The new pharmacy service had increased discharge times and increased cost. However, both patients and ward health care professionals felt the new service was having a positive benefit on the discharge process.
Continuity of medication supply and provision of patient information on discharge: Development of a survey tool	Couch, R., et al., 2007, Australia	**Intervention type**: Development and validation of a survey tool for medication continuity at discharge. **Comparator**: No comparator. **Duration**: 229 interviews using the survey tool over 1 year.	**Carer Group**: Healthcare professionals involved patient discharge. **Care Recipient Group**: 229 patients discharged from hospital.	Evaluate parameters of continuation of medication supply after discharge.	Survey tool development and results evaluation.	Patient report issues with continued medication supply via survey telephone discussion.	The survey tool effectively identified no differences in continuity of medication supply between patients receiving discharge prescriptions or discharge medication. Higher risk of running out of medication identified in rural areas.
Study	**Author(s), Year of Publication, Study Location**	**Intervention Type, Comparator, and Duration**	**Study Populations**	**Aims of the Study**	**Methodology**	**Outcome Measures**	**Important Results**

Wastage of medications supplied by hospitals to facilitate continuity of care when patients are discharged to residential care facilities in Victoria, Australia	Elliott, R., et al., 2021, Australia	**Intervention type**: Observational study on medication wastage in residential care facilities post-discharge. **Comparator**: None. **Duration**: 3 months	**Carer Group**: Hospital Pharmacists. **Care Recipient Group**: 73 Patients in residential care.	To evaluate medication wastage in residential care facilities after hospital discharge.	Observational study using structured telephone reviews.	Amount of medication wasted, contributing factors.	High levels of medication wastage were reported. All patients had discharge medication returned to community pharmacy for disposal after discharge.
Effect of electronically delivered prescriptions on compliance and pharmacy wait time among emergency department patients	Fernando, S., et al., 2012, Australia	**Intervention type**: Electronically delivered discharge prescriptions to community pharmacies. **Comparator**: Previous paper prescriptions. **Duration**: 6 months.	**Carer Group**: Emergency department pharmacists. **Care Recipient Group**: 224 Emergency department patients.	To determine the effect of electronic prescriptions on medication adherence and community pharmacy wait time.	Randomised control study with follow up via structured telephone review.	Pharmacy wait time, medication adherence, patient satisfaction.	Electronically delivered prescriptions reduced wait times and patient satisfaction but did not improve medication adherence among patients.
Experience with technology-supported transitions of care to improve medication use	Frail, M., et al., 2016, USA	**Intervention type**: Technology-supported (video call) transitions of care. **Comparator**: Standard discharge process. **Duration**: 1 year.	**Carer Group**: Hospital and community pharmacists. **Care Recipient Group**: 18 Patients transitioning from hospital to home.	To explore the role of technology in supporting medication management during hospital discharge.	Patient satisfaction data collected using a tool modified from 5-item transition measure.	Medication adherence, patient satisfaction, healthcare provider perceptions.	Technology-supported transitions improved medication adherence and communication between healthcare providers.
Study	**Author(s), Year of Publication, Study Location**	**Intervention Type, Comparator, and Duration**	**Study Populations**	**Aims of the Study**	**Methodology**	**Outcome Measures**	**Important Results**

Transfer of care - a randomised control trial investigating the effect of sending the details of patients' discharge medication to their community pharmacist on discharge from hospital	Hockly, S., et al., 2018, England	**Intervention type**: Electronic communication of discharge medication details to community pharmacists. **Comparator**: Standard discharge procedures. **Duration**: 4 months.	**Carer Group**: Hospital and community pharmacists. **Care Recipient Group**: 33 Patients with discharge medications.	To assess the impact of sending discharge medication details to community pharmacists.	Randomised controlled trial.	Medication accuracy.	Improved medication accuracy and reduced errors through electronic transfer of discharge information to patient community pharmacist.
Post-discharge medicines management: the experiences, perceptions and roles of older people and their family carers	Tomlinson, J., et al., 2020, England	**Intervention type**: Patient interviews to explore how they managed post discharge medication. **Comparator**: None **Duration**: 14 months	**Carer Group**: Healthcare providers in post-discharge care. **Care Recipient Group**: 42 patients.	To develop a conceptual framework for improving post-discharge medication management.	Semi-structured interviews, data analysis used the framework method.	Thematic analysis of patient interview.	Patients attended community pharmacy for support on medication after discharge highlighting information should be shared with their community pharmacies.
Improving Post Discharge Medication Adherence: A Collaboration between an Academic Medical Centre and a Community Pharmacy Chain	Trinkley, K., et al., 2017, USA	**Intervention type**: Collaboration transfer of care service between hospital and community pharmacy. **Comparator**: None. **Duration**: 3 months.	**Carer Group**: Hospital and community pharmacists. **Care Recipient Group**:22 Patients discharged from hospital.	To evaluate the impact of collaboration between hospitals and community pharmacies on medication adherence.	Test of change, feasibility study.	Medication adherence.	The collaboration was seen to improve post hospital discharge medication adherence in the small cohort of patients.
Study	**Author(s), Year of Publication, Study Location**	**Intervention Type, Comparator, and Duration**	**Study Populations**	**Aims of the Study**	**Methodology**	**Outcome Measures**	**Important Results**

Impact of pharmacists' interventions on the paediatric discharge medication process	Voirol, P., et al., 2004, USA	**Intervention type**: Pharmacist-led interventions including communication with patients' community pharmacy. **Comparator**: Standard discharge process. **Duration**: 1 year.	**Carer Group**: Paediatric pharmacists. **Care Recipient Group**: 81 Paediatric patients discharged from the hospital.	To assess the impact of pharmacists' interventions on patients' likelihood of obtaining medications within 24 hours of discharge.	Prospective cohort study with pharmacist-led intervention.	Discharge medications collected within 24 hours and carers knowledge on how to administer the medications.	Pharmacist interventions in the discharge process and improved communication with both patients and community pharmacies can increase patients' collection of discharge medication within 24 hours.
Stakeholder perceptions of a new model of care for medication supply at hospital discharge	Wright, P., et al., 2019, United Kingdom	**Intervention type**: Explore the opinions of stakeholders involved in delivery or use of the proposed new model of care. **Comparator**: None.	37 participants including patients, hospital pharmacy staff, primary care pharmacy staff and community pharmacists.	To explore stakeholder perceptions of a new model for medication supply at hospital discharge.	Qualitative interviews and focus groups with stakeholders.	Stakeholder perceptions, barriers, facilitators.	Stakeholders viewed the new model as beneficial, but identified challenges in logistics and resources.
UK hospital patient discharge: The patient perspective	Wright, P., et al., 2017, United Kingdom	**Intervention type**: Exploration of patient experiences with the hospital discharge process. **Comparator**: None. **Duration**: 2 months.	98 patients completed the survey.	To understand patient experiences and perceptions of medication management at discharge.	Surveys of discharged patients.	Patient perceptions of discharge experience and patient suggestions for improvement.	Patients were generally satisfied with the discharge experience, however did perceive that delayed discharge was due to waiting on medication.

A key theme that emerged from the papers is that medication supply at discharge may be responsible for a percentage of delayed discharges (Wright et al., 2017) and can also have a negative impact on hospital resources (Bullock et al., 2016). Medication discrepancies can also occur during hospital discharge, this can result in medication errors which may cause unnecessary harm to patients and result in hospital readmission (Bullock et al., 2016; Wright et al., 2019). The research also highlighted a lack of patient involvement in the discharge process and poor communication between hospital and community pharmacies (Wright et al., 2019). Of the three previous studies within the UK context, participants (chief pharmacists) in the study by Bullock et al. (2016) also found that *"the supply of medication at discharge from hospital was highlighted as an area of waste in terms of cost and time"* (Bullock et al.: 279). It was also identified that the hospital-based discharge approach is responsible for medication wastage in residential care facilities (Elliott et al., 2021).

Another theme emerging from the first scoping review, was the role that community pharmacy could potentially play in facilitating improvements in this area. As discussed in Chapter 1, Section 1.1, the transfer of care between secondary and primary care is recognised to be a high-risk time for patient pharmaceutical care with an increased risk of medication errors occurring between care settings (Picton, 2012). However, sending discharge medication details to community pharmacists has resulted in greater medication accuracy and reduced errors (Hockly et al., 2018). Furthermore, Bloodworth et al. (2019) conducted a study of pharmacist-led care during transition from inpatient to community setting, with follow up care provided by community pharmacists. It was established that with access to patient records, pharmacists positively affected patient outcomes through medication management during care transitions. Research with a small cohort of patients in the USA also found that collaboration between hospitals and community pharmacies led to improved hospital discharge medication adherence (Trinkley et al., 2017), while improved communication with both patients and community pharmacies has also increased patients' collection of discharge medication within 24 hours, and that pharmacists' interventions during the discharge process can have positive impacts on the patient discharge process (Voirol et al., 2004).

Tomlinson (2020) noted that older patients' can experience confusion due to changes that are often made to their medications during hospital admission, which can potentially result in harm if medicines are taken incorrectly. Tomlinson found that patients often attended

their community pharmacy for support with these medication changes after discharge and noted it would be beneficial for information to be shared with a patient's community pharmacy.

Wright et al. (2017) explored inpatients perspectives of the discharge process and found that most patients felt it took too long, with the perceived main cause of delay being 'waiting for medicines'. Participants were supportive of alternative models that could be used for medication supply at discharge in the UK, including supply from their own community pharmacy. Additionally, the 2019 paper established "enthusiastic" stakeholder engagement (a variety of hospital and community-based healthcare professionals as well as expert patients and carers) with the concept of an alternative medication supply at discharge model in the UK (Wright et al., 2019). The stakeholders agreed the proposed model would reduce delays to discharge, although some challenges relating to logistics and resources were also identified. However, it was felt the proposed model was feasible as long as appropriate resources were in place. Stakeholders stressed the communication between the hospital and community pharmacy would be "essential to ensure patients receive their medication". The stakeholders suggested the appropriate infrastructure would be important, such as the human infrastructure (staffing levels, integrated ward teams) and also having the appropriate technology in place. Some felt the proposed model would utilise community pharmacists' existing skills, therefore additional training would be minimal, while others felt community pharmacists would require further clinical training.

2.5 Second Scoping Review: Process Mapping Within a Hospital or Community Pharmacy Setting

Following the first scoping review which identified a paucity of research exploring medication supply at the point of hospital discharge, the second scoping review focused on the methodology that could be applied within this research project to investigate the medication supply process at patient discharge in a selection of hospitals in Scotland. This secondary review examined the question: *'*has process mapping been used as a tool to identify areas for improvement within a hospital or community pharmacy setting?'. As highlighted in the introduction (Section 2.1) a scoping review was chosen as an established methodology to

both investigate a body of literature and clarify the concepts/methodology used in the research (Munn et al., 2018).

Process mapping is a technique used to represent the steps and stages of a process, typically within a defined process. It involves creating a diagram that outlines the sequence of activities, decision points, inputs and outputs, allowing for a clearer understanding of how a process operates. Commonly represented through hierarchical task diagrams, it is widely used in process management, quality control and systems analysis, to optimize workflows, ensure consistency and improve decision-making (Kirwan and Ainsworth, 1992).

The process to be mapped within this research - dispensing discharge medication - can be considered to be similar to the dispensing process that occurs within a community pharmacy. In both settings the supply of medication to patients is completed under the Medicines Act 1968 (UK Goverment, 1968) and the misuse of drugs act 1971 (UK Government, 1971). The Royal Pharmaceutical Society publication "Medicines, Ethics and Practice" (Royal Pharmaceutical Society, 2022) is used in both hospital and community pharmacy as the gold standard guide to ensure safe dispensing of patient medication. The process involved in dispensing medication to patients in the hospital and community pharmacy setting both involve dispensing and labelling medication to be issued to a patient from a signed prescription or order from a clinician. Both the hospital and community pharmacy setting will also complete a clinical safety check on the prescribed medication, however in community pharmacy this may be limited by the information that the community pharmacy hold on other medications prescribed to the patient. Another difference between the process for labelling and dispensing medication between community and hospital pharmacy can be seen by the use of electronic barcodes present on prescription in the community. The barcode, present on prescription from a GP practice in Scotland, contains digital information on the medication prescribed including quantity and directions. In the community pharmacy setting this digital information can be used to prepopulate the drug, quantity and directions for the labels. This system does not exist within the hospital pharmacy setting. Including community pharmacy dispensing process maps enables a more robust evidence base for process mapping used as a tool in any pharmacy setting to identify areas for improvement.

The second review to identify if process mapping has been used as a tool to identify areas for improvement within a hospital or community pharmacy setting, used the key search terms of: process mapping, hospital discharge, prescriptions, model of care and pharmacy. The

structure of the searches is presented in Appendix 1 and the key search terms in Table 2.1 within the methods and study selection in Chapter 2.2.

As highlighted in the Methods and Study Selection (Section 2.2), initially papers were screened from reading the abstract of the published paper. Where this was found to meet the inclusion criteria the paper was then moved into the full text review, where the inclusion and exclusion criteria were again applied. The inclusion and exclusion criteria, along with the rationale for the criteria, are presented in Table 2.5

Table 2.5 Inclusion and Exclusion Criteria for Second Scoping Review.

Inclusion Criteria	**Rationale**
Use of process mapping only within a hospital or community pharmacy setting	Ensure the literature reviewed is relevant to the pharmacy setting where the planned research is to be completed.
Description of the mechanisms used to create a process map.	Ensure the literature reviewed could be used to form a basis of how to create a process map in the appropriate setting.
Exclusion Criteria	**Rationale**
Full paper not available in English.	No translation service was be available as part of this research.
Paper published prior to the year 2000.	Ensure the literature reviewed accounted for modern day techniques and technological changes within both the mechanism of the process mapping and within the pharmacy settings.

2.6 Results of Second Scoping Review

The second scoping review looked at process mapping as a tool to identify areas for improvement in a hospital or community pharmacy setting. Overall, 371 records were identified from three databases, after removal of 124 duplicates, 247 papers were screened by reviewing title and abstract. A further 157 papers were excluded as not relevant to the topic and 90 papers taken forward to full review. Full paper review excluded a total of 64 papers, using the inclusion and exclusion criteria previously discussed. 26 papers were

included in the scoping review. This information is presented in the PRISMA diagram, Figure 2.2.

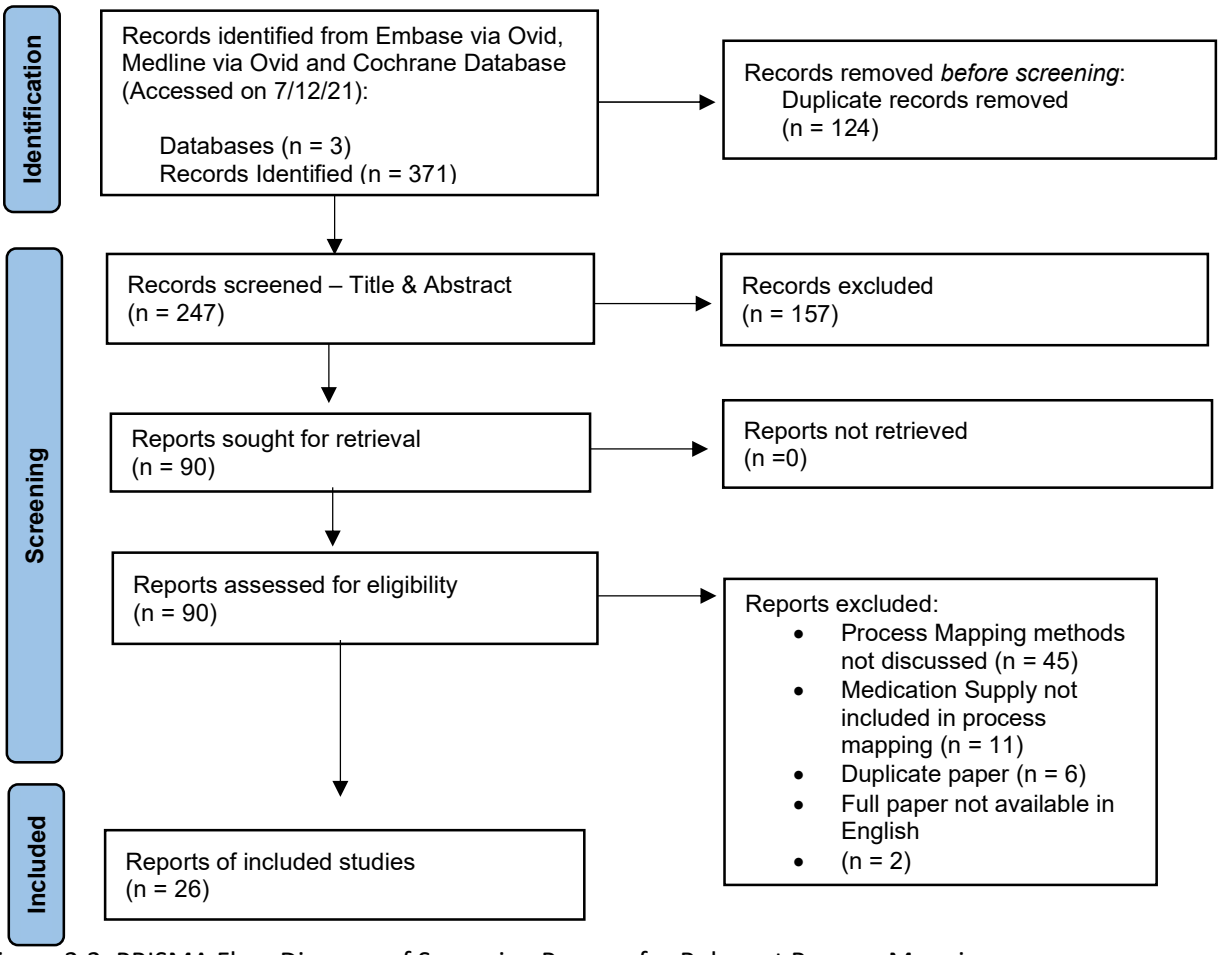


Figure 2.2. PRISMA Flow Diagram of Screening Process for Relevant Process Mapping Studies

Table 2.6 shows the percentage of agreement, the Cohens K value and the level of agreement that was reached for the 20% randomly selected subsets at each stage of the screening process for the second scoping review.

Table 2.6. Summary of Agreement by Reviewers for Second Scoping Review

Has process mapping been used as a tool to identify areas for improvement within a hospital or community pharmacy setting?"?		
Title and Abstract Screening	86% agreement (Cohen's k = 0.661)	Substantial agreement
Full text review	89% agreement (Cohen's k = 0.679)	Substantial agreement

The scoping review identified 26 papers where process mapping had been used as a tool to identify areas for improvement within a hospital or community pharmacy setting. These papers also highlighted a number of other tools that can be used alongside process mapping to identify areas for improvement. The literature also demonstrated that hierarchal task analysis diagrams can be used to visually displace the output of the process mapping (Ashour et al., 2022). Table 2.7 provides a summary of the key points from papers as identified in the literature search described in the PRISM flow diagram in Figure 2.2. This table follows the charting the data framework for scoping review as set out by Arksey & O'Malley (2005).

Table 2.7 Summary of the Key Findings From Papers Reviewed on the Utilisation of Process Mapping Within a Hospital or Community Pharmacy (n=26)

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Re-engineering the Hospital Discharge: An Example of a Multifaceted Process Evaluation	Anthony et al., 2005, USA	**Intervention type**: Multi-method hazard analysis for care quality and safety **Comparator**: None. **Duration**: None.	Study completed by multidisciplinary hospital team.	To assess the discharge process and improve efficiency.	Process Mapping, Qualitative analysis, failure mode and effects analysis.	Implementation of new hospital discharge process.	Process mapping as a foundation to understand a process prior to further evaluation of areas of risk with additional tools.
Process Mapping in Healthcare: A Systematic Review	Antonacci et al., 2021, (completed in USA however was literature review)	**Intervention type**: Systematic review of process mapping applications **Comparator**: None. **Duration**: None.	Published papers in process mapping.	To assess how process mapping has been applied in healthcare.	Systematic review of existing literature.	Various outcome measures depending on studies reviewed.	Process mapping is a valuable tool for healthcare improvement, but requires rigor to be successfully applied in healthcare setting.
Using Six Sigma DMAIC Methodology and Discrete Event Simulation to Reduce Patient Discharge Time in King Hussein Cancer Centre	Arafeh et al., 2018, Jordan	**Intervention type**: Utilising Six Sigma DMAIC methodology and discrete event simulation to create now discharge process **Comparator**: None. **Duration**: 1 month	**Carer group:** Healthcare staff within hospital **Care recipient group:** 41 Patients discharge from Cancer centre.	To reduce patient discharge time using Six Sigma methodology.	DMAIC methodology and discrete event simulation.	Reduced discharge time, improved process efficiency.	Process mapping was utilised as a fundamental stage of the sigma six methodology to describe the current patient model, this was utilised to improve patient discharge times.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Predicting Dispensing Errors in Community Pharmacies: An Application of the Systematic Human Error Reduction and Prediction Approach (SHERPA)	Ashour et al., 2022, United Kingdom	**Intervention type**: SHERPA approach to predict dispensing errors and propose solution. **Comparator**: None.	**Carer group:** Community Pharmacy staff **Care recipient group:** Community pharmacy patients receiving a prescription medicine.	To predict and reduce dispensing errors in community pharmacies.	Process mapping used to create hierarchical task analysis diagrams with subsequent SHERPA analysis.	Identification of potential errors in the dispensing process along with suggested remedial measures.	Focus groups used to develop process maps as a hierarchical task analysis of the process of dispensing medication in a community pharmacy. SHERPA model applied to find remedial solutions to potential errors in dispensing patient medication.
The Pre/Peri/Post-Operative Provincial Pacemaker Project (P6) - A Quality Improvement Initiative to Drive High Quality Pacemaker Care in British Columbia	Bashir et al., 2017, Canada	**Intervention type**: Quality improvement initiative for pacemaker care **Comparator**: None. **Duration**: Data analysis for 27,556 patients over a historic 6-year period.	**Carer group:** Healthcare staff within hospital sites. **Care recipient group:** Patients receiving a pacemaker.	To improve pacemaker care across all stages of the patient journey.	Process Mapping and Quality Improvement project.	Process variances between pacemaker operations across sites, readmission rates.	Process mapping was used in each hospital setting as the basis for quality improvement work shared across all the sites.
Development of a Clinical Pathway for the Assessment and Management of Suicidality on a Paediatric Psychiatric Inpatient Unit	Boafo et al., 2020, Canada	**Intervention type**: Clinical pathway development for suicidality management. **Comparator**: None.	**Carer group:** Mental health providers **Care recipient group:** Paediatric psychiatric patients.	To develop a structured care pathway for suicidality management.	Clinical pathway development.	3 lean methodologies and process mapping.	Process mapping was used as a tool to define sequenced work process activates. Reviewing process map improved care structure and safety for suicidal patients.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Nursing-Led Intervention to Improve Use of Prolonged Arrhythmia and Polysomnography in Veterans with Ischemic Stroke	Bottomley et al., 2017, USA	**Intervention type**: Nursing-led intervention for arrhythmia and polysomnography. **Comparator**: None. **Duration**: 1 year	**Carer group:** Nursing staff with the ward **Care recipient group:** 21 Veterans with ischemic stroke.	To improve the use of arrhythmia monitoring and polysomnography.	Lean six sigma process improvement methods including process mapping.	Patient outcomes/diagnosis from test of change.	Increased use of discharge arrhythmia monitoring and identification of clinically relevant findings. Process mapping was important to establish how the current process could be improved.
Mapping Out the Emergency Department Disposition Decision for High-Acuity Patients	Calder et al., 2012, Canada	**Intervention type**: Mapping the emergency department disposition decision **Comparator**: N/A	**Carer group:** Emergency staff **Care recipient group:** High-acuity emergency patients.	To map the decision-making process for high-acuity patients.	Focus groups to create process maps and identify error prone areas.	Consensus on most important contributors to emergency department decision-making errors.	Creation of process maps, via focus groups enabled visualisation to identify key areas that contributed to decision making errors.
Mapping the Care Transition from Hospital to Skilled Nursing Facility	Campbell Britton et al., 2020, USA	**Intervention type** Mapping care transition from hospital to skilled nursing facilities. **Comparator**: None.	**Carer group:** Healthcare providers **Care recipient group:** Patients transitioning to skilled nursing facilities.	To map and improve the hospital-to-skilled nursing facility transition.	Quality improvement methodology and Process Mapping.	Identification of activities that required improved coordination between patient care teams.	Process mapping the patient journey during the transition of care highlighted specific areas for improvement in time sensitive exchange of clinical and administrative information.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Using a Multi-Method, User-Centred, Prospective Hazard Analysis to Assess Care Quality and Patient Safety in a Care Pathway	Dean et al., 2007, England	**Intervention type** Hazard analysis of the COPD supported discharge program **Comparator**: None.	**Carer group:** Hospital staff **Care recipient group:** Patients being discharged on various private insurance schemes.	To identify areas where improvements could be made to patient discharge time in relation to payments via private insurers.	Process Mapping, semi-structured interviews and two round modified Delphi study.	Identified safety risks, care quality improvements	A detailed process map was used to triangulate the areas of concern raised by patients to allow health care staff to identify areas for improvement.
Impact of Patients' Healthcare Payment Methods on Hospital Discharge Process: Evidence from India	Drew et al., 2016, India	**Intervention type:** Analysis of payment methods on discharge process. **Comparator**: Different payment methods **Duration**: 1 year	**Carer group:** Hospital healthcare professionals **Care recipient group:** Patients being discharged on the COPD supported program.	To explore the impact of payment methods on discharge timing.	Process Mapping, Linear Regression Analysis.	Discharge timing, payment method impact.	Payment methods significantly influenced discharge timing; process mapping was used to identify potential areas for improvement in payment methods to enable more timely patient discharge.
Leveraging the Outpatient Pharmacy to Reduce Medication Waste in Paediatric Asthma Hospitalizations	Hoefgen et al., 2020, USA	**Intervention type:** Outpatient pharmacy intervention **Comparator**: Baseline data prior to intervention **Duration**: 6 months.	**Carer group:** Hospital healthcare providers **Care recipient group** Paediatric asthma patients.	To decrease the number of patients administered more than one ICS during an admission.	Process Mapping and QI Methodology.	Medication waste reduction.	Process mapping allowed oversight of the medication ordering pathway, enabling areas to be targeted to reduce patients being administered more than one ICS during admission.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Process Mapping Evaluation of Medication Reconciliation in Academic Teaching Hospitals: A Critical Step in Quality Improvement	Holbrook et al., 2016, Canada	**Intervention type:** Process mapping of medication reconciliation **Comparator**: 3 hospitals in Hamilton, Canada.	**Carer group:** Hospital healthcare providers **Care recipient group:** Patients admitted to the hospitals.	To evaluate medication reconciliation processes.	Process mapping of medication reconciliation, Quality improvement methodology.	Discussion across the 3 hospitals of the completed process maps to identify areas for improvement.	Process mapping was used as a key tool to identify areas of difference between the medication reconciliation process between the hospital sites.
New Year - New Tool: Process Mapping	Chia Swee, 2010, England	**Intervention type:** Introduction of process mapping technique **Comparator**: None.	**Carer group:** Healthcare practitioners.	To introduce process mapping as a healthcare tool.	Process Mapping technique.	Understandin g of process mapping.	Detailed explanation of the role that process mapping can play in healthcare to identify areas for improvement.
Searching for the Missing Pieces Between the Hospital and Primary Care: Mapping the Patient Process During Care Transitions	Johnson et al., 2012, USA, Poland, Sweden, Italy, Spain and the Netherlands	**Intervention type:** Mapping the patient process during care transitions **Comparator**: Hospitals across 6 countries.	**Carer group:** Healthcare providers **Care recipient group:** Patients transitioning to primary care.	To map the patient process during hospital-to-primary care transition.	Process mapping completed via focus group interviews.	Gaps and barriers in care transition.	Process mapping used as a tool to visualise a complex process enabling identification of barriers to effective transitions of care.
Leveraging Electronic Health Record Documentation for Failure Mode and Effects Analysis Team Identification	Kricke et al., 2017, USA	**Intervention type:** EHR for failure mode and effects analysis (FMEA) **Comparator**: Reported current discharge process **Duration**: 6 months.	**Carer group:** Hospital healthcare providers **Care recipient group:** Patients discharged from cardiology ward.	To evaluate the discrepancies between expected and observed activities by clinicians at patient discharge.	Process mapping, Failure Mode and Effects Analysis (FEMA).	Failure modes identified, improvements in care processes.	Process mapping used to define discharge process and then compared to electronic health record notes to highlight variances in expected process.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Securing the Paediatric Use of Oral Chemotherapy: A Proactive Risk Assessment	Mouffak et al., 2017, France	**Intervention type:** Proactive risk assessment for paediatric oral chemotherapy **Comparator**: 100 previous discharge prescriptions **Duration**: 1 month.	**Carer group:** Hospital healthcare providers **Care recipient group:** Paediatric patients discharged from chemo ward.	To assess risks associated with paediatric oral chemotherapy discharge prescriptions.	Process mapping, Failure mode and Effects analysis (FEMA).	Prescription errors, medication dispensing errors.	Process maps created using a multi-disciplinary group for the oncology pathway. Process maps then analysed with FEMCA methodology. Learnings taken from process failures identified.
Effectiveness and Sustainability of a Standardized Care Pathway Developed with Use of Lean Process Mapping for the Treatment of Patients Undergoing Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis	Oetgen et al., 2018, USA	**Intervention type:** Lean process mapping to care pathway for paediatric patients requiring posterior spinal fusion **Comparator**: 44 patients managed prior to new pathway **Duration**: 2 years.	**Carer group:** Healthcare providers within the paediatric hospital ward **Care recipient group:** 169 Paediatric patients undergoing spinal fusion.	To implement and evaluate a new care pathway for paediatric patients requiring posterior spinal fusion.	Lean Process Mapping.	Clinical outcomes, care variability.	Use of the Lean process mapping technique to create an evidence-based protocol for preoperative, operative, postoperative and post-discharge care.
Lean Methodology for Performance Improvement in the Trauma Discharge Process	O'Mara et al., 2014, USA	**Intervention type:** Lean process mapping methodology applied to improve communication and discharge planning **Comparator:** Previous discharge processes **Duration**: 8 months.	**Carer group:** Trauma care staff **Care recipient group:** Patients being discharge from trauma ward.	To apply lean methodology to improve trauma discharge processes.	Lean techniques, process mapping.	Discharge time, process efficiency.	Process mapping was used to identify areas for immediate analysis and intervention-defining metrics for the stakeholders. The result was an improvement in patient discharge times.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Multidisciplinary Engagement Increases Medications In-Hand for Patients Hospitalized with Asthma	Parikh et al., 2019, USA	**Intervention type:** Multidisciplinary intervention to number of asthmatic patients discharged with inhalers **Comparator:** Previous discharge processes **Duration**: 2 years.	**Carer group:** Multidisciplinary team on paediatric Asthma ward **Care recipient group:** Children being discharged after an asthma exacerbation.	To improve the number of patients discharged with inhalers.	Process mapping and iterative plan-do-study-act cycles.	Percentage of patients who received their inhalers at time of discharge.	Utilising process mapping as the basis to understand the current process enabling targeted PDSA cycles resulted in more patients leaving the hospital with inhalers at discharge.
Physician Assistants Improve Efficiency and Decrease Costs in Outpatient Oral and Maxillofacial Surgery	Resnick et al., 2016, USA	**Intervention type:** Physician assistant (PA)involvement in outpatient surgery **Comparator:** Usual process with PA involvement **Duration**: 6 months.	**Carer group:** Physicians and Physician assistant **Care recipient group** Outpatient oral and maxillofacial surgery patients.	To evaluate the impact of physician assistants on surgery efficiency and costs.	Prospective cohort study, Process Mapping.	Average times and costs for discharge across the two cohorts and complication rates.	Process mapping created to capture all activities from room preparation to patient discharge completed prior to time driven costing variance analysis. This showed the roles completed by the physicians' assistants and the cost savings generated.
Failure Modes and Effects Analysis to Improve Transitions of Care in Patients Discharged on Outpatient Parenteral Antimicrobial Therapy	Sadler et al., 2021, USA	**Intervention type:** identify barriers to safe and effective completion of outpatient parenteral antimicrobial therapy (OPAT) in patients discharged from an academic medical centre **Comparator**: None.	**Carer group:** Ward MDT **Care recipient group** Patients discharged on parenteral antimicrobial therapy.	To improve discharge pathway for patients with parenteral antimicrobial therapy.	Process Mapping, Failure Mode and Effects Analysis (FEMA).	Changes to discharge processes to improve patient care.	Process mapping used as the basis for failure mode and effects analysis. This allowed the multidisciplinary team to identify areas of improvement leading to changes to the existing discharge processes.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Process Mapping: Enhancing the Implementation of the Liverpool Care Pathway	Taylor and Randall, 2007, New Zealand	**Intervention type:** Process mapping of Liverpool Care Pathway **Comparator**: None.	**Carer group:** Healthcare providers **Care recipient group** End-of-life patients (care recipient group).	To improve the implementation of the Liverpool Care Pathway in a 12-bed hospice.	Process Mapping	Redesign of how the Liverpool care pathway is implemented in the hospice in line with patient views.	Improvement in palliative care pathway shown via patient metrics with process mapping technique used to understand processes.
Process Mapping the Patient Journey: An Introduction	Trebble et al., 2010, England	**Intervention type:** Papper aims to provide a framework for process mapping a patient journey through a healthcare service **Comparator**: None.	**Carer group:** Healthcare providers **Care recipient group** Patients within a healthcare service.	To introduce process mapping to the patient journey in healthcare systems.	Process Mapping.	Understandin g of process mapping.	Process mapping enables the reconfiguring of the patient journey from the patient's perspective in order to improve quality of care and release resources.
Shifting Stroke Care from the Hospital to the Nursing Home: Explaining the Outcomes of a Dutch Case	Van Raak et al., 2010, Netherlands	**Intervention type:** Redesign of a care pathway for a stroke patients discharged to nursing home **Comparator**: Regular discharge process. **Duration**: 1 months.	**Carer group:** Healthcare providers (hospital and nursing home staff). **Care recipient group** 51 Stroke patients discharged to nursing home.	To evaluate the shift of stroke care to nursing homes.	Case study, Process Mapping.	Total patient time spent in hospital, stroke unit and nursing home.	Process mapping used to define the service delivery to patients and enabled redesign of service that lead to reduced inpatient hospital durations.

Study	Author(s), Year of Publication, Study Location	Intervention Type, Comparator, and Duration	Study Populations	Aims of the Study	Methodology	Outcome Measures	Important Results
Application of Process Mapping to Understand Integration of High-Risk Medicine Care Bundles within Community Pharmacy Practice	Weir et al., 2018, Scotland	**Intervention type:** Process mapping medication dispensing processes within 4 community pharmacies **Comparator**: Existing processes.	**Carer group:** Community pharmacy staff **Care recipient group** Patients served by community pharmacy.	To optimize the use of care bundles in the community pharmacies existing dispensing processes.	Process Mapping, Hierarchical Task Analysis diagram.	Implementation of the high-risk medicine care bundles within the community pharmacies.	Process maps can be utilised to gain a greater understanding of a complex process such as dispensing medication. This enabled integration of the high-risk medicine care bundles within the existing dispensing processes.

The second scoping review identified multiple examples where process mapping has been used to identify areas for improvement within a hospital or community pharmacy setting, including one systematic review of process mapping in the health care setting. The review by Antonacci et al. (2021) established that process mapping has been used within a wide range of healthcare settings and is a tool that can be used to identify areas for change in complex systems. Most of the studies in Antonacci's review focused on process improvement and quality improvement initiatives. The review assessed process mapping to be a valuable tool for healthcare improvement as long as it applied with rigor and stated that *"[i]f appropriately used, PM brings together perspectives of diverse stakeholders to harness tacit knowledge and understand complex processes, as well as to find common solutions and enhance team engagement"* (Antonacci et al., 2021: p.10).

In the hospital setting, process mapping has been used for a number of years to identify areas for potential improvement in the patient's journey (Antonacci et al., 2021). It was applied as an evaluation tool of current processes within a hospital setting during the redesign of the Liverpool care pathway (Taylor and Randall, 2007).

Antonacci (2021) noted that healthcare research increasingly incorporates quality improvement and process-orientated management practices from other industries alongside process mapping, and this was found to be the case in a number of the papers in this study, while others used process mapping as a standalone methodology.

