Analysis of Clinical Pharmacy Services and Development of a Model to Inform the Appropriate Skill Mix for a Clinical Pharmacy Workforce to Achieve the Optimisation of both Patient Outcomes and Cost-Effectiveness.

By

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Dedication

I would like to dedicate this work to my beloved family (my father ”Sayed”, my mother ”Gamila”, my wife “Nermeen” and my two lovely sons “Eslam &Adam”). I am deeply grateful for their unconditional love and overwhelming care which pushed me forward throughout this work. Nevertheless, I’m profoundly appreciative for their continuous encouragement and everlasting patience.

Declaration

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Abstract

Objective

to quantitatively measure and analyse the different types of daily clinical pharmacy services and develop an appropriate skill mix model for the clinical pharmacy workforce.

Method

Data was collected from 8 medical and surgical wards for two weeks each in addition to 129 days for the analysis of in-patient clinical pharmacist interventions. The duties were compared between different staff grades and ward specialties. Also, daily in-patient clinical pharmacists` interventions over 129 days, were collected, analysed and compared. Two potential elements were identified to develop a skill mix model. The first was relocation of two senior clinical pharmacy technicians CPTs to complete the medication histories for newly admitted patients. The second was assigning another senior CPT to complete any final check requests from hospital wards.

Main results

Clinical Pharmacy Technicians (CPTs) undertaken seven different clinical pharmacy related activities throughout the day while completing medicines reconciliation by ward pharmacists was the main activity provided during hospital admission and discharge which required more than half of pharmacist daily time and supported only 30% of the patients within each ward. Also, eight daily interventions were made by each ward pharmacist during in-patient stay. These equated to an estimated reduction in daily costs between £520 and £1200 in each ward. Four accurate and complete medicines histories were completed by each senior CPTs during the afternoon with similar accuracy and amount of time as junior pharmacist. Also, a reallocated CPT was able to complete 96.83% of all final check requested from 8 wards during afternoon.

Conclusion

Different clinical pharmacy services were delivered by pharmacists and CPTs throughout the patient hospital journey. CPTs roles can be enhanced to release more time allowing pharmacists to focus on more therapeutic issues. Reallocation of numbers, staff grades and competency will ensure best use of staff resources and improve the provided clinical pharmacy services, patient outcomes and cost-effectiveness

Dissemination of results

- Abuelhana A, Ashfield L, Scott M, Fleming G, Farghaly S, Sabry N, Burnett K. Analysis of Clinical Pharmacy Services Supported By Ward-Based Clinical Pharmacy Technicians during Patient Hospital Journey. **European Journal of Hospital Pharmacy. Published online, 2019 October 29.** doi: 10.1136/ejhpharm-2019-001972.

- Abuelhana A, Ashfield L, Scott M, Fleming G, Farghaly S, Sabry N, Burnett K. Comparison between clinical pharmacy technician working load and activities in Medical, Surgical and Cardiology with long stay wards. Poster Presented at: 38th of Ireland Schools of pharmacy Conference, ***Dublin, Ireland; 2016 March 21-22***.

- Abuelhana A, Ashfield L, Scott M, Fleming G, Farghaly S, Sabry N, Burnett K. Clinical Pharmacy technician workload and activities during a typical working day. Poster Presented at: Clinical Pharmacy Congress, London Excel, London, ***UK; 2016 April 22-23.***

- Abuelhana A, Ashfield L, Scott M, Fleming G, Farghaly S, Sabry N, Burnett K. Analysis of Medicine Reconciliations Undertaken from Monday to Friday in a District General Hospital. Poster Presented at: Hospital Pharmacy in Europe Conference, ***London, UK; 2016 November 10th.***

Contents

Abbreviations

ACCP	American College of Clinical Pharmacy
ACPT	Accuracy Checking Pharmacy Technician
AfC	Agenda for Change
ANOVA	Analysis of Variance
BNF	British National Formulary
CPS	Clinical Pharmacy services
CPTs	Clinical Pharmacy Technicians
DOACs	Direct Oral Anticoagulants
EPICS	Electronic Pharmacists Intervention Clinical System
GPhC	General Pharmaceutical Council
HSC	Health and Social Care
IMM	Integrated medicines Management
MAI	Medication Appropriateness Index
MedRec	Medicines Reconciliation
NHS	National Health Services
NHSCT	The Northern Health and Social Care Trust
NICE	National Institute of Health and Care Excellence
NICPLD	Northern Ireland Center for Pharmacy Learning and Development
NIECR	Northern Ireland Electronic Care Record
NVQ	National Vocational Qualification
OSD	One Stop Dispensing
PharmD	Doctor of pharmacy
PODs	Patients Own Drugs
SD	Standard Deviation

SEM	Standard Error of Mean
SPSS	Statistical Package for the Social Sciences
VTE	Venous Thromboembolism

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Chapter I

General Introduction and aim of the work

1. Introduction

1.1 Clinical Pharmacy

Pharmacy practice has transformed remarkably over the past few years from mainly dispensing of patients` prescription medicines into more clinical roles. This shift introduced many professional degrees such as master in clinical pharmacy and Doctor of Pharmacy (PharmD) required to enrich the competency level and clinical skills of the pharmacist needed for this new transition of practice (Brown, 2013).

One of many definitions available for the clinical pharmacy that of the American College of Clinical Pharmacy (ACCP) which described clinical pharmacy as "*a health science discipline in which pharmacists provide patient care that optimises medication therapy and promotes health, wellness, and disease prevention, it is area of pharmacy concerned with the science and practice of rational medication use"*(American College of Clinical Pharmacy 2008; Brien 2019)

1.2 Clinical Pharmacy history in UK

Until the mid of the seventh decade of the past century (1960s), hospital pharmacists were almost fully engaged in and responsible for their traditional dispensing and compounding roles. Then, with the wide increase in the numbers of drugs available and consequent complexity and increase in drug related errors, their roles began to be shifted into more clinical involvement and patient care responsibilities (Calvert 1999).

According to the *Nuffield* report (1986) the clinical roles of the hospital pharmacist became more recognisable and quickly expanded across 1970s and 1980s to more direct patient interactions and more recognition by health professionals (Nuffield Foundation and Clucas 1986; Cotter *et al.* 1994). The *Nuffield* report recommended more involvement of hospital pharmacist in clinical services which later became known as "clinical pharmacy services" (Nuffield Foundation 1986, Clucas 1986).

The suggestions and recommendations within the Nuffield report were formally identified and considered one of the main objectives by the UK Department of Health in 1988. In the early 1990s and as the clinical pharmacy services expanded and quickly progressed, the majority of NHS hospitals in the UK provided several clinical pharmacy related activities and many hospital pharmacists were involved in many clinical related tasks and duties which later demonstrated both clinical and cost benefits (Stephens 2011).

1.3 Clinical Pharmacy Services

Clinical Pharmacy services (CPS) are implemented and provided by a highly trained and skilful team of clinical pharmacists and ward based clinical pharmacy technicians (CPTs) to ensure best patient outcomes through optimising all patient medicines related needs (Anderson and Schumock 2009). CPS improve disease and medicines management, health quality and disease prevention through the use of clinical pharmacy staff skills, applied knowledge and gained experiences in addition to evidence-based practice and continuing education (Burke *et al.* 2008).

Over the past few years, hospital pharmacists` roles and responsibilities have shifted from medication supply into more clinical related activities including medication history interviews, medicines reconciliation and medicines optimisation where patient safety is the priority within an effective and efficient prescribing and administration environment (Kaboli *et al.* 2006; Picton and Wright 2013).

Several studies assessed the impact of implementation of CPS throughout the patients` hospital journey which showed remarkable patient outcomes and cost effectiveness (Schumock 1996; Schumock *et al.* 2003; Kaboli *et al.* 2006; Doloresco *et al.* 2008; Touchette *et al.* 2014).

Another systemic review which analysed several studies within European countries highlighted the positive impact of increased appropriateness of medicines uses and reduction of medicines related harm through applying clinical pharmacy services within hospital sittings (Kiesel and Hopf 2018).

Implementation of CPS should be guided by clinical pharmacy standards. Within the UK there are published standards which represent a professional guideline outlining the framework of CPS and highlight the competencies and expected roles of clinical pharmacy team for patient care and safety (Henman 2019).

Both the Royal Pharmaceutical Society (RPS) and the National Institute for Health and Care Excellence (NICE) have developed the basic concepts and gold standards for CPS within hospitals (Fitzpatrick and Boardman 2005; Martin 2014; NICE Medicines and Prescribing Centre (UK) 2015)

Although there are guaranteed clinical and cost benefits and advantages though supporting patients with proper CPS during their hospital journey, it still inconsistently implemented across hospitals and health care trusts (Pande *et al.* 2013; Bilal *et al.* 2016; Shanika *et al.* 2017).

For this reason, research studies are required to measure and analyse the types and impact of CPS and also to identify the challenges, resistance and barriers that may confront the proper implementation.

1.4 Clinical Pharmacy workforce

The pharmacy workforce in the United Kingdom is mainly made up of pharmacists, pharmacy technicians and assistant technical officers (pharmacy assistants) (Howe and Wilson 2012; Center for Workforce intelligence London 2013; John, Christopher and Brown 2017).

The pharmacy support workforce including pharmacy technicians and assistants help in advancing the clinical roles and pharmaceutical care services of the pharmacists (Koehler and Brown 2017).

Several standards and frameworks identify the tasks, duties and the scope of practice of the pharmacy support staff (pharmacy technicians and assistants) within different sittings including hospitals, community and general practice (Bradley *et al.* 2013; Duggan *et al.* 2013; John, Christopher and Brown 2017).

1.4.1 Clinical Pharmacist

The term clinical pharmacist is used to describe a pharmacist who interact with patients and liaise with other health care providers to analyse, evaluate, recommend and monitor patients` therapeutic plans in order to optimise patients` safety and disease management (Brody *et al.* 2009; Albanese *et al.* 2010; Pharmaceutical Society of Australia 2010; Scheckelhoff 2014; Schulze 2014; Swetenham *et al.* 2014).

Clinical pharmacists contribute in providing better patient care through optimisation and management of medicines and supporting other health-care team with evidence-based drug information services. These essential and irreplaceable services supported by clinical pharmacists are attributed to their deep and comprehensive knowledge as drug experts with profound skills and competence within this area of specialty (American College of Clinical Pharmacy 2014; Ray *et al.* 2018).

Several studies have highlighted the positive impact of clinical pharmacists on overall health care expenditure (Lee, J. *et al.* 2002; Bond and Raehl 2005; Barnett *et al.* 2009; Isetts *et al.* 2012; Viswanathan *et al.* 2015).

The essential and elementary tasks and duties of clinical pharmacists` support patients with a wide range of necessary clinical services throughout the full hospital journey from admission to the discharge (Jennings *et al.* 2019).

Consequently, clinical pharmacist have become an essential and integral part of the health care team and health services process (Bluml 2005; American Pharmacists Association and National Association of Chain Drug Stores Foundation 2008; Jennings *et al.* 2019).

Over the past years, there is a significant increase in the need, acceptance and satisfaction of other health practitioners to incorporate clinical pharmacist into multidisciplinary teams within hospitals and other health care sitings (Chisholm-Burns *et al.* 2010; Miller, S. *et al.* 2010; Freeman *et al.* 2014; Tan *et al.* 2014).

1.4.2 Agenda for Change

Within the UK, pharmacists are categorised according to their experience, qualifications, skills and competencies into several grades (bands). Theses grades match with the payment scheme developed and implemented by the National Health Services (NHS) for their workforce (excluding doctors, dentists and senior managers) which was known as Agenda for Change (AfC) (Buchan and Evans 2007; Brock and Franklin 2007; Brown, B. 2009; Buchan and Ball 2011; Stephens 2011; Burgin *et al.* 2014; National Health services (NHS) 2019).

Table 1-1: Types of bands for pharmacists and pharmacy technicians according to NHS Agenda for Change (AfC).

AfC band	Job level
Band 2	- Pharmacy support worker
Band 3	- Pharmacy support worker - higher level - Student pharmacy technician
Band 4	- Pharmacy technician
Band 5	- Pharmacist entry level (pre-registration pharmacist) - Pharmacy technician - higher level (additional responsibilities)
Band 6	- Pharmacist - Pharmacy technician specialist

Band 7	- Pharmacist specialist - Pharmacy technician team manager
Band 8a-b	- Pharmacist advanced
Band 8b-c	- Pharmacist team manager
Band 8c	- Pharmacist consultant
Band 8c-9	- Professional manager pharmaceutical services (chief pharmacist)

1.4.3 UK Pharmacist grades (bands)

Junior, senior and consultant hospital pharmacists

Junior (Band 6) pharmacists are newly qualified pharmacists within the first three years of their post. They usually complete the straightforward uncomplicated medication related issues which require basic clinical skills. They also rotate between different ward specialties to gain more experience, skills and level of competencies. Senior (Band 7) pharmacist are more experienced and skilful clinical pharmacist who are able to provide advanced clinical pharmacy services within an area of specialty. Specialist and consultant (Band 8a-c) pharmacists are highly expert clinical pharmacists that can lead and deliver specialist CPS in addition to clinical leadership with regards to medicines such as antimicrobial pharmacist and pharmacists managing outpatient clinics. They also contribute to the evaluation and development of clinical pharmacy standards and strategies (Brock and Franklin 2007; Burgin *et al.* 2014; Engle *et al.* 2014; Graham-Clarke 2014).

1.4.4 Advanced clinical pharmacy services

Recently, clinical pharmacists are able to support advanced clinical services such as independent prescribing of patients` medicines during hospital discharges, reviewing of patients` health conditions and running of pre-admission and post discharge out-patient clinics (Smith *et al.* 2013; Jackson *et al.* 2015; Thomas *et al.* 2019).

1.4.5 Pharmacist Independent prescriber

Independent prescriber pharmacists has been implemented in many countries such as UK, USA, Canada and New Zealand, however pharmacist prescribing is considered the most developed and advanced in UK where the pharmacist prescriber is independently capable and allowed to write new prescriptions, review and amend existing prescriptions for best patient safety and outcomes (Stewart *et al.* 2017; Jebara *et al.* 2018).

Within the UK, pharmacists are allowed and have the right to prescribe within their area of competency after successfully completing an accredited prescribing qualification (Tonna *et al.* 2007).

Two patterns of pharmacist prescribing exist in UK; the first is supplementary prescriber pharmacist which was presented in launched in 2003 and based on optional non-compulsory cooperation between the pharmacist and doctor or dentist within pre-agreed specific clinical management plan for the patient. The second pattern is independent prescriber pharmacist which was introduced for the first time in 2006 after changing the regulations and roles allowing this legal entitlement for the qualified pharmacists. The independent prescriber pharmacist, within their area of competency can assess and evaluate patient health status and accordingly make a prescribing management decision to clinically improve patient health care either for diagnosed or undiagnosed conditions (Boynton and Greenhalgh 2004; Department of Health 2006; Tonna *et al.* 2007; Nissen 2011).

For the pharmacist to be an independent prescriber they must have at least two years of direct patient care experience of practice and then need to be enrolled and successfully complete a General Pharmaceutical Council (GPhC) accredited prescribing qualification. This is usually a six months part time course comprising of at least four weeks of direct teaching and self-learning in addition to a minimum of 12 days of learning within an area of practice under mentoring by a health practitioner (George, J. *et al.* 2007; Hobson *et al.* 2009; General Pharmaceutical Council 2019; Royal Pharmaceutical Society 2019).

Reid et al (2018) reported that medication prescribing is a complicated and difficult process and requires deep knowledge, skills and competence, however prescribing safety assessments of the independent prescriber pharmacist were evaluated and confirmed.

There are many benefits over introducing pharmacist prescribers within the health care system including reducing doctors' workloads and releasing more time for them to review more patients, enhance patient outcomes and better safety prescribing and greater use of pharmacists' skills and knowledge. Moreover, several studies reported that the rate of medication related problems were significantly decreased with pharmacist prescribers when compared with medical doctors (Baqir *et al.* 2015; Abuzour *et al.* 2018; Jebara *et al.* 2018).

1.4.6 Clinical pharmacy technician

Over many years, the advantages of utilising ward pharmacy technicians in completing particular activities such as medicines distribution and other technical tasks were highlighted and proved (Lewis 2003). Since 2001 the roles of pharmacy technicians started to change to include more medicines management related activities (Cooksey *et al.* 2002; Alkhateeb *et al.* 2011).

Clinical pharmacy technicians (CPTs) can help and support clinical pharmacists` activities within hospital wards to attain and ensure proper clinical pharmacy services and consequently best patient care and best use of medicines. Although the responsibilities of CPTs were developed and initiated without definite standards or uniformity in practice between healthcare institutions, the values of CPTs roles in assisting clinical pharmacists within different hospital wards were identified in many published studies (Turner *et al.* 2005; Boughen, Melanie *et al.* 2017).

Because the main focus of hospital pharmacists` activities is on clinical services with more patient interaction activities, many responsibilities have shifted directly to the pharmacy technicians to undertake. More recently within UK hospitals, hospital pharmacy technicians routinely manage the dispensary activities and CPTs work closely with the clinical pharmacists in an appropriate skill mix to complete many ward CPS (Napier *et al.* 2016; Boughen, Melanie *et al.* 2017).

CPTs facilitate medication supply and administration during in-patient hospital stay which helps in decreasing missed doses, improve medicine management and increase patient medication safety (Seaton and Adams 2010).

Because of the essential supportive role of CPTs in CPS there is an increased demand for experienced skilful and competent CPTs within health care systems. This demand increases day by day because of the significant concentration on the values and benefits of the pharmaceutical care and medication safety (Paul 2008; Lundy 2010; US Department of Health and Human Services 2013).

Although several published studies suggested and supported advancing the roles of CPTs which will positively impact the workload of the clinical pharmacist and enable expanding the delivered CPS, many studies are still needed to assess and evaluate the impact and the benefits of expanding CPTs roles and responsibilities (Mattingly 2018; Gernant *et al.* 2018).

1.4.7 Pharmacy assistant

Pharmacy assistants (assistant technical officer) are part of the pharmacy workforce who provide support and assistance to both pharmacists and pharmacy technicians. Within hospitals, pharmacy assistants are responsible for several duties including distribution of medicines to different hospital wards, checking and topping up medicines and other supplementary medicinal products within the relevant cupboards in hospital wards. There are no particular qualifications required for the entry level of pharmacy assistant job, however good educational level is preferred and usually training is provided within the first year including NVQ level 2 in pharmacy service skills and BTEC level 2 in pharmaceutical sciences. Pharmacy assistants are important members of the pharmacy team and their roles are essential for the optimum medicines` stock control and supply (John, and Brown 2017; Rathbone *et al.* 2018; National Health services (NHS) 2019).

1.5 Medicines Optimisation Quality Framwork

Medicines optimisation is defined by the National Institute of Health and Care Excellence (NICE) as "*a person-centered approach to safe and effective medicines use to ensure that people gain the best possible outcomes from their medicines*" (NICE Medicines and Prescribing Centre (UK) 2015).

The Northern Ireland Medicines Optimisation Quality Framework is a blueprint strategy published in 2016 and aims to improve the quality use of medicines whenever they are prescribed in order to ensure the best achievable clinical benefits for the people across Northern Ireland. It also represents a quality standard for all Health and Social Care (HSC) trusts through supporting a guideline for the delivery of evidence-based services for the best safe and effective use of medicines based on a patient-centered approach with five R rights (Right patient, Right medicine, Right time, Right outcome, Right cost) (Table: 1-2). This framework supports involvement of pharmacists within a multidisciplinary team throughout the full patient hospital journey (admission, in-patient stay and discharge) and in all settings of patient care. The framework developed a regional model and set ten quality standards representing the minimum requirements for the safe and effective use of medicines. These standards are associated with three main domains (safety, effectiveness and patient/client focus) and compatible with the quality standards of NICE on medicines optimisation (Table: 1-2) (*Northern Ireland Medicines Optimisation Quality Framework.* 2016).

Table 1-2: Northern Ireland Quality Standards for Medicines Optimisation framework

Quality Domain	**Medicines Optimisation Standards**
Patient/Client Focus Patients are involved in decisions about their treatment with medicines.	1. Safer Prescribing with Patient Involvement
	2. Better Information about Medicines
	3. Supporting Adherence and Independence
Safety Preventing and minimising harm related to medicines use.	4. Safer Transitions of Care
	5. Risk Stratification of Medicines
	6. Safety/Reporting and Learning Culture
Effectiveness Right patient, Right medicine, Right time, Right outcome, Right cost.	7. Access to Medicines you Need
	8. Clinical and Cost-effective Use of Medicines and Reduced Waste
	9. Clinical Medication Review
	10. Administration

https://www.health-ni.gov.uk/publications/northern-ireland-medicines-optimisation-quality-framework

1.6 Northern Ireland Electronic Care Record

Northern Ireland Electronic Care Record (NIECR) is a computer based medical record system which includes the essential health information about each patient across Northern Ireland. Within this system each patient has a unique identification number (Health and Care Number (HCN)) used for storing and recalling the essential health information such as past medical history, regular medicines, allergy history and chronic conditions. The medical information within NIECR is gathered automatically from the electronic records of hospitals and clinics across Northern Ireland in addition to direct input to the system by an authorised staff. NIECR is used across all Health and Social Care (HSC) trusts and the information records are generated, gathered and managed only through authorised NHS healthcare staff. According to Northern Ireland Clinical Pharmacy standards and Medicines Optmisation Framework, NIECR is an important element for the confirmation of patient`s medicines history during hospital admission as part of medicines reconciliation process and also during patient`s hospital discharge (Scullin *et al.* 2012; Ashfield 2013; *Northern Ireland Clinical Pharmacy Standards.* 2013; Scott *et al.* 2015; *Northern Ireland Medicines Optimisation Quality Framework.* 2016; Nicholson EHR Conference 2008).

1.7 One Stop Dispensing

Over the last few years in the UK, most trusts have introduced the One Stop Dispensing (OSD) model of service for medicines supply.

OSD was introduced to Antrim hospital as a new method of supplying medications for patients several years ago. On admission the CPT will assess any medication the patient has brought into hospital and if suitable these medicines will be stored in secure bedside lockers. These lockers will then be supplemented with any medicines to replace the ones that were not suitable for use in hospital and any newly prescribed medicines. Senior CPTs are required to check medicine prescription charts on a daily basis in order to supply these new or amended medicines. These medicines are administered to the patients during the inpatient stay and then used to prepare medicines required on discharge from hospital (Fitzpatrick, Ray, Peter Cooke, Carol Southall, K. Kaudhar, and Pat Waters 2005; James *et al.* 2008; Ashfield 2013).

This method has been shown to reduce time to complete medication administration rounds, reduce the possibility of medication administration errors and reduce the time of preparation of discharge medicines. It has also been shown to release time for clinical pharmacy staff to carry out more clinical duties and this was consistent with the findings of *Houlind et al* (2018).

1.8 Pharmacy services in Northern Health and Social Care Trust (NHSCT)

The Northern Health and Social Care Trust (NHSCT) provides health and social services to a population of almost 436,000 people across a geographical area of 1,733 square miles representing ten local districts (*Antrim, Ballymena, Ballymoney, Carrickfergus, Coleraine, Cookstown, Larne, Magherafelt, Moyle and Newtownabbey*) within Northern Ireland. It is the biggest geographical Trust out of the six Trusts within Northern Ireland (Irwin, C. 2012; Northern Health and Social Care Trust 2017). With the increase burden of medication errors which have been recognised mostly occurring at the patient transition of care, the Integrated medicines Management (IMM) service has been introduced to NHSCT hospitals many years ago. The IMM project was the first randomised controlled research study within the UK to evaluate and analyse the influence of the multidisciplinary process developed, and provided evidence to enhanced the safety, efficacy and cost effectiveness of the medication (Table: 1-3) (Scullin *et al.* 2007; Scullin *et al.* 2012).

The IMM service supports the integration between pharmacist and pharmacy technicians to provide the optimum clinical pharmacy services supporting patients throughout all care settings. It endorses clinical pharmacy staff involvement and input by reviewing the patient throughout the hospital journey from admission to discharge. The service improved both overall clinical and economic impact within secondary care through decreased length of patient hospital stay and readmission rate, increased accuracy of medication history taking, increased utilisation of patient own drugs (PODs) after assessment of the safety and appropriateness, facilitated the discharge process and improved both doctors and nurses time management and allocation (Scullin *et al.* 2012; Scott *et al.* 2015).

The Medication Appropriateness Index (MAI) is one of the common tools which measures the appropriateness of medicines prescribed for elderly patients through the use of standardised ten questions for each medicine. Implementation of the IMM service significantly improved the MAI score by 4.28 on discharge (Burnett *et al.* 2009).

Table 1-3: Impact of implementation of IMM service on health services within NHSCT hospitals.

Service/element	Impact of IMM Implementation
Drug history at admission	Reduction of 4.2 errors per patient
Length of patient hospital stay	Reduced by two days
Patient readmission	Increased time to readmission by 20 days
In-patient medication chart review (Kardex monitoring)	An average of 5.5 interventions per patient
Discharge time and accuracy	- Facilitated the patient discharge and accelerated the time by 90 minutes quicker - Increased the accuracy of discharge to less than 1% errors compared to 25% by other health practitioners
Mortality	Reduced risk adjusted mortality rate
MAI	Improved MAI scores on both admission and discharge

Though IMM, the clinical pharmacy team (pharmacist and pharmacy technicians) work as a ward-dedicated staff to support different clinical pharmacy services on admission, in-patient stay and discharge. Currently IMM services are implemented within most of the adult acute surgical and medical wards in NHSCT hospital and also throughout many hospitals across Northern Ireland. The proved benefits of providing the IMM service throughout the patient journey encouraged many hospital trust in England, Sweden, South Ireland and Norway to reproduce the same service to enhance the clinical and economic advantages (Irwin, C. 2012; Ashfield 2013; Scott *et al*. 2015).

1.9 Pharmacy practice in Antrim Area Hospital at the beginning of the study

Antrim Area hospital is the largest hospital within NHSCT with 426 acute beds in which the current study was conducted. It provides health services to approximately 436000 population within Northern Ireland and comprises general medical wards, cardiology, renal, maternity, paediatric and intensive care units as well as a big emergency department and out-patient clinic services (Northern Health and Social Care Trust 2017).

The pharmacy practice within Antrim Area hospital is provided in the light of IMM service where a pharmacist and pharmacy technician pair are dedicated within each medical and general ward to support different clinical pharmacy services throughout the patient hospital journey from admission to discharge (Irwin, C. 2012; Ashfield 2013; Scott *et al.* 2015).

According to NICE recommendations and Northern Ireland clinical pharmacy standards 95% of patients should have their medicines reconciled within 24 hours of admission by a qualified staff ideally a pharmacist (Irwin, C. 2012; *Northern Ireland Clinical Pharmacy Standards.* 2013; Ashfield 2013; NICE Medicines and Prescribing Centre (UK) 2015). This usually requires allocation of a large number of pharmacy staff to complete this phase. Also, clinical pharmacists within Antrim hospital are responsible for the review and generation of the discharge prescriptions by completing the medicines reconciliation on discharge. Because of the increased burden on the health services including hospitals, there is a big concern on the patients` length of hospital stay and this require acceleration of the discharge process for medically stable patients deemed fit for discharge. As per guidelines, all simple discharge patients should be ready to leave hospital within six hours of being confirmed medically fit. Within Antrim Hospital and because the increased workload required focus of the clinical pharmacy resources on completing medicines reconciliations during both admission and discharge phases to fulfil the clinical pharmacy standards` recommendations, the chance of reviewing each patients during the in-patient stay by pharmacy team was reduced (Ashfield 2013; Scott *et al.* 2015).

1.10 Pharmacy workforce skill mix

Worldwide, many countries are encountering insufficiency of health care workers. Decision makers have developed a range of ways to optimise the available workforce resources and in the proper number and mix to ensure delivery of high-quality care for the best patient outcomes and cost-effectiveness (Dubois and Singh 2009; Nelson *et al*. 2018).

As mentioned earlier, the pharmacy workforce is a mix of pharmacists, technicians and assistant technical officers. A skill mix is defined as "*having the right grades of staff with the right levels of competence to complete all the required tasks in the working environment*" (Acres 2005).

The determination of the number of each of these disciplines is often driven by the available workforce and resources, but what is the optimum number of each to provide the best clinical service for patients for the greatest cost-effectiveness, this is still a question (Royal Pharmaceutical Society 2013).

In its review of the hospital pharmacy workforce in 2011 the Department of Health, Social Services and Public Safety recommended that Trusts should regularly review their pharmacy skill mix to identify the possible opportunities for balance (Department of Health, Social Services and Public Safety 2011).

The moving of pharmacy technicians into clinical roles is now well recognised, however concerns have been raised about pharmacy technicians` training and ensuring that they have the necessary skills, knowledge and competency for these roles (Schafheutle *et al.* 2017).

Pharmacists carry out many extended roles, including prescribing, medicines reconciliation, assessing medication appropriateness, and out-patient clinics; with simultaneous extension of the clinical technicians’ roles into obtaining drug histories, assessing patients own drugs (PODs) and preparing discharge medications. Alongside these, there has been an increase in assistant technical officer within the pharmacy team to focus on drug supply and stock control. However, there has been no determination made of the optimum ratio and staff grades of these disciplines in relation to patient outcomes and cost-effectiveness; or whether this ratio is dependent upon the patient demographics (Willis *et al.* 2011; Ashfield 2013; Scott *et al.* 2015).

Determination of an appropriate skill mix model for the hospital pharmacy workforce will have a significant impact on the services provided by the clinical pharmacy team. Many benefits could be achieved through implementation of such skill mix model such as improving the access to the healthcare practitioners, releasing up higher grades` staff time to focus on more complex clinical tasks and patient`s level of satisfaction.

1.10 Aim of the work

The main aim of this study is to quantitatively measure and analyse the different types and scope of clinical pharmacy services delivered by the clinical pharmacy workforce including the pharmacist and pharmacy technician throughout the patient`s hospital journey from admission to the discharge.

Also, this study aims to develop and suggest an appropriate skill mix model for the clinical pharmacy workforce through development and testing of different potential elements for the enhanced roles of the clinical pharmacy technicians. The developed model should suggest re-allocation of the clinical pharmacy staff based on their grades, knowledge, skills and level of competency in a way that ensures both best patient outcomes and cost-effectiveness through

1.11 Conclusion

The clinical pharmacist is an integral and irreplaceable member of the healthcare team. CPS delivered by pharmacists and pharmacy technicians are an essential part of the health services that ensures medicines safety, efficacy and overall improvement of the healthcare quality. However, the types of services delivered, the model of implementation and the level of staff grades providing these services are still different between hospitals and healthcare Trusts. Also, the appropriate skill mix model for the clinical pharmacy workforce which ensures the best use of the staff resource for better patient outcomes and cost effectiveness remaining an important question

Chapter II

General Method

2. Method

2.1 Declaration

The detailed specific methods will be described within each relevant chapter of the thesis however the following is a brief general methodology for the entire thesis.

2.2 Study design

a. Part of the research structure of the thesis (chapters 3 and 4) was designed as a prospective observational study to quantitively identify, measure and analyse the current scope and types of clinical pharmacy services delivered as well as define the tasks and responsibilities of the different pharmacy staff levels and grades within the study site hospital.

b. Another part of the thesis (chapter 5) was designed as a retrospective based study to measure and analyse different types, grades and cost-effectiveness of clinical pharmacists` interventions during in-patient hospital stay.

c. The last part (chapter 6) was designed as a prospective based interventional trial to test certain potential elements for developing an appropriate skill mix model for the pharmacy workforce which enables better use of the staff resources, skills and competencies.

2.3 Study setting

This study was conducted at Antrim Area Hospital, a 426-bed acute general hospital which provides care to a population of almost 436,000 people across a geographical area of 1,733 square miles. Antrim Area Hospital is the largest hospital within Northern Health and Social Care Trust (NHSCT). Data was collected from eight different medical, surgical, cardiology and long stay wards. The selected wards were representative for all hospital wards and the investigators were keen to collect data from wards that had consistency in number of beds, staff grades and working hours to minimise confounding factors as much as possible.

2.4 Method of data collection

For the purposes of this research, all clinical pharmacy staff were asked to ensure full completion of their pharmaceutical activities for a defined period of time which was different for each element of the research. During this time all clinical pharmacy grades of ward staff were asked to complete work sheets of activities developed by the research investigators to measure all clinical pharmacy activities throughout the full patient`s hospital journey from admission to discharge. While it is recognised that this in itself is time-consuming, it is an accepted method of obtaining data for a defined time period and has been used previously within the Trust.

Also, clinical pharmacists within the study site hospital recorded their daily interventions using EPICS (Electronic Pharmacists Intervention Clinical System) for one week every month. This electronically records clinical pharmacist activities and interventions during the day. During the research all clinical pharmacists` interventions during in-patient hospital stay were retrieved from EPICS and used to identify and analyse numbers, types and grades of clinical pharmacists` interventions in each ward during in-patient hospital stay.

The data obtained were assessed to determine if the grade of staff that has carried out the task was the most appropriate in terms of competence and skills, or whether an alternative grade would be more appropriate

All pharmacy staff on designated adult wards (medical, surgical, cardiology and long stay) alongside with the PhD researcher were asked to collect activity data. Patients on these wards who have an intervention carried out by a member of pharmacy staff as part of routine care activity had some key indicators recorded from their medical notes. No patients were interviewed by the researcher and no patient identifiers were recorded.

The data collection method was designed to be as efficient as possible, with tick boxes where appropriate, to ensure the burden was kept to a minimum. Also, two weeks was determined to be a reasonable time frame to get a picture of all activities without being overly burdensome. Where possible the PhD researcher designed data collection sheets which could be completed from existing data sources

The data obtained were used to develop a model for the clinical pharmacy workforce within the hospital to determine the most appropriate skill mix for that area in terms of patient outcomes and cost-effectiveness (such as staff time).

2.5 Inclusion Criteria:

a. All patients admitted and/ or transferred to the defined wards

b. Length of the stay within the ward is at least 24 hours

c. All pharmacy staff within the ward are included

d. Data collected from each ward for 2 weeks at each research key element and only during weekdays (from Monday to Friday) and normal working hours from 09:00 am to 05:00 pm which represented a sum of 70 to 80 days. Only in-patient pharmacists' interventions were retrospectively collected over 129 days. Data were collected over 2015 and J2016.

2.6 Exclusion Criteria:

a. Length of the stay is less than 24 hours within the ward
b. Band 5 Pharmacist (pre-registration pharmacist)
c. Weekend clinical pharmacy services and extended hours

Rationale for exclusion criteria: The period of 24 hours was the minimum duration required to evaluate significant clinical services for the patient. Band 5 pharmacists were not considered part of the normal pharmacy work force.

2.7 Piloting

Initially, a pilot data collection period was carried out in each ward involved in the study for two weeks to standardise data collection by both the pharmacy staff within the ward and the PhD researcher. This pilot provided reassurance that the same procedures for data collection would be followed in all wards. Data collected during the pilot were not included in the final analysis of the results.

2.8 Method of statistical analysis

Initially all results were tested for normality using either Kolmogorov test (for sample size more than 10) or Shapiro test (for sample size less than 10). If the result of either Shapiro or Kolmogorov tests was significant ($P<0.05$) it reflects non-parametric data distribution and suggests carrying out a suitable non-parametric test for comparison. Analysis of data was carried out by an SPSS® software version 22 (Statistical Program for Social Science) as follows:

a. Description of quantitative variables were reported as mean, standard error of men (SEM), Standard Deviation (SD).

b. Chi-square test was used to measure and compare qualitative variables such as number and percentage between groups.

c. Unpaired t-test was used to compare quantitative variables, in parametric data and Mann Whitney test in case of non-parametric data.

d. One- and two-ways ANOVA (analysis of variance) tests were used to compare more than two groups as regard to quantitative variable.

e. Tukey HSD as a post HOC test of ANOVA was used to show the statistical significance between groups. Kruskal Wallis test was used in case of non-parametric data

f. Spearman and Pearson Correlation co-efficient tests were used to test for the direction and strength of the association between variables (rank variables versus each other positively or inversely).

2.9 Data confidentiality and protection

The researcher had an honorary contract with the Trust so was bound by Data Protection and Confidentiality requirements. No patient or pharmacist personale or identifiers were recorded

2.10 Ethical Approval

Application for Ethical approval (RG1a) has been sent to the School of Biomedical Sciences Ethical Filter Committee in line with good research practice. However, this study was classed as a service evaluation so no ethical approval was required (Appendix). Approval to proceed were obtained from the Trust Research and Development Office (Appendix).

This study had no ethical considerations as it was classed as Service Evaluation in accordance with the National Research Ethics Service ‘Defining Research’ guidance (National Research Ethics Service 2013). It was conducted solely to judge current care and designed to answer “what standard does this service achieve” in terms of types of clinical pharmacy services and the grade of the staff used to achieve this task or service. It measured the current service within the study site hospital without reference to a standard. There was no patient intervention and only involved analysis of existing data. Accordingly, it did not require ethical review. Also, no consent forms were used as all data collection was regarding the pharmacy staff service evaluation including all pharmacy work force activities.

2.11 Shadowing

Prior to the beginning of gathering pilot data, the PhD researcher spent three months within three hospital sites (Antrim area, Causeway and Hollywell hospitals) of the Northern Trust (NHSCT) shadowing all pharmacy staff team within different surgical and medical wards. The aim of the shadowing was to allow the researcher experiencing the normal daily work environment, identify the key duties and responsibilities for all pharmacy staff grades and levels and develop the appropriated data collection forms for the research project.

2.12 Limitations

Data was mostly collected by the PhD researcher with the support of the pharmacy workforce and throughout the regular hospital working day so some data was not possible to be collected, such as the exact time spent for each task or activity achieved by each pharmacy staff level and grade within the ward.

Also because the data were collected with the support of the pharmacy workforce, performance bias may be considered as one of the limitation of this study, however the data collection was piloted for a week to ensure the ease of the process and minimise the expected bias.

Moreover, although the data analysis and findings were based on different ward specialties and pharmacy staff grades and levels with interesting conclusions, this study was conducted only within one hospital and this may not be accurately reflecting general analysis within other hospitals. Future studies with multicenter testing should be carried out.

Chapter III

Analysis of clinical pharmacy technicians` workloads and activities

3.1 Introduction

3.1.1 Hospital pharmacy workforce

In the United Kingdom, pharmacists, pharmacy technicians and pharmacy support staff (dispensing, counter and pharmacy assistants) make up the pharmacy workforce (Smith *et al.* 2013). They work together with the right skill mix to ensure outstanding CPS for the best patients' outcomes and cost effectiveness (Koehler and Brown 2017).

3.1.2 Pharmacy technicians` training and qualifications

Current pharmacy technician training involves completing both a knowledge- and a competency-based qualification. This is undertaken by part time study at a local college distance learning supplemented by work-based training and assessment (NVQ). The accredited qualification required to practice as a pharmacy technician in UK involves a level 3 NVQ pharmacy services diploma, which consists of both; the skills required for pharmacy technicians as well as the knowledge of pharmacy legislations (*The Pharmacy Order 2010, General Pharmaceutical Council (GPhC)*; Rosado *et al.* 2015; Northern Ireland Center for Pharmacy Learning and Development (NICPLD) 2019). From July 2011, all pharmacy technicians in GB had to register with the General Pharmaceutical Council (GPhC) to be eligible to work as pharmacy technicians, however, in Northern Ireland this is not required although they still have to achieve the same accredited competency based qualification and training to work as pharmacy technicians in Northern Ireland (Boughen, M. *et al.* 2017). Moreover, qualified pharmacy technicians can apply for an additional training qualification to be an Accredited Checking Pharmacy Technician or ACPT (senior pharmacy technicians who are accredited to assess patients` own drugs (POD) and to check the dispensed prescriptions on patient discharge) (Ashfield 2013; Northern Ireland Center for

Pharmacy Learning and Development (NICPLD) 2019). This training qualification is an accredited program for employed pharmacy technicians who wish to extend their roles; and are provided by many colleges and accredited educational bodies across the UK, including the Northern Ireland Centre for Pharmacy Learning and Development (NICPLD) (Northern Ireland Center for Pharmacy Learning and Development (NICPLD) 2019). The program is designed to meet the standard requirements of the national framework for pharmacy technicians working in medicines management (NHS Pharmacy 2016). The ACPT training program is available only for qualified pharmacy technicians with at least two years of working experience with a minimum of six months dispensing experience. Qualified ACPTs have to revalidate their qualification every two years (Northern Ireland Center for Pharmacy Learning and Development (NICPLD) 2019).

3.1.3 Supportive roles of CPTs

Previous studies recognise insufficient time as an obstacle to pharmacists expanding their clinical based activities and services (Napier *et al*. 2018). Napier et al stated "*Lack of time has been identified as a barrier to pharmacists increasing their clinical activities*". For such a reason the role of well-trained CPTs is to assist and support the clinical pharmacy service to achieve the best patient outcomes by medicines optimisation (Turner *et al.* 2005), and to release pharmacist time to complete more complex clinical related activities.

This enhancement role of CPTs was highlighted in a review of clinical pharmacy services in Northern Ireland. It was recognised that pharmacy technicians may be in a position to support the development of clinical pharmacy services further through involvement in ward-based work (*Review of Clinical Pharmacy Services in Northern Ireland.* 2001).

The Integrated Medicines Management (IMM) project supported this view by promoting the integration of pharmacy technicians into the clinical pharmacy team and training them to perform a limited range of activities to support pharmacists. This released pharmacists' time to deal with more highly complicated medication related issues (Scullin *et al.* 2007).

The IMM clinical research project was designed and conducted in Northern Ireland hospitals between 2005 and 2006 to assess and evaluate the clinical and economic impacts of the increased clinical pharmacy staff involvement throughout the full patient journey from admission to discharge (Scullin *et al.* 2007). At admission, the technician assessed patient's own drugs (PODs) to ensure safety and suitability for use during the patient's stay in hospital. During the inpatient stay they were responsible for stock management of medicines on the wards which included a daily review of the medication prescription chart. The technician also highlighted queries from the chart to their pharmacist. At discharge they assisted with communication of information to primary care health professionals (Boughen, M. *et al.* 2017).

Considering how CPTs can boost and support pharmacists in health care will promote and aid in developing health systems with the capability of achieving the desirable sustainable goals including optimising patient care and medicines management (Koehler and Brown 2017).

3.1.4 Rationale

CPS, supported by ward-based CPTs, is a multidisciplinary process achieved by utilising a variety of competent team members, however, it is not clear if these services are provided similarly between different hospitals and also there is still shortage in research investigating CPTs roles, tasks and responsibilities during their day to day work.

3.2 Aims and objectives of the study

3.2.1 Aims

The aim of this study was to demonstrate quantitatively the range and extent of the daily activities supported by ward based CPTs in terms of integrated medicines management. Another aim of the study was to summarise the current roles of the CPTs working in the hospital.

This study was a part of a bigger research project about the hospital pharmacy workforce aimed to enable the best use of the staff resources available based on grades and skills competencies to achieve certain tasks.

3.2.2 Specific objectives

Specific objectives were the following:

i. Analyse the numbers of professional services, tasks and activities carried out by CPTs during the typical working day and identify any different roles between different CPTs` staff grades (bands).

ii. Quantitatively assess the time needed for each task completed by the ward CPTs throughout the day.

iii. Analyse the time distribution for tasks achieved by CPTs throughout the daily working hours.

iv. Evaluate the current CPTs workload to further suggest any possible new roles or tasks that allow better skill mix for the hospital pharmacy workforce.

v. Compare the difference in workload between CPTs working in different ward specialties, particularly medical, surgical, cardiology and long stay wards.

3.3 Method

3.3.1 Study Design

This study was designed as part of a prospective clinical pharmacy services trial. All daily working services and activities undertaken by ward based CPTs were quantitatively documented using data collection forms, and the study was conducted within different 8 wards.

3.3.2 Settings (study site)

This study was conducted in Antrim Area Hospital, the largest regional hospital within the Northern Health & Social Care Trust (NHSCT) with a total of 426 beds. The study involved eight different wards with an average number of 30 beds in each. The selection of these wards was based on different specialties, staff grades and workload. The distribution of the eight wards involved in the study were as following:

- **A3** (Medical ward, Respiratory)
- **A4** (Medical ward, Respiratory)
- **B2** (Medical ward, Elderly care)
- **B3** (Cardiology & Acute Coronary Unit ward)
- **B4** (Medical ward, Endocrine)
- **C5** (Surgical ward)
- **C6** (Surgical ward)
- **C7** (Medical ward for longer stay chronic problems)

3.3.3 Data collection forms

Data collection forms were designed and developed by the lead researcher with the help of the principal supervisor of the project and the principal pharmacist of clinical services in NHSCT who involved also in the overall seeing of the project/study. Two meetings were conducted at the study site with all members of the research group to discuss and finalise the data collection forms and methodology for the whole project including the current study within this chapter.

The data collection forms were designed to enable assessment and analysis of all necessary information (Appendix A). The data collection forms used to record all clinical pharmacy related activities and professional services supported by the ward CPTs during the typical working day and throughout the complete patient journey. This included services for newly admitted patients and pharmacy technicians` services during in-patient hospital stay (e.g medicines dispensing and management during patients' hospital stay and referral of patients` medication charts to the ward pharmacists for further review as well as the supportive services for patients` prescriptions on discharge.

3.3.4 Data collection

Initially, a pilot data collection period was carried out in each ward involved in the study for one week to standardise data collection by both CPTs and the lead investigator. This pilot data collection provided reassurance that the same procedures for data collection would be followed in all wards. Data collected during the pilot was not included in the final analysis of the results.

After ensuring a standardised procedure for data collection and documentation was followed, data was collected from 5 medical, 2 surgical and 1 cardiology wards over a period of one to two weeks for each ward. This represented a total of seventy days (14 weeks) collected; 15 days from surgical wards, 17 days from cardiology and long stay wards, and 38 days from medical wards. The pharmacy workforce in each ward comprised one clinical pharmacist and one CPT (band 5 CPT i.e. senior or higher-level CPT).

The data were collected by the lead investigator assisted by pharmacy staff in each ward. The duties were compared from day to day during the working week and hour to hour during the working day, and moreover between different ward specialties.

3.3.5 Duration of the study

The duration of the valid data collection for this study from all involved wards was total of 70 days (14 weeks excluding weekends).

3.3.6 Inclusion / exclusion criteria

All CPTs professional services for all patients within the selected wards were included. The data were collected only during working days from Monday to Friday (weekends were excluded) and between 09:00 am and 05:00 pm every day (late shifts were excluded). The final check service was only limited to the wards where accredited pharmacy technicians (ACPT) were working.

A period of 24 hours of hospital stay was the minimum duration required to evaluate significant clinical services for any patient within the selected wards.

3.3.7 Method of statistical analysis

Analysis of the data was undertaken using SPSS® software (Statistical Package for Social Sciences) version 22, (Verma 2012; Barton and Peat 2014) . Results were reported as mean ± standard error of the mean (SEM), and standard deviation (SD) was also calculated. Qualitative variables such as percentage were compared using the non-parametric Chi-square test.

Statistical analysis was performed using the Kruskal Wallis Test for non-parametric data with pairwise comparison as a post Hoc test.

- P value >0.05 considered non-significant.
- P value <0.05 considered significant
- P value <0.01 considered highly significant.

3.3.8 Data security

Paper copies of the collected data forms were used and stored securely, ensuring confidentiality of all data contained therein. After analysis of the data, all paper copies were confidentially destroyed. The main investigator together with the principle supervisor acted as custodians for the data processed and generated by the study and they were also responsible for the access to any information included.

3.3.9 Ethical approval

This was a quality service evaluation observational study, so ethical approval was not required.

3.4 Results

3.4.1 Demographic Characteristics of pharmacy workforce within the hospital site.

The pharmacy workforce in Antrim hospital at the beginning of the study period comprised eighty-four (84) pharmacists and sixty-two (62) pharmacy technicians working in all hospital departments including patient care, clinical care facilities, management, policies and other tasks (Figure 3-1). The clinical pharmacy team in the hospital made of pharmacists and pharmacy technicians represents 42.46 % (62 staff) from the total number of pharmacy workforce (146 staff), (Figure 3-1).

The clinical pharmacy team consists of different bands (staff grades); this includes juniors, seniors, consultant and team leaders. At the beginning of the study, the clinical pharmacists` team represented 46.4 % (39 pharmacists) of all working pharmacists within the hospital; while the ward based clinical pharmacy technicians` represent 37.09 % (23) from the total numbers of the working technicians, (Figure 3-1)

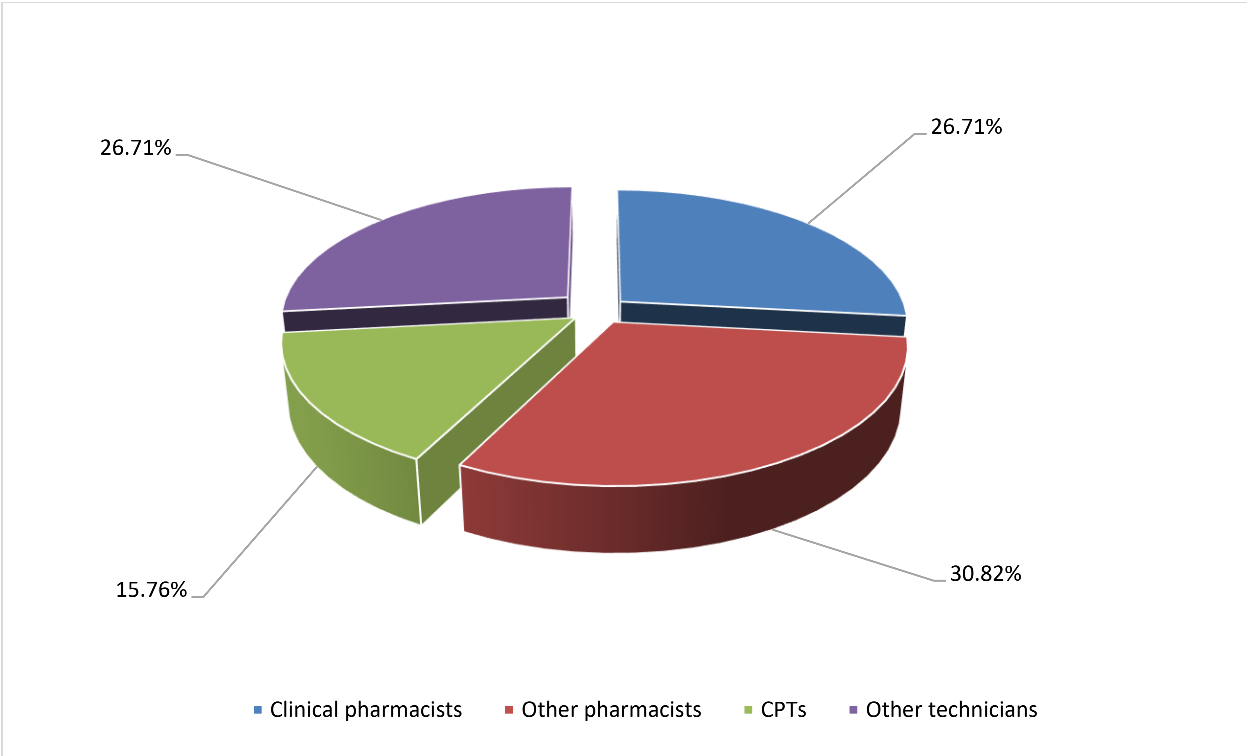


Figure 3-1: Distribution of pharmacists and pharmacy technicians in Antrim Area Hospital at the beginning of the study.

3.4.2 Clinical Pharmacy Technicians services

Data was collected for 70 working days (from Monday to Friday) within 8 different medical and surgical hospital wards with an average number of thirty patients daily in each (30±0.51).

Figure 3-2 in results showed that CPTs undertake seven different clinical pharmacy related activities throughout a typical working day with the main working load focusing on reviewing the patients' medication charts, with an average number reviewed of 23.17±0.85 representing 77.23% of the total patients in the ward (Figure 3-3). Results also revealed that 15.63±1.41 (67.45%) of the patients had their medication lockers checked, with10.84±0.74 (46.78%) of them requiring medication supply by the CPTs (Figure 3-3).