Of those studies incorporating other methods alongside process mapping, one of the most prevalently used was Failure mode and effects analysis (FMEA) used in four of the studies reviewed (Anthony et al., 2005; Kricke et al., 2017; Mouffak et al., 2017 and Sadler et al. (2021). FMEA is an example of a quality improvement approach and is a "*proactive process that acknowledges that errors are inevitable and predictable, anticipates their occurrence, and designs systems that will minimise their impact*" (Anthony et al, 2005. p387) and in doing so it can be used to identify potential failures before implementing new processes. In Anthony et al. (2005) the aim was to develop interventions which could improve the risks associated with the discharge process when transferring patient care from the hospital team to primary care. In Kricke et al. (2017) process mapping and FMEA was used to define the discharge process and then compared to electronic health record notes to highlight variances in the expected process, in doing so it was utilised for quality improvement. Mouffak et al. (2017) used FMEA alongside process mapping as part of a proactive risk assessment for

paediatric oral chemotherapy. Process maps were created using a multi-disciplinary group for the oncology pathways, with process maps then analysed using FMEA. Learnings could then be made from the process failures identified. In Sadler et al. (2021) process mapping was used as the basis for failure mode and effects analysis. This allowed the multidisciplinary team to identify areas of improvement leading to changes to the existing discharge processes.

Other methods used alongside process mapping in the papers identified, include the six-sigma process improvement methodology, which was used to improve patient discharge times (Arafeh et al., 2018) and in a nursing-led intervention for arrhythmia and polysomnography (Bottomley et al., 2017). Process mapping and quality improvement methodology was utilised in three studies (Campbell Britton et al., 2020; Bashir et al 2017 and Holbrook et al., 2016). Other studies incorporated Lean process mapping (Oetgen et al., 2018 and O'Mara et al., 2014). This is a visual technique used to make improvements to patient care processes, particularly through streamlining workflows and improving efficiency and quality. Boafo et al. (2020) utilised three lean methodologies alongside process mapping in a study to develop a clinical pathway for the assessment and management of suicidality in a paediatric psychiatric inpatient unit.

The scoping review also identified that process mapping has been used alongside a SHERPA - Systematic Human and Error Reduction Prediction Approach (Embrey, 1986) in one study by Ashour et al. (2022). In this paper, focus groups developed process maps as a hierarchical task analysis of the process of dispensing medication in a community pharmacy. The SHERPA model was applied to find remedial solutions to potential errors in dispensing patient medication. One of the main parts of the SHERPA analysis is task classifications, where each step in a process is described as either an action, retrieval, checking, selection or information communication step.

Additionally, in Scotland, process mapping was used to describe the supply of medication to a patient in a community pharmacy setting (Weir et al., 2018) where process maps were found to be valuable to gain a greater understanding of the complex process of dispensing medication. The study by Weir et al. (2018) enabled integration of the high-risk medicine care bundles within the existing dispensing processes. Weir et al. (2018) also used a hierarchical task analysis diagram to visualise the output from the process mapping exercise. The

hierarchical task analysis diagram was again used in the study by Ashour et al. (2022) to visualise the output of the process mapping completed in the study.

No papers were identified which involved the application of process mapping to the medication supply at discharge within hospital settings in Scotland. Bullock et al. (2016) evaluated the current hospital discharge process from a range of NHS hospitals across the North-West of England; however, this paper utilised semi-structured interviews to define a common process and did not include the process mapping of the medication supply at discharge.

In summary, the second scoping review identified a wide range of studies where process mapping has been used successfully in a healthcare setting to highlight issues and make improvements. It also identified a number of methods used alongside process mapping including SHERPA analysis task classification and a hierarchical task analysis diagram to visualise the output from the process mapping exercise.

2.7 Discussion

The scoping review on the existing knowledge base on medication supply at the point of hospital discharge from either the hospital pharmacy or community pharmacy setting identified 16 papers that met the inclusion and exclusion criteria. The papers highlighted a range of medication supply models that exist globally for supplying patient medication at the point of hospital discharge. A 2012 paper (Fernando, Nguyen and Baraff, 2012), for instance, highlighted the effectiveness of electronic prescriptions issued to a patient's community pharmacy at discharge in both terms of reduced patient waiting times and overall patient satisfaction within the USA. The current discharge medication supply model within the UK involves patients being issued with discharge medication from the hospital pharmacy at discharge rather than the patient's own community pharmacy, no electronic prescription transfer is currently possible from NHS hospitals in Scotland to a community pharmacy.

The papers also highlighted the risk associated with the transition of care for patient between hospital care and community care. Other papers (Bloodworth et al., 2019; Hockly, Williams and Allen, 2018) highlighted the benefits of inclusion of the patient's community pharmacy as part of the discharge process to both reduce medication errors and improve patient outcomes by medication management at the transition of care.

In the UK, only three studies have been published on medication supply at the point of patient discharge from hospital. A 2016 paper (Bullock et al., 2016) evaluated the current hospital discharge process from a range of NHS hospitals across the North West of England. The semi structured interview with NHS staff involved in patient discharge included discussion of medication supply at discharge and highlighted the current processes were "an area of waste in terms of time and cost". Another paper (Wright et al., 2017) focused on the patient perspective of hospital discharge from a single large city centre hospital. The findings within the paper highlighted that 70% of the patients' perceived reason for delay to discharge was due to waiting for medication. The participants also suggested alternative models that could be used for medication supply at discharge, including supply from their own community pharmacy. The 2019 paper showed stakeholder engagement with the idea of an alternative medication supply at discharge model (Wright et al., 2019); however, no testing of a community pharmacy discharge medication model was reported. No papers could be identified that focused on the medication supply models at the point of patient discharge from NHS hospitals in Scotland.

The scoping review on the topic of process mapping as a tool to identify areas for improvement within a hospital or community pharmacy setting identified 26 paper that met the eligibility criteria. The papers demonstrated multiple examples where process mapping has been used to identify areas for improvement within a hospital or community pharmacy setting. In 2021, Antonacci et al. published a systematic review of process mapping in the health care setting (Antonacci et al., 2021). It was noted in this review that process mapping has been used within a wide range of healthcare settings and is a tool that can be used to identify areas for change in complex systems. Process mapping has also been used within the hospital setting as part of an evaluation tool. In a 2007 paper (Taylor and Randall, 2007) it was demonstrated how process mapping could be used as part of the evaluation of current processes within a hospital setting.

The second scoping review also showed other models such as the FMEA model (Anthony et al., 2005; Kricke et al., 2017; Mouffak et al., 2017 and Sadler et al., 2021); the six sigma process improvement methodology (Arafeh et al., 2018) and the LEAN methodology (Oetgen et al., 2018 and O'Mara et al., 2014) could be used alongside process mapping to identify areas from for potential improvements in the process. Consideration was given to utilisation of these models within this research. However, to understand the medication supply at

discharge across a selection of Scottish hospitals, it is important to be able to compare the process maps across the different hospitals. Identification of areas for potential improvement within each individual process map was not felt to add to this comparison, as identification of areas for improvement would focus more on the individual process, rather than the comparisons of the existing processes to identify any similarities or differences that exist in the current medication supply at discharge pathways across the hospitals.

The second scoping review also identified that the Systematic Human and Error Reduction Prediction Approach (SHERPA) could be utilised after process mapping to identify possible areas where an error could occur within a process (Ashour et al., 2022). Interestingly the first part of a SHERPA analysis involved the classification of each step within the process map to either an action, retrieval, checking, selection or information communication step. The research into the medication supply at hospital discharge did not include an aspect of investigating areas where errors could occur in each individual process map and instead would focus on comparison across the different hospital sites process maps. However, the step classification could be used as a method to compare the processes between the hospital. Identification of the types of steps within each of the hospitals process maps would enable comparison to understand the similarities and differences between both the number and types of steps within the different hospitals' medication supply at discharge processes. Therefore, the SHERPA task classifications have been used in the results and discussion within Chapter 3 as part of the analysis between the different hospitals medication supply at discharge pathways.

The scoping review for the use of process mapping review also uncovered a hierarchical task analysis diagram as a viable model that can be used to visualise the output from the process mapping exercise. An example is seen where both process mapping and hierarchical task analysis are used in conjunction to understand dispensing of medication in the community pharmacy setting (Weir et al., 2018). As discussed in Section 2.1, the process of dispensing patient medication on discharge in a hospital setting can be considered to be similar to the process of dispensing patient medication in a community pharmacy setting. No papers could be found that demonstrated the same techniques being applied to the complex dispensing systems within hospital settings in Scotland.

The main strengths of the scoping reviews include the use of well-established databases, (Embase, Medline and the Cochrane library) along with a wide selection of keywords and MeSH terms to identify relevant papers. The review process was further strengthened by utilising a second reviewer to screen a subset of 20% of the papers alongside the main reviewer to reduce risk of primary review bias for the papers that should be included in the literature review. The main weakness of both the scoping reviews was seen in the exclusion criteria of only including papers in English. This was due to the fact that no interpreting service was available as part of this review process; however, this may have led to the exclusion of relevant papers based solely on the language the paper is presented in and as such important contributions may have been omitted. A further limitation on the methods for the scoping review for 'has process mapping been used as a tool to identify areas for improvement within a hospital or community pharmacy setting' involves the inherent differences between the medication supply processes within the community pharmacies and hospital pharmacy dispensaries. These differences have previously been discussed in Section 2.1, however the use of process mapping in the community pharmacy setting could provide details that can be adapted for use within the hospital environment.

Upon completion of the literature review, with the conclusions that process mapping is a viable tool to be used to identify areas for improvement within a hospital setting and with no papers investigating the medication supply at discharge process in hospitals in Scotland having been identified, the next stage of this research was to design a protocol to examine the medication supply at discharge processes in a selection of Scottish hospitals.

Chapter 3: Process Mapping Medication Supply at Hospital Discharge

3.1 Introduction

The scoping reviews (Chapter 2) highlighted that no current literature exists to define the process of medication supply to patients at the point of discharge from hospital in Scotland. Additionally, limited literature exists on medication supply to patients at the point of hospital discharge in the UK. Bullock et al. (2016) evaluated the current hospital discharge process from a range of NHS hospitals across the North-West of England; however, their paper utilised semi-structured interviews to define a common process and did not include the process mapping of the medication supply at discharge. Fernando, Nguyen and Baraff (2012) highlighted the discharge medication supply process in the USA, demonstrating that electronic prescription delivery to a community pharmacy improved both patient waiting times and patient satisfaction when compared to handwritten discharge prescription.

Furthermore, the second scoping review established that process mapping is routinely used in a hospital setting as a tool to enable understanding of complex systems (Chapter 2, Section 2.6). The scoping review demonstrated that where process mapping is used as a tool to investigate a complex process, a hierarchical task analysis diagram can be used to display the findings from the process mapping. A hierarchical task analysis diagram displays the stages of a process with the individual steps required to complete each stage shown sequentially below the stages. The scoping review also highlighted that process mapping is used as the first step in a SHERPA analysis. As discussed in section 2.6, this research does not aim to investigate areas for potential errors within the current medication at discharge processes. However, the task classifications used within the SHERPA analysis, where each step in a process is described as either an action, retrieval, checking, selection or information communication step was considered to be useful in this research to investigate the similarities and differences in both the number and types of steps within each hospital's medication at discharge pathways. Understanding the current medication supply pathway at the point of discharge in this detail is key prior to discussing areas where change could be suggested to improve the process.

Historically hospitals in Scotland have used a written prescription for all inpatient medication, called a Kardex. A variety of IT systems have been used across Scotland to create an immediate discharge letter at the time of discharge that contains the patient's final medication list as shown on the Kardex. The Scottish Government eHealth Strategy 2014-

2017 (Scottish Government, 2015) has the clear aim for the Hospital Electronic Prescribing and Medicines Administration system (HEPMA) to be used in all hospitals across Scotland. This system replaces the handwritten Kardex and can be used to electronically transfer the patient's final medication list to the immediate discharge letter. Different hospital sites are at different points in the process of rolling out the HEPMA system. In this research only hospitals with completed roll out of the HEPMA system were visited to ensure the research will remain relevant once HEPMA is the standard IT system used across Scotland.

3.2 Aim and Objectives

Aim

To examine the patient medication supply process at the point of discharge in a selection of Scottish hospitals.

Objectives:

1. To process map the pathway of patient medication supply at the point of discharge.
2. To extract and analyse the timing data associated with the pathway of medication supply at the point of discharge from within the HEPMA system.

Study Design:

This research uses a mixed methodology approach utilising process mapping within a healthcare setting (Antonacci et al., 2021), and timing data analysis, to examine the pathway of patient medication supply at the point of hospital discharge in a selection of Scottish hospitals.

3.3 Setting

Scotland has a population of around 5.5million people (National Records of Scotland, 2022). The healthcare of the population is served by the publicly funded National Health Service (NHS) Scotland. NHS Scotland was founded through the National Health Service (Scotland) Act 1947 (UK Government, 1947), establishing the public funding of the NHS via taxation to provide healthcare services free at the point of access to the population.

In 1998 The Scottish Act (UK Government, 1998) transferred the control of NHS Scotland to the devolved Scottish Government. The current structure of NHS Scotland is divided into 14 geographical health boards with 277 hospitals located across the country (UK Government, 2013). The hospitals range in both size and in the types of patients they serve. The types of hospitals are classified using the hospital classification index with nine main categories (Public Health Scotland, 2020). All the health boards in Scotland include "general hospitals" that offer acute health care to the population. Each of these hospitals have a general medical ward(s) along with speciality wards for a variety of medical conditions including cardiology and respiratory specialties. This study focused on general medical wards to ensure similar ward types were considered for consistency. General medical wards tend to be short stay wards where patients will have acute medical issues, such as an acute asthma exacerbation, that may result in new or changed medication being prescribed for the patient. Where patients have a longer admission to hospital, they are more likely to be moved from a general medical ward onto a specialist ward to manage their condition. The discharge time from a general medical ward can have a significant impact on the patient flow within a hospital as patients tend to be triaged from an acute receiving ward onto a general medical ward, hence delayed discharges from the general medical ward can contribute to a perceived lack of beds within a hospital and disruption to the flow of patients through the hospital system.

As previously highlighted, the Scottish Government eHealth Strategy 2014-2017 has the clear aim for the HEPMA IT system to be used in all hospitals across Scotland (Scottish Government, 2015). Health boards and hospital sites are at a variety of points in the process of rolling out the HEPMA system across Scotland. At April 2022 the roll-out of HEPMA has been completed in six of the health boards (Scottish Government, 2022). The health boards with completed HEPMA rollout are: NHS Ayrshire and Arran; NHS Dumfries and Galloway; NHS Forth Valley; NHS Greater Glasgow and Clyde; NHS Lanarkshire; and NHS Lothian. In this

study only hospitals with completed roll out of the HEPMA system were visited to ensure the research will remain relevant once HEPMA is the standard IT system used across all the health boards in Scotland.

The selected hospitals also included a minimum of one hospital using a patient's own drug dispensing (POD) model and one hospital with discharge medication supplied to patients via a traditional hospital dispensary model that involves a patient's discharge medication being supplied from a hospital pharmacy department. This ensured the process maps covered the two different types of discharge medication supply models in operation across the hospitals in Scotland. Table 3.1 defines the inclusion criteria for the hospitals.

Table 3.1 Inclusion Criteria for Hospital Selection

Inclusion Criteria	Rational
HEPMA IT system	Scottish Government eHealth strategy 2014-2017 has the aim for all hospitals to use this system across Scotland
General medical ward	To ensure similar ward type is visited in each hospital
Minimum of one hospital with patients own dispensing (POD) model	To ensure the process mapping covered the main types of medication supply at discharge in Scottish hospitals
Minimum of one hospital with traditional hospital dispensary model	To ensure the process mapping covered the main types of medication supply at discharge in Scottish hospitals

3.3.1 Hospital Recruitment

As previously described in Section 3.3 the NHS in Scotland is divided into 14 different geographical health boards. The criteria used to select the hospitals to visit to complete the process mapping involved contacting the lead pharmacists for acute services for the six health boards in Scotland that had completed the rollout of the HEPMA system as of April 2022. The lead pharmacist for acute services for each health board provided the researcher with a hospital to visit and confirmed the hospital identified had a general medical ward. The contact details for the identified hospital lead pharmacist were also supplied. Subsequently, the lead pharmacist for each hospital site was contacted to establish if they used patient own dispensing or traditional dispensing from a hospital pharmacy department. The criteria were

to have a minimum of at least one hospital that used patients own dispensing model and at least one hospital that used the traditional hospital dispensary model. If these criteria were not met then the lead pharmacists for acute services would be re-contacted to suggest an alternative hospital until the criteria was satisfied. Once the inclusion criteria were satisfied this formed the final list of hospitals to visit to complete the process mapping. The hospital recruitment process is summarised in Figure 3.1.

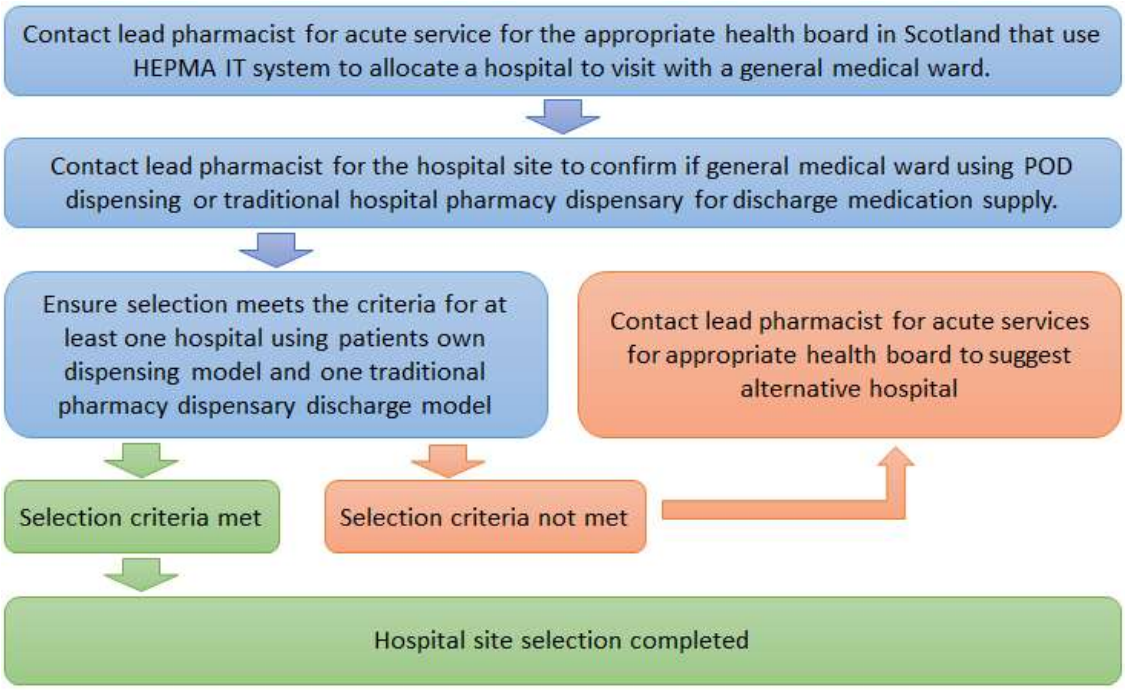


Figure 3.1. Hospital Recruitment Process

3.4 Process Mapping

Process mapping is a tool that has been used extensively across many settings to define the individual steps within a complex model (Chia Swee, 2010). In the hospital setting, process mapping has been used for a number of years to identify areas for potential improvement in the patients' journey (Bloodworth et al., 2019). Additionally, in Scotland, Weir et al. (2018)

used process mapping to describe the supply of medication to a patient in a community pharmacy setting. As described previously, the process of supplying medication to patients at discharge and dispensing medication to patients in a community pharmacy setting can be considered similar as it is covered by the same medication supply legislation.

3.4.1 "Walk and Talk" Technique

Creation of the process maps involved visiting each hospital and following a simulated patient journey through the medication supply at discharge pathway using the "Walk and Talk" technique. The "Walk and Talk" technique was first introduced by Kirwan and Ainsworth (1992) as a methodology to build a process map of a complex process. The "Walk and Talk" technique involves a subject expert demonstrating and explaining the steps required to complete a complex process in a simulated or real environment to the analyst. The analyst can request additional information during any part of the simulated process to the subject expert for clarification of steps or processes followed. The "Walk and Talk" technique offers a repeatable methodology that can be used at each hospital site to develop the process maps for the medication supply at discharge.

The key points of the "Walk and Talk" technique are summarised below:

- At the start of the session the analyst should explain the process of the "walk and talk" through session to the subject expert, including the specific process to be described and the role of the analyst to understand the details involved in the process.
- Data sheets and written comments can be used by the analyst to ensure a detailed and accurate process is recorded.
- The subject expert can use either a simulated, real time or mixed process to demonstrate the steps involved in completing the process to the analyst.
- The analyst should ask questions to the subject expert to clarify any steps within the process to ensure accuracy in the description of the steps.

- A debriefing should be held with the analyst and the subject expert at the conclusion of the "walk and talk" process to review and validate the process as recorded by the analyst.

Each hospital was provided in advance with a "Walk and Talk" through guide, and observation data collection documents were created to support the processes (Appendix 2 and Appendix 3). The documents were reviewed and validated by Dr Natalie Weir who had utilised the "Walk and Talk" technique with similar documentation to understand integration of high-risk medicine care bundles within community pharmacy practice (Weir et al., 2018). These documents were used to ensure continuity in the process of data collection in all hospitals for both the process map and to understand the environment of the hospital on the day of the visit.

A pilot was undertaken in the Glasgow Royal Infirmary in May 2022. The pilot followed the "Walk and Talk" through methodology and used both the "Walk and Talk" through guide and observation data collection. The pilot successfully generated a process map of the medication supply at discharge covering both the stages required to complete the medication supply at discharge pathway and the detailed steps required to be completed within each stage of the process map. No changes were made to the "Walk and Talk" through methodology or the guide/observation data collections sheets following completion of the pilot. The results from the pilot are not included in the final results.

The method used to complete the process mapping at hospital discharge in each hospital is outlined below.

Prior to completion of the process mapping:

1. Researcher contacted, by email, the lead pharmacist for the hospital site to arrange a suitable date for the process mapping to occur on a general medical ward and arrange for a pharmacist/pharmacy technician to accompany the researcher on the day of the process mapping as the subject expert.

On the day of the process mapping:

1. Researcher met initially with the pharmacist/pharmacy technician and explained the" Walk and Talk" through methodology and confirmed the ward to be visited. This discussion covered the following points:

    - The task to be processed mapped would be the patient pathway for medication supply at discharge from the doctor completing the patient discharge medication prescription to the patient leaving the hospital with the medication supply.
    - The role of the subject expert to define both the stages of the medication supply at discharge and the detail of each step involved to complete the stages.
    - Explanation of the implementation of the "Walk and Talk" technique to follow a simulated patient through the medication supply at discharge pathway.
    - The intended use of the "Walk and Talk" through guide and observation data sheet by the researcher.
    - Confirmation that the ward to be visited would be a general medical ward.
    - Agreement for the subject expert to review a draft process map with the researcher at the completion of the visit.

2. The subject expert (pharmacist/pharmacy technician) guided the researcher through each stage of the medication supply processes. This involved visiting the setting for where each stage was completed. This included visiting both the hospital general medical ward and the pharmacy dispensary. A variety of hospital staff at each location were engaged with by the researcher to understand the steps required to complete each stage of the patient medication supply process. These staff members included:

    - Ward staff – Doctors, nursing staff and ward ancillary staff such as ward clerks and ward managers.
    - Pharmacy staff including pharmacists, pharmacy technicians and pharmacy support workers.

3. During the process mapping, the "Walk and Talk" through guide was followed by the researcher and an observation data collection sheet was completed by the

researcher. Notes were collected on both the stages and the steps within each stage by the researcher.

4. Following completion of the patient medication supply at discharge pathway, when the patient was discharged from hospital with a supply of medication, the researcher compiled a handwritten draft process map covering all the stages and the individual steps within each stage as described by the subject expert.

5. The draft process map was presented back to the subject expert by the researcher to validate both the stages and the step required to complete each stage. Any amendments to the draft process map were completed by the researcher under the instruction of the subject expert.

3.4.2 Hierarchical Task Analysis

Hierarchical task analysis (HTA) is described by Kirwan and Ainsworth (1992) as the "best-known task analysis technique". The initial paper written on the method of HTA by Annett and Duncan (1967) suggests that there are three main principles that govern hierarchical task analysis:

"1. At the highest level we choose to consider a task as consisting of an operation and the operation is defined in terms of its goal. The goal implies the objective of the system in some real terms of production units, quality or other criteria.

2. The operation can be broken down into sub-operations each defined by a sub-goal again measured in real terms by its contribution to overall system output or goal, and therefore measurable in terms of performance standards and criteria.

3. The important relationship between operations and sub-operations is really one of inclusion; it is a hierarchical relationship. Although tasks are often proceduralised, that is the sub-goals have to be attained in a sequence..." (Annett et al., 1967)

In essence HTA is focused on decomposing a high-level task into a set of subtasks required to complete the main objective.

Since 1967 HTA has been used in a large variety of industries to investigate the subtasks required to complete a main objective. These industries and settings include a wide variety, from commercial distribution driving in the UK (Bedinger et al., 2015) to medical safety in the hospital environment (Bourne et al., 2022).

A HTA diagram is a form of a functional decomposition diagram that is used to visually show the set of subtasks and steps required to be completed as part of a main objective. The layout of a HTA diagram should have the main objective at the top with the subtasks and steps to complete the subtasks displaced underneath. This is represented in Figure 3.2.

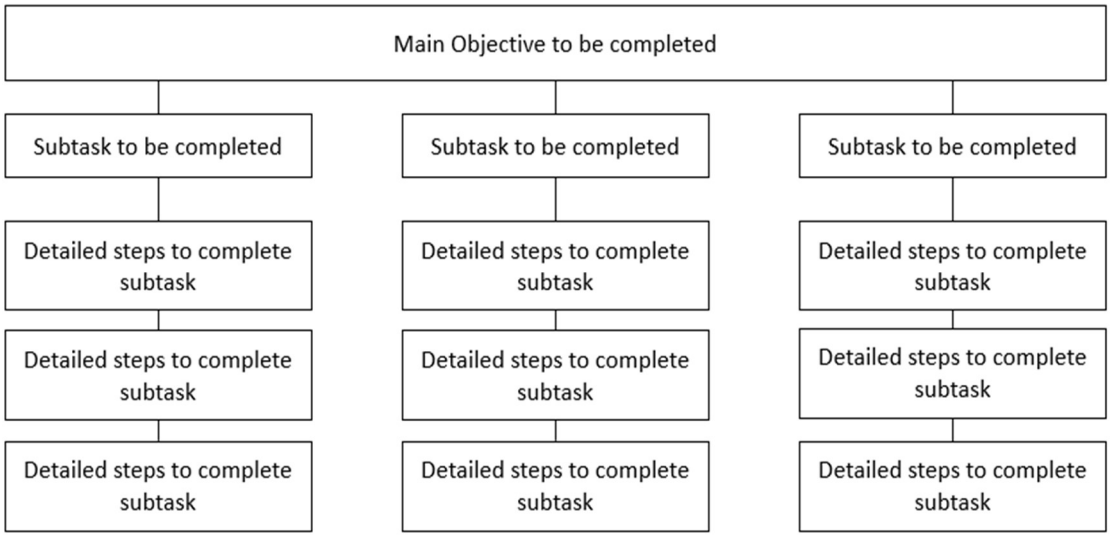


Figure 3.2 Generic Layout for Hierarchical Task Analysis (HTA) Diagram

Following completion of the hospital process mapping visit and the validation from the subject expert of the draft process map, a HTA diagram was created using Microsoft Visio software. Each stage in the draft process map that had been described by the subject expert formed the subtasks to be completed in the HTA diagram. The steps required to be done for completion of each stage in the draft process map were then added under each same subtask in the HTA diagram as the detailed steps to be completed. Figure 3.3 details how each element of the draft process map was added to the HTA diagram.

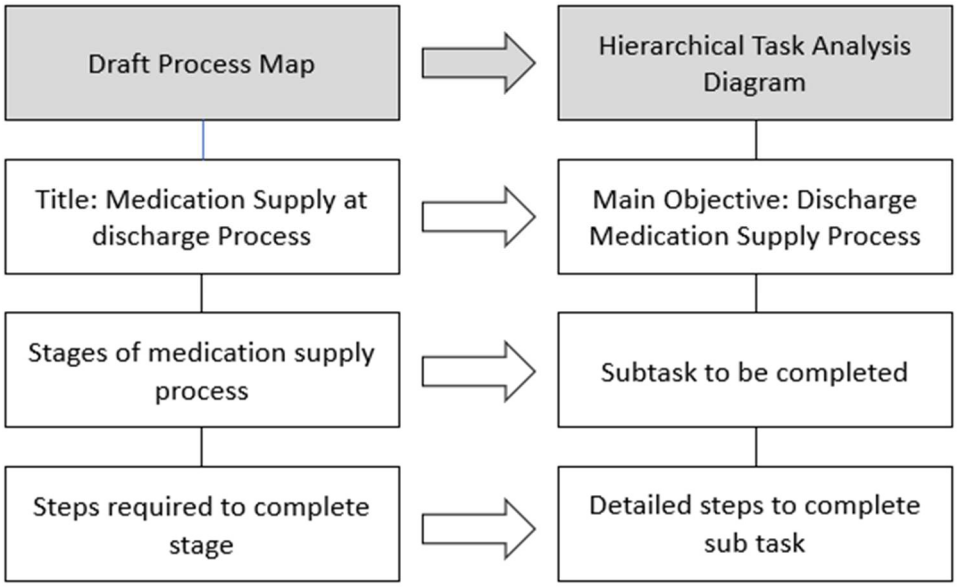


Figure 3.3 Conversion From Draft Process Map to Hierarchical Task Analysis Diagram

3.4.3 Systemic Human Error Reduction and Prediction Analysis

Systemic human error reduction and prediction analysis (SHERPA) was developed by Embrey (1986) to predict human errors using a structured framework. SHERPA has undergone various validation trials (Stanton and Stevenage, 1998; Stanton et al., 2009) and has been used within both the hospital and the community pharmacy setting in the UK and internationally (Lane, Stanton and Harrison, 2006; Ashour, Phipps and Ashcroft, 2022). The first step of a SHERPA framework is to classify each step of the process map into the SHERPA task classification system. The SHERPA task classifications are: actions, retrieval, checking, selection and information communication. Table 3.2 highlights these classifications with their definitions (Embrey, 1986). In this study the HTA diagram created from the "Walk and Talk "technique used during each hospital visit was used as the process map for the first stage of the SHERPA framework.

Table 3.2 Systemic Human Error Reduction and Prediction Analysis (SHERPA) Classification Definitions.

Systemic human error reduction and prediction analysis (SHERPA) classification	Definition of classification	Example
Action	Performing a physical task.	Pressing a button on a computer keyboard.
Retrieval	Getting information from a screen, manual or expert.	Asking a question to a subject expert to clarify a decision.
Checking	Performing a task to check for accuracy or safety.	Conducting a procedural check.
Selection	Choosing one alternative over another.	Selection of the correct medication to be dispensed to a patient.
Information Communication	Can be verbal or electronic.	Informing a patient about their discharge medication.

The SHERPA task classification was applied to each detailed step in the completed HTA diagram. This was displayed on the HTA diagram as a letter in the detailed step box as shown in Figure 3.4. Utilisation of the SHERPA task analysis applied to each detailed step in the HTA diagram allowed for similarities and differences in both number of detailed steps and classification of detailed step to be discussed across the different hospital HTA diagrams. As the project aim did not include error prediction analysis, no further stages of the SHERPA framework was applied to the results.

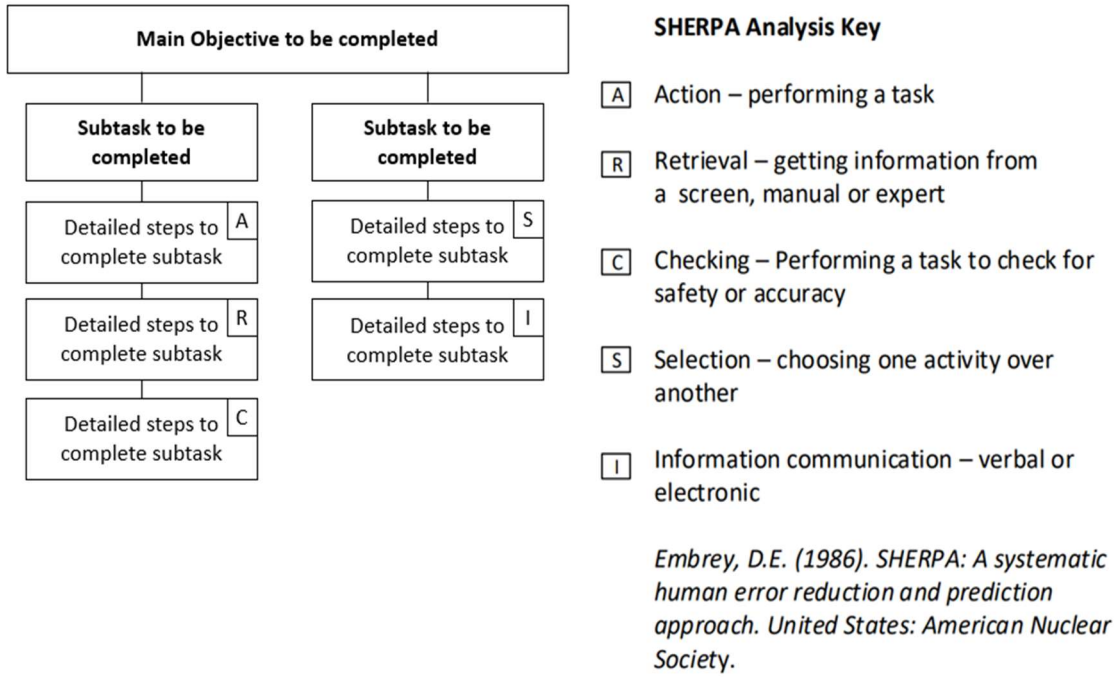


Figure 3.4 Application of SHERPA Classification and Key

The completed HTA diagram with the SHERPA categories and the SHERPA classification definitions was then sent to both the lead pharmacist of the hospital visited and the subject expert, i.e., the pharmacist or pharmacy technician that completed the "Walk and Talk" through session, for validation of the HTA diagram. Any corrections or amendments were made and re-sent to both the lead pharmacist for the hospital and the subject expert for final validation. The only corrections that were requested during the HTA diagrams validation came from subject experts and involved amending the name of IT systems used within the hospital; no fundamental changes occurred to the HTA diagrams at this final stage of validation.

3.5 Medication Supply at the Point of Discharge Timing Data

As described above, only hospitals with the HEPMA IT system were included in the research. One of the functions of the HEPMA IT system includes the ability to generate reports with time stamps for when any specific action occurred within the system. This is achieved via a

function within the HEPMA system called a search and report tool. A specific search and report tool is required for each search in the HEPMA system with key search points such as the ward number and time period to be included in the search.

To satisfy the stated objective of this research, a search and report tool was built in partnership with the lead author and the NHS HEPMA team within NHS Ayrshire and Arran to extract the timing data associated with the pathway of medication supply at the point of discharge from the HEPMA system. The search and report tool created was used by each hospital HEPMA team to extract the timing data.

The search and report tool was configured to extract the timing data from the ward where the process mapping had occurred from the 1st of June 2022 until it reached 50 patients, to ensure consistency across all included hospital sites.

The 1st of June 2022 was also selected to ensure the hospitals were not under additional pressures such as increased admissions in the winter period or during the peak summer holiday period where additional staff may be on annual leave.

The first 50 patients were selected, as running the search and report tool was a manual process completed by the HEPMA team at each hospital site and this was agreed to be a feasible number alongside the team's existing workloads.

The search and report tool was used by each hospital's HEPMA team and the output data was sent directly to the researcher after the report was generated. No patient or hospital employee identifiable data was extracted during this process.

The specific points of the medication at discharge pathway, with the associated time data, are dependent upon the processes used within each hospital site and the version of the HEPMA software used within the hospital. Consequently, some hospitals were unable to extract timing data for the points of the discharge medication supply pathway where a pharmacist had completed a clinical check, or where dispensing of medication has been completed. All hospitals could extract the timing data for when a patient discharge medication prescription was generated by the doctor and when the patient was discharged from hospital. These time points mirror the beginning and the end of the discharge medication supply pathway that is described in the process mapping. Figure 3.5 gives an example of the timing data extraction report along with an explanation of the terminology

used by the HEPMA system for each step of the discharge medication supply pathway along with what hospitals could extract at each timing data point.

Patient	Earliest TTA order	Earliest TTA verification	Earliest TTA dispensing	HEPMA Discharge
1	2022-06-01 14:38:52	2022-06-01 14:43:04	2022-06-01 15:27:38	2022-06-01 18:44:04
2	2022-06-01 10:11:51	2022-06-01 11:31:34	2022-06-01 12:08:11	2022-06-01 18:45:10
3	2022-06-01 15:40:00	2022-06-01 15:48:41	2022-06-01 16:22:38	2022-06-01 18:45:10
4	2022-06-01 15:07:34	2022-06-01 15:45:38	2022-06-01 16:23:45	2022-06-01 18:46:15
5	2022-06-02 14:50:17	2022-06-02 15:22:14	2022-06-02 15:39:36	2022-06-02 19:01:59
6	2022-06-02 13:09:03	2022-06-02 14:20:04	2022-06-02 14:37:27	2022-06-03 10:36:40

HEPMA extraction tool terminology	Patient medication supply journey point
Earliest TTA* Order	Discharge medication prescribed by doctor
Earliest TTA* Verification	Pharmacist discharge medication clinical check completed
Earliest TTA* dispensing	Discharge medication dispensing completed
HEPMA Discharge	Patient discharged from hospital with supply of discharge medication

**TTA – to take away (medication)*

Figure 3.5 Timing Data Extraction Report With Terminology Guide.

University Hospital Crosshouse had the HEPMA system configured to flag all patients that are marked as discharged from the hospital by the ward nursing staff, and not immediately discharge them from the HEPMA system. The HEPMA system then runs a search across the entire hospital site at 8pm and discharges any patients flagged as discharged sequentially. The result of this process is that from the HEPMA search and report for University Hospital Crosshouse all the HEPMA discharge times appear directly after 8pm. This would not be an accurate indication of the time the patient was actually discharged from the hospital. Discussions with the HEMPA IT teams from University Hospital Crosshouse revealed that another IT system, Trakcare, was used to mark patients as discharged from the hospital and this system then linked into the HEPMA IT system to store the patient to be marked as discharged at 8pm. Trakcare is an IT system used within the hospital setting, that can be used alongside HEPMA, to record and manage all episodes of patient care. Trakcare includes the facility to electronically request tests and procedures required for a patient, such as blood tests or scans, such as x-rays or computerised tomography (CT) scans. The HEPMA IT system is used to manage patient medication and the Trakcare system is used to manage the patient

episodes of care. The systems can be interlinked where marking a patient as discharged from Trakcare can also mark the patient as discharged from the hospital in the HEPMA system. The University Hospital Crosshouse HEMPA team agreed to match the patients in the HEMPA search and report tool with the accurate discharge time stored on the Trakcare system and submit these results to the researcher to ensure an accurate discharge time was recorded for the patients in this research. This was not required at any of the other hospitals visited during this research as the HEPMA discharge time displayed on the search and report tool was confirmed by the HEPMA IT team for each hospital as an accurate discharge time for the patients.

Data was summarised using median and interquartile range to describe the total time taken for patient discharge at each hospital site. The overall patient medication supply at discharge time for each patient from the individual hospital sites was also analysed as a number of patients that complete the pathway in each two-hour time interval period. Two-hour time periods were selected to break down the regular eight hour working day into segments to identify trends within the discharge timing data supplied by each hospital. Additionally, the median time for each section of the medication supply pathway, as described in Figure 3.5, was calculated as a percentage of the median time taken for the complete mediation supply pathway to understand the time taken for each stage of the medication supply at discharge process pathway.

3.6 Hospital Pharmacy Team Feedback and Discussion Session

A group feedback session for the hospitals that had taken part in the study was organised. The dual purpose of the session was to both share the results with the pharmacy team participants from each hospital and to validate the assumptions that were made following the analysis of the data. The feedback group session was conducted as a feedback and discussion focus group session virtually on Microsoft Teams.

The focus group adhered to the focus group methodology and principles as described by Liamputtong (2011), with the exceptions that the group composition in terms of gender, age and ethnicity was not controlled by the researcher. As the session was planned to only be a

single feedback and discussion session, no thematic analysis was applied to the results of the session.

An email was sent to each of the lead pharmacists for the hospital sites to invite them or a representative to attend the 90-minute feedback session. A mixture of job roles within the pharmacy team including lead pharmacists for the hospitals, ward-based and dispensary-based pharmacists and pharmacy technicians were invited to the session. Due to current work pressures within the hospitals', further engagement with the multidisciplinary teams was not sought for the feedback session.

Two weeks prior to the feedback and discussion session each participant was sent a copy of the results presentation that included the figures from the results section of the study along with the questions to be discussed. (Appendix 4).

During the session, each participant was given the opportunity to discuss the questions raised and to reflect on the results for both their own hospital and the other hospitals. The session was recorded by the researcher, with verbal consent from the group. As the dual aims of the session were to share the results with the participants from the hospital pharmacy teams and for validation of assumptions from the results data, as opposed to the session being considered additional research, a written summary of the session without participant identifiable details is provided at the end of the results section to covering the main points discussed by the group.

3.7 Ethics and Governance

No patient or healthcare worker identifiable data was collected during this research. As this research extended across multiple health boards in Scotland, application for national NHS ethics advice was sought from the West of Scotland Research Ethics Service. An email was sent to the West of Scotland Research Ethics Service to describe the project, along with a project protocol (Appendix 5), to ask for their advice on the ethics requirements for the project. The advice returned, included in Appendix 6, states the project would not fall under the NHS ethics definition of research and, as such, no NHS ethics approval would be required.

The advice from the NHS West of Scotland Ethics Service suggested consideration of advice from Public Benefit and Privacy Panel for Health and Social Care Scotland. This consideration was discussed with the project supervisors, who agreed that this would not be required as the project included no patient level data being collected by the researcher.

As the research was to be conducted by a student of Strathclyde University, ethics advice was also sought from the University Ethics Committee. An email was sent to the Strathclyde University ethics service to describe the project, along with a project protocol (Appendix 5), to ask for their advice on the ethics requirements for the project. The research was deemed to be investigating process rather than people and, as no patient or healthcare worker identifiable information was required, the project did not meet the criteria of research involving human participation as defined by the university Code of Conduct. The email in Appendix 6 highlights that the project requires no ethical review by Strathclyde University.

3.8. Results

The following sections describe the results obtained from the methods previously described, to satisfy the research aim of examining the patient medication supply process in a selection of Scottish hospitals. This includes the results linked to the research objectives of both process mapping the pathway of medication supply at the point of discharge and extraction of timing data associated with the pathway of medication supply at discharge from within the HEPMA system.

3.8.1. Setting

NHS Scotland, the national health care provider for the population of Scotland, is divided into 14 different geographic health boards. Figure 3.6 displays the location of the health boards visited during this research.

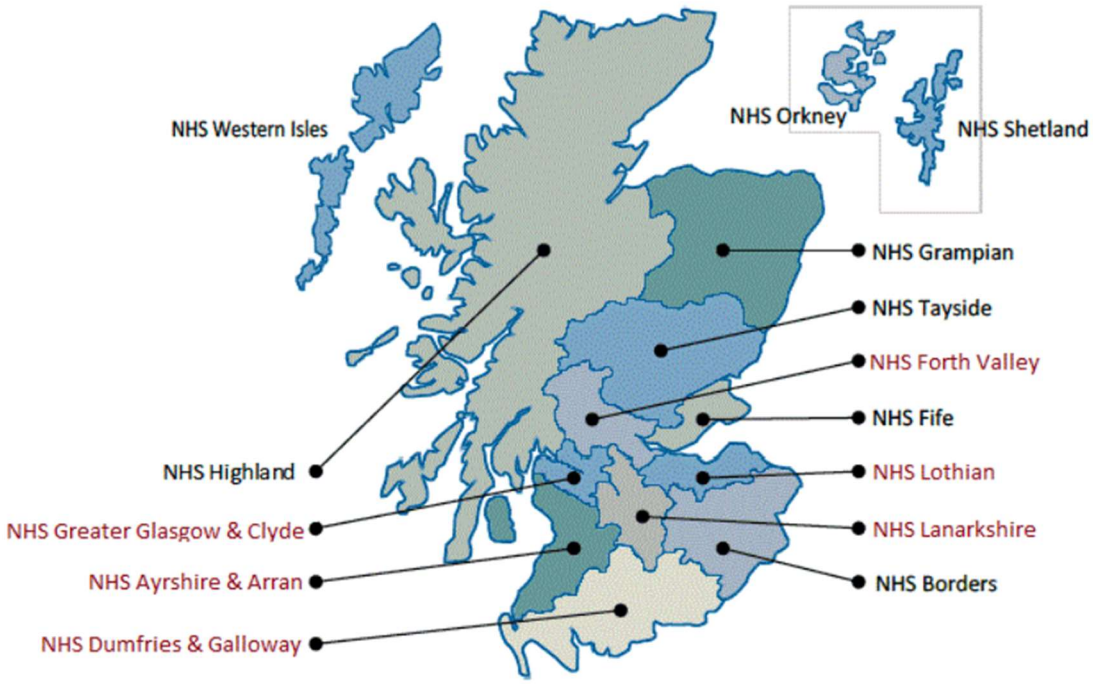


Figure 3.6 Scottish Geographic Location of Health Boards

All hospitals initially approached via the lead pharmacists for acute services in each health board met the inclusion criteria and, therefore, no alternative hospitals had to be considered.

The six hospital sites recruited into the study were:

- Dumfries and Galloway hospital is a large general hospital located on the outskirts of the town of Dumfries. Patients in the hospital each have their own medication locker where their medication is administered from during their inpatient stay. The hospital also has a main dispensary site with an automated medication dispensing process of both full and split packs of medication. The hospital can discharge patients via either suppling discharge medication from the patient's own supply at ward level, or via supply from the main hospital dispensary.

- Edinburgh Royal Infirmary is located within a district of Edinburgh, the capital city of Scotland. The major acute teaching hospital offers acute medical and surgical services to patients from across Lothian and the south-east of Scotland. Patients can

be discharged using medication supplied via either a ward stock only dispensing model, or via the hospital pharmacy dispensary department. The hospital pharmacy dispensary utilises automated dispensing for full packs of medication.

- Forth Valley Royal Infirmary serves a population in the Forth Valley region in the centre of Scotland between the two major cities of Edinburgh and Glasgow. The hospital discharges all patients via the main pharmacy dispensary department. The pharmacy dispensary utilises an automated dispensing process for full pack medications.

- University Hospital Crosshouse is a large general hospital located within Ayrshire and Arran in the south-west of Scotland. The hospital discharges all patients with medication from the main pharmacy dispensary department. The pharmacy dispensary utilises an automated dispensing process for full pack medication only.

- University Hospital Hairmyres is located in Lanarkshire in the central lowlands of Scotland, situated in-between the largest population cities of Glasgow and Edinburgh. Discharge medication is supplied for patients from the main hospital pharmacy dispensary department. The pharmacy dispensary department does not utilise any automation as part of the medication dispensing process.

- Queen Elizabeth University Hospital is located in Scotland's largest city of Glasgow. The hospital has satellite dispensaries on each floor of the hospital that cover two wards each. The hospital also has a main pharmacy dispensary department that utilises automated dispensing for full pack medications. Patients can be supplied discharge medication via either the satellite dispensary on the same floor as the hospital ward, or via the main hospital pharmacy dispensary department, dependent on pharmacy staffing levels and work load levels in each satellite dispensary.

Tablet 3.3 displays the details for each of the hospitals visited to complete the process mapping of the supply of medication at discharge between the period of 25th of July 2022 and 16th September 2022.

Table 3.3 Hospital Demographic Information

Hospital Name	NHS Health board	Year Hospital Opened	Health Board Population number (*)	Hospital classification (**)	Number of beds (***)	Urban/Rural classification (****)	Number of beds on Ward visited
Dumfries & Galloway Royal Infirmary	NHS Dumfries and Galloway	2018	150,000	Large general hospital	298	Rural	29
Edinburgh Royal Infirmary	NHS Lothian	2003	916,000	Teaching hospital	896	Urban	46
Forth Valley Royal Hospital	NHS Forth Valley	2011	300,000	Large general hospital	618	Urban	37
University Hospital Crosshouse	NHS Ayrshire and Arran	1984	369,000	Large general hospital	556	Rural	34
University Hospital Hairmyres	NHS Lanarkshire	2006	655,000	Large general hospital	418	Urban	24
Queen Elizabeth University Hospital	NHS Greater Glasgow and Clyde	2015	1,185,000	Teaching hospital	1446	Urban	28

(*) Heath Board population data from public health Scotland, data and intelligence 2021. (Figures rounded to nearest thousand).

(**) As defined from information services division Scotland hospital classification index 2021/22.

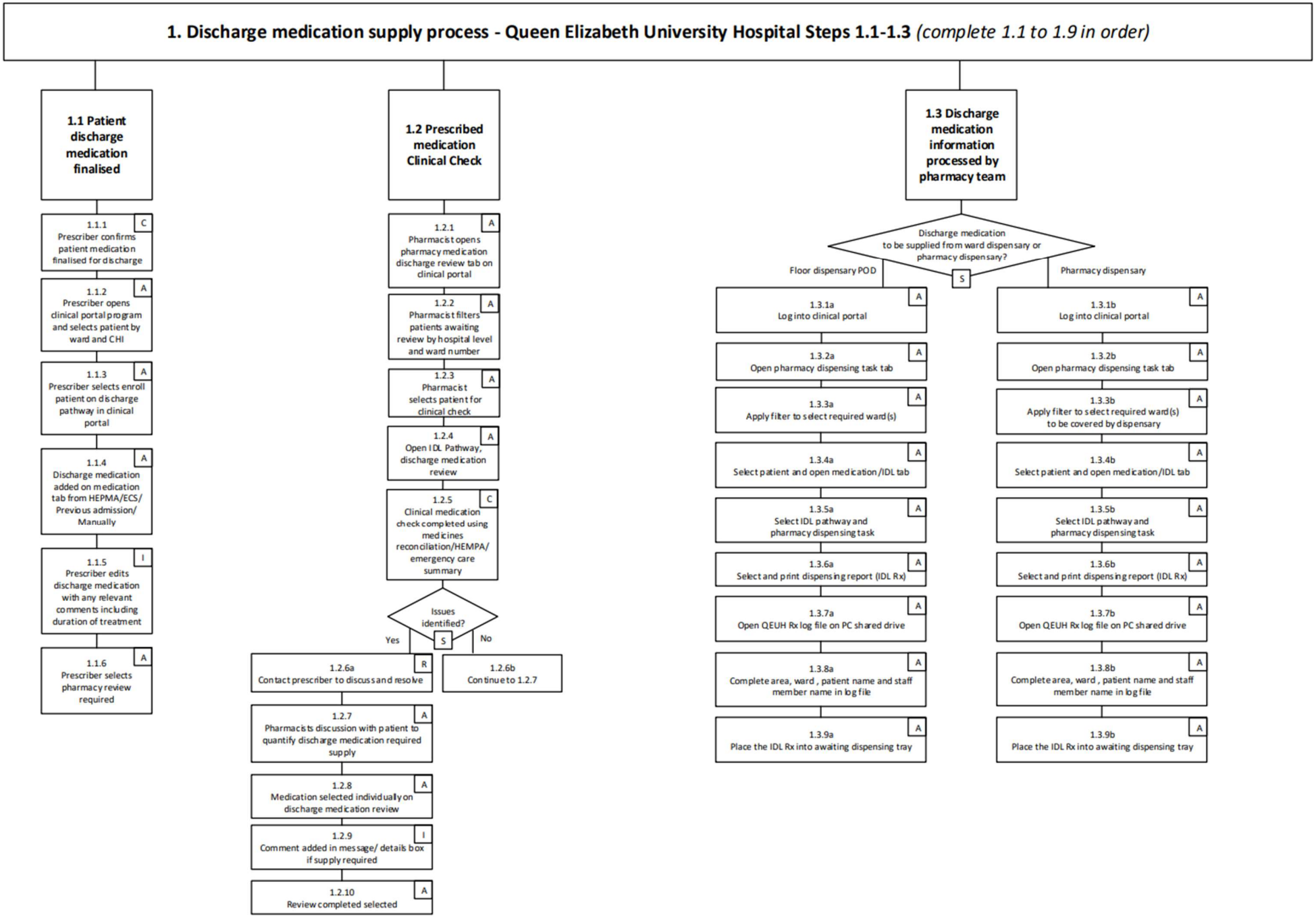
(***) Information from NHSperform.scot last updated Dec 2021.

(****) As defined using spatialdata.gov.scot urban/rural map with the definitions available at https://www.data.gov.uk/dataset/f00387c5-7858-4d75-977b-bfdb35300e7f/urban-rural-classification-scotland

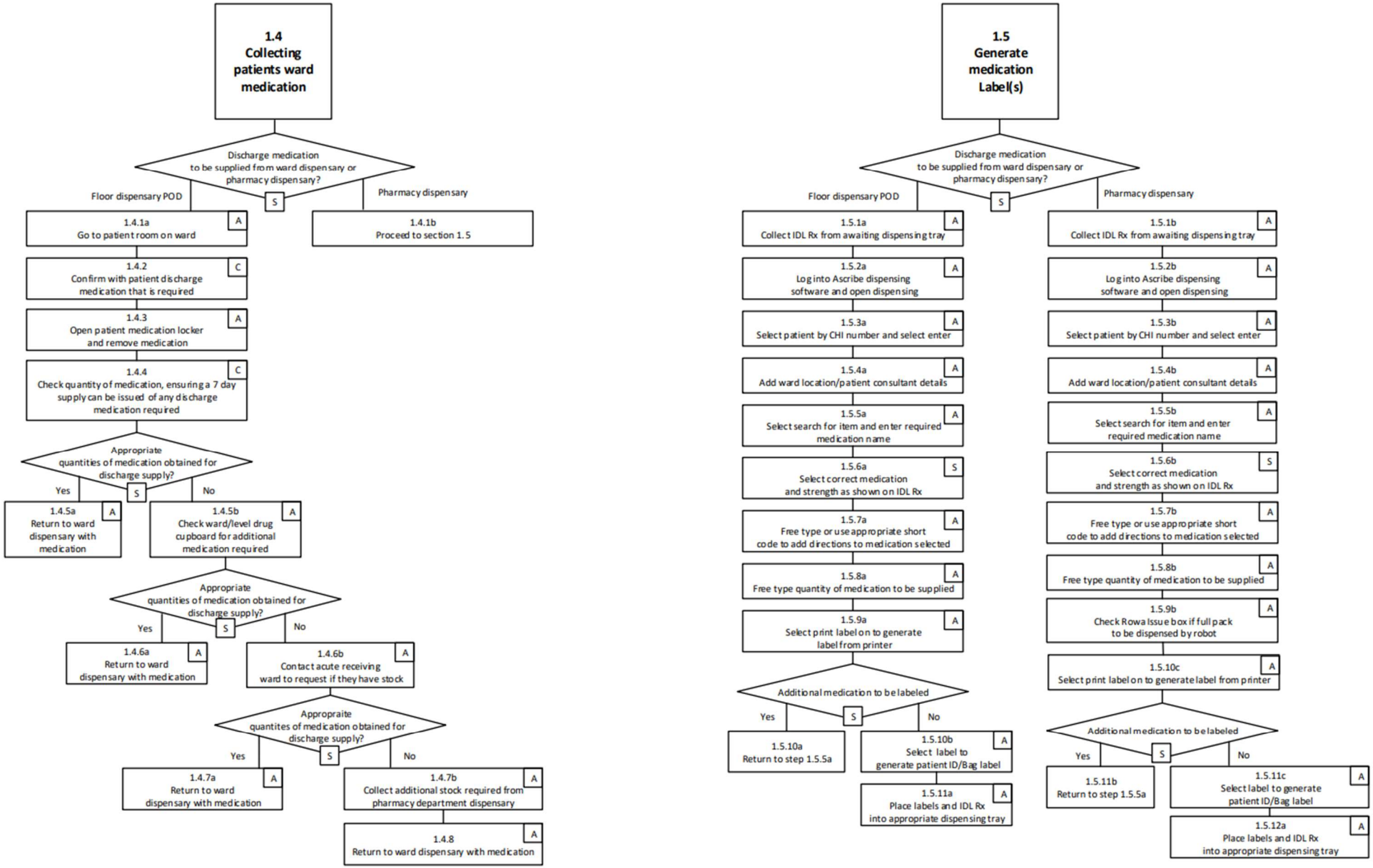
3.8.2. HTA Process Mapping and SHERPA Task Classification

The process map HTA diagram for Queen Elizabeth University hospital is shown below in Figure 3.7. The process map HTA diagrams for all hospitals can be found in appendix 7. Figure 3.8 displays the number of steps in each part of the discharge process from the process maps from each hospitals site.

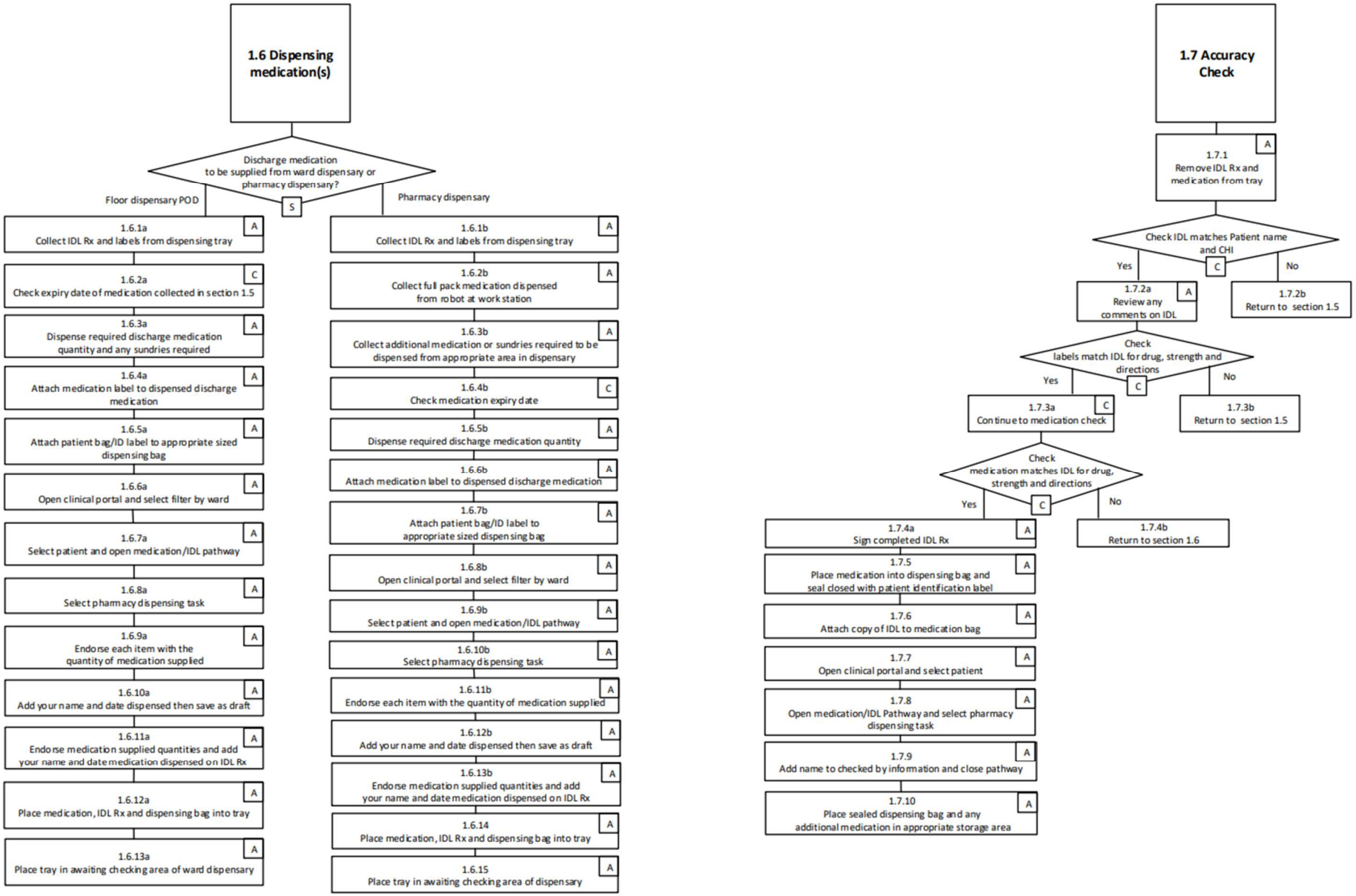
1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.1-1.3 *(complete 1.1 to 1.9 in order)*



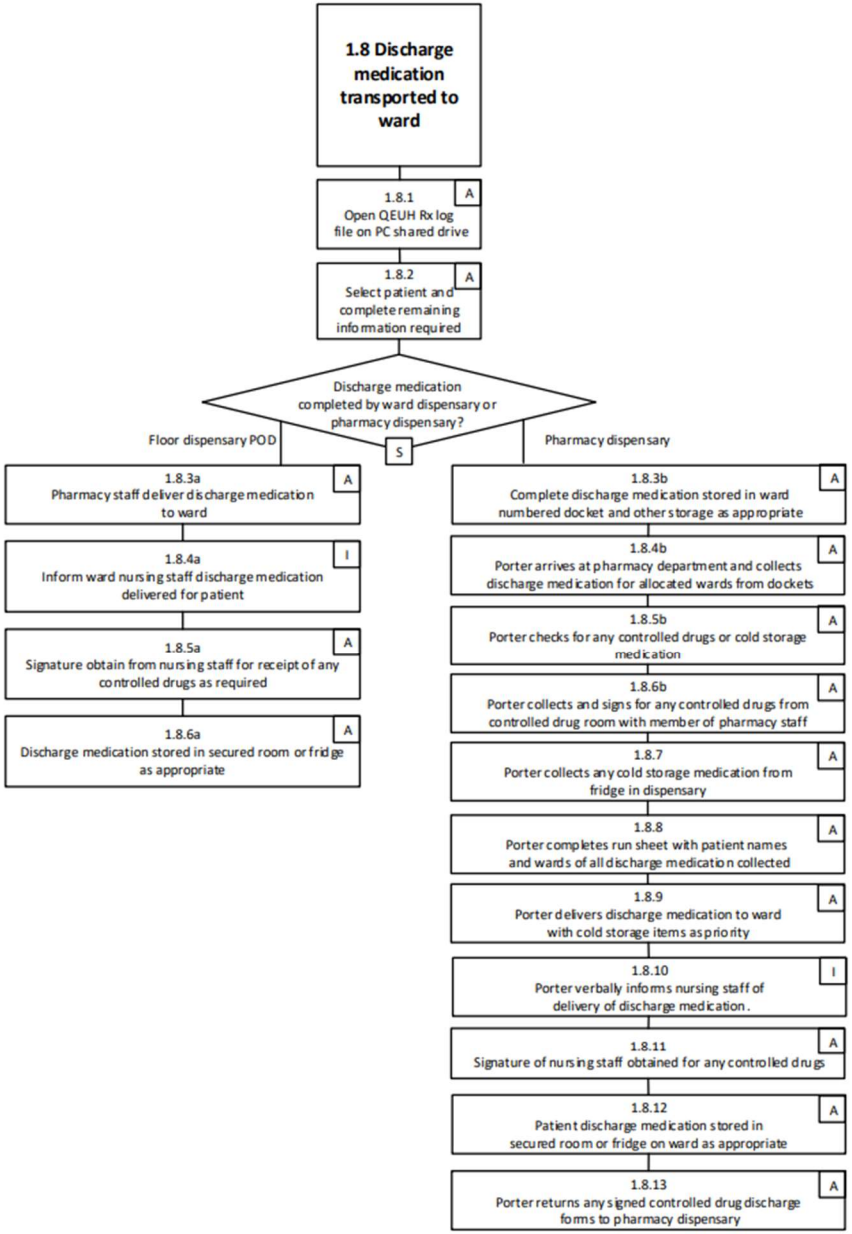
1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.4-1.5 *(complete 1.1 to 1.9 in order)*

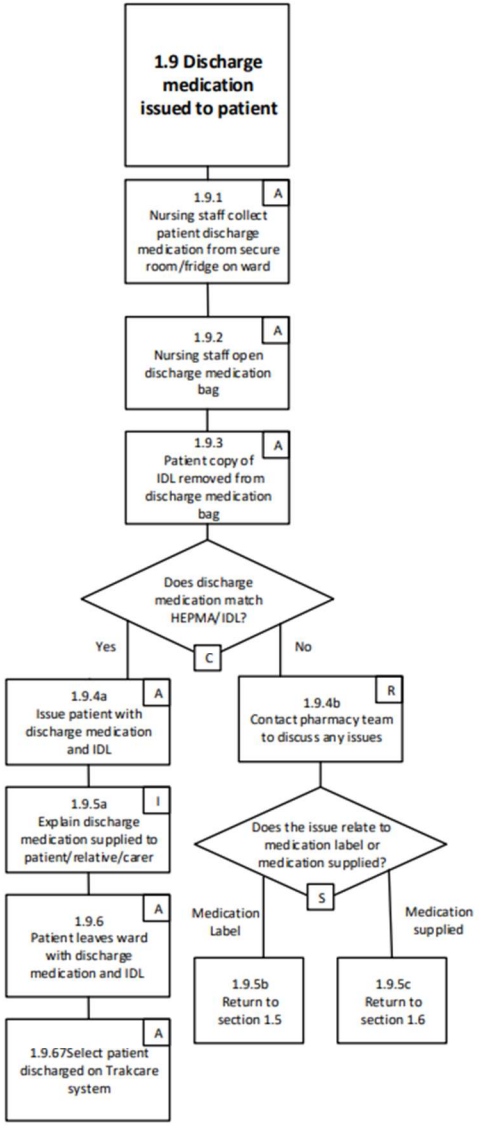


1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.6-1.7 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.8-1.9 *(complete 1.1 to 1.9 in order)*





1. Discharge medication supply process - Queen Elizabeth University Hospital Terminology and SHERPA Analysis Key

Terminology

Clinical Portal - Web based patient record and IT system

HEPMA - Hospital Electronic Prescribing and Medicines Administration

ECS - Emergency Care Summary record

IDL - Immediate discharge letter

IDL Rx - Immediate discharge letter prescription

QEUH Rx log - Spreadsheet used within Queen Elizabeth hospital to document discharge medication process

Ward dispensary/Floor dispensary POD - Pharmacy dispensary based on a ward or floor of the hospital

Pharmacy dispensary - Main pharmacy dispensary department located separately from the wards

Ascribe - Pharmacy dispensary software system

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

Porter - a hospital employee who moves equipment, medication and patients around the hospital as required.

TrakCare - IT software system used to manage patient journey during hospital admission

SHERPA Analysis Key

[A] Action – performing a task

[R] Retrieval – getting information from a screen, manual or expert

[C] Checking – Performing a task to check for safety or accuracy

[S] Selection – choosing one activity over another

[I] Information communication – verbal or electronic

Embrey, D.E. (1986). SHERPA: A systematic human error reduction and prediction approach. United States: American Nuclear Society.

Figure 3.7. Process Map HTA diagram for Queen Elizabeth University hospital

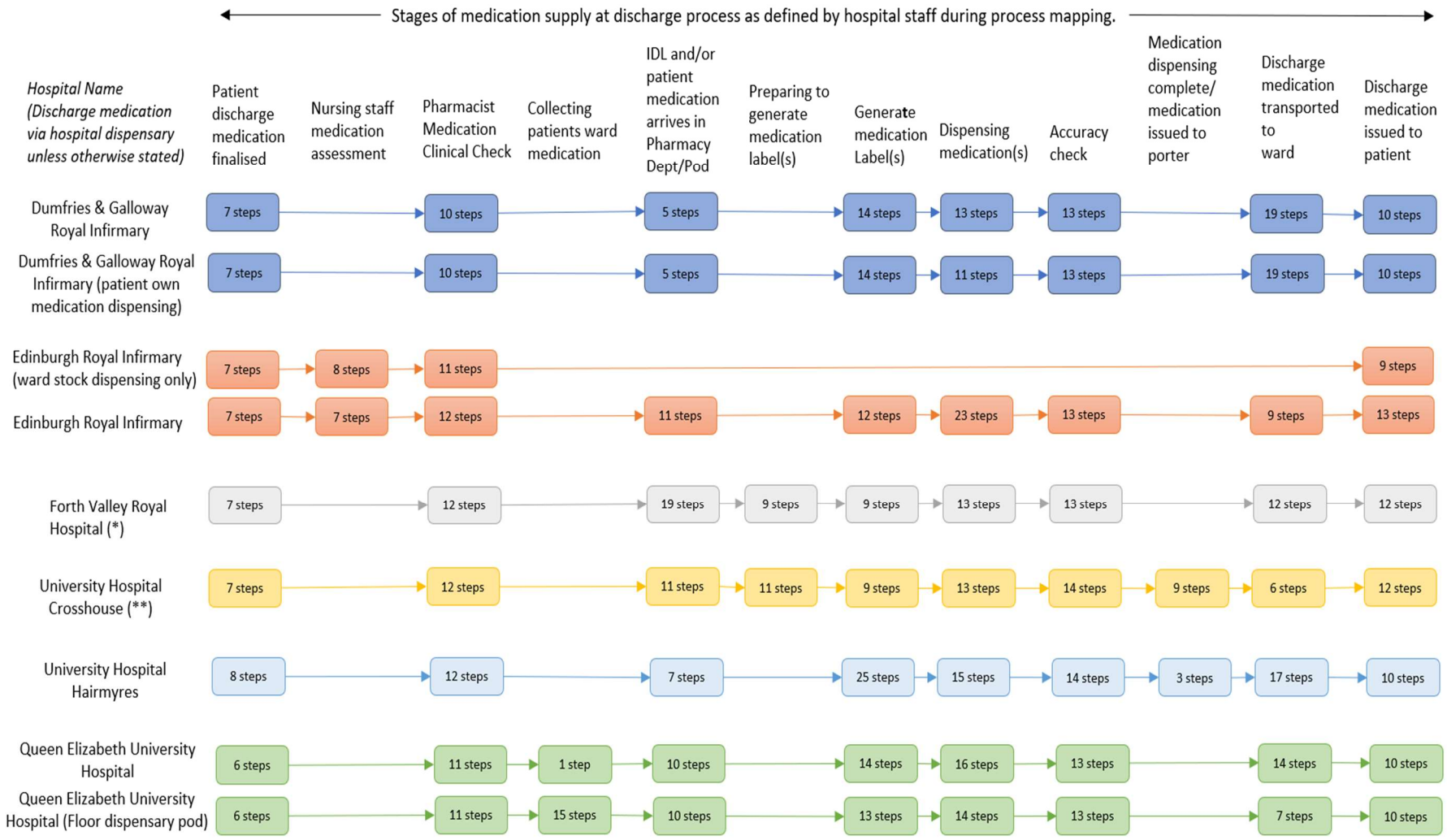


Figure 3.8 Process Mapping Stages and Steps.

(*) Forth Valley Royal Hospital – merged stages electronic IDL received in pharmacy dispensary and printed IDL received in pharmacy department into single stage of discharge letter and/or patient medication arrives in pharmacy department

(**) University Hospital Crosshouse – merged stages printed IDL prescription preparation and preparing to generate labels process into single stage of preparing to generate labels as both stages involve preparation to generate the medication labels.

Figure 3.8 demonstrates the similarities between the discharge processes in the hospitals, as all the hospitals share eight of the stages within their processes. The shared stages are patient discharge medication finalised, pharmacist medication clinical check, IDL and/or patient medication arrives in pharmacy department or dispensary pod, generate medication labels, dispensing medication, accuracy check, discharge medication transported to ward and discharge medication issued to patient. However, variances can be seen between the number of steps required to complete each of these shared stages from hospital to hospital. Only one hospital, Edinburgh Royal Infirmary, has a nursing staff assessment of medication within their process map. This process involves the nursing staff assessing the patient medication, which is stored in the patient locker, to decide if additional supply of medication is required from the main hospital dispensary. The Edinburgh Royal Infirmary ward stock only dispensing model has the fewest number of both stages in the discharge medication supply process map and total number of steps required to complete each stage when compared to the other models. This is due to a reduced involvement from the main pharmacy department in this model compared with the others. Queen Elizabeth Hospital is the only site that has a bespoke section for collecting patient medication from wards. This is due to each satellite dispensary covering at least two wards on the same floor. Forth Valley Royal Hospital and University Hospital Crosshouse both have preparing to generate medication labels stages. These are administrative stages that occur prior to the dispensing of the patients discharge medication. The total number of steps required to complete each stage of the process mapping are similar within most of the hospitals, this indicates a degree of similarity in the process. However, University Hospital Hairmyres has a larger number of steps in the process to generate patient medication labels and Edinburgh Royal Infirmary has a larger number of steps in the stage of dispensing medication. Both of these examples highlight where individual hospitals processes are different due to both historic processes that occur within the stages and where the layout or location of the hospital dispensary department can influence the medication dispensing processes.

Table 3.4 displays the number of stages for each hospital as described by the hospital teams, along with the number of steps that are required to complete each stage from each of the hospital process maps. The SHERPA classification was applied to each step in the process map HTA diagram as descried in the methods section. This information is displayed as a percentage of the total number of steps in the HTA process map. The table also displays where a single hospital utilises different models of medication supply at discharge.