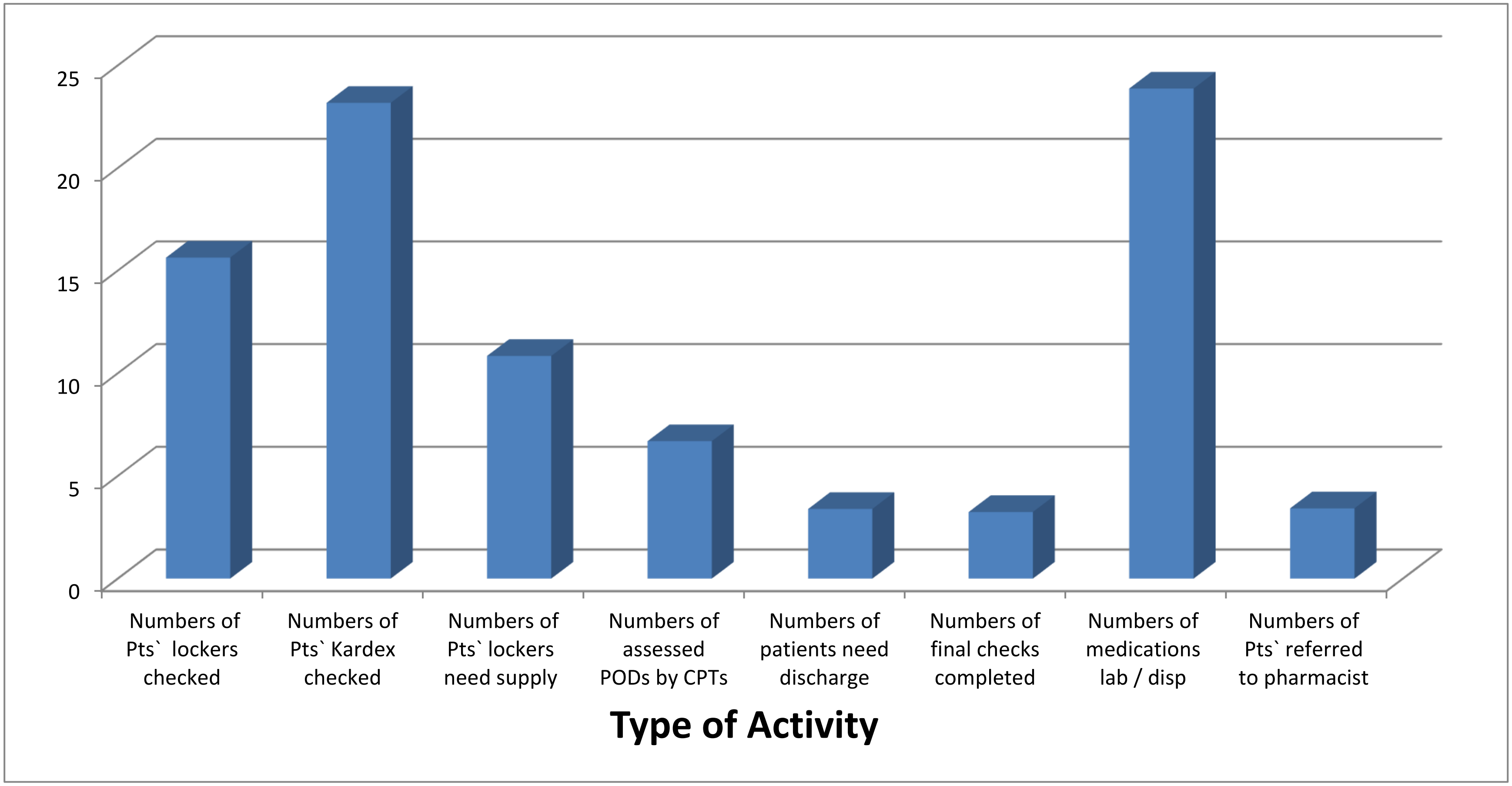


Figure 3-2*:* Types of activities and average working loads completed by CPT in each ward during typical working day.

*CPTs= clinical pharmacy technicians Kardex= patient medication chart PODs= patient own drugs lab= labeled disp= dispensed

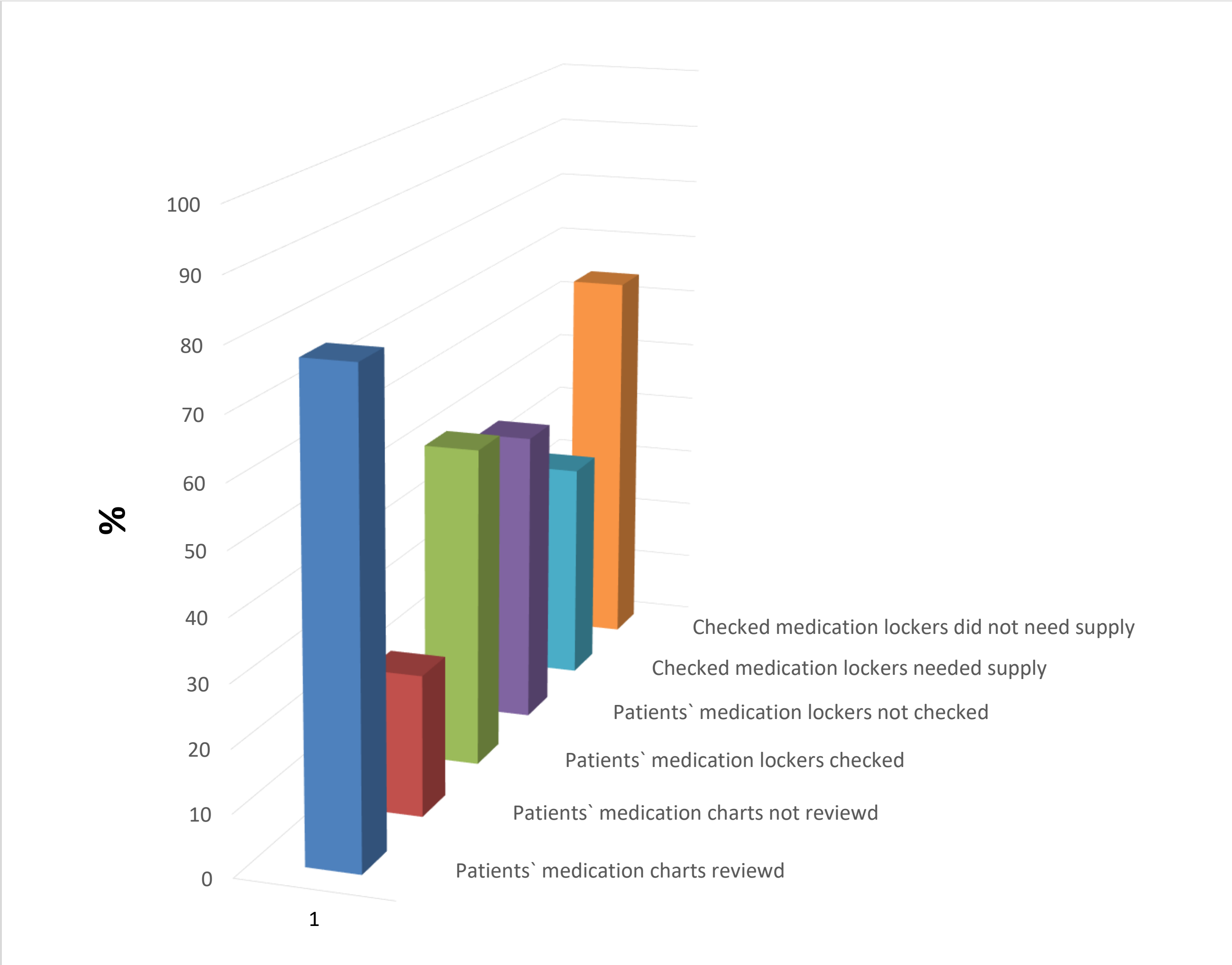


Figure 3-3: Average percent of the daily patients` medication charts (Kardex) reviewed, medication lockers checked and needed supply by CPT in each ward

3.4.3 Analysis of CPTs working loads and activities completed in each ward over a typical day, daily working hours and weekly days.

Results showed that CPTs undertake seven different clinical pharmacy related activities throughout a typical working day with the main working load focusing on reviewing the patients’ medication charts (Table 3-1, Figure 3-2).

It has also shown that, the seven clinical pharmacy related activities were distributed between morning and afternoon hours. Four activities (patients` medication lockers check, medication lockers supply, patients` medication charts review, and referral of patients to the pharmacists for further clinical check) were almost always completed during morning hours (Figure 3-4,5). On the other hand, three other tasks were mostly completed during the afternoon including assessment of the patients own drugs (PODs), labeling and dispensing of medications for discharge, and final checks for the dispensed discharge medicines (Figure 3-4,5).

Patients` medication lockers check and patients` medication charts reviewing were the main work activity of technicians working in all wards (Table 3-1, Figure 3-5). It was shown also that the working load during morning hours was increased compared with the afternoon ones, especially that the final check of the patients` discharge scripts is done only by qualified accredited clinical pharmacy technicians (ACPTs) and not all technicians (Table 3-1, Figure 3-5). Patients` medication lockers check and patients` medication charts reviewing were the main and cornerstone work activity of the technicians working in all wards. Results also revealed that, the CPTs highest workload was on Mondays and Fridays for all activities except labeling and dispensing of patients` medicines for which the highest workload was on Thursdays (Table 3-1, Figure.3-6).

Table 3-1: Mean ± SEM of different CPTs daily working activities and responsibilities over weekly days as well as on an average typical day.

CPT activity	Monday N= 15	Tuesday N= 14	Wednesday N= 14	Thursday N= 14	Friday N= 13	Typical day N= 70	% of patients serviced within the ward *	Significance between weekly days
Average No. of lockers checked	23.33 ± 2.29	12.5 ± 2.2	13.64 ± 2.41	12.35 ± 1.9	16.69 ± 2.97	15.63 ± 1.41	(67.45%) from reviewed	P > 0.05
SD	8.88	8.26	9.02	7.14	10.71	9.58		
Average No. of Kardexes checked	27.06 ± 1.87	23.64 ± 1.87	22.07 ± 1.87	19.35 ± 1.87	23.67 ± 1.87	23.17 ± 0.85	(77.23%)	P > 0.05
SD	7.26	8.32	6.6	5.15	6.83	7.19		
Average No. of lockers needed supply	14.33 ± 1.63	8.5 ± 1.63	10 ± 1.63	8.71 ± 1.63	12.92 ± 1.63	10.84 ± 0.74	(46.78%) from checked	P > 0.05
SD	6.32	5.43	5.89	5.19	6.72	6.22		
Average No. of assessed PODs	7 ± 2.27	7 ± 3.1	5.85 ± 8.93	6.5 ± 3.26	7.23 ± 3.97	6.69 ± 1.13	22.3%	P > 0.05
SD	8.79	11.6	8.93	12.22	14.31	10.96		
Average No. of final check done**	3.70 ± 0.76	3.33 ± 0.52	2.88 ± 0.85	2.11 ± 0.67	4.55 ± 1.6	3.24 ± 0.40	10.8 %	P > 0.05
SD	2.40	1.58	2.57	2.02	4.52	2.71		
Average No. of medicines labeled or dispensed by CPT	17.6 ± 4.06	19.5 ±	25.07 ± 5.28	30 ± 6.95	28.07 ± 5.65	23.87 ± 2.58	N/A	P > 0.05
SD	15.72	25.39 6.78	19.75	26.01	20.38	21.64		
Average No. of patients referred to pharmacist by CPT	5 ± 1.04	2.85 ± 0.85	2.64 ± 0.99	2.57 ± 0.62	4 ± 0.91	3.42 ± 0.40	11.4 %	P > 0.05
SD	4.03	3.18	3.71	2.34	3.29	3.41		

***** % of patients serviced within the ward considering that the average daily numbers of patient is 30

****** Total sample size for the final check done by CPT = 45 from different 5 wards of only accredited CPT checkers (Monday n=10, Tuesday n=9, Wednesday n=9, Thursday n=9, Friday n=8).

N= number of days **No**.= numbers **Kardex**= patient medication chart

SD= Standard Deviation **N/A**= Not Available **P > 0.05** considered non-significant, Kruskall Wallist test

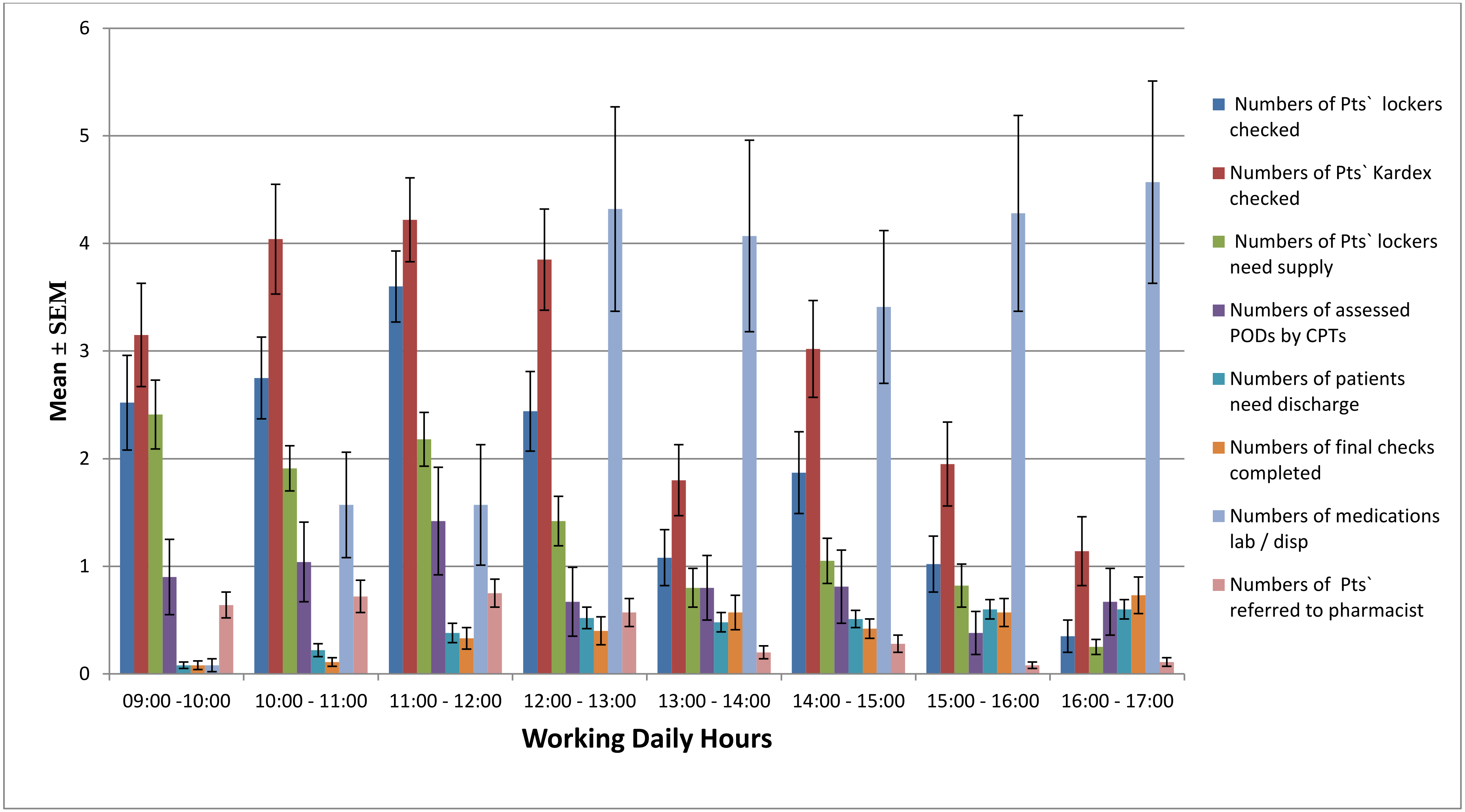


Figure 3-4: Average number of all working loads and activities completed by CPT in each ward over the daily working hours.

*CPTs= clinical pharmacy technicians Kardex= patient medication chart PODs= patient own drugs lab= labeled disp= dispensed

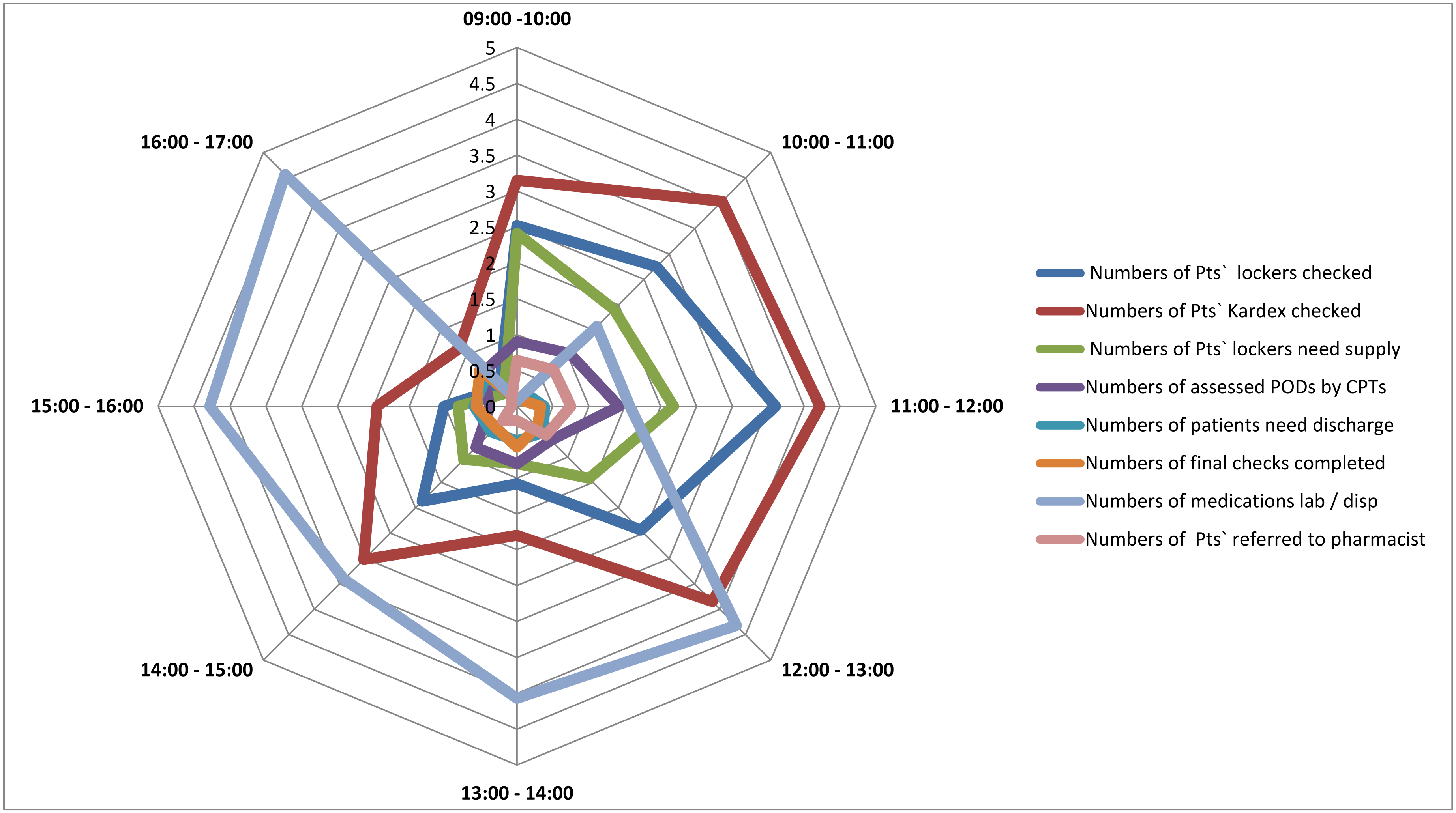


Figure 3-5: Schematic presentation for the average distribution and interaction of different activities completed by CPTs within the ward over daily working hours.

*CPTs= clinical pharmacy technicians Kardex= patient medication chart PODs= patient own drugs lab= labeled disp= dispensed

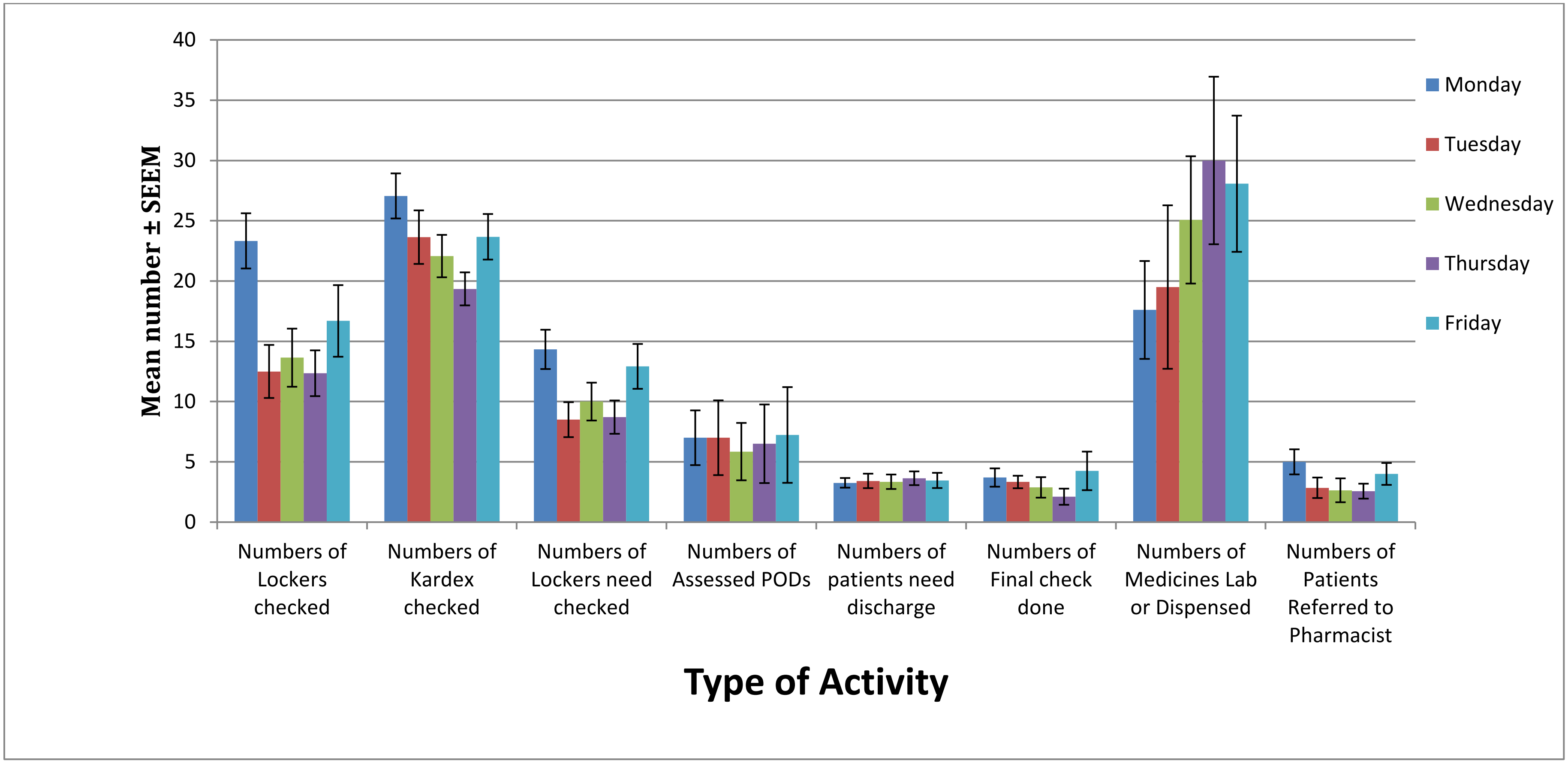


Figure 3-6: Average number of the total working loads and activities completed by CPTs in each ward over weekly days.

*CPTs= clinical pharmacy technicians Kardex= patient medication chart PODs= patient own drugs lab= labeled disp= dispensed

3.4.4 Analysis of the working capacity for CPTs to check the patients` medication lockers within each ward over the daily working hours

Results revealed that the main working load for the checking of patients ` medication lockers was during the morning hours, particularly between 09:00 and 12:00 (Table 3-2, Figures 3-7, 8). It has also shown that, the working capacity during the morning hours allowed the possibility of other activities to be completed by CPTs.

On the other hand, afternoon hours were reserved for other different clinical related activities to be achieved by ward CPTs with sometimes very few numbers of patients` medication lockers being checked (Table 3-2, Figure 3-8).

Table 3-2*:* Statistical analysis of the average number of patients` medication lockers checked by CPT in each ward over the daily working hours**.**

Time	% of Zero Values (No lockers checked)	% of Positive Capacity (working capacity of lockers check)	N (zero values)	N ((+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	55.70%	44.30%	39	31	3.60 ± 2.34	0 (0 – 19)	0.41	2.75 – 4.46
10:00 -11:00	44.30%	55.7%	31	39	3.93 ± 2.23	2 (0- 12)	0.35	3.20 – 4.66
11:00 -12:00	21.40%	79.6%	15	55	5.2 ± 2.68	4 (0 – 10)	0.35	4.48 – 5.93
12:00 -13:00	48.6%	51.4%	34	36	3.48 ± 2.04	1 (0-12)	0.33	2.79 – 4.17
13:00 -14:00	72.8%	27.2%	51	19	1.55 ± 0.94	0 (0-9)	0.21	1.09 – 2.01
14:00 -15:00	55.7%	44.3%	39	31	2.67 ± 2.29	0 (0-14)	0.41	1.82 – 3.51
15:00 -16:00	71.4%	28.6%	50	20	1.48 ± 1.16	0 (0-10)	0.25	0.92 – 2.01
16:00 -17:00	88.6%	11.4%	62	8	0.5 ± 0.39	0 (0-8)	0.13	0.17- 0.83

N: sample size
SEM: standard error of mean
CI: confidence interval
Total sample size = 70

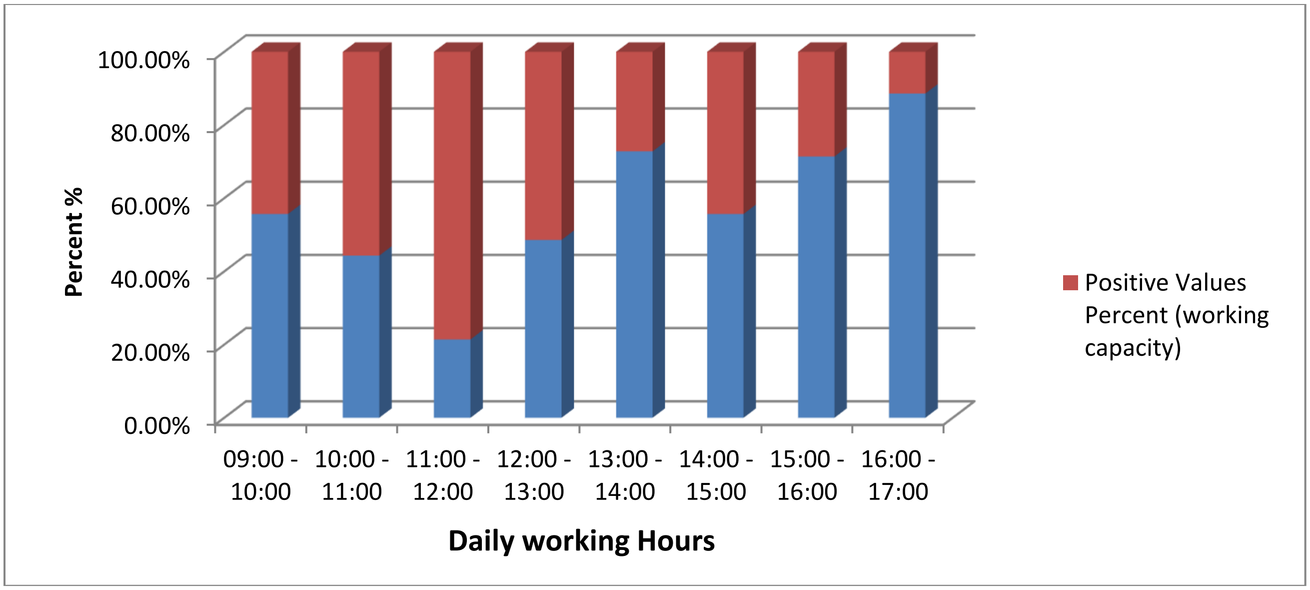


Figure 3-7: Average percentage (%) of the working capacity for the numbers of patients` medication lockers checked by CPTs in each ward over the daily working hours during 70 days sample collection.

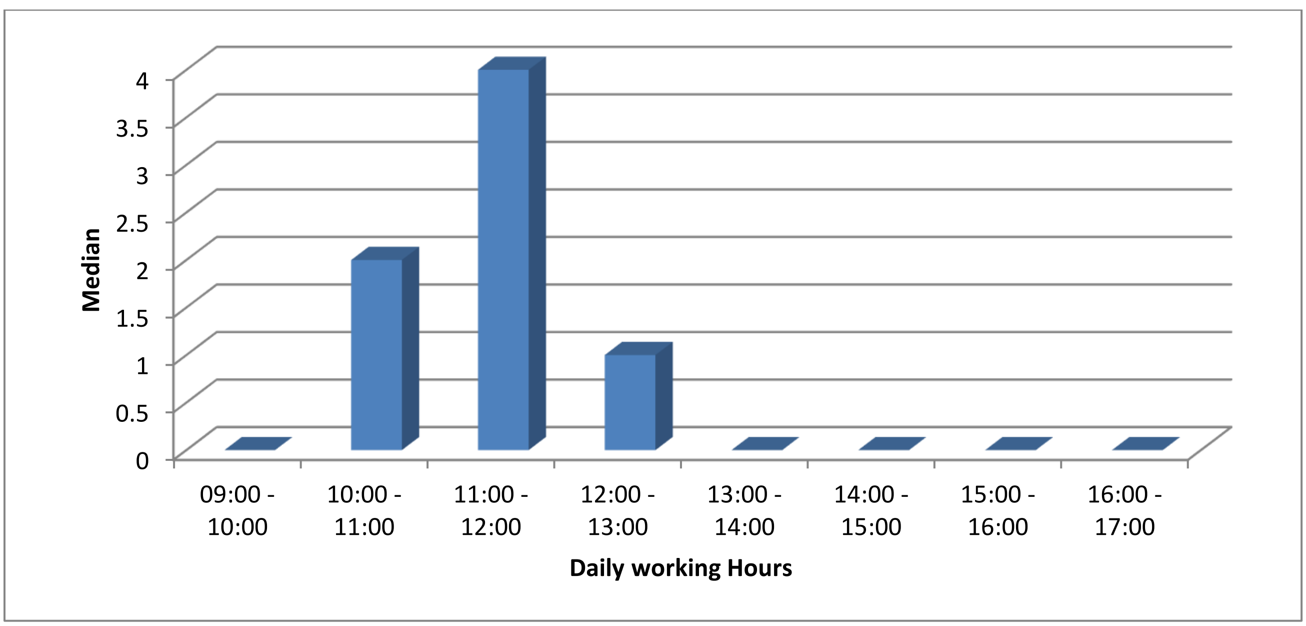


Figure 3-8: Average median number of the Positive working capacity for the numbers of the lockers checked by each ward CPT over the daily working hours.

3.4.5 Analysis of the working capacity for of the patients` medication charts (Kardex) reviewed by CPTs within the ward over the daily working hours.

Results showed that the reviewing of the patients` medication charts (Kardex) by CPTs represented the main working load during morning working hours (Table 3-3, Figures 3-9, 10). However, few numbers of the patients` medications charts were sometimes needed to be reviewed during the afternoon hours (Table 3-3, Figure 3-10).

Table 3-3*:* Statistical analysis of the number of patients` medication charts (Kardex) reviewed by CPT in each ward over the daily working hours.

Time	% of Zero Values (No Kardex checked)	% of Positive Capacity (working capacity of Kardex check)	N (zero values)	N ((+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	48.57%	51.43%	34	36	4.5 ± 2.65	6 (1 -19)	0.44	3.6 - 5.4
10:00 -11:00	34.28%	65.72%	24	46	4.83 ± 3.71	5 (1 – 26)	0.54	4.66 - 6.88
11:00 -12:00	22.85%	77.15%	16	54	6.03 ± 2.94	6 (1 – 12)	0.39	5.23 - 6.84
12:00 -13:00	37.14%	62.86%	26	44	5.5 ± 2.96	6 (1 – 20)	0.44	4.6 - 6.41
13:00 -14:00	60.00%	40.00%	42	28	2.57 ± 1.5	4 (1 – 10)	0.28	1.98 - 3.15
14:00 -15:00	48.57%	51.43%	34	36	4.32 ± 2.51	5 (1 – 15)	0.41	3.47 - 5.17
15:00 -16:00	65.71%	34.29%	46	24	2.79 ± 1.56	5 (1 – 14)	0.31	2.13 - 3.45
16:00 -17:00	75.71%	24.29%	53	17	1.63 ± 1.27	4 (1 – 13)	0.3	0.97 - 2.28

N: sample size **SEM**: standard error of mean **CI**: confidence interval Total sample size = 70

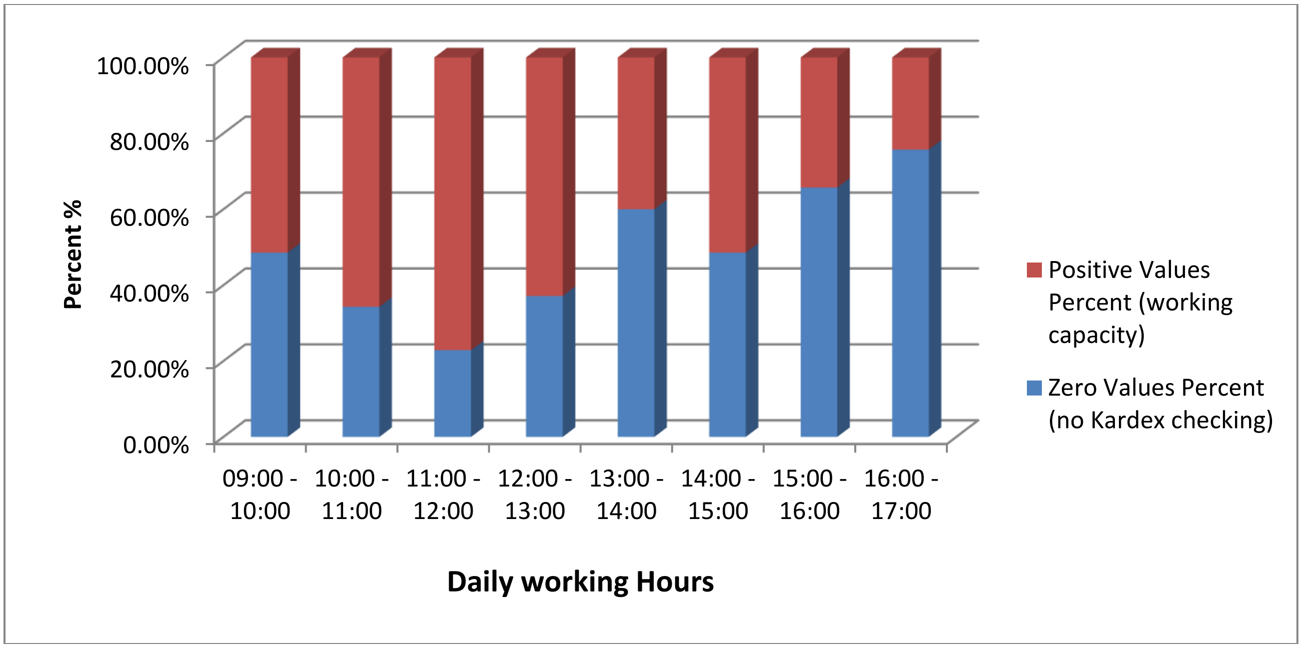


Figure 3-9: Average percentage (%) of the working capacity for the numbers of patients` medication charts (Kardex) checked by CPT in each ward over the daily working hours.

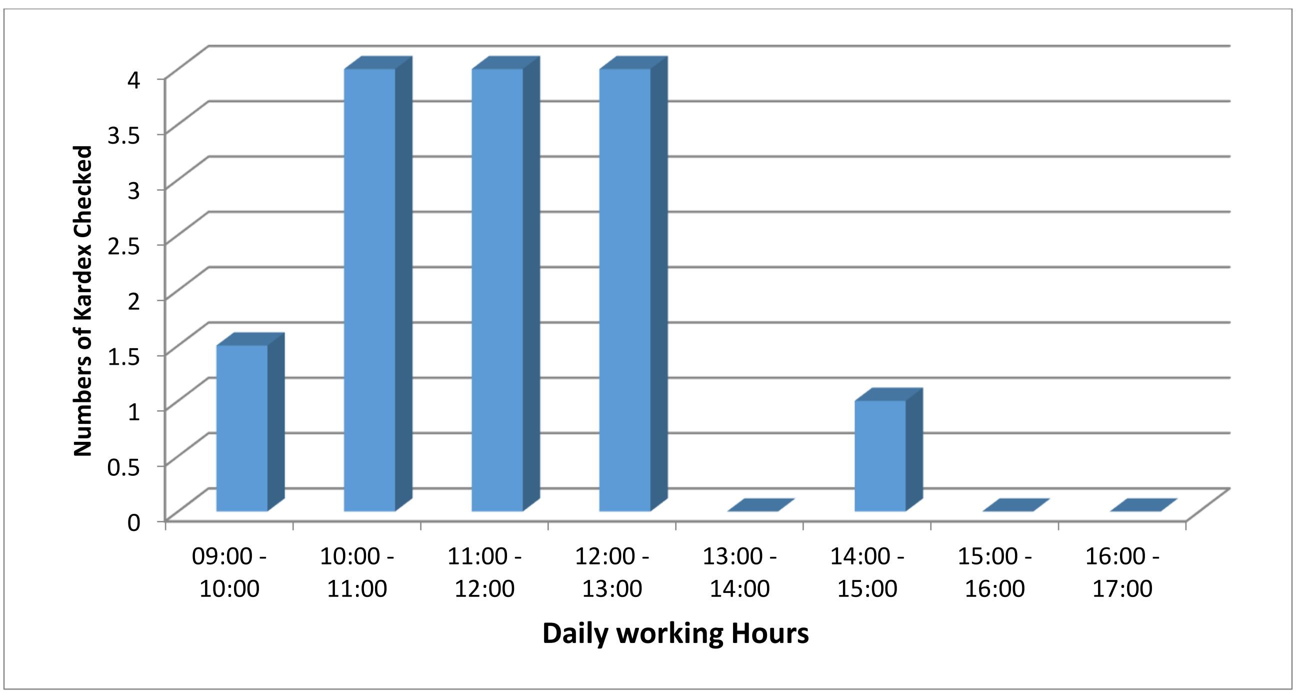


Figure 3-10: Average median number of the Positive working capacity for the numbers of the patients` medication charts (Kardex) reviewed by each ward CPT over the daily working hours.

3.4.6 Analysis of the working capacity of the patients` medication lockers needed supply by CPTs within the ward over the daily working hours.

Because patients` medication lockers supply and top up by ward CPTs are closely connected with, and dependent up on both medication charts reviewing and patients` lockers checking, results showed a higher working load and capacity during the morning working hours compared with the afternoon (Table 3-4, Figures 3-11, 12).

Table 3-4*:* Statistical analysis of the number of patients` medication lockers needed supply by CPT in each ward over the daily working hours.

Time	% of Zero Values (No lockers need supply)	% of Positive Capacity (working capacity of lockers need supply)	N (zero values)	N (+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	34.28%	65.72%	24	46	3.44 ± 2.44	3 1 – 16	0.35	2.71 - 4.1
10:00 -11:00	31.42%	68.58%	22	48	2.73 ± 1.48	2 1 – 6	0.21	2.29 - 3.16
11:00 -12:00	30.00%	70.00%	21	49	3.12 ± 1.87	3 1 – 8	0.26	2.58 - 3.66
12:00 -13:00	54.28%	45.72%	38	32	2.03 ± 1.11	3 1 – 7	0.19	1.63 - 2.44
13:00 -14:00	71.42%	28.58%	50	20	1.14 ± 0.64	2 1 – 6	0.17	0.84 - 1.44
14:00 -15:00	61.42%	38.58%	43	27	1.51 ± 1.11	2 1 – 10	0.21	1.06 - 1.95
15:00 -16:00	70.00%	30.00%	49	21	1.18 ± 0.86	2 1 – 9	0.18	0.78 - 1.57
16:00 -17:00	81.42%	18.58%	57	13	0.36 ± 0.17	1 1 - 3	0.04	0.26 - 0.46

N: sample size
SEM: standard error of mean
CI: confidence interval
Total sample size = 70

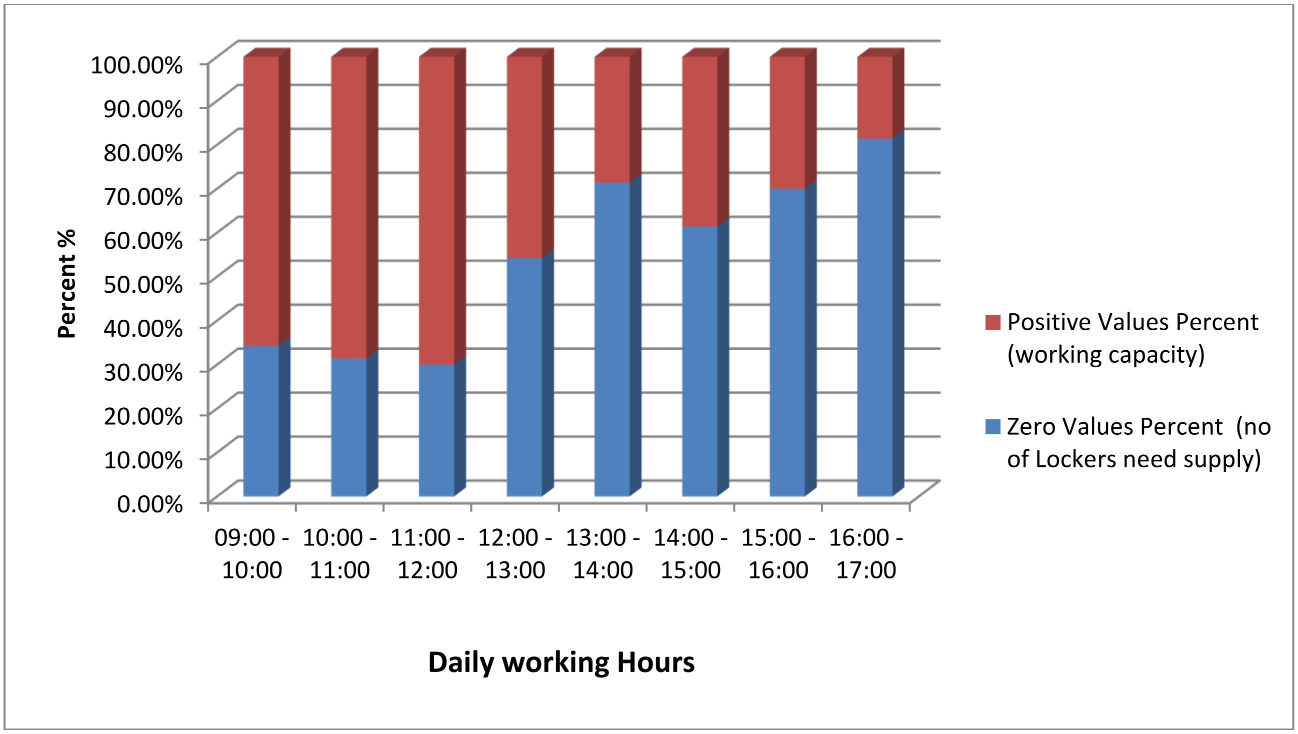


Figure 3-11: Average percentage (%) of the working capacity for the numbers of patients` medication lockers needed supply by the CPT in each ward.

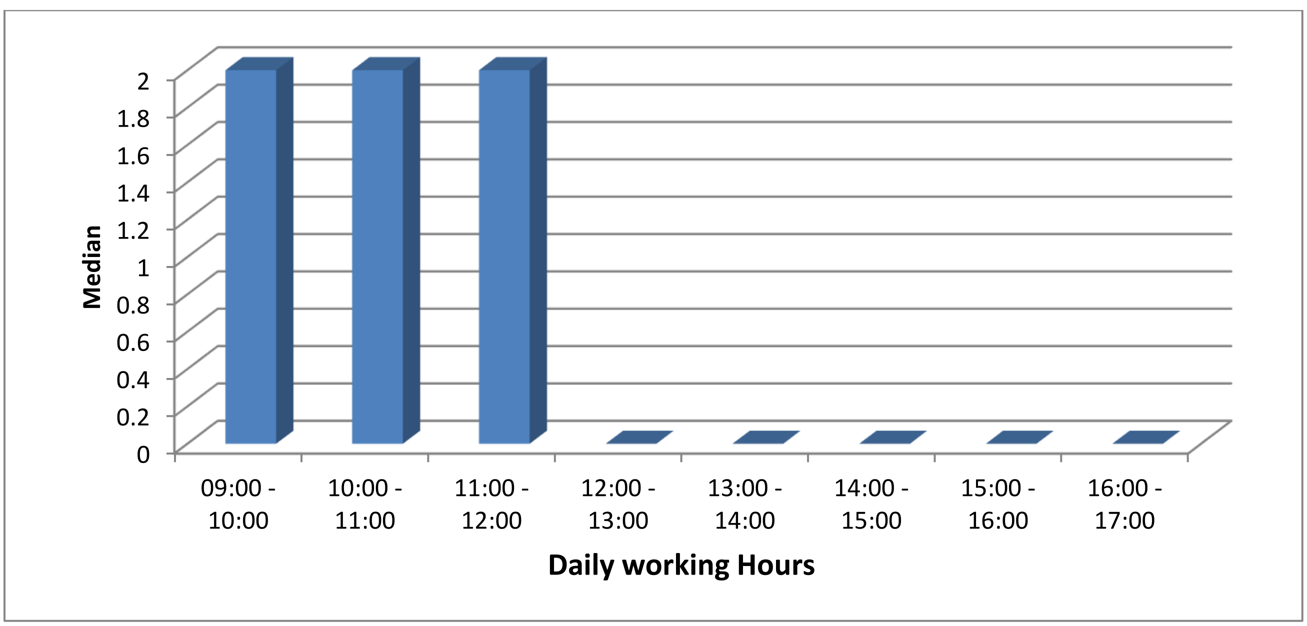


Figure 3-12: Average median number of the lockers need supply by each ward CPT over the daily working hour

3.4.7 Analysis of the working capacity for the numbers of Patients` Own Drugs (PODs) assessed by CPTs within the ward over the daily working hours.

Results showed that the assessment of PODs by CPTs distributed all over the day with nearly equal working load and capacity between morning and afternoon hours (Table 3-5, Figures 3-13, 14). However, an extra significant working load was seen between 12:00 and 13:00. Due to a wide variation in the mean average number of PODs assessed by CPTs between different ward specialties (medical, surgical, cardiology and long stay wards), it was much more reliable and better to present the average results in Median than in mean as the median reflected the real working load and capacity of this activity. However, we plotted both graphs for clarity.

Table 3-5*:* Statistical analysis for the numbers of patients` Own Drugs (PODs) assessed by CPT in each ward over the daily working hours.

Time	% of Zero Values (No PODs assessed)	% of Positive Capacity (working capacity of PODs assessed)	N (zero values)	N (+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	87.14%	12.86%	61	9	1.28 ± 0.94	6 (1 – 15)	0.31	0.55 - 2.01
10:00 -11:00	85.71%	14.29%	60	10	1.49 ± 0.99	6 (1 – 16)	0.31	0.77 - 2.2
11:00 -12:00	84.29%	15.71%	59	11	2.04 ± 1.53	6 (3 – 23)	0.46	1 - 3.07
12:00 -13:00	92.86%	7.14%	65	5	0.95 ± 0.49	11 (1 – 13)	0.21	0.34 - 1.56
13:00 -14:00	88.57%	11.43%	62	8	1.14 ± 0.59	6 (3 – 14)	0.2	0.6 - 1.63
14:00 -15:00	90.00%	10.00%	63	7	1.16 ± 0.73	6 (3 – 17)	0.27	0.47 - 1.84
15:00 -16:00	94.29%	5.71%	66	4	0.55 ± 0.22	6 (4 – 10)	0.11	0.19 - 0.9
16:00 -17:00	90.00%	10.00%	63	7	0.95 ± 0.79	7 (1 – 17)	0.3	0.22 - 1.69

N: sample size **SEM**: standard error of mean
CI: confidence interval
Total sample size = 70

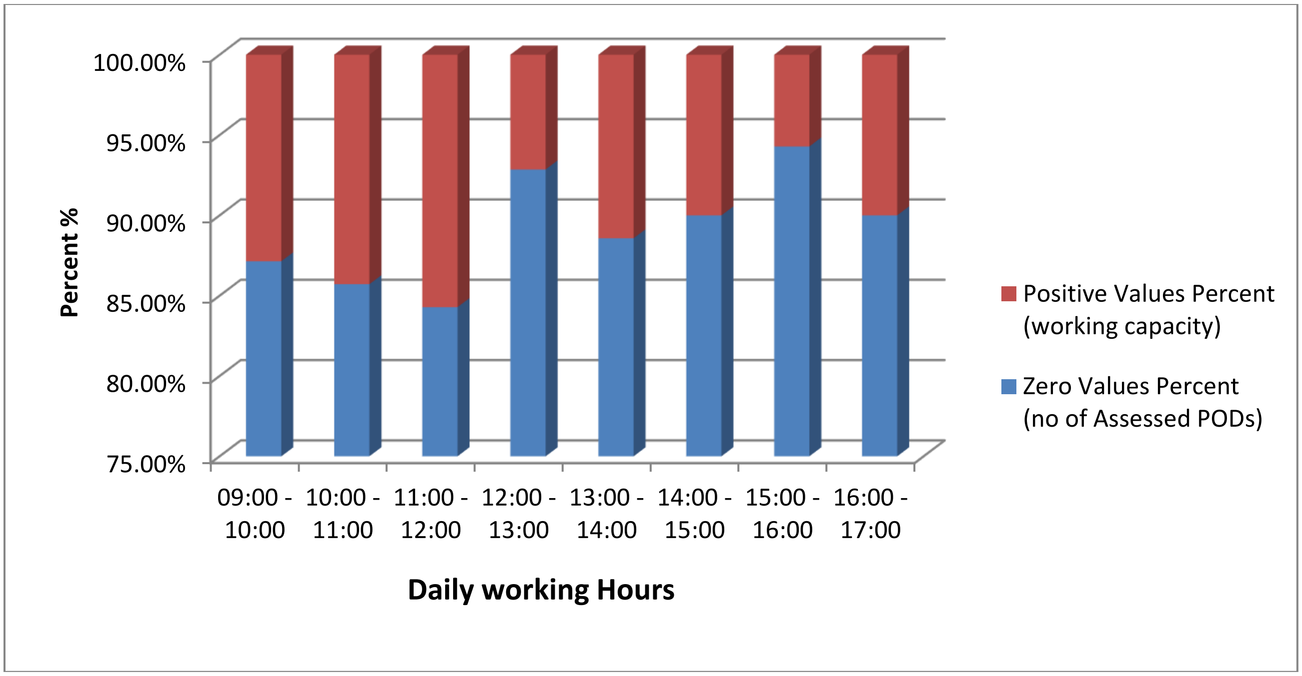


Figure 3-13*:* Average percentage (%) of the working capacity for the numbers of patients` own drugs (PODs) assessed by each ward CPT over the daily working hours.

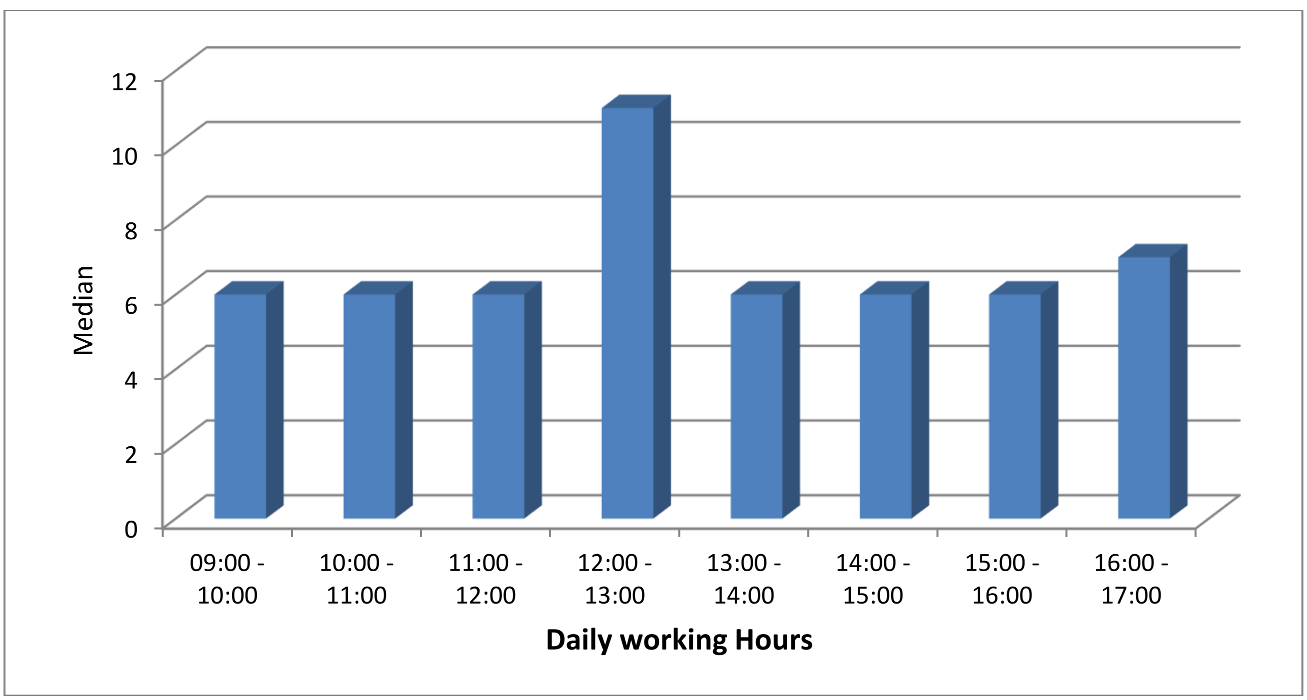


Figure 3-14*:* Average median number of patients` own drugs PODs assessed by each ward CPT over the daily working hours.