Table 3.4 SHERPA Hierarchical Task Analysis Information

Hospital Name (*)	Number of HTA stages in process map (**)	Number of HTA steps in process map (***)	Number of Action steps in process map *(% of steps in process map)*	Number of Retrievals steps in process map *(% of steps in process map)*	Number of Checking steps in process map *(% of steps in process map)*	Number of Selection steps in process map *(% of steps in process map)*	Number of Information Communication steps in process map *(% of steps in process map)*
Dumfries & Galloway Royal Infirmary *(patient own medication from ward dispensing only)*	**8**	**89**	**67** *(75.3%)*	**2** *(2.2%)*	**9** *(10.1%)*	**8** *(9.0%)*	**3** *(3.4%)*
Dumfries & Galloway Royal Infirmary	**8**	**91**	**69** *(75.8%)*	**2** *(2.2%)*	**9** *(9.9%)*	**8** *(8.8%)*	**3** *(3.3%)*
Edinburgh Royal Infirmary *(ward stock dispensing only)*	**4**	**35**	**19** *(54.3%)*	**1** *(2.9%)*	**4** *(11.4%)*	**7** *(20.0%)*	**4** *(11.4%)*
Edinburgh Royal Infirmary	**9**	**107**	**78** *(72.9%)*	**2** *(1.9%)*	**11** *(10.3%)*	**10** *(9.4%)*	**6** *(5.5%)*
Forth Valley Royal Hospital	**10**	**106**	**78** *(73.5%)*	**2** *(1.9%)*	**11** *(10.4%)*	**10** *(9.5%)*	**5** *(4.7%)*
University Hospital Crosshouse	**11**	**104**	**77** *(74.0%)*	**2** *(1.9%)*	**9** *(8.7%)*	**10** *(9.6%)*	**6** *(5.8%)*
University Hospital Hairmyres	**9**	**111**	**86** *(77.5%)*	**2** *(1.8%)*	**10** *(9.0%)*	**8** *(7.2%)*	**5** *(4.5%)*
Queen Elizabeth University Hospital *(Floor dispensary pod)*	**9**	**99**	**71** *(71.7%)*	**2** *(2.0%)*	**10** *(10.1%)*	**12** *(12.1%)*	**4** *(4.1%)*
Queen Elizabeth University Hospital	**9**	**95**	**72** *(75.8%)*	**2** *(2.1%)*	**8** *(8.4%)*	**9** *(9.5%)*	**4** *(4.2%)*

(*) Discharge medication dispensed via hospital main dispensary unless otherwise stated

(**) HTA stages are the main title stages seen in the hierarchical task analysis required to complete the process of discharge medication supply

(***) HTA steps are the individual steps required to complete each of the hierarchical stage as displayed in the process map for each hospital.

The data in Table 3.4 highlights that the different hospital pathways followed at each site to discharge patient with medication involves between eight and ten main stages, and between 89 to 111 individual steps required to complete the stages within the pathway. The median number of stages in the medication supply process across the six hospitals is nine stages (IRQ 1.5), with a median number of 99 steps (IQR 16.5) required to complete the stages. The main exception to this is the data from the Edinburgh Royal Infirmary discharge medication supply pathway when ward stock dispensing only is used for patient discharge medication. This pathway has both fewer stages and fewer total steps required to complete the stages when compared to the other discharge pathways. The data demonstrates that in all the hospitals medication supply at discharge pathways, with the exception again of Edinburgh Royal Infirmary ward stock dispensing only pathway, over 70% of the steps are described as an action being taken, as defined by the SHERPA analysis task classification. The Edinburgh Royal Infirmary ward dispensing only pathway has a lower number of action steps at 19 (54% of total steps in the process), but a higher percentage of both checking steps at 11% and information communication steps at 11%, when compared to the other discharge medication supply pathways.

The SHERPA task classification reveals that the most common task classification across all the hospitals was the action classification. A number of the action steps of all the hospitals can be described as processes for hospital staff to log into a variety of different systems. Different systems are used within the pathways, including the HEPMA IT system, a separate software system for labelling patient medication, a software system for any automated dispensing that occurs at the dispensing stage, bespoke prescription status IT tracking systems or spreadsheets and the Trakcare IT system. A summary description of each of these systems that appear on the SHERPA task analysis classification HTA diagram process maps can be found in Table 3.5.

Table 3.5 Hospital IT Systems Within the Discharge Medication Supply Pathway

Hospital IT System	IT System Definition	Hospital where IT system is used
HEPMA IT system	Hospital Electronic Prescribing and Medicines Administration system – used to prescribe medication during the patient hospital stay and provides the finalised medication list for an immediate discharge letter prescription.	University Hospital Crosshouse Dumfries and Galloway Royal Infirmary Edinburgh Royal Infirmary Forth Valley Royal Hospital University Hospital Hairmyres Queen Elizabeth University Hospital
IDL Messenger system	An instant messenger system used to communicate between ward and pharmacy department.	University Hospital Crosshouse
Microsoft Teams	IT software used for communications between members of the pharmacy team.	University Hospital Hairmyres
Prescription Tracking system (PTS)	IT software used to track the stages of the dispensing process following a prescription being received in the pharmacy department.	University Hospital Crosshouse
IDL pending verification system	IT software used to track the progress of discharge medication supply.	Dumfries and Galloway Royal Infirmary
Rx log system	IT software used to log prescription requests in the pharmacy department.	Edinburgh Royal Infirmary
Epharmacy tracking system	IT software used to track the progress of discharge medication supply.	University Hospital Hairmyres
WellSky system/disp	IT software used to label medication and enable dispensing via robotics.	University Hospital Crosshouse Forth Valley Royal Hospital
JAC labelling system	Modular IT software used to generate medication labels and enable dispensing via robotics.	Dumfries and Galloway Royal Infirmary Edinburgh Royal Infirmary University Hospital Hairmyres

Hospital IT System	IT System Definition	Hospital where IT system is used
Ascribe	Pharmacy dispensing and labelling software used to generate medication labels and enable robotic dispensing.	Queen Elizabeth University Hospital
TrakCare	IT system used within the hospital setting to record and manage all episodes of patient care.	University Hospital Crosshouse Dumfries and Galloway Royal Infirmary Edinburgh Royal Infirmary Forth Valley Royal Hospital University Hospital Hairmyres Queen Elizabeth University Hospital

3.8.3 Timing Data

Table 3.6 displays the medium (IQR) time taken in minutes, for the discharge process for the first 50 patients discharged from each ward visited after the 1st of June 2022.

The Queen Elizabeth University Hospital in Glasgow submitted data for the first 50 patients discharged after the 1st of August 2022 as the roll out of HEPMA across the hospital ward was still an ongoing project in June and July 2022. However, following discussions with the Queen Elizabeth University Hospital HEPMA team it was found that two different, unlinked IT systems could still be used to mark patients as discharged from hospital at this point and as such these results were deemed not to be robust. As the process mapping had already taken place in this hospital, and no other suitable hospitals were available within Greater Glasgow and Clyde Health Board, it was decided to omit the time point data from the Queen Elizabeth University Hospital but keep the process map for the hospital within this research.

University Hospital Crosshouse, Forth Valley Royal Hospital and University Hospital Hairmyres were able to extract the timing data from the HEPMA IT system, using the search and report tool, for points of the discharge medication supply pathway where a pharmacist completed a clinical check and when dispensing of medication was completed. This data was not available from the other hospitals due to the bespoke internal IT systems used to track discharge medication supply not being linked to the HEPMA IT system.

Table 3.6 Median Time Taken for Discharge Process With Discharge Medication Supplied

	Time taken to complete medication supply at discharge (n=50 patients) Median Time (IQR) in minutes	Time taken from immediate discharge letter completed to pharmacist clinical check completed (n=50 patients) Median Time (IQR) in minutes	Time taken from pharmacist clinical check completed to medication dispensing completed (n=50 patients) Median Time (IQR) in minutes	Time taken from discharge medication dispensing complete to patient discharged (n=50 patients) Median Time (IQR) in minutes
Dumfries & Galloway Royal Infirmary	319 (204-568)	Not Available	Not Available	Not Available
Edinburgh Royal Infirmary	309 (178-626)	Not Available	Not Available	Not Available
Forth Valley Royal Hospital	1709 (648-2524)	53 (31-81)	84 (43-128)	1115 (1676-2103)
University Hospital Crosshouse	1249 (220-4321)	136 (52-1522)	66 (28-130)	223 (111-2065)
University Hospital Hairmyres	523 (304-2130)	42 (19-78)	43 (21-91)	297 (167-1223)
Queen Elizabeth University Hospital	Excluded (*)	Excluded (*)	Excluded (*)	Excluded (*)

(*) The data supplied from Queen Elizabeth University Hospital has been excluded as it was agreed with the GGC HEPMA team not to be a robust measure. This was due to the HEPMA system being newly rolled out in the ward and the discharge process was still linked to the previous discharge IT system.

The data in Table 3.6 shows the largest median time for the supply of discharge medication to patients was 1709 minutes (28.4 hours) in Forth Valley Royal Hospital. The shortest median time was 309 minutes (5.2 hours) in Edinburgh Royal Infirmary. The interquartile ranges in each hospitals timing data highlights the wide range of times that the complete discharge medication supply pathway can take for an individual patient. The largest range in interquartile time data can be seen in University Hospital Crosshouse with the range between IRQ1 and IRQ3 of 4101 minutes (68.4 hours).

The median time for the supply of discharge medication across all the five hospitals was 513 minutes (IQR 262-1685), i.e., across the five hospital sites the median time that a patient waited for the supply of medication at discharge was 8.5 hours (for a sample size of 250 patients across the wards visited).

Where the hospitals were able to supply the individual time points it can be seen that in all the hospitals the processes completed after the discharge medication has been dispensed account for the largest proportion of the time taken in the discharge process. The largest median time taken after the discharge medication has been dispensed for a patient to the point when the patient is discharged from the hospital can be seen in Forth Valley Royal hospital at 18.6 hours. The median time taken for the patient to be discharged after medication dispensing had been completed across the three hospital that were able to submit the relevant timing data was 9.8 hours (588 minutes).

Figure 3.9 displays the data for the time taken to discharge the first 50 patients from each hospital ward visited. The graph is formatted to not display the outlier points, as displaying these results graphically resulted in the over extension of the y-axis and reduced the readability of the graph. The data from Queen Elizabeth University Hospital remains excluded from these results as previously discussed.

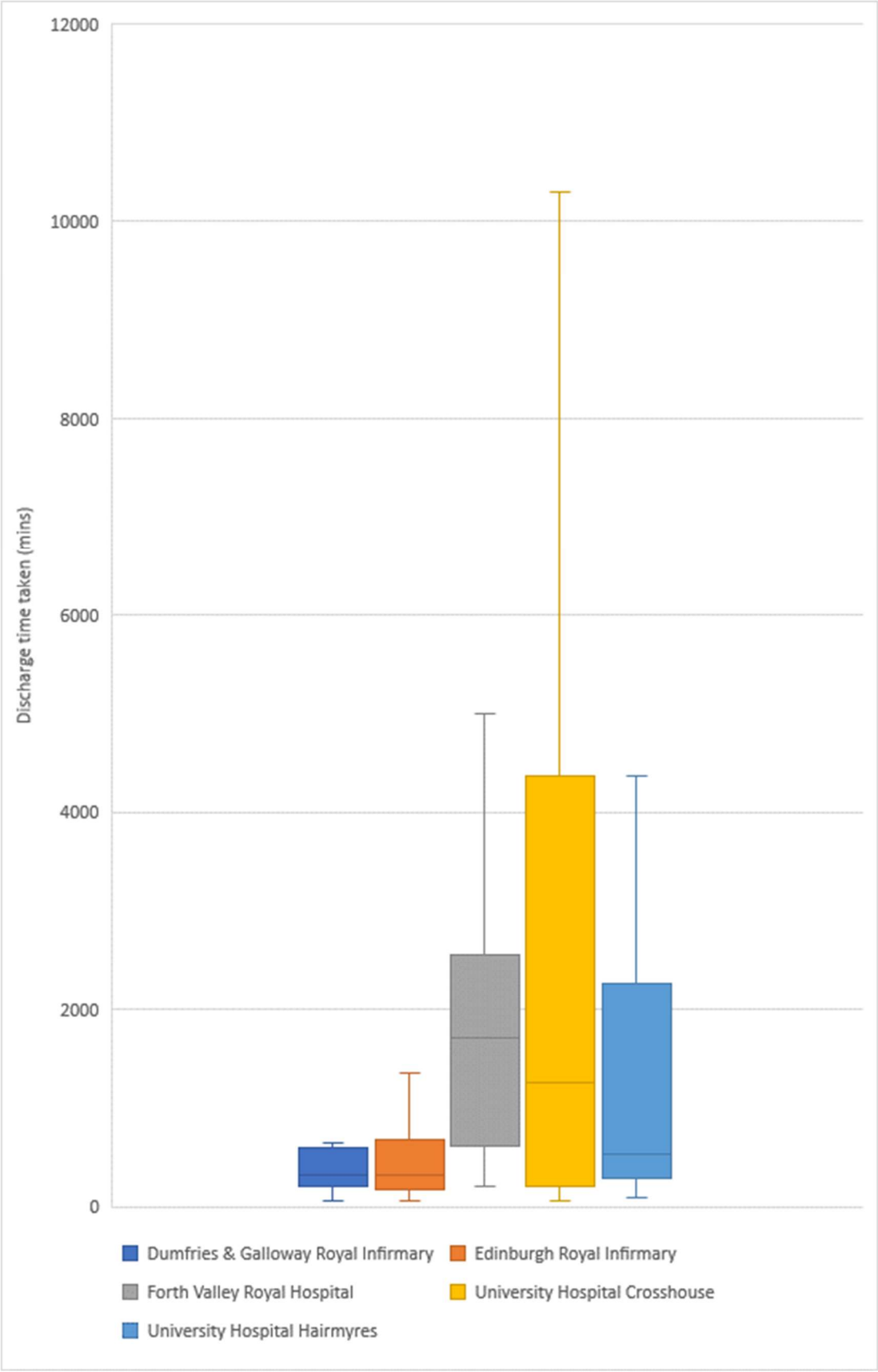
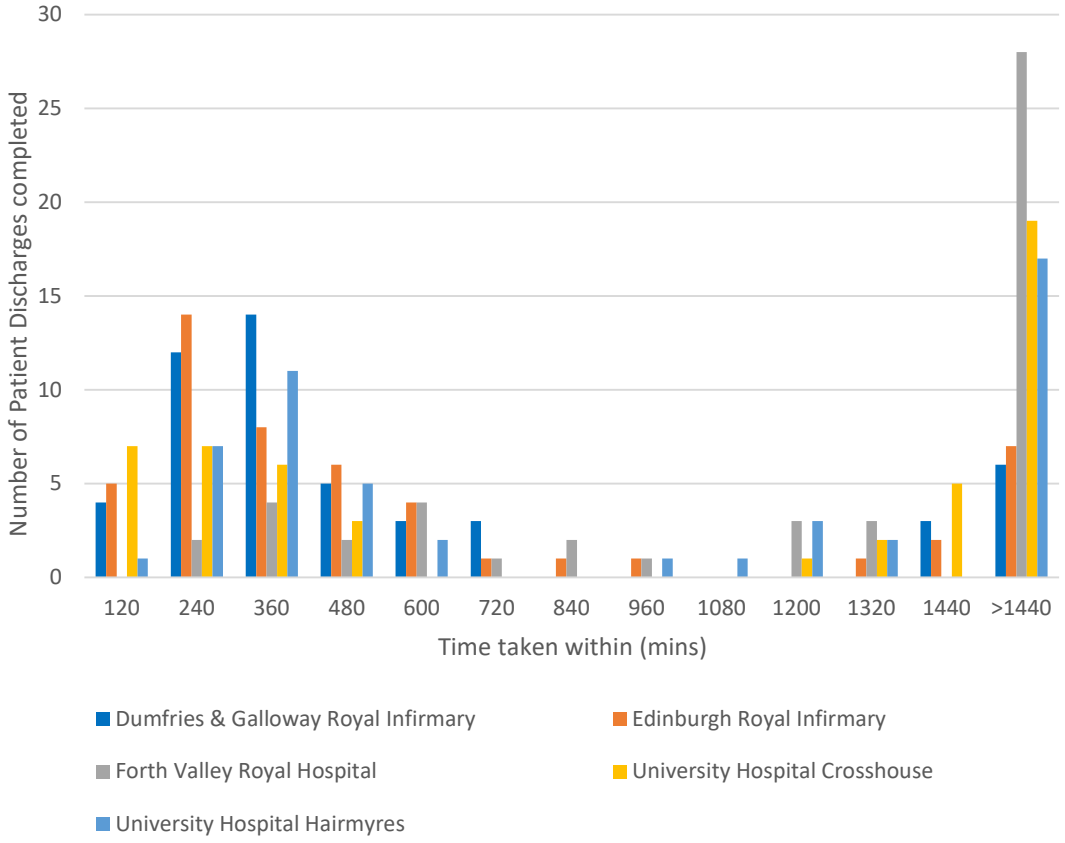


Figure 3.9 Time Taken For Patient Discharged From Ward Visited (n=50 patients per hospital)

Figure 3.9 shows the similarties between the median time taken for patient discharge with medication supply in the three hospital sites of Dumfires and Galloway Royal Infirmary, Edinbugh Royal Infirmary and University Hospital Hairmyres. The area of the box for each hospitals shows the interquartile range. The interquartile range for Dumfires and Galloway Royal Infirmary and Edinburgh Royal Infirmary is smaller than the other hospital sites. This shows that the variance in time taken to discharge each patient with discharge medication supplied across the 50 patients measured in Dumfies and Galloway Royal Infirmary and Edinburgh Royal Infirmary was smaller than in the other hospial sites. The whiskers, reprepresenting the maximum and minimun time taken for a patient discharge, excluding outliers, also show that the maximum time take for medication supply at the point of discharge was much smaller at Dumfries and Galloway Royal Infirmary and Edinburgh Royal Infirmary when compaired to the other hospital sites.

Figure 3.10 depicts the number of patients discharged from each ward where process mapping occurred within two-hour time frames.



	% number of discharges completed within hours												
	2	4	6	8	10	12	14	16	18	20	22	24	>24
Dumfries & Galloway Royal Infirmary	8%	24%	28%	10%	6%	6%	0%	0%	0%	0%	0%	6%	12%
Edinburgh Royal Infirmary	10%	28%	16%	12%	8%	2%	2%	2%	0%	0%	2%	4%	14%
Forth Valley Royal Hospital	0%	4%	8%	4%	8%	2%	4%	2%	0%	6%	6%	0%	56%
University Hospital Crosshouse	14%	14%	12%	6%	0%	0%	0%	0%	0%	2%	4%	10%	38%
University Hospital Hairmyres	2%	14%	22%	10%	4%	0%	0%	2%	2%	6%	4%	0%	34%

Figure 3.10 Hospital Discharge Timing Data in Two-hourly Intervals

The information from Figure 3.10 demonstrates that 23.6% of discharges across the five hospitals take within four hours to complete, while 30.8% of the discharges take over 24 hours to be completed. A difference in spread of how long the discharge process can take between the hospitals is also noted where Forth Valley Royal Hospital, University Hospital Crosshouse and University Hospital Hairmyres have at least 34% of discharges taking over 24 hours, while Dumfries and Galloway Royal Infirmary and Edinburgh Royal Infirmary complete at least 32% of discharges within 4 hours.

As previously described, the timing data extracted from the HEPMA search and report tool for University Hospital Crosshouse, Forth Valley Royal Hospital and University Hospital Hairmyres was able to collect the time stamped data for various points of the medication supply at discharge pathway. The time points collected for these three hospitals were, as described in the methods section, discharge prescription finalised by the doctor, pharmacist clinical check completed, discharge medication dispensing completed and patient discharged from hospital with supply of discharge medication. Figure 3.11, displays the stacked percentage median time taken between these time points on the patient medication supply at discharge pathway.

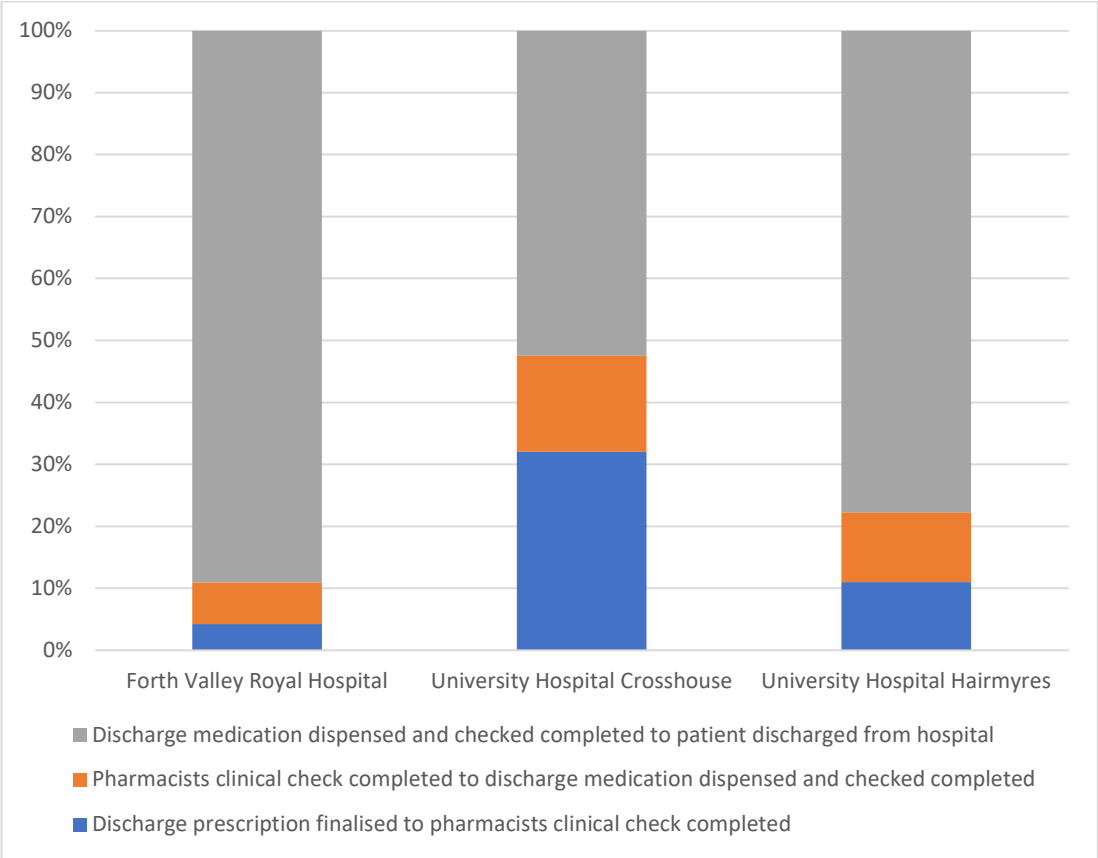


Figure 3.11 Stacked Percentage of Median Time Taken to Complete Stages of the Discharge Process.

As shown in Figure 3.11, for each of the three hospitals the largest % median time for the overall discharge process occurs after the dispening and checking of the discharge medication has been completed. In the patient medication supply at discharge pathway this is the point where the patients discharge medication is completed and is ready to be transported to the ward and issued to the patient to enable them to be discharged from the hospital. This accounted for over 50% of the total time in all of the three hospitals and over 75% of the total time in Forth Valley Royal Hospital and University Hospital Hairmyres. Interestingly, the dispensing and checking of patient discharge medication only accounted for up to 15% of the overall discharge medication supply pathway.

3.8.4 Hospital Pharmacy Team Feedback & Discussion Session

At the hospital pharmacy team feedback and discussion session, two representatives from each hospital that had taken part in the process mapping exercise were invited to attend, no participants from the Edinburgh Royal Infirmary were available to attend. The job roles of the pharmacy team members that attended the meeting included lead pharmacist for acute service, hospital-based pharmacist and hospital-based pharmacy technician. As highlighted in the methods section, no further input was sought from the multidisciplinary team. A summary of the feedback discussed from the group can be found below, listed by topics.

Figure 3.8 Process Mapping Stages and Steps

1. **Do you agree or disagree with the stages of the medication supply at the discharge process?**

   Each hospital representative agreed that the stages displayed on the figure are an accurate representation of the stages required for the medication supply at discharge pathway. It was noted that each process map HTA diagram had also been individually validated by each hospital upon their completion as described in the methods section of the research.

2. **Only Edinburgh Royal Infirmary has a nursing staff assessment of medication. This is used when the ward stock only is used for the patient's discharge. Have other hospitals considered or trialled a similar method?**

   The hospital representatives concluded that the addition of workload onto the nursing staff would be a challenge with the existing high current workload pressures on the nursing staff within the hospital system. One of the larger hospitals, Queen Elizabeth University Hospital, informed the group that they had trialled the ward only stock discharge model that was described in the process map for the Edinburgh Royal Infirmary. The feedback was that they had found it challenging in a larger hospital to maintain the labelled medication stock levels required at ward level to facilitate this method of patient medication supply at discharge.

Table 3.2 Systemic Human Error Reduction and Prediction Analysis (SHERPA) Classification Definitions and Table 3.4 SHERPA Hierarchical Task Analysis Information.

3. **In table 3.4 SHERPA Hierarchical Task Analysis Information, Edinburgh Royal Infirmary has a lower number of stages and steps when using ward stock dispensing only. As the process mapping occurred from the point the IDL was finalised by the doctor, would it be an appropriate assumption that additional process to have medication stored at the ward, to be used for discharge supply, would have occurred prior to the process mapping?**

   The participants of the group agreed this was an appropriate assumption due to the process mapping commencing at the point the doctor finalised the medication on the IDL prescription. The participants from the Queen Elizabeth University Hospital, that had previously trialled this medication supply at discharge pathway, highlighted that a significant number of both process stages and steps are omitted from the Edinburgh Royal Infirmary ward only stock pathway, as numerous stages will occur prior to the doctor completing the IDL prescription. These stages may include: ordering stock for the ward, labelling the medication that can be supplied at discharge, transporting the medication to the ward and storing the medication at an appropriate location in the ward. Unfortunately, no participants from the Edinburgh Royal Infirmary were available at the time to join the group feedback and session. It is interesting to note that all the participants agreed that the hospitals had an initial medication supply at discharge model that was implemented when the hospitals first opened and then iterative changes to that process occurred over a number of years for a variety of reasons, including learning from any incidents that occurred during the medication supply at discharge pathway to the implementation of new technology, such as automation seen in the dispensary robotics that can aid the medication dispensing process.

Table 3.6 Median Time Taken For Discharge Process

4. **The overall median timing data is from a cohort of 50 patients from the ward where the discharge mapping was carried out. Do you feel this time is indicative of the usual process across the whole hospital?**

The group agreed that as the data provided only had a small sample size of 50 patients, it was difficult to assume that the data would be the same across all the wards in the hospital. It was noted that if a hospital had four or five discharges in the data that had been delayed for a verity of reasons, which may not all have been related to medication supply, this would have a large effect on the median times of the discharge data in a sample size of 50 patients. The participants stated that delays to patient discharge can occur for multiple reasons that are out with the control of the pharmacy team, including patients awaiting test results or social care provision prior to discharge. It was noted that these instances had been out with the scope of the process maps in this research. The group did, however, agree that the data provided in this research relating to the patient discharge times from the wards selected was an accurate and interesting snapshot for the timescales discussed in the research.

Figure 3.9 Time Taken For Patient Discharged From Ward Visited For Process Mapping.

5. **The box and whisker plot show the ranges of times between IRQ1-IRQ3 in the size of the boxes. Do you feel this is indicative of the normal variances in the discharge times?**

   The group suggested that this data was likely replicated across many of the wards within the hospitals, as the multifactorial challenges involved in the patient discharge process, as previously discussed, can lead to multiple instances of delayed discharges that would be shown in the time range between IRQ1-IRQ3. It was again noted by the group that the various causes for delayed discharges do not always include issues with supply of discharge medication. However, delays to supply of discharge medication most commonly occurred due to pharmacy staff seeking further information on a patient's prescribed medication or where medication stock supply issues affect the supply of patient discharge medication as alternative medication or medication strengths may be required for the discharge medication supply to the patient.

Figure 3.10 Hospital Discharge Timing Data in Two-hourly Intervals

6. **The Hospital Discharge timing data in two-hourly intervals histogram shows that 23.6% of discharges occur within 4 hours. Do you feel this is an accurate representation?**

   It was agreed by the group that this figure was an accurate representation and it was felt that this figure would be similar across each of the hospital sites other wards. The group discussed that most of the hospitals had a "target time" for the medication supply of the discharge pathway of under 4 hours.

7. **The shape of the hospital timing data shows a small number of discharges occurring in the middles section between the 720 minutes to 1320 minutes time points (12 hours to 24 hours). This would seem to represent an overnight period. Would you agree with this assumption and what could be the reasons for discharges completed overnight?**

   The group agreed that the shape of the graph did appear to indicate an overnight period between the 720 minute and 1320 minute time points (12 hours to 24 hours). The hospital representatives all agreed that the discharges that occurred between these points would have most likely occurred where the patient had actually been discharged during the day but had not been marked as discharged from the HEPMA system correctly. The group discussed that, in these instances, the ward nursing staff will have noted at shift change that the patient had been discharged during the day shift and not marked as discharged off the HEPMA system and they would then mark the patient as discharged from the HEPMA system at this time point.

8. **The Hospital Discharge timing data in two-hourly intervals histogram shows that 30.8% of discharges take over 24 hours. What do believe are the main reasons behind the discharges that take over 24 hours?**

   The hospital representatives highlighted a number of instances where a patient discharge could be delayed. These included issues with the discharge medication, an example of this was cited as where the pharmacists may enquire to the prescriber the plan or duration of any medication that had been withheld during the patient hospital treatment. It was also discussed that medication stock supply issues could result in delays to medication supply at discharge, an example of this was cited if a

medication was out of stock and the hospital pharmacy had an insufficient supply for the patient discharge. In this instance the prescriber would be contacted or an independent prescribing pharmacist would change the prescription to an alternative strength with a change in dosage instruction for the patient. The pharmacist would discuss any medication changes with the patient prior to the discharge to ensure the patient understood where any late prescription alterations had occurred. The hospital representative also stated that many delayed discharges occurred due to factors out with the control of the pharmacy team. The examples cited for this included if the patient required additional social care arrangements to be put in place for their return to home, or if the doctors were awaiting any additional test results for the patient prior to discharge. The hospital representatives from Forth Valley Royal Hospital, University Hospital Crosshouse and University Hospital Hairmyres also believed that both the larger median medication supply at discharge time and the larger variance in their discharge times between IRQ1 and IRQ3 could be due to the advance discharge planning that is encouraged within their hospital. In these instances, the doctor may finalise the patients discharge IDL prescription the day before the patient is planned to be discharged. This enables the pharmacy team to supply any discharge medication in advance of the patient's planned discharge the following day. This also allows for advance booking of any transport and other social care required for the patient upon discharge in advance. It was agreed by the group that where advance discharge planning the day before discharge worked well for the patient, if no late changes to medication was requested, it allowed for a smooth discharge process on the day of discharge. In the result data for this project these discharges would be shown as taking over 24 hours as the data was submitted from the point the doctor finalised the patient discharge medication to the point the patient was discharged from the hospital. It was discussed that, unfortunately, there were no methods to identify from the data submitted in this research if the patient had been an advanced planning discharge patient or where the discharge time had been affected by any other factors for delayed discharge. The group felt this would be an interesting area for future research.

Figure 3.11 Stacked Percentage of Median Time Taken to Complete Stages of the Discharge Process.

9. **The stacked percentage of median time taken to complete stages of the discharge process deomstrates that the largest section of the discharge process occurs after the medication dispensing has been completed. Do you feel this is accurate?**

   The hospital representatives all agreed that the data would be accurate in showing that the largest time section of the discharge process would be after the discharge medication had been dispensed and checked by the pharmacy team. The group suggested that many reasons could account for this, including the time taken for the discharge medication to be taken to the ward being dependent on the time of any porters or ward staff attending the dispensary to collect the discharge medication, and the availability of the nursing staff, at ward level, to complete the medication supply discharge pathway by issuing the patient with the discharge medication and marking them as discharged from the ward. Again, it was noted the multifactorial complexity of discharges could have a large impact in this time section as a patient could be waiting for hospital provided transport to be available, or waiting for relatives to attend, before they could be discharged from the hospital.

3.9 Discussion of Key Findings

The aim of this mixed methodology research was to examine the patient medication supply at the point of discharge in a selection of Scottish hospitals. The research demonstrated that the process of medication supply at discharge contained several similar processes across the different hospital sites. The timing data highlighted the time taken to process discharge medication in each hospital site.

3.9.1 Number of Stages and Steps Within the Medication Supply at Discharge Pathway.

It was evident from Table 3.4 SHERPA Hierarchical Task Analysis Information, that - with the exception of the Edinburgh Royal Infirmary ward stock dispensing only pathway - the hospital discharge pathways had both a similar number of stages (8 to 11 stages) in the pathway and a similar number of steps (91 to 111 steps) required to complete the medication supply at discharge pathway. This indicated a level of similarity across the medication at supply pathways at the different hospitals. The hospital pharmacy feedback and discussion group all agreed that the hospitals had an initial medication supply at discharge model that was implemented when the hospitals first opened and then iterative changes to that process occurred over a number of years for a variety of reasons; including, for instance, learnings from any prior incidents that occurred during the medication supply at discharge, to the implementation of new technology such as dispensary robotics to aid the medication dispensing process. These iterative changes to the processes gave rise to the variances seen across the number of stages and steps of the medication supply at discharge pathways at each hospital.

The HTA diagrams for the community pharmacy dispensing process (Weir et al., 2018) covered two pharmacies: Pharmacy X with 12 stages and 49 steps, and; pharmacy Y with 11 stages and 55 steps. The methodology used to complete the process maps in the community pharmacies is similar to this research, indicating that the community pharmacies may have a reduced number of steps to complete the medication dispensing process. Further research would be required to both complete process maps within the community pharmacy setting, following the exact same methodology as this research, and to analyse differences between the community pharmacy and hospital pharmacy medication supply processes.

3.9.2 Stages of Process Maps Shared Across All Hospitals

All the hospitals visited for the process mapping shared eight stages within their discharge medication supply at discharge pathways (Figure 3.8). These shared stages were: patient discharge medication finalised; pharmacist medication clinical check; IDL and/or patient medication arrives in pharmacy department or dispensary pod; generate medication labels, dispensing medication; accuracy check; discharge medication transported to ward, and;

discharge medication issued to patient. It would be expected that parts of the discharge medication at supply pathways would be similar across all the hospitals as both the legislation that governs the supply of prescription only medicines and the ethical advice on supply of medication is the same across all aspects of pharmacy in the UK. The legal framework to supply prescription only medicines are governed by both the Medicines Act 1968 (UK Goverment, 1968) and the Misuse of Drugs Act 1971 (UK Government, 1971). The ethical advice on this legislation is provided by the Royal Pharmaceutical Society (RPS) in the publication Medicines, Ethics and Practice (Royal Pharmaceutical Society, 2022). The Human Medicines Regulation 2012 (UK Government 2012) is the UK government legalisation that includes the legislation for labelling and supply of medication for use in humans across the UK. The legislation and ethical advice would be prudent to the shared stages of patient discharge medication finalised, patient medication clinical check, generation of medication labels, dispensing of medication, and medication accuracy check.

The remaining three shared stages are IDL and/or patient medication arrives in pharmacy department or dispensary pod, discharge medication transported to ward and discharge medication issued to patient. It is reasonable that all the hospitals would share these stages in the medication supply at discharge pathway, where a separate dispensing setting within the hospital, i.e. a pharmacy dispensary department located separate from the ward, is utilised to dispense patient medication. Each hospital pharmacy dispensary has a process that is followed when an IDL prescription is sent to them from the wards that occurs prior to the labelling, dispensing and checking of the patients discharge medication. In each hospital this was seen as an administrative process to occur before the start of the dispensing medication processes in the dispensary. This includes steps such as printing a copy of the IDL prescription or entering information into an IT system with regards to the time an IDL prescription was received into the dispensary. The transportation of medication, back to the ward and then onto the patient for discharge, is covered in the two remaining shared process pathway stages. In all the hospitals the discharge medication was handed to the patient by ward nursing staff immediately prior to discharge, as part of the final discharge pathway process.

3.9.3 Median Time For Medication Supply at the Point of Discharge

The median time for completion of the patient medication supply at the point of discharge ranged from 309 minutes (5.1 hours) in the Edinburgh Royal infirmary to 1709 minutes (28.4 hours) in Forth Valley Royal Hospital (Table 3.6). The medication supply at discharge data supplied from each hospital was for a selection of 50 patients and where the hospital used more than one medication supply at discharge pathway, the timing data did not identify what discharge pathway had been followed by the patient. An example of this can be seen in the timing data supplied by Edinburgh Royal Infirmary, as it did not separate if patients had been discharged via the ward stock only dispensing model or via the traditional hospital pharmacy dispensing model. Due to this limitation in the data, it was not possible to examine the time differences between these two pathways within the one hospital.