3.4.8 Analysis of the working capacity for the number of final checks of discharge prescriptions reviewed by CPTs within the ward over the daily working hours.

Final check of the patients` discharge prescriptions is an essential task usually completed by qualified CPTs (ACPTs) during the discharge phase, which is closely correlated with the number of patients need discharge (Table 3-6, Figures 3-15). Results showed that, most of patients needed to be discharged were during the afternoon hours (Table 3-6, Figures 3-15). Also, final checks for discharge prescriptions were closely relevant to patients on only discharge and consumed relatively less than 50 % of CPTs working load during afternoon hours, allowing other activities to be conducted by the ward CPTs during these hours (Table 3-7, Figures 3-16).

Table 3-6*:* Statistical analysis for the number patients needed discharge within the each ward over daily hours.

Time	% of Zero Values (pts don`t need discharge)	% of Positive Capacity ((No. of pts need discharge)	N (zero values)	N (+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	92.85%	7.15%	65	5	0.12 ± 0.04	1 (1 – 2)	0.02	0.06 - 0.17
10:00 -11:00	81.42%	18.58%	57	13	0.32 ± 0.15	1 (1 – 3)	0.04	0.22 - 0.42
11:00 -12:00	70.00%	30.00%	49	21	0.54 ± 0.4	1 (1 – 5)	0.008	0.36 - 0.73
12:00 -13:00	41.43%	38.58%	45	25	0.75 ± 0.41	1 (1 – 4)	0.08	0.58 - 0.92
13:00 -14:00	61.42%	41.43%	43	27	0.68 ± 0.39	1 (1 – 4)	0.07	0.53 - 0.84
14:00 -15:00	58.57%	41.43%	41	29	0.73 ± 0.3	1 (1 – 3)	0.05	0.61 - 0.84
15:00 -16:00	54.28%	45.72%	38	32	0.85 ± 0.45	1 (1 – 4)	0.78	0.69 - 1.01
16:00 -17:00	58.57%	41.43%	41	29	0.85 ± 0.37	1 (1 – 3)	0.06	0.71 - 0.99

N: sample size **SEM**: standard error of mean **CI**: confidence interval **Total sample size** = 70

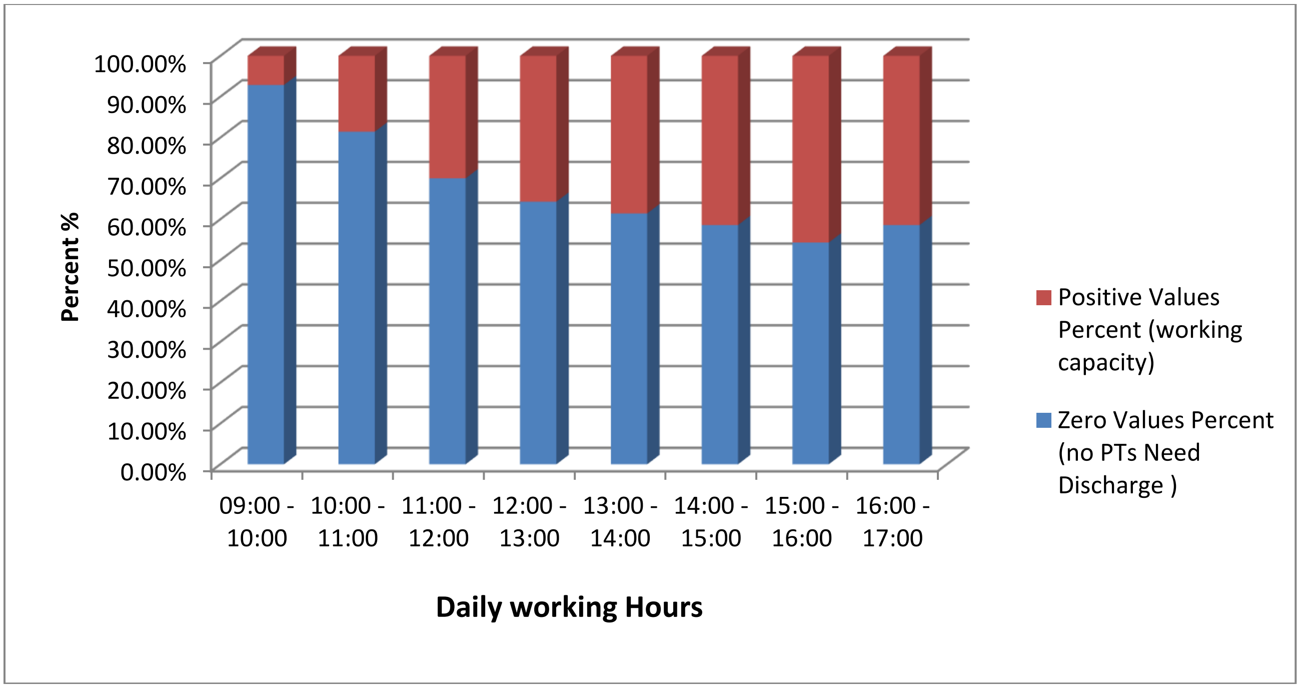


Figure 3-15*:* Average percentage (%) of the working capacity for the numbers of patients needed discharge in each ward over the daily working hours.

Table 3-7: Statistical analysis for the number of final checks of the discharge prescriptions completed by CPT in each ward over the daily working hours.

Time	% of Zero Values (No final checks done)	% of Positive Capacity (working capacity of final checks done)	N (zero values)	N (+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	91.11%	8.89%	41	4	0.20 ± 0	1 (1 – 1)	0	0.20 – 0.20
10:00 -11:00	88.89%	11.11%	40	5	0.25 ± 0	1 (1 – 1)	0	0.25 – 0.25
11:00 -12:00	73.33%	26.67%	33	12	0.74 ± 0.51	1 (1 – 4)	0.25	0.41 – 1.07
12:00 -13:00	73.33%	26.67%	33	12	0.89 ± 0.69	1 (1 – 5)	0.33	0.44 – 1.33
13:00 -14:00	68.89%	31.11%	36	14	1.28 ± 0.80	1 (1 – 4)	0.31	0.82 – 1.75
14:00 -15:00	64.44%	35.56%	34	16	0.93 ± 0.43	1 (1 – 3)	0.13	0.70 – 1.16
15:00 -16:00	62.22%	37.78%	27	17	1.28 ± 0.66	1 (1 – 3)	0.19	0.93 – 1.63
16:00 -17:00	60.00%	40.00%	28	18	1.63 ± 1.07	1 (1 – 5)	0.28	1.09 – 2.16

N: sample size
SEM: standard error of mean
CI: confidence interval
Total sample size for the final checks done by CPTs = 45 from different 5 wards of only accredited CPT checkers (Monday n=10, Tuesday n=9, Wednesday n=9, Thursday n=9, Friday n=8).

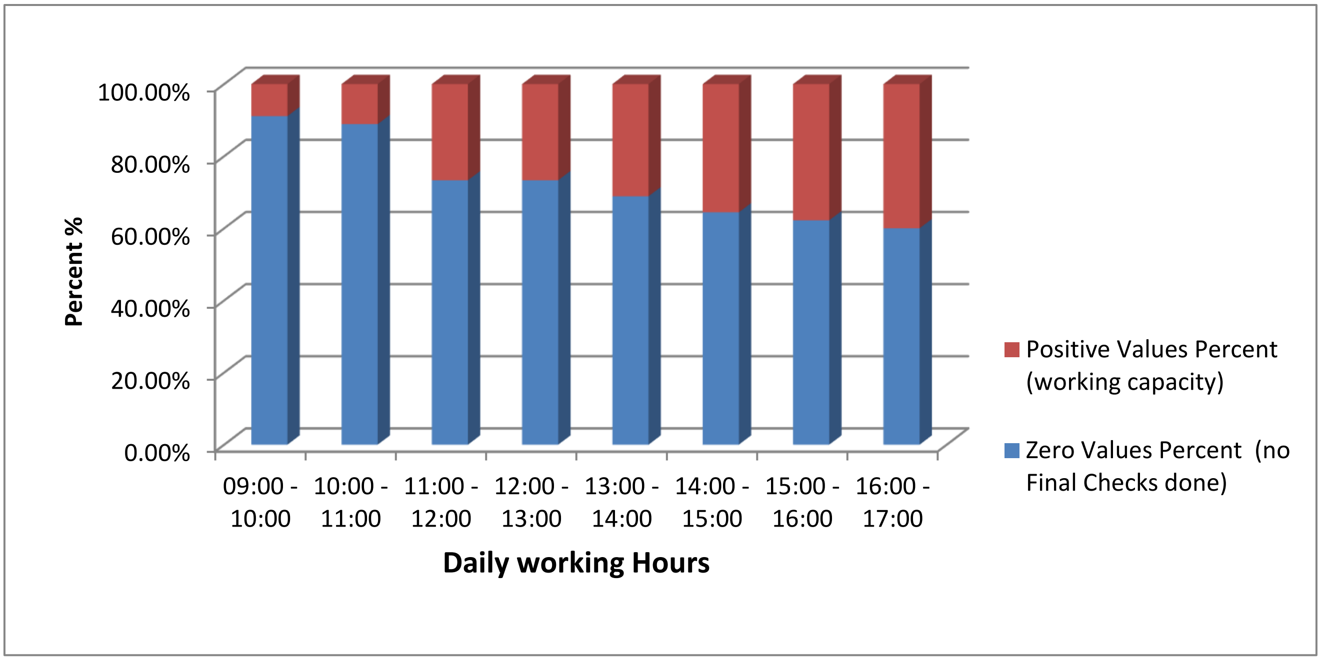


Figure 3-16*:* Average percentage (%) of the working capacity for the numbers of final checks done by a qualified CPT in each ward over the daily working hours during 45 days sample collection.

3.4.9 Analysis of the working capacity for the number of medicines labeled or dispensed by CPTs within the ward over the daily working hours.

Results showed that one of the daily activities done by CPTs is labeling and dispensing of the medicines of the discharge prescriptions in the right way ensuring the right patients, right dose and right regimen. As labeling and dispensing of the medicines were done during the discharge time, so the working load of this activity was mainly during the afternoon time with a maximum working capacity of only 35.71 % between 16:00 and 17:00. Because the working load of this activity was minimum during the other afternoon hours, thus allowed other tasks to be done in parallel (Table 3-8, Figures 3-17,18).

Table 3-8*:* Statistical analysis for the number of medicines labeled or dispensed by CPT in each ward over the daily working hours**.**

Time	% of Zero Value (No medicines lab/dispen)	% of Positive Capacity (working capacity of medicines lab/dispen)	N (zero values)	N (+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	97.14%	2.86%	68	2	0.12 ± 0	3 (3 – 3)	0	0.12 – 0.12
10:00 -11:00	81.43%	18.57%	57	13	2.24 ± 1.57	6 (1 – 18)	0.44	1.29 – 3.19
11:00 -12:00	77.14%	22.86%	54	16	2.24 ± 2.60	4.5 (1 – 34)	0.65	0.86 – 3.63
12:00 -13:00	65.71%	34.29%	46	24	6.18 ± 4.49	11 (1 – 36)	0.92	4.29 – 8.08
13:00 -14:00	67.14%	32.86%	47	23	5.82 ± 3.86	12 (2 -34)	0.80	4.15 – 7.49
14:00 -15:00	67.14%	32.86%	47	23	4.88 ± 2.84	9 (1 – 23)	0.59	3.65 – 6.10
15:00 -16:00	65.71%	34.29%	47	24	5.65 ± 4.25	9 (2 – 38)	0.83	3.93 – 7.37
16:00 -17:00	64.29%	35.71%	45	25	6.53 ± 4.21	11 (1 – 34)	0.84	4.79 – 8.27

N: sample size **SEM**: standard error of mean **CI**: confidence interval Total sample size = 70

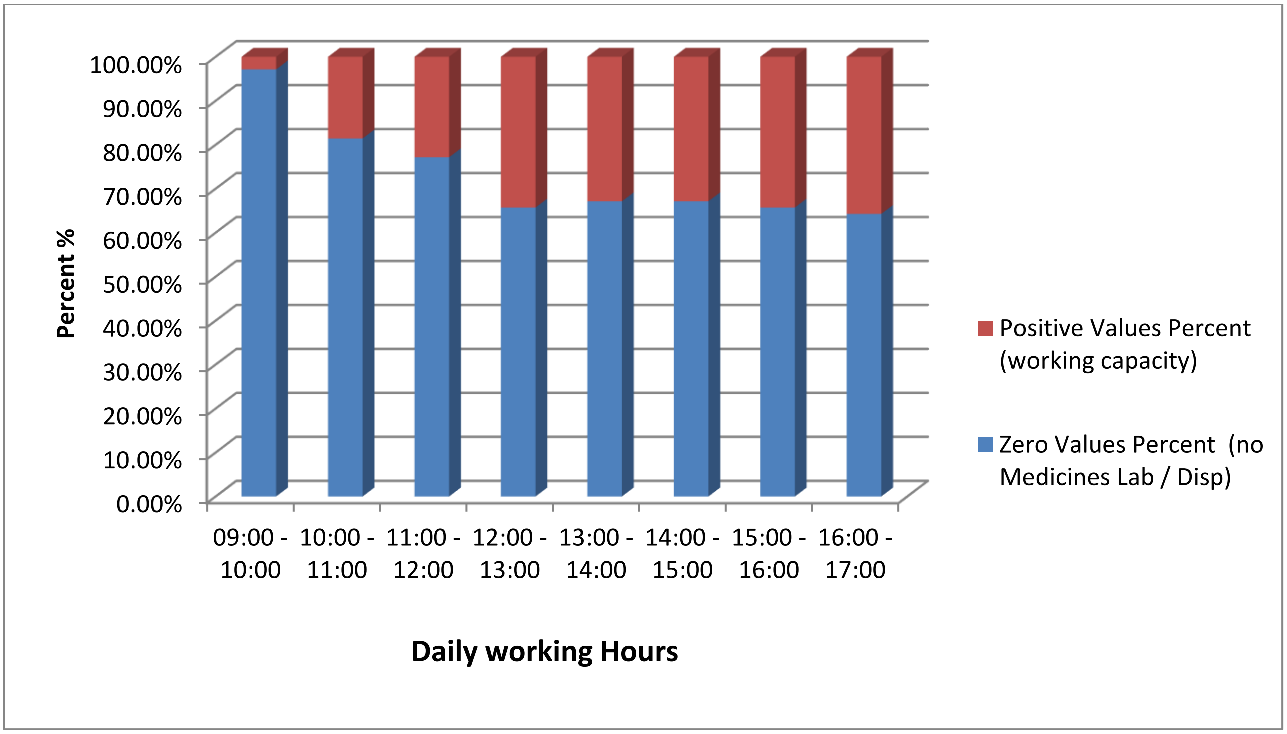


Figure 3-17*:* Average percentage (%) of the working capacity for the numbers of medicines labeled or dispensed by the CPT in each ward over the daily working hours.

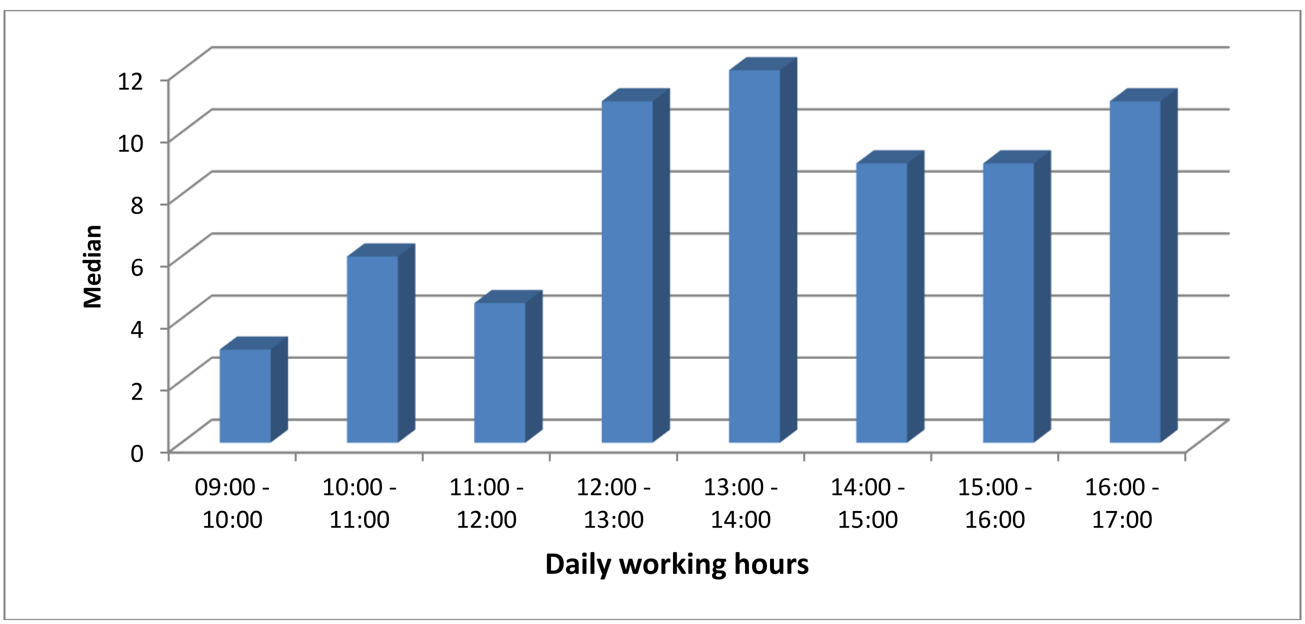


Figure 3-18*:* Average median number of medicines labeled or dispensed by CPT in each ward over the daily working hours.

3.4.10 Analysis of the working capacity for the number of patients' referral to the pharmacists by CPTs within the ward over the daily working hours.

Results revealed that the patients were mostly referred to the pharmacists by CPTs for further clinical check of their medication charts during the morning hours, because this activity was done during the patients` medication charts review (Kardex) and medicines lockers check and topping up (Table 3-9, Figure. 3-19). The working load for this activity was less than 50 % during the morning hours allowing other activities to be conducted and also was very low during the afternoon time (Figure 3-19).

Table 3-9*:* Statistical analysis for the number of patients` referral to pharmacists by CPT in each ward over the daily working hours**.**

Time	% of Zero Value (No. of patients referred)	% of Positive Capacity (working capacity of patients referred)	N (zero values)	N (+ve values)	Mean ± SD Positive Capacity	Median (Min – Max) Positive Capacity	SEM (+ve values)	95%CI (Lower - Upper)
09:00 -10:00	64.29%	35.71%	45	25	0.92 ± 0.51	1 (1 – 4)	0.10	0.70 – 1.13
10:00 -11:00	64.29%	35.71%	45	25	1.04 ± 0.71	2 (1 – 7)	0.14	0.74 – 1.33
11:00 -12:00	60.00%	40.00%	42	28	1.08 ± 0.61	2 (1 – 5)	0.11	0.84 – 1.31
12:00 -13:00	72.86%	27.14%	51	19	0.81 ± 0.51	2 (1 – 6)	0.12	0.57 – 1.06
13:00 -14:00	85.71%	14.29%	60	10	0.29 ± 0.10	1 (1 – 2)	0.03	0.21 – 0.36
14:00 -15:00	75.71%	24.29%	53	17	0.53 ± 0.30	1 (1 – 3)	0.08	0.35 – 0.71
15:00 -16:00	92.86%	7.14%	65	5	0.12 ± 0.04	1 (1 – 2)	0.02	0.07 – 0.18
16:00 -17:00	91.43%	8.57%	64	6	0.16 ± 0.06	1 (1 – 2)	0.03	0.10 – 0.23

N: sample size **SEM**: standard error of mean **CI**: confidence interval Total sample size = 70

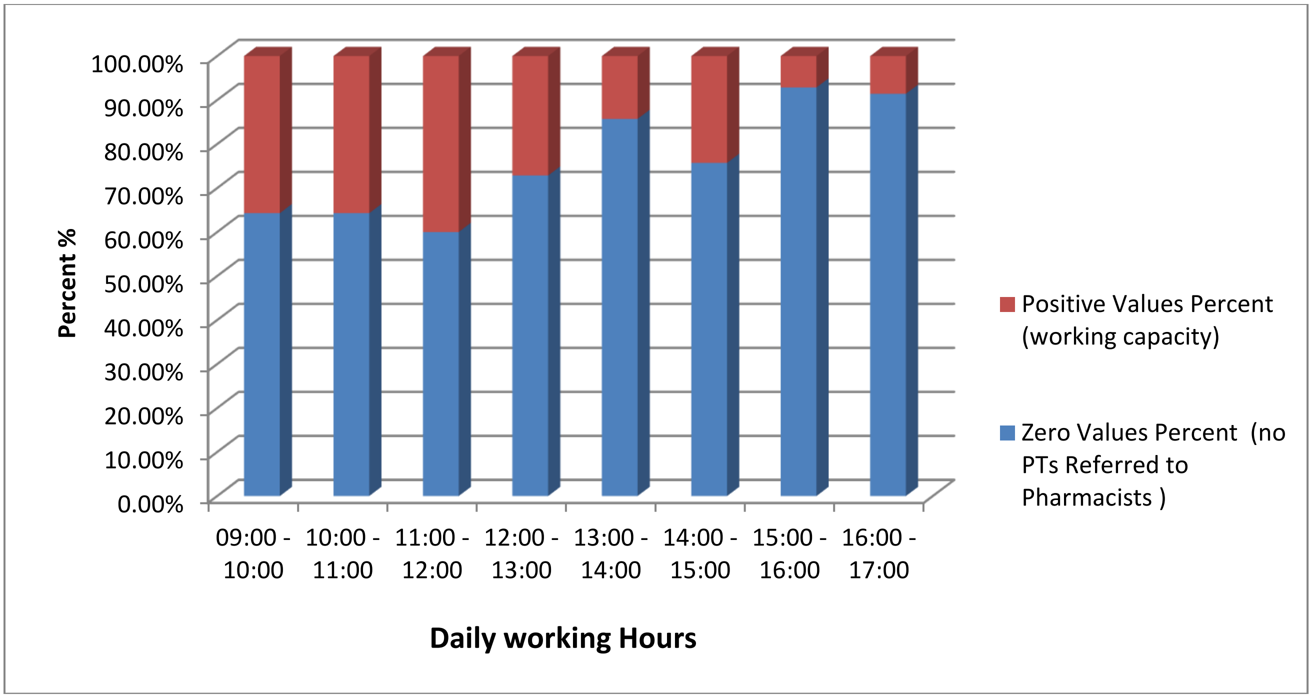


Figure 3-19*:* Average percentage (%) of the working capacity for the numbers of patients` referred to the pharmacists by CPTs in each ward over the daily working hours.

3.4.11 Analysis of information queries received and answered by CPTs from different health care providers within the ward.

Results showed that the average number of information queries received and answered by CPTs in each ward per day was less than two queries (Table 3-10). It was also noticed that, most of queries take less than 5 minutes to be received from one of the health practitioners; and also less than 5 minutes to be answered by the ward CPT (Table 3-10). Most of the information queries answered by CPTs were depending on CPTs knowledge and experience rather than other sources like BNF, medicines information center or recent online guidelines (Figure 3-20). Results revealed also that, one of the two surgical wards did not receive or answer any information queries by the working CPTs, while on the other hand, the CPTs working in cardiology ward received and answered the highest (most) number of information queries (Figure3-21)

Table 3-10*:* Mean ± SEM of the daily information queries received and answered by CPT in each ward and the time taken to complete this task**.**

	Time taken < 5:00 min (N= 70)	Time taken 05:00 - 10:00 min (N= 70)	Time taken 10:00 - 15:00 min (N= 70)	Time taken 15:00 - 20:00 min (N= 70)	Time taken > 20:00 min (N= 70)	Mean average for all wards
Average number of information queries received by CPTs in each ward during the day	1.29 ± 0.18	0.19 ± 0.06	0.06 ± 0.02	0.03 ± 0.02	0.01 ± 0.01	1.57 ± 0.20
Average number of information queries answered by CPTs in each ward during the day	0.96 ± 0.18	0.34 ± 0.07	0.11 ± 0.04	0.06 ± 0.02	0.10 ± 0.04	1.57 ± 0.35

N= sample size

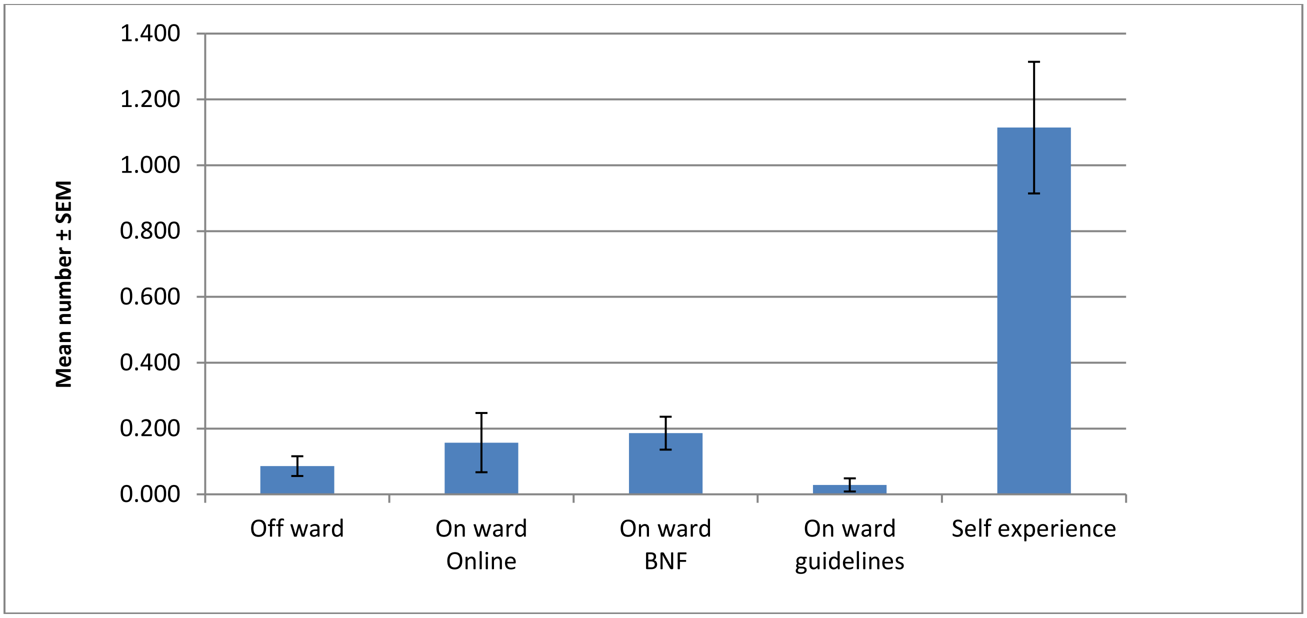


Figure 3-20: Average numbers and types of the different sources used by CPTs to answer the information queries each ward per day.

*Off ward= CPT had to leave the ward to get the information asked such as from medicines information center or meeting consultant

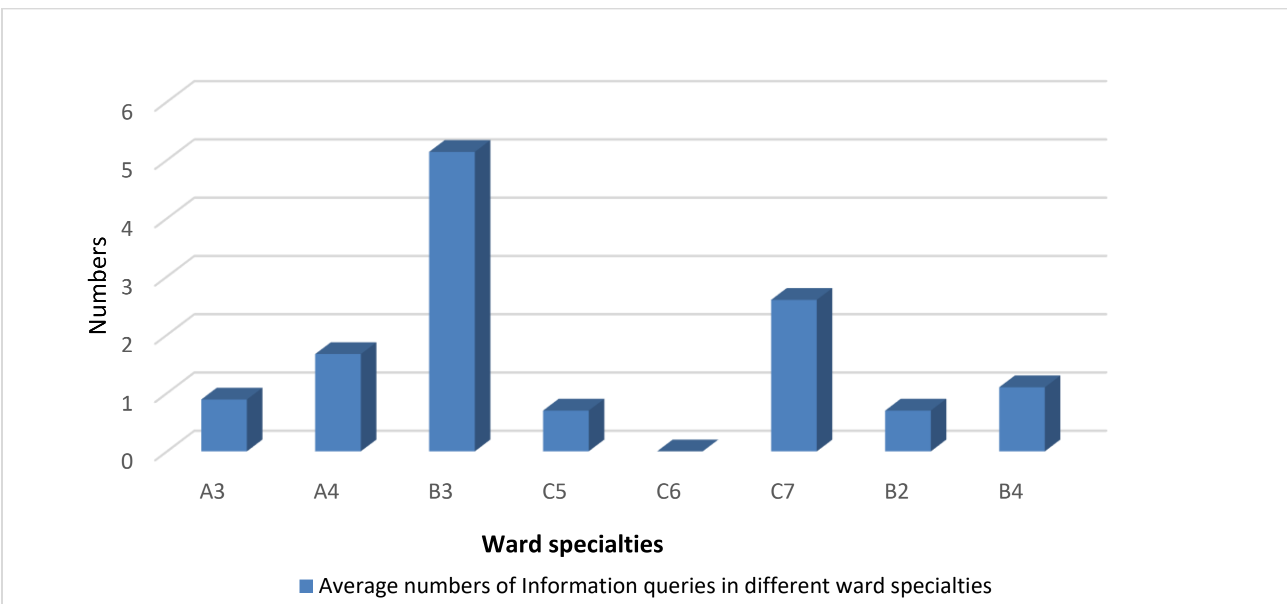


Figure 3-21: Average numbers of information queries received and answered by CPTs within different ward specialties.

3.4.12 Analysis of CPTs working load and activities within different ward specialties.

Results showed, that statistical significant differences (P < 0.05; Kruskal Wallis Test) existed between three different ward specialties (medical, surgical, and cardiology with long stay wards) in 5 clinical activities out of 7 undertaken by CPT per day (Table 3-11). However, there were no significant differences between different weekly days with different ward specialties for all CPTs working activities

Table 3-11: Mean ± SEM of different CPTs daily activities & working load over different wards specialties.

CPT activity#	Medical wards N= 38	Surgical wards N= 15	Cardiology & Long stay wards N= 17	Significance
Numbers of Lockers checked	15.84 ± 1.55	21.40 ± 1.72 [a]	10.76 ± 2.27 [a]	P < 0.05[a]
SD	9.59	6.67	9.39	
Numbers of Kardex checked	22.34 ± 1.20	22.06 ± 1.65	26.23 ± 1.65	NS
SD	7.44	6.39	6.80	
Numbers of Lockers need supply	11.71 ± 0.96 [b]	13.46 ± 1.74 [a]	6.88 ± 1.12 [a,b]	P < 0.05[a,b]
SD	5.92	6.74	4.63	
Numbers of Assessed PODs	2.73 ± 0.81[c]	17.53 ± 4.07 [c]	6.05 ± 2.34	P < 0.05[c]
SD	5.05	15.76	9.67	
Numbers of Final check done	3.05 ± 0.40	0.53 ± 0.32	3.23 ± 0.63	P < 0.01[a,c]
SD	2.51	1.24	2.63	
Numbers of Medicines Labelled or Dispensed	21.94 ± 3.79	33.33 ± 5.66	19.94 ± 3.63	NS
SD	23.39	21.94	14.99	
Numbers of Patients Referred to Pharmacist	3.50 ± 0.59	5.46 ± 0.75	1.47 ± 0.46	P < 0.05[a]
SD	3.67	2.92	1.90	

a: significant difference between cardiology with long stay and surgical wards
b: significant difference between cardiology with long stay and medical wards
c: significant difference between medical and surgical wards
P<0.05: considered significant **P<0.01**: considered highly significant **NS**: no significance
Kruskal Wallis Test for non parametric data with pairwise comparison as a post Hoc test

3.5. Discussion

Currently advanced CPS are supporting patients during the whole hospital journey (admission, inpatient stay and discharge). Such advanced and standardised services are delivered by competent levels of different pharmacy staff members comprising clinical pharmacists, qualified CPTs, and pharmacy assistant technical officers.

CPTs are vital as partners in the pharmacy workforce with their supporting role allowing pharmacists enough time to focus on more clinical related activities (Alkhateeb *et al.* 2011). It has been reported that "*the expanded role of CPTs improved clinical pharmacy service-delivery, staff satisfaction and patient care*" (Elliott *et al.* 2014).

Throughout this study, all daily working services and activities undertaken by ward based CPTs were quantitatively collected and documented from different ward specialties including medical, surgical and cardiology wards. All documented activities were analysed and compared between different working days, daily hours and ward specialties.

Seven different clinical pharmacy related activities were shown to be completed by the ward CPTs working in the hospital. Activities included checking and supply of medicines for patients` medication lockers, reviewing their medication charts, and referring of some patients to the pharmacist for further evaluation, and review, as well as dispensing and checking of medications for patients on discharge, these activities are in harmony with the conclusion of *Gernant et al* which emphasised the supportive roles of CPTs in patients` medication management (Gernant, Stephanie A. *et al.* 2018).

This wide range of professional services completed by CPTs facilitates the pharmacist work and releases time for the ward clinical pharmacist to carry more therapeutic related activities especially for high risk patients and more complicated cases. The range of activities of CPTs were consistent with integrated medicines management (IMM) strategy and one stop dispensing (OSD) policy in the hospital (Scott *et al.* 2015).

The seven clinical pharmacy related activities completed by CPTs were distributed throughout the day. Four activities based around the Kardex (patient medication chart) review, and subsequent supply of medication (patients` medication lockers check, medication charts review, lockers top up and referral of patients to the pharmacists for further clinical check) were almost completed during the morning. On the other hand, other tasks mainly based around the discharge process were predominately completed during the afternoon. This included dispensing and final checking of medications for discharges; the final check is almost completed by accredited CPT checker. Although this study identified seven standardised clinical related activities undertaken by CPTs, however *Schafheutle et al* (2017) stated that, the roles of hospital CPTs still need to be well clarified, regulated and standardised as it is still not unified or consistent between different health care institutions.

It was also shown that, the workload during the morning was greater than the afternoon. So, there is the possibility for some extra clinical pharmacy activities to be added to the responsibilities of CPTs during the afternoon. Activities which are more flexible with regards to timing, such as patient counseling on inhalers or direct oral anticoagulants (DOACs), could be undertaken during this time. The CPTs highest workload was on Mondays and Fridays and mainly during the morning working hours (09:00 – 12:00).

Based on the pilot data collection, it was noted that while some CPTs were used to checking lockers first, all CPTs were advised that time savings could be made if Kardexes were checked before the lockers during the CPTs morning activities. This was adopted during the formal data collection.

Within the study period, reviewing of patients` medicines charts represented the main working load for the CPTs during the morning hours. This may be because CPTs are required as a part of medicines management procedures within OSD to review most of the patients` medication charts within the ward on daily basis and this is usually takes long time (Ashfield 2013; Scott *et al.* 2015).

As a result of reviewing the medicines charts, the senior CPTs currently refer medication related issues to the clinical pharmacists according to a standardised medication scheme list (Scott *et al.* 2015). The role of CPTs is to identify and refer any medicines related issues to the clinical pharmacist, but they were not required to make any clinical judgment.

According to this standardised referral scheme (Appendix D), referrals by CPTs were classified in to three types, red, amber and green; this traffic light system to indicate patient priority for pharmacist assessment and interventions based on their urgency need for the clinical pharmacy services and also, to ensure that pharmacist interventions are completed in a timely manner (Ashfield 2013; Scott *et al.* 2015).

Although the standardised referral scheme was based on identification of any medicines related issues by CPTs within the patient medication chart such as drug allergy, doses and frequency depending on medicines list classification (high risk medicines such as warfarin, insulin, potassium, lithium, immunosuppressents and clozapine; or medium risk medicines such as ACE inhibitors, beta blockers and digoxin; or medicines with no risk such as antihistamines). However, this study showed that, senior CPTs were able to identify and refer more clinical related issues with the patient prescriptions, such as drug-drug interactions, appropriate drug not prescribed and inappropriate drug prescribed.

The following referral examples were done by senior CPTs within medical, long stay and cardiology wards within this study:

- Patient with a significant drug-drug interaction (*simvastatin* 40mg + *amlodipine* 5mg)
- NBM (nil by mouth) patient on *rivaroxaban*, and no *enoxaparin* cover.
- Patient administered an inhaler, which was different from prescribed in Kardex
- Patient with drug duplication (*ipratropium* and *tiotropium*)
- Patient prescribed *slow K*, was administered *slow sodium* over the weekend
- Patient prescribed *ticagrelor*, has missed 4 doses
- A new start of *rivaroxaban* and patient require counseling
- Patient prescribed an Item short from the manufacture, guidelines checked by the CPT and patient was referred to the pharmacist to amend the prescription
- Patient administered a drug not prescribed in Kardex
- Patient on unlicensed medicine
- Patient prescribed *teicoplanin* (IV), needs dose correction

Most of these referrals were completed by the senior accredited CPTs in cardiology and long stay elderly medical wards. Looking at these referrals gave an idea on the competency knowledge of the senior CPTs that may suggest more use of their skills (based on structured training packages) in supporting the clinical pharmacy services. This suggestion is in agreement with *Ronald et al* (2018) who mentioned that, senior, experienced, well-trained and accredited CPTs can support more clinical roles that would improve the efficiency and performance of clinical pharmacy services.

Also, other referrals identified by CPTs included medicines management issues such as, risk of Venous Thromboembolism (VTE, not completed or signed, wrong name of medicine, un-approved abbreviations (IMN; for iso-sorbide mono-nitrate), no strengths for some medicines and oxygen prescription not signed.

Within this study, an average of at least three patients with different medication related issues were referred daily by CPTs to the ward clinical pharmacist for further clinical assessment and interventions.

On other hand, significant differences existed in 5 out of 7 activities undertaken by CPTs between the three ward specialties (medical, surgical and cardiology with long stay wards), this included; numbers of patients` medication lockers check, lockers top up and referral of patients to the pharmacists for further clinical check in addition to numbers of assessed patients own drugs (PODs) and final checking of medications for discharges.

Based on findings from other studies, the significant difference may be attributed to the difference in patients` length of the stay between surgical wards and other ward specialties, within surgical wards, patients may stay for shorter duration than other wards (Liu *et al.* 2001; Lagoe *et al.* 2016), although the daily patient numbers within the wards are similar at around thirty. This was obvious in the significantly increased numbers of medication lockers check, lockers top up and referral of patients to the pharmacists as well as assessing PODs when compared with other ward specialties.

Also, and according to *Nobili et al* (2011), within medical and cardiology with long stay wards, patients almost always have pre-existing co-morbidities and consequently are prescribed an increased number of regular medications (poly-pharmacy), justifying the imperative need of accurate final checks for patients' discharge prescriptions achieved by accredited CPTs checkers. On the other hand, in surgical wards, the discharge prescriptions almost always comprise one, two or three medications, usually none of which is a high-risk medication. For such reasons the accredited CPTs checker are vital in both cardiology and medical wards for accurate checking of the discharge prescriptions for patients with multi chronic illnesses.

In terms of workloads over weekly days, there were no significant statistical differences between the three ward specialties in the average numbers of the seven clinical related activities completed by the ward CPTs.

Answering of medicines` information queries from other health care staff in the ward was another activity completed by CPTs within their wards with at least one query answered by CPT in each ward every day, this activity was in accordance with the findings of *Koehler and Brown* (2017) who confirmed that the well trained, experienced and certified CPTs can independently answer some of medicines information queries by other healthcare staff. Many different evidenced based resources were used by CPTs to answer the queries from other health care staff in the ward, this included on ward use of British National Formulary (BNF), online published local and national guidelines, experience based competency knowledge and through the help of medicines information center in the trust. However, most of the answers of CPTs were based upon their previous knowledge and experiences. Receiving and answering of each query by CPTs for most of questions took less than 10 minutes that did not significantly affect the time for other tasks to be completed.

The following are some examples of queries received by CPTs from other health care providers in the ward:

- Question about Renasys® pump for wound therapy
- Questions about different strengths and doses for some medicines
- Storage of prepared IV fluids
- Antibiotic reconstitutions
- Questions on medidose use
- Questions on insulin device use
- Questions about refilling of hypercalcemia kit
- Questions about alternatives for some medicines

Answering some medicines related enquires by CPTs seemed to save some time for the pharmacist to focus on other tasks, however there was no opportunity within this study to check for the CPTs answers if it was correct and completed.

Most of information queries received by CPTs were in cardiology and medical wards comparing to other wards; however, one of the surgical wards did not receive any query during the study period.

In addition to the seven regular clinical related activities completed by CPTs, other administrative related tasks were done by CPTs like printing of NIECR for the newly admitted patients; updating the white board of the OSD pharmacy room within the ward; and communication with primary care for some patient needed information and issues, this was consistent with other published findings regarding the different management tasks and activities of hospital pharmacy technicians (Leversha *et al.* 2001; Carroll *et al.* 2003; Alkhateeb *et al.* 2011).

Also, other stock related issues and tasks were completed by the ward CPTs as required. Examples of such included, checking of the stock cupboard; top up and create orders for the weekends; collection of urgent orders from the dispensary pharmacy (e.g. discharge prescription urgently needed within 10 minutes, insulin needed urgently and urgent aseptic prescriptions); order fluids for a patient on dialysis and going around all wards to look for a stock of an item which dispensary did not have (e.g. a patient needed bumetanide IV). This supportive task to facilitate the delivery of the patients medicines within the ward was in harmony with some of *Seaton* and *Adam`s* findings (2010).

Occasionally, CPTs were involved in the training of the nurse staff on the use of JAC system (a software for order and labeling of medicines), but this was irregular and ad-hoc.

CPTs have an integral role as part of the CPS within secondary care. The introduction of Electronic prescribing and medicines administration systems in the future will remove some of the tasks undertaken in this study but will provide time to undertake new roles, currently pharmacy technicians are not registered in Northern Ireland (unlike colleagues in the rest of the UK). This has to some extent limited the progression to more complex clinical roles.

Despite this, the clinical part of their role has increased since the study with the introduction of a further accredited course for patient history taking and one for patient counseling currently being developed. This expansion role will further increase the skillset of CPTs ensuring optimum clinical pharmacy services and best patient outcomes.

CPTs numbers and bands (grades), as well as competency level such as accredited pharmacy technician checker, should be considered when allocating CPTs within different clinical specialties of nearly equal patient number. This would ensure optimum clinical pharmacy services and best patient outcomes.

3.6 Strengths / Limitations

This is one of very few studies that quantitatively measured and analysed the clinical roles, activities and responsibilities of CPTs within hospitals, compared with most of other studies, which were based on feedback questionnaires from both clinical pharmacists and CPTs.

Data were mostly collected with the support of pharmacy workforce, performance bias may be considered as one of the limitations of the study, however data collection were piloted just to ensure the ease of the process an minimise the expected bias. Also, data were collected throughout the regular hospital working day so some data was not possible to be collected such as exact time spent for each task or activity achieved by CPTs in the ward.

3.7 Conclusion

CPTs are vital to support clinical pharmacy services and their roles can be enhanced to release more time allowing pharmacists to focus on therapeutic issues and use their prescribing skills. CPTs complete more than seven clinical pharmacy related activities which support the role of medicines optimisation, medicines management and patient care. Although CPTs completed seven standardised clinical related activities beside some other administrative and stock related issues, there is still possibility for them to undertake some other duties during the afternoon.

This study provides an overview of the different CPTs roles and responsibilities over the working week and during different period of the working day. This will inform decision-makers how to make optimum use of available workforce

CPTs numbers and bands (grades) as well as competency level such as accredited pharmacy technician checker and years of work experience should be considered when allocating CPTs within different clinical specialties of nearly equal patient number. For the best use of the CPT staff resources, experienced, certified and senior ACPTs should be reallocated in an appropriate skill mix with other clinical pharmacy workforce together with development of new structured training programs to promote their clinical skill. This will help enhance performance of CPS and also release up pharmacists' time to focus on more complicated clinical tasks and for best use of their skills.

This overview will enable the optimum utilisation of the current CPT workforce, providing job satisfaction and career development that meet the needs of service users and carers, thus ensuring the most efficient use of resources to achieve best patients` outcomes.

Further studies are needed to test the impact of development and upgrading of the CPTs to an enhanced clinical role on the clinical pharmacists` responsibilities, time, patients` outcome and cost effectiveness.

Chapter IV

Analysis of clinical pharmacists` activities during patients` hospital admission and discharge

4.1 Introduction

4.1.1 Clinical Pharmacist

Many factors such as increased frequency of incidence and occurrence of diseases and intricacy of therapeutic innovations and treatment choices, including medicines, initiated an opportunity for clinical pharmacists to develop and extend their roles to provide a complete clinical pharmacy service throughout the whole patient journey from hospital admission to discharge (Kumar 2011; American College of Clinical Pharmacy *et al.* 2015).

The conventional medicines dispensing task of inpatient pharmacist has modified over the years to incorporate supporting direct patient care integrated with other health care providers. Also, clinical pharmacists support development of patients` therapeutic plans, management policies and guidelines and conduct research relevant to pharmacy practice within their hospital sites (Kaboli *et al.* 2006; Cobaugh *et al.* 2008).

Clinical pharmacists work as an integral part of the healthcare team to confirm and assure that prescribed medicines are the most appropriate, safe and effective (Briggs *et al.* 2015). The services provided by ward dedicated clinical pharmacists like patients` medication charts reviews, identifying and reporting of adverse drug reactions, monitoring and management of patient care plans, are all aimed to achieve patients` medicines optimisation (Olson *et al.* 2005).

Furthermore, pharmacists with advanced practice specifications are working to support many clinical pharmacy services in different patient hospital settings, including prescribing medicines on patients` discharge by senior pharmacists with relevant prescribing qualification (Murawski *et al.* 2011). IMM services allowed pharmacist to support patients during all stages of hospital care (admission, inpatient hospital stay and discharges) (Scullin *et al.* 2012).

In addition to the clinical benefits achieved through implementation of clinical pharmacy services on admissions and discharges, it could help reducing other health care usage such as the time taken by doctors or nurses for reviewing and reconciling patients` medication histories, optimising inpatient hospital medicines and reviewing discharge prescriptions (Grimes *et al.* 2010).

4.1.2 Medicines Reconciliation

Medicines Reconciliation (MedRec) is the process of obtaining and confirming the most full, correct and accurate list of patient`s current medicines, including pre-hospital, on admission and at all interfaces where there is a transition of care (Barnsteiner and Hughes 2008; Rose *et al.* 2017).

This process involves detection and correction of any medicines related discrepancies with evidence-based recommendations to the health care providers (Barnsteiner and Hughes 2008; Lee, R. *et al.* 2019). The procedure of MedRec on admission and discharge aims to ensure patient safety and improve medicines appropriateness and effectiveness (Institute for Health Care Improvement 2011; Belda-Rustarazo *et al.* 2015; Almanasreh *et al.* 2016).

Conducting MedRec by clinical pharmacists on admissions and discharges were shown to significantly decrease the number of unintended medicines related errors and discrepancies as well as enhance the course of patient care (Mekonnen *et al.* 2016; Bravo *et al.* 2019; Salameh *et al.* 2019).

According to NICE (National Institute for Health and Care Excellence) recommendations and guidance, MedRec is considered one of the top priorities of medicines optimisation where the patient is at the center of all clinical services (Payne 2015; Shah and Barnett 2015).

The involvement of the clinical pharmacist is a crucial and decisive element during transitions` of patients care (from home to hospital, within hospital stages and during discharge from hospital to home and nursing homes). Conduction of MedRec on both hospital admission and discharge in addition to other clinical services supported by the clinical pharmacist became an essential part of overall health services within hospitals (American College of *et al.* 2012; Manias *et al.* 2012; Marvin *et al.* 2016). Getting the detailed and definite medicines history and carrying out the reconciliation diminishes the risk of an adverse drug reaction (McLeod *et al.* 2008; Manias *et al.* 2012).

Pharmacist-led MedRec together with the delivery of detailed definite correct discharge information have been recognised as enhancing the continuance of medicines management during the patient transfer of care (Fredrickson and Burkett 2019; Lee, R. *et al.* 2019). Approximately 33% of medication errors were determined, analysed and resolved on admission through carrying out MedRec (Breuker *et al.* 2017). MedRec conducted by pharmacists has been proven to be cost effective and significantly economical, in addition to the clinical advantages (Onatade and Quaye 2018).

Although the principle of MedRec appears to be appropriately direct and simple, carrying out this process has been shown to be difficult and challenging (Greenwald *et* *al.* 2010). Complicating factor includes length of hospital stay, number of hospital admissions and frequent care stages and transfer (Lertxundi *et al.* 2017).

Number, regularity and uniformity of delivering clinical pharmacy services, in particular MedRec on both admission and discharge is affected by workforce limitations that may suppress and obstruct the service enhancement. Development of standards of practice will facilitate the eradication and ruling out the differences between hospitals and help service improvement (Grimes *et al.* 2010).

Implementation of MedRec on admissions and discharge is an essential process for patient care, however, it was shown that there are higher risks and with a greater numbers of medicines-related problems occurring at patients` admissions comparing to those on discharge, thus early identification and resolution of medicines discrepancies on admission will decrease the number of medication errors on and facilitate efficient discharge (Belda-Rustarazo *et al.* 2015). Daily roles and tasks of the clinical pharmacy team should be designated and assigned in a way that permits the best use of his/her skills, experience and staff grade (junior, senior or consultant pharmacist). This should enable time to be realised for other additional clinical pharmacy activities (Sowell *et al.* 2017).

The time required to conduct different clinical pharmacy services is influenced by many different factors such as; ward specialty (medical or surgical), staff grade, staff ratio and numbers of patients within the ward (Stuchbery *et al.* 2008).

4.1.3 Rationale

Many studies have analysed the importance and benefits of conducting Medicines Reconciliation on hospital admissions and discharge, however; it is also very important to look at pharmacy staff work load to carryout such an activity such as time needed, grade of staff allocated, length and number of patients per ward taking in consideration the difference in ward specialties.

4.2 Aims and objectives of the study

4.2.1 Aims

The primary aim of this study was to analyse the main clinical pharmacy services completed by ward-dedicated clinical pharmacist during patients` hospital admissions and discharges. In particular, analysis of medicines reconciliation workload in each ward on hospital admissions and discharges, including the number of MedRecs completed, time spent by different staff grades and differences between ward specialties to enable the best use of the hospital pharmacy workforce resources.

Another goal was to identify any challenges or barriers which limit pharmacists from supporting this activity according to hospital allocated standards and guidelines.

4.2.2 Specific objectives

Specific objectives were the following:

i. Analysis of the main daily activities completed by the ward dedicated clinical pharmacist during both patients` hospital admission and discharge.

ii. Quantitatively measure and assess:

a) Daily numbers of MedRecs completed in each ward and the time taken by the pharmacist on this activity during both hospital admissions and discharges.
b) Percent (%) of patients reviewed daily by the ward dedicated clinical pharmacists in each ward.

c) Total numbers of medicines and also, the frequency of high-risk medicines included in the daily discharge prescriptions which are clinically checked by clinical pharmacist in each ward

iii. Evaluate and compare

a) Different clinical pharmacy staff grades (bands) contributing to hospital MedRec activity during admissions and discharge.

b) Difference in numbers and time taken by clinical pharmacists to complete MedRecs within different ward specialties.

iv. Test for any correlation between pharmacy staff grades (bands) and number of MedRecs completed, time spent for this activity, numbers of total medicines for each patient, number of high-risk medicines and length of patient hospital stay.

4.3 Method

4.3.1 Study Design

This study was designed as a prospective clinical pharmacy observational study. The main daily working services and activities undertaken by ward dedicated clinical pharmacists during patients` hospital admissions and discharges were quantitatively documented using data collection forms, and the study was conducted within different eight wards.

4.3.2 Settings (study site)

This study was conducted in Antrim Area Hospital, the largest hospital within the Northern Health & Social Care Trust (NHSCT) with a total of 426 beds. The study involved eight different wards with an average number of 30 beds in each. The selection of theses wards was based on different specialties, staff grades and workload. The distribution of the eight wards involved in the study were as following:

- **A3** (Medical ward, Respiratory)
- **A4** (Medical ward, Respiratory)
- **B2** (Medical ward, Elderly care)
- **B3** (Cardiology & Acute Coronary Unit ward)
- **B4** (Medical ward, Endocrine problems)
- **C5** (Elective surgery admission ward)
- **C6** (Elective surgery admission ward)
- **C7** (Medical ward for long stay chronic problems)

4.3.3 Data collection forms

Data collection forms were designed by the lead researcher and with the help of the principal supervisor of the project and the principal pharmacist of clinical services in

NHSCT who was the study site supervisor for the project. Several meetings were conducted at the study site with the research group to discuss and finalise the data collection forms and methodology for the whole project including the current study within this chapter. The data collection forms were designed to enable assessment and analysis of all necessary information (Appendix A).

The data collection forms were used to record the main daily clinical pharmacy services and activities achieved by the ward dedicated clinical pharmacists during patients` hospital admissions and discharges, in particular the medicines reconciliation service. This included services for newly admitted patients (medicines history interviews and reconciliations) and services for patients on discharge such as clinical check and writing of the discharge prescriptions as well as patients counseling service.

4.3.4 Data collection

Initially, a pilot data collection period was carried out in each ward involved in the study for one week to standardise data collection by both ward clinical pharmacist and the lead investigator. This pilot provided reassurance that the same procedures for data collection would be followed in all wards. Data collected during the pilot was not included in the final analysis of the results.

After ensuring a standardised procedure for data collection and documentation was being followed, data were collected from 5 medical, 2 surgical and 1 cardiology wards over a period of one to two weeks for each ward. This represented a total of seventy days (14 weeks) collected; 20 days from surgical wards, 20 days from cardiology and long stay wards, and 40 days from medical wards. The pharmacy workforce in each ward comprised one clinical pharmacist (junior, senior, or consultant i.e band 6, 7 or 8a respectively) and one clinical pharmacy technician (CPT) (band 5 CPT i.e. senior or higher-level CPT).

The data were collected by the lead investigator, assisted by pharmacy staff in each ward. The duties were compared between different pharmacy staff grades (junior, senior and consultant) and also between different ward specialties (medical, surgical, cardiology and long stay wards). The types of data collected included, numbers and time spent for MedRecs completion in each ward during both hospital admission and discharge including time for medicines history interviews; pharmacy staff grades contributed in this activity and their working loads; total numbers of medicines clinically checked by the pharmacist for each patient on discharge; numbers and frequency of high risk medicines in discharge prescriptions; length of patients` hospital stay; and assessment of workload for patients needed counseling on discharge.

4.3.5 Duration of the study

The duration of the valid data collection for this study from all involved wards was total of 80 days (14 weeks excluding weekends).

4.3.6 Inclusion / exclusion criteria

The main clinical pharmacy services (in particular MedRecs activities) on admission and discharge for all patients within the selected wards were included. The data was collected only during working days from Monday to Friday (weekends were excluded) and between 09:00 am and 05:00 pm every day (night shifts were excluded). All clinical pharmacists` grades (bands) within the selected wards were included (band 5 pharmacist i.e pre-registration pharmacists` activities' were excluded).

Only clinical pharmacy services on admission and discharge were investigated.

4.3.7 Method of statistical analysis

Analysis of the data was done using SPSS® software (Statistical Package for the Social Sciences) version 22, (Verma 2012; Barton and Peat 2014) . Results were reported as mean ± standard error of the mean (SEM), and standard deviation (SD) was also calculated. Qualitative variables such as percentage were compared using the non-parametric Chi-square test.

Statistical analysis was performed using the following:

- Un-paired T-test to compare between two groups or variables of parametric data
- Mann-Whitney test to compare between two groups or variables of non-parametric data.
- One-way ANOVA to compare parametric data of three or more groups with one variable with Tukey HSD as a post HOC test.
- Kruskal Wallis Test for non-parametric data with pairwise comparison as a post Hoc test.
- Two way ANOVA to compare three or more groups with more than one variable (multivariate).

  - P value >0.05 considered non-significant.
  - P value <0.05 considered significant
  - P value <0.01 considered highly significant.

- Pearson correlation (bivariate) for parametric and continuous data
- Spearman correlation (bivariate) for non-parametric and/or nominal data.

  Correlation coefficient= *r*

  - ***r* = 0 - 0.4** (a weak and positive association between the two variable)
  - ***r* = 0.4 - 0.7** (a moderate and positive association between the two variable)

- ***r* = 0.7 – 1** (a strong and positive association between the two variables)
- ***r* = -1 – 0** (a negative association between the two variables "strong, moderate or weak").
- ***r* = 0** (no linear relation between the two variables)

*** *r***= Correlation coefficient

4.3.8 Data security

Paper copies of the collected data forms were used and stored securely, ensuring confidentiality of all data contained therein. After analysis of the data, all paper copies were confidentially destroyed. The main investigator together with the principle supervisor acted as custodians for the data processed and generated by the study and they were also responsible for the access to any information included.

4.3.9 Ethical approval

This was a quality service improvement observational study, so ethical approval was not required.

4.4 Results

4.4.1 Summary of Pharmacists` grades (bands) working within different ward specialties involved in the study.

Ten ward dedicated pharmacists with different staff grades and years of experience (junior, senior and consultants) were working within the selected wards for the study (Table: 4-1). The wards involved in the study were selected based on testing the clinical pharmacy services in different specialties (surgical, medical, cardiology and long stay) as well as different staff grades and skills.

Table 4-1: Distribution of different pharmacist bands (grades working within the tested wards involved in the study**.**

Ward Specialty	Numbers and grades of working Pharmacists			Note
	B6	**B7**	**B8a**	
A3 (Respiratory ward, chronic)	1			
A4 (Respiratory ward, Acute)		1		
B3 (Cardiology & ACU ward)	1		1	
C5 (Elective surgery admission ward)	1			supervised by one B8 pharmacist
C6 (Emergency & non elective surgery ward)	1 (during the second week)	1 (during the first week)		supervised by one B8 pharmacist
C7 (Medical ward for long stay chronic problems)		1		
B2 (Elderly care medical ward)		1		
B4 (Medical ward, Endocrine problems)		1		

B= Pharmacist band (grade) **B6**= Junior pharmacist **B7**= Senior Pharmacist **B8a**= Consultant Pharmacist

4.4.2 Analysis of ward dedicated clinical pharmacists` activities during patients` hospital admissions.

Ward clinical pharmacists complete many different activities throughout the full patient hospital journey, however the pilot data collection of the study revealed that; the main clinical pharmacists` activities during patients' admissions was Medicines Reconciliation (MedRec).

4.4.2.1 Analysis of the daily numbers of MedRecs completed by the ward dedicated clinical pharmacists during patients` hospital admissions.

4.4.2.1.1 Daily numbers of admission MedRecs completed by the ward dedicated clinical pharmacists during within all wards involved in the study.

Results showed that, the average number of newly admitted patients per ward every day is 5.36 ± 2.48 which represented 19.2 % of the total number of patients in each ward at 27.86 ± 4.64 (Table 4-2, Figures 4-2). About 86 % of those newly admitted patients required their MedRecs to be completed within the ward (4.61 ± 2.71). However, the analysis of the data found that the average number of MedRecs completed on admission by the pharmacist per ward every day is 4.08±2.35 and this represented about 88 % from the total number of daily MedRecs required in each ward (Table 4-2, Figure 4-1). Results revealed also that, 99% (4.05 ± 2.36) of all the MedRecs that were completed (4.08±2.35) required prior confirmation of the medicines history by interviewing the relevant patients / carers (Table 4-1, Figures 4-2). Moreover, further data collection and analysis found that, in addition to the above results, an average of less than one MedRec was completed daily outside the ward (0.75±0.01) and before the patient transferred to the ward (i.e. the patient MedRec was completed while patient review in the emergency department or admission ward) and if this correlated will mean about 14 % from the newly admitted patients (i.e an extra 14% over the already assigned workload). Also, results showed that 0.52±0.02 was not completed by the ward clinical pharmacist within the same day (Table 4-3).

Table 4-2: Analysis of the average numbers and percentage of daily MedRecs completed on admission by ward dedicated clinical pharmacists for all wards involved in the study over 80 days data collection.

	Mean ± SD	Median (Min – Max)	SEM	95%CI (Lower - Upper)
Numbers of daily MedRecs required	4.61 ± 2.71	4 (0 – 12)	0.30	4.0 – 5.21
Numbers of daily medicines history interviews completed*	4.05 ± 2.36	4 (0 – 10)	0.26	3.52 – 4.57
Numbers of daily MedRecs completed	4.08 ± 2.35	4 (0 – 10)	0.26	3.56 – 4.0
Total number of patients per ward per day	27.86 ± 4.64	27 (15 – 36)	0.51	26.82 – 28.89
Numbers of daily newly admitted patients in each ward	5.36 ± 2.48	5 (1 – 12)	0.27	4.81 – 5.91
% of MedRecs completed from required	88.36 ± 20.68	100 (0 – 100)	2.31	83.76 – 92.97

Sample size = 80 days

SEM= Standard error of mean
CI= confidence interval
MedRecs= Medicines reconciliations
*Numbers of daily medicines history interviews completed as a part of MedRec process.

Table 4-3: Mean±SEM of the daily admissions` MedRecs completed outside the ward and those not completed within the same day.

	Average Number	Percentage (%) from newly admitted patients
Daily MedRecs Completed outside The Ward	0.75 ± 0.01	13.99
MedRecs not Completed within the same day	0.52 ± 0.02	9.79

SEM= Standard error of mean

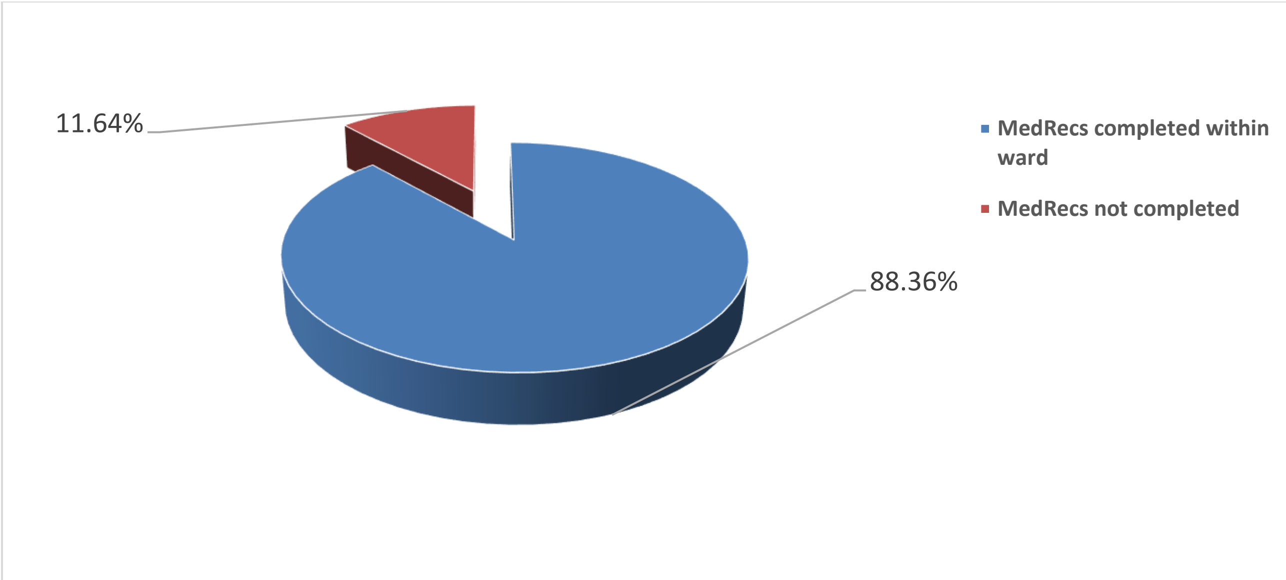


Figure 4-1: Average percentage (%) of the daily MedRecs completed by ward dedicated clinical pharmacists from those required for the newly admitted patients.

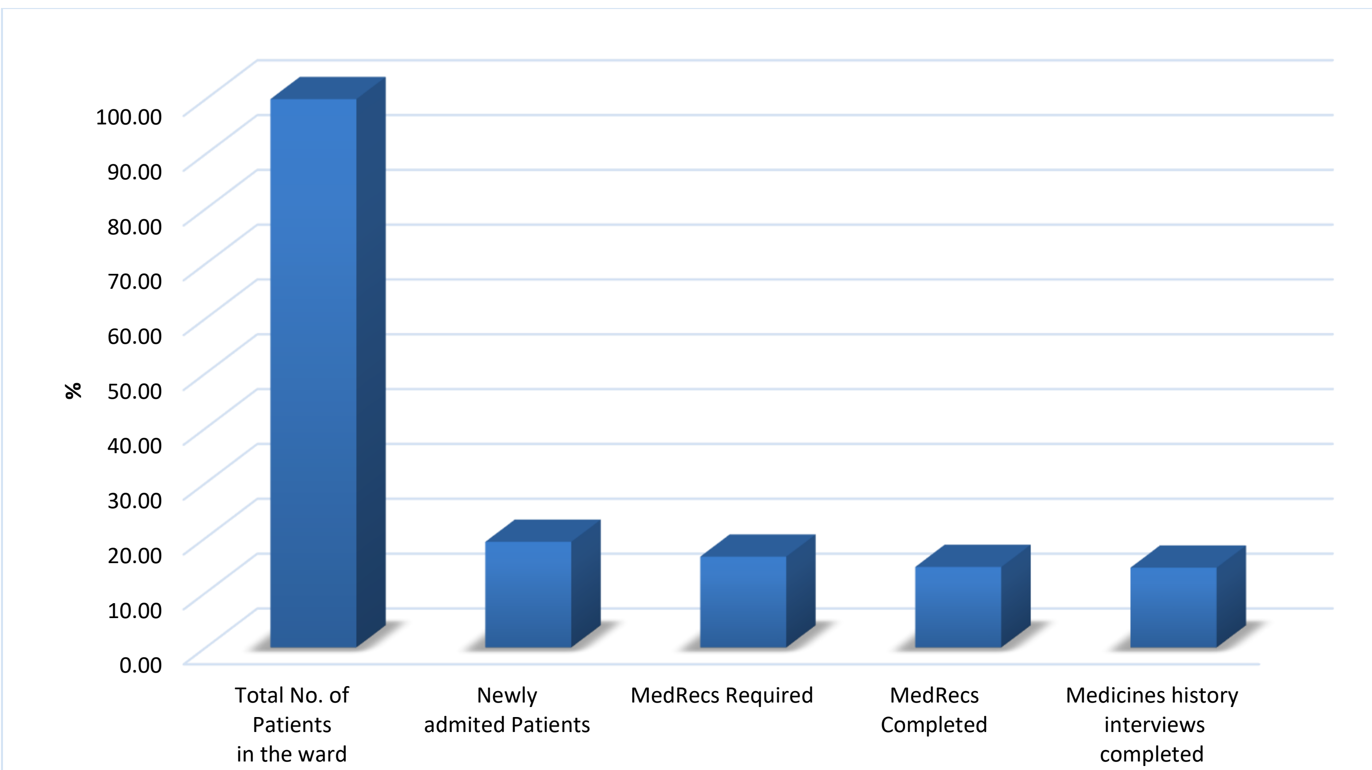


Figure 4-2: Average percentage (%) of the daily newly admitted patients and their required/completed medicines history reviews and MedRecs

4.4.2.1.2 Analysis of MedRecs workloads within different ward specialties during patients` hospital admissions.

Results showed that, although the average number of the newly admitted patients per day within the three different ward specialties (medical, surgical and cardiology with long-stay wards) was nearly equal with no significant differences (P>0.05; Kruskal Wallis test), a significant difference existed between both medical and surgical wards in numbers of MedRecs required (P<0.05; Kruskal Wallis test); numbers of MedRecs completed (P<0.01; Kruskal Wallis test); and also numbers of medicines histories interviews completed (P<0.01; Kruskal Wallis test) (Table 4-4, Figures 4-3a,b).

Kruskal Wallis test with pair wise comparison as a post hoc showed that surgical wards significantly required and completed greater numbers of MedRecs and medicines histories interviews than medical wards although the percentage of the MedRecs completion from that required was still closely the same between the two ward specialties (Table 4-4).

Moreover, there was no significant difference (P>0.05; Kruskal Wallis test) between the average total numbers of patients within any of the ward specialties which ranged between 26 and 30 patients per ward per day (Table 4-4, Figures 4-3a).

Within the four medical wards (A3, A4, B2 and B4) involved in the study, results showed no significant differences (P>0.05; One way Anova) between the numbers of MedRecs required, completed and also the number of daily newly admitted patients in each ward (Table 4-5, Figures 4-4a). However, it has been shown that there were significant differences found (P<0.01; Kruskal Wallis test with pair wise comparison as a post hoc) between three out of four medical wards in total daily numbers of patients per ward and also the percentage of MedRecs completed from the required (Table 4-5, Figures 4-4a,b).

On the other hand, there was no significant differences ($P>0.05$; unpaired t-test and Mann-Whitney test for non-parametric data) between the surgical wards (C5 and C6) involved in the study with regards to the admissions` MedRecs workload including number of MedRecs required, completed, daily newly admitted patients in each ward and also the percentage of MedRecs completed from required (Table 4-6)

Table 4-4: Mean±SEM of the numbers and percentage of the daily MedRecs completed on admissions by ward dedicated clinical pharmacists in different ward specialties involved in the study.

Activity	All medical wards N= 40	All surgical wards N= 20	Cardiology & Long stay wards N= 20	Level of significance #
Average Numbers of daily MedRecs required #	4.02 ± 0.39	5.75 ± 0.43	4.65 ± 0.76	P < 0.05*a
SD	2.52	1.94	3.40	
Median	4.0	5.0	4.0	
95% CI (upper-lower)	3.21 – 4.83	4.84 – 6.65	3.05 – 6.24	
Average Numbers of daily medicines history interviews completed#	3.55 ± 0.35	5.30 ± 0.40	3.80 ± 0.60	P < 0.01*a
SD	2.24	1.80	2.72	
Median	3.0	5.0	3.5	
95% CI (upper-lower)	3.83 – 4.26	4.45 – 6.14	2.52 – 5.07	
Average Numbers of daily MedRecs completed#	3.65 ± 0.35	5.25 ± 0.42	3.80 ± 0.60	P < 0.01*a
SD	2.22	1.88	2.72	
Median	3.0	5.0	3.5	
95% CI (upper-lower)	2.93 – 4.36	4.36 – 6.13	2.52 – 5.07	
Average number of total patients per ward per day#	27.55 ± 0.70	26.25 ± 0.74	30.1 ± 1.22	NS
SD	4.44	3.33	5.46	
Median	27	27	29.5	
95% CI (upper-lower)	26.12 – 28.97	24.68 – 27.81	27.54 – 32.65	
Average Numbers of daily newly admitted patients in each ward#	5.52 ± 0.41	5.75 ± 0.47	4.65 ± 0.55	NS
SD	2.62	2.12	2.49	
Median	5.0	6.0	5.0	
95% CI (upper-lower)	4.68 – 6.36	4.75 – 6.74	3.48 – 5.81	
Average % of MedRecs completed from required#	92.01 ± 2.27	90.95 ± 2.78	78.49 ± 7.28	NS
SD	14.38	12.43	32.58	
Median	100.0	100.0	100.0	
95% CI (upper-lower)	87.41 – 96.91	85.13 – 96.77	63.24 – 93.74	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean **CI**= confidence interval **MedRecs**= Medicines reconciliation

P<0.05: considered significant **P<0.01**: considered highly significant **NS**: no significance P>0.05

Kruskal Wallis Test for non parametric data with pairwise comparison as a post Hoc test

a: significant difference between medical and surgical wards

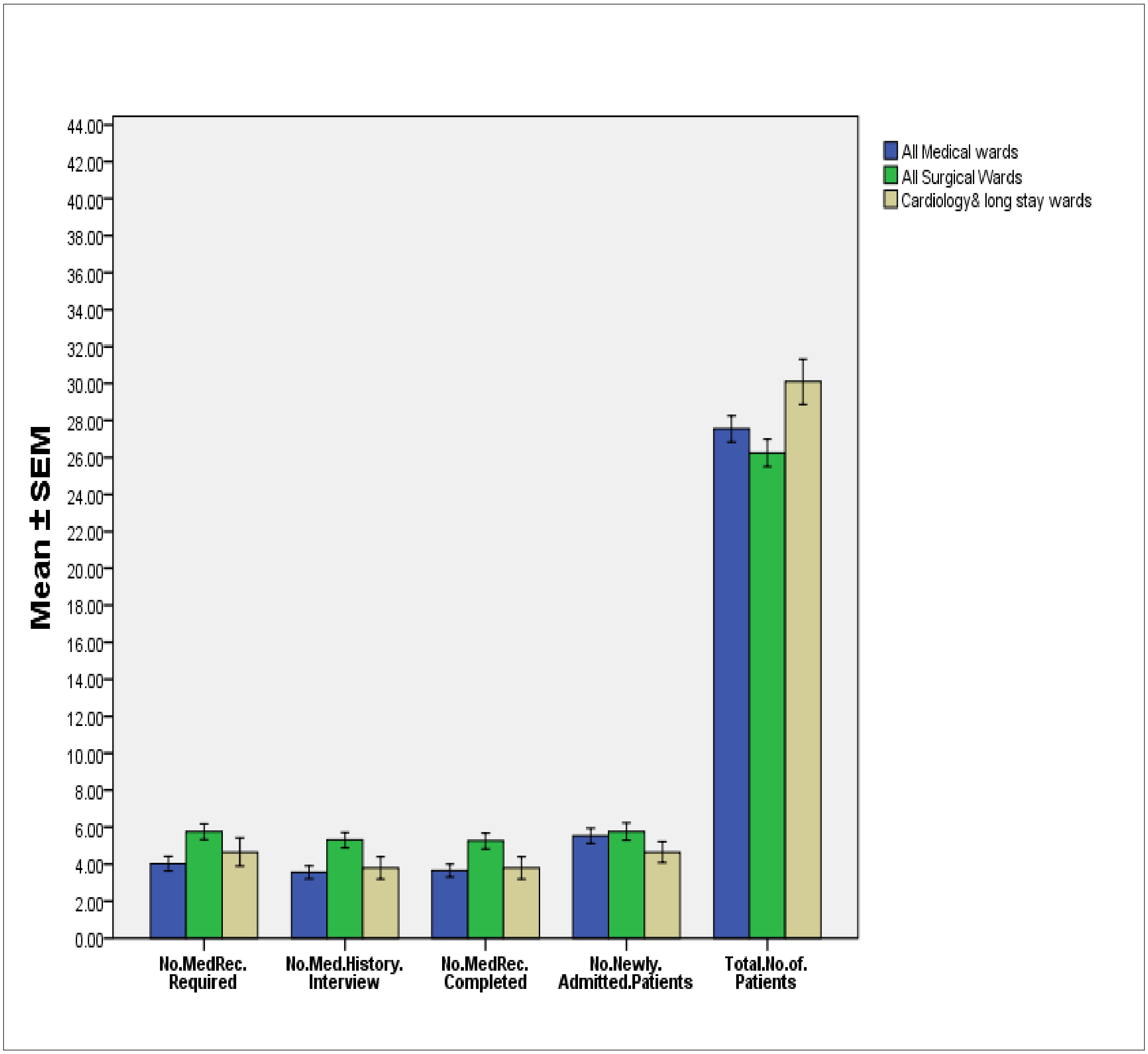
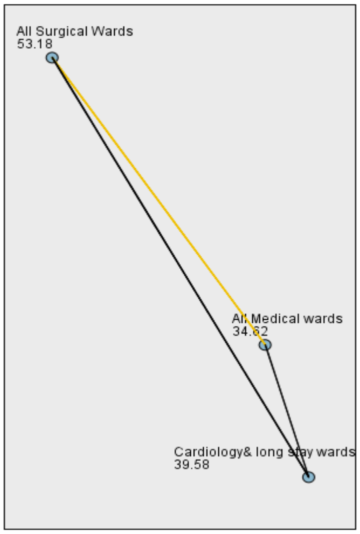


Figure 4-3a: Comparison between the average numbers of the daily MedRecs completed by ward based clinical pharmacists during patients` hospital admissions within different ward specialties.

No. of MedRecs required

Pairwise Comparisons of Ward



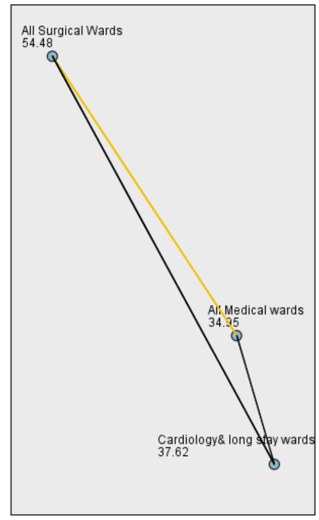
Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
All Medical wards-Cardiology& long stay wards	-4.950	6.308	-.785	.433	1.000
All Medical wards-All Surgical Wards	-18.550	6.308	-2.941	.003	.010
Cardiology& long stay wards-All Surgical Wards	13.600	7.284	1.867	.062	.186

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

No. of Medicines history interviews completed

Pairwise Comparisons of Ward



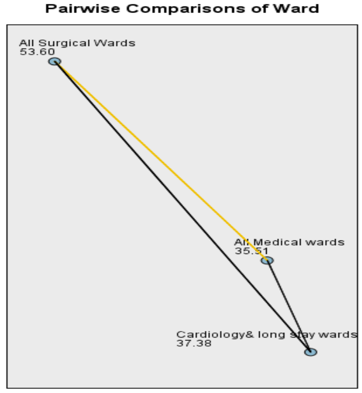
Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
All Medical wards-Cardiology& long stay wards	-2.675	6.298	-.425	.671	1.000
All Medical wards-All Surgical Wards	-19.525	6.298	-3.100	.002	.006
Cardiology& long stay wards-All Surgical Wards	16.850	7.272	2.317	.021	.062

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

No. of MedRecs completed

Pairwise Comparisons of Ward



Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
All Medical wards-Cardiology& long stay wards	-1.862	6.296	-.296	.767	1.000
All Medical wards-All Surgical Wards	-18.088	6.296	-2.873	.004	.012
Cardiology& long stay wards-All Surgical Wards	16.225	7.270	2.232	.026	.077

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Figure 4-3b: Post hoc Kruskal Wallis Test with pair wise comparison for the numbers of the daily MedRecs completed by ward based clinical pharmacists during patients` hospital admissions within different ward specialties showing the significant differences between.

Table 4-5: Mean±SEM of the numbers and percentage of the daily MedRecs completed on admissions by ward dedicated clinical pharmacists within different medical wards involved in the study.

Activity	A3 Respiratory ward N= 10	A4 Respiratory ward N= 10	B2 Elderly Care ward N= 10	B4 Endocrine ward N= 10	Level of significance #
Average Numbers of daily MedRecs required #	4.60 ± 1.11	3.40 ± 0.33	3.10 ± 0.54	5.00 ± 0.90	NS
SD	3.53	1.07	1.72	2.86	
Median	4.0	3.0	3.0	4.5	
95% CI (upper-lower)	2.07 – 7.12	2.63 – 4.16	1.86 – 4.33	2.94 – 7.05	
Average Numbers of daily medicines history interviews completed#	4.00 ± 0.98	3.20 ± 0.32	3.10 ± 0.54	3.90 ± 0.84	NS
SD	3.12	1.03	1.72	2.68	
Median	3.5	3.0	3.0	3.5	
95% CI (upper-lower)	1.76 – 6.23	2.46 – 3.93	1.86 – 4.33	1.79 – 5.82	
Average Numbers of daily MedRecs completed#	4.30 ± 0.93	3.30 ± 0.30	2.80 ± 0.44	4.20 ± 0.90	NS
SD	2.94	0.94	1.39	2.85	
Median	4.0	3.0	2.5	3.5	
95% CI (upper-lower)	2.19 – 6.40	2.62 – 3.97	1.79 – 3.80	2.15 – 6.24	
Average number of total patients per ward per day##	34.10 ± 0.17	26.20 ± 0.13	22.00*	27.90 ± 0.34	$P < 0.01^{*a,b,c}$
SD	0.56	0.42	Same number of patients during data collection days	1.10	
Median	34.0	26.0		27.50	
95% CI (upper-lower)	33.69 – 34.50	25.89 – 26.50		27.11 – 28.68	
Average Numbers of daily newly admitted patients in each ward#	6.20 ± 1.07	5.40 ± 0.70	4.50± 0.67	6.00 ± 0.82	NS
SD	3.39	2.22	4.00	2.62	
Median	5.0	5.0	4.0	6.00	
95% CI (upper-lower)	3.77 – 8.62	3.81 – 6.98	2.98 – 6.01	4.12 – 7.87	
Average % of MedRecs completed from required##	97.22 ± 1.89	98.00 ± 2.00	94.16 ± 3.93	78.67 ± 6.26	$P < 0.01^{*a,d}$
SD	6.00	6.32	12.45	19.82	
Median	100.0	100.0	100.0	81.25	
95% CI (upper-lower)	92.92 – 101.51	93.47 – 102.52	85.25 – 103.07	64.49 – 92.85	

*Total no of patients in B4 was consistent during all days data collection, so was omitted from this item comparison

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean

CI= confidence interval **MedRecs**= Medicines reconciliation

P<0.01: considered highly significant **NS**: no significance P>0.05

One way Anova with Tukey HSD as a post Hoc test

Kruskal Wallis Test for non parametric data with pairwise comparison as a post Hoc test

a= significant difference between B4, A4 wards **b**= significant difference between B4, B2 wards

c= significant difference between A4, B2 wards **d**= significant difference between B4, A3 wards

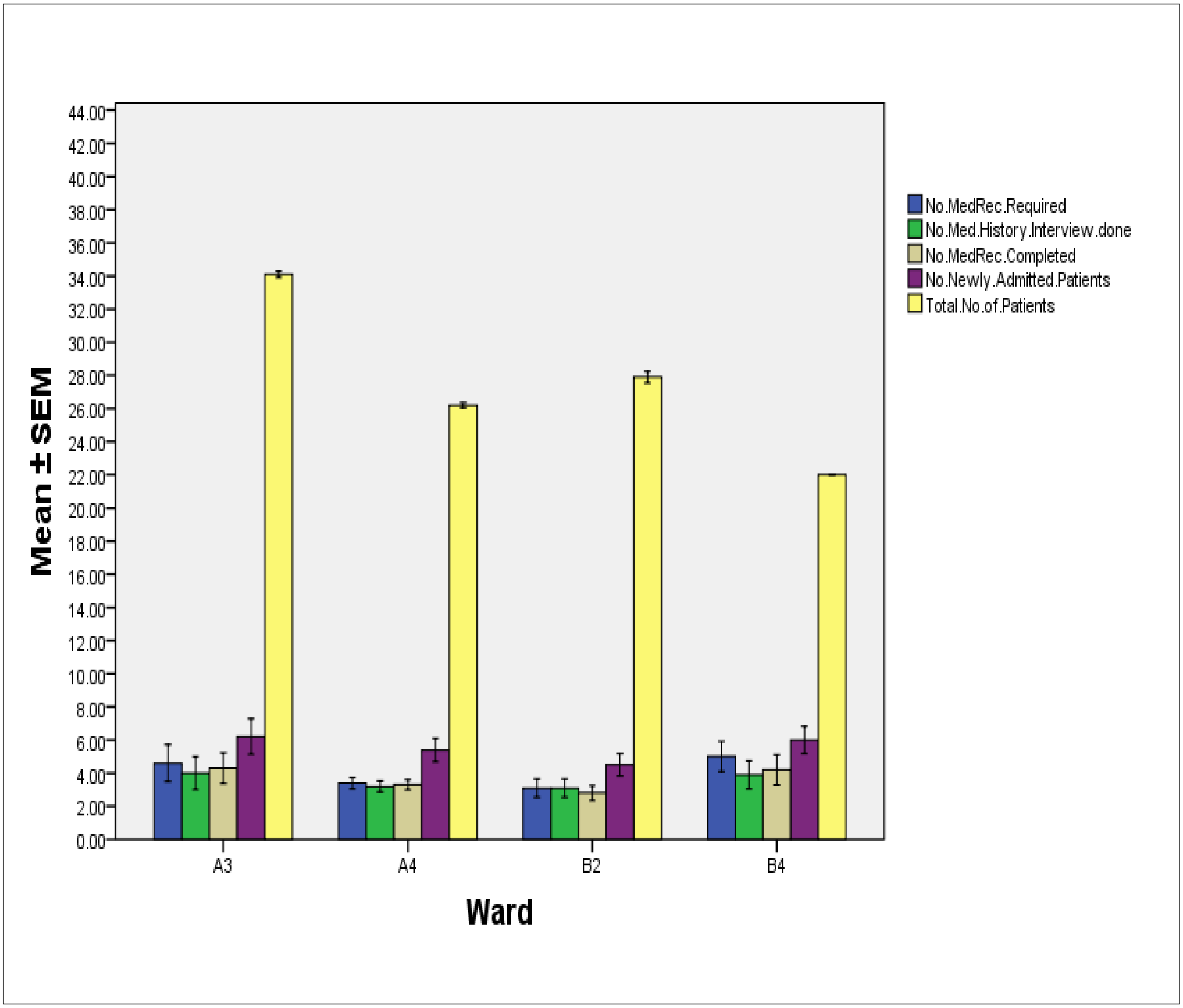
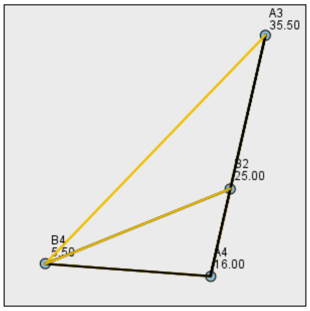


Figure 4-4a: Comparison between the average numbers of the daily MedRecs completed by ward based clinical pharmacists during patients` hospital admissions within medical wards.

Average of total numbers of patients in the ward

Pairwise Comparisons of Ward



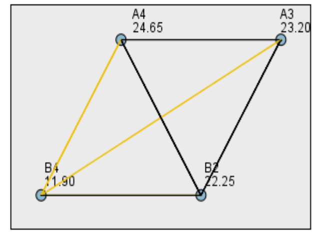
Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
B4-A4	10.500	5.138	2.044	.041	.246
B4-B2	19.500	5.138	3.795	.000	.001
B4-A3	30.000	5.138	5.839	.000	.000
A4-B2	-9.000	5.138	-1.752	.080	.479
A4-A3	19.500	5.138	3.795	.000	.001
B2-A3	10.500	5.138	2.044	.041	.246

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Percent of MedRecs completed from required

Pairwise Comparisons of Ward



Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
B4-B2	10.350	4.237	2.443	.015	.087
B4-A3	11.300	4.237	2.667	.008	.046
B4-A4	12.750	4.237	3.009	.003	.016
B2-A3	.950	4.237	.224	.823	1.000
B2-A4	2.400	4.237	.566	.571	1.000
A3-A4	-1.450	4.237	-.342	.732	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Figure 4-4b: Post hoc Kruskal Wallis Test with pair wise comparison for the percentage (%) of the daily MedRecs completed by ward based clinical pharmacists and total numbers of patients in each ward during patients` hospital admissions within medical ward showing the significant differences.

Table 4-6: Mean±SEM of the numbers and percentage of the daily MedRecs completed on admissions by ward dedicated clinical pharmacists within both surgical wards involved in the study.

Activity	C5 Surgical ward N= 10	C6 Surgical ward N= 10	Level of significance #
Average Numbers of daily MedRecs required #	5.30 ± 0.47	6.20 ± 0.72	NS
SD	1.49	2.29	
Median	5.0	6.0	
95% CI (upper-lower)	4.23 – 6.36	4.55 – 7.84	
Average Numbers of daily medicines history interviews completed #	5.00 ± 0.47	5.60 ± 0.66	NS
SD	1.49	2.11	
Median	5.0	5.5	
95% CI (upper-lower)	3.93 – 6.06	4.08 – 7.11	
Average Numbers of daily MedRecs completed #	5.00 ± 0.55	5.50 ± 0.65	NS
SD	1.76	2.06	
Median	5.0	5.5	
95% CI (upper-lower)	3.73 – 6.26	4.02 – 6.97	
Average number of total patients per ward per day #	24.80 ± 1.28	27.70 ± 0.49	NS
SD	4.04	1.56	
Median	26.0	27.0	
95% CI (upper-lower)	21.90 – 27.69	26.57 – 28.82	
Average Numbers of daily newly admitted patients in each ward #	5.60± 0.61	5.90 ± 0.75	NS
SD	1.95	2.37	
Median	6.0	6.0	
95% CI (upper-lower)	4.20 – 6.99	4.19 – 7.60	
Average % of MedRecs completed from required ##	92.66 ± 3.90	89.23 ± 4.09	NS
SD	12.35	12.93	
Median	100.0	95.0	
95% CI (upper-lower)	83.83 – 101.50	79.98 – 98.49	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
NS: no significance P>0.05
Un-paired T-test
Mann-Whitney test

4.4.2.1.3 Analysis of MedRecs workloads within different clinical pharmacists` grades (bands) during patients` hospital admissions.

a. Analysis of the MedRecs workloads between senior clinical pharmacists (band 7s) working in all medical and surgical wards involved in the study.

A significant difference in workload ($P<0.05$; One way Anova with Tukey HSD as a post Hoc test) for the numbers of MedRecs to be completed was found between the senior clinical pharmacists (band 7) working within the medical and surgical wards involved in the study, ranging from 2.0±0.49 to 7.0±1.26 in each ward per day (Table 4-7, Figure 4-5a). These results were partly consistent with the difference in the daily numbers of newly admitted patients in one medical and two surgical wards (Table 4-7). Consequently, results showed a significant difference ($P<0.05$; One Way Anova with Tukey HSD as a post Hoc test) in the number of MedRecs completed by the senior clinical pharmacists (band 7) within one medical (B2) and one surgical (C6) ward (2.80±0.44 and 6.00±1.14) and also between the two surgical wards (6.00±1.14 and 1.90±0.45) (Table 4-7, Figure 4-5a).

There was a significant difference between the senior clinical pharmacists (band 7s) in the workload of MedRecs during the admission phase which included numbers of newly admitted patients per day in each ward, numbers of MedRecs required and numbers of MedRecs completed. Results also revealed that the percentage (%) of the daily MedRecs completed from those required was not significantly different ($P>0.05$; Kruskal Wallis Test with pairwise comparison as a post Hoc test) between all senior clinical pharmacists (band 7s) working within all medical and surgical wards involved in the study (Table 4-7).

Table 4-7: Mean±SEM of the numbers and percentage of the daily MedRecs completed on admissions by ward dedicated senior clinical pharmacists (band 7s) within different hospital wards involved in the study.

Activity	A4 Band 7 (Medical) N= 10	B2 Band 7 (Medical) N= 10	B4 Band 7 (Medical) N= 10	C6 Band 7 (Surgical) N= 5	C7 Band 7 (Surgical) N= 10	Level of significance
Average Numbers of daily MedRecs required #	3.40 ± 0.33	3.10 ± 0.54	5.00 ± 0.90	7.00 ± 1.26	2.0 ± 0.49	$P < 0.05^{a,b,c,d}$
SD	1.07	1.72	5.86	2.82	1.56	
Median	3.0	3.0	4.5	8.0	2.0	
95% CI (upper-lower)	2.36 – 4.16	1.86 – 4.33	2.94 – 7.05	3.48 – 10.51	0.88 – 3.11	
Average Numbers of daily medicines history interviews completed #	3.20 ± 0.32	3.10 ± 0.54	3.90 ± 0.84	6.00 ± 1.14	1.90 ± 0.45	$P < 0.05^{c}$
SD	1.03	1.72	2.68	2.54	1.44	
Median	3.0	3.0	3.5	6.0	2.0	
95% CI (upper-lower)	2.46 – 3.93	1.86 – 4.33	1.97 – 5.82	2.83 – 9.16	0.86 – 2.93	
Average Numbers of daily MedRecs completed #	3.30 ± 0.30	2.80 ± 0.44	4.20 ± 0.90	6.00 ± 1.14	1.90 ± 0.45	$P < 0.05^{b,c}$
SD	0.94	1.39	2.85	2.54	1.44	
Median	3.0	2.5	3.5	6.0	2.0	
95% CI (upper-lower)	2.62 – 3.97	1.79 – 3.80	2.15 – 6.24	2.83 – 9.16	0.86 – 2.93	
Average number of total patients per ward per day ##	26.20 ± 0.13	27.90 ± 0.34	22.00*	28.60 ± 0.74	24.80 ± 0.13	$P < 0.01^{c,f,g,h,i}$
SD	0.42	1.10	Was	1.67	0.42	
Median	26.0	27.5	consistent	29.0	25.0	
95% CI (upper-lower)	25.89 – 26.50	27.11 – 28.68	during all days	26.52 – 30.67	24.49 – 25.10	
Average Numbers of daily newly admitted patients in each ward #	5.40 ± 0.70	4.50 ± 0.67	6.00± 0.82	7.40 ± 0.92	3.10 ± 0.65	$P < 0.05^{c,e}$
SD	2.22	2.12	2.62	2.07	2.07	
Median	5.0	4.0	6.0	8.0	2.5	
95% CI (upper-lower)	3.81 – 6.98	2.98– 6.01	4.12 – 7.87	4.82 – 9.97	1.61 – 4.58	
Average % of MedRecs completed from required ##	98.00 ± 2.00	94.16 ± 3.93	78.67 ± 6.26	86.33 ± 6.71	77.50 ± 13.14	NS
SD	6.32	12.45	19.82	15.01	41.85	
Median	100.0	100.0	81.25	90.0	100.0	
95% CI (upper-lower)	93.47 – 102.52	85.25 – 103.07	64.49 – 92.85	67.86 – 104.98	47.75 – 107.24	

*****Total no of patients in B4 was consistent during all days data collection, so was omitted from this item comparison
N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
P<0.01: considered highly significant **P<0.05**: considered significant **NS**: no significance P>0.05
One way Anova with Tukey HSD as a post Hoc test
Kruskal Wallis Test for non parametric data with pairwise comparison as a post Hoc test
a= significant difference between A4, C6 wards **b**= significant difference between B2, C6 ward
c= significant difference between C6, C7 ward **d**= significant difference between B4, C7 ward
e= significant difference between B4, C7 ward **f**= significant difference between B2, B4 ward
g= significant difference between B4, C6 ward **h**= significant difference between A4, B4 ward
i= significant difference between B2, C7 ward

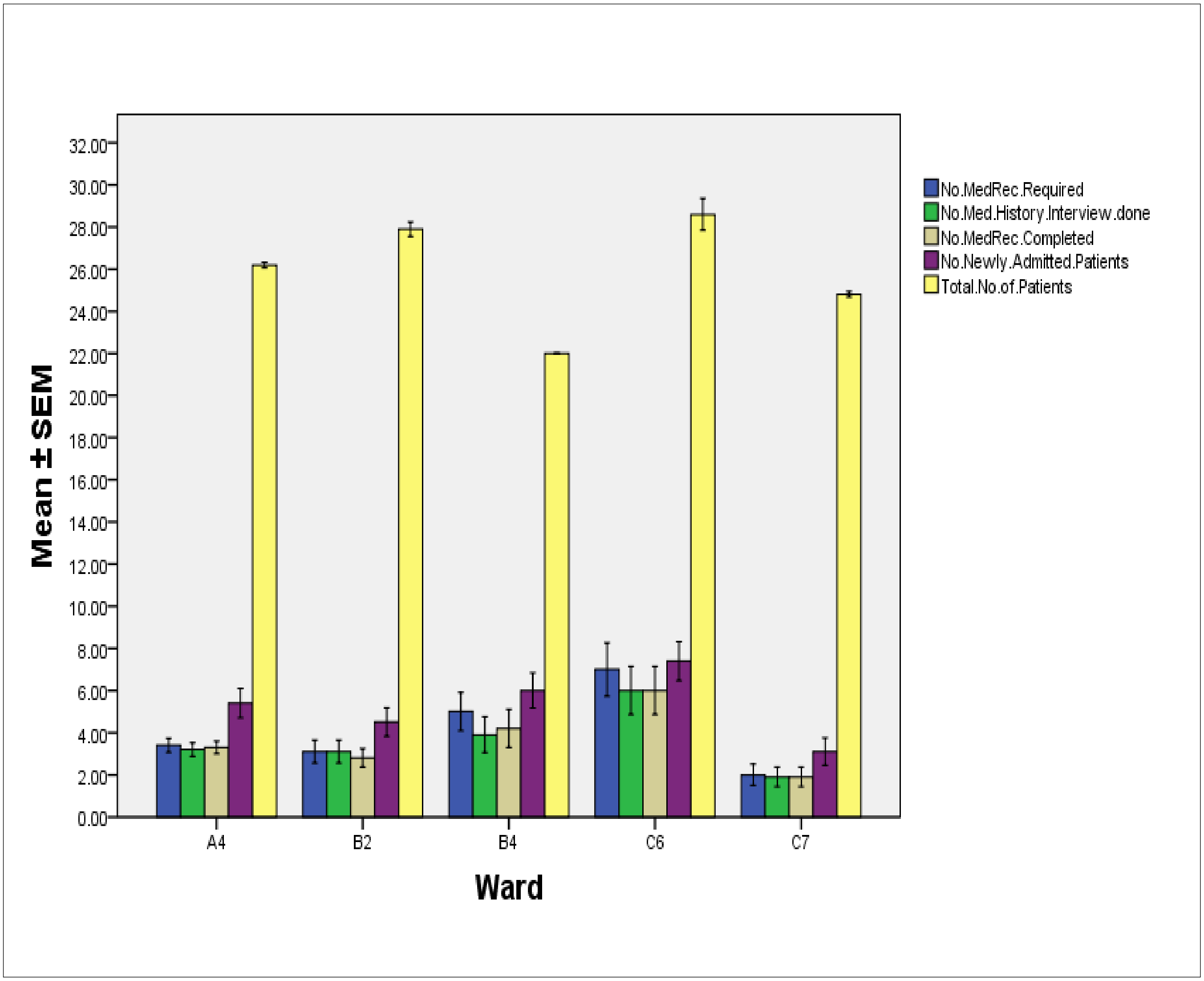
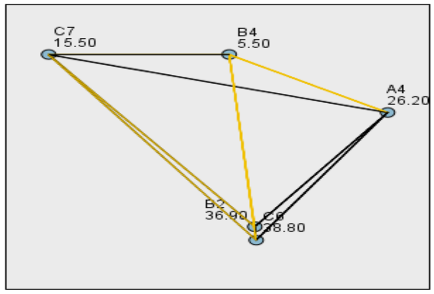


Figure 4-5a: Comparison between the average numbers of the daily MedRecs completed by ward based senior clinical pharmacists (band 7s) during patients` hospital admissions within different hospital wards.

Average of total numbers of patients in the ward

Pairwise Comparisons of Ward



Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
B4-C7	-10.000	5.783	-1.729	.084	.838
B4-A4	20.700	5.783	3.579	.000	.003
B4-B2	31.400	5.783	5.430	.000	.000
B4-C6	-33.300	7.083	-4.702	.000	.000
C7-A4	10.700	5.783	1.850	.064	.643
C7-B2	21.400	5.783	3.700	.000	.002
C7-C6	23.300	7.083	3.290	.001	.010
A4-B2	-10.700	5.783	-1.850	.064	.643
A4-C6	-12.600	7.083	-1.779	.075	.752
B2-C6	-1.900	7.083	-.268	.789	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Figure 4-5b: Post hoc Kruskal Wallis Test with pair wise comparison for the total numbers of patients in different medical wards with senior (band 7s) clinical pharmacists during patients` hospital admissions within different hospital wards showing the significant differences.

b. Analysis of the MedRecs workloads between junior (band 6s) and senior clinical pharmacists (band 7s) working in medical and surgical wards involved in the study.

Results showed that, no significance differences were found (P>0.05; Un-paired T-test) between junior (band 6) and senior (band 7) clinical pharmacists working within medical wards involved in the study when comparing the admission MedRecs workload between both of them through numbers of MedRecs required, numbers of MedRecs completed, numbers of medicines history interviews and also numbers of daily newly admitted patients in each ward (Table 4-8, Figure 4-6). Further, the average percentage of the daily admission MedRecs completed from that required was non-significant (P>0.05; Mann-Whitney test) between the two pharmacists staff grades within the surgical wards involved in the study and showed 86.33 ± 6.71 (%) and 92.66 ± 3.90 (%) for juniors and seniors clinical pharmacists respectively (Table 4-8).

Similarly, no significant differences existed (P>0.05) between junior (band 6s) and senior (band 7s) clinical pharmacists working within different medical wards with regards to the MedRecs workload during the patients hospital admission phase. This showed by results when numbers of MedRecs required, numbers of MedRecs completed, numbers of medicines history interviews, numbers of daily newly admitted patients and also the percentage (%) of MedRecs completed from required in each ward were compared (Un-paired T-test and Mann-Whitney test) between the two pharmacist staff grades (Table 4-8, Figure 4-7). This was despite the total numbers of patients in each ward being significantly different (P>0.01; Mann-Whitney test) between the two surgical and two medical wards when both junior and senior clinical pharmacists` workloads on admission were compared (Table 4-8).

Table 4-8: Mean±SEM of the numbers and percentage of the daily MedRecs completed on admissions by both ward dedicated junior (band 6) and senior (band 7) clinical pharmacists within surgical and medical hospital wards involved in the study.

Activity	C5 Band 6 N= 10	C6 Band 7 N= 5	Level of significance		A3 Band 6 N= 10	A4 Band 7 N= 10	Level of signif-cance
Average Numbers of daily MedRecs required #	5.30 ± 0.47	7.00 ± 1.26	NS		4.60 ± 1.11	3.40 ± 0.33	NS
SD	1.49	2.82			3.53	1.07	
Median	5.0	8.0			4.0	3.0	
95% CI (upper-lower)	4.23 – 6.36	3.48 – 10.51			2.07 – 7.12	2.63 – 4.16	
Average Numbers of daily medicines history interviews completed #	5.00 ± 0.47	6.00 ± 1.14	NS		4.00 ± 0.98	3.20 ± 0.32	NS
SD	1.49	2.54			3.12	1.03	
Median	5.0	6.0			3.5	3.0	
95% CI (upper-lower)	3.93 – 6.06	2.83 – 9.16			1.76 – 6.23	2.46 – 3.93	
Average Numbers of daily MedRecs completed #	5.00 ± 0.55	6.00 ± 1.14	NS		4.30 ± 0.93	3.30 ± 0.30	NS
SD	1.76	2.54			2.94	0.94	
Median	5.0	6.0			4.0	3.0	
95% CI (upper-lower)	3.73 – 6.26	2.83 – 9.16			2.19 – 6.40	2.62 – 3.97	
Average number of total patients per ward per day ##	24.80 ± 1.28	28.60 ± 0.74	P < 0.01		34.10±0.17	26.20 ± 0.13	P < 0.01
SD	4.04	1.67			0.56	0.56	
Median	26.0	29.0			34.0	34.0	
95% CI (upper-lower)	21.90 – 27.69	26.52 – 30.67			33.69 – 34.50	25.89 – 26.50	
Average Numbers of daily newly admitted patients in each ward #	5.60 ± 0.61	7.40 ± 0.92	NS		6.20± 1.07	5.40 ± 0.70	NS
SD	1.95	2.07			3.39	2.22	
Median	6.0	8.0			5.0	5.0	
95% CI (upper-lower)	4.20 – 6.99	4.82– 9.97			3.77 – 8.62	3.81 – 6.98	
Average % of MedRecs completed from required ##	92.66 ± 3.90	86.33 ± 6.71	NS		97.22 ± 1.89	98.00 ± 2.00	NS
SD	12.35	15.01	NS		6.00	6.32	
Median	100.0	90.0			100.0	100.0	
95% CI (upper-lower)	83.83 – 101.50	67.68 – 104.98			92.92 – 101.51	98.88 – 102.52	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
NS: no significance P>0.05 **P<0.01**: considered highly significant
Un-paired T-test
Mann-Whitney test

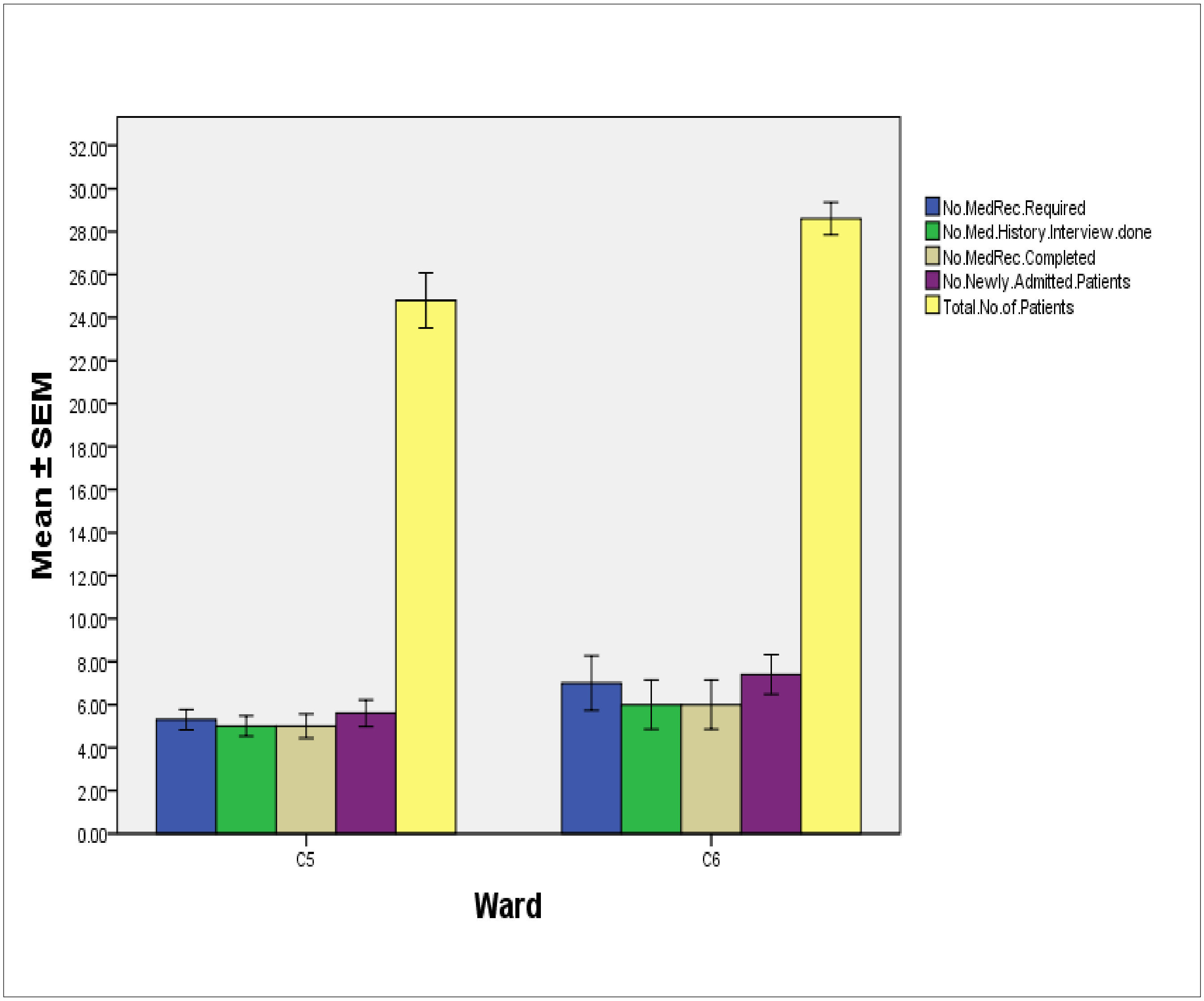


Figure 4-6: Comparison between the average numbers of the daily MedRecs completed by both ward-based junior (band 6) and senior (band 7) pharmacists working respectively in C5 and C6 wards during patients` hospital admissions.