The hospitals with the largest number of stages, Forth Valley Royal Hospital and University Hospital Crosshouse, also had the longest median time for medication supply at the point of discharge. However, the discharge pathway with the highest number of steps, Edinburgh Royal discharge pathway via the hospital pharmacy department, correlated to the hospital with the lowest median time for medication supply at discharge. As previously mentioned, the timing data supplied did not indicate what discharge pathway had been used where a hospital used multiple medication supply at discharge pathways. As such in both Edinburgh Royal Infirmary and Dumfries and Galloway Royal Infirmary, the timing data could be from exclusively one pathway or a mixture of both pathways. As a result of this it is not possible to accurately compare the number of stages and steps reliably against the medication supply at discharge timing data for the hospitals.

The overall median time for completion of the patient medication supply at the point of discharge using the data for the 250 patients across the five hospitals was 513 minutes (8.5 hours). Overall, 23.6% of discharges across the five hospitals were completed within four hours while 30.8% of the discharges took over 24 hours to be completed. All hospitals showed large variances between the IRQ1 and IRQ3 times. The smallest variance between the IQR1 and IQR3 was seen in Dumfries and Galloway Royal infirmary - 204-568 minutes. The largest variance between the IQR 1 and IQR3 was seen in the University Hospital Crosshouse - 220-4321 minutes (Table 3.6). Due to the small sample size of only 50 patients per hospital ward it is difficult to draw definitive conclusions from the IQR variances, however

it could be hypothesised that a smaller IQR variance may demonstrate a more consistent medication supply at discharge process. The hospital feedback and discussion session provided some valuable content on the figures describing the overall complexity of the patient discharge process that not only involves the supply of discharge medication. Factors including social care requirements for ongoing patient support in the community, transport requirements to take patients home from hospital, and awaiting any final test results, were all highlighted as areas out with the control of the pharmacy teams that can have a major impact in the time that it takes to discharge the patient from the hospital. This point was further noted when observing that in the three hospitals that provided the additional time point data, the time taken for the patient to be discharged after the dispensing of the discharge medication had been completed by the pharmacy teams accounted for over 50% of the total medication supply at discharge pathway time: whereas the dispensing and checking of discharge medication accounted for only up to 15% of the total time (Figure 3.11). The hospital group highlighted various examples where the delay in the patient being issued discharge medication would be out with control of the pharmacy teams. These examples included where the medication had been dispensed and was waiting collection at the pharmacy department by ward staff or a porter. It was also highlighted that patient discharge medication may sit on the ward for a period of time awaiting a nurse to issue the patient with the medication. As overall timing data indicated that over 50% of the total discharge medication time accounted for after the pharmacy dispensing process had been completed, these areas could be the subject of further research to determine if additional time could be saved on the patient discharge process.

The hospital feedback and discussion group also highlighted that some of the instances where the patient medication supply at discharge appears to take over 24 hours could be due to positive patient experiences, where discharge planning had occurred the day before the patient's actual planned discharge. It was highlighted by the hospital pharmacy teams that patient medication could be finalised by the doctor the day prior to discharge, allowing the pharmacy teams to assemble the supply of discharge medication for the patient the day prior to the discharge, ensuring it is ready for the patient on the planned day of discharge. It was also highlighted that the discharge planning model would allow additional time for other vital factors to be arranged, including any social care requirements for the patient's return home and any transport required to be booked a day in advance. It was felt by the group that this model tended to ensure a smoother discharge for the patient as it allowed all the parties

involved in the patient's discharge, including the patient, to make advanced arrangements for a planned discharge date.

3.10 Context of the Results

Delayed discharges, defined as "when a hospital patient who is clinically ready for discharge and inpatient hospital care continues to occupy a hospital bed beyond the date they are ready for discharge" (Public Health Scotland, 2021) is an ongoing issue for hospitals in Scotland. From a patient perspective, delayed discharge results in a prolonged hospital stay when they could be back in their own home or homely setting to continue their recovery from a hospital admission. Delayed discharge can also affect patients that are being admitted to hospital, as a delay in discharging a patient will reduce the number of available beds within the hospital. This may result in patients spending additional time in accident and emergency departments while awaiting a bed within an appropriate hospital ward. The delayed discharges can affect the flow of patients through the hospital system as described above, which can result in patients waiting longer to be seen in accident and emergency if they are unable to transfer patients out of the department and onto suitable hospital wards. This adds additional stress to the hospital systems for both patients and staff.

As previously discussed in the results section within the hospital pharmacy feedback and discussion group, medication supply at discharge is a key component in the discharge process and can have an impact on delayed discharges, along with other factors including the requirements for arranging any ongoing social care requirements. The detailed HTA diagram process maps in this research, while focused on the medication supply at discharge, can be used as a starting point for identification of areas where improvements could be made in the medication supply at discharge process to enable patients to be discharged from hospital in a timely manner. The use of process maps as a tool to understand complex systems and enable visualisation of the system, as the first stage in system improvements, is well established both within the hospital processes, as seen in the paper by Taylor and Randell on using process mapping to enhance the implementation of the Liverpool Care Pathway for dying patients (Taylor and Randall, 2007), as well as by other industries; for example, investigating improvements for the supply chain of the Brazilian automotive industry (Miyake et al., 2010).

3.10.1 SHERPA Task Classification HTA Diagram Process Maps

As described in Section 3.4.3, the first stage of SHERPA analysis - Task Classification - was applied to each step in the process maps to allow for comparison between the different hospital processes stages. The SHERPA task classification applied to each step required to complete each stage of medication supply at discharge pathway are classified as either Action, Retrieval, Checking, Selection or Information Communication. A detailed explanation of each of the classifications can be found in the fieldwork section of this research in Table 3.2. In all the hospitals visited, the majority of steps within the process maps were classified as action steps according to the SHERPA task analysis classification. These action steps, being the largest component of the discharged medication supply pathway, would be an ideal place to begin investigations for streamlining the process.

As described in the summary of key findings, it was identified that all the hospital medication supply at discharge pathways included eight shared stages. Table 3.5 highlights that several different IT systems are used in various parts of these shared stages across all the hospitals visited for the process mapping. A number of the action stages involved an individual using multiple IT systems across the medication supply at discharge pathway.

A single IT software solution, or an improved integration between IT systems, that could provide the hospital teams with a single system that could be used to prescribe the patient medication and label the patient discharge medication potentially with integration of dispensing medication via automated robotics, may be advantageous in reducing the time taken to supply discharge medication. It is also noted from Table 3.5 that most of the hospitals have a bespoke system to track the progress of the patient medication supply at discharge pathway. This can be used by staff on the wards to check on progress of a patient's discharge medication supply from the pharmacy department. Again, if this was integrated into a single system or had improved IT integration with the current systems, the processes of updating this system, either manually of via the scanning of barcodes, could be omitted from the discharge medication supply pathway. This could, again, lead to a decrease in the time taken on the patient medication supply at discharge pathway, resulting in a reduction in delayed discharges for the patients and improving the flow of the patients across the

hospital site from accident and emergency department to an appropriate ward bed for acutely unwell patients.

3.10.2 Location Where Medication Supply to Patients at Hospital Discharge is Completed

NHS hospitals within the UK provide patients with a supply of medication at the point of hospital discharge; however, across parts of Europe and further afield in North America, a patient is discharged from hospital with a prescription that can be either a physical prescription or an electronic prescription that is sent via a secure digital pathway to a patient's community pharmacy (Brühwiler et al., 2019 and Fernando, Nguyen and Baraff, 2012).

The timing data from Table 3.6 highlighted that in some instances over 50% of the medication supply at discharge time can occur after the pharmacy team have completed the dispensing of the medication process. It was suggested from the hospital feedback and discussion group, that various causes for this may occur, including medication awaiting collection by a porter or ward staff from the dispensary and the availability of nursing staff on the ward to issue discharge medication to the patient. An alternative discharge pathway where the discharge medication is not supplied to the patient in the hospital at the time of discharge could have an impact on reducing both the time spent by the hospital pharmacy team dispensing discharge medication and the wait for a dispensed discharge medication to be issued to a patient. This may result in a timelier discharge for the patient.

An alternative pathway could be considered from NHS hospitals in Scotland where a patient may be issued with a discharge prescription, or an electronic prescription is sent via a secure digital pathway, to a patient's community pharmacy. The community pharmacy survey 2020 indicated that Scotland has 1256 community pharmacies that are contracted to provide NHS services across the country (NHS Education for Scotland, 2021). Utilisation of the network of community pharmacies to supply patients with discharge medication could reduce the discharge time for patients by enabling a patient to be discharged from the hospital when a doctor finalises the patient's discharge medication; a prescription could be generated for the patient or an electronic IDL prescription could be sent to the patient's community pharmacy.

A small-scale test of change research paper following the Plan-Do-Study-Act cycles (Tait et al., 2023) aimed to establish whether the patient medication supply at the point of discharge could be made more time efficient by enabling community pharmacy supply of patient discharge medication. The study used a cohort of 335 patients from a single general medical hospital in Glasgow, Scotland, and demonstrated that the community pharmacy medication supply model had a median time of 154mins (IQR 82-272). The median discharge time for the community pharmacy medication supply is lower than observed in any of the hospitals visited in this research (Table 3.6). In the context of the complex process maps shown in this research it is evident that all the hospitals process maps could be simplified by the medication supply function being delivered by the community pharmacy. Moving the setting where the discharge medication is supplied, away from the hospital pharmacy to the community pharmacy, may reduce the median times for the discharge medication pathway in every hospital. This time reduction would be beneficial to the patients, as they can be discharged from hospital and return to their own home quicker, and allow for improvements in hospital flow with less patient waiting in beds for discharge medication. However, further research would be required to understand how any change in the discharge medication supply process would be accepted by patients or patient care givers.

As previously outlined, the study by Weir et al. (2018) completed process maps for two community pharmacies that had 49 and 55 steps respectively to complete the stages of the medication dispensing process. The hospital medication supply at discharge pathway, excluding the Edinburgh Royal Infirmary ward stock dispensing model, has a median of 94 steps after the doctor has finalised the patient's medication up to the point the patient is discharged with the medication across all the hospitals visited for the process mapping. This indicates a lower number of steps required to complete the dispensing and issuing of medication to patients in the community pharmacy when compared to the hospital setting. Various factors can be considered as significant differences between the process maps of the community pharmacy medication supply process and the hospital pharmacy medication supply at discharge pathway. The main difference would appear to be the community pharmacy prescriptions containing a barcode that is scanned at the community pharmacy, which automatically populates some of the information required on the patient medication label in the community pharmacy IT system. This includes the information on drug name, strength, and directions for the patient. This information is added manually into the hospital pharmacy dispensary IT system as part of the hospital discharge medication supply process

pathway. The community pharmacy also does not have stages to transfer the completed medication to a secondary location, as seen in the hospital process maps where the completed medication is transferred from the hospital dispensary to the patient's ward. The community pharmacy dispensing pathway has medication being issued to the patient, with appropriate counselling advice, by the pharmacist directly after the medication has been clinically checked, dispensed and accuracy checked by the appropriate members of the pharmacy team. It was also noted that the community pharmacies used a single IT software package during the medication dispensing process. In contrast the hospitals used multiple IT software packages. Login into each different IT system in the hospital discharge process, along with manually adding the correct information while labelling the medication, may also account for increased steps and time in the hospital process when compared to the community pharmacy process. Further research would be required to compare the community pharmacy medication dispensing process to the hospital pharmacy discharge medication dispensing pathway, and to establish if the community medication dispensing process, including the use of barcoded prescription information, could be embedded in the hospital pharmacy setting to correlate to a reduction in time taken for patient medication supply at hospital discharge.

3.11 Strengths and Limitations

The research within this thesis is novel, as no research could be identified within Scotland, the UK or further afield that had used the mixed methodology of process mapping using a "Walk and Talk" technique to create a HTA diagram process map for the medication supply at discharge process pathway within a hospital setting. The research has used well established and validated techniques in the "Walk and Talk" model to create the content for the process maps and HTA diagrams to display the process maps. The use of the validated SHERPA task classifications to classify the steps within a process map is a well-established technique that usually form part of the full SHERPA analysis. This research is novel in using the SHERPA task classification to compare process maps from different geographic sites that undertake a process pathway with the same goal of discharging patients with a supply of medication. The process described in this research to create the process maps could be used

in other hospitals to map the discharge medication supply to patients at discharge and form the basis for future discussions around process optimisation.

The research processed mapped six hospitals across Scotland and obtained the medication supply at discharge timing data from five hospitals. One of the limitations of the research was visiting only a small proportion of the general classification hospitals in Scotland (16.7%), and not visiting any of the other classifications of hospitals in Scotland. The results therefore could not be generalised to either all the hospitals in Scotland or all the general classification of hospitals in Scotland. The results are accepted as a snapshot of the hospitals visited only.

The process mapping of the medication supply at discharge pathway was defined in the methods section as covering the point from when the doctor finalised the patient's medication for discharge, to the point the patient is discharged from the hospital with a supply of medication. However, during the research it was discovered that this definition does not include all the stages required for discharge medication supply in the Edinburgh Royal Infirmary ward stock only discharge model. The discussion with the pharmacy feedback group indicated that a significant amount of work would have been carried out by the pharmacy teams, including managing stock levels at the ward, dispensing and labelling stock for supply to the ward store and transporting medication to the ward store prior to the doctor finalising the patients discharge medication in the ward only discharge model. This research did not include these processes as they have occurred prior to the doctor completing the patient IDL prescription. As such the Edinburgh Royal Infirmary, ward stock only dispensing model pathway, could not be considered to be fully processed mapped by this research.

The data collection on the day of the visit to each hospital for the process mapping in Appendix 3, Observational Data Sheet, has not been reported within the results section. The rationale for this was that the observational data did not correlate to the dates where the timing data was supplied as the observational data was collected on the day of the process mapping, and the timing data was supplied for the first 50 patients discharged from the ward from 1st of June 2022. As highlighted previously, this date was chosen to be the same across all hospitals to ensure the timing data could be compared across the hospitals. As a result of this the impact of staffing levels and the environment in the dispensary and wards could not be used to add any detail for the medication supply at discharge times supplied by the hospitals. This is a limitation of the research and could be an area for future research to

establish the links between both staffing levels and ward or dispensary environments between hospitals on medication supply at discharge time taken.

Each hospital submitted data for 50 patients discharged with a supply of medication from the ward. The data was extracted from the HEPMA system from 1st June 2022, selecting a timescale of routine hospital level of service. The HEPMA search and report tool was run by the HEPMA team in each hospital alongside their existing workload, and no additional funding was included as part of this research. As such, the number of patients was set at 50 in agreement with the HEPMA teams to ensure this could be completed alongside the teams existing workload. The results for the timing data and the discussions with the hospital pharmacy feedback and discussion group indicated that the sample size of 50 patients would be too small to generalise the results across the entire hospital sites, but did provide an interesting snapshot of the medication supply at discharge times from the wards where the data was extracted from the HEPMA system. It was also noted that, from the data collected, it was not possible to identify which pathway a patient followed if a hospital used more than one medication supply at discharge pathway. An example of this can be seen in the Edinburgh Royal Infirmary where, as previously discussed, the ward stock only medication supply pathway has fewer stages and steps to complete these stages, but it is unknown from the discharge timing data which patients went through this pathway, as compared to the standard discharge medication supplied via the hospital pharmacy dispensary. As the timing data supplied from each hospital did not identify which discharge pathway a patient followed in the hospital, it is a limitation as the results cannot be used to compare multiple discharge pathways within one hospital. Furthermore, the results cannot be generalised across the full year as additional pressure, such as known increased admission during the winter months, may have an impact on the discharge medication at discharge supply timing data. The data supplied from each hospital contained no patient information or information on medication supplied. This is a limitation of the research as patient demographics and number of items supplied at discharge cannot be compared across the hospitals.

The hospital discharge process is a complex multi-factorial process that can involve a variety of professions engaging with the patient to facilitate the discharge of the patient back into the community setting. The process mapping in this research focused only on the medication supply process as part of the patient discharge, but as highlighted by the hospital pharmacy feedback and discussion group delays to patient discharge can occur from a number of

sources that are not related to pharmacy. The data used for the discharge timing information in this research cannot be used to define the cause of any delayed patient discharge, such as social care arrangements or a change in a patient clinical condition. The timing data in this research covers any cause of patient delayed discharge and is not limited to instances where medication supply at discharge has resulted in a delay to patient discharge. Therefore, the cause of any delay in discharge cannot be assigned to any specific reason and it cannot be assumed that all delayed discharges shown in the timing data are solely due to medication supply at discharge issues.

3.12 Implications For Future Research

This research has generated a number of interesting results. However, it has also established questions for further research. This work has established a methodology for creating SHERPA Task Classification HTA Diagram process maps for the medication supply at discharge pathway. This methodology can be replicated in other hospital sites. Within this research, six hospitals were visited and the eight shared stages of the medication supply at discharge pathway are proposed; further research at additional hospital sites would be required to validate these proposed eight shared stages of hospital discharge in Scottish hospitals. The methodology used in this research may also extend beyond hospitals in Scotland, and further research could enable comparison of hospital medication supply at discharge pathways across both the UK and international settings.

Further research would be required to understand the full process map for the Edinburgh Royal Infirmary ward stock only discharge pathway as it was highlighted that it may contain stages that were omitted by this research's definition of the starting point for the medication at discharge supply pathway.

The timing elements for the discharge pathways extracted from the HEPMA systems had a small number of patients, starting from a fixed time point. Further research could be undertaken to both increase the number of patients extracted from the HEPMA IT system and sampling at different points over a year by using a modified version of the HEPMA search and report tool used within this research. This may yield more robust results on the time taken by both the sections of the medication supply at discharge pathway and the total time taken by the medication at supply pathway. Sampling at different points across the year may

also give an indication of where additional pressures within the hospital, such as the well documented busier winter period, may impact the time taken for the medication at supply pathway to be completed.

Collecting additional information alongside the timing data, such as number of medications dispensed and reason for any delayed discharges, such as medication supply issues, deterioration in the clinical condition of the patient, or availability of onwards social care for patients, would allow for further analysis to understand if number of medications supplied has an impact on discharge times and to quantify the number of delayed discharges that can be attributed to waiting for discharge medication.

The time taken to enable medication supply at discharge demonstrated in this research, highlights that utilising other locations - such as community pharmacies - could be explored as an alternative route for patient medication supply at discharge. Further research would be required to understand the framework required to establish discharge medication supply at the community pharmacy, alongside the time implications for the patient discharge pathway at the hospital sites.

Chapter 4: Conclusions

4.1 Introduction

A delayed discharge is defined by NHS Scotland as *"when a hospital patient who is clinically ready for discharge from inpatient hospital care continues to occupy a hospital bed beyond the date they are ready for discharge"* (Public Health Scotland, 2021: p3). In the UK, the majority of hospital discharges are from NHS hospitals and the patient is issued with discharge medication by the hospital pharmacy at the time of discharge. However, "waiting for medicines" is the most common patient reported reason for delayed discharge given by 69% of patients who experienced a delayed discharge (Scottish Government, 2018). This indicates that medication supply at discharge could be a potential area for improvement, yet there is a paucity of research on the medication supply at discharge process, with only three UK studies identified which explored medication supply at the point of patient discharge from hospital (Bullock et al., 2016; Wright et al., 2017; 2019), and no papers having yet focused on this within NHS hospitals in Scotland.

This research has sought to address this through examination of the patient medication supply process at the point of discharge in six hospitals within different health boards in NHS Scotland – Dumfries and Galloway, Edinburgh Royal Infirmary, Forth Valley Royal Infirmary, University Hospital Crosshouse, University Hospital Hairmyres and Queen Elizabeth University Hospital. This included one hospital that used the patient's own dispensing model and at least one hospital that used the traditional hospital dispensary model. Through utilising a mixed methodology approach, incorporating existing validated techniques, this research created SHERPA Task Classification HTA diagram process maps for each hospital site visited, alongside the extraction and analysis of process timing data from within the hospital HEPMA IT systems. The creation of the process maps at each hospital involved following a simulated patient journey through the medication supply at discharge pathway using the 'Walk and Talk' technique (Kirwan and Ainsworth, 1992). This allowed a detailed analysis of the pathway of patient medication supply at the point of hospital discharge in a selection of Scottish hospitals.

This chapter will summarise the findings of this research after initially providing an overview of the two scoping reviews conducted to identify knowledge gaps and inform the methodology. Thereafter it considers the significance of the results in relation to the broader

knowledge base in this area and the potential contribution to informing NHS Scotland strategy going forward.

4.2 Summary of Scoping Reviews (Chapter 2)

Two scoping reviews were conducted to inform this research (Chapter 2), with papers for both reviews selected based on specific inclusion criteria and carried out by a primary and secondary reviewer in order to limit the possibility of selection bias.

For the first scoping review, 16 papers were identified and reviewed on the subject of *"the existing knowledge base on medication supply at the point of hospital discharge from either the hospital pharmacy or community pharmacy".* This scoping review established the lack of current research in this area within a UK hospital context. It was also established from the scoping review that medication supply at the point of patient discharge from hospital can be a contributing factor to delayed discharges (Wright et al., 2017). It was identified that delayed discharges can have a negative impact on patient outcomes and hospital resources, therefore it was evident from the papers that medication supply at discharge is an area where improvements to process could be beneficial.

A key theme to emerge was the role that community pharmacy could potentially play in facilitating reducing delayed discharges, alongside other benefits such as: increased medication accuracy and reduced medication errors, improved medication adherence and increased support for patients (Hockly et al., 2018; Bloodworth et al., 2018; Tomlinson, 2020; Trinkley et al., 2017). The review also found previous studies have demonstrated agreement from patients and stakeholders regarding a potential new medication supply at discharge model that would incorporating community pharmacy to supply discharge medication (Wright et al., 2017; 2019). Furthermore, a small-scale study conducted in a single hospital in Scotland that utilised community pharmacy in the discharge medication process demonstrated this approach could result in timesaving on the patient discharge time (Tait et al., 2023).

Following on from the identification in the first scoping review that no previous studies had mapped the process of discharge medication supply in hospitals in Scotland, a second scoping

review was conducted in order to inform the methodology of this research. This proposed the question: "*has process mapping been used as a tool to identify areas for improvement within a hospital or community pharmacy setting?"* and 26 papers were subsequently identified.

Process mapping is a technique used to represent the steps and stages of a process, typically within a defined process, through creating a diagram illustrating the sequence of activities, decision points, inputs and outputs. In doing so it enables a clearer understanding of how a process operates. This scoping review identified multiple examples where process mapping has been used for process improvement and quality improvement initiatives within a hospital or community pharmacy setting (Antonacci et al., 2021). In Scotland, process mapping was used to describe the supply of medication to a patient in a community pharmacy setting (Weir et al., 2018). Differences do exist between hospital medication dispensing and community pharmacy medication dispensing, such as use of electronic barcodes that contain prescription information in the community pharmacy setting, however the same legislation governs both prescription medication supply from both the hospital and community pharmacy setting. No papers were identified which had yet involved the application of process mapping to discharge medication supply in the complex dispensing systems within hospital settings in Scotland.

Many of the papers in the scoping review incorporated quality improvement and process-orientated management practices from other industries in conjunction with the process mapping, while others used process mapping as a standalone methodology. The scoping review identified SHERPA – Systematic Human and Error Reduction Prediction Approach (Embrey, 1986) and specifically the task classification analysis, as being appropriate for use in this study alongside process mapping. The task classifications used within the SHERPA analysis, where each step in a process is described as either an action, retrieval, checking, selection or information communication step, would allow for classification of each step and so permit investigation of the similarities and differences in both the number and types of steps within each hospital's medication at discharge pathways. It is essential to understand the current medication supply pathway at the point of discharge in this detail prior to discussing areas where change could be suggested to improve the process. The studies by Weir et al. (2018) and Ashour et al. (2022) both utilised a hierarchical task analysis diagram as a viable model that can be used to visualise the output from the process mapping exercise.

The second scoping review demonstrated that process mapping is therefore shown to be an acceptable methodological approach to improve process and outcomes in healthcare settings and was appropriate to use in this study.

4.3 Summary Results of Process Mapping Medication Supply at Hospital Discharge (Chapter 3)

The different hospital pathways followed at each site to discharge patients with medication involved between eight and eleven stages across all hospital pathways and between 89 to 111 individual steps required to complete the stages within the pathway (Table 3.4). The median number of stages in the medication supply process across the six hospitals is nine stages with a median number of 99 steps required to complete the stages. Eight shared stages were identified in medication supply at discharge pathways in all six hospitals (Figure 3.8). All the hospital process maps showed the SHERPA task classification of an Action task as the main task classification, demonstrating the pathways are labour intensive (Table 3.4).

The median time for completion of the patient medication supply at the point of discharge for 50 patients in each hospital varied from 309 minutes (5.1 hours) to 1709 minutes (28.4 hours). The median discharge time for the 250 patients across the five hospitals was 513 minutes (8.5 hours). Analysis of the stages of discharge time data, available from three hospitals, highlighted that over 50% of the discharge time occurred after the pharmacy team had completed the dispensing process for the discharge medication.

4.4 Discussion in Context of Existing Knowledge Base

As previously mentioned, to date there have only been three UK studies exploring medication supply at the point of patient discharge from hospital (Bullock et al., 2016; Wright et al., 2017; 2019). This study is the first to look at the medication supply models at the point of patient discharge from NHS hospitals in Scotland and in doing so it contributes to furthering the knowledge base in this area. The process maps created in this research can be used as a

starting to point to enable discussion on areas for improvement within the medication supply at discharge process, contributing to the wide body of healthcare research using process mapping in recent years (Antonacci et al., 2021). It was discovered that all six hospitals shared eight stages in the medication supply at discharge pathways and the SHERPA task classification of an Action task as the main task classification demonstrated these pathways are labour intensive. The evidence of these shared stages throughout, suggests a level of similarity in the process across all the hospitals, and indicates the pathway is time consuming for all. This implies improvements to the medication supply at discharge pathway may reduce how labour intensive it is for staff, reducing the time staff currently spend carrying out tasks on the pathway, potentially freeing up this time for other tasks which could consequentially improve workflow.

Such changes to the pathway could therefore also potentially reduce discharge time for the patient. It is widely documented that delayed discharge due to patients waiting for medication supply impacts hospitals by reducing the number of beds within the hospital, and also results in new patients waiting longer to be admitted and seen (Bullock et al., 2016; Wright et al., 2019). These factors add additional stress to the hospital system for patients and for staff (Bullock et al., 2016). Therefore, the results from this study suggest improvements to the medication supply at discharge process could potentially result in a timelier discharge for the patient.

The results of this study involving process mapping of the medication supply at the point of discharge process in a selection of Scottish hospitals, can be tentatively compared to the results of the small-scale test of change research paper published by Tait et al. (2023), which aimed to establish whether the patient medication supply at the point of discharge could be made more time efficient by enabling community pharmacy supply of patient discharge medication. In the research conducted by Tait et al. (2023) it was demonstrated that the community pharmacy medication supply model had a median time of 154mins (IQR 82-272). The median discharge time for the community pharmacy medication supply is lower than those observed in any of the hospitals visited in this research, suggesting that it could potentially be a more time efficient process. The complex hospital process maps shown in this research could potentially be simplified by the medication supply function being delivered by the community pharmacy, as opposed to being supplied to the patient in the hospital at the time of discharge. The results revealed that the largest time section (in some

instances over 50%) of the discharge process was after the discharge medication has been dispensed and checked by the pharmacy team. The hospital pharmacy feedback and discussion group suggested various causes for this, including medication awaiting collection by a porter or ward staff from the dispensary and the availability of nursing staff on the ward to issue discharge medication to the patient. This highlights the complex multifactorial nature of the process to discharge a patient from hospital and identifies that future research would be required to identify areas for improvement within the process maps developed by this research.

The results of this study found that the hospital discharge pathways had both a similar number of stages (8 to 11 stages) in the pathway and a similar number of steps (91 to 111 steps) required to complete the medication supply at discharge pathway. This indicated a level of similarity across the medication at supply pathways at the different hospitals. This can be contrasted to research by Weir et al. (2018) who completed process maps for two community pharmacies that had 49 and 55 steps respectively to complete the stages of the medication dispensing process. This suggests fewer steps are required to complete the dispensing and issuing of medication to patients in the community pharmacy when compared to the hospital setting. The methodology used to complete the process maps in the community pharmacies (Weir et al., 2018) is similar to this research, indicating that the community pharmacies may have a reduced number of steps to complete the medication dispensing process. However, further research would be required to complete process maps within the community pharmacy setting, following the exact same methodology as this research to validate this hypothesis. It is noted from the community pharmacies process maps from Weir et al. (2018) that the community pharmacies use one single IT system in each community pharmacy in the medication supply process, however the hospital process maps show multiple IT systems are used in the hospital setting. A single IT software solution, or an improved integration between existing IT systems, that could provide the hospital teams with a single system that could be used to prescribe the patient medication and label the patient discharge medication - potentially with integration of dispensing medication via automated robotics - may be advantageous in reducing the time taken to supply discharge medication.

Moving the discharge medication supply from the hospital pharmacy to the community pharmacy setting, may reduce the median times for the discharge medication pathway in

every hospital. This time reduction would be beneficial to the patients, as they can be discharged from hospital and return to their own home in a timelier manner, and would allow for improvements in hospital flow with fewer patients waiting in beds for discharge medication. However, further research would be required to understand how any change in the discharge medication supply process would be accepted by patients or patient care givers. Wright et al. (2017; 2019) did find 'enthusiastic' support for such an alternative model amongst both patients and stakeholders in his studies, indicating such changes may receive considerable support. However, it should be noted that discharging the patient from hospital with a written or electronic prescription may be associated with particular challenges, including patient nonadherence to filling discharge medication prescriptions (Farris et al., 2018) and patient understanding of any new or changed medication regimens at discharge (Ziaeiani et al., 2012; Bulut et al., 2013, Al-Hashar et al., 2018,).

4.5 Significance of Research to NHS Scotland Strategy

Previous NHS Scotland strategies, such as "Prescription for Excellence" (Scottish Government, 2013a), have stressed the importance of closer working between healthcare teams in hospitals and communities to support patients pharmaceutical care at the transition between primary and secondary care. The "NHS Scotland Healthcare Quality Strategy" (NHS Scotland, 2010) emphasised the importance of partnership working, including between NHS Scotland and independent contractors, such as community pharmacists. The evolving role of community pharmacists, including closer partnership working with this NHS, has been highlighted in multiple NHS Scotland strategies and this could be integrated into patient pharmaceutical care at the transition of care between primary and secondary care via providing discharge medication alongside patient education of any new or changed medication in the community pharmacy setting.

A "National Clinical Strategy for Scotland" (2016) emphasised that patients should be discharged from hospital as soon possible, with support from both primary and community colleagues. This research has shown the complex processes that are involved in each of the hospitals visited to map the medication supply at discharge, along with a snapshot of the time these processes can take. The process maps developed in this research could be used

as a starting point to identify areas for process improvement within the existing processes, or consider where another setting, i.e. community pharmacy, could be used in the process to support the medication at discharge pathway. The NHS Scotland strategy "Achieving Excellence in Pharmaceutical Care: A Strategy for Scotland" (2017) had nine key commitments, which included closer working between primary and secondary care pharmacy teams to improve patient pharmaceutical care at the point of hospital discharge. Another key commitment was the transforming of hospital pharmacy services, and of this, one of the main actions underpinning this commitment was a review of the hospital discharge process. This research further underpins the importance and value of closer partnership working between primary and secondary care pharmacy, as this has the potential to bring about improvements in the medication supply at discharge pathway in Scottish hospitals.

The "NHS Recovery Plan" (Scottish Government, 2021) further committed to establishing a new community pharmacy hospital discharge and medicines reconciliation service. This service was envisaged to help decrease the time it takes for patients to be discharged from hospital back into the community setting. The findings of this research further emphasise the potential of such a service, as the results of this study highlight the labour-intensive process of the current pathway which may increase the discharge time for patient, and the published evidence indicates the community pharmacy discharge pathway has the potential to result in a timelier discharge for the patient (Tait et al., 2023; Weir et al., 2018). This utilisation of the network of community pharmacies to supply patients with discharge medication could reduce the discharge time for patients by enabling a patient to be discharged from the hospital when a doctor finalises the patient's discharge medication; a prescription could be generated for the patient or an electronic IDL prescription could be sent to the patient's community pharmacy.

One of the three quality ambitions of the "NHS Scotland Healthcare Quality Strategy" (2010) was that of 'effective' health care. The 'effective' ambition specifies that: *"The most appropriate treatments, interventions, support and services will be provided at the right time to everyone who will benefit, and wasteful or harmful variation will be eradicated"* (Scottish Government, 2010: p7). The process mapping of the medication supply at discharge pathway conducted in this research resonates with this ambition, by demonstrating that this process

could be more efficient and improvements made to the pathway could increase its effectiveness, thus reducing delayed discharges.

4.6 Further Research Possibilities

This research has generated a number of interesting results and has also established questions for further research. It has established a methodology for creating SHERPA Task Classification HTA diagram process maps for the medication supply at discharge pathway and this methodology could be replicated in other hospital sites within and beyond Scotland to compare hospital medication supply discharge pathways.

In order to validate the findings of this research, further research would be required in additional hospitals across Scotland. The methods described within this research could be applied to additional hospital sites to gain a further understanding of the medication supply at discharge pathway, and the process maps generated can be used for both comparisons across different hospital sites and as a visual tool to understand the current medication supply at discharge pathway. Additional research would be required to understand the full process map for the Edinburgh Royal Infirmary ward stock only discharge pathway, as it was highlighted that it may contain stages that were omitted by this researcher's definition of the starting point for the medication at discharge supply pathway.

In all the hospitals visited, the majority of steps within the process maps were classified as action steps according to the SHERPA Task Analysis classification. These action steps, being the largest component of the discharged medication supply pathway, would be an ideal place to begin investigations for streamlining the process.

The hospital representative discussion group noted it was not possible to identify from the data submitted in this research if the patient had been an advanced planning discharge patient - i.e. where the patients discharge is planned the day before discharge with medication being dispensed on the day prior to discharge - and felt that some of the discharges times over 24 hours could have included this cohort of patients. The group also noted the timing data could not identify where the discharge time had been affected by any other factors for delayed discharge (such as awaiting social care arrangements). The group

felt that having the timing data corelated to reasons for the delayed discharge would be an interesting area for further research.

The timing elements for the discharge pathways extracted from the HEPMA systems had a small number of patients, starting from a fixed time point. Further research could be undertaken to both increase the number of patients extracted from the HEPMA IT system and sampling at different points over a year, by using a modified version of the HEPMA search and report tool used within this research. This may yield more robust results on the time taken by both the sections of the medication supply at discharge pathway and the total time taken by the medication at supply pathway. Sampling at different points across the year may also give an indication of where additional pressures within the hospital, such as the well documented busier winter period, may impact the time taken for the medication at supply pathway to be completed. Further research to establish the links between both staffing levels and ward or dispensary environments between hospitals on medication supply at discharge time taken could also be insightful.

It would also be valuable to research the viability of an alternative medication supply at discharge pathway and to investigate if such a change would lead to a reduction in the time taken for patients to be discharged from hospital. The time taken to enable the medication supply at discharge found in this research has highlighted that utilising other locations, such as community pharmacies, could be explored as an alternate route for patient medication supply at discharge. Further research would be required to both complete process maps within the community pharmacy setting, following the exact same methodology as this research, and to analyse differences between the community pharmacy and hospital pharmacy medication supply processes. Additional research, perhaps also incorporating patient and stakeholder perspectives, would be necessary to understand the framework required to establish discharge medication supply at the community pharmacy setting, alongside the time implications for the patient discharge pathway at the hospital sites.

4.7 Final Remarks

Delayed discharge resulted in patients spending an additional 358,426 days in hospitals across Scotland in 2021 (Public Health Scotland, 2021). Reducing delayed discharge through identifying potential process improvements is an important endeavour which may positively impact both patient discharge times and hospital resources. The research within this thesis is novel, as no research could be identified within Scotland, the UK or further afield, that had used the mixed methodology of process mapping using a "Walk and Talk" technique to create a HTA diagram process map for the medication supply at discharge process pathway within a hospital setting. The results of this study indicate that the majority of discharge pathways in the hospitals visited for the process mapping shared similar stages and numbers of step within their pathways. The SHERPA Task Classification highlighted that the action steps were the most prominent classification, as the action steps are the most labour-intensive steps in the process these may be an area where improvements in the current processes could be investigated. The results also highlighted the variances in discharge times within each hospital, due to the multifactorial complex nature of patient discharge from hospital. More than 50% of the total discharge time in the hospitals able to supply the additional timing data occurred after the medication dispensing process had been completed. In some instances, this may be due to availability of porters to take discharge medication back to the ward, or availability of nursing staff to issue patients with the completed discharge medication. Consideration could be given by NHS Scotland to an alternative medication supply at discharge pathway model where patient discharge medication is supplied from a different location, such as a community pharmacy, as this may reduce medication supply delayed discharges.