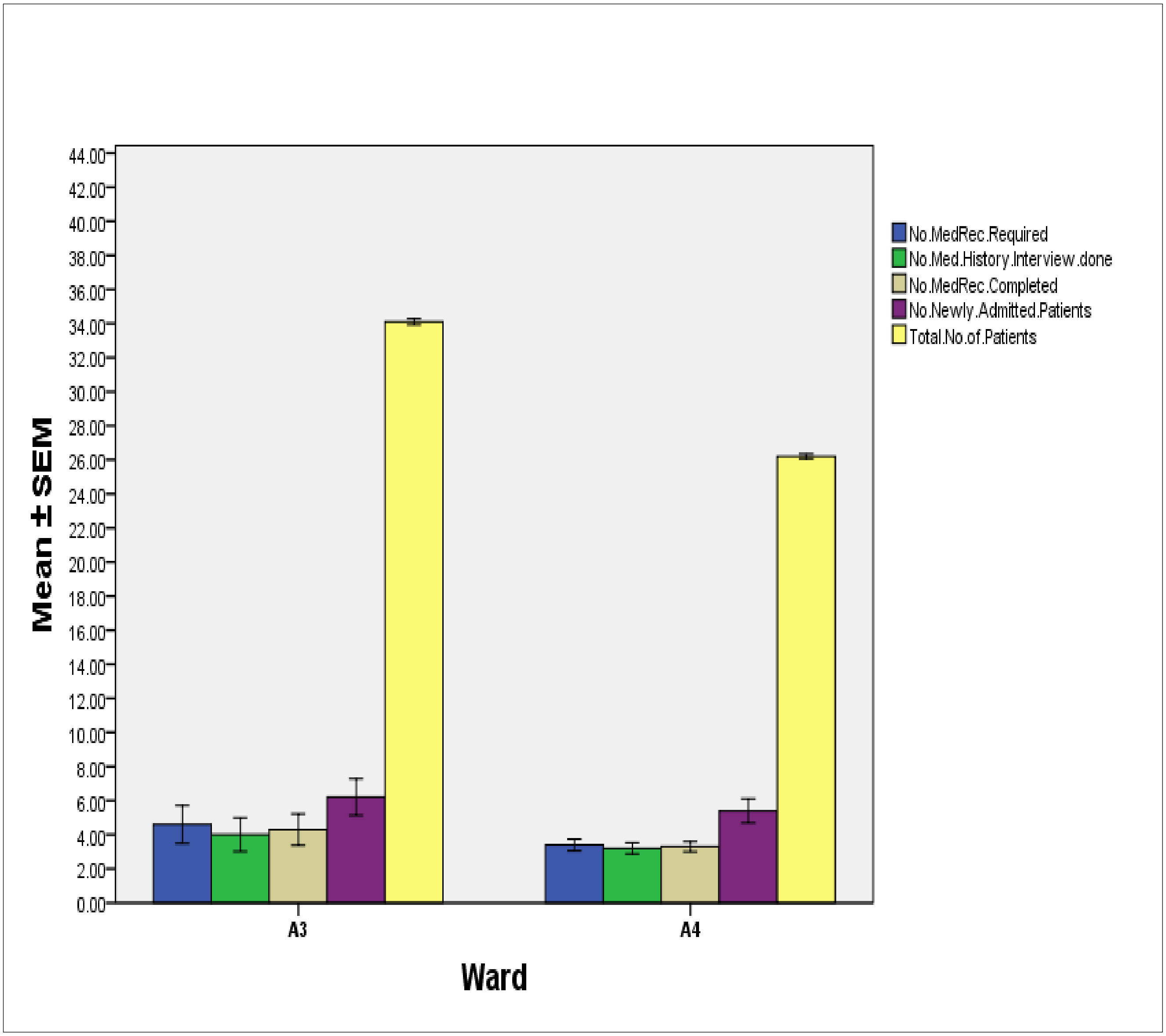


Figure 4-7: Comparison between the average numbers of the daily MedRecs completed by both ward-based junior (band 6) and senior (band 7) pharmacists working respectively in A3 and A4 wards during patients` hospital admissions

c. Analysis of the MedRecs workloads between junior (band 6s) and senior clinical pharmacists (band 7s) working within the same surgical ward.

Results showed, no significant differences existed ($P>0.05$; Un-paired T-test) between the junior (band 6) and the senior (band 7) clinical pharmacist in numbers and percentage of MedRecs required and completed during patients` hospital admission within the same surgical ward although the number of daily admitted patients was significantly different between the two weeks (($P<0.05$; Un-paired T-test) between both of them (Table 4-9, Figure 4-8).

Table 4-9: Mean±SEM of the numbers and percentage of the daily MedRecs completed on admissions by both ward dedicated junior (band 6) and senior (band 7) clinical pharmacists within the same surgical ward.

Activity	C6 Band 6 N= 5	C6 Band 7 N= 5	Level of significance
Average Numbers of daily MedRecs required #	5.40 ± 0.67	7.00 ± 1.26	NS
SD	1.51	2.82	
Median	5.0	8.0	
95% CI (upper-lower)	3.51 – 7.28	3.48 – 10.51	
Average Numbers of daily medicines history interviews completed #	5.20 ± 0.80	6.00 ± 1.14	NS
SD	1.78	2.54	
Median	5.0	6.0	
95% CI (upper-lower)	2.97 – 7.42	2.83 – 9.16	
Average Numbers of daily MedRecs completed #	5.00 ± 0.70	6.00 ± 1.14	NS
SD	1.58	2.54	
Median	5.0	6.0	
95% CI (upper-lower)	3.03 – 6.96	2.83 – 9.16	
Average number of total patients per ward per day #	26.80 ± 0.37	28.60 ± 0.74	NS
SD	0.83	1.67	
Median	27.0	29.0	
95% CI (upper-lower)	25.76 – 27.83	26.52 – 30.67	
Average Numbers of daily newly admitted patients in each ward #	4.40 ± 0.74	7.40 ± 0.92	$P < 0.05$
SD	1.67	2.07	
Median	4.0	8.0	
95% CI (upper-lower)	2.32 – 6.47	4.82– 9.97	
Average % of MedRecs completed from required #	92.14 ± 5.10	86.33 ± 6.71	NS
SD	11.40	15.01	
Median	100.0	90.0	
95% CI (upper-lower)	77.97 – 106.30	67.68 – 104.98	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
NS: no significance P>0.05 **P<0.05**: considered significant
Un-paired T-test

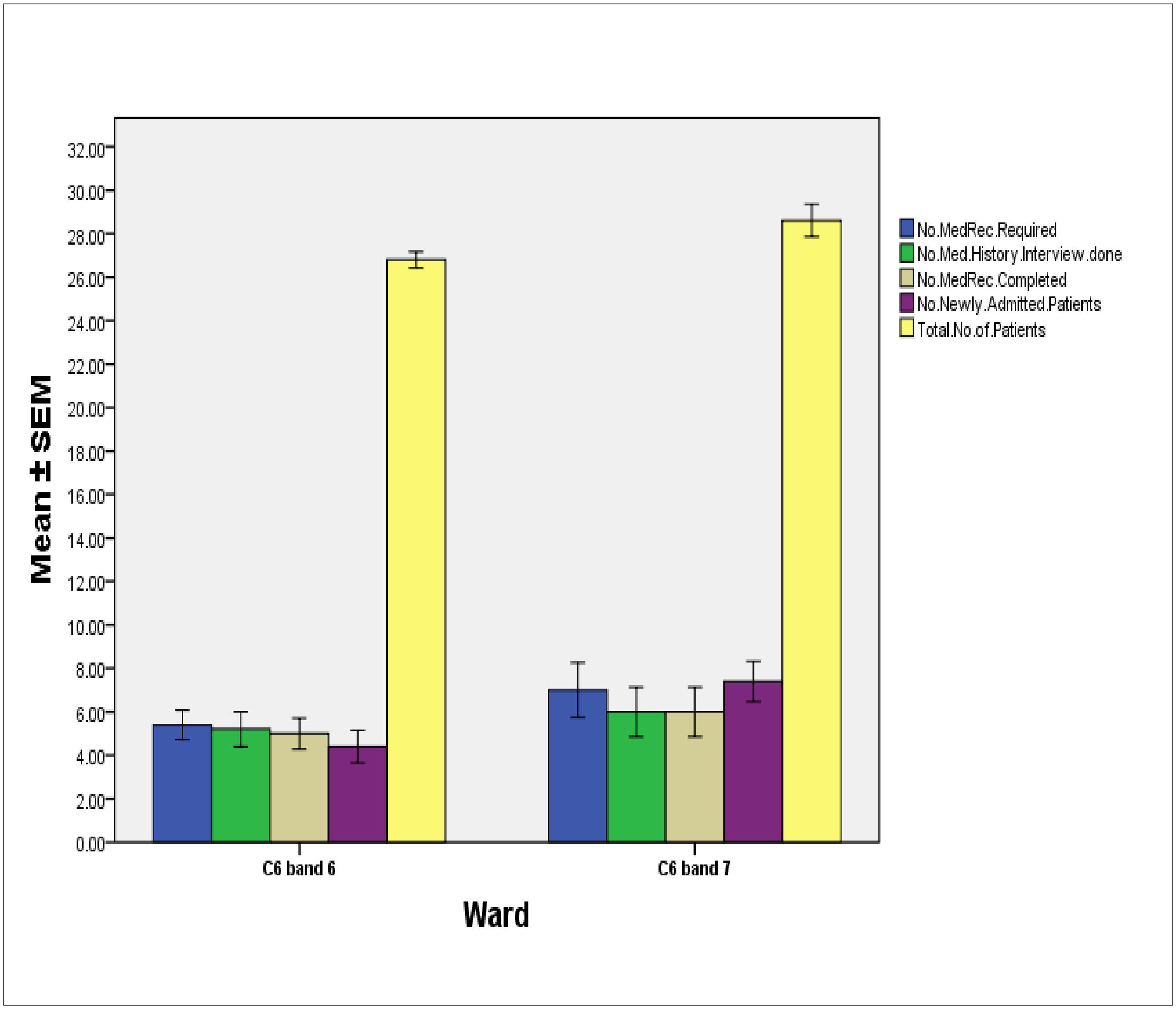


Figure 4-8: Comparison between the average numbers of the daily MedRecs completed by both ward-based junior (band 6) and senior (band 7) pharmacists working within the same surgical (C5) ward during patients` hospital admissions

d. Analysis of the MedRecs completed by consultant clinical pharmacists (band 8a) during patients` hospital admission.

Results revealed that consultant clinical pharmacists (band 8a) within some wards involved in the study contributed in completing numbers of MedRecs during patients` hospital admission. In average about 18 % of all admission MedRecs were completed by consultant (band 8a) pharmacists and this particularly was within one cardiology and two surgical wards (three out of eight wards involved in the study) (Figure 4-9).

Within the cardiology ward the consultant (band 8a) pharmacist contributed by an average of about 23 % of the daily MedRecs required within the wards (8.30 % from the total MedRecs completed in all wards) while within the two surgical wards they contributed by about 14 % of the total daily MedRecs completed on admissions(9.20 % from the total MedRecs completed in all wards) (Figure 4-9).

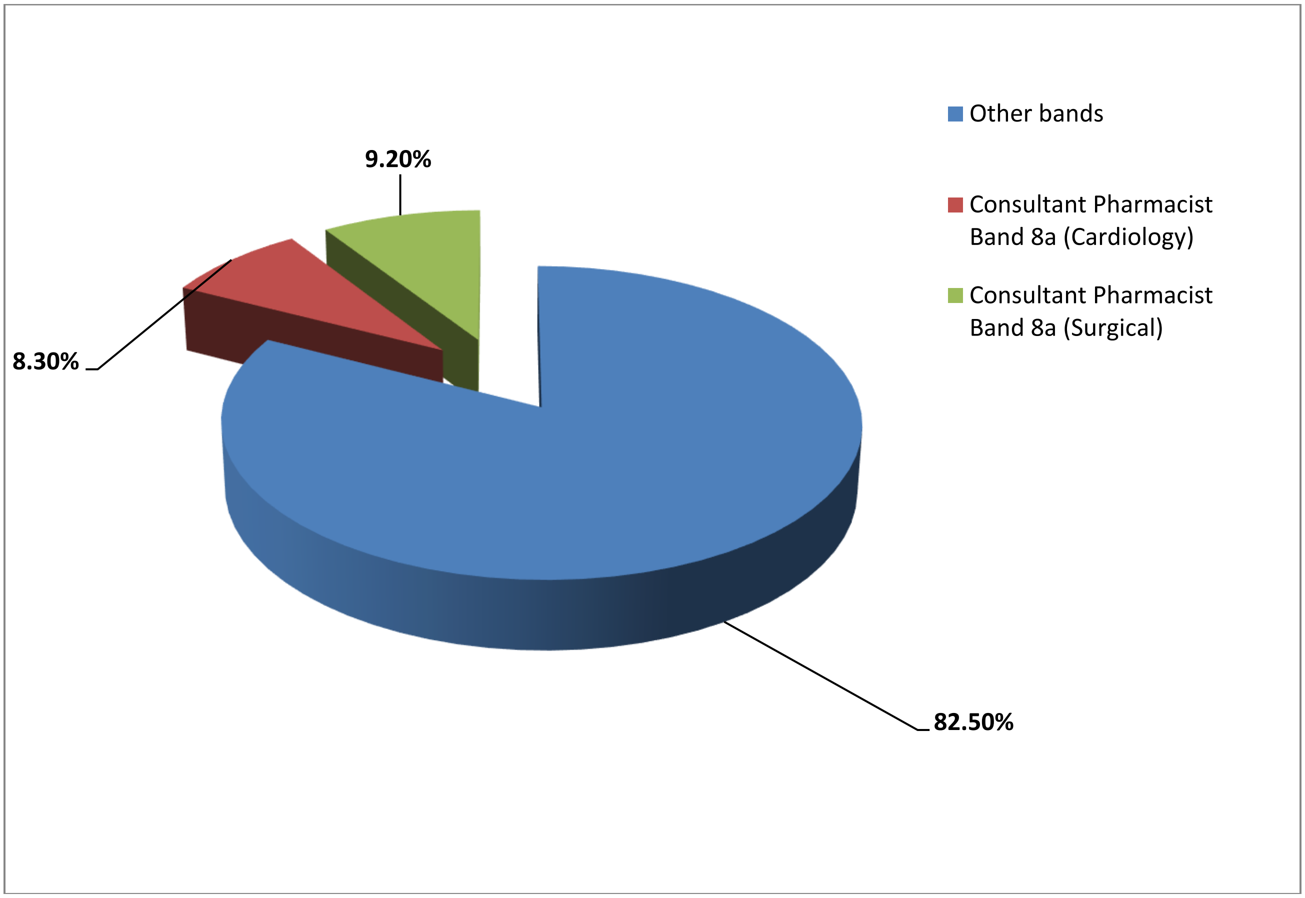


Figure 4-9: Average percentage (%) of consultant clinical pharmacists (band 8a) contribution in completing MedRecs during patients` hospital admission within all wards with band 8a pharmacists (surgical & cardiology wards).

4.4.2.2 Analysis of the daily time spent by the ward dedicated clinical pharmacists for MedRecs completion during patients` hospital admissions.

4.4.2.2.1 Analysis of the daily time spent by the ward dedicated clinical pharmacists for MedRecs completion during patients` hospital admissions within all wards involved in the study.

It has shown that about two hours (115.28 ± 7.69 min) were spent daily by the ward dedicated clinical pharmacists to complete an average of four MedRecs for patients on admissions. About 42 minutes of this time (36.40 %) was spent on medicines history interviews with the patients or the carer while 74 minutes of the time (63.60 %) spent for the reconciliation (Table 4-10).

Results have also revealed that about one third (27.43 %) of the daily clinical pharmacist`s time was spent completing the required MedRecs on admission and was split between medicines history confirmation (9.85%) and reconciliations (17.42) while the other 2/3 were reserved for other activities (Figure 4-10).

Table 4-10: Analysis of the average time (min) spent by ward dedicated clinical pharmacists to complete the daily MedRecs required in each ward on admission for all wards involved in the study over a period of 80 days data collection.

	Mean ± SEM	Median (Min – Max)	SD	95%CI (Lower - Upper)
Time (min) spent on medicines history interviews	41.96 ± 3.53	31.5 (0 – 147)	31.62	34.92 – 49.00
Time (min) spent on Reconciliations	73.32 ± 5.74	63.0 (0 – 267)	51.36	61.89 – 84.75
Total time (min) spent on both medicines history interviews and Reconciliations	115.28 ± 7.69	107.00 (0 – 339)	68.85	99.96 – 130.61
Numbers of daily MedRecs completed	3.95 ± 0.25	4.0 (0 – 10.0)	0.51	26.82 – 28.89

sample = 80days **SEM**= Standard error of mean **SD**= Standard deviation **CI**= confidence interval
MedRecs= Medicines reconciliations **Min**= minutes

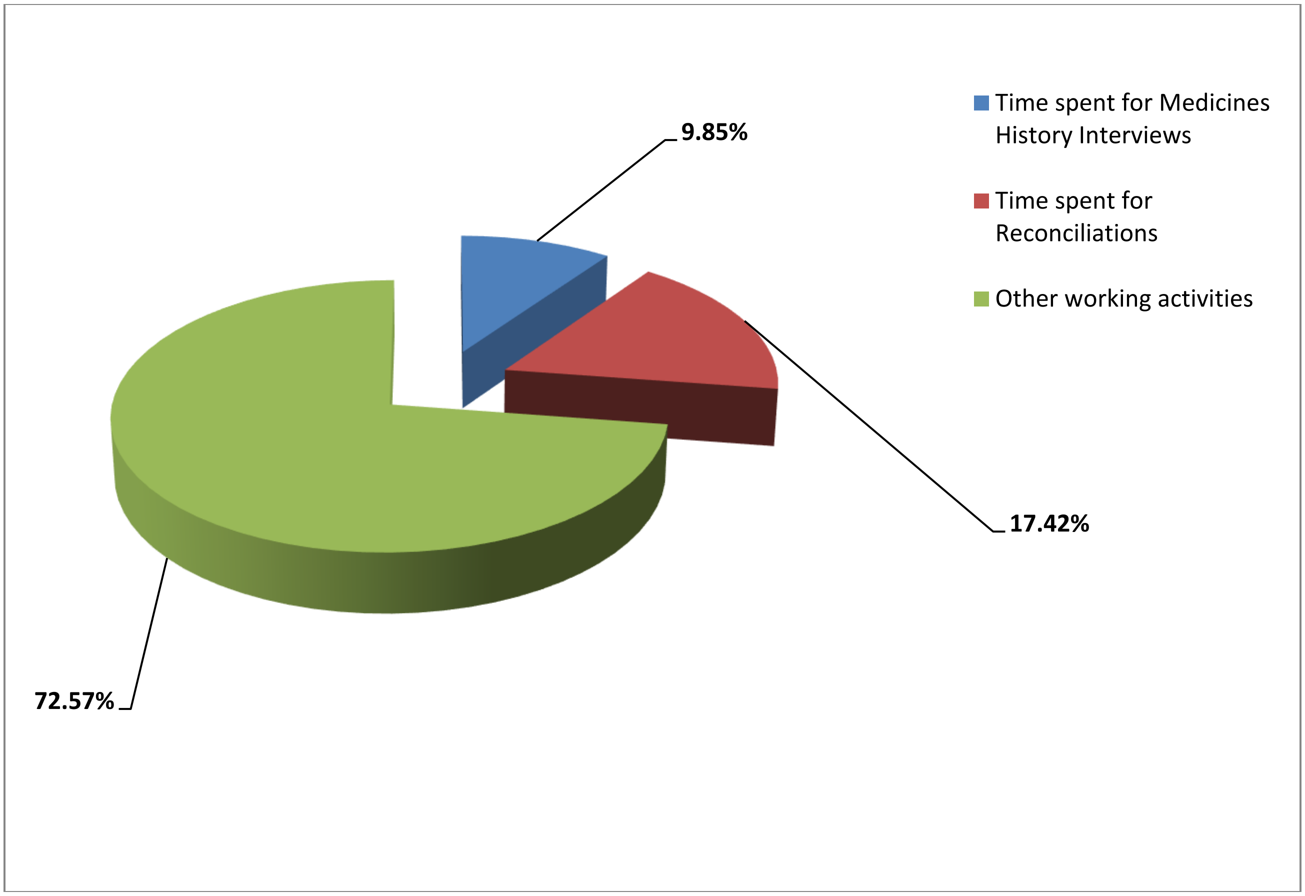


Figure 4-10: Percentage (%) of the daily time spent by ward based clinical pharmacist on both medicines history interviews and Reconciliation throughout the whole MeRec process during patients` hospital admission.

4.4.2.2.2 Analysis of the daily time spent by the ward dedicated clinical pharmacists for MedRecs completion during patients` hospital admissions within different wards.

Within medical wards, results showed that although significant differences were found ($P<0.05$ and $P<0.01$; One way Anova with Tukey HSD as a post Hoc test) between three out of four medical wards involved in the study in the average time spent on medicines history interviews; and also between the four medical wards (($P<0.05$; One way Anova with Tukey HSD as a post Hoc test) in the time spent for reconciliations (Table 4-11, Figure 4-11), there was no significant difference ($P>0.05$; One way Anova) in the total time spent by the pharmacist for the whole MedRec process during the admission phase between all medical wards involved in the study (Table 4-11, Figure 4-15). The time spent to complete the daily required MedRecs for patients on admission within each medical ward ranged between 1.5 and 2.0 hours to complete 3 to 4 MedRecs (Table 4-11, Figure 4-11).

Within the two surgical wards involved in the study no significant differences found ($P>0.05$; Un-paired t-test) between both of them in time spent by the clinical pharmacist for medicines history interviews, reconciliations, total time for the complete admission MedRecs process and also numbers of daily MedRecs completed on admission (Table 4-12, Figure 4-12). The total daily time (min) spent for the admission MedRecs process was 120.70 ± 10.94 and 139.50 ± 25.49 which was used to complete about 5 daily MedRecs in each ward (Table 4-12). When comparing the three ward type specialties involved in the study (Medical, Surgical and cardiology with long stay wards) results showed that the time spent by the pharmacist on reconciliations was significantly different ($P<0.01$; Kruskal Wallis Test with pairwise comparison as a post Hoc test) between the three ward types (Table 4-13, Figure 4-13a,b). Medical wards spent less than one hour daily while each of surgical and cardiology with long stay wards spent nearly one and half hour every day on reconciliations. However, the total daily time spent for the whole MedRecs process on admission was still non-significant between the three ward types which ranged daily from 97 to 135 minutes (Table 4-13, Figure 4-13a). Also, results revealed that the number of daily MedRecs completed was significantly different ((P<0.01; Kruskal Wallis Test with pairwise comparison as a post Hoc test) between both surgical and medical ward specialties (Table 4-13, Figure 4-13b).

Table 4-11: Mean±SEM of the average time (min) spent by ward dedicated clinical pharmacists working within different medical wards to complete the daily MedRecs required on admission.

	A3 Respiratory ward N= 10	A4 Respiratory ward N= 10	B2 Elderly Care ward N= 10	B4 Endocrine ward N= 10	Level of significance#
Time (min) spent on medicines history interviews	74.40 ± 14.59	32.70 ± 3.31	12.50 ± 2.46	46.20 ± 12.31	$P < 0.05^{a,}$ $P < 0.01^{b}$
SD	47.30	10.46	7.80	38.92	
Median	75.0	30.0	10.0	30.0	
95% CI (upper-lower)	40.55 – 108.24	25.21 – 40.18	6.91 – 18.08	18.35 – 74.04	
Time (min) spent on Reconciliations	40.30 ± 11.98	52.10 ± 7.49	90.00 ± 12.15	43.50 ± 8.39	$P < 0.05^{a,c}$
SD	37.89	23.70	38.44	26.53	
Median	31.0	50.0	92.50	32.50	
95% CI (upper-lower)	13.19 – 67.40	35.13 – 69.06	62.50 – 117.49	24.51 – 62.48	
Total time (min) spent on both medicines history interviews and Reconciliations	114.70 ± 24.93	84.80 ± 9.76	102.50 ± 14.14	89.70 ± 20.19	NS
SD	78.86	30.88	44.74	63.85	
Median	114.0	82.5	99.5	60.0	
95% CI (upper-lower)	58.28 – 171.11	62.70 – 106.89	70.49 – 134.50	44.01 – 135.38	
Numbers of daily MedRecs completed	3.80 ± 0.69	3.10 ± 0.27	2.90 ± 0.50	4.00 ± 0.82	NS
SD	2.20	0.87	1.59	2.62	
Median	4.0	3.0	2.5	4.0	
95% CI (upper-lower)	2.22 – 5.37	2.47 – 3.72	1.75 – 4.04	2.12 – 5.78	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
P<0.05: considered significant **P<0.01**: considered highly significant
NS: no significance P>0.05 **#** One way Anova with Tukey HSD as a post Hoc test
a= significant difference between A3, A4 wards **b**= significant difference between A3, B2 wards
c= significant difference between B2, B4 wards

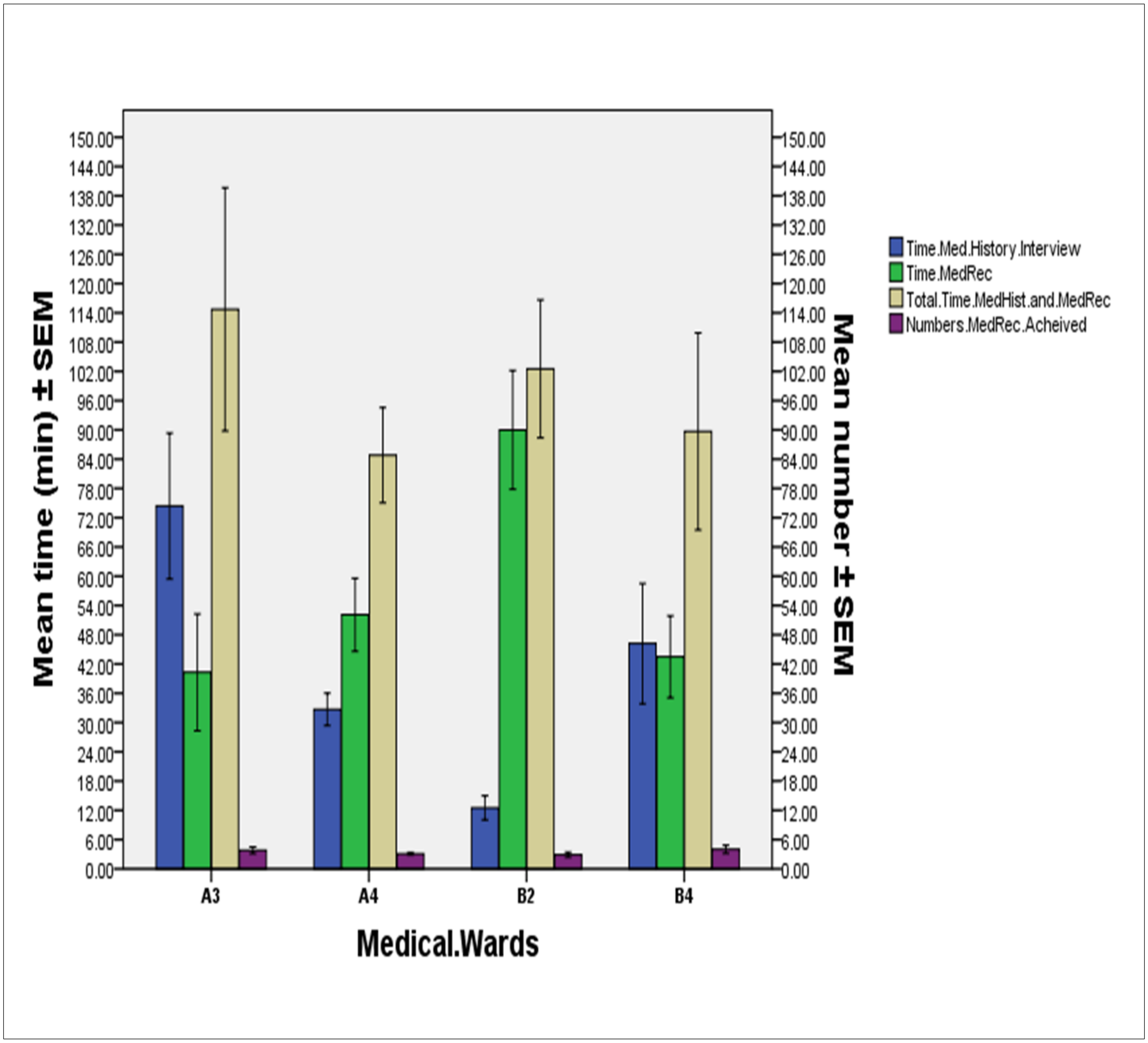


Figure 4-11: Comparison between the average time (min) spent by ward dedicated clinical pharmacists working within different medical wards to complete the daily MedRecs required on admission.

Table 4-12: Mean±SEM of the average time (min) spent by ward dedicated clinical pharmacists working within surgical wards to complete the daily MedRecs required on admission.

	C5 Surgical ward N= 10	C6 Surgical ward N= 10	Level of significance#
Time (min) spent on medicines history interviews	35.70 ± 3.51	37.60 ± 6.56	NS
SD	11.12	20.74	
Median	35.0	32.0	
95% CI (upper-lower)	27.74 – 43.65	22.75 – 52.44	
Time (min) spent on Reconciliations	85.00 ± 7.63	101.90 ± 19.08	NS
SD	24.15	60.36	
Median	82.50	77.50	
95% CI (upper-lower)	67.72 – 102.27	58.71 – 145.08	
Total time (min) spent on both medicines history interviews and Reconciliations	120.70 ± 10.94	139.50 ± 25.49	NS
SD	34.59	80.61	
Median	115.0	104.5	
95% CI (upper-lower)	95.94 – 145.45	81.83 – 197.16	
Numbers of daily MedRecs Completed	5.20 ± 0.48	5.60 ± 0.65	NS
SD	1.54	2.06	
Median	5.5	5.0	
95% CI (upper-lower)	4.09 – 6.30	4.12 – 7.07	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
NS: no significance P>0.05
Un-paired t-test

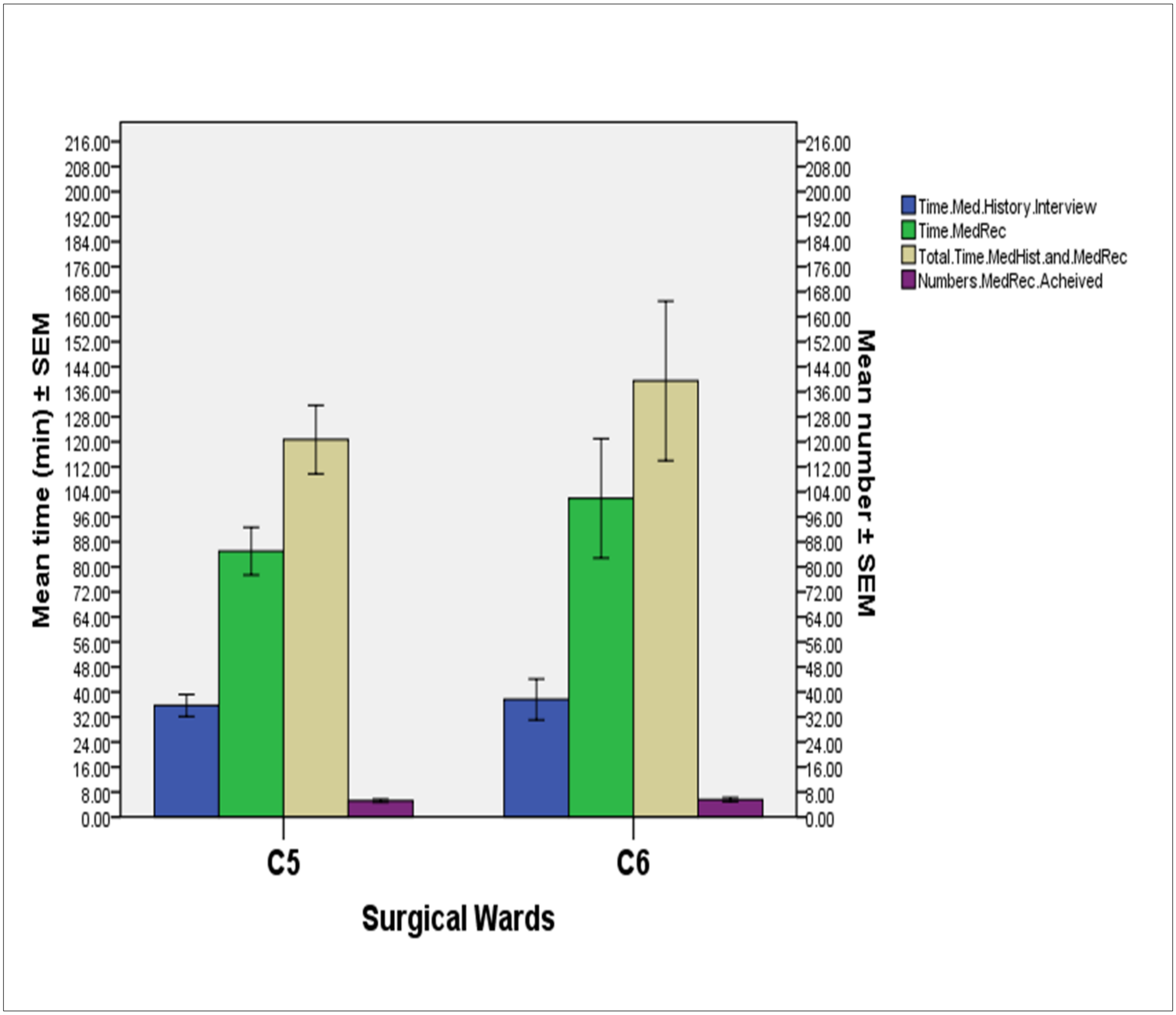


Figure 4-12: Comparison between the average time (min) spent by ward dedicated clinical pharmacists working within surgical wards to complete the daily MedRecs required on admission.

Table 4-13: Mean±SEM of the average time (min) spent by ward dedicated clinical pharmacists working within different ward specialties to complete the daily MedRecs required on admission.

	Medical wards N= 40	Surgical wards N= 20	Cardiology & Long stay wards N= 20	Level of significance##
Time (min) spent on medicines history interviews	41.45 ± 5.69	36.65 ± 3.62	48.30 ± 6.70	NS
SD	37.73	16.23	29.98	
Median	30.0	35.0	51.0	
95% CI (upper-lower)	29.38 – 53.51	29.05 – 44.24	34.26 – 62.33	
Time (min) spent on Reconciliations	56.47 ± 5.84	93.45 ± 10.19	86.90 ± 15.59	P < 0.01[a,b]
SD	36.98	45.58	69.76	
Median	50.0	80.0	77.0	
95% CI (upper-lower)	44.64 – 68.30	72.11 – 114.78	54.25 – 119.54	
Total time (min) spent on both medicines history interviews and Reconciliations	97.92 ± 8.94	130.10 ± 13.67	135.20 ± 20.15	NS
SD	56.54	61.14	90.15	
Median	90.0	109.5	139.0	
95% CI (upper-lower)	79.84 – 116.00	101.48 – 158.71	93.00 – 177.39	
Numbers of daily MedRecs completed	3.45 ± 0.30	5.40 ± 0.40	3.50 ± 0.60	P < 0.01[a]
SD	1.92	1.78	2.72	
Median	3.5	5.0	3.0	
95% CI (upper-lower)	2.83 – 4.06	4.56 – 6.23	2.22 – 4.77	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
Kruskal Wallis Test for non-parametric data with pairwise comparison as a post Hoc test
P<0.01: considered highly significant
NS: no significance P>0.05
a= significant difference between medical wards, surgical wards
b= significant difference between medical wards, cardiology & long stay wards

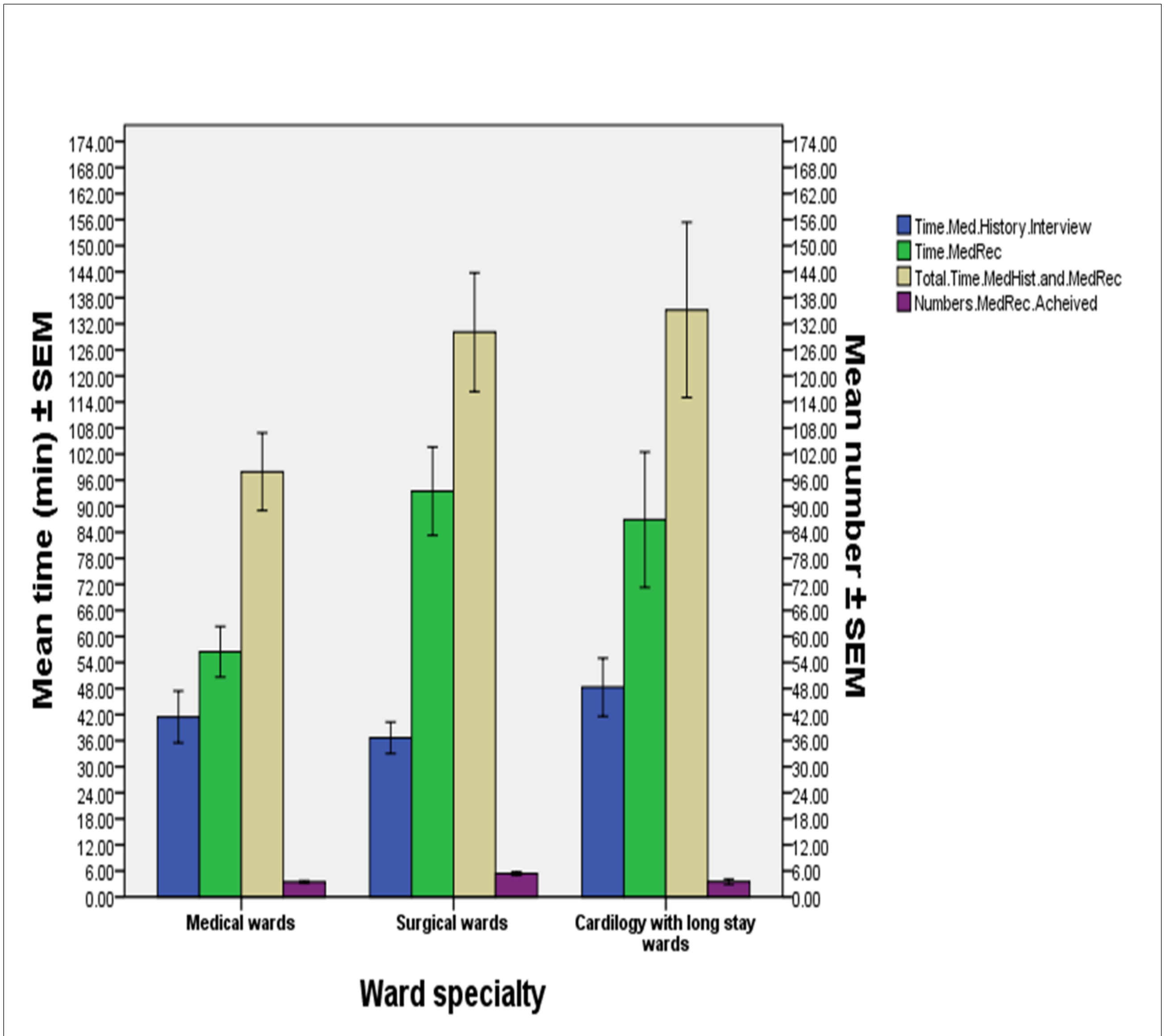
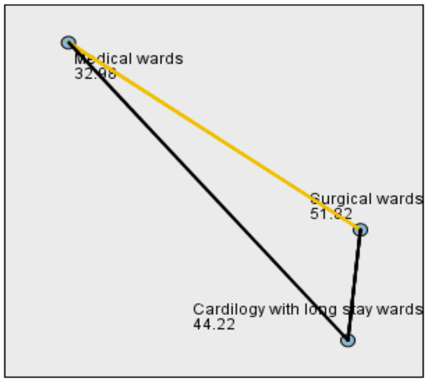


Figure 4-13a: Comparison between the average time (min) spent by ward dedicated clinical pharmacists working within different ward specialties to complete the daily MedRecs required on admission.

Numbers of MedRecs completed

Pairwise Comparisons of Ward



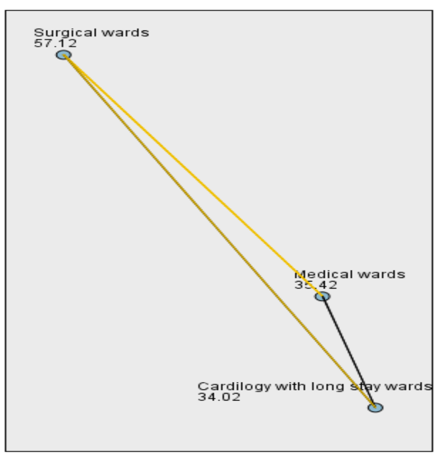
Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Medical wards-Cardilogy with long stay wards	-11.250	6.361	-1.769	.077	.231
Medical wards-Surgical wards	-18.850	6.361	-2.963	.003	.009
Cardilogy with long stay wards-Surgical wards	7.600	7.345	1.035	.301	.902

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Time for Reconciliations

Pairwise Comparisons of Ward



Each node shows the sample average rank of Ward.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Cardilogy with long stay wards-Medical wards	1.400	6.295	.222	.824	1.000
Cardilogy with long stay wards-Surgical wards	23.100	7.269	3.178	.001	.004
Medical wards-Surgical wards	-21.700	6.295	-3.447	.001	.002

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Figure 4-13b: Post hoc Kruskal Wallis Test with pair wise comparison for the average time (min) spent by ward dedicated clinical pharmacists working within different ward specialties to complete the daily MedRecs required on admission.

4.4.2.3 Analysis of time spent for MedRecs by different clinical pharmacists` grades (bands) during patients` hospital admissions

a. Analysis of the time spent on admissions` MedRecs between senior clinical pharmacists (band 7s) working in all medical and surgical wards involved in the study.

Results showed that there were significant differences ($P<0.05$; One Way Anova with Tukey HSD as a post Hoc test) in time spent by senior clinical pharmacists (band 7s) for medicines history interviews between three wards and reconciliations between four wards during patients` hospital admissions within the five wards involved in the study. However, there was no significant difference ($P>0.05$; One Way Anova) in the total time spent for the whole MedRecs process (Table 4-14, Figure 4-14). Further, significant differences existed ($P<0.05$; One Way Anova with Tukey HSD as a post Hoc test) between senior clinical pharmacists (band 7s) in number of daily MedRecs completed on admission within four out of the five wards in which there were working; this number ranged from two to six MedRecs per ward every day (Table 4-14, Figure 4-14).

b. Analysis of the time spent on admissions` MedRecs between junior (band 6s) and senior clinical pharmacists (band 7s) working in medical and surgical wards involved in the study.

Within surgical wards, results revealed no significant differences existed ($P<0.05$; Un-paired T-test) between time spent by junior (band 6s) and senior (band7s) clinical pharmacists to complete medicines history interviews, reconciliations or the total time spent for the whole MedRecs process during patients hospital admissions (Table 4-15, Figure 4-15). Moreover, results also revealed that, when comparing time spent by junior (band 6s) and senior (band 7s) clinical pharmacists within medical wards, it has shown that, significant differences existed ($P<0.05$; Mann-Whitney test) in time spent on medicines history interviews and also in the total time spent for the whole MedRecs process during admission between the two pharmacists staff grades. Junior pharmacists (band 6s) within medical wards spent about 35% more time in history interviews and also in total time of MedRecs process when compared with senior clinical pharmacist (band7s) working within also medical wards to complete the same number of MedRecs on admission (Table 4-15, Figure 4-16).

c. Analysis of the time spent on admissions` MedRecs between junior (band 6s) and senior clinical pharmacists (band 7s) working within the same surgical ward.

Results showed that no significant differences existed ($P>0.05$; Un-paired T-test) between junior (band 6) and senior (band 7) clinical pharmacists in time spent on medicines history interviews, reconciliations and also the total time spent for the whole MedRecs process during patients` hospital admission within the same surgical ward (Table 4-16, Figure 4-17).

Table 4-14: Mean±SEM of the average time (min) spent by ward dedicated senior clinical pharmacists (band 7s) within different hospital wards to complete the daily MedRecs required on admission.

Activity	A4 Band 7 N= 10	B2 Band 7 N= 10	B4 Band 7 N= 10	C6 Band 7 N= 5	C7 Band 7 N= 10	Level of significance #
Time (min) spent on medicines history interviews	32.70 ± 3.31	12.50 ± 2.46	46.20 ± 12.31	47.00 ± 11.29	47.00 ± 10.90	$P < 0.05^{a,b}$
SD Median 95% CI (upper-lower)	10.46 30.0 25.21 – 40.18	7.80 10.0 6.91 – 18.08	38.92 30.0 18.35 – 74.04	25.25 55.0 15.36 – 78.36	34.49 60.0 22.32 – 71.67	
Time (min) spent on Reconciliations	52.100 ± 7.49	90.00 ± 12.15	43.50 ± 8.39	121.00 ± 34.59	47.50 ± 13.66	$P < 0.05^{c,d,e}$
SD Median 95% CI (upper-lower)	23.70 50.0 35.13 – 69.06	38.44 92.5 62.50 – 117.49	26.53 32.50 24.51 – 62.48	77.35 140.0 24.94 – 217.05	43.22 42.5 16.58 – 78.41	
Total time (min) spent on both medicines history interviews and Reconciliations	84.80 ± 9.76	102.50 ± 14.14	89.70 ± 20.19	168.00 ± 45.71	94.50 ± 22.46	NS
SD Median 95% CI (upper-lower)	30.88 82.5 62.70 – 106.89	44.74 99.5 70.49 – 134.50	63.85 60.0 44.01 – 135.38	102.22 195.0 41.07 – 294.92	71.04 107.5 43.67 – 145.32	
Numbers of daily MedRecs completed	3.10 ± 0.27	2.90 ± 0.50	4.00 ± 0.82	6.40± 1.07	1.90 ± 0.45	$P < 0.05^{c,e,f}$
SD Median 95% CI (upper-lower)	0.87 3.0 2.47 – 3.72	1.59 2.50 1.75 – 4.04	2.62 4.0 2.12 – 5.78	2.40 7.0 3.40 – 9.39	1.44 2.0 0.86 – 2.93	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
P<0.05: considered significant **NS**: no significance P>0.05
One way Anova with Tukey HSD as a post Hoc test
a= significant difference between B2, B4 wards
b= significant difference between B2, C7 wards
c= significant difference between A4, C6 wards
d= significant difference between B4, C6 wards
e= significant difference between C6, C7 wards
f= significant difference between B2, C6 wards

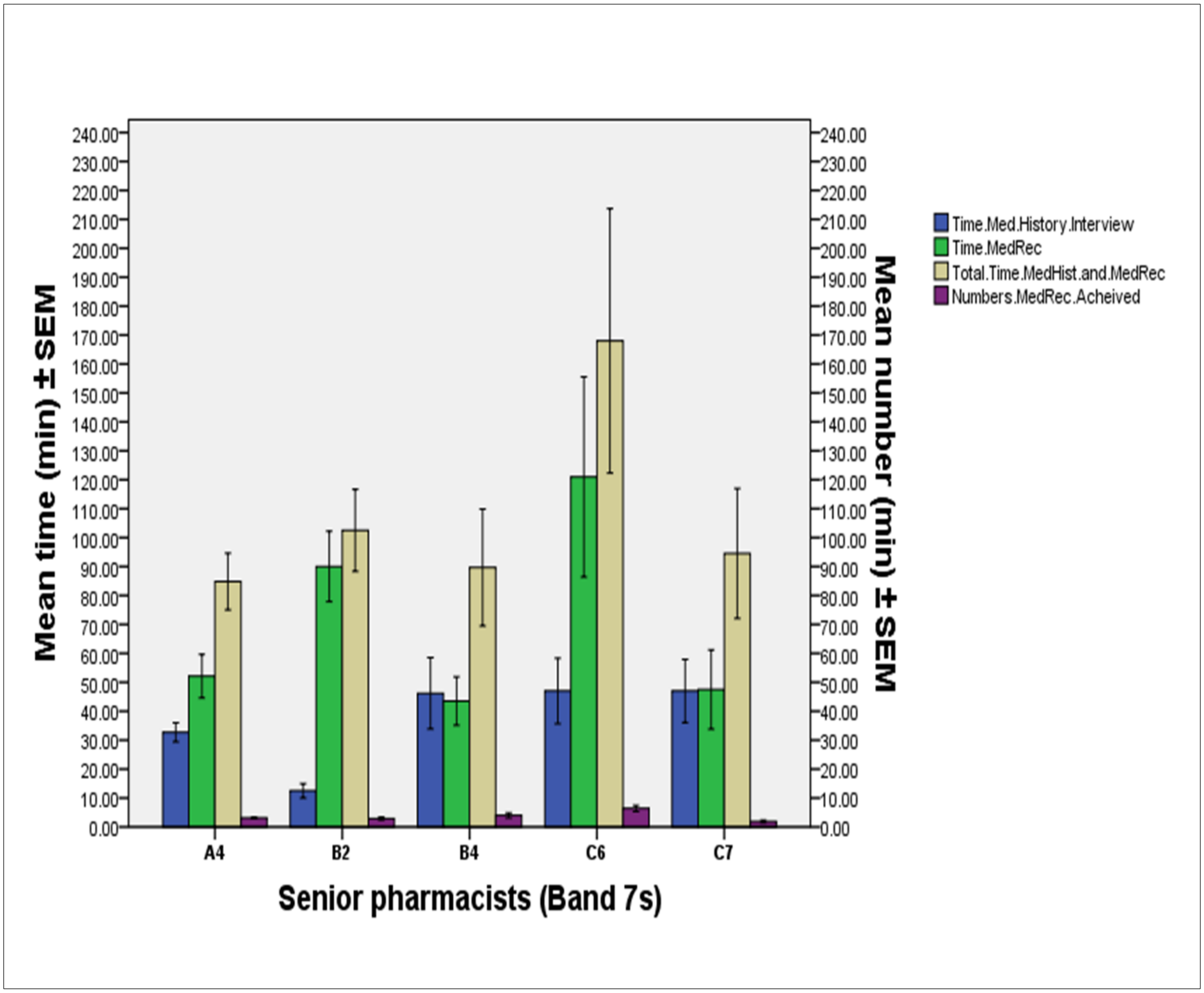


Figure 4-14: Comparison between the average time (min) spent by ward dedicated senior (band 7s) clinical pharmacists working within different ward specialties to complete the daily MedRecs required on admission

Table 4-15: Mean±SEM of the average time (min) spent by ward dedicated junior (band 6) and senior (band 7s) clinical pharmacists working within the surgical and medical hospital wards involved in the study.