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Appendices

Appendix 1. Detailed literature search structure and number of results

Question 1. What is the existing knowledge base on medication supply at the point of hospital discharge from either the hospital pharmacy or community pharmacy setting?

EMBASE OVID DATABASE

#	Search term	Results
1	Exp hospital discharge/	197070
2	Medication adj1 sup*. ti,ab,kw.	2545
3	Exp "pharmacy (shop)"/	31053
4	Pharmacy. ti,ab,kw	107331
5	1 and 2	54
6	3 or 4	121298
7	5 and 6	16

70 papers taken forward for literature review (rows number 6 and 7)

MEDLINE OVID DATABASE

#	Search term	Results
1	Exp Patient Discharge/	41629
2	Medication adj1 sup*. ti,ab,kw.	1537
3	Exp Pharmacy/	10746
4	Models of care. ti,ab,kw	5421
5	Exp Pharmacies/	10038
6	Pharmacy.mp.	78437
7	Community pharmacy. ti,ab,kw.	4815
8	1 and 2	13
9	3 or 5	17756
10	6 or 9	80963
11	8 and 3	0
12	8 and 7	3
13	8 and 9	0
14	8 and 10	4

7 papers taken forward for literature review (rows number 12 and 14)

Cochrane Library

#	Search term	Results
1	Patient Discharge – MeSH term exploded	2660
2	Prescription – MeSH term exploded	1576
3	Community Pharmacy – MeSH term exploded	223
4	Pharmacy:ti,ab,kw	6474
5	Pharmacy service, Hospital – MeSH term exploded	223
6	medication adj1 sup* ti,ab,kw.	83
7	discharge adj1 medi* ti,ab,kw.	47
8	1 and 2	22
9	1 and 3	2
10	1 and 4	75
11	1 and 5	32
12	1 and 6	0
13	1 and 7	0

131 papers taken forward for literature review (rows number 8-11)

Question 2. Has process mapping been used as a tool to identify areas for improvement within a hospital or community pharmacy setting?

EMBASE OVID DATABASE

#	Search term	Results
1	Process adj1 map*. ti,ab,kw	3150
2	Exp hospital discharge/	197070
3	Exp prescription	267164
4	Exp model/	4228447
5	Pharmacy. ti,ab,kw	107331
6	Exp prescription/	267164
7	Model of care. Kw	298
8	1 and 2	67
9	8 and 3	5
10	2 and 4 and 5	153
11	10 and 6	29

12	2 and 7	5

259 papers taken forward for literature review (rows number 8-12)

MEDLINE OVID DATABASE

#	Search term	Results
1	Process adj1 map*. ti,ab,kw	1574
2	Exp Patient Discharge/	41629
3	Exp Prescriptions/	42550
4	Models of care. ti,ab,kw	5421
5	Exp Pharmacy/	10746
6	1 and 2	18
7	3 and 6	1
8	2 and 4	92
9	5 and 8	0

111 papers taken forward for literature review (rows 6-9)

Cochrane Library

#	Search term	Results
1	(process map*):ti,ab,kw	3215
2	Patient Discharge – MeSH term exploded	2660
3	Prescription – MeSH term exploded	1576
4	1 and 2	1
5	3 and 4	0

1 paper taken forward for literature review (Row 4)

Appendix 2. "Walk and Talk" Through Guide

Location - Ward.

1. **Can you please show me the process for highlighting that a patient's discharge medication list is finalised and ready to be sent on to pharmacy department?**

   1.1 Prompts

   - How is it highlighted?
   - Who can complete this step? (Job roles)
   - What is the sequence that needs to be followed on the IT system?
   - Where in the ward is this step completed?
   - How are the Pharmacy dept. aware the patient's medication is to be dispensed for discharge?
   - How long do you think this step usually takes?
   - Is the patient involved in this stage in any way?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc

Location – Pharmacy/Ward

2. **Can you please show me the processes around dispensing discharge medication for a patient?**

   2.1 Prompts – Clinical Check?

   - How are you made aware that a medication list is ready to be clinically checked?
   - How is a clinical check completed?
   - When is a clinical checked completed?
   - Where is the location that this step is completed?

- What is the sequence that needs to be followed on the IT system for a clinical check?
- Who can complete the clinical check?
- How long do you think this step usually takes?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage? Another pharmacist, the ward staff, the patient, the patients GP/CP?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc.

NB – Ask what order labelling and dispensing of medication occurs. If dispensing/getting medication occurs first move to section 2.3 before section 2.2

2.2 Prompts – Dispensing Process (Labelling)

- How is the information taken from HEPMA drugs list to be dispensed?
- Where is the location that this step is completed? (If in another area of dispensary how is information/physical items moved?)
- What systems are used to produce medication labels for the drugs?
- What is the sequence that needs to be followed on the IT systems to produce medication labels?
- Who can complete this step? (Job roles)
- How long do you think this step usually takes?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc.

2.3 Prompts – Dispensing Process (Getting the medication / appliances)

- What is the process for getting the medication / appliances?

- Is any technology used as part of the process? (e.g. robots, scanners)
- Where is the location that this step is completed?
- How is information moved across the dispensary? (e.g. physical copies of discharge drug lists or medication labels?
- What are the sequences that need to be followed in the drug dispensing process?
- Who can complete this step? (Job roles)
- How long do you think this step usually takes?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc.

2.4 Prompts – Attaching label to dispensed medication

- What is the process for attaching the label to the dispensed medication?
- Where is the location that this step is completed? (If in another area of dispensary how is information/physical items moved?)
- What are the sequences that need to be followed at this step?
- Who will attach the label to the medication & have they dispensed or labelled the medication in the prior steps?
- Who can complete this step? (Job roles)
- How long do you think this step usually takes?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc.

2.5 Prompts – Accuracy checking

- What is the process for accuracy checking the dispensed/labelled medication?

- Is any technology involved? E.g. barcode scanning
- Where is the location that this step is completed? (If in another area of dispensary how is information/physical items moved?)
- What are the sequences that need to be followed at this step?
- Who can complete this step? (Job roles)
- Are medications placed in a sealed bag for the patients at this point?
- What is the process for putting medication into a sealed bag for the patient?
- Who will place the medication into a sealed bag for the patients? (Job roles)
- How long do you think this step usually takes?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage? Another pharmacist, the ward staff, the patient, the patients GP/CP?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc.

2.6 Prompts – Completed patient medication leaving the pharmacy

- Where is the completed medication stored for the patients? (If in another area of dispensary how is information/physical items moved?)
- What are the processes involved in the completed medication being collected from the pharmacy?
- Who collects the completed medication from the pharmacy? (Job role)
- How often is completed medication collected from the pharmacy?

Pharmacy to ward

3. **Can you tell me who the medication is physically transferred to the ward from the pharmacy?**

3.1 Prompts

- Where is the area dispensed discharge medication is collected?
- What route is taken to transfer the medication to the ward?
- Does the route include more than one ward?
- How many wards are typically visited in a single journey?
- Typical frequency of porter visits to the pharmacy department?
- Typical length of time for porter to wait at pharmacy department to collect medication?
- Why do you need to wait to collect medication?
- Typical time taken to return to the general medical ward?
- Who can complete this step?
- Any IT systems involved in this step?
- How long do you think this process usually takes?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage? Another porter, the pharmacy team the ward staff?

Role of person discussed this with: e.g. nurse / medic / pharmacist / technician etc.

Location - Ward.

4. **Can you show me how you receive the completed discharge medication for the patient back from the pharmacy department?**

   4.1 Prompts – Medication arriving at ward from pharmacy

   - Are you alerted that the medication has now arrived at the ward?
   - Who brings the medication to the ward from the Pharmacy?
   - Where is the discharge medication stored?
   - Any additional checks performed on discharge medication?
   - What is the process for checking discharge medication?
   - Are any IT systems used to check the discharge medication?

- Are any IT systems used to note arrival of patients discharge medication at the ward?
- Who can complete this step? (Job roles)
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage?

Role of person discussed this with: e.g. nurse / doctor / pharmacist / technician etc.

4.2 Prompts – Discharge medication given to patient.

- Can you show me the process for giving discharge medication to patients?
- How long does this usually happen after the medication has arrived at the ward?
- Are any IT systems used when giving the patient the discharge medication?
- Any discussions with the patient about the discharge medication?
- Who can complete this step? (Job roles)
- How long does this process usually take?
- Does the patient leave the hospital following this step?
- Are any IT systems used to mark the patient as discharged from hospital?
- For the process you have just described, is this the same as what somebody else would do, or is this way unique to you?
- Is there ever anyone else involved in this stage? (Pharmacy team, the ward staff, the patient, the patients GP/CP?)

Role of person discussed this with: e.g. nurse / Doctor / pharmacist / technician etc.

Summary

Following the completed walk-and-talk for the supply of discharge medication the following questions will be asked

1. Do you have any standard operating procedures for any parts of this process? (If Yes, then a copy will be requested)

2. Is there ever a time anything is done differently?
    - Why?
    - Was this anticipated/unanticipated?
    - How long does this last?
    - To what extend is this a regular occurrence?
3. What else is important or relevant to process that we haven't discussed?

End of talk and walk though summary

The interviewer will discuss all the stages of the medication supply at the point of hospital with the interviewees using a rough draft paper process map.

Any alterations on the rough draft process map will be completed by the interviewer in conjunction with the participants of the walk-and-talk process.

A completed process map will be emailed to the lead interviewee for dissemination to the relevant teams with comments and corrections sent back to the interviewer within a two-week time. The comments and subsequent updates to the process map will form the finial validated process map.

Appendix 3. Observation data collection sheet

Date of observation_____ Hospital_____

Observations Area		**Notes**
Ward *(At start of discharge medication supply process)* ***Discussed with (Grade):*** *Pharmacist / Doctor / nurse / other (state)*	n of occupied beds = n of free beds =	*Ask Staff about business of ward – more than usual? Normal? Less than usual?*
Ward *(At start of discharge medication supply process)* ***Discussed with (Grade):*** *Pharmacist / doctor / nurse / other (state)*	Number of Nurses = Number of Doctor = Number of Pharmacists = Number of Pharmacy Techs = Any other job roles?	*Ask about staffing levels –* 1. *Today - Would you consider the ward (i) understaffed, (ii) adequate staff, (iii) over staffed?* 2. *Today – Are the staff levels (i) less than usual (ii) normal, (iii) more than usual?* *Nurses-* *Doctor-* *Pharmacists-* *Pharmacy Techs-* *Any other job roles?*
Dispensary *Staffing numbers in Dispensary*	Number of Pharmacists = Number of Pharmacy Techs = Number of ACTs =	*Ask about staffing levels –* 1. *Today - Would you consider the ward (i) understaffed, (ii) adequate staff, (iii) over staffed?* 2. *Today – Are the staff levels (i) less than usual, (ii) normal, (iii) more than usual?* *Pharmacists-*

Discussed with (Grade): *Pharmacist / pharmacist technician / ACT / dispenser / PSW / other (state)*	Number of dispensers = Number of Pharmacy support workers = Any other job roles?	*Pharmacy Techs-* *ACTs-* *Dispensers-* *Pharmacy support works-* *Any other job roles?*
Dispensary *Overall busyness of the dispensary* ***Discussed with (Grade):*** *Pharmacist / pharmacist technician / ACT / dispenser / PSW / other (state)*	How busy is the dispensary today? • More than usual • Normal • Less than usual	*Why? Any times that are known to be busier during the working day?*
Dispensary *Physical attributes of the dispensary*	• Size • Sufficient floor space • Sufficient desk space • Sufficient number of PCs • Sufficient worktop space • Design • Layout • Flow • Any robotics • Any other issues	*Ask a selection of staff how overall size of dispensary feels against workload levels? (i) too large, (ii) adequate, (iii) too small* *Pharmacists-* *Pharmacy Techs-* *ACTs-* *Dispensers-* *Pharmacy support works-* *Any other job roles?*

Observations Area		Notes
Porters *Dispensed discharge medication returning to ward* ***Discussed with (Grade):*** *Porter / other (state)_____*	Where is the area that dispensed discharge medication is collected? How is the medication stored in the area? (i.e., by ward?)	*Is the collection area neat, tidy and organised?*
Ward *(When discharge medication arrives at ward and given to patient)* ***Discussed with (Grade):*** *Pharmacist / medic / nurse / other (state)*	Area where discharge medication is stored? Where is patient marked as "discharged from hospital"?	*Is the area where the patient discharge medication stored neat, tidy and organised?* *Ample functioning PC/IT equipment to mark patient as discharged?*

Additional Notes

Appendix 4. Stakeholder feedback – Medication supply at hospital discharge 6/6 via MS teams invite

Format

1. Overview of results using tables and figures from results section – (30mins)
2. Round table discussion to highlight variances and validate assumptions - using the questions below (60mins)

Questions

Figure 3.8 Process mapping stages and steps

1. Do you agree or disagree with the stages of the medication supply at the discharge process?

2. Only Edinburgh Royal Infirmary has a nursing staff assessment of medication. This is used when the ward stock only is used for the patients discharge. Have other hospitals considered or trialled a similar method?

Table 3.2 Systemic human error reduction and prediction analysis (SHERPA) classification definitions and Table 3.5 SHERPA hierarchical task analysis information and

1. In table 3.3 SHERPA hierarchical task analysis information Edinburgh Royal Infirmary has a lower number of stages and steps when using ward stock dispensing only. As the process mapping occurred from the point the IDL was finalised by the doctor would it be an appropriate assumption that additional process to have medication stored at the ward, to be used for discharge supply, would have occurred prior to the process mapping?

Table 3.6 Median time taken for discharge process

1. The overall median timing data is from a cohort of 50 patients from the ward where the discharge mapping was carried out. Do you feel this time is indicative of the usual process across the whole hospital?

Figure 3.9 Time taken for patient discharged from ward visited for process mapping (n=50)

1. The box and whisker plot show the ranges of times between IRQ1-IRQ3 in the size of the boxes. Do you feel this is indicative of the normal variances in the discharge times?

Figure 3.10 Hospital Discharge Timing Data in two-hourly intervals

1. The Hospital Discharge Timing Data in two-hourly intervals histogram shows that 23.6% of discharges occur within 4 hours. Do you feel this is an accurate representation?

2. The shape of the graph hospital timing data shows a small number of discharges occurring in the middles section between 720 mins to 1320 mins (12hours to 24 hours). This would seem to represent an overnight period. Would you agree with this assumption and what could be the reasons for discharges completed overnight?
3. The Hospital Discharge Timing Data in two-hourly intervals histogram shows that 30.8% of discharges take over 24 hours. What do believe are the main reasons behind the discharges that take over 24 hours?

Figure 3.11 Stacked percentage of median time taken to complete stages of the discharge process.

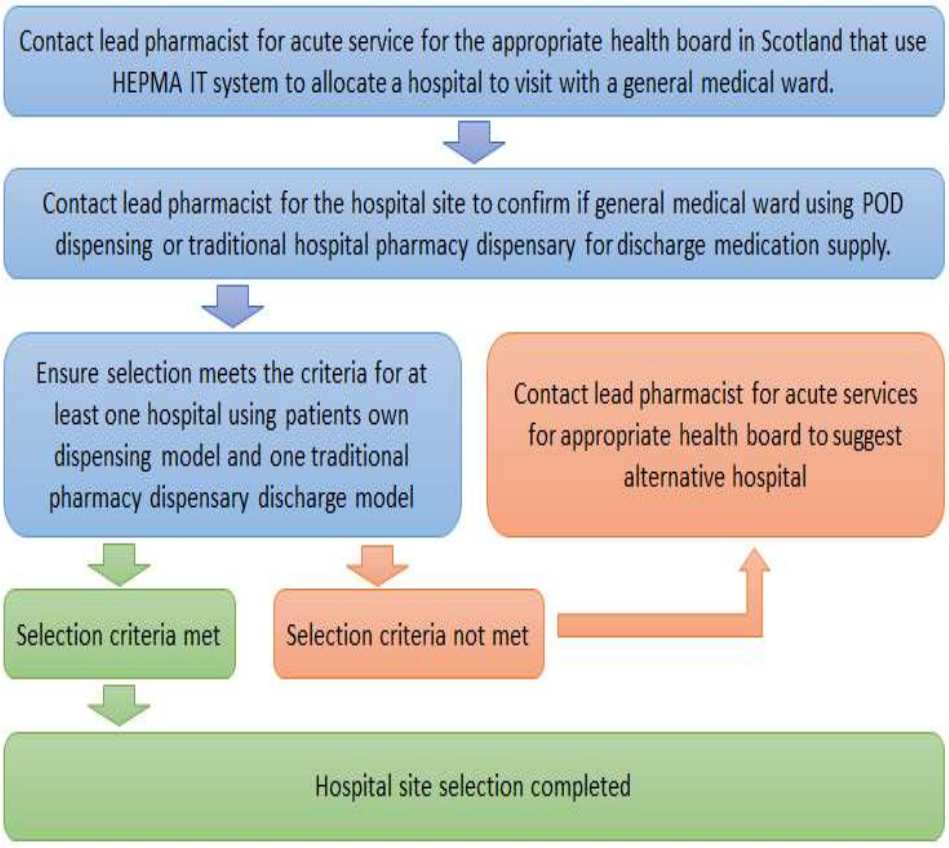
1. The Stacked percentage of median time taken to complete stages of the discharge process deomstrates that the largest section of the discharge process occurs after the medication dispensing has been completed. Do you feel this is accurate?

Appendix 5. Project Protocol

Title	Describe the medication supply process at discharge across a selection of hospitals in Scotland
Introduction	Delayed discharges for patients from Scottish hospitals in 2020/21 accounted for an additional 358,426 days spent in hospital. (1) Patients perceive medication supply at the point of discharge as a major contributing factor to delayed discharges (2). The effects of delayed discharges are seen across the hospital system and contribute to increased waiting times within accident and emergency departments as the flow of patients across the hospital is reliant upon patients being discharged in a timely manner to have beds available for new inpatients. Scotland has a land mass comprised of 98% rural areas (3), however only 17% of the population live in a rural or very rural setting as defined by the Scottish government urban rural classification, 6-fold method (3). The average daily number of patients with delayed discharges varies across the individual health boards in Scotland. The largest number of delayed discharges are seen in the urban areas of Lothian, Greater Glasgow and Clyde and Lanarkshire health boards. (4) By contrast the more rural settings such as Orkney and Shetland have much lower numbers of delayed discharges (4). Patient perception of delayed discharges was included in the 2018 Scottish Government inpatient experience survey (2). The most common reason that was cited by patients for delayed discharges was “waiting on medications”. Current evidence on the medication supply at the point of hospital discharge in the UK is limited, with most previous studies focused on medicines reconciliation (5) or patient counselling at the point of discharge (6). No studies have been published on the current medication supply at the point of discharge in Scotland. Redesign of the medication supply pathway at the point of hospital discharge has been previously discussed by Wright et al (7), with a consideration to using the patient’s own community pharmacy to supply medication. A number of hospitals across Scotland use a patients’ own drugs/medication (POD or POM) where a patient will bring in their own medication, dispensed in the community, with them during their hospital stay. Current evidence shows this can both reduce medicines wastage and decrease medication errors during the patient’s hospital stay. (8) Using patients own medication, along with a one stop dispensing process, at the patient’s bedside has been shown to reduce staff time involved in the medication supply at the point of hospital discharge (9). Use of one stop dispensing has been found to be beneficial to both patients and staff (10) In 2015 the Scottish Government published the 2014-2017 eHealth strategy (11). One of the key recommendations in the strategy was to advise NHS hospitals on the deployment of the new hospital electronic prescribing and medication

	administration (HEPMA) computer systems with the aim for this system to be used in all hospitals within Scotland. The implementation of the HEPMA computer systems is at varying stages across Scotland's health boards and hospitals. In 2020, during the COVID pandemic, the NHS established Nightingale hospitals in response to the increased patient hospitalisation. In Greater Glasgow and Clyde health board the NHS Louisa Johnston was set up in the Scottish Conference and Exhibition Centre. (12). One of the challenges of the site was that the pharmacy department within the hospital was too small to be able to supply patients with discharge medication. Greater Glasgow and Clyde health board, in conjunction with Community Pharmacy Scotland developed a pilot from the Glasgow Royal Infirmary hospital to supply patients with discharge medication from the patient's own community pharmacy. This pilot demonstrated a reduction in discharge time on average of two hours per patient. (13) The 2021 the NHS Recovery Plan (14), published by the Scottish Government, has a commitment to establish a community pharmacy hospital discharge and medicines reconciliation service. Scottish Government has funded an extension to the community pharmacy discharge medication service pilot within Greater Glasgow and Clyde to further evaluate the service. Medication supply at the point of hospital discharge is a complicated and multifactorial system that can operate differently within different hospital settings. To understand how a community pharmacy medication supply at the point of hospital discharge could work it is important to understand the current medication supply process in a number of different hospitals in Scotland. The aim of this research is to understand the hospital discharge medication supply process in Scotland.
Research Question Aims and Objectives	Aim – To examine the patient medication supply process at the point of discharge in a selection of Scottish hospitals Objectives – To describe the patient medication supply process at point of discharge in Scottish hospitals. To quantify the time elements during the process of supplying medication to patients at the point of hospital discharge To explore any similarities and differences in the hospital discharge medication supply process

	A process map for the medication supply at discharge for a selection of hospital will be created with key timing metrics for different steps within the process identified. The process map will define the process from the point the patient's medication is considered optimised for discharge by the clinical care team. This would be the point the request would be sent to pharmacy to begin the process to supply a patient with discharge medication. The end point of the process map will be the point of when the patient is discharged from the hospital with a supply of discharge medication. Comparison of the different hospital process maps will be undertaken to identify any area of commonality and any steps with significant time delays in the process will be identified.
Subjects & settings	<u>Setting</u> The process mapping and time metrics are to be completed in 6 hospitals in Scotland. A selection of 6 hospitals will allow the study to completed in a compact time frame across the sites while also ensuring a geographical split of hospitals across Scotland could be included. A Health Boards will only contribute one hospital to the study to ensure a geographic spread of hospitals selected. <u>Hospital selection criteria</u> The individual hospital selection will include only hospitals that have a general medical ward to complete the process mapping and time metrics within. This is to ensure comparable ward types are used across the different hospitals. The individual hospitals selected will only be using the HEPMA computer system. The Scottish Government eHealth Strategy 2014-2017 (11) has the clear aim for HEPMA to be used in all hospitals across Scotland. Using only hospitals with the HEPMA system will ensure the research will remain relevant once the roll out is complete across Scotland. The included hospitals must be able to extract the timing data for elements of the medication supply discharge pathway. This can be completed by running an extraction query, search and report from HEPMA. Trakcare can also be utilised to define an end point for a patients' hospital stay. The data will be obtainable from within the hospitals current systems to limit the impact on staff time to retrieve this data. The data will be submitted to the research team in a non-patient identifiable format from the hospital pharmacy team. The selected hospital will include a minimum of 1 hospital using patients own drug dispensing (POD) model and 1 hospital with discharge medication supplied to patients via a traditional hospital dispensary model. This will ensure the

	process maps will show the most common different types of discharge medication supply models in operation across the hospitals in Scotland.
Methods	***Objective 1 - To describe the patient medication supply process at point of discharge in Scottish hospitals.*** Hospital Recruitment The criteria used to select the hospitals to visit to complete the process mapping involved contacting the lead pharmacists for acute services for the 6 health boards in Scotland that had completed the rollout of the HEPMA system as of April 2022. Subsequently, the lead pharmacist for each hospital site was contacted to establish if they used patient own dispensing or traditional dispensing from a hospital pharmacy department. If these criteria were not met then the lead pharmacists for acute services was re-contacted to suggest an alternative hospital until the criteria was satisfied. Once the inclusion criteria were satisfied this formed the final list of hospitals to visit to complete the process mapping. The hospital recruitment process is summarised in Figure 1  Figure 1 – Hospital recruitment process

Process Mapping

A qualitive case study approach will be adopted to build a process map of the medication supply pathway at the point of hospital discharge.

Process mapping is a tool that is has been used extensively across many settings to define the individual steps within a complex model (15). Process mapping has been used for a number of years within the hospital setting to identify areas for potential improvement in the patients' journey (16). Process mapping the hospital pharmacy service at the point of patient discharge, including the medication supply function has limited research evidence. However, it has been previously proposed by Wright et al (7) that a process map within community pharmacy completing the medication supply could be possible. The walk and talk though technique has been used in the community pharmacy setting (17) to build a detailed process map of the complex process of dispensing a patients medication. Using the walk and talk through technique will be the foundation to build the process map for each of the hospitals selected.

The method to be used to complete the process mapping at hospital discharge in each hospital is outlined below.

Prior to completion of the process mapping.

2. Researcher contacted, by email, the lead pharmacist for the hospital site to arrange a suitable date for the process mapping to occur on a general medical ward and arrange for a pharmacist/pharmacy technician to accompany the researcher on the day of the process mapping as the subject expert.

On the day of the process mapping,

6. Researcher met initially with the pharmacist/pharmacy technician and explained the" walk and talk" through methodology and confirmed the ward to be visited. This discussion covered the following points:

    - The task to be processed mapped would be the patient pathway for medication supply at discharge from the doctor completing the patient discharge medication prescription to the patient leaving the hospital with the medication supply.
    - The role of the subject expert to define both the stages of the medication supply at discharge and the detail of each step involved to complete the stages.
    - Explanation of the implementation of the "walk and talk" technique to follow a simulated patient through the medication supply at discharge pathway.

- The intended use of the "walk and talk "through guide and observation data sheet by the researcher
- Confirmation that the ward to be visited would be a general medical ward
- Agreement for the subject expert to review a draft process map with the researcher at the completion of the visit.

7. The subject expert (pharmacist/pharmacy technician) guided the researcher through each stage of the medication supply processes. This involved visiting the setting for where each stage was completed. This included visiting both the hospital general medical ward and the pharmacy dispensary. A variety of hospital staff at each location were engaged with by the researcher to understand the steps required to complete each stage of the patient medication supply process. These staff members included:

    - Ward staff – Doctors, nursing staff and ward ancillary staff such as ward clerks and ward managers
    - Pharmacy staff including pharmacist, pharmacy technicians and pharmacy support workers.

8. During the process mapping exercise, the "walk and talk" through guide was followed by the researcher and an observation data collection sheet was completed by the researcher. Notes were collected on both the stages and the steps within each stage by the researcher.

9. Following completion of the patient medication supply at discharge pathway, when the patient was discharged from hospital with a supply of medication, the researcher compiled a handwritten draft process map covering all the stages and the individual steps within each stage as described by the subject expert.

10. The draft process map was presented back to the subject expert by the researcher to validate both the stages and the step required to complete each stage. Any amendments to the draft process map were completed by the researcher under the instruction of the subject expert.

Objective 2 - To quantify the time elements during the process of supplying medication to patients at the point of hospital discharge

As described above, only hospitals with the HEPMA IT system are suggested to be included in the research. One of the functions of the HEPMA IT system includes

	the ability to generate reports with time stamps for when any specific action occurred within the system. This is achieved via a function within the HEPMA system called a search and report tool. A specific search and report tool is required for each search in the HEPMA system with key search points such as the ward number and time period to be included in the search The search and report tool can be configured to extract the timing data from the ward where the process mapping had occurred from the 1st of June 2022 until it reached 50 patients to ensure consistency across all included hospital sites. The search and report tools can be used by each hospital HEPMA team and the output data sent directly to the researcher after the report is generated. No patient or hospital employee identifiable data will be present in the extract sent to the researcher. Additional time points within the process the medication supply at the point of discharge may be supplied by the hospital dependant on other internal systems used in each hospital. This data would be seen as an addition to break down the overall medication supply time data however will not be essential as part of the research. No patient identifiable details will be included in either of the data extracts to be sent from the hospital to the research team as part of this work.
Analysis of findings	No patient identifiable information will be present within the analysis of the findings. Process Maps will be created and comparison drawn between number of steps and stages in each process map. Comparison will also be made between the process maps to understand any stages that are common across all the hospital medication supply at discharge processes. SHERPA task analysis will be used to identify the nature of the steps within the process. The timing data will be used to compare median times for medication supply at discharge across each hospital site, and any additional timing data supplied will be used to identify the timing of individual stages within the medication supply at discharge process. These findings will form the discussion for potential areas of further research.
Collaborators	Hospitals TBC – Maximum of 1 hospital from each of the 6 health boards across Scotland
References	1. Scotland P. Delayed discharges in NHSScotland annual - Annual summary of occupied bed days and census figures – data to March 2021 (planned revision) - Delayed discharges in NHSScotland annual -

Publications - Public Health Scotland [Internet]. Publichealthscotland.scot. 2021 [cited 4 February 2022]. Available from: https://publichealthscotland.scot/publications/delayed-discharges-in-nhsscotland-annual/delayed-discharges-in-nhsscotland-annual-annual-summary-of-occupied-bed-days-and-census-figures-data-to-march-2021-planned-revision/Inpatient Experience Survey 2018: national results - gov.scot (www.gov.scot)

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Appendix 6. Ethics advice from NHS West of Scotland Research Ethics Service and from University of Strathclyde

RE: NHS Ethics process advice

GJ Godden, Judith
To: Jamieson, Derek
Thu 10/03/2022 11:34

Hi Derek
This project won't fall under the definition of research therefore NHS ethics approval would not normally be required however it may benefit from PBPP approval particularly since you will be covering a number of Health Boards.
https://www.informationgovernance.scot.nhs.uk/pbpphsc/home/for-applicants/
I suggest you check with PBPP is an application to them would be appropriate.

Kind regards

Judith

Dr Judith Godden
Scientific Officer/ Manager
West of Scotland Research Ethics Service
07960 044211

Fw: Ethics Query

From: Christopher Prior <c.b.prior@strath.ac.uk>
Sent: 15 March 2022 09:42
To: Derek Jamieson <derek.jamieson@strath.ac.uk>
Subject: RE: Ethics Query

Hi Derek,

Thank you for the information. Having read through your proposal I have reached the following conclusion. Since the project is investigating process rather than people, and does not involve any personally identifiable information, it does not meet the University's definition of research involving human participants as defined by the Code of Conduct. Therefore, it does not require any ethical review by the University.

Regards,

Chris.

Christopher Prior BSc, PhD
Strathclyde Institute of Pharmacy and Biomedical Sciences
University of Strathclyde
161 Cathedral Street
GLASGOW
G4 0RE
United Kingdom

tel: (44) 141 548 2459

Appendix 7. Process Map Hierarchical Task Analysis Diagrams

- **University Hospital Crosshouse**
- **Dumfries and Galloway Royal Infirmary**
- **Edinburgh Royal Infirmary**
- **Forth Valley Royal Hospital**
- **University Hospital Hairmyres**
- **Queen Elizabeth University Hospital**

Discharge Medication Supply Process - University Hospital Crosshouse Step 1.1-1.5 *(complete 1.1 to 1.11 in order)*

1.1 Patient discharge medication finalised

- 1.1.1 Prescriber confirms patient medication finalised for discharge — C
- 1.1.2 Prescriber opens patient HEPMA record at discharge prescription tab — A
- 1.1.3 Discharge summary information completed with date of discharge and brief GP summary — I
- 1.1.4 Drug information added to discharge prescription tab from inpatient medication tab — A
- 1.1.5 Medication selected as GP to continue and added to discharge as appropriate — A
- 1.1.6 Number of days required for medication added as appropriate — I
- 1.1.7 Completed discharge selected — A

1.2 Electronic IDL Prescription received in pharmacy dispensary

- 1.2.1 Pharmacy support worker opens IDL messenger system — A
- 1.2.2 IDL prescription appears on messenger when completed by prescriber — I
- 1.2.3 IDL prescription selected and copy of IDL printed — A
- 1.2.4 Prescription tracking system (PTS) program opened — A
- 1.2.5 Book in patient selected in PTS — A
- 1.2.6 Patient CHI number entered from IDL — A
- 1.2.7 Prescription type discharge selected along with correct ward number — A
- 1.2.8 Book in information completed and select create — A
- 1.2.9 Patient barcode ID automatically printed from label printer — A
- 1.2.10 Patient barcode ID attached to IDL — A
- 1.2.11 IDL with Patient ID label placed into pharmacist work tray — A

1.3 Prescribed Medication Clinical Check

- 1.3.1 Pharmacist collects IDL from work tray — A
- 1.3.2 Open prescription tracking system program — A
- 1.3.3 Select patient by CHI and click start clinical check — S
- 1.3.4 Log into HEPMA system and searches for patient by CHI — A
- 1.3.5 Open discharge prescription tab in HEPMA — A
- 1.3.6 Medication screened for clinical appropriateness and accuracy — C
- Issues identified? — C
  - Yes
    - 1.3.7a Suspend patient on PTS and contact prescriber to discuss and resolve issues — R
    - 1.3.8 Medication verified selected for each medication — A
    - 1.3.9 Copy of IDL Rx printed to dispensary printer — A
    - 1.3.10 Open PTS and select patient — A
    - 1.3.11 Select end clinical check for patient — A
  - No
    - 1.3.7b Continue to 1.3.8

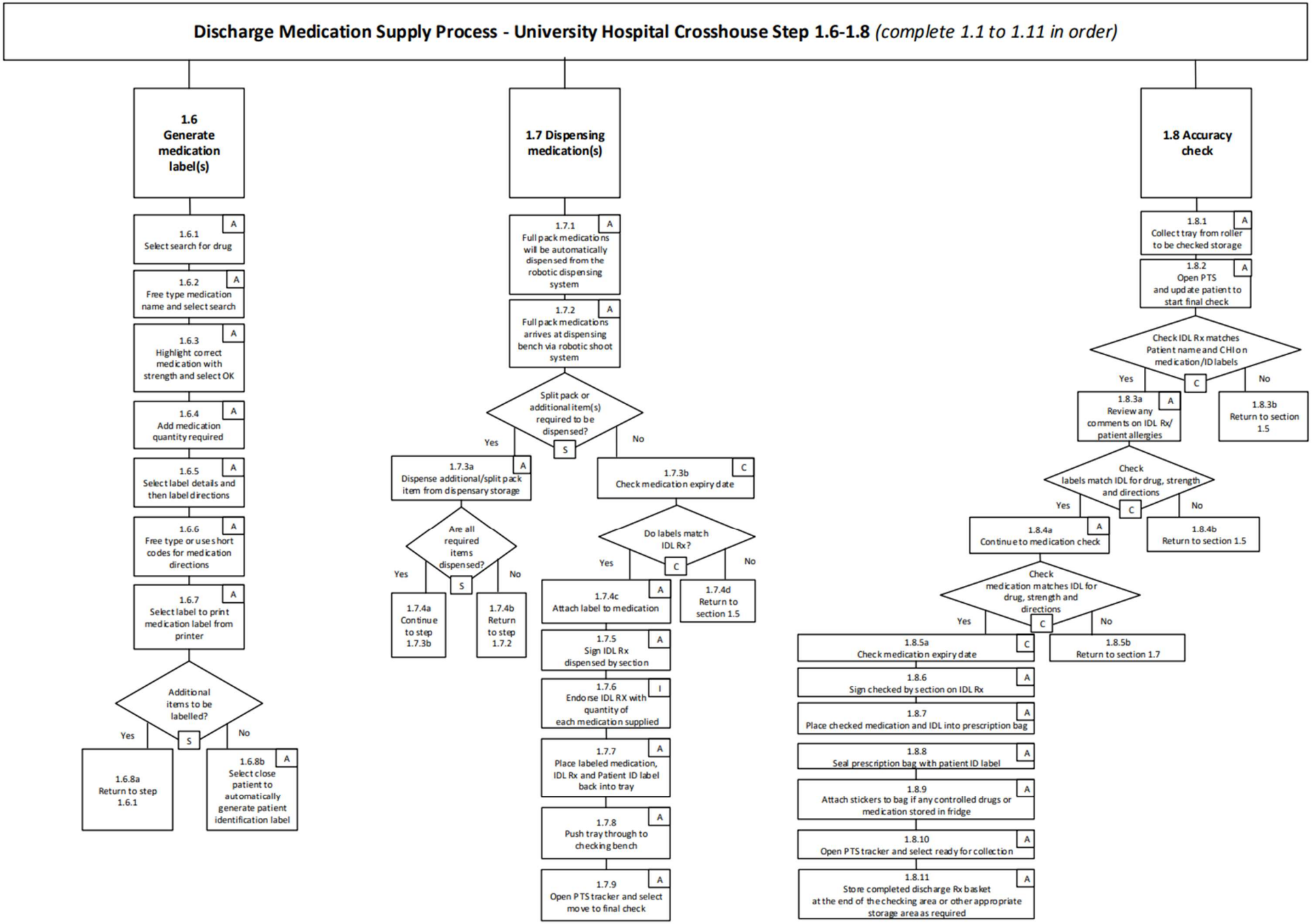
1.4 Printed IDL Prescription preparation

- 1.4.1 Collect IDL Rx from dispensary printer — A
- 1.4.2 IDL Rx stamped if monitored dosage system or controlled drug — S
- 1.4.3 IDL Rx placed in appropriate awaiting dispensing tray — A

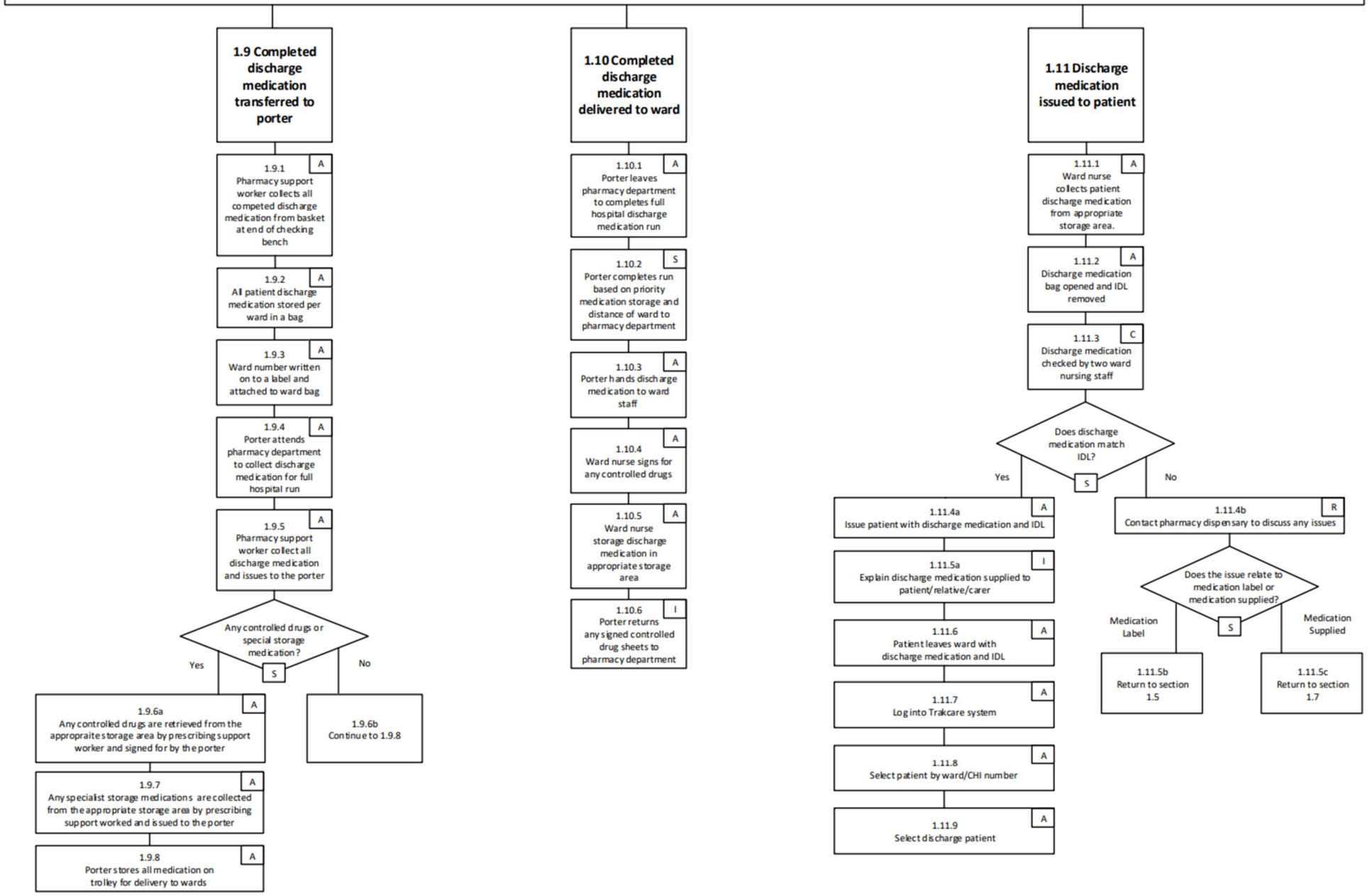
1.5 Preparing to generate medication label(s)

- 1.5.1 Open PTS and view waiting for dispensing que — A
- 1.5.2 Select patient with current longest waiting time — S
- 1.5.3 Collect IDL Rx from awaiting dispensing tray — A
- 1.5.4 Select start dispensing in PTS tracker — A
- 1.5.5 Log into WellSky program and select dispensing module — A
- 1.5.6 Open disp (dispenser) sub menu — A
- 1.5.7 Search for patient by CHI and select patient — A
- 1.5.8 Select issue type TTA and correct ward for patient — A

Discharge Medication Supply Process - University Hospital Crosshouse Step 1.6-1.8 *(complete 1.1 to 1.11 in order)*



Discharge Medication Supply Process - University Hospital Crosshouse Step 1.9-1.11 *(complete 1.1 to 1.11 in order)*



1. Discharge medication supply process - University Hospital Crosshouse Terminology and SHERPA Analysis Key

Terminology

HEPMA - Hospital Electronic Prescribing and Medicines Administration

GP Summary - Summary information about the patients hospital treatment for the patient GP

IDL - Immediate discharge letter

IDL messenger system - IT system used to send information relating to IDLs

IDL Rx - Immediate discharge letter prescription

Prescription Tracking system/PTS - IT software used to track the preparation of a prescription

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

WellSky system/disp - IT software used to label medication and enable dispensing via robotics

Porter - a hospital employee who moves equipment, medication and patients around the hospital as required.

TrakCare - IT software system used to manage patient journey during hospital admission

SHERPA Analysis Key

[A] Action – performing a task

[R] Retrieval – getting information from a screen, manual or expert

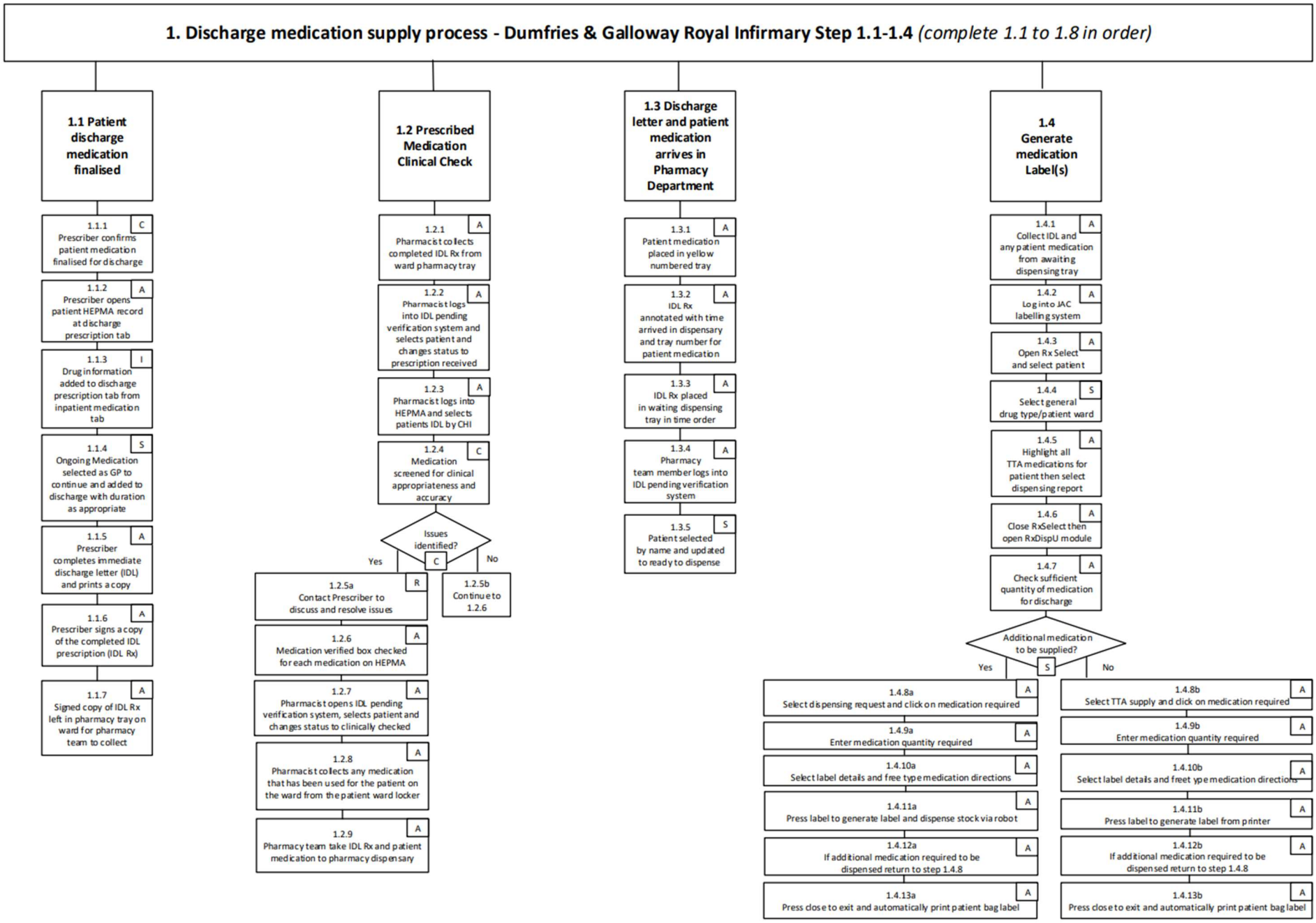
[C] Checking – Performing a task to check for safety or accuracy

[S] Selection – choosing one activity over another

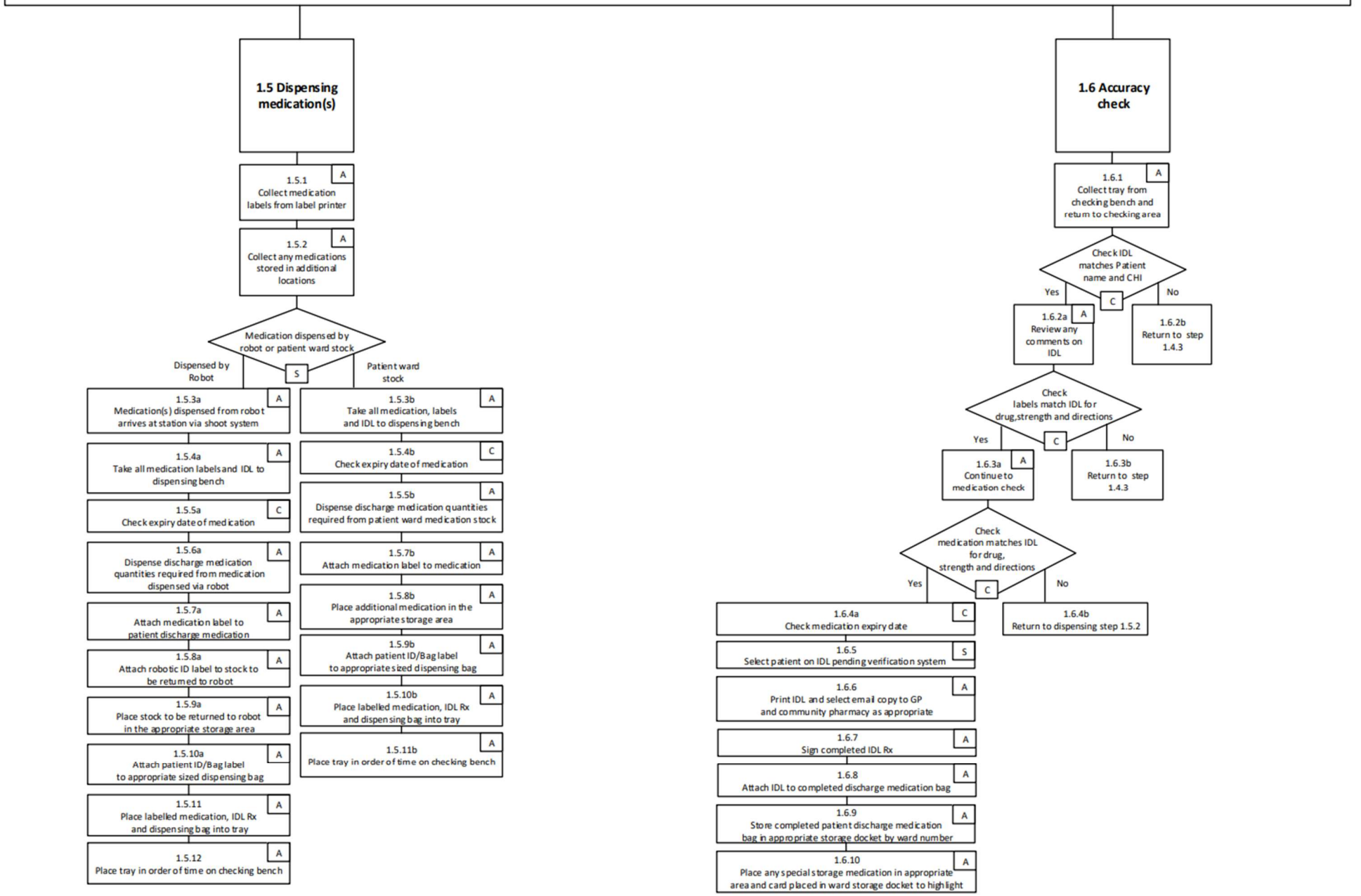
[I] Information communication – verbal or electronic

Embrey, D.E. (1986). SHERPA: A systematic human error reduction and prediction approach. United States: American Nuclear Society.

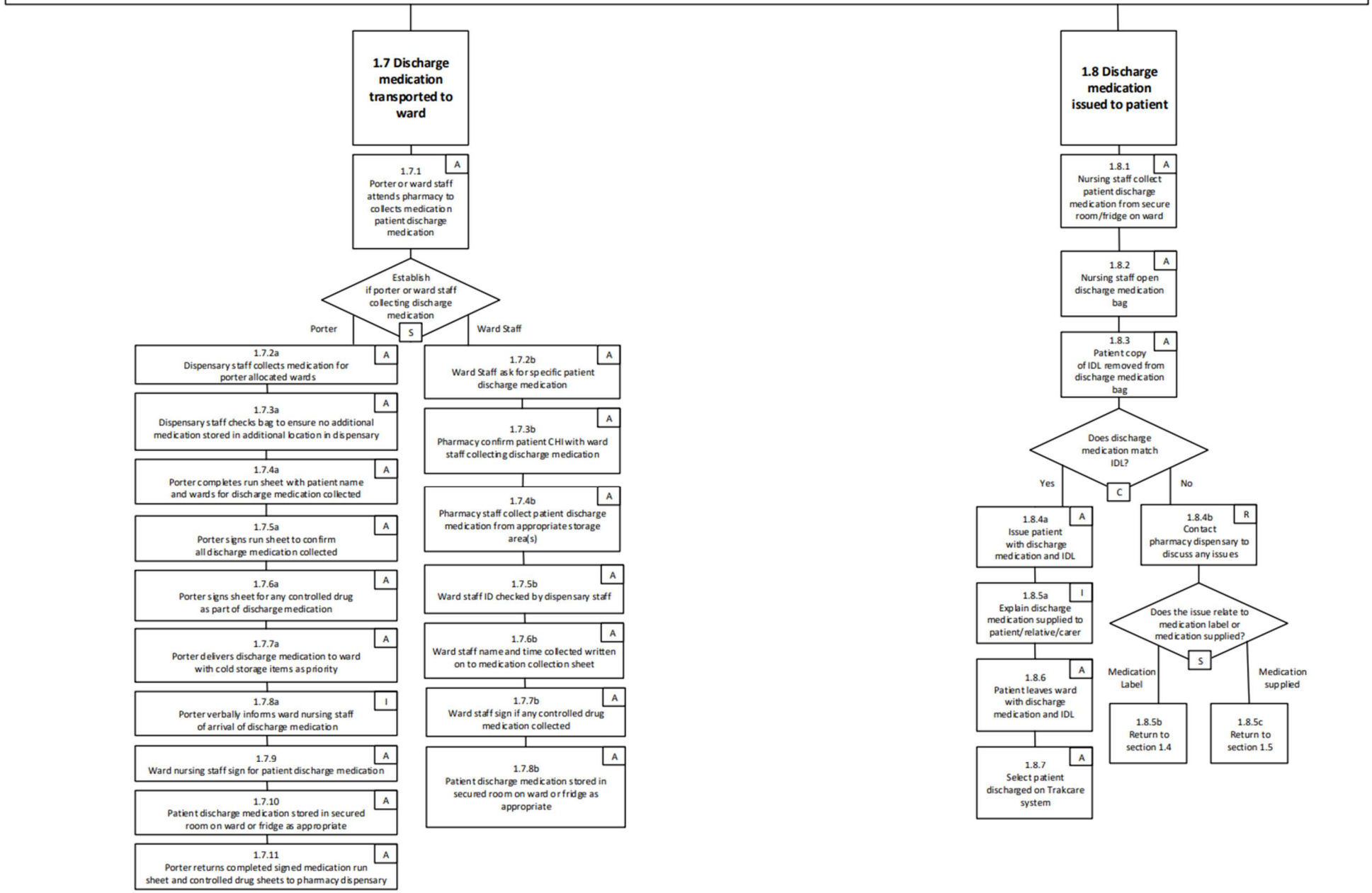
1. Discharge medication supply process - Dumfries & Galloway Royal Infirmary Step 1.1-1.4 *(complete 1.1 to 1.8 in order)*



1. Discharge medication supply process - Dumfries & Galloway Royal Infirmary Step 1.5-1.6 *(complete 1.1 to 1.8 in order)*



1. Discharge medication supply process - Dumfries & Galloway Royal Infirmary 1.7-1.8 *(complete 1.1 to 1.8 in order)*



1. Discharge medication supply process - Dumfries & Galloway Royal Infirmary Terminology and SHERPA Analysis Key

Terminology

HEPMA - Hospital Electronic Prescribing and Medicines Administration

IDL - Immediate discharge letter

IDL Rx - Immediate discharge letter prescription

Ward Pharmacy Tray - storage area on the ward where IDL are placed for pharmacy team to collect

IDL pending verification system - IT software used to track the progress of the discharge medication supply

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

Patient ward locker - Individual patient locker used to store medication

JAC labelling system - IT software used to generate medication labels and activate robotic dispensing

Rx select/Rx DipsU - Software program modules within the JAC labelling system used as part of the medication labelling and automated dispensing process

TTA supply/TTA Medication - To take away supply of medication

Robotic dispensing system - Automated process for dispensing of medication linked to labelling IT software system

Porter - a hospital employee who moves equipment, medication and patients around the hospital as required.

TrakCare - IT software system used to manage patient journey during hospital admission

SHERPA Analysis Key

[A] Action – performing a task

[R] Retrieval – getting information from a screen, manual or expert

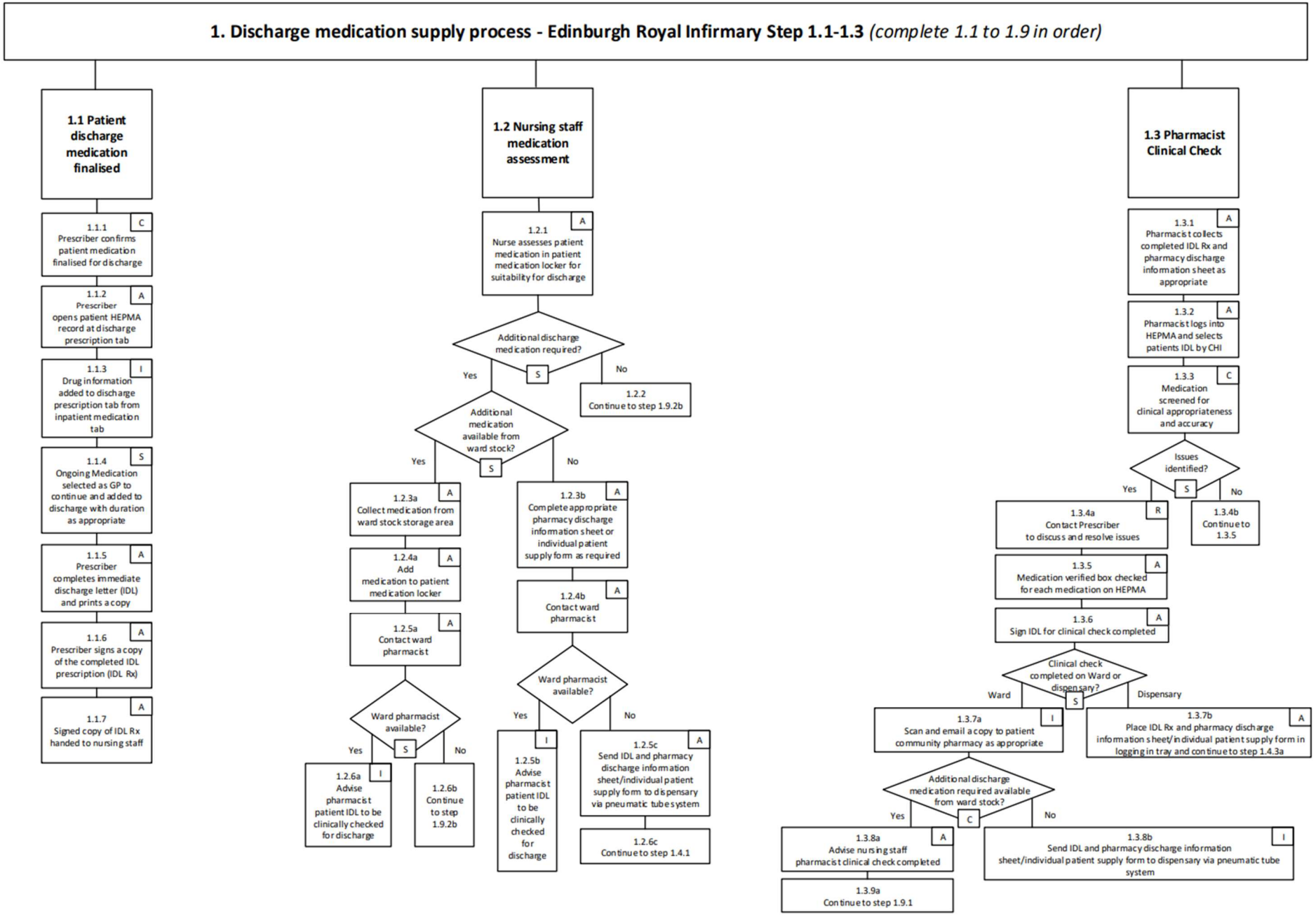
[C] Checking – Performing a task to check for safety or accuracy

[S] Selection – choosing one activity over another

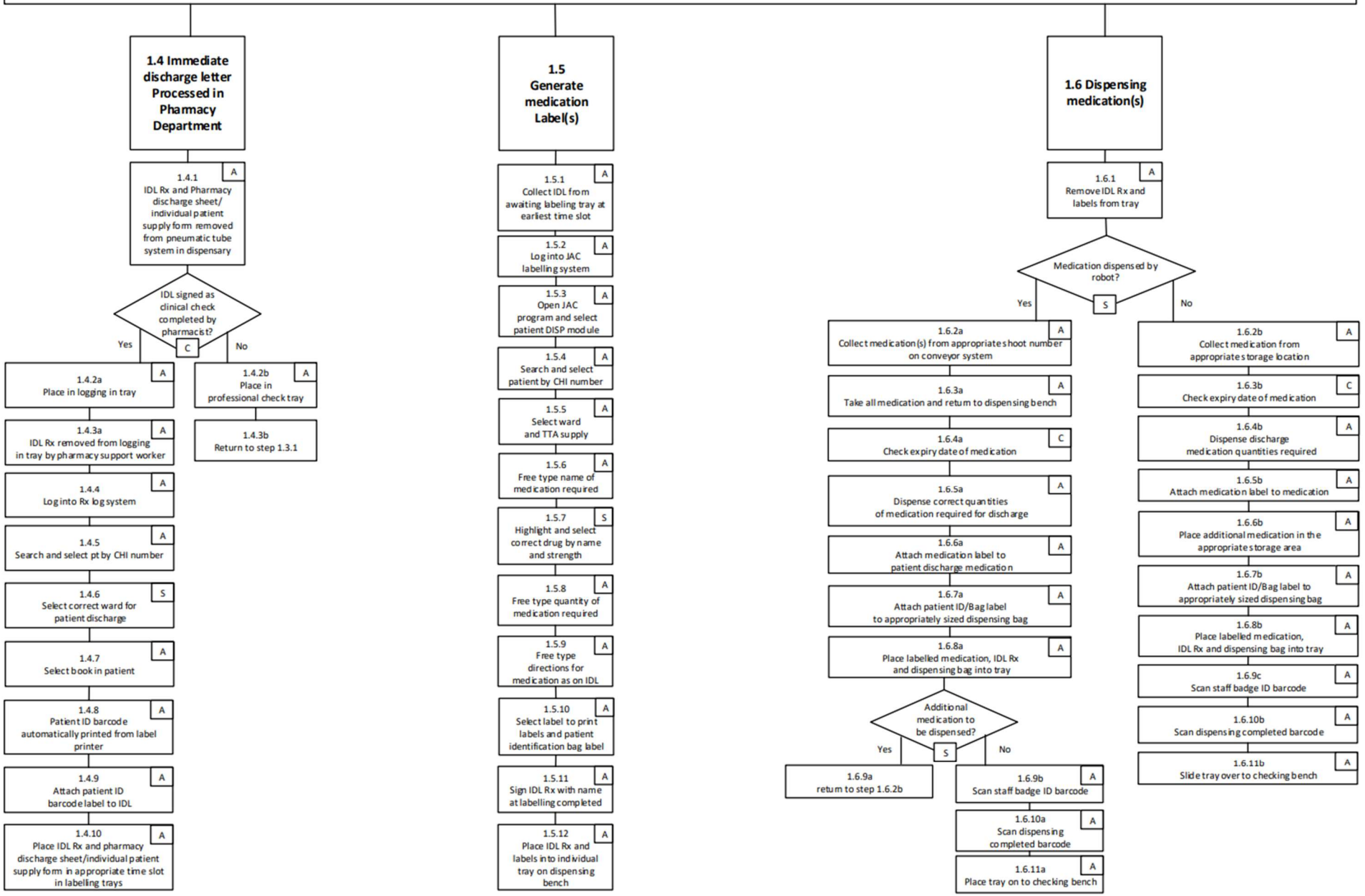
[I] Information communication – verbal or electronic

Embrey, D.E. (1986). SHERPA: A systematic human error reduction and prediction approach. United States: American Nuclear Society.

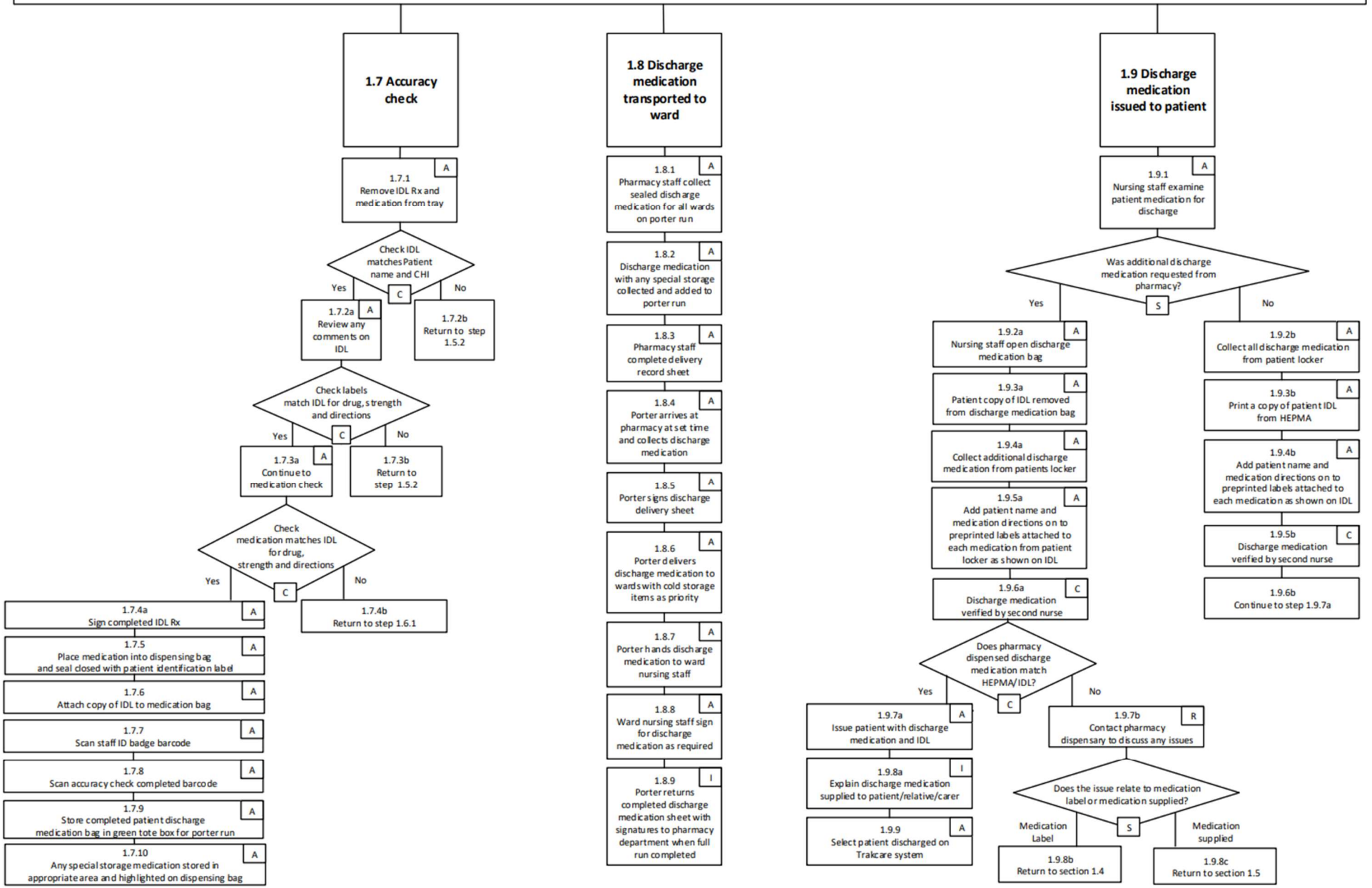
1. Discharge medication supply process - Edinburgh Royal Infirmary Step 1.1-1.3 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - Edinburgh Royal Infirmary Step 1.4-1.6 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - Edinburgh Royal Infirmary 1.7-1.9 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - Edinburgh Royal Infirmary Terminology and SHERPA Analysis Key

Terminology

HEPMA - Hospital Electronic Prescribing and Medicines Administration

IDL - Immediate discharge letter

IDL Rx - Immediate discharge letter prescription

Patient medication locker - Individual patient locker used to store medication

Pharmacy discharge information sheet - Information on expected discharge completed by ward staff, includes anticipated discharge time and date.

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

Pneumatic tube systems - System of interconnected air pressured tubes used to send small physical objects across the hospital

Rx log system - IT software used to log prescription requests in the pharmacy department

JAC labelling system - IT software used to generate medication labels and activate robotic dispensing

TTA supply - To take away supply of medication

Porter - a hospital employee who moves equipment, medication and patients around the hospital as required.

Porter run - When the porter delivers discharge medication to various wards across the hospital

TrakCare - IT software system used to manage patient journey during hospital admission

SHERPA Analysis Key

[A] Action – performing a task

[R] Retrieval – getting information from a screen, manual or expert

[C] Checking – Performing a task to check for safety or accuracy

[S] Selection – choosing one activity over another

[I] Information communication – verbal or electronic

Embrey, D.E. (1986). SHERPA: A systematic human error reduction and prediction approach. United States: American Nuclear Society.