Activity	C5 Band 6 N= 10	C6 Band 7 N= 5	Level of significance #	A3 Band 6 N= 10	A4 Band 7 N= 10	Level of signif-cance #
Time (min) spent on medicines history interviews	35.70 ± 3.51	47.00 ± 11.29	NS	74.40 ± 14.95	32.70 ± 3.31	P < 0.05
SD	11.12	25.25		47.30	10.46	
Median	35.0	55.0		75.0	30.0	
95% CI (upper-lower)	27.74 – 43.65	15.63 – 78.36		40.22 – 108.24	25.21 – 40.18	
Time (min) spent on Reconciliations	85.00 ± 7.63	121.00 ± 7.63	NS	40.30 ± 11.98	52.10 ± 7.49	NS##
SD	24.15	77.35		37.89	23.70	
Median	82.5	140.0		31.0	50.0	
95% CI (upper-lower)	67.72 – 102.27	24.94 – 217.05		13.19 – 67.40	35.13 – 69.06	
Total time (min) spent on both medicines history interviews and Reconciliations	120.70 ± 10.94	168.00 ± 45.71	NS	114.70 ± 24.93	84.80 ± 9.76	P < 0.05
SD	34.59	102.22		78.86	30.88	
Median	115.0	195.0		114.0	82.5	
95% CI (upper-lower)	95.94 – 145.45	41.07 – 294.92		58.28 – 171.11	62.70 – 106.89	
Numbers of daily MedRecs completed	5.20 ± 0.48	6.40 ± 1.07	NS	3.80±0.69	3.10 ± 0.27	NS##
SD	1.54	2.40		2.20	0.87	
Median	5.5	7.0		4.0	3.0	
95% CI (upper-lower)	4.09 – 6.30	3.40 – 9.39		2.22 – 5.37	2.47 – 3.72	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliation
NS: no significance P>0.05 **P<0.05**: considered significant
Un-paired T-test
Mann-Whitney test

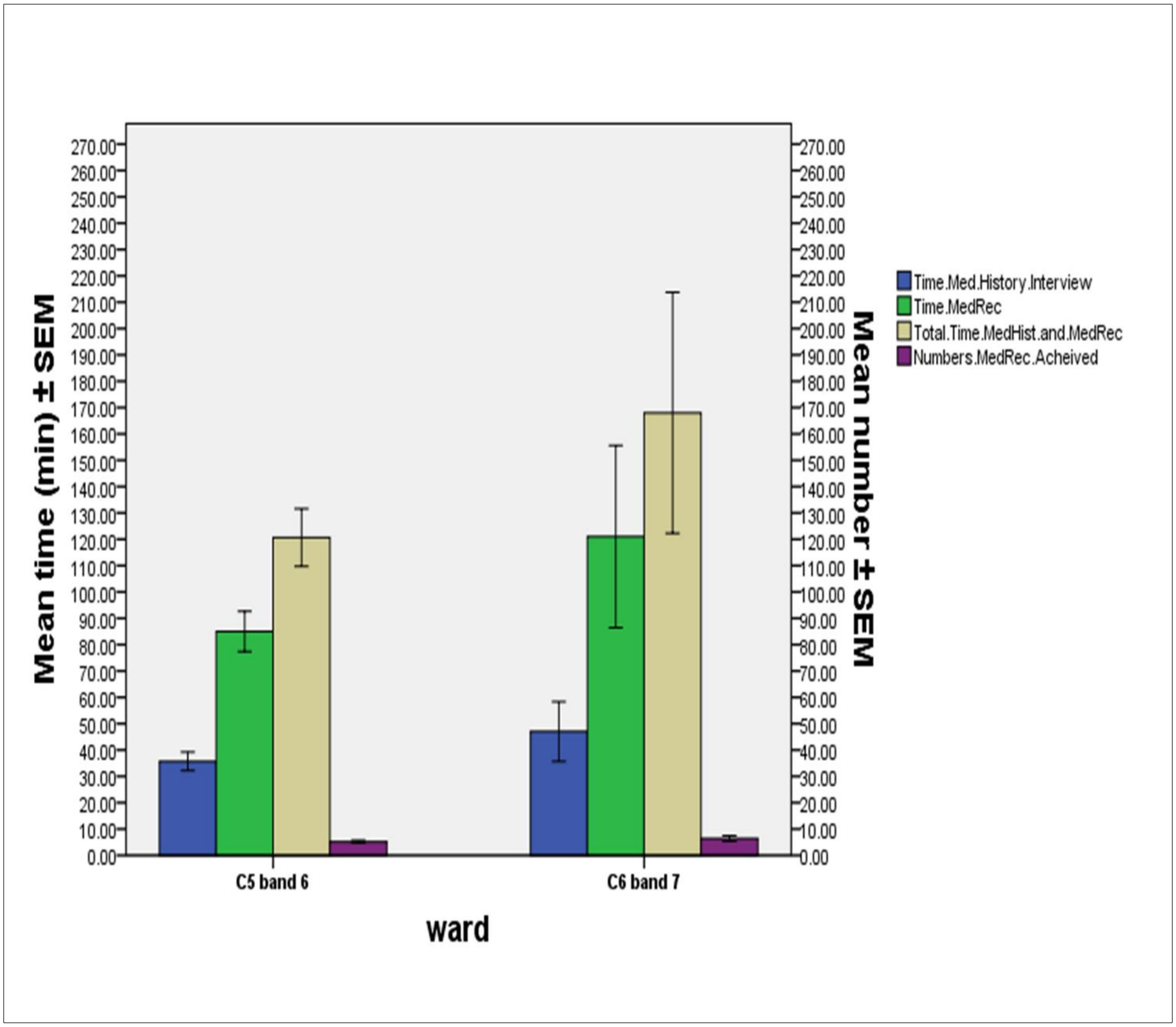


Figure 4-15: Comparison between the average time (min) spent by both ward based junior (band 6) and senior (band 7) pharmacists working respectively in C5 and C6 surgical wards during patients` hospital admissions.

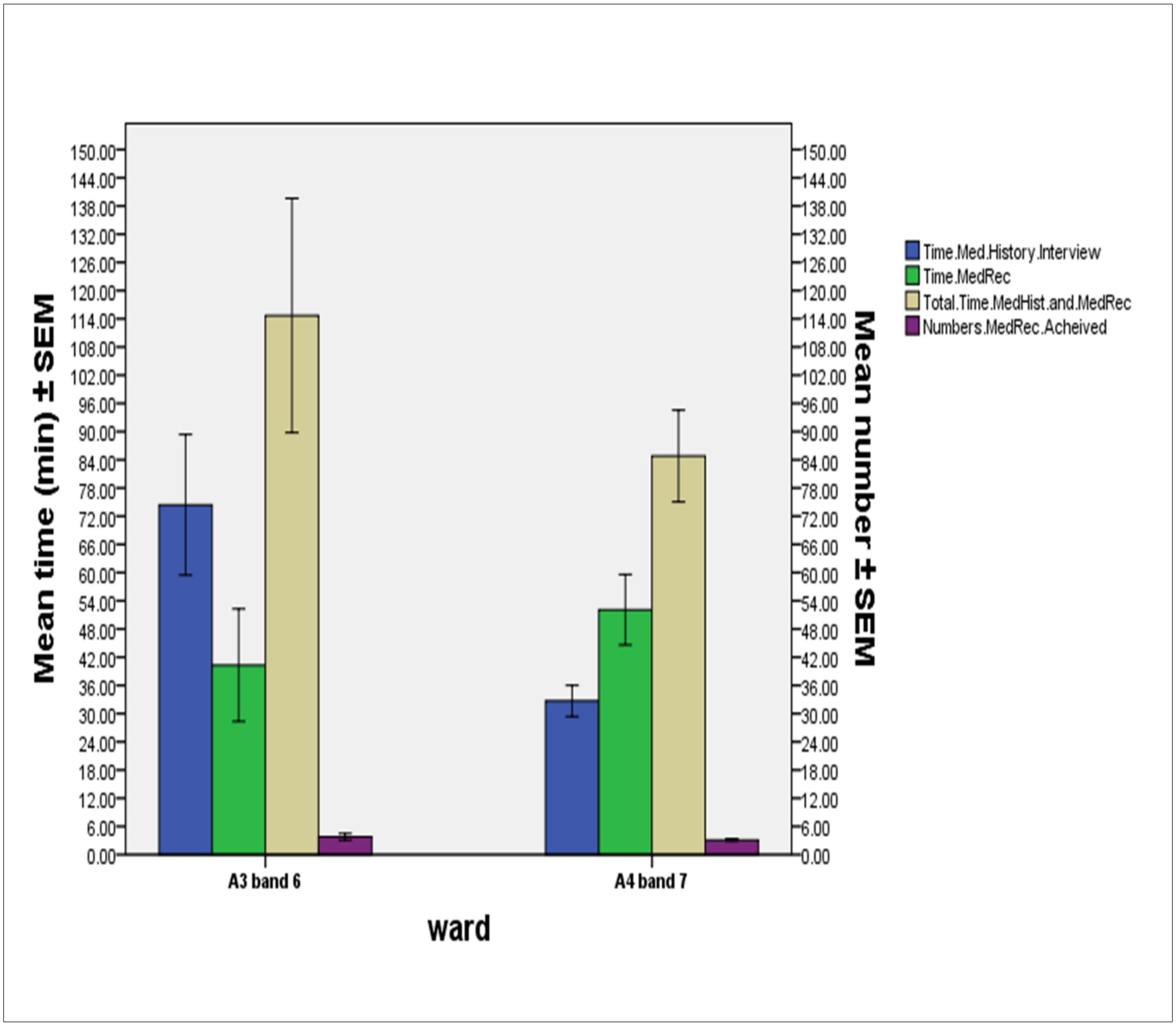


Figure 4-16: Comparison between the average time (min) spent by both ward based junior (band 6) and senior (band 7) pharmacists working respectively in A3 and A4 medical wards during patients` hospital admissions.

Table 4-16: Mean±SEM of of the average time (min) spent by both ward dedicated junior (band 6) and senior (band 7) clinical pharmacists within the same surgical ward to complete the daily MedRecs required on admission.

Activity	C6 Band 6 N= 5	C6 Band 7 N= 5	Level of significance
Time (min) spent on medicines history interviews	28.20 ± 4.68	47.00 ± 11.29	NS
SD	1047	25.25	
Median	24.0	55.0	
95% CI (upper-lower)	15.19 – 41.20	15.63 – 78.36	
Time (min) spent on Reconciliations	82.80 ± 16.14	121.00 ± 34.59	NS
SD	36.09	77.35	
Median	75.0	140.0	
95% CI (upper-lower)	37.98 – 127.61	24.94 – 217.05	
Total time (min) spent on both medicines history interviews and Reconciliations	111.00 ± 20.69	168.00 ± 45.71	NS
SD	46.28	102.22	
Median	99.0	195.0	
95% CI (upper-lower)	53.53 – 168.46	41.07 – 294.92	
Numbers of daily MedRecs Completed	4.80 ± 0.66	6.40 ± 1.07	NS
SD	1.48	2.40	
Median	5.0	7.0	
95% CI (upper-lower)	2.95- 6.64	3.40 – 9.39	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **MedRecs**= Medicines reconciliations
NS: no significance P>0.05
Un-paired T-test

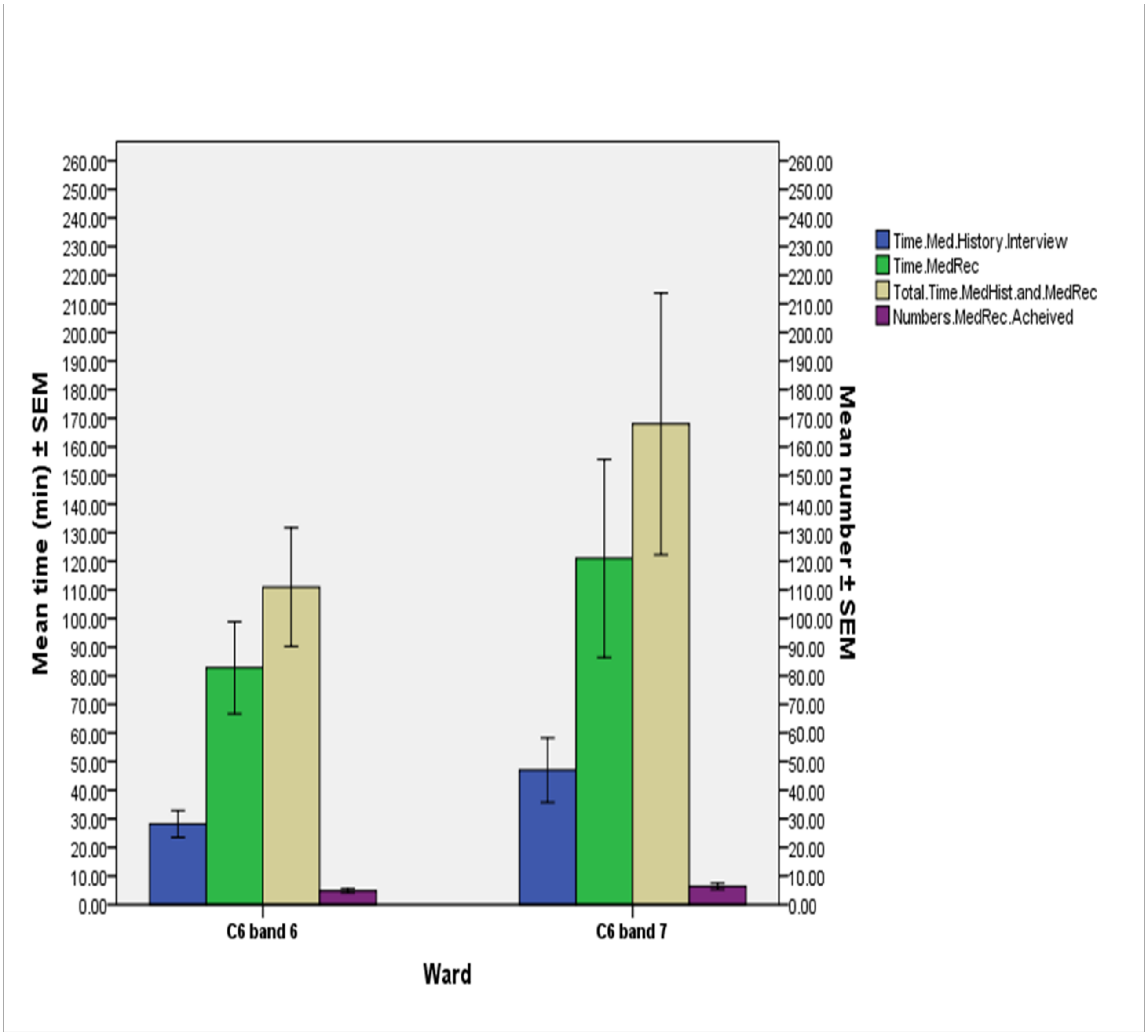


Figure 4-17: Comparison between the average time (min) spent by both ward based junior (band 6) and senior (band 7) pharmacists working within the same surgical (C5) ward during patients` hospital admissions

4.4.3 Analysis of ward dedicated clinical pharmacists` services and activities during patients` hospital discharge.

Ward clinical pharmacists complete many different activities throughout the full patient hospital journey, however the pilot data collection of the study revealed that; the main clinical pharmacists` activities during patients discharges was clinical check and writing of the discharge prescriptions (Medicines Reconciliations on discharge).

4.4.3.1 Analysis of the daily discharge MedRecs workload (numbers & time) completed by the ward dedicated clinical pharmacists in each ward involved in the study.

Results revealed that the numbers of daily discharge prescriptions which were clinically checked and written by a clinical pharmacist in each ward was different between wards involved in the study. However the only significant difference which existed ($P<0.01$; One Way Anova with Tukey HSD as a post Hoc test) was between C7 (elderly care medical ward) and C5 (surgical) wards and represented 2.20 ± 0.44 and 6.00 ± 0.88 respectively (Table 4-17). In addition, the time required by the pharmacist to complete the daily discharge prescriptions was very different between all wards and ranged from about 0.5 to 2.5 (hours) daily (Table 4-17)

Results also showed that in general the average number of daily discharge prescriptions clinically checked and written by a clinical pharmacist in each ward was 4.13 ± 0.23 and this required a time of 1.50 ± 0.10 (hours) to be completed (Table 4-17). Moreover, it has also shown that the number of discharge prescriptions which were not completed before 5:00pm (end of the working day) was 0.32 ± 0.06 and this represented about 7% of all daily required prescriptions for discharges (Table 4-17).

Table 4-17: Mean±SEM of the average daily numbers & time (hrs) spent for clinical check and writing of the discharge prescriptions by the ward dedicated clinical pharmacist in each ward during patients` hospital discharge (Medicines reconciliation on discharge).

Activity	Numbers of daily discharge prescriptions completed by the pharmacist N= 80	Level of significance	Daily time (Hrs)spent by the pharmacist for discharges N= 80	Level of significance
A3 (Respiratory ward, chronic)	4.20 ± 0.41	NS	1.32 ± 0.19	$P < 0.05^{*g}$
SD	1.31		0.61	
Median	4.0		1.16	
95% CI (upper-lower)	3.25 – 5.14		0.88 – 1.76	
A4 (Respiratory ward, Acute)	3.50 ± 0.52	NS	0.91 ± 0.15	$P < 0.01^{*a,b}$
SD	1.64		0.49	
Median	3.5		0.87	
95% CI (upper-lower)	2.31 – 4.68		0.55 – 1.26	
B3 (Cardiology & ACS ward)	4.50 ± 0.26	NS	2.28 ± 0.26	$P < 0.01^{*a}$, $P < 0.05^{*e,f}$
SD	0.84		0.82	
Median	4.5		1.99	
95% CI (upper-lower)	3.89 – 5.10		1.69 – 2.87	
C5 (Elective surgery admission ward)	6.00 ± 0.88	$P < 0.01^{*h}$	0.99 ± 0.13	$P < 0.01^{*c}$, $P < 0.05^{*e}$
SD	2.78		0.42	
Median	5.0		0.79	
95% CI (upper-lower)	4.00 – 7.99		0.69 – 1.29	
C6 (Emergency & non elective surgery ward)	4.70 ± 0.61	NS	1.14 ± 0.22	$P < 0.01^{*d}$, $P < 0.05^{*f}$
SD	1.94		0.72	
Median	5.0		0.96	
95% CI (upper-lower)	3.30 – 6.09		0.62 – 1.66	
C7 (Medical ward for long stay chronic problems)	2.20 ± 0.44	$P < 0.01^{*h}$	1.50 ± 0.30	NS
SD	1.39		0.97	
Median	2.5		1.71	
95% CI (upper-lower)	1.19 – 3.20		0.81 – 2.20	
B2 (Elderly care medical ward)	4.30 ± 0.70	NS	2.48 ± 0.38	$P < 0.01^{*b,c,d}$, $P < 0.05^{*g}$
SD	2.21		1.22	
Median	4.50		2.67	
95% CI (upper-lower)	2.71 – 5.88		1.60 – 3.36	
B4 (Medical ward, Endocrine problems)	3.70 ± 0.68	NS	1.40 ± 0.25	NS
SD	2.16		0.81	
Median	4.0		1.42	
95% CI (upper-lower)	2.15 – 5.24		0.81 – 1.98	
Mean average for all wards	4.13 ± 0.23	-	1.50 ± 0.10	-
SD	2.06		0.93	
Median	4.0		1.31	
95% CI (upper-lower)	3.67 – 4.59		1.29 – 1.71	

Numbers of discharge prescriptions not completed by 05:00pm (same day)	0.32 ± 0.06
SD	0.61
Median (min – max)	0.0 (0.0 – 2.0)
95% CI (upper-lower)	0.18 – 0.46

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean **CI**= confidence interval

P<0.05: considered significant **P<0.01**: considered highly significant **NS**: no significance P>0.05

*****One way Anova with Tukey HSD as a post Hoc test

a= significant difference between A4, B3 wards
b= significant difference between A4, B2 wards
c= significant difference between B2, C5 wards
d= significant difference between B2, C6 wards
e= significant difference between B3, C5 wards
f= significant difference between B3, C6 wards
g= significant difference between B2, A3 wards
h= significant difference between C5, C7 wards

4.4.3.2 Analysis of the daily discharge MedRecs workload (numbers & time) completed by the ward dedicated clinical pharmacists within different ward specialties.

The data analysis found significant differences between the three types of ward specialties involved in the study in numbers of daily discharge prescriptions completed by the pharmacist, daily time required to complete this activity and numbers of discharge medicines reviewed by the pharmacist every day.

Testing by two way Anova (general linear model, multivriate with Tukey HSD as a post Hoc test) found that the numbers of daily discharge prescriptions within surgical wards were significantly larger than those of medical ($P<0.01$) and cardiology with long stay ($P<0.05$) wards. However, the time required to complete these numbers of discharge prescriptions was significantly shorter within surgical than cardiology with long stay wards and remained non-significant ($P>0.05$) between medical and surgical wards (Table 4-18). In addition, the total daily number of medicines reviewed by the pharmacist for patients` discharges was significantly different ($P<0.05$) between medical and cardiology with long stay wards (45.87 ± 3.83 and 31.45 ± 4.07 respectively) including an average number of 9 to 10 high-risk medicines for each of them (Table 4-18). Furthermore, pharmacists in surgical wards appeared to review an average of 33.60 ± 3.57 medicines for daily patients' discharges including only about four to five high-risk medicines (Table 4-18).

Table 4-18: Mean±SEM of the average daily numbers & time (hrs) required for discharge scripts completed by the ward dedicated clinical pharmacist in different wards specialties during patients` hospital discharge (Medicines reconciliation on discharge).

Activity	Medical wards N= 40	Surgical wards N= 20	Cardiology & Long stay wards N= 20	Level of significance#
Numbers of daily discharge prescriptions completed by the pharmacist	3.92 ± 0.28	5.35 ± 0.54	3.35 ± 0.36	$P < 0.05^{a}$ $P < 0.01^{b}$
SD	1.83	2.43	1.63	
Median	4.0	5.0	4.0	
95% CI (upper-lower)	3.33 – 4.51	4.21 – 6.48	2.58 – 4.11	
Daily time (Hrs) spent by the pharmacist for completing discharge prescription	1.57 ± 0.16	1.07 ± 0.13	1.89 ± 0.21	$P < 0.05^{b}$
SD	1.04	0.58	0.96	
Median	1.29	0.79	1.86	
95% CI (upper-lower)	1.23 – 1.90	0.79 – 1.34	1.44 – 2.34	
Total number of medicines reviewed daily by the pharmacist for patients` discharges (including high-risk medicines)	45.87± 3.83	33.60 ± 3.57	31.45 ± 4.07	$P < 0.05^{c}$
SD	24.25	15.98	18.22	
Median	44.5	30.5	30.5	
95% CI (upper-lower)	38.11 – 53.63	26.11 – 41.08	22.91 – 39.98	
Number of high risk medicines reviewed daily by the pharmacist for patients` discharges	9.55 ± 0.89	4.75 ± 0.66	9.05 ± 1.60	$P < 0.05^{a}$
SD	5.67	2.95	7.19	
Median	9.0	4.0	8.0	
95% CI (upper-lower)	7.73 – 11.36	2.36 – 6.13	5.68 – 12.41	
Number of daily new admitted patients in the ward	5.57 ± 0.40	5.75 ± 0.47	4.56 ± 0.55	NS
SD	2.53	2.12	2.49	
Median	5.0	6.0	5.0	
95% CI (upper-lower)	7.76 – 6.38	4.75 – 6.74	3.48 – 5.81	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean **CI**= confidence interval
P<0.05: considered significant **P<0.01**: considered highly significant **NS**: no significance P>0.05
\# Two ways Anova (General Linear Model, Multivriate) with Tukey HSD as a post Hoc test
a= significant difference between medical & surgical wards
b= significant difference between surgical & cardiology with long stay wards
c= significant difference between medical & cardiology with long stay wards

4.4.3.3 Analysis of the daily discharge MedRecs workload (numbers & time) completed by the ward dedicated clinical pharmacists within different weekly days.

Results showed that, no significant differences existed ($P<0.05$; Two ways Anova (General Linear Model, Multivariate with Tukey HSD as a post Hoc test) when the discharge MedRecs workload between different week days (Monday to Friday) was compared within the wards involved in the study. The numbers of discharge prescriptions completed by the clinical pharmacist in each ward over the different weekly days ranged between four and five and required between 1.3 to 1.8 (hours) to be completed. Also the number of daily discharge medicines reviewed over the weekly days ranged between 32 and 47 including from 8 to 10 high risk medicines (Table 4-19).

4.4.3.4 Analysis of the daily discharge MedRecs workload (numbers & time) completed by different clinical pharmacy staff grades.

Time taken and numbers of medicines in each discharge prescriptions were compared between junior, senior and consultant clinical pharmacists using Kruskal Wallis test with pairwise comparison as a post Hoc. Junior clinical pharmacists (band 6s) significantly ($P<0.01$) required significantly less time than senior clinical pharmacists (band7s) on completing the discharge prescription, however no significant differences existed ($P>0.05$) between senior (band 7s) and consultant (band 8s) clinical pharmacists in clinical reviewing and writing of patient discharge prescription (Table 4-19, Figure 4-18a,b). In addition, the average total number of medicines reviewed in each prescription was significantly different ($P<0.01$) between different clinical pharmacy staff grades (junior, senior and consultant) while the number of high-risk medicines in each prescription reviewed by them was non-significant ($P>0.05$) and relatively similar and ranged between one and two in each prescription (Table 4-19).

Table 4-19: Mean±SEM of the average daily numbers & time (hrs) required for discharge scripts completed by the ward dedicated clinical pharmacist in different weekly days during patients` hospital discharge (Medicines reconciliation on discharge).

Activity	Monday N= 16	Tuesday N= 16	Wednesday N= 16	Thursday N= 16	Friday N= 16	Level of significance#
Numbers of daily discharge prescriptions completed by the pharmacist	3.93 ± 0.42	3.81 ± 0.59	4.56 ± 0.40	3.87 ± 0.58	4.50 ± 0.57	NS
SD	1.69	2.37	1.63	2.33	2.30	
Median	4.0	3.5	4.0	4.0	4.5	
95% CI (upper-lower)	3.03 – 4.83	2.54 – 5.07	3.69 – 5.43	2.63 – 5.11	3.26 – 5.73	
Daily time (Hrs) spent by the pharmacist for completing discharge prescription	1.47 ± 0.24	1.29 ± 0.20	1.77 ± 0.20	1.50 ± 0.32	1.59 ± 0.22	NS
SD	0.97	0.83	0.80	1.29	0.91	
Median	1.0	1.26	1.61	1.23	1.58	
95% CI (upper-lower)	0.95 – 1.98	0.84 – 1.74	1.34 – 2.20	0.81 – 2.19	1.11 – 2.08	
Total number of medicines reviewed daily by the pharmacist for patients` discharges	40.31 ± 7.25	31.87 ± 4.57	46.50 ± 4.73	35.50 ± 5.42	41.81 ± 4.82	NS
SD	29.02	18.28	18.93	21.68	19.30	
Median	35.0	32.0	44.5	34.5	44.5	
95% CI (upper-lower)	24.84 – 55.77	22.12 – 41.62	36.40 – 56.59	23.94 – 47.05	31.52 – 52.09	
Number of high risk medicines reviewed daily by the pharmacist for patients` discharges	7.75 ± 1.47	7.68 ± 1.21	9.62 ± 1.60	7.43 ± 4.54	8.62 ± 1.59	NS
SD	5.90	4.86	6.40	6.19	6.36	
Median	6.0	8.5	9.5	6.5	7.5	
95% CI (upper-lower)	4.60 – 10.89	5.09 – 10.28	6.21 – 13.03	4.13 – 10.73	5.23 – 12.01	
Number of daily new admitted patients in the ward	7.06 ± 0.69	4.68 ± 0.52	4.06 ± 0.58	5.62 ± 0.53	5.50 ± 0.48	$P < 0.05^a$ $P < 0.01^b$
SD	2.76	2.08	2.32	2.15	1.93	
Median	7.0	4.5	3.5	5.5	5.0	
95% CI (upper-lower)	5.58 – 8.53	3.57 – 5.80	2.82 – 5.30	4.47 – 6.77	4.47 – 6.52	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean **CI**= confidence interval
P<0.05: considered significant **P<0.01**: considered highly significant **NS**: no significance P>0.05
Two ways Anova (General Linear Model, Multivariate) with Tukey HSD as a post Hoc test
a= significant difference between Monday and Tuesday
b= significant difference between Monday and Wednesday

Table 4-20: Mean±SEM of the average daily time (hrs) spent for each discharge prescription completed by different pharmacist grades (bands) during patients` hospital discharge (Medicines reconciliation on discharge).

	Band 6 N= 135	**Band 7 N= 151**	**Band 8 N= 47**	**Level of significance#**
Time (Hr) spent on each discharge prescription	0.30 ± 0.01	0.41 ± 0.01	0.39 ± 0.04	$P < 0.01^{a}$
SD	0.22	0.24	0.29	
Median	0.25	0.42	0.25	
95% CI (upper-lower)	0.26 – 0.33	0.38 – 0.45	0.30 – 0.47	
Number of medicines in each discharge prescription	8.67 ± 0.50	10.72 ± 0.46	7.48 ± 0.73	$P < 0.01^{a,b}$
SD	5.82	5.75	5.02	
Median	8.0	11.0	7.0	
95% CI (upper-lower)	7.68 – 9.66	9.79 – 11.64	6.01 – 8.96	
Number of high risk medicines in each discharge prescription	2.13± 0.18	1.86 ± 0.13	1.89 ± 0.27	NS
SD	2.16	1.63	1.89	
Median	2.0	2.0	1.0	
95% CI (upper-lower)	1.76 – 2.50	1.59 – 2.12	1.33 – 2.44	

N= sample size (number of discharge precriptions) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval
# Kruskal Wallis Test for non-parametric data with pairwise comparison as a post Hoc test
P<0.01: considered highly significant
NS: no significance P>0.05
a= significant difference between band 6 and band 7 pharmacists
b= significant difference between band 7 and band 8 pharmacists

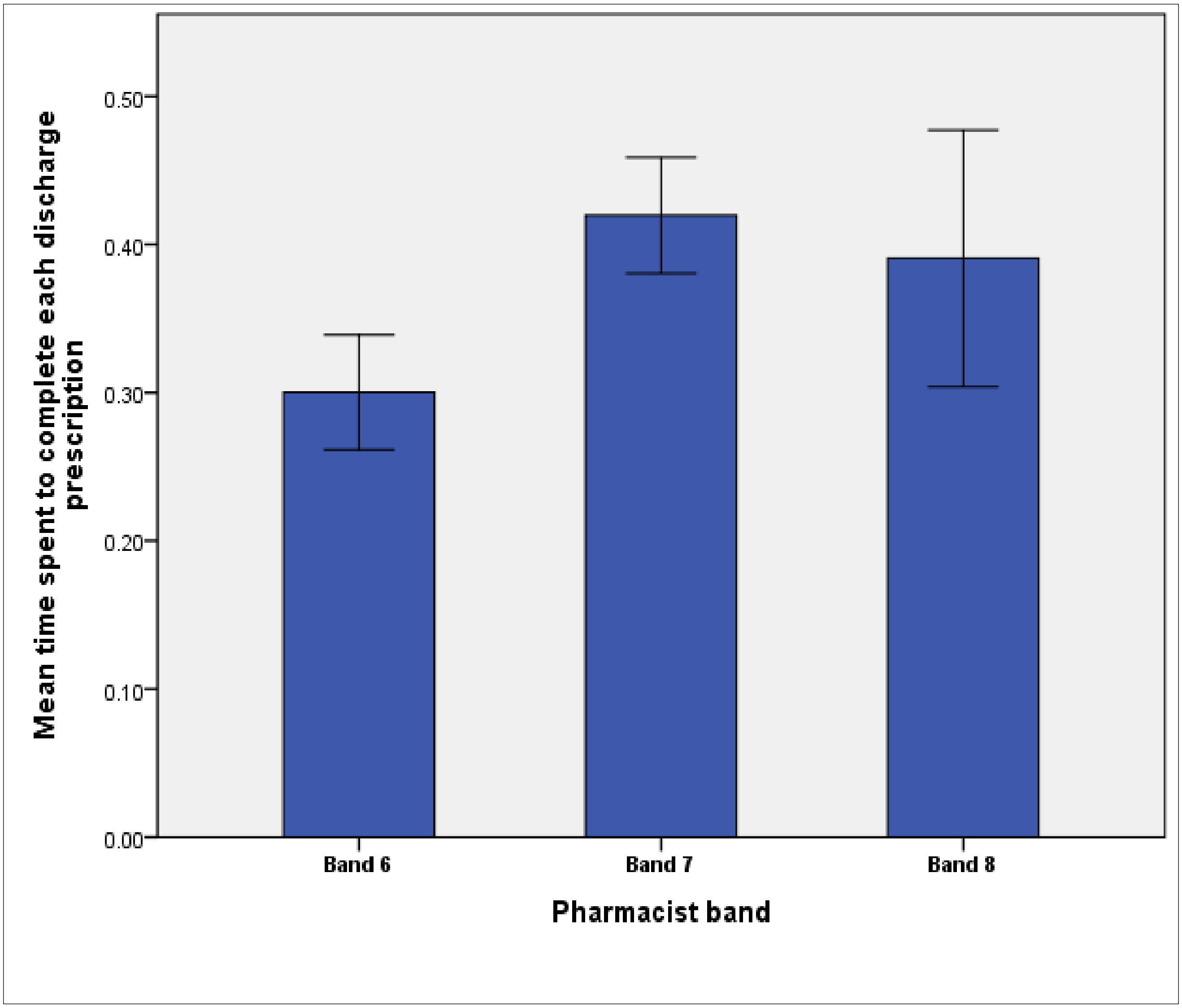
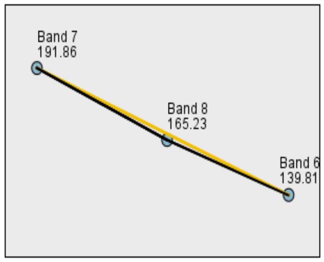


Figure 4-18a: Average time (hrs) taken by different clinical pharmacists` staff grades (junior, senior and consultant) in each discharge prescription.

Pairwise Comparisons of Pharmacist.band



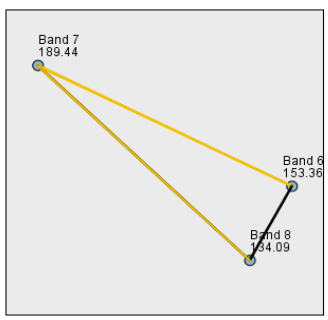
Each node shows the sample average rank of Pharmacist.band.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Band 6-Band 8	-25.423	16.201	-1.569	.117	.350
Band 6-Band 7	-52.047	11.330	-4.594	.000	.000
Band 8-Band 7	26.624	15.978	1.666	.096	.287

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Time taken for each discharge prescription

Pairwise Comparisons of Pharmacist.band



Each node shows the sample average rank of Pharmacist.band.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Band 8-Band 6	19.274	16.277	1.184	.236	.709
Band 8-Band 7	55.355	16.052	3.448	.001	.002
Band 6-Band 7	-36.081	11.383	-3.170	.002	.005

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Number of medicines for each discharge

Figure 4-18b: Differences in time (hrs) taken and numbers of medicines reviewed by different clinical pharmacists` staff grades (junior, senior and consultant) in each discharge prescription.

4.4.3.5 Analysis of the correlations between different MedRecs workload (numbers & time) during patients` hospital discharges.

Testing of the results for association showed that significant moderate positive correlations existed (P<0.01; Pearson correlation) between daily time spent by the ward clinical pharmacist to complete discharge prescriptions, number of daily discharge prescriptions completed, total numbers of daily medicines reviewed by the pharmacist on discharges and daily number of high-risk medicines included. This reflected that as the daily numbers of discharges or numbers of medicines within the discharge prescription (specially high-risk medicines) increased, the time spent by the pharmacist on this activity increased (Table 4-21, Figure 4-19).

Similarly, significant weak to moderate positive correlations existed (P<0.01; Spearman correlation) when time taken, total numbers of medicines, number of high-risk medicines were tested in each discharge prescription completed by a clinical pharmacist (Table 4-22, Figure 4-20). Furthermore, a weak positive correlation was shown (Spearman correlation) between the clinical pharmacy staff grades and time taken to complete each discharge prescriptions (Table 4-22).

Table 4-21: Analysis of correlations (Pearson correlation) between daily different discharge MedRecs workloads (time and numbers) within the wards involved in the study.

Correlations

		Time spent by ward pharmacist to complete discharge prescriptions	Numbers of daily discharge prescriptions completed	Total number of daily medicines reviewed by the pharmacist for patients` discharges	Number of high risk medicines daily reviewed by the pharmacist for patients` discharges
Time spent by ward pharmacist to complete discharge prescriptions	Pearson Correlation	1	.531**	.604**	.524**
	Sig. (2-tailed)		**.000**	**.000**	**.000**
	N	80	80	80	80
Numbers of daily discharge prescriptions completed	Pearson Correlation	.531**	1	.713**	.424**
	Sig. (2-tailed)	**.000**		**.000**	**.000**
	N	80	80	80	80
Total number of daily medicines reviewed by the pharmacist for patients` discharges	Pearson Correlation	.604**	.713**	1	.749**
	Sig. (2-tailed)	**.000**	**.000**		**.000**
	N	80	80	80	80
Number of high risk medicines daily reviewed by the pharmacist for patients` discharges	Pearson Correlation	.524**	.424**	.749**	1
	Sig. (2-tailed)	**.000**	**.000**	**.000**	
	N	80	80	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

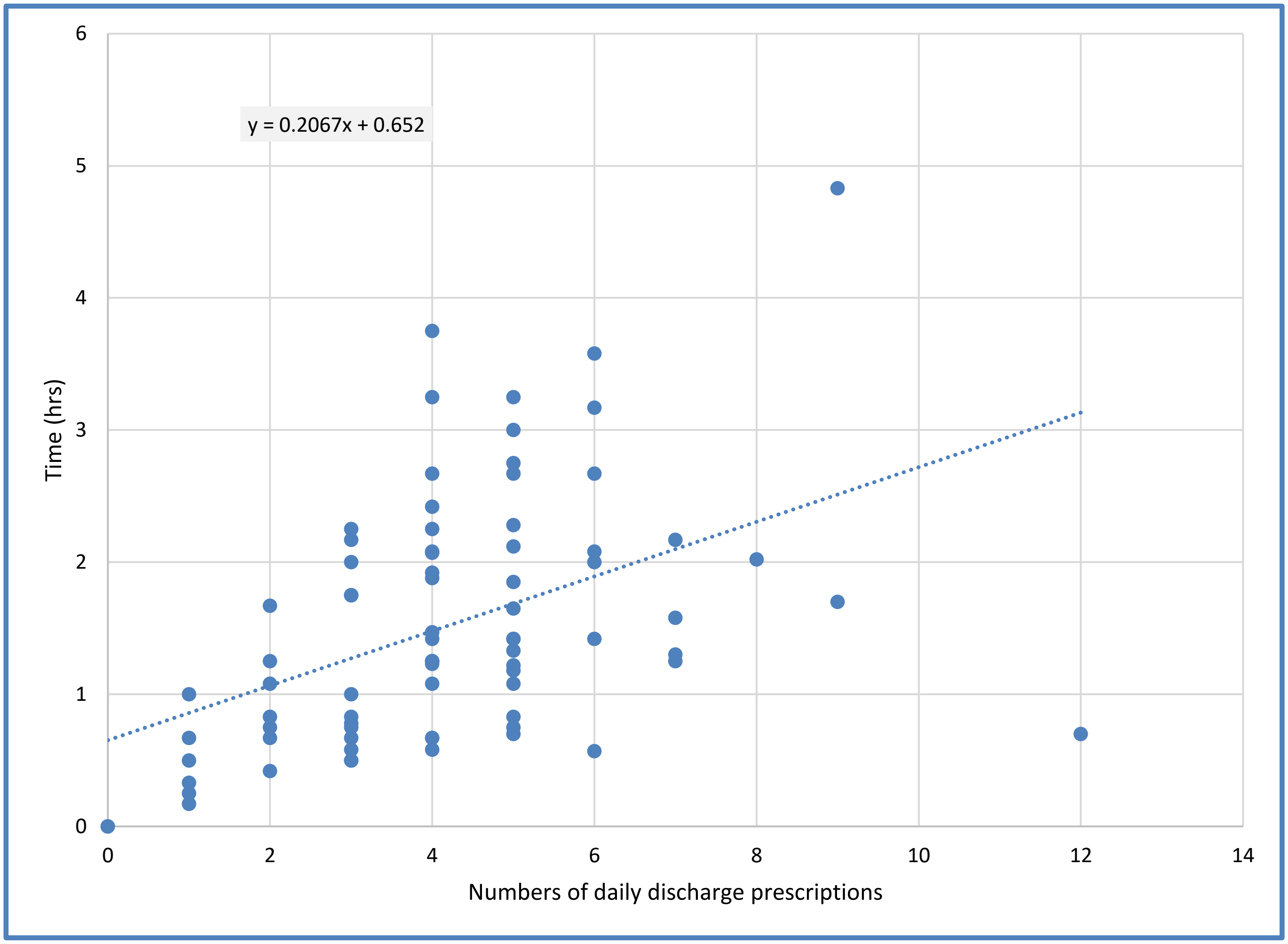


Figure 4-19: Pearson correlation between the time (hrs) spent by the ward dedicated clinical pharmacist for discharge MedRecs and the numbers of daily discharge prescriptions completed in each ward involved in the study**.**

Table 4-22: Testing of correlations (Spearman correlation) within each discharge prescription activities including time taken, numbers of medicines, patient length of the stay and clinical pharmacy staff grade.

Correlations

			Clinical Pharmacist staff grade	Time for each discharge prescription	Number of total medicines in each discharge prescription	Number of high risk medicines in each discharge prescription	Length of patients hospital stay
Spearman's rho	Clinical Pharmacist staff grade	Correlation Coefficient	1.000	.185**	.039	-.031	-.025
		Sig. (2-tailed)	.	**.001**	.476	.574	.654
		N	333	333	333	333	333
	Time for each discharge prescription	Correlation Coefficient	.185**	1.000	.453**	.413**	.285**
		Sig. (2-tailed)	**.001**	.	**.000**	**.000**	**.000**
		N	333	333	333	333	333
	Number of total medicines in each discharge prescription	Correlation Coefficient	.039	.453**	1.000	.689**	.349**
		Sig. (2-tailed)	.476	**.000**	.	**.000**	**.000**
		N	333	333	333	333	333
	Number of high risk medicines in each discharge prescription	Correlation Coefficient	-.031	.413**	.689**	1.000	.231**
		Sig. (2-tailed)	.574	**.000**	**.000**	.	**.000**
		N	333	333	333	333	333
	Length of patients hospital stay	Correlation Coefficient	-.025	.285**	.349**	.231**	1.000
		Sig. (2-tailed)	.654	**.000**	**.000**	**.000**	.
		N	333	333	333	333	333

**. Correlation is significant at the 0.01 level (2-tailed).

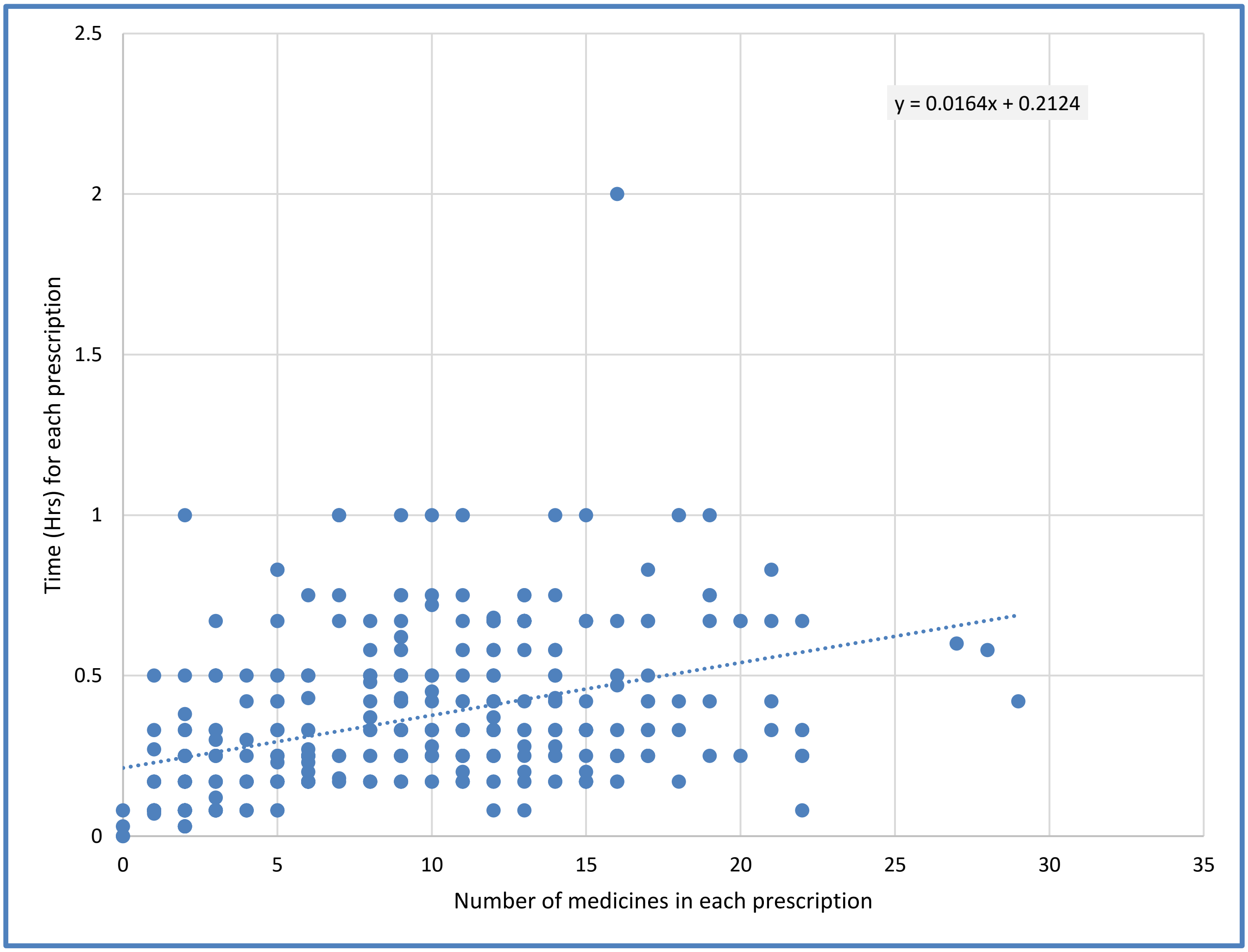


Figure 4-20: Spearman correlation between the total numbers of medicines within each discharge prescriptions and the time (hrs) taken by the ward dedicated clinical pharmacist to review and complete this prescription.

4.4.3.6 Analysis of the counselling needed for patients during hospital discharges.

It has been shown that, an average of 78% of patients discharged needed counseling by a pharmacist on their medicines, while 22% did not. Further, 74.32% of patients who did not need counseling were discharged from surgical wards while 25.68% were discharged from other ward specialties.

4.4.3.7 Analysis of the frequency of high-risk medicines prescribed during patients` hospital discharges.

Analysis of the 333 discharge prescriptions reviewed and completed by clinical pharmacists during 80 days of data collection showed that the top high-risk medicines frequently prescribed on patients` discharges were bisoprolol (19.82%), furosemide (12.61%), prednisolone long use (10.51%), warfarin (9.91%), nitrates (9.61%) and codeine (8.71%) followed by diazepam, citalopram, insulin and digoxin (Figure 4-21).

4.4.4 Analysis of the daily patient services during hospital admissions and discharges every day.

Results showed that about 15% of the patients were admitted daily in each ward and similarly about 15% of patients were daily discharged from each ward, so almost 30% of patients in each ward were serviced by the clinical pharmacy team either during admissions or discharges (Figure 4-22).

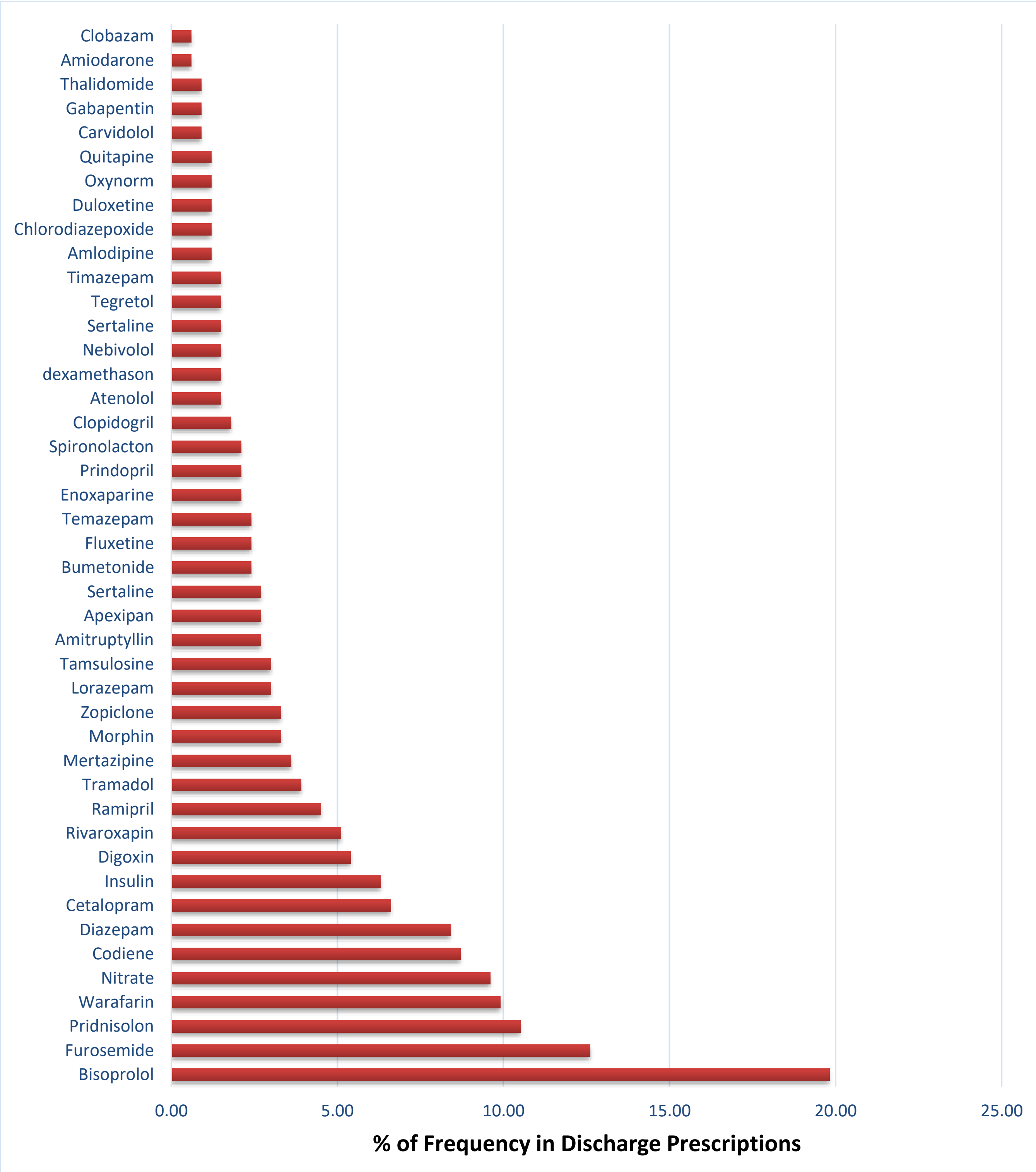


Figure 4-21: Percent (%) of the frequently prescribed high-risk medicines during patients` hospital discharges.

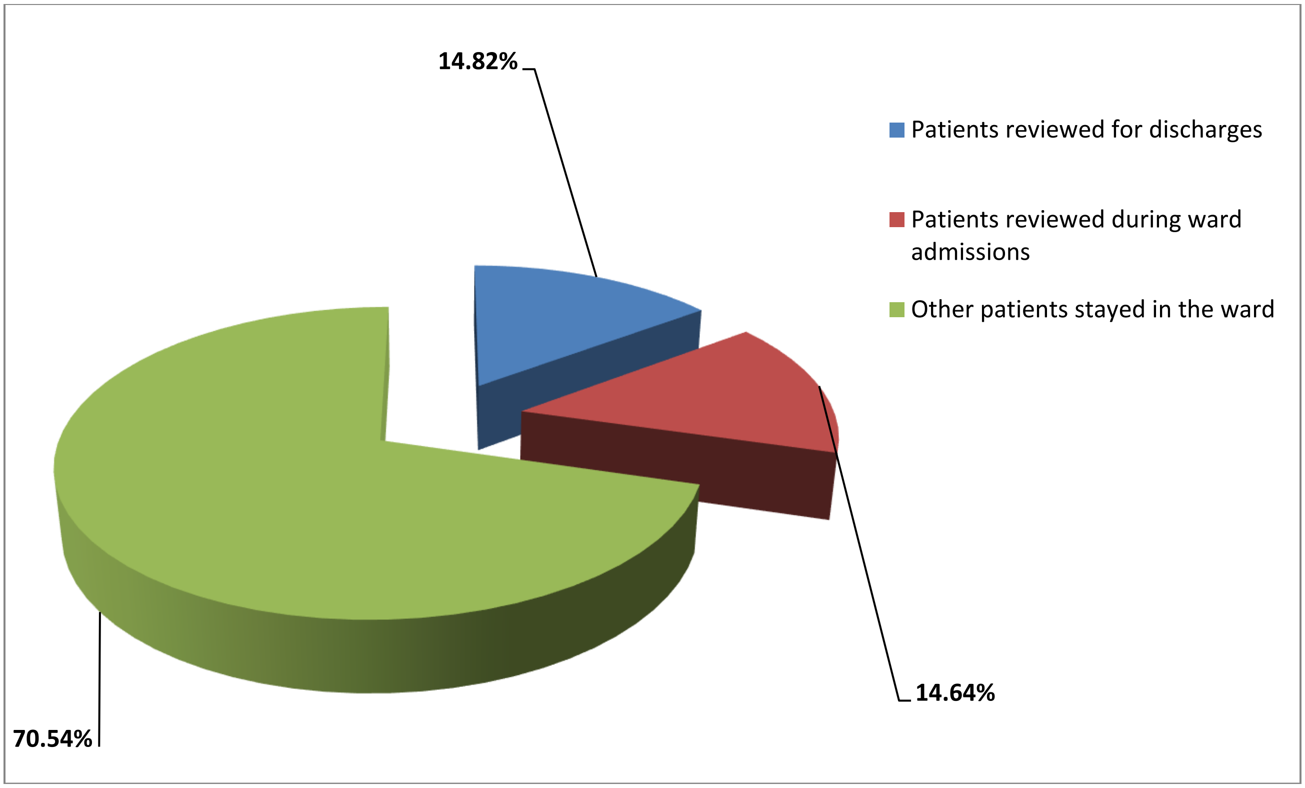


Figure 4-22: Percent (%) of the ward patients reviewed daily by clinical pharmacists during either admissions or discharges.

4.5 Discussion

The Clinical Pharmacy Services provided during patients` hospital admissions and discharges help in enhancing the safety and appropriateness of prescribed medicines and reduce the need for other healthcare usage (Bergkvist *et al.* 2009; Karnon *et al.* 2009; Schnipper *et al.* 2009).

Medicines Reconciliations (MedRecs) completed by pharmacists were seen to significantly reduce the numbers of medicines related discrepancies (Cater *et al.* 2015; Choi and Kim 2019). According to the Northern Ireland Medicines Optimisation Quality Framework, all hospital admitted patients should have their medicines reconciled by an appropriate health care professional (most preferably a pharmacist) within 24 hours or shortly afterwards according to the clinical necessity. Further, the MedRec process should be repeated before patients' discharges and also sometimes during patients` hospital transitions of care (*Northern Ireland Medicines Optimisation Quality Framework.* 2016).

Throughout this study, MedRec activities on patients` hospital admissions and discharges undertaken by ward based clinical pharmacists were quantitatively collected and documented from different ward specialties including medical, surgical and cardiology wards. All documented activities were analysed and compared between different ward specialties, staff grades, numbers of medicines clinically checked by the pharmacist and numbers of high-risk medicines within the prescriptions.

a) Clinical pharmacist services during patient hospital admission

Within this study, completing MedRecs by ward dedicated clinical pharmacists in each ward was the main activity provided by the pharmacist during both hospital admissions and discharges which was in line with the NICE guidance on medicines optimisation which stated that, MedRec is vital and important for safety and effectiveness of patient care and considered as a key priority for clinical pharmacy services (NICE Medicines and Prescribing Centre (UK) 2015). Further, as MedRecs completion was found within the current study to be the main clinical pharmacist activity during patients` hospital admissions and discharges, this activity was similar to the findings of other investigators (Grimes *et al.* 2010; Shah and Barnett 2015). In addition, several studies reported that Pharmacy-Led MedRecs were proven to increase patient safety, decrease medication errors; and imperative to reduce pharmacy and medical workloads (Lawrence *et al.* 2015; Mekonnen *et al.* 2016; Salameh *et al.* 2019).

Although MedRec has been classified as the main clinical pharmacy service on admission and discharge which should be optimally completed by a competent skilled clinical pharmacist however, time, clinical pharmacist resources and staff grades (level) have been identified as barriers for MedRecs to be ideally and efficiently completed (O'Leary *et al.* 2010; Boockvar *et al.* 2011; Athuraliya *et al.* 2017). For this reason, this study quantitatively measured the daily numbers of MedRecs completed and the time taken to complete them on admissions and discharges against clinical pharmacy staff grades and ward specialties.

Within this study hospital site (Antrim hospital) one ward-dedicated clinical pharmacist together with one senior CPT were allocated to each ward with a capacity of almost 30 patients. This resource is consistent and agrees with the guidance of the

Society of Hospital Pharmacists Association which recommended a ratio of one clinical pharmacist for 30 beds in the hospital (Athuraliya *et al.* 2017).

An average of five new patients were admitted to each ward daily representing about 20% of the total patients on the ward. About four to five of those newly admitted patients daily required their MedRecs to be completed by a clinical pharmacist within the ward, which represented nearly 85% of all newly admitted patients in the ward. Although time has been identified as a key barrier for completing the MedRecs on admission (Boockvar *et al.* 2011), the clinical pharmacist in each ward was able to complete daily average of four MedRecs for new patients on admissions, which represented 88 % from the daily-required MedRecs in each ward. Also, almost all MedRecs completed (99%) required preceding confirmation of patients` medicines histories as an essential element for the MedRec process, this was in harmony and consistency with the findings of other investigators (Heard *et al.* 2016; Welch and Finckh 2019).

In terms of time, the clinical pharmacist required an average of about two hours every morning to complete these four MedRecs for the newly admitted patients. Three quarters of an hour was spent confirming patients` medicines histories, while an hour and quarter spent on the reconciliations themselves. These daily morning two hours spent by the pharmacists for admissions` MedRecs completion represented about 30% of the total daily working hours of the clinical pharmacist in each ward and serviced more than 15% of the total patients in the ward. These findings were in contrast with the results of two Australian studies, which stated that the average time spent by the pharmacist to complete each admission MedRec was only about ten minutes within medical wards and eight minutes within surgical wards (Stuchbery *et al.* 2008; O'Leary *et al.* 2010). While within this study, the average time spent by the pharmacist on each admission MedRec was about half an hour. In the same context, another narrative review reported that hospital pharmacists` services and activities are very difficult to be measured due to the complexities and diversities of the type of their work (Lloyd *et al.* 2015).

In addition, apart from the daily-required MedRecs on admission in each ward, an average of one MedRec was completed daily outside the ward. Moreover, less than one MedRec (0.52) from the daily required on admissions was not completed within the same day (09:00am – 05:00pm), which represented about 11 % of the daily required, however this was completed before the end of the following day (before 05:00pm second day) which is still being consistent with the clinical pharmacy standards of the hospital trust that required all admissions` MedRecs to be completed within 24 hours (*Northern Ireland Medicines Optimisation Quality Framework.* 2016).

When comparing the workloads of MedRecs during patients` hospital admissions between different ward specialties involved in the study (medical, surgical and cardiology with long stay), the average numbers of the newly admitted patients daily were nearly equal within the three types of ward specialties and ranged between five and six new patients every day. Despite that, the numbers of daily MedRecs required varied between each of the ward specialties and ranged from four to six but was significantly different between medical and surgical wards. Numbers of daily MedRecs required and completed within surgical wards were significantly greater than those of medical wards. This finding was in accordance with *Rough et al*, who stated that, some clinical pharmacy activities and workload will be different within different care types and specialties (Rough *et al.* 2010).

An average of six MedRecs were required daily within each surgical ward while only four were required within each of the medical wards, however the percentage of MedRecs completed from those required was almost the same between medical and surgical wards and remained around 90 % completed within the same working day. The greater number of MedRecs required within surgical wards may be attributed to the decreased length of patients` stay and higher number of daily discharges than other wards (Lyons *et al.* 2019).

Furthermore, although the percentage of daily MedRecs completed within cardiology and long stay wards were less than that of the other wards (78%), it was still not significantly different. In addition, no significant differences existed between the numbers of daily MedRecs required or completed within the five medical wards and also within the two surgical wards involved in the study. These findings confirm that despite the numbers of MedRecs workloads being different between some ward specialties, the percent of achievements were relatively similar in all wards. This reflected the capacity of the workload that could be achieved by the ward clinical pharmacists who can adopt their priorities to meet with the standards of their clinical pharmacy services (*Northern Ireland Clinical Pharmacy Standards.* 2013; Martin 2014; *Northern Ireland Medicines Optimisation Quality Framework.* 2016).

The justification of the above findings could not be absolute and completely concluded without analysing the daily time spent by the ward clinical pharmacist within each ward to complete these numbers of admissions` MedRecs. In connection with that and despite the variation between them, no significant differences existed between the three ward specialties in the total time spent by the ward clinical pharmacist every day to complete the required MedRecs on admissions which ranged daily in each ward from slightly more than an hour and half to two and a quarter hours.

Despite the fact that no significant differences were found in total time spent between medical and surgical wards every day to complete the required admissions` MedRecs, the numbers of completed MedRecs between the two ward specialties were significantly different. Each surgical ward spent about two and a quarter hours every day to complete five MedRecs while each medical ward spent almost an hour and half to complete three MedRecs.

Relating the time spent in each ward specialty to the daily numbers of achieved MedRecs on admission reflected that an average of twenty-eight minutes were consumed by each medical ward to complete a single MedRec while within each surgical ward twenty-four minutes were spent for one MedRec; so in general, pharmacists in both ward specialties were seen to spent nearly the same amount of time to complete one MedRec. This finding has disagreed with another published study which reported that the time required to complete a clinical pharmacy service is influenced by whether the patient is within a medical or a surgical ward and also reported that time taken within medical wards is longer than that of surgical ones (Stuchbery *et al.* 2008).

Despite the fact that no significant differences exist between medical and surgical wards in total daily time spent by the ward clinical pharmacist to complete the admissions` MedRecs, and since this time usually comprised of two processes including confirming patients` medicines histories and reconciliations, significant differences were found between both ward specialties in time taken for reconciliations, while no significant differences were found in time taken for medicines history confirmation.

Each medical ward on a daily basis spent an average of 41 minutes for medicines histories interviews and 56 minutes for admissions reconciliations, while each surgical wards spent 36 minutes to confirm medicines histories and about 93 minutes to complete reconciliations However, in light of correlating the time spent on this activity with the daily completed and achieved numbers of MedRecs, each single MedRec completed within a medical ward required twelve minutes for medicines history confirmation and seventeen minutes for reconciliation, whilst within each surgical ward time taken to complete one MedRec divided between eight minutes to confirm the medicines history and sixteen minutes for the reconciliation.

It was notable that pharmacists within a medical ward specialty spent about one third (33%) more time on medicines histories confirmation than those within surgical wards, and which might be because of the increased numbers of medicines usually taken by medical ward patients for their disease state. This may be because within surgical wards most of the patients admitted are being prescribed two or three medicines requiring shorter time to be confirmed, while within medical wards, patients almost always have pre-existing co-morbidities and consequently are on an increased number of regular medications (poly-pharmacy) that required longer time for medicines history confirmation (Nobili *et al.* 2011).

Although different daily workloads were seen between different ward specialties to complete the required MedRecs during patients` hospital admissions (in particular medical and surgical wards), the time taken by the clinical pharmacists within these specialties was still not significantly different and also the percentage of achievements (completed from required) was relatively similar with about 90 % within the same day of admission. This achievement is consistent with the guidance and target assigned by the hospital Trust within its clinical pharmacy standards which declared that all required MedRecs during patient admission should be completed as soon as possible and ideally within 24hrs (Ashfield 2013; Scott *et al.* 2015).

In terms of different clinical pharmacy staff grades (junior, senior and consultant), different MedRecs workloads were seen between senior clinical pharmacists working within different medical and surgical ward specialties, ranging from two to seven MedRecs required during patients` hospital admission every day. Senior clinical pharmacists were able to complete up to six MedRecs every day. Additionally, the percent of MedRec completion by all senior clinical pharmacists working within different medical and surgical wards was not significantly different and reached up to 98 % within the same working day which was consistent with the clinical pharmacy standards of Northern Ireland (*Northern Ireland Clinical Pharmacy Standards.* 2013).

Similarly, the total time taken by the senior clinical pharmacists working within different wards was varied and ranged from an hour and half to more than two and half hours but was still not significantly different, especially when this time correlated with the numbers of the difference in numbers of MedRecs achieved in each ward. A wide difference in time spent by the senior clinical pharmacist on each of the two stages of the MedRec process (medicines history confirmation and reconciliation) was found, however the total time spent by each of them to complete one single MedRec was still non-significant and was almost around half an hour with the exception of the senior pharmacist working within long stay medical ward who spent an average of slightly more than three quarters of an hour for each MedRec. This may be justified by the multiple disease state and high numbers of medicines usually found with the patients admitted in the long-stay medical wards (Ono *et al.* 2010; Andersson *et al.* 2011; Barisonzo *et al.* 2013).

No significant differences were shown when the daily workloads and achievements of admission`s MedRecs were compared between junior and senior ward clinical pharmacists working in different medical and surgical wards.

Junior and senior clinical pharmacists working within different medical wards were able to complete an average of three to four MedRecs daily during patients` hospital admissions, which represented between 97% and 98% of the daily load required.

Within different surgical wards both junior and senior clinical pharmacists were able to complete between five and six MedRecs for the newly admitted patients daily, which represented between 86% and 93% of the required MedRecs. Moreover, within the same surgical ward, the study tested the number of admissions` MedRecs completed by both pharmacists' staff grades on two different consecutive weeks and the results showed no statistical difference between them, both being able to complete nearly the same number of MedRecs every day.

Based on the reflection from these findings, both clinical pharmacists` staff grades were able to complete relatively the same numbers of MedRecs daily during admissions and also achieved nearly the same daily targets.

In terms of time taken to complete these numbers of daily MedRecs on admissions, no significant differences existed between both junior and senior clinical pharmacists working within different surgical wards involved in the study. Both pharmacists` staff grades within their surgical wards spent a total of two hours (junior pharmacist) and two and half hours (senior pharmacist) every day to complete five to six admissions`

MedRecs. There was no significant difference in time distribution for the MedRec process on medicines histories confirmation and reconciliations between the two pharmacists` staff grades. This can be explained by the reported observation that most of the patients within surgical wards are on a fewer number of medicines during their admissions than other wards (Nobili *et al.* 2011) and also comprise almost nil or rarely high-risk medicines. In addition these patients usually attend a pre surgical pharmacy clinic (Scullin *et al.* 2007; George, *et al.* 2011; Bansal *et al.* 2019).

Conversely, within medical wards a significant difference existed between junior and senior clinical pharmacists in time taken to complete relatively the same numbers of MedRecs during patients` hospital admissions. Junior clinical pharmacists spent about the double of senior clinical pharmacists` time on medicines histories confirmation for the newly admitted patients, and this increased their total time taken on the whole process by about 35% more than that taken by senior ones. These findings were partly consistent with a published UK study about the relationship between service, intervention and level of experience of clinical pharmacists, which reported that, although the impact of intervention was similar, junior clinical pharmacists spent longer time to review lesser numbers of patient MedRecs than higher staff grade pharmacists (Rudall *et al.* 2017).

Furthermore, consultant clinical pharmacists were seen to partly contribute in completing some of MedRecs during patients’ hospital admissions. Within three out of eight wards involved in this study, these pharmacists contributed in some days in completing the required MedRecs. In particular, this was within two surgical and one-cardiology wards as their staff structure comprised a consultant clinical pharmacist, which is necessary for the pre-surgical and anticoagulants clinics they usually manage. On average, 23% and 14% of the daily MedRecs within cardiology and surgical wards respectively were completed by consultant clinical pharmacists. However, consultant clinical pharmacists tended to complete more senior clinical activities, their contribution in completing admissions` MedRecs was not every day and was only during busy day.

b) Clinical pharmacist`s services during patient hospital discharge

It has been shown that the main clinical pharmacists` activities during patients` hospital discharges were the clinical check and writing of the discharge prescriptions (Medicines Reconciliations on discharge). Completing the MedRecs on discharge is the top daily priority as per the clinical pharmacy standards (*Northern Ireland Clinical Pharmacy Standards.* 2013; *Northern Ireland Medicines Optimisation Quality Framework.* 2016).

The daily numbers and time taken by the ward clinical pharmacists to clinically check and write the discharge prescriptions in each ward were varied and ranged between two and six discharge prescriptions which consumed between half to two and half hours every day. However, the overall average of numbers of daily discharge prescriptions clinically checked and written by the ward pharmacists (MedRecs on discharge) every day was four discharges and the daily time taken by the pharmacist on this activity was about one and half hours. These findings were inconsistent with the results of Musgrave et al (2013) which stated an average of fifteen minutes for each discharge MedRec completed by the clinical pharmacist. This inconsistency may be attributed to the difference in the model of clinical pharmacy services provided. Within *Musgrave et al* study, clinical pharmacist only reviews and verifies the already written discharge prescription by other health care staff within the ward.

Usually discharge MedRecs were completed by the ward pharmacist during afternoon hours. It has been shown within this study that almost all required discharges were completed within the same day and before 05:00pm. However, less than one discharge prescription (0.32) on some days was not completed before 05:00pm, representing less than 7% of all discharges required. According to the standards all discharges should be completed as a top priority as early as possible and preferably before the end of the same day working hours (Irwin, C. 2012; *Procedure for medicines reconciliation.* 2016; *Northern Ireland Medicines Optimisation Quality Framework.* 2016).

Within different ward specialties, significant differences existed between the three ward types in numbers of daily discharge MedRecs completed and also the total time taken to complete this activity. The numbers of discharge MedRecs completed daily within surgical wards were larger than those of medical and cardiology with long-stay wards, however the time required to complete these numbers of MedRecs was shorter than that taken within other wards to complete less numbers of discharges; this may attributed to the same reasons as discussed earlier of fewer numbers of discharge medicines and lesser comorbidities with those patients than other wards (George, L. J. W. *et al.* 2011; Nobili *et al.* 2011; Bansal *et al.* 2019). Pharmacists within surgical wards spent an average of an hour every day to complete more than five discharge MedRecs, while pharmacists within both medical and cardiology with long stay wards spent between an hour and half to two hours to complete only three or four MedRecs.

Additionally, the average total numbers of medicines reviewed daily by the pharmacists for discharge prescriptions were significantly different between the three ward types. Pharmacists within medical wards reviewed a daily average of forty-six medicines for patients on discharges, about ten of which were classified as high-risk medicines (Ashfield 2013; Scott *et al.* 2015). This was the largest numbers of medicines reviewed every day when compared with other ward specialties.

Thirty-four and thirty-one medicines were reviewed daily within surgical and cardiology with long stay wards respectively for patients on discharge. This comprised six high-risk medicines within surgical and nine high-risk medicines within cardiology and long stay wards. The numbers of high risk-medicines reviewed within either medical or cardiology with long stay wards were shown to be the double of that of surgical wards and this may be the reason why they required longer time than those within surgical wards.

The findings of this study showed that both the numbers of discharge MedRecs and the time taken to complete them were not significantly different over different days of the week. An average of four to five discharge MedRecs were completed daily and was almost similar over each day of the week and also required about one and half hours daily in each ward to be completed.

The study also analysed the daily discharge MedRecs workload differences between different pharmacists` staff grades (junior, senior and consultant). A total of 333 discharge prescriptions completed by different pharmacists` staff grades were analysed during the study period (135, 151 and 47 prescriptions completed by junior, senior and consultant pharmacists respectively). The time taken and numbers of medicines in each discharge prescriptions were compared between the three pharmacists` staff grades. Junior pharmacists appeared to take an average of eighteen minutes to complete each discharge MedRec, which was significantly shorter than that taken by senior or consultant pharmacists who spend an average of twenty-five minutes to complete each discharge prescriptions. This significant difference may be attributed to the different responsibilities between junior and other ward pharmacists` staff grades on patients discharges. Junior pharmacists are allowed only to clinically check the medicines for patients on discharges, however the discharge prescription still needs to be written and completed either by the doctor or senior clinical pharmacist. Both senior and consultant clinical pharmacists are able to clinically review all medicines for discharge and also write the discharge prescriptions which may justify the longer time taken by them for each discharge prescription than that taken by junior ones, these findings were in harmony with *Rudall et al* (2017). Moreover, the average number of medicines for each discharge prescription completed by either senior and consultant clinical pharmacists ranged from eight to eleven while was only eight to nine for those completed by junior ones that may also be another reason for the increased time taken by the senior and consultant pharmacists for each discharge prescription, this is in accordance with the findings of *Bansal et al* (2019). Each discharge prescription completed by all staff grades comprised an average of two high-risk medicines.

Testing through correlations found that direct relationships were found between daily time spent by the ward clinical pharmacist to complete discharge prescriptions, number of daily discharge prescriptions completed, total numbers of daily medicines reviewed by the pharmacist on discharges and daily number of high-risk medicines included which reflect the association between the time and the increased workload or prescription complexity. Similar relationships were also found within each discharge prescription. In addition, positive correlation existed between the clinical pharmacy staff grades and time taken to complete each discharge prescriptions, this because senior and consultant clinical pharmacists required more time than junior ones to write the discharge prescription.

Furthermore, more than three quarters (78%) of all discharged patients in each ward needed counseling on their discharge medicines by the ward clinical pharmacist, while less than a quarter (22%) did not need counseling. A considerable percentage (74%) of patients who did not need counseling about their medicines were discharged from surgical wards, while the other 26% of them were from all other wards involved in the study. This was different and disagreed with the findings of *Poh et al* (2009) which reported that only an average of 49% of all discharged patients required counselling on their medicines. This is might be due to the difference in wards involved in the study or geographic health conditions of the patients that lead to prescribing different classes of medicines within patients discharges prescriptions for both study site hospitals.

This study also found that, the top five high-risk medicines most frequently prescribed within discharge prescriptions were *bisoprolol*, *furosemide*, *prednisolone, warfarin* and *nitrate*. *Bisoprolol* was prescribed in one fifth of all discharge prescriptions while, *furosemide, prednisolone, warfarin* and *nitrate* were repeatedly prescribed within one tenth of all prescriptions. Other medicines followed the top five most frequently high-risk medicines prescribed on discharges such as, *codeine, diazepam, citalopram, insulin* and *digoxin* with considerable frequency. This findings were partly consistent with that of *El Hajj et al* (2015) which enlisted *b-blockers* and *diuretics* from the top five high-risk medicines frequently prescribed and also mentioned *warfarin, digoxin, antidepressants and opiates within the top ten list.* Knowing the top list of high-risk medicines frequently prescribed on discharge gives an idea about the priorities of clinical training which may be tailored to enrich the level of competency for both ward clinical pharmacists and CPTs.

The study showed that within each ward, the clinical pharmacist spent more than half of his/her daily working hours completing MedRecs for patients on both admission and discharge; this time did not include final checks of the discharge prescriptions and also the time taken for patient counseling. This time was used daily to support about 15 % of newly admitted patients in the ward and 15 % of patients discharged from the ward with clinical pharmacy services. This reflected that, the ward clinical pharmacist spends more than a half of his/her time to complete admissions and discharge activities that supported a total of about 30 % of the patients within the ward on a daily basis.

4.6 Strengths / Limitations

This study is one of a very few studies which has quantitatively measured and analysed the main ward-based clinical pharmacists` activities during both hospital admission and discharge with deep insight on the type of service, ward specialties and staff grades.

However, there are some limitations with the current study such the amount of time taken by the pharmacist for patient counseling on discharge and also the time from the writing the discharge prescription and the final check by accredited clinical pharmacy technicians was not possible to be measured or analysed because data was collected throughout the regular hospital working day. The time taken by the pharmacist for daily interaction with the ward clinical team training tasks and time distribution between clinical check and writing of the discharge prescriptions were not also possible to be measured for the same reason.

4.7 Conclusion

Completing MedRecs by ward dedicated clinical pharmacists in each ward was the main activity provided by the pharmacist during both hospital admissions and discharges. Although MedRec was classified as the main clinical pharmacy service on admission and discharge, which is optimally completed by competent skilled clinical pharmacist, however time availability, clinical pharmacist resources and suitable staff grade are the most important factors for ideal provide of this service.

Despite the availability of a clinical pharmacists` time being identified as a key barrier for completing the MedRecs on admission, the clinical pharmacist in each ward was able to complete a daily average of four MedRecs for new patients on admission, which represented 88 % from the daily-required MedRecs in each ward. Also, almost all MedRecs completed (99%) required preceding confirmation of patients` medicines histories as an essential element for the MedRec process. The clinical pharmacist consumed an average of about two hours every morning to complete these four MedRecs for the newly admitted patients. Three quarters of an hour were spent to confirm patients` medicines histories, while an hour and quarter spent on reconciliations. Further, it has been shown that the main clinical pharmacists` activities during patients` hospital discharges was clinical check and writing of the discharge prescriptions (Medicines Reconciliations on discharge)

Analysis of the clinical pharmacy services showed that pharmacist spent more than half of the daily working hours to complete MedRecs for patients on both admissions and discharges, this time did not include final checks of the discharge prescriptions and also the time taken for patients` counseling to support about 15 % of newly admitted patients in each ward and 15 % of patients on discharge from the ward with clinical pharmacy services. About 70% of the patients within each ward still need to have their medicines reviewed by the pharmacist during their in-patient stay in order to achieve the best patient outcomes and ensure medicines safety but because of more than half of clinical pharmacist daily time spent to complete MedRecs on admission and discharges, most of these patients did not get this opportunity. Re-allocation of different pharmacists` staff grade is important that the right grade complete the right task within the right time and also to ensure that all patients within the ward provided with the appropriate clinical pharmacy services throughout the full hospital journey (admission, in-patient stay and discharge).

Chapter V

Analysis of clinical pharmacists` in-patient interventions

5.1 Introduction

Clinical pharmacists` intervention can be defined as any activity conducted by pharmacists to identify, resolve or prevent any medicines related problems with the aim being to ensure patients` safety and improve patients` outcomes (Harris *et al.* 2014).

The roles of the clinical pharmacist became an essential and fundamental element for successful patient care plans and optimisation of medicines use. Clinical pharmacists` contribution within in-patient care ensures the safety, appropriateness and effectiveness of the prescribed medicines (Nigro *et al.* 2014; Bourne *et al.* 2016).

Clinical pharmacists` interventions,, through clinical pharmacy services and medicines optimisation, have been shown to reduce the rates of adverse drug reactions, medicines errors, hospital readmissions and also have a positive economic impact (Bond and Raehl 2006; Viktil and Blix 2008; Gillespie *et al.* 2009; Altowaijri *et al.* 2013; Gillespie *et al.* 2013; Langebrake *et al.* 2015). However to ensure these benefits there must be adequate clinical pharmacists to meet the increased workload and overcome issues relating to the lack of time (Rudall *et al.* 2017). Many studies within the UK reported that most of clinical pharmacists` interventions (approximately more than 90%) are accepted by other medical staff (Bourne *et al.* 2014; Shulman *et al.* 2015).

In Antrim Area hospital, clinical pharmacists review and interventions support patients during their full hospital journey including admission, in-patient stay and discharge. Clinical pharmacists’ interventions completed on admissions and discharge usually is a part of medicine reconciliations process discussed in another chapter.

During in-patient stay the ward-dedicated clinical pharmacist reviews some patients based on the essential referral by the ward CPTs but not all patients within the ward have the opportunity to be reviewed by the pharmacist during their in-patient phase (Scullin *et al.* 2007; Scullin *et al.* 2012; Ashfield 2013). The reason for that is the increased workload of the clinical pharmacist with admissions and discharge activities which represent the top priorities according to the recommendations of Northern Ireland clinical pharmacy standards (*Northern Ireland Clinical Pharmacy Standards.* 2013).

All ward clinical pharmacists working within the NHSCT are requested to record all their daily activities including interventions on EPICS (Electronic Pharmacists Intervention Clinical System) for at least one week every month. This software was developed several years ago by the pharmacy team at Antrim Area Hospital in conjunction with Yarra Software Limited and Queen`s University Belfast. EPICS allows pharmacists to record their activities and interventions against the patient`s hospital journey including admission, in-patient stay and discharge (Scullin *et al.* 2012; Ashfield 2013; Miller, 2014).

Ward-pharmacists are required to grade their interventions when they record them on EPICS according to the Eadon scale grading tool for clinical pharmacists’ interventions. The Eadon scale for clinical pharmacists` interventions categorises interventions into six grades, with grade 1 being potentially detrimental to the patient's well-being and grade 6 potentially life-saving (Eadon 1992; Scullin *et al.* 2007; Scullin *et al.* 2012; Ashfield 2013; Vo *et al.* 2016).

Table 5-1: Eadon scale categories for pharmacist interventions

Grade	Outcome
Grade 1	Intervention is detrimental to patient's well-being
Grade 2	Intervention is of no significance to patient care
Grade 3	Intervention is significant but does not lead to an improvement in patient care
Grade 4	Intervention is significant and results in an improvement in the standard of care
Grade 5	Intervention is very significant and prevents a major organ failure or adverse reaction of similar importance
Grade 6	Intervention is potentially life saving

In addition to the improved patient outcomes as a result of significant clinical interventions and prevented medicines related harms, some studies calculated the positive economic impact and cost effectiveness achieved from avoided medicines errors which was linked to Eadon scale grades. According to the Eadon scale cost reference, preventable medicines related problem equivalent to a grade 4 reduced care cost between £65 and £150 while a grade 6 intervention related to medication incidents reduced cost between £713-£1,484 (Campbell *et al.* 2007; Karnon *et al.* 2009; Ashfield 2013).

Analysing and understanding the ward-based clinical pharmacists' interventions during in-patient hospital stay, including types of interventions, numbers, frequency and economic impact is very important and can help in the allocation and optimal use of staff resources and grades.

5.2 Aims and objectives of the study

5.2.1 Aims

The primary aim of this study was to analyse quantitatively the daily numbers and types of clinical pharmacists` interventions completed by the ward-dedicated clinical pharmacists in each ward during in-patient hospital stay.

The secondary aim was to analyse the distribution of the interventions` grades according to their classification on the Eadon scale grading system.

5.2.2 Specific objectives

Specific objectives were the following:

i. Quantitatively analyse the numbers and Eadon scale grades of different clinical pharmacists' interventions completed in each ward during in-patient hospital stay

ii. Analyse the frequency of the types and outcomes of in-patient interventions during the study period.

iii. Compare the numbers of in-patient clinical pharmacists` intervention completed within different ward specialties particularly medical, surgical, cardiology and long stay wards.

iv. Analyse the different Eadon grades of interventions completed by different clinical pharmacists` staff grades.

v. Calculate the cost effectiveness achieved by avoiding medicines related errors through different clinical pharmacists` interventions.

5.3 Method

5.3.1 Study Design and data collection

This study was designed as a retrospective based clinical study.

Clinical pharmacists in each ward within the study site hospital usually record their daily interventions using EPICS (Electronic Pharmacists Intervention Clinical System) for at least one week each month. Electronic recording of the ward clinical pharmacist activities including interventions is considered as part of their daily work patterns and provide information on the clinical pharmacy performance. The recorded interventions by the ward clinical pharmacists must be also be self-classified according to the Eadon scale grading system for interventions.

All daily clinical pharmacists` interventions during their in-patient hospital stay were retrieved from EPICS and quantitatively analysed. Data were retrieved from two medical, two surgical, one cardiology and one long stay wards between January 2015 and July 2015. This represented a total of six wards involved in the study; 129 days of data retrieval from 471 patients and 1070 in-patient clinical pharmacists` interventions being gathered.

The types of information retrieved were specified to enable assessment and analysis of all necessary information including the type, outcomes of the intervention, Eadon scale grade, ward specialty and staff grade completed this activity. All the retrieved information was analysed and quantitatively compared. The cost reduction by preventable medication errors through pharmacists` interventions was also calculated based on the Eadon scale grading reference cost. The cost of a grade 4 intervention ranging £65 and £150 while a grade 6 intervention cost is between £713-£1,484.

5.3.2 Settings (study site)

This study was conducted in Antrim area hospital, the largest hospital within the Northern Health & Social Care Trust (NHSCT) with a total of 426 care beds. The study involved 6 different wards with an average number of 30 beds in each. The selection of theses wards was based on different specialties, distribution of staff grades and workload. The distribution of the six wards involved in the study were as the following:

- **A3** (Medical ward, Respiratory)
- **B2** (Medical ward, elderly care)
- **B3** (Cardiology & Acute coronary unit ward)
- **C5** (Elective surgery admission ward)
- **C6** (Elective surgery admission ward)
- **C7** (Medical ward for long stay chronic problems)

5.3.3 Duration of the study

The study included 129 days data retrieval over a period of seven months from January to July 2015. The retrieved 129 days information included A3 (18 days) B2 (24 days) C5 (9 days) C6 (25) B3 (20) and C7 (33 days).

5.3.4 Inclusion / exclusion criteria

All clinical pharmacists` interventions for all patients during in-patient hospital stay within the selected wards were included. Interventions made during both patients` hospital admissions and discharges were excluded. The data were collected only during working days from Monday to Friday (weekends were excluded) and between 09:00 am and 05:00 pm every day (evening shifts were excluded).

The period of 24 hours of hospital stay was the minimum duration required to include the interventions made for any patient within the selected wards.

5.3.5 Method of statistical analysis

Analysis of the data was undertaken using SPSS® software (Statistical Package for the Social Sciences) version 22, (Verma 2012; Barton and Peat 2014). Results were reported as mean ± standard error of the mean (SEM), and standard deviation (SD) was also calculated. Initially results were tested for normality using Kolmogorov test, then statistical analysis was performed using Kruskal Wallis Test for non-parametric data. Qualitative variables such as percentage were calculated and compared using the Chi-square test

- P value >0.05 considered non-significant.
- P value <0.05 considered significant
- P value <0.01 considered highly significant.

5.3.6 Data security

Paper copies of the collected data forms were used and stored securely, ensuring confidentiality of all data contained therein. After analysis of the data, all paper copies were confidentially destroyed. The main investigator together with the principal supervisor acted as custodians for the data processed and generated by the study and they were also responsible for the access to any information included.

5.3.7 Ethical approval

This was a quality service improvement study, so ethical approval was not required.

5.4 Results

5.4.1 Analysis of the average numbers of daily in-patient interventions within each ward.

Results showed that within ward-based clinical pharmacy services with an average of 30 patients to each ward, the average daily numbers of interventions completed by the ward-dedicated clinical pharmacists during the in-patient hospital stay was 8.42± 0.74 (Table 5-2). These eight interventions supported an average of 4.03 ± 0.27 patients in each ward involved in the study every day, which reflected approximately two interventions for each patient. As the Eadon scale was used as a tool to record the grades of pharmacists` interventions in each ward, results revealed that the average Eadon scale grade for all interventions was 4.01 ± 0.27 (Table 5-2).

Table 5-2: Mean±SEM of the average numbers and grade of daily in-patient interventions completed by ward-dedicated clinical pharmacists for all wards involved in the study**.**

	Mean ± SEM (N= 127)	**Median (Min – Max)**	**SD**	**95%CI** (Lower - Upper)
Numbers of daily in-patient interventions in each ward	8.42± 0.74	6 (1 – 39)	8.34	6.96 – 9.89
Numbers of daily patients receiving interventions in each ward	4.03 ± 0.27	3.0 (1 – 15)	3.08	3.49 – 4.58
Average grade of Eadon scale for the interventions	4.01 ± 0.27	4 (3.28 – 5)	0.30	3.96 – 4.06

N= sample size (number of days)
SEM= Standard error of mean
SD= Standard deviation
CI= confidence interval

5.4.2 Analysis of the average numbers of daily in-patient interventions within different ward specialties.

The average number of daily in-patient clinical pharmacists` interventions within different ward specialties were 8.14 ± 1.17, 8.23 ± 1.44 and 8.78 ± 1.25 for medical, surgical and cardiology with long stay wards respectively with no statistically significant difference between them (P>0.05, Kruskal Wallis test). Moreover, the average numbers of patients had received these interventions were 4.04 ± 0.40, 3.52 ± 0.47 and 3.88 ± 0.45 for medical, surgical and cardiology with long stay wards respectively which showed no significant difference between the three ward specialties. Also, the average Eadon grade of the interventions was similar showed average grade of four with no significant difference existence (P>0.05, Kruskal Wallis test) (Table 5-3, Figure 5-1).

Table 5-3: Mean±SEM of the average numbers and grade of daily in-patient interventions completed by ward-dedicated clinical pharmacists working within different ward specialties.

Activity	Medical wards N= 42	Surgical wards N= 34	Cardiology & Long stay wards N= 51	Level of significance #
Numbers of daily in-patient interventions in each ward	8.14 ± 1.17	8.23 ± 1.44	8.78 ± 1.25	NS
SD	7.64	8.42	8.96	
Median	6.0	5.5	6.0	
95% CI (upper-lower**)**	5.76 – 10.52	2.29 – 11.17	6.26 – 11.30	
Numbers of daily patients received interventions in each ward	4.64 ± 0.48	3.52 ± 0.47	3.88 ± 0.45	NS
SD	3.12	2.74	3.23	
Median	4.0	2.5	3.0	
95% CI (upper-lower)	3.66 – 5.61	2.57 – 4.48	2.97 - .79	
Average grade of Eadon scale for the interventions	4.04 ± 0.40	3.94 ± 0.04	4.04 ± 0.04	NS
SD	0.26	0.27	0.35	
Median	4.0	4.0	4.0	
95% CI (upper-lower)	3.96 – 4.12	3.84 – 4.03	3.94 – 4.14	

N= sample size (number of days) **SD**= Standard deviation **SEM**= Standard error of mean
CI= confidence interval **NS**: no significance (P>0.05) # Kruskal Wallis Test for non-parametric data
Note: Normality of data was tested using Kolmogrove- Smirnov test for normality

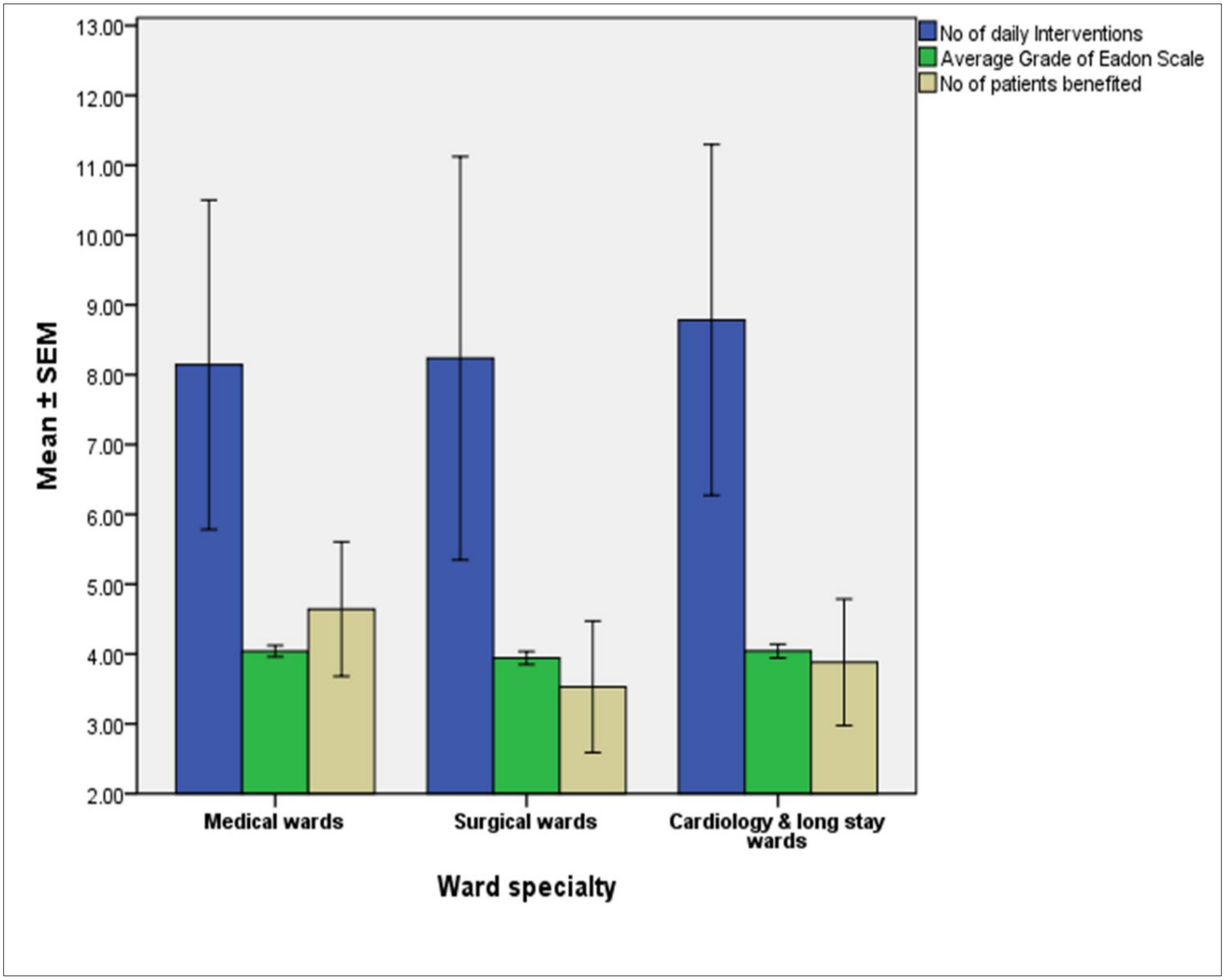


Figure 5-1: Average numbers and grades of clinical pharmacist interventions during in-patient hospital stay within different wards specialties over 129 days.

5.4.3 Analysis of different types and outcomes of clinical pharmacists` interventions during in-patient hospital stay.

Analysis of 1070 interventions over 129 days showed that the clinical pharmacists working within different wards completed 55 different types of interventions during in-patient hospital stay with different frequency and grades throughout the duration of the study.

The main clinical intervention frequently completed by the ward clinical pharmacist during in-patient hospital stay was reviewing and confirming the laboratory results associated with patients` medicines, which represented 33.08% of all interventions. This highest frequent intervention was followed by six other types of frequently completed interventions, including reviewing and confirming the appropriateness of the patients` prescriptions (7.10%); requesting particular laboratory tests for patients` safe use of medicines (4.77%); identifying that appropriate medicines had not been started (4.49%); identifying administration information on the Kardex (4.49%); requesting extra information from the doctor (4.39%) and completion of therapeutic drug monitoring and calculation of drug levels (4.30%). Together these seven types of interventions accounted approximately 58% of all interventions (Figure 5-2,3).

The other 42 % of interventions included missing or incorrect information relating to the patient name, medication dose, dosage form, frequency, duration, stop date (for antibiotics), time of administration, route of administration, diluent to be used and administration rate. Additional interventions related to drug duplication, drug interactions, contraindications, management of adverse drug reactions and others such drug or brand replacement through the PCEP (Pharmaceutical Clinical Effectiveness Programme), inappropriate drug chosen and the requirement for an intravenous to oral switch for an antibiotic (Figure 5-2).

Nine different outcomes were identified as being due to the clinical pharmacists' interventions, with the highest frequently occurring outcome being prescription alteration (29.44%) (Figure 5-4).

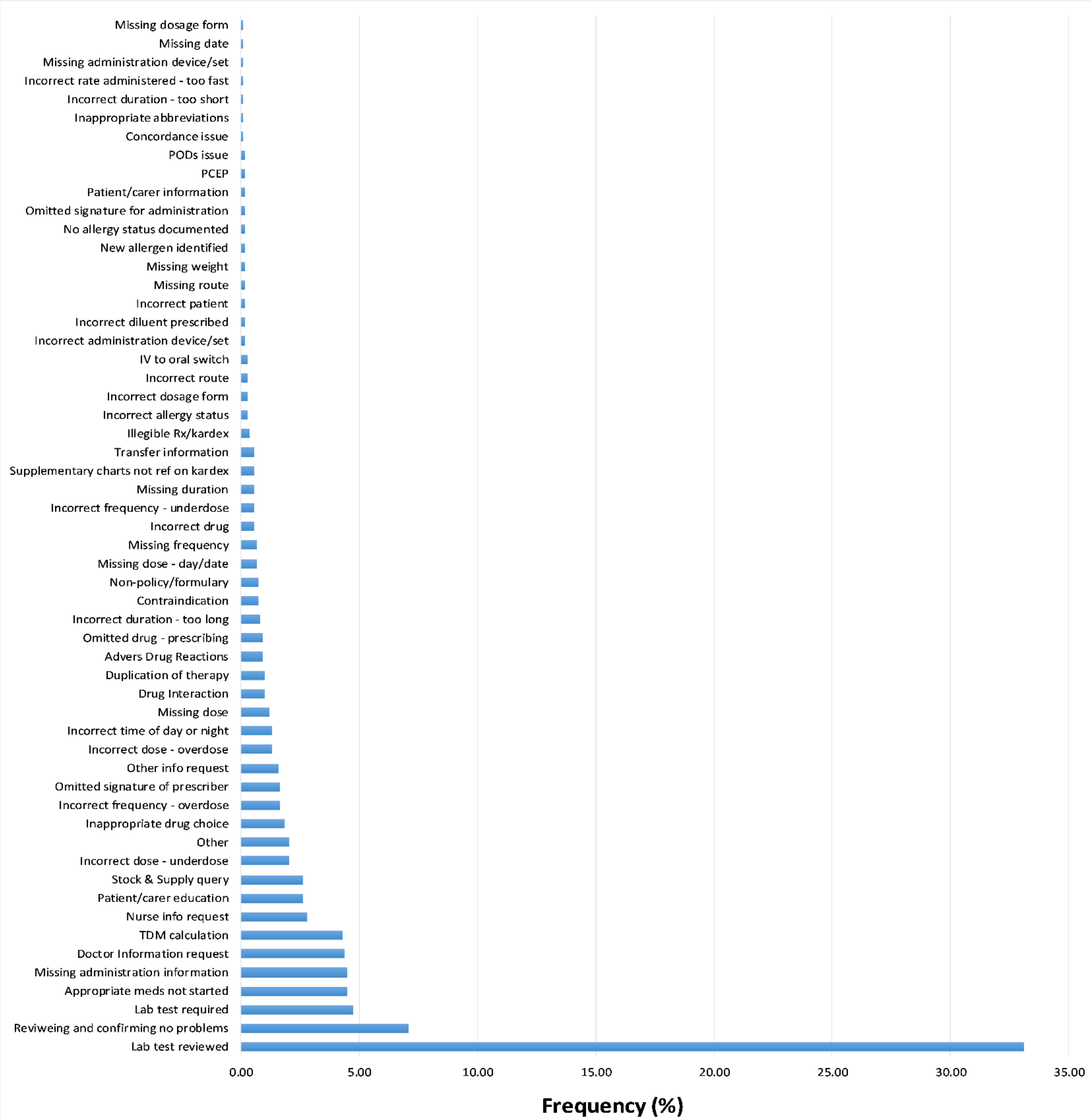


Figure 5-2: Percent (%) of the frequently completed interventions during in-patient hospital stay.

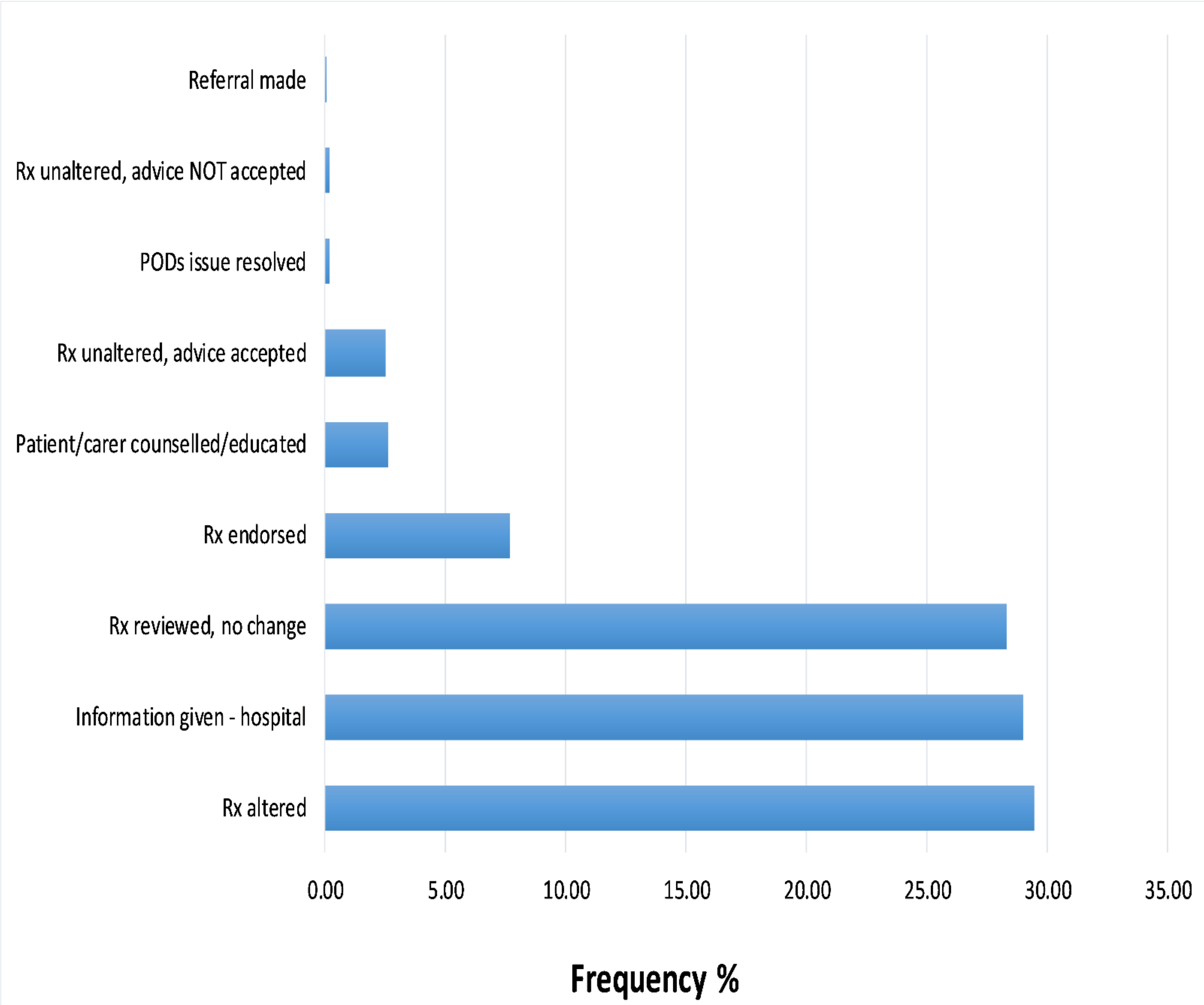


Figure 5-3: Frequency percent (%) of the pharmacist interventions` outcomes during in-patient hospital stay.

5.4.4 Analysis of the grades for all clinical pharmacists` interventions completed during in-patient hospital stay for all wards.

Analysis of 1070 clinical pharmacists' in-patient interventions throughout 129 working days showed that grade 4 interventions was the most common (84.58%) type of all pharmacists' interventions in all wards while grade 3 represented 9.35% and grade 5 represented 5.98% (Figure 5-4). Only one Grade 6 intervention was reported which demonstrated 0.09%.

5.4.5 Analysis of the contribution of different clinical pharmacists` grades in completing the interventions during in-patient hospital stay.

Analysis of 1070 clinical pharmacists' in-patient interventions throughout 129 working days revealed that the largest numbers of interventions (47%) was completed by senior clinical pharmacists (band 7) while junior (band 6) and consultant (band 8a) clinical pharmacists completed 32% and 21 % respectively of all inpatient interventions during the study period (Figure 5-5). Most of the junior clinical pharmacists' interventions (81.29%) were classified as grade four on Eadon scale while the rest of their interventions were distributed between grade three (17.25%) and grade five (1.46%) (Figure 5-6).

Approximately 96% of senior clinical pharmacists` interventions were grade four on the Eadon scale while 3% of their interventions were classified as grade three and only about 1% was classified as grade five (Figure 5-6). More than half (65%) of all consultant (band 8a) interventions were categorised as grade four on the Eadon scale while about 23% were classified grade five and 11% classified grade six (Figure 5-6).