Discharge Medication Supply Process - Forth Valley Royal Hospital Step 1.1-1.5 *(complete 1.1 to 1.10 in order)*

1.1 Patient discharge medication finalised

- 1.1.1 Prescriber confirms patient medication finalised for discharge — C
- 1.1.2 Prescriber opens patient HEPMA record at discharge prescription tab — A
- 1.1.3 Discharge summary information completed with date of discharge and brief GP summary — I
- 1.1.4 Drug information added to discharge prescription tab from inpatient medication tab — A
- 1.1.5 Medication selected as GP to continue and added to discharge as appropriate — A
- 1.1.6 Number of days required for medication added as appropriate — I
- 1.1.7 Complete discharge selected — A

1.2 Electronic IDL Prescription received in pharmacy dispensary

- 1.2.1 Prescription tracking system (PTS) opened in dispensary — A
- 1.2.2 Open prescribing booking in tab — A
- 1.2.3 Dispensary coordinator monitors prescribing booking in tab for new IDL prescriptions — A
- 1.2.4 New IDL prescription (IDL Rx) generated when prescriber completes step 1.1.6 — A
- 1.2.5 New IDL Rx selected when appears in booking in tab — A
- 1.2.6 Open patients IDL Rx — A
- 1.2.7 Book in IDL option selected — A
- 1.2.8 Pt barcode label automatically generated from label printer connected to PC — A
- 1.2.9 Close button selected on patient IDL Rx — A

1.3 Prescribed Medication Clinical Check

- 1.3.1 Ward pharmacist monitors PTS for IDL Rx awaiting clinical check periodically — A
- 1.3.2 IDL Rx appears in clinical check section for ward covered by pharmacist — A
- 1.3.3 Select patient and click start clinical check — A
- 1.3.4 Pharmacist opens HEPMA and searches for patient by CHI — A
- 1.3.5 Open discharge prescription tab in HEPMA — A
- 1.3.6 Medication screened for clinical appropriateness and accuracy — C
- Issues identified? — S
  - Yes
    - 1.3.7a Contact Prescriber to discuss and resolve issues — R
    - 1.3.8 Medication verified selected for each medication — A
    - 1.3.9 Copy of IDL Rx printed to dispensary printer — A
    - 1.3.10 Open PTS and select patient — A
    - 1.3.11 Select end clinical check for patient — A
  - No
    - 1.3.7b Continue to 1.3.8

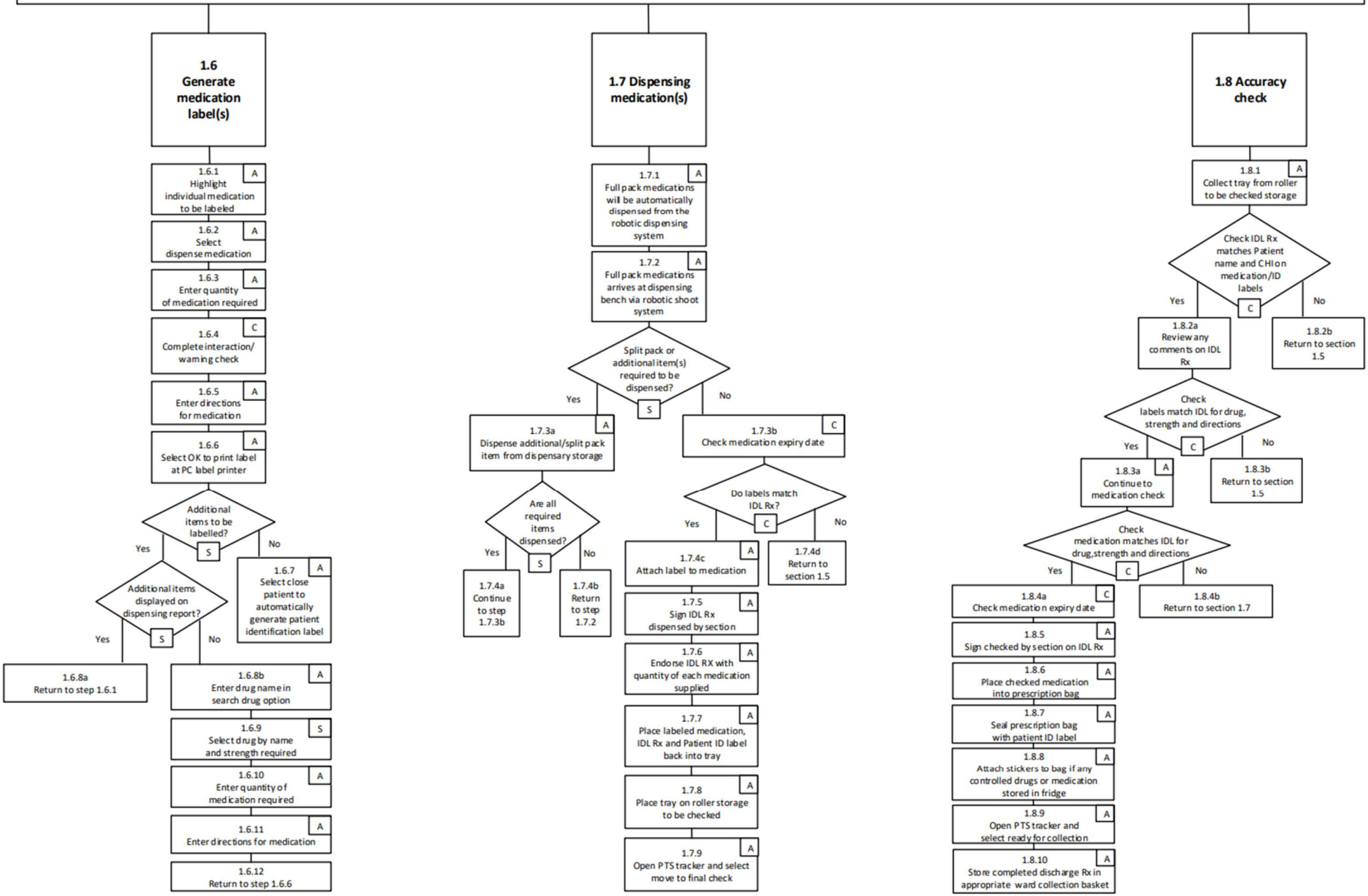
1.4 Printed IDL Prescription received in pharmacy department

- 1.4.1 Collect IDL Rx from dispensary printer — A
- 1.4.2 Patient barcode (1.2.8) attached to IDL Rx — A
- 1.4.3 IDL Rx stamped if monitored dosage system or controlled drug — S
- 1.4.4 IDL Rx stamped with turnaround time assigned stamp — A
- 1.4.5 Turnaround time assigned stamp completed with required turnaround time — I
- 1.4.6 IDL Rx placed in appropriate awaiting dispensing tray by time slots — A

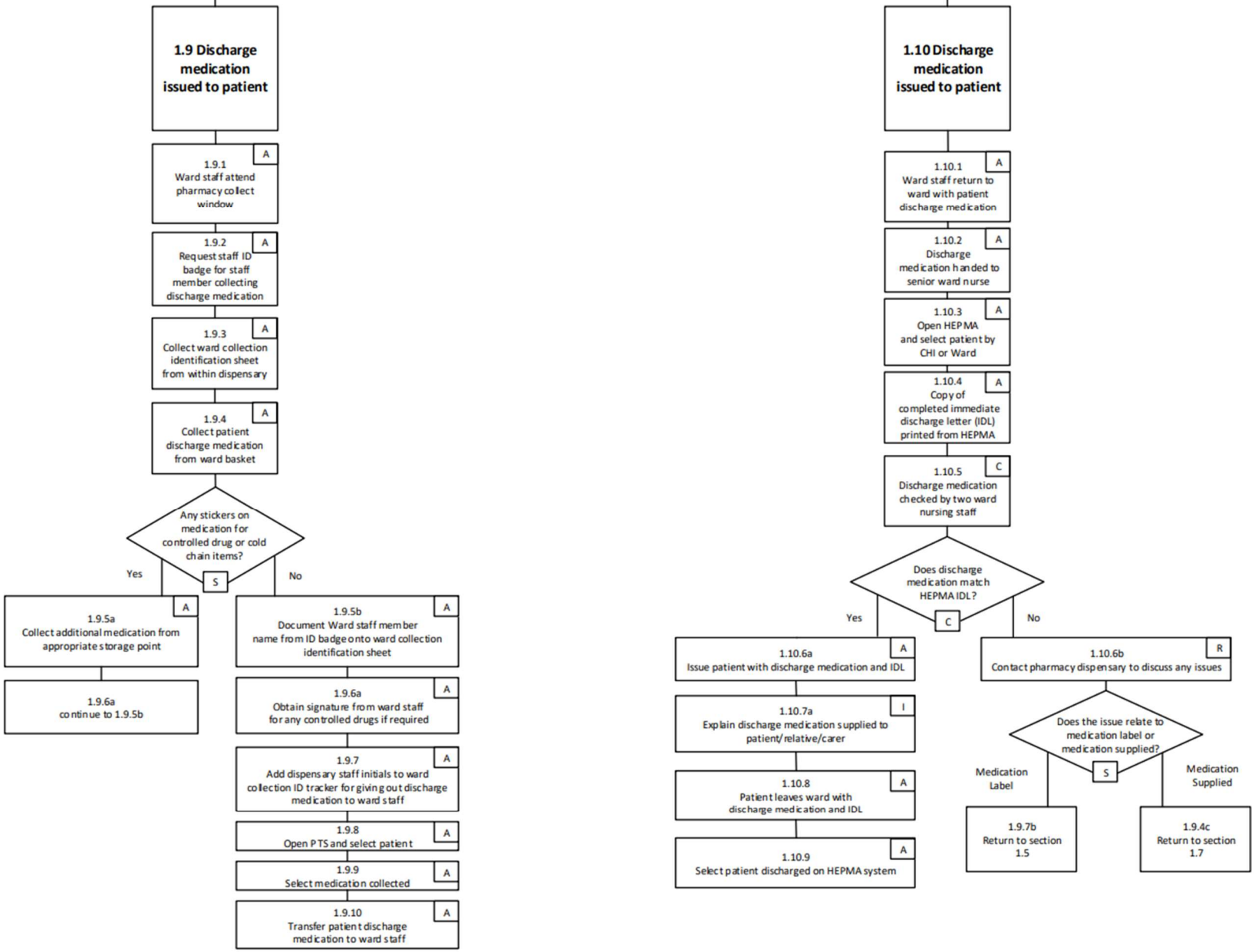
1.5 Preparing to generate medication label(s)

- 1.5.1 IDL Rx collected from appropriate time tray slot — A
- 1.5.2 IDL Rx placed in tray with corresponding time slot — A
- 1.5.3 Patient name written on ward collection medication sheet — I
- 1.5.4 Open PTS and select patient — A
- 1.5.5 Select start labelling/dispensing — S
- 1.5.6 Open WellSky program and select Rx dispensing module — A
- 1.5.7 Select hospital from drop down list — A
- 1.5.8 Highlight and select patient TTA supply — A
- 1.5.9 Select dispensing report — A

Discharge Medication Supply Process - Forth Valley Royal Hospital Step 1.6-1.8 *(complete 1.1 to 1.10 in order)*



Discharge Medication Supply Process - Forth Valley Royal Hospital Step 1.9-1.10 *(complete 1.1 to 1.10 in order)*



1. Discharge medication supply process - Forth Valley Royal Hospital Terminology and SHERPA Analysis Key

Terminology

HEPMA - Hospital Electronic Prescribing and Medicines Administration

IDL - Immediate discharge letter

IDL Rx - Immediate discharge letter prescription

Prescription Tracking system/PTS - IT software used to track the preparation of a prescription

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

WellSky system/disp - IT software used to label medication and enable dispensing via robotics

TTA supply - To take away supply of medication

Robotic dispensing system - Automated process for dispensing of medication linked to labelling IT software system

Ward collection identification sheet - Information sheet manually completed with the ID of staff collecting discharge medication from the pharmacy department and the details of the pharmacy team member issuing the discharge medication

SHERPA Analysis Key

[A] Action – performing a task

[R] Retrieval – getting information from a screen, manual or expert

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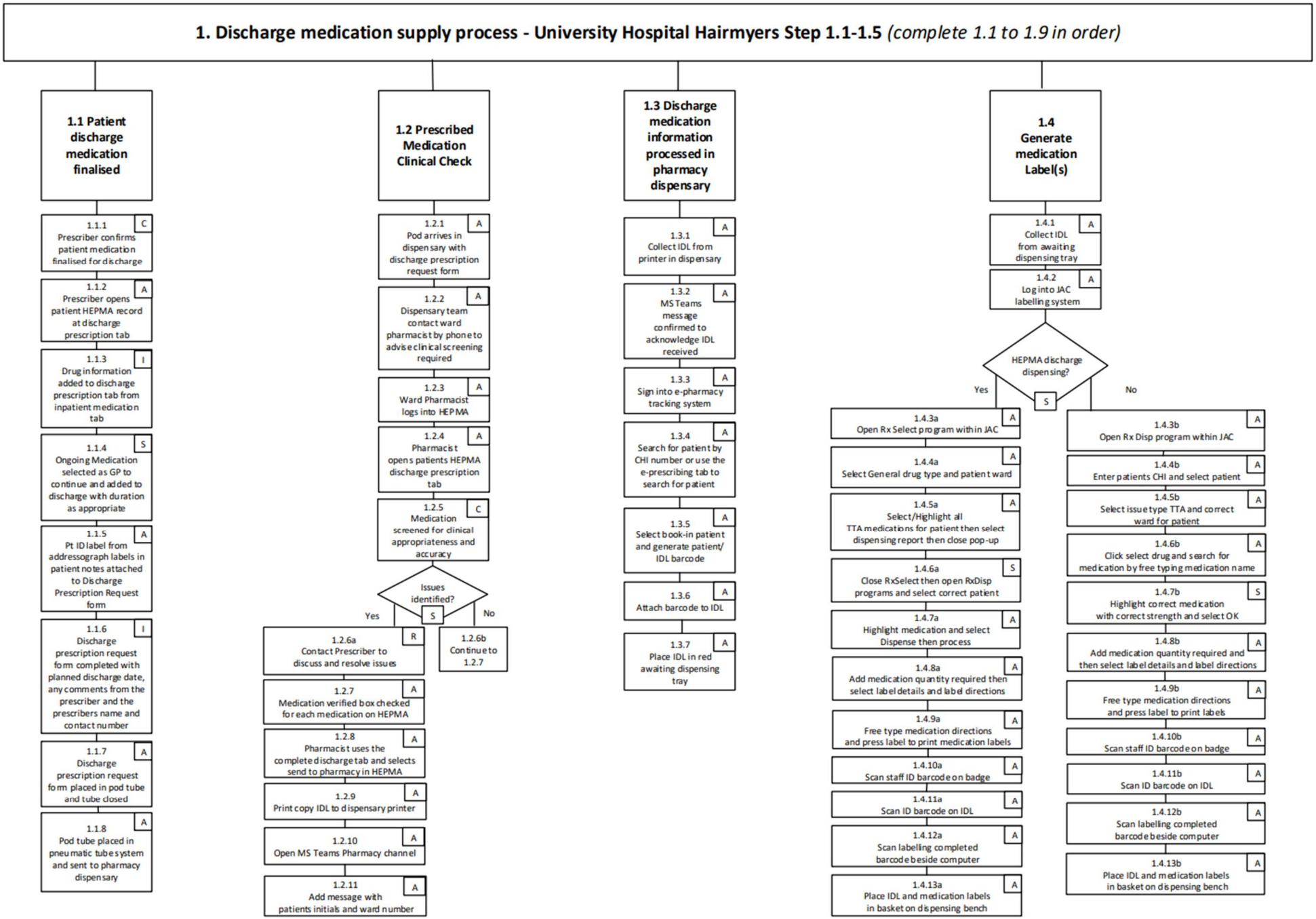
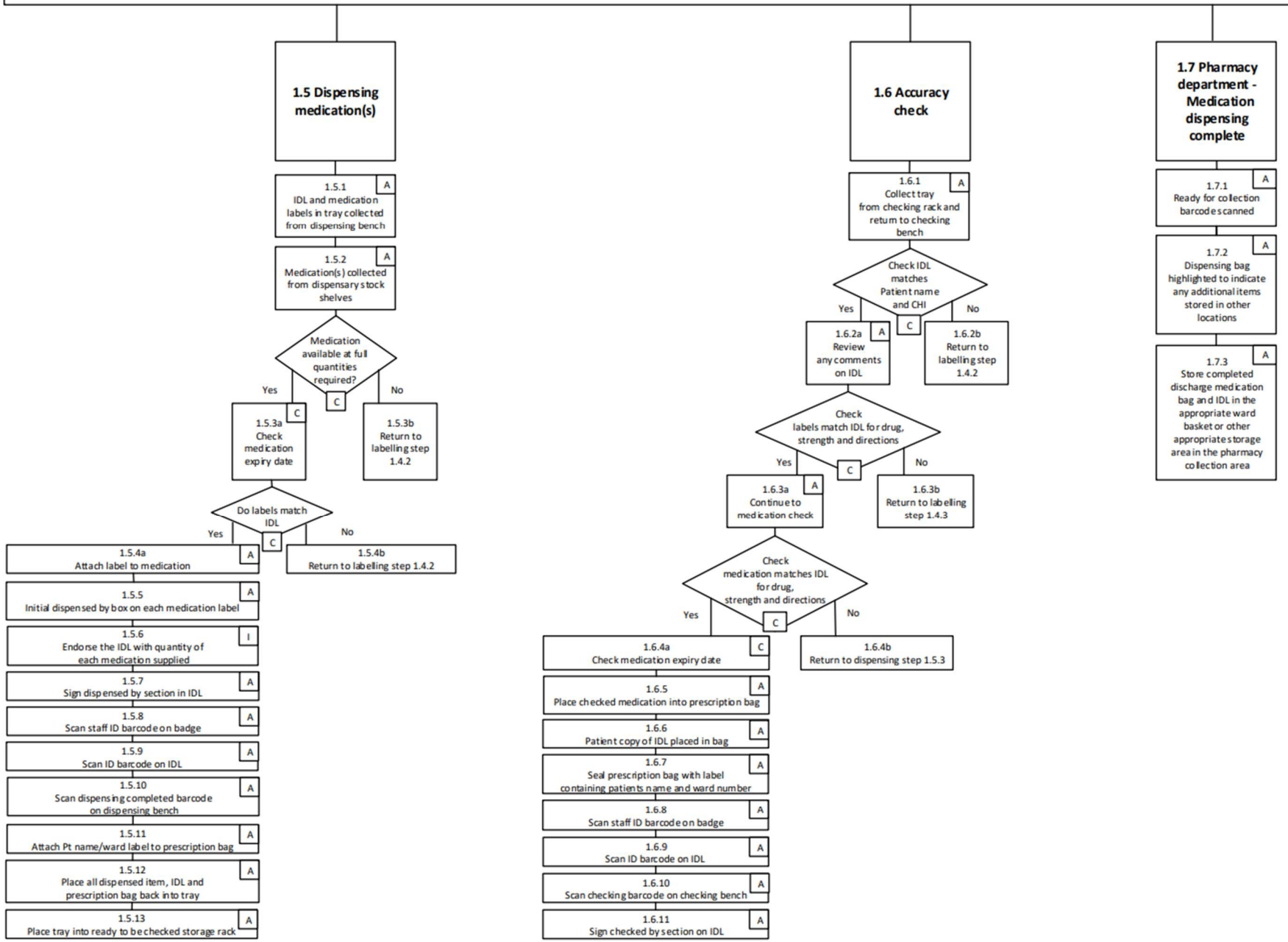
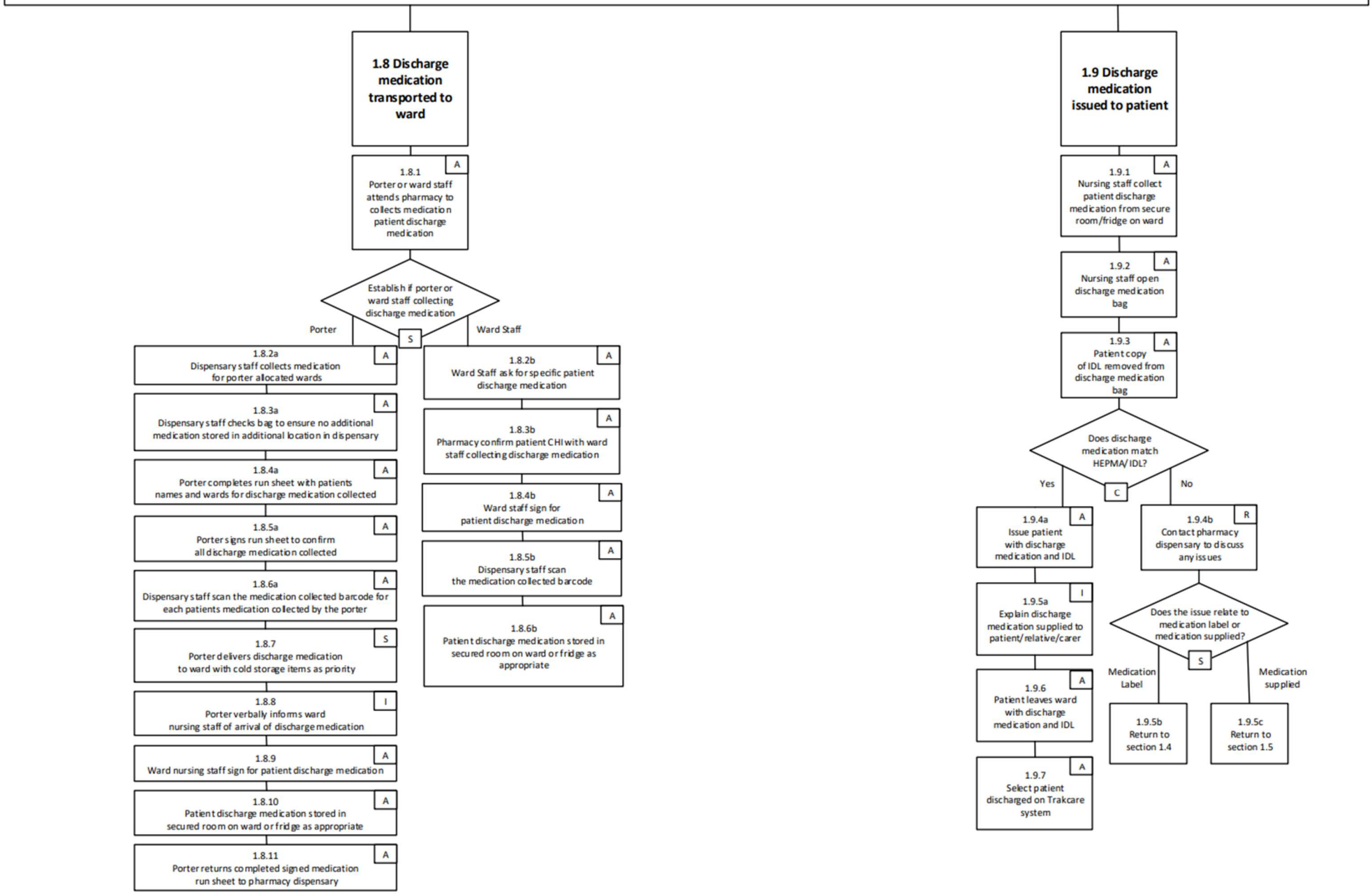
1. Discharge medication supply process - University Hospital Hairmyers Step 1.1-1.5 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - University Hospital Hairmyres Step 1.6-1.9 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - University Hospital Hairmyres Step 1.6-1.9 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - University Hospital Hairmyres Terminology and SHERPA Analysis Key

Terminology

HEPMA - Hospital Electronic Prescribing and Medicines Administration

IDL - Immediate discharge letter

IDL Rx - Immediate discharge letter prescription

Discharge Medication Request form - Information form that is completed prior to discharge including details of planned discharge date and prescriber contact details

Pneumatic tube systems - System of interconnected air pressured tubes used to send small physical objects across the hospital

MS Teams - Microsoft Teams IT software, pharmacy channel used for communication across the pharmacy team

epharmacy tracking system - IT software used to track the progress of the discharge medication supply (Barcodes scanned during the discharge medication supply process update the system showing the completed stages)

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

JAC labelling system - IT software used to generate medication labels and activate robotic dispensing

Rx select/Rx Disp - Software program modules within the JAC labelling system used as part of the medication labelling and automated dispensing process

TTA supply/TTA Medication - To take away supply of medication

Porter - a hospital employee who moves equipment, medication and patients around the hospital as required.

TrakCare - IT software system used to manage patient journey during hospital admission

SHERPA Analysis Key

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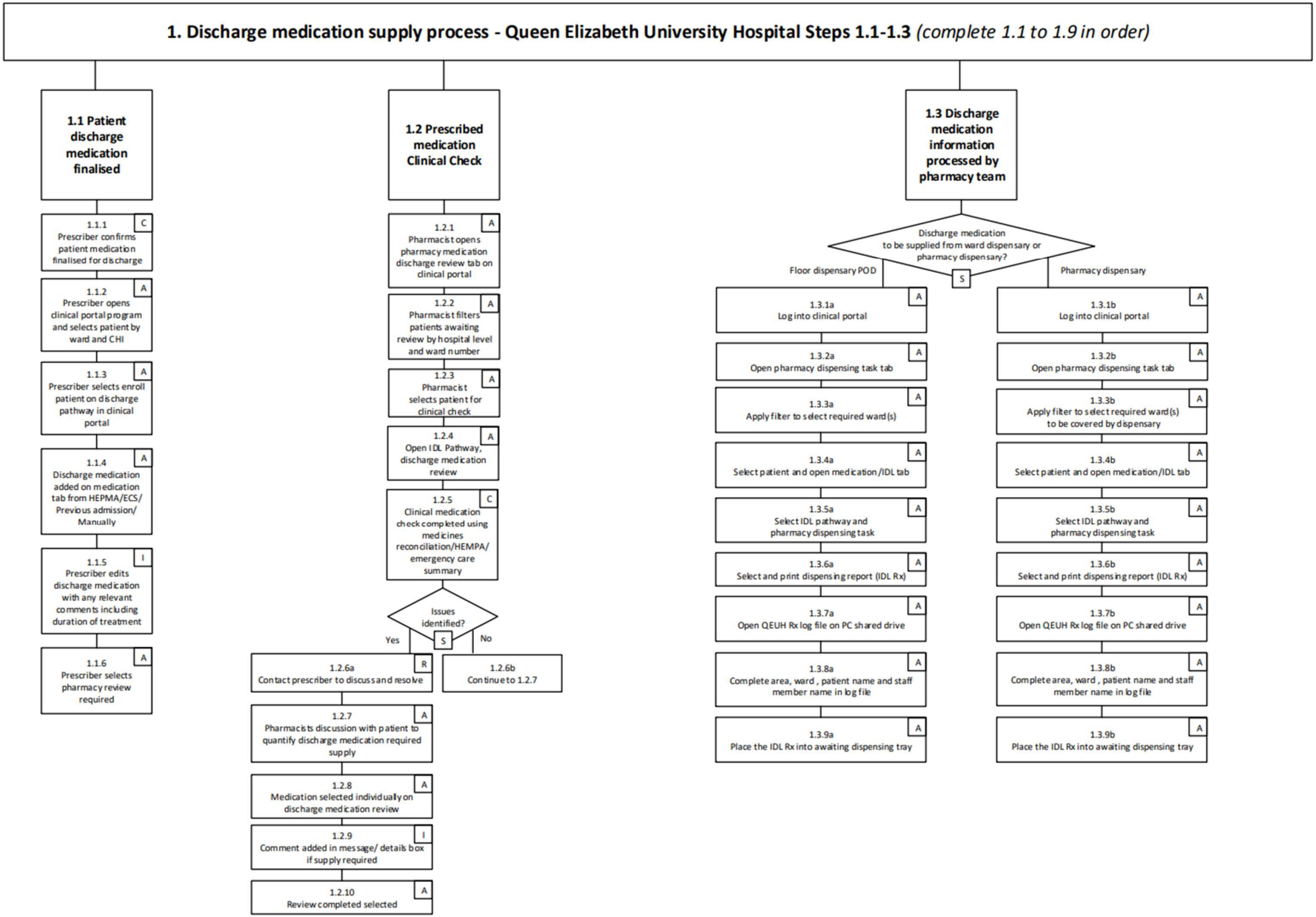
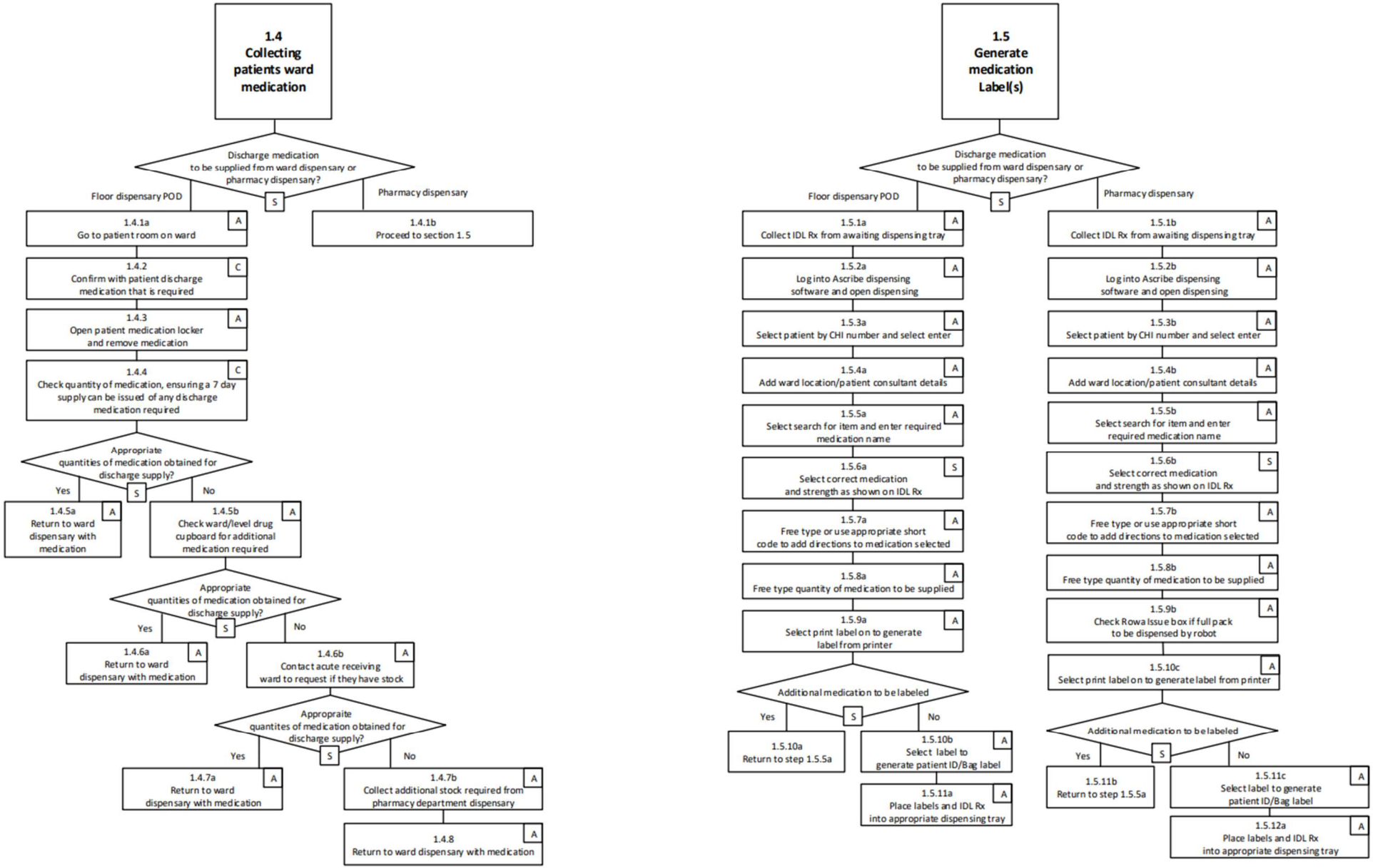
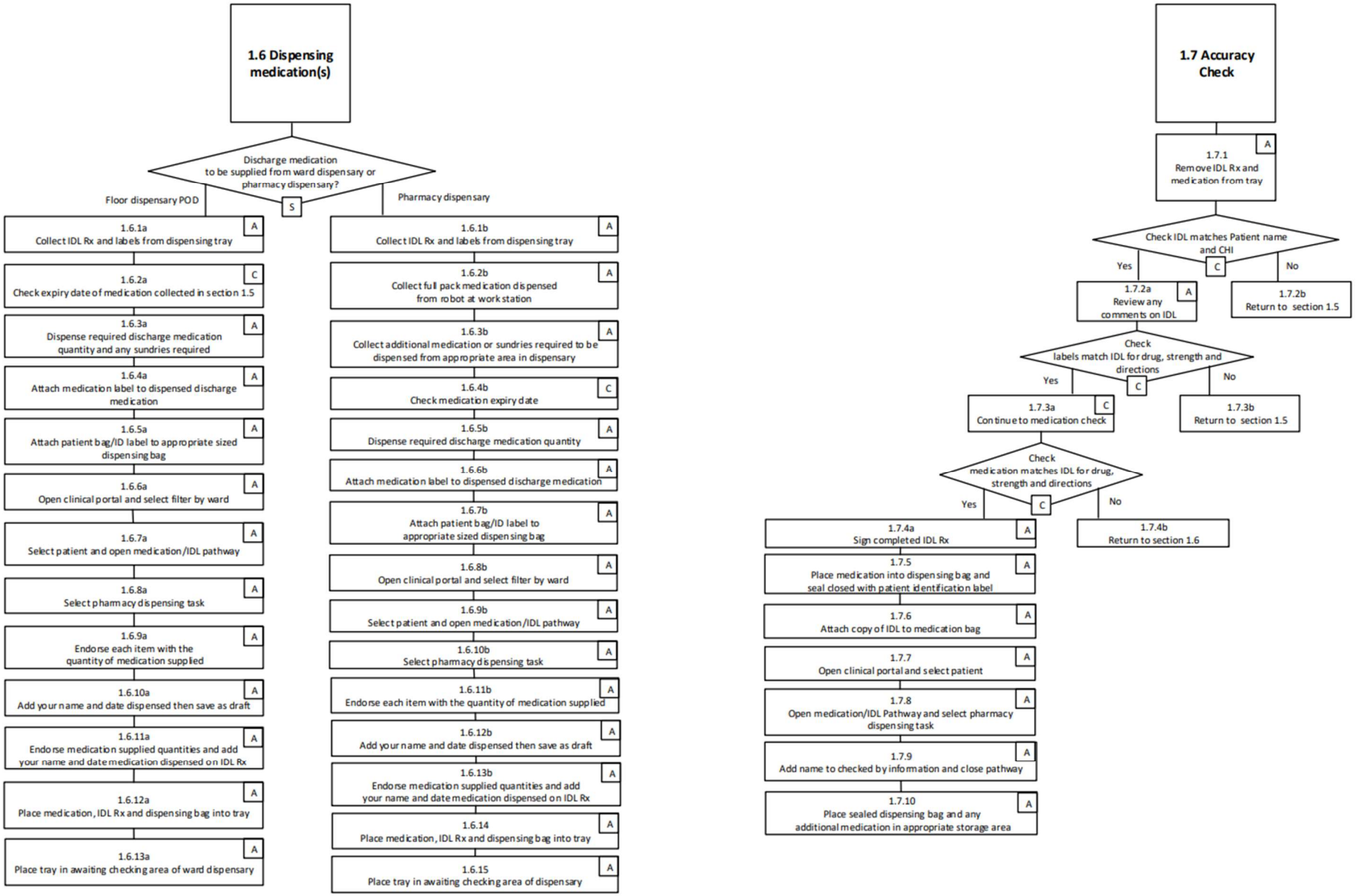
1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.1-1.3 *(complete 1.1 to 1.9 in order)*



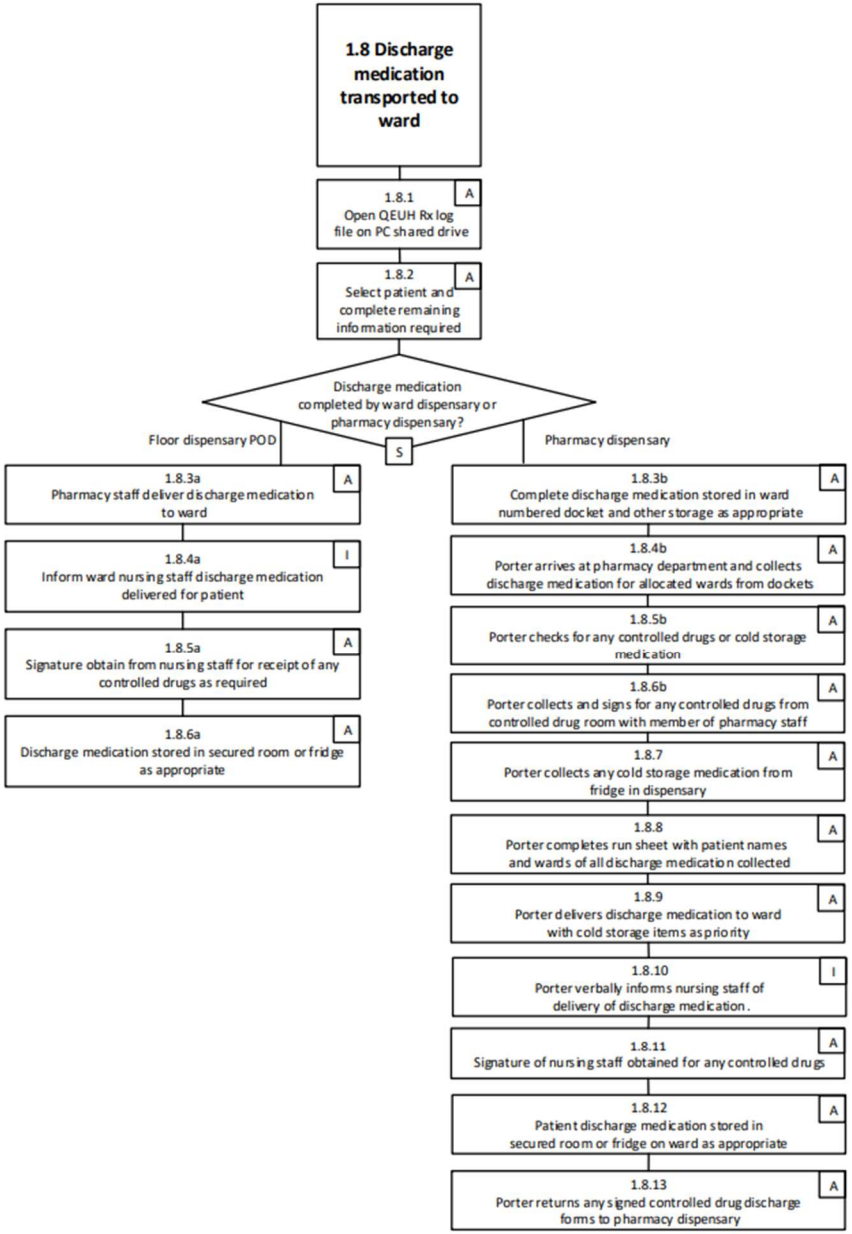
1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.4-1.5 *(complete 1.1 to 1.9 in order)*

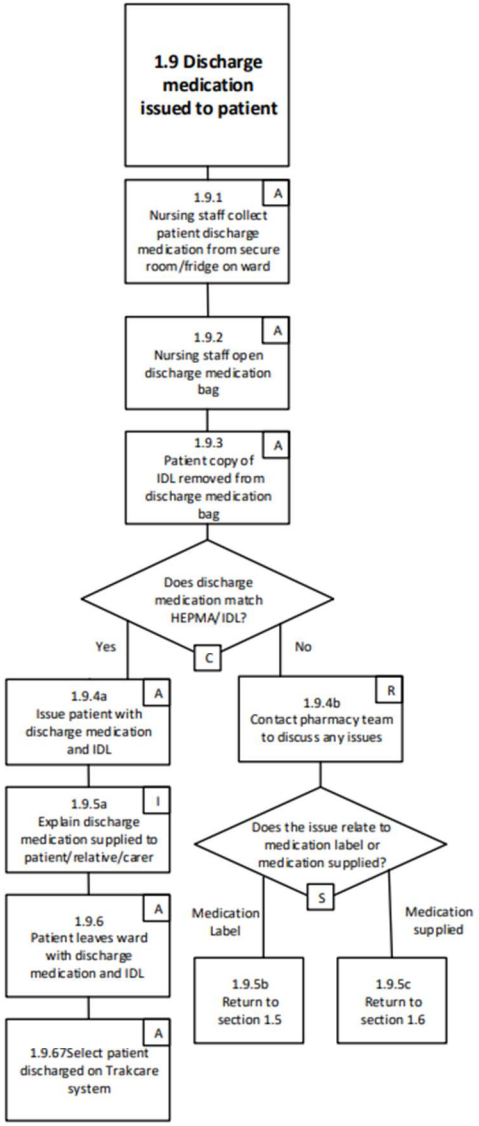


1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.6-1.7 *(complete 1.1 to 1.9 in order)*



1. Discharge medication supply process - Queen Elizabeth University Hospital Steps 1.8-1.9 *(complete 1.1 to 1.9 in order)*





1. Discharge medication supply process - Queen Elizabeth University Hospital Terminology and SHERPA Analysis Key

Terminology

Clinical Portal - Web based patient record and IT system

HEPMA - Hospital Electronic Prescribing and Medicines Administration

ECS - Emergency Care Summary record

IDL - Immediate discharge letter

IDL Rx - Immediate discharge letter prescription

QEUH Rx log - Spreadsheet used within Queen Elizabeth hospital to document discharge medication process

Ward dispensary/Floor dispensary POD - Pharmacy dispensary based on a ward or floor of the hospital

Pharmacy dispensary - Main pharmacy dispensary department located separately from the wards

Ascribe - Pharmacy dispensary software system

CHI - a unique 10-character numeric identifier, allocated to each patient on first registration within NHS Scotland

Porter - a hospital employee who moves equipment, medication and patients around the hospital as required.

TrakCare - IT software system used to manage patient journey during hospital admission

SHERPA Analysis Key

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