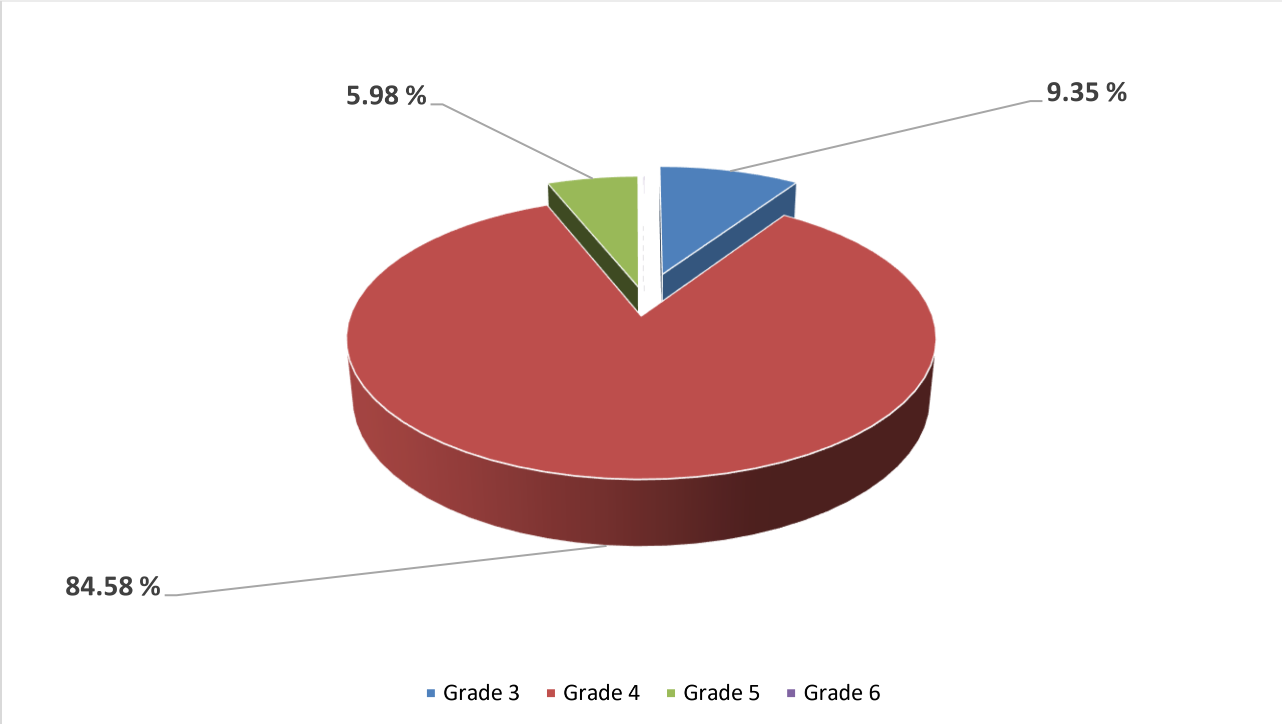


Figure 5-4: Percent (%) of different in-patient pharmacist interventions` grades during the study period within all wards.

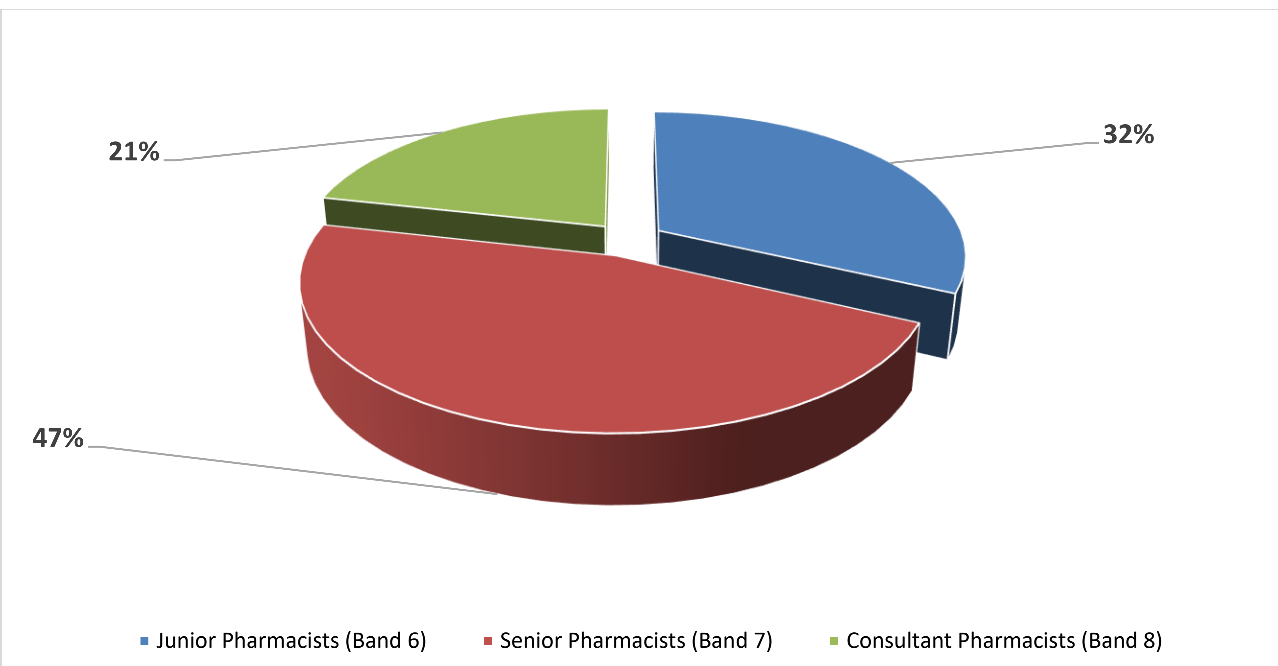


Figure 5-5: Percent (%) of the in-patient interventions completed by different pharmacists` staff grades during the study period.

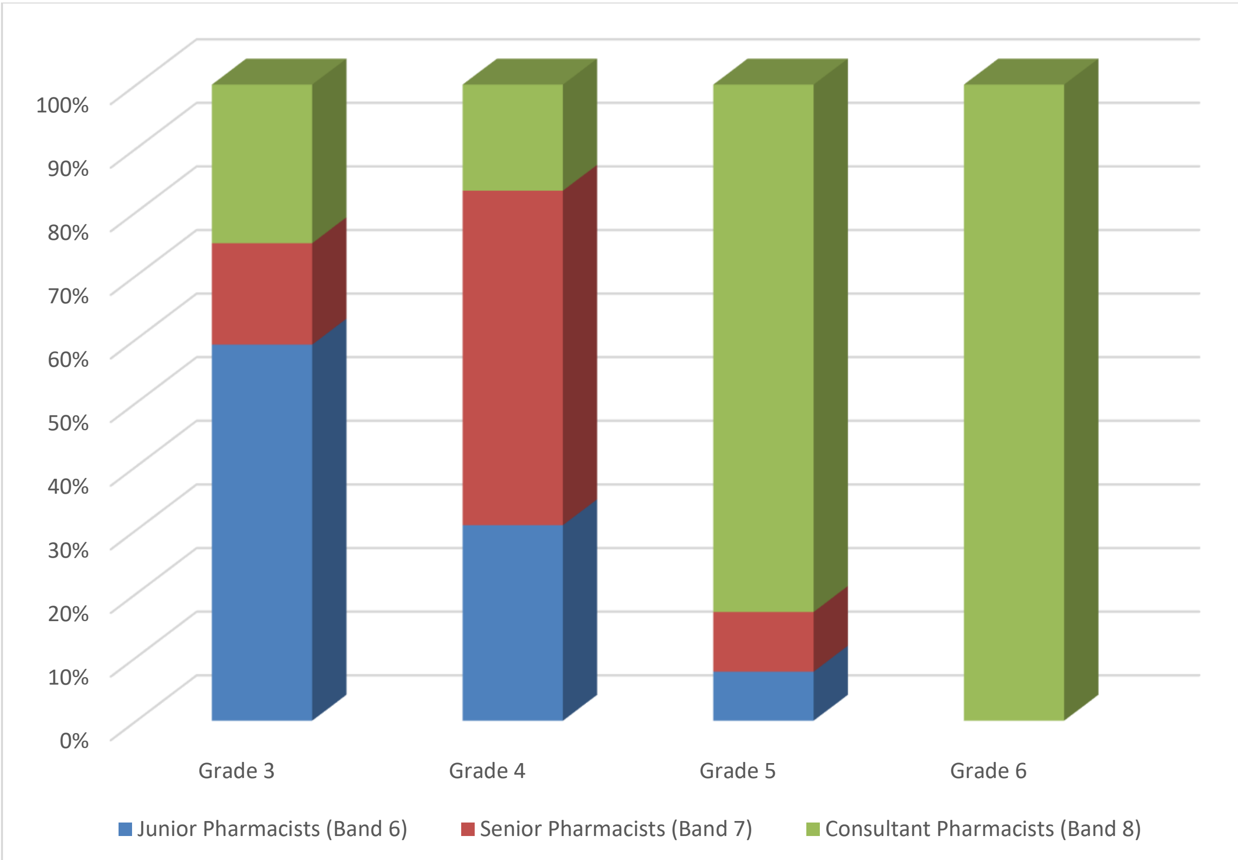


Figure 5-6: Distribution of different clinical pharmacists` interventions on the Eadon scale grades by junior (band 6), senior (band 7) and consultant (band 8a) pharmacists.

5.4.6 Cost effectiveness of the interventions made by ward clinical pharmacists through avoidance of medicines related errors during in-patient hospital stay.

Results showed that the clinical pharmacists in each ward were able to complete an average of eight interventions during in-patient hospital stay on daily basis. Most of these interventions were categorised as grade four on the Eadon scale grading system which equated to a reduction in daily costs between £520 and £1200 in each ward which was predicted to be associated with the prevented medication errors (Figure 5-7).

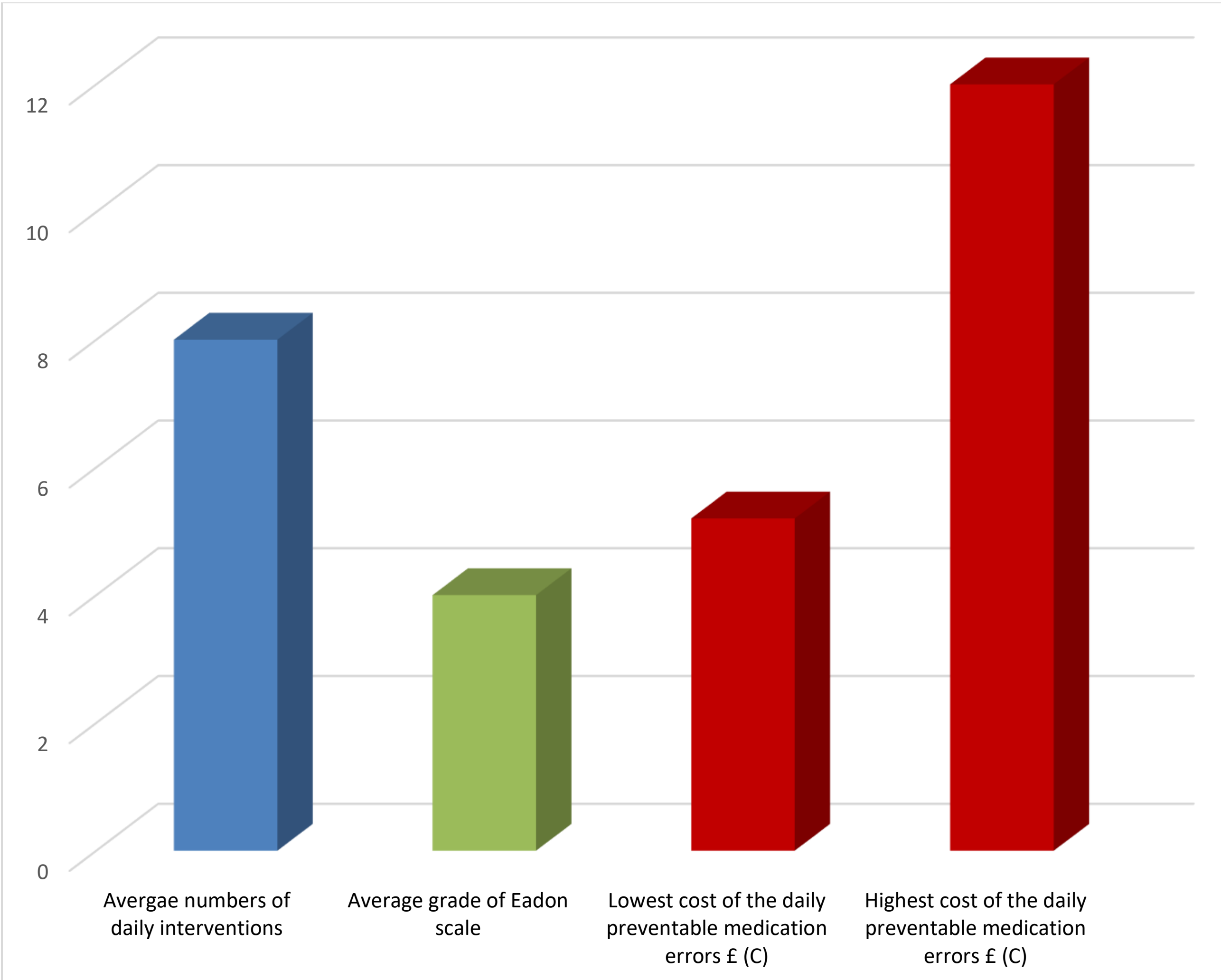


Figure 5-7: Daily cost reduction (£) achieved in each ward through clinical pharmacists' interventions associated with medication related errors` prevented during in-patient hospital stay.

*(c)= 100

5.5 Discussion

Pharmacist interventions enhance and promote patient outcomes, supporting the recognition of the important contribution that clinical pharmacists can make to patient care with other health care providers (Garrett and Reeves 2009).

During in-patient hospital stay and through medicines therapy review, clinical pharmacists optimise all medicines-related issues by confirming medication appropriateness, safety, efficacy, cost-effectiveness and maximise clinical usefulness (Schlaifer and Rouse 2010; Cipolle *et al.* 2012). Avoidance and minimising of medicines related problems can help in improving the clinical benefits, quality of life and reduce the overall cost of health services (Rogan *et al.* 2019).

Within this study, all clinical pharmacists` interventions during in-patient hospital stay were retrieved from EPICS and then quantitatively analysed and compared.

Results of the study showed that there was a daily average of eight clinical pharmacists interventions made in each ward during in-patient hospital stay. This number did not include any interventions made by the ward pharmacist the patients admitted to or discharged from the ward on the same day. The eight clinical pharmacy in-patient interventions were on average, made for four patients in the ward reflecting two interventions per patient, a result was comparable with the findings of *Rodrigues et al* (2019) who reported that the clinical pharmacists interventions made to follow up the patients pharmacotherapy during hospital stay within a 26-bed ward in a tertiary teaching hospital were 2.3 per patient. However, these findings were inconsistent with an American study which found an average of 38 daily pharmacist interventions of inpatient care within a 28-bed unit (Hammond *et al.* 2019). This inconsistency may be because within the *Hammond et al* study the analysis of the pharmacists interventions was only based on acute intensive care units in which the clinical pharmacist`s time is assigned to the daily review and follow up of the in-unit patients as there is no direct admissions to or discharge from the intensive care units; in addition to the critical illness status of the intensive care patients and slower turnover of patients within an intensive care ward.

It is also important to mention that all in-patient interventions analysed within our study were self –reported and graded by the ward-dedicated pharmacists in real-time, so it is possible that some interventions might not have been reported during very busy periods. This hypothesis is supported by *Garrett et al* (2009) who mentioned that the under-reporting of pharmacists interventions is common and frequent due to obstacles and challenges including time and software technologies.

The eight daily interventions within the current study completed for four patients in a 30-bed ward indicated that the clinical pharmacists` services during in-patient hospital stay support approximately 13% of the patients in the ward. This is a similar finding to that of *Reis et al* (2013) who concluded that up to 14.6% of patients in a medical cardiology ward and two intensive care units within a tertiary hospital had clinical pharmacist interventions during their hospital stay, with the slight difference being potentially due to the different ward specialty.

Considering the results of chapter IV of this thesis which concluded that about 15% of the patients within the ward were supported with clinical pharmacy services on admissions and a similar percent (15%) were supported during discharges. Inclusion of the 13% of the patients supported within the ward during their hospital stay through clinical pharmacist interventions, reflects a total of 43% of the ward patients benefitted from and are supported daily with clinical pharmacy activities. However, this leaves 57% of ward patients with the largest proportion being during the in-patient stage, not geting the opportunity to be reviewed by a clinical pharmacist daily. This is may be attributed to the increased pressure on, and workloads of the clinical pharmacist during both the admission and discharge phases, as these are the priority areas of activity as recommended by the Northern Ireland Clinical Pharmacy Standards, which provides guidance that clinical pharmacy services for patients during transition between care settings, such as in hospital discharge, should be the top priority followed by admissions and then the in-patient phase (*Northern Ireland Clinical Pharmacy Standards.* 2013; Ashfield 2013).

The analysis of the grades of all interventions made by the clinical pharmacists during in-patient hospital stay within all wards showed that the vast majority of all interventions (84.58%) were grade 4 on the Eadon scale meaning that the interventions were significant and resulted in an improvement in the standard of care. This conclusion was in accordance with the *Ashfield* trial (2013) which reported that grade 4 was the most common grade (84%) of total interventions and also consistent with the two Northern Ireland based IMM projects which indicated 75% and 79 % of all pharmacist interventions were at grade 4 Eadon scale (Scullin *et al.* 2007; Scott *et al.* 2015; McKee *et al.* 2016).

No significant differences existed when the three ward specialties (medical, surgical and cardiology with long stay wards) were compared in relation to the numbers of daily interventions, average grade of interventions or numbers of patients who had interventions on each ward. However, there may be a possibility of difference between the three specialties in terms of the types and frequency of interventions, but this was not measured within the current study.

Fifty-five different types of interventions with different frequency and outcomes were made by clinical pharmacists in all wards involved in the study. Reviewing and confirming the laboratory results associated with patients` medicines was the most frequent intervention completed by the clinical pharmacists in all wards which represented about one third of all interventions made. This was followed by six other types of frequently completed interventions, including reviewing and confirming the appropriateness of the patients` prescriptions; requesting particular laboratory tests for patients` safe use of medicines; identifying that appropriate medicines had not been started; missing of administration information on the Kardex; requesting extra information from the doctor and completion of therapeutic drug monitoring and calculation of drug levels. Those top seven frequently completed interventions represented more than 50 % of all interventions, while the other 48 types of interventions formed the second half of all interventions completed. These findings were inconsistent with that of *Rodrigues et al* (2019) which reported that 16 types of interventions completed by the ward pharmacist during in-patient stay and the most frequent intervention was untreated condition which represented 27% of all interventions; and followed by management of adverse drug reactions (8%), sub therapeutic dose corrections (7.5%), unnecessary medicines prescribed (7%), essential laboratory monitoring not performed (7%), significant drug interactions (6%) and others.

The findings were also different from that of *Reis et al* (2013) which indicated that the top frequent intervention made by the pharmacist during in-patient stay was dosing errors (47%) followed by inappropriate/unnecessary medicines (19%) and drug interactions (7%) and others.

Findings *of Satti et al* (2014) reported that safety interventions (adverse drug reactions, therapeutic drug monitoring, contraindications, interactions and dosing adjustment) represented the most frequent interventions (40%) completed by the pharmacist during in-patient stay, followed by indication interventions (drug duplication, indication without medication and medication with no indication) which represented about 36% of all interventions. Slightly less than 30% of all in-patient prescriptions which were reviewed by the pharmacist resulted in no change or alteration needed, while prescription alterations were required for about 30% of other patients. Prescription alteration represented the most frequent outcome resulting from the pharmacist interventions during in-patient stay followed by prescription review confirmed with no change, information given to the hospital (28%) and prescription endorsed (7%). In *Rodrigues et al* (2019) introducing a new medicine within the patient prescriptions was the most frequent outcome (27.5%) during the in-patient pharmacist review followed by withdrawing another prescribed medicine (17%) while within *Reis et al* study (2013) suspending of one or more medicines was the most frequent outcome (19%) of the pharmacist intervention. The differences between these studies may be due to the different ward specialties involved within each study, country of the study or type of clinical pharmacy services provided.

Results of the current study showed that about 96.5% of all pharmacists` interventions during the in-patient hospital phase were directly accepted by doctors while less than 1% was not accepted and 2.5% was communicated with and advice accepted with no prescription alterations were made, which reflected how these interventions were significantly important for patients` outcomes. These findings were in agreement with an Italian study which indicated that about 93% of all pharmacist interventions were directly accepted by doctors (Lombardi *et al.* 2018), and with two UK studies which confirmed that more than 90% of clinical pharmacists interventions were accepted by medical staff (Bourne *et al.* 2014; Shulman *et al.* 2015).

The relationship between pharmacist staff grade and interventions was also investigated, and it has been shown that about 50% of all in-patient interventions within all wards were made by the senior clinical pharmacists (band 7), with 30% being completed by junior pharmacists (band 6) and 20% being completed by consultant pharmacists (band 8a). This may be because senior pharmacists (band 7) are the most ward-dedicated grade that regularly stay on the ward, while junior pharmacists are usually rotated between wards, and consultant pharmacists (band 8a) sometimes leave the ward for clinic management (such as anticoagulant clinics and pre-surgery clinics) or managerial tasks. This justification was supported by the findings of the two Northern Ireland IMM studies in NHSCT (Scullin *et al.* 2007; Scott *et al.* 2015).

It has also been shown that more than 80% and 90% of interventions completed by junior and senior clinical pharmacists respectively were grade 4. Also 17% of junior pharmacists' interventions were grade 3 with only 3% of the same grade were completed by senior pharmacists, with only between 1% and 2% of the junior pharmacist interventions being grade 5. Although senior clinical pharmacists (band 7) completed a larger percentage of higher intervention grades than juniors (band 6), neither grades completed any grade 6 interventions.

Differently, in-patient interventions made by the consultant (band 8a) clinical pharmacists were grade 4 (65%), grade 5 (23%) and grade 6 (11%). No grade three interventions were completed by consultant (band 8a) pharmacists and this was the only staff grade who completed grade 6 interventions which are considered as medicines incidents. These findings may be attributed to limited specialist knowledge of junior pharmacists and an increased the level of experience, knowledge and competency with higher staff grades; this is directly comparable with the findings of *Rudall et al* (2017).

Although it has been demonstrated that clinical pharmacists` interventions significantly improve healthcare and patient outcomes, the economic impact has also been calculated. Within the current study, the daily preventable medicines related problems through eight grade 4 clinical pharmacy interventions during in-patient hospital stay reduced the monthly cost between £11,440 and £26,400 per ward which reflects that one clinical pharmacist was able to save this amount through only a part of his/her daily working routine and during only one phase of the patient journey. This economic impact was calculated based on the NHSCT tool to estimate the cost of the preventable medicines related problems in reference to the Eadon scale cost reference (Campbell *et al.* 2007; Karnon *et al.* 2009). These findings were in agreement with many published other studies which indicated the significant economic impact and cost effectiveness of clinical pharmacists interventions during the full patients journey, including the in-patient stage (Touchette *et al.* 2014; Samp *et al.* 2014; Chen *et al.* 2017; Bao *et al.* 2018; Bosma *et al.* 2018; Rogan *et al.* 2019).

5.6 Limitations

All in-patient clinical pharmacists` interventions within the current study were self-reported by the ward clinical pharmacists in real time so both performance bias and under-reporting may be considered as limitations to this study.
Also, the time taken by the pharmacist to resolve and report the daily interventions was difficult to measure.

5.7 Conclusion

Ward clinical pharmacists completed an average of eight daily interventions during the in-patient hospital phase which was equivalent to 13% of ward patients. Considering this finding together with the 30% of the patients being reviewed during both hospital admissions and discharge reported earlier, reflects that 57% of the ward patients did not get opportunity to be regularly reviewed by the clinical pharmacist during their in-patient stay, most likely due to lack of pharmacy resources including staff time. Despite this, significant cost savings were realised from the in-patient clinical pharmacists' interventions which represented only part of the daily pharmacists` activities. The saving calculated represent at least three times the amount of an average monthly salary for only one clinical pharmacist. It was also noticed that the grade of interventions was directly proportional with the pharmacy staff grade and only serious medicines incident reports were made by consultant (band 8a) pharmacists. The time shortage of the ward clinical pharmacist which prevented the regular reviewing of all patient during their in-patient stay may under-estimate the average daily numbers of interventions during this phase.

Chapter VI

Implementation and analysis of anticipated elements of potential models

6.1 Introduction

Clinical pharmacy technicians (CPTs) are essential and integral members within the hospital pharmacy workforce (Alkhateeb *et al.* 2011). Expanding the role of CPTs is crucial to support clinical pharmacists' activities and development of clinical pharmacy services (CPS) through engagement in more ward-based duties (Turner *et al.* 2005; Abuelhana *et al.* 2019), which can optimise patient care, improve quality of life and impact significantly on the safe use of medicines through a patient's hospital journey (Seaton and Adams 2010).

CPTs are completing more than seven different clinical pharmacy-supportive tasks which promote medicines optimisation and medicines management aiming for best patient outcomes (Abuelhana *et al.* 2019). Expanding CPTs roles and responsibilities can facilitate the provision of more advanced clinical pharmacy services (Elliott *et al.* 2012).

Ward-based pharmacy technicians are undoubtedly the most suitable candidates to whom re-assignment of some historical pharmacists` duties and responsibilities would allow enhancement of pharmacists to be engaged with and participate in more direct patient care activities. Several additional tasks could possibly be assigned to CPTs after ensuring the achievement of satisfactory levels of competency and skills, based on accredited structured training (Adams *et al.* 2011; Schafheutle *et al.* 2017).

The need for extended CPTs supportive roles was globally highlighted as clinical pharmacists` time insufficiency has been identified as a barrier for advancing their clinical pharmacy services (Boockvar *et al.* 2011; Schommer and Gaither 2014; Napier *et al.* 2018; Abuelhana *et al.* 2019).

The expanded roles and extent of CPTs activities currently includes accuracy checking of dispensed prescriptions, assisting in medicines reconciliations and education of patients about their medicines (Adams *et al.* 2011; Education NHS Pharmacy 2013; Hickman *et al.* 2018).

CPTs can assist clinical pharmacists in completing medicines reconciliation by collecting and confirming patients medicines history on admission, releasing pharmacists` time to focus on more patient clinical centered approaches (Elliott *et al.* 2014; Borchert *et al.* 2019).

Several published studies suggested and recommended the expanded scope of CPTs beyond confirming patients' medicines histories to other tasks such as measuring patients' vital signs, recording laboratory results for pharmacists review and patients counseling on discharge (Bright *et al.* 2009; Adams *et al.* 2011; Irwin, *et al.* 2014; Mobley Smith *et al.* 2014; Rubin *et al.* 2016; Markovic *et al.* 2017; McKeirnan *et al.* 2018).

Within the United Kingdom some senior CPTs are Accredited Checking Pharmacy Technicians (ACPTs). This additional role of the pharmacy technicians requires a successful completion of a structured competency based training to qualify them to do the final checks for patients` discharge prescriptions (Education NHS Pharmacy 2013).

Final checks of patient prescriptions on hospital discharge by ACPTs were seen to reduce pharmacists time during the discharge phase by 19%, time which could be used for more clinically focused activities such as the clinical assessment of the prescriptions, which would further improve patient outcomes (Napier *et al.* 2015; Napier *et al.* 2018).

Delayed final checks of discharge prescriptions within hospital wards due to insufficient numbers of ACPTs has been shown to postpone and slow the discharge process (Scullin *et al.* 2007; Scullin *et al.* 2012; Ashfield 2013).

The ideal skill mix within hospital clinical pharmacy services will result from optimising CPTs skills and level of competency and this can positively impact the improvement of health care (Bader and Anderson 2019; Abuelhana *et al.* 2019; Pyzik 2019).

Currently within the study hospital site all medicines history for patients on admission are taken by ward pharmacists, and also not all ward-pharmacy technicians hold accredited checking qualifications. Results of the previous chapters showed a significant shortage of the clinical pharmacist time to support optimum clinical pharmacy services to all patients within the ward on a regular basis; this has led to investigate changing of the skill mix of the clinical pharmacy workforce to determine if expanding the clinical role of CPTs could enhance the clinical pharmacy services and releasing pharmacist time for more advanced clinical duties.

6.2 Aims and objectives of the study

6.2.1 Aims

The primary aim of this study was to provide evidence for expanding role of senior trained CPTs through their contribution in completing medicines history interviews during patients` hospital admissions, thereby releasing some of the pharmacist`s time to focus on more advanced clinical pharmacy activities.

Another goal was to analyse the impact of releasing one ACPT during afternoons to focus only on finishing all daily final checks requests for discharge prescriptions in all medical and surgical wards.

6.2.2 Specific objectives

Specific objectives were the following:

i. Analyse time required by senior CPTs to confirm medicines history for patients during hospital admission as a part of admission MedRec process.

ii. Assess the CPTs` competencies to get an accurate and completed medicines history

iii. Compare the time taken by CPTs and junior (band 6) clinical pharmacist in completing patients` medication histories as a part of MedRec process

iv. Analyse the priority referrals made by CPTs to the ward-pharmacists to completed reconciliations and if the pharmacist has re-confirm or complete the medicines history with the patient again.

v. Evaluate the time taken and impact of a released CPT to complete all requested final discharge prescription accuracy checks from all medical and surgical wards during the afternoon

vi. Calculate the average time taken between receiving a final check request and beginning of the process by the assigned CPT

vii. Analyse the average daily time taken by the assigned CPT to complete all requested final checks for discharge prescriptions within both medical and surgical OSD wards, including numbers of wards requested and numbers of medicines checked.

6.3 Method

6.3.1 Study Design and data collection

This study was designed as a prospective based clinical trial.

First element of the trial

Two senior ward-based CPTs were re-assigned each afternoon to interview newly admitted patients within different wards and confirm their medicines histories as part of the MedRec process. The two selected CPTs for this trial were senior technicians with several years of experience in clinical ward settings, both of whom had successfully completed the Medicine Management Accredited programme (MMAP). This is an accredited programme delivered by the Northern Ireland Centre for Pharmacy Learning and Development (NICPLD). It is competency based and consists of three modules:

- Module 1 – The supply of medication to individual patients:
- Module 2 – The assessment of patients' own drugs (PODS):
- Module 3 – Medicines reconciliation (Drug history).

Second element of the trial

Within the same study period, another ACPT was pre-assigned from all ward duties during the afternoon to focus on and complete any final check requests from all medical and surgical wards. All ward pharmacy staff were informed of contact details to notify the ACPT for any final checks required for discharge prescriptions. They were also advised to indicate the urgency and flexibility of the time for the requests to be completed according to the patient`s discharge plan to for prioritising of all requests from different hospital wards.

Data collection forms were designed by the lead researcher with the help of the principal supervisor of the project and the principal pharmacist for clinical services in NHSCT who was also involved in oversight of the project/study. The data collection forms were designed to enable assessment and analysis of all the necessary information required.

The first element of the study included time taken by the CPT to confirm medicines history for newly admitted patients to the ward; number of medicines confirmed for every patient; type and priority of referrals made by the CPT to the ward pharmacist to complete; and if the pharmacist had to go back to the patient to complete any missed information after CPT history interviews. During medicines history interviews, CPT prioritized patients referred to the ward-pharmacist for reconciliation according to traffic light system discussed in chapter III.

For the second element of the study, data collection included, the time taken to check each prescription, numbers of the items checked, time difference between the call request and beginning of the check, total daily time spent to check prescriptions and also number of wards serviced and how many daily requests were rejected.

Initially, a pilot data collection period was carried out by the CPTs involved in the study for one day to standardise data collection and provided reassurance that the same procedures for data collection would be followed before formal data collection was completed.

6.3.2 Settings (study site)

This study was conducted in Antrim Area hospital, the largest hospital within Northern Health & Social Care Trust (NHSCT) with a total of 426 beds. The study involved different medical and surgical wards with an average number of 30 beds in each. The selected CPTs for both elements were asked to record data from any medical or surgical wards in the hospital that required either medicines history interviews for newly admitted patients or completing final checks for patients on discharge during allocated times.

6.3.3 Duration of the study

The first element of the study included 29 patients over 7 working days data collection, while the second element of the study included 63 discharge prescriptions over a one-week period.

6.3.4 Inclusion / exclusion criteria

The data was collected only during working days from Monday to Friday (weekends were excluded) and between 09:00 am and 05:00 pm every day (evening shifts were excluded). Some weekdays were excluded either due to leave of the involved CPT or training purposes or the involvement of an urgency needed duties within the hospital

6.3.5 Method of statistical analysis

Analysis of the data was undertaken using SPSS® software (Statistical Package for the Social Sciences) version 22, (Verma 2012; Barton and Peat 2014). Results were reported as mean ± standard error of the mean (SEM), and standard deviation (SD) was also calculated. Statistical analysis was performed using One-way ANOVA with Tukey pairwise comparison as a post hoc. Qualitative variables such as percentage were calculated and compared using the Chi-square test.

- P value >0.05 considered non-significant.
- P value <0.05 considered significant
- P value <0.01 considered highly significant.

6.3.6 Data security

Paper copies of the collected data forms were used and stored securely, ensuring confidentiality of all data contained therein. After analysis of the data, all paper copies were confidentially destroyed. The main investigator together with the principal supervisor acted as custodians for the data processed and generated by the study and they were also responsible for the access to any information included.

6.3.7 Ethical approval

This was a service evaluation study, so ethical approval was not required.

6.4 Results

First element of the trial

6.4.1 Analysis of the average time taken by senior CPTs to complete medicines history for each patient on admissions.

Results showed that the senior trained CPT spent an average of 20.72 ± 1.87 minutes to confirm a medicine history for one newly admitted patient to the ward. The average number of the medicines confirmed for each interview was 8.44 ± 0.69 (Table 6-1). It has also been shown that an average of four patients were interviewed daily over different weekdays during the time allocated. The average time (min) spent on each medicines history interview on different weekdays was 22.66 ± 2.96 on Monday, 21.50 ± 3.43 on Tuesday and 14.83 ± 1.53 on Thursday to confirm an average number of 9.26 ± 1.09, 7.75 ± 0.99 and 7.33 ± 1.42 medicines respectively (Figure 6-1).

Table 6-1: Mean±SEM of the average time taken (min) and numbers of medicines confirmed during medicines history interview by senior CPT on admission for each patient involved in the study.

	Mean ± SEM (N= 29)	**Median (Min – Max)**	**SD**	**95%CI (Lower - Upper)**
Average time (min) taken by CPT on each medicines history interview	20.72 ± 1.87	20.09 (5 - 50)	10.07	16.89 – 24.55
Average Numbers of medicines confirmed by CPT for each medicines history interview	8.44 ± 0.69	9.0 (0 – 13)	3.72	7.03 – 9.86

N= sample size (number of patients)
SEM= Standard error of mean
SD= Standard deviation
CI= confidence interval

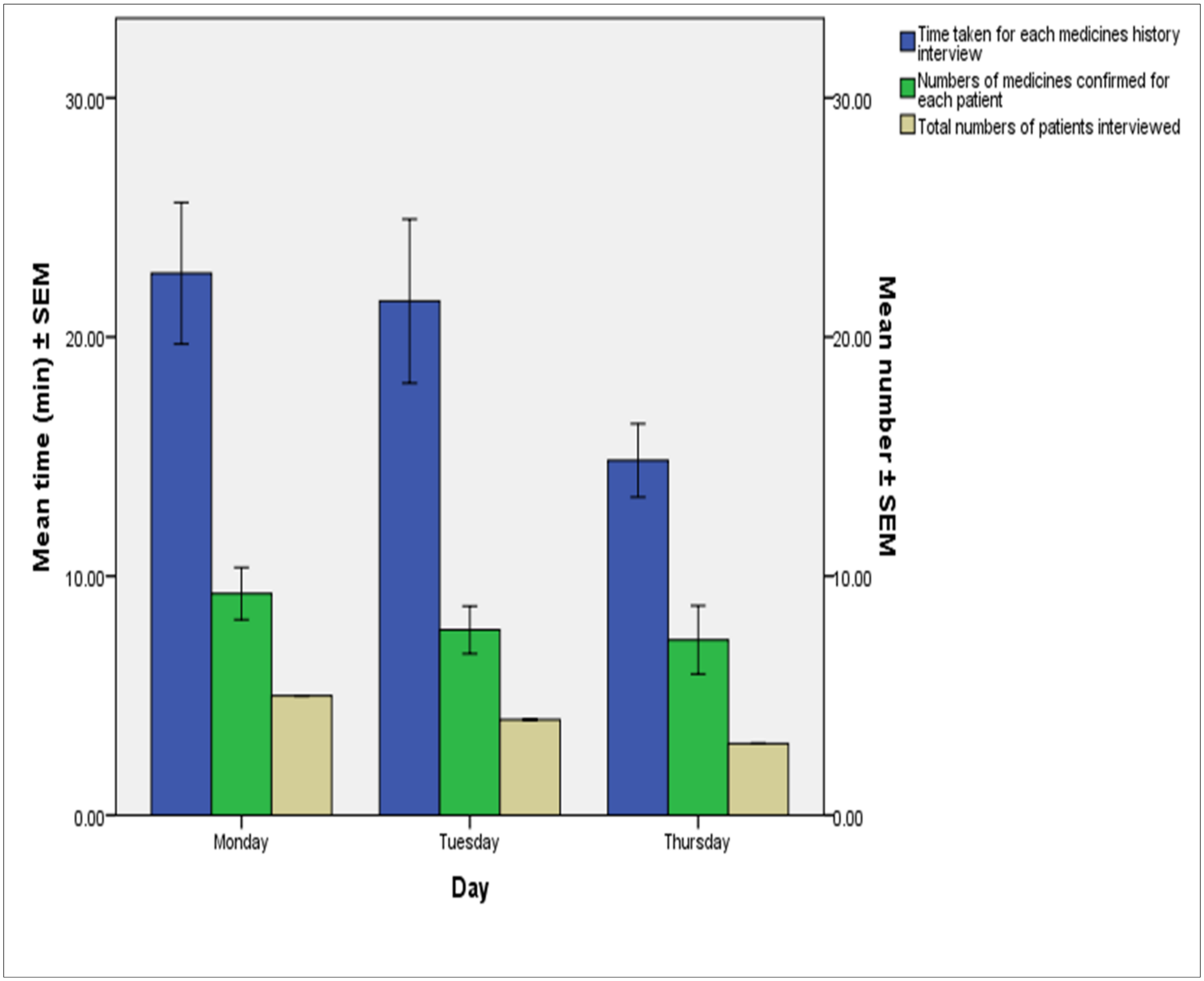


Figure 6-1: Average time (min) taken and numbers of medicines confirmed during medicines history interview by senior CPT on admission for each patient over some weekdays and total numbers of patients daily interviewed during afternoon time.

6.4.2 Analysis of the average time taken by senior CPTs and junior clinical pharmacist to complete medicines history interview on admission.

Results revealed that the average time spent by all pharmacists' grades (band 6, 7 and 8a) was significantly (P<0.01, One-way Anova with Tukey HSD as a post Hoc test) shorter than that spent by CPT to complete medicines history for one patient on admission. However, no significant difference existed (P>0.05, One-way Anova) when time spent by CPT was compared with that spent by only junior (band 6) clinical pharmacists grade as both spent relatively similar amount of time which was about 20 minutes (Table: 6-2).

Table 6-2: Mean±SEM of the Average time (min) taken by senior CPTs and pharmacists (all grades) and junior (band 6) pharmacists to complete medicines history interview for each patient on admission.

	Senior CPTs N= 29	Pharmacists (All grades) N= 80	Junior pharmacists (band 6) N= 80	Level of significance#
Average time taken by CPT and pharmacist on each medicines history interview	20.72 ± 1.87	10.62 ± 0.89	19.57 ± 3.93	P < 0.01[a] P >0.05[b]

N= sample size (numbers of patients)
# One-way Anova with Tukey HSD as a post Hoc test
P>0.05: considered non-significant
P<0.01: considered highly significant
a= significant difference between CPTs and pharmacists (All grades)
b= no significant difference between CPTs and junior (band 6) pharmacists

6.4.3 Analysis of CPTs referral types to the ward pharmacist and accuracy of completed medicines history interviews.

Results showed that 48.28% of the interviewed patients were classified as green with no high-risk medicines included, 20.69% were classified as amber and 31.01% were classified as red with high-risk medicines use which was confirmed during their interview and therefore the patient was categorised as top priority for reconciliations (Figure 6-2).

All medicines histories (100%) confirmed by senior CPTs during this study were accurate and complete and the pharmacist reconciling was not required to re-interview any patients for any incomplete information.

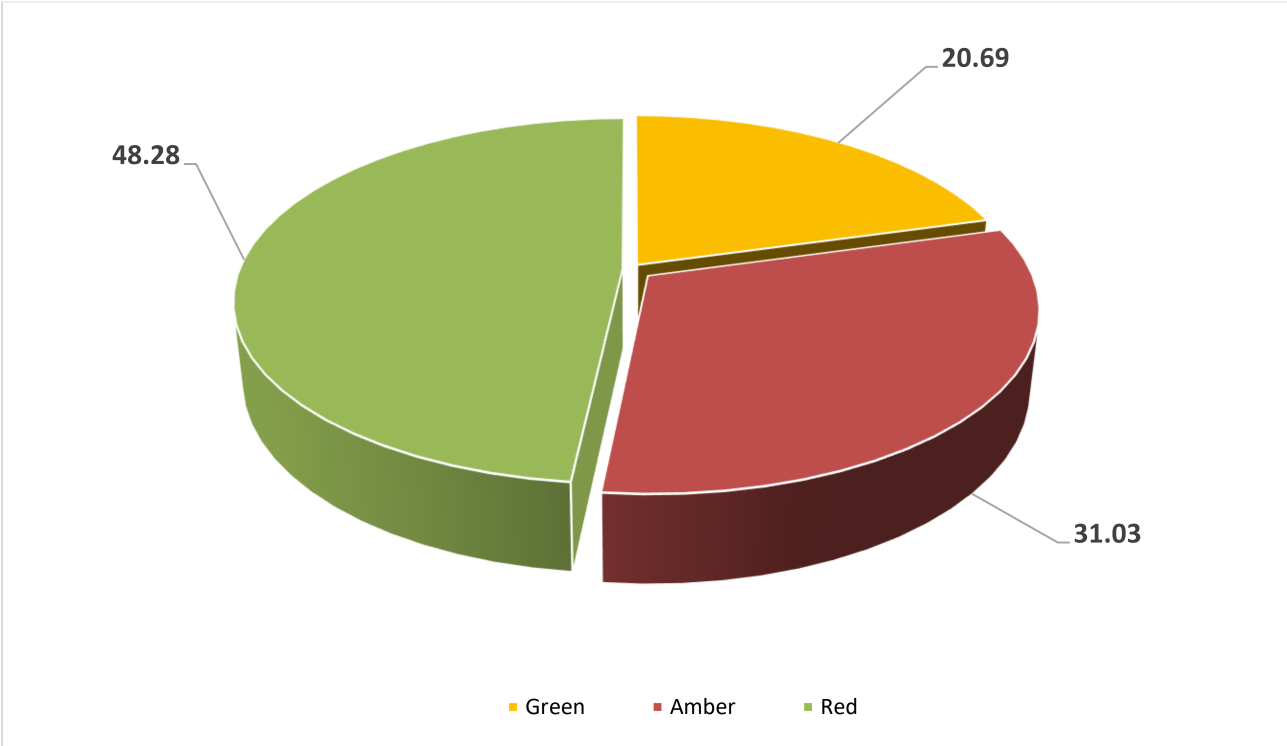


Figure 6-2: Percent (%) of different types of CPTs referrals to the ward pharmacist to priortise patients` reconciliations.

Second element trial

6.4.4 Analysis of allocated ACPT to complete all required discharge prescription final checks from all OSD medical and surgical wards.

Results showed that the average time between the accepted request and the beginning of final check for the discharge prescription by the ACPT was 13.61 ± 1.69 minutes. It has also been shown that the ACPT spent an average of 9.65 ± 0.66 minutes to complete the final check of an average of 12.98 ± 0.83 medicines (Table 6-3).

Results also revealed that Monday and Wednesday were the highest workloads for final checks (2.25 and 2.97 hours) to complete 216 and 221 items respectively which covered 8 wards on Monday and 10 wards on Wednesday (Figures 6-3,4,6). Thursday and Friday were the lowest workload and the longest time taken from request to response was on Friday (Figure 6-5). Also, the dedicated ACPT accepted 96.83% of the requests while 3.17% were rejected.

Table 6-3: Mean±SEM of the average time taken (minutes) to begin and complete final checks for patients discharge prescriptions by a dedicated ACPT.

	Mean ± SEM (N= 63)	**Median (Min – Max)**	**SD**	**95%CI (Lower - Upper)**
Average time between bleep request and beginning of final checks by ACPT	13.61 ± 1.69	10.0 (0 - 50)	13.48	10.22 – 17.01
Average time taken by ACPT to complete final check for each discharge prescriptions	9.65 ± 0.66	10.0 (3 - 30)	5.25	8.32 – 10.97
Average number of checked medicines in each discharge prescription	12.98 ± 0.83	12.0 (2 – 42)	6.66	11.30 – 14.66

N= sample size (number of final checks completed) **SEM**= Standard error of mean **SD**= Standard deviation
CI= confidence interval

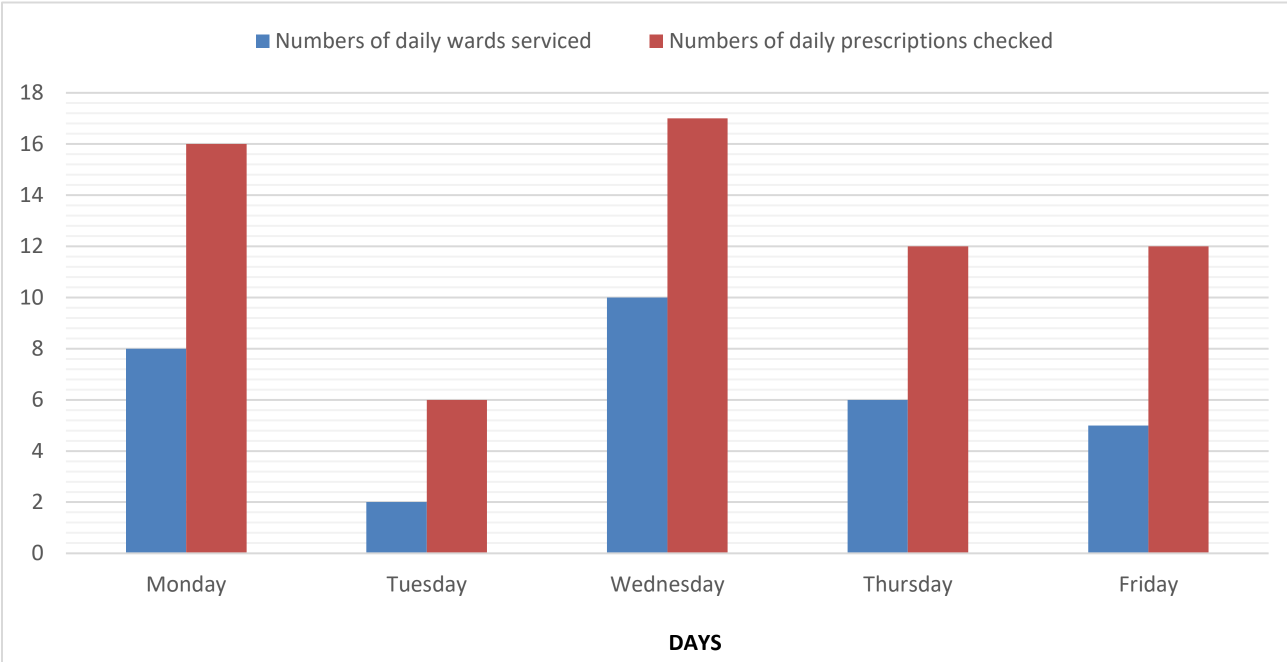


Figure 6-3: Average numbers of prescriptions checked and ward serviced by the allocated ACPT over weekdays

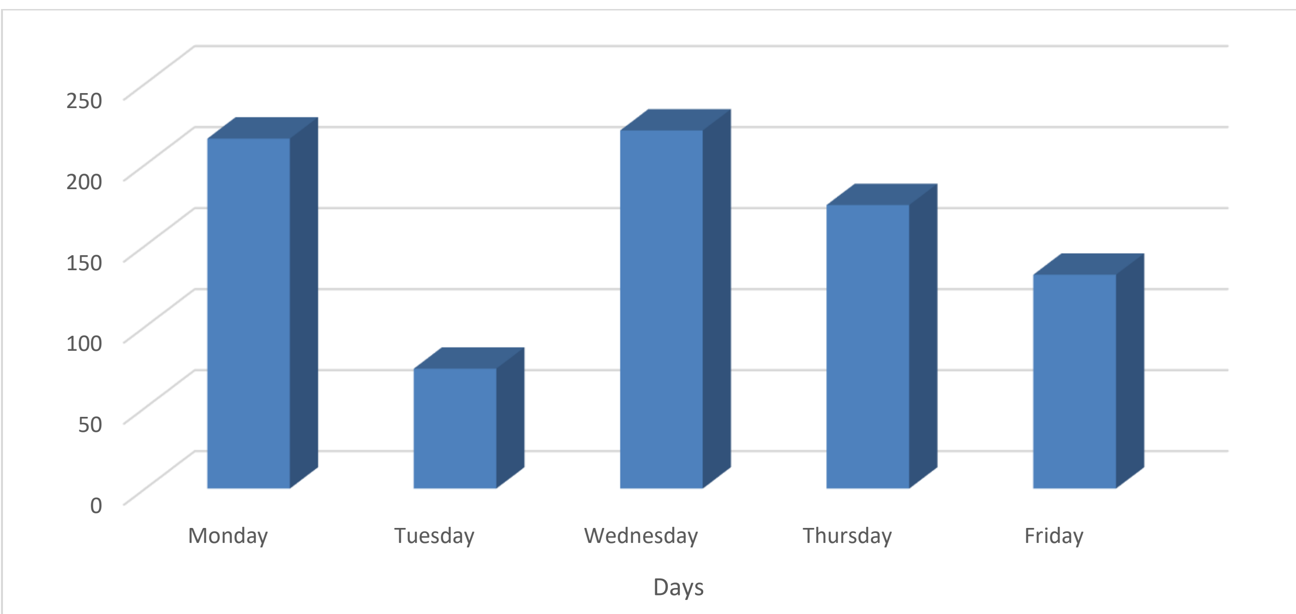


Figure 6-4: Average numbers of medicines checked by the allocated ACPT over weekdays.

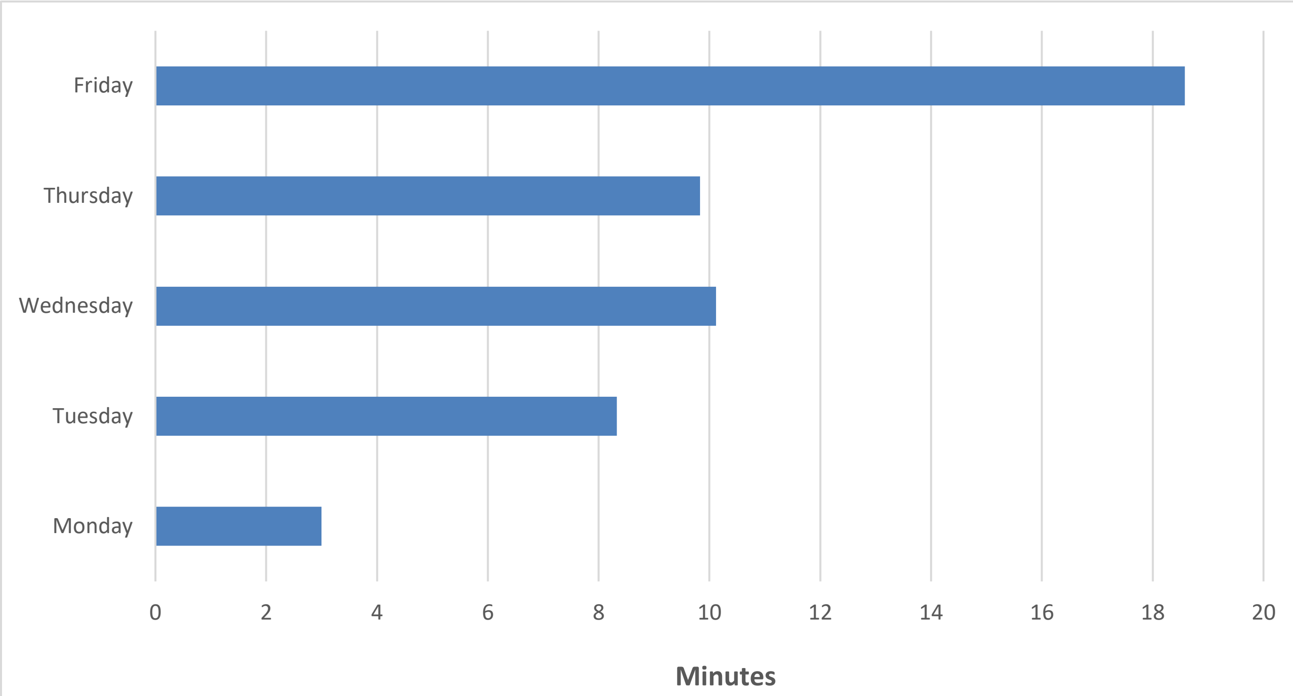


Figure 6-5: Average time (min) taken between the accepted request to the beginning of the final check by the allocated ACPT over weekdays.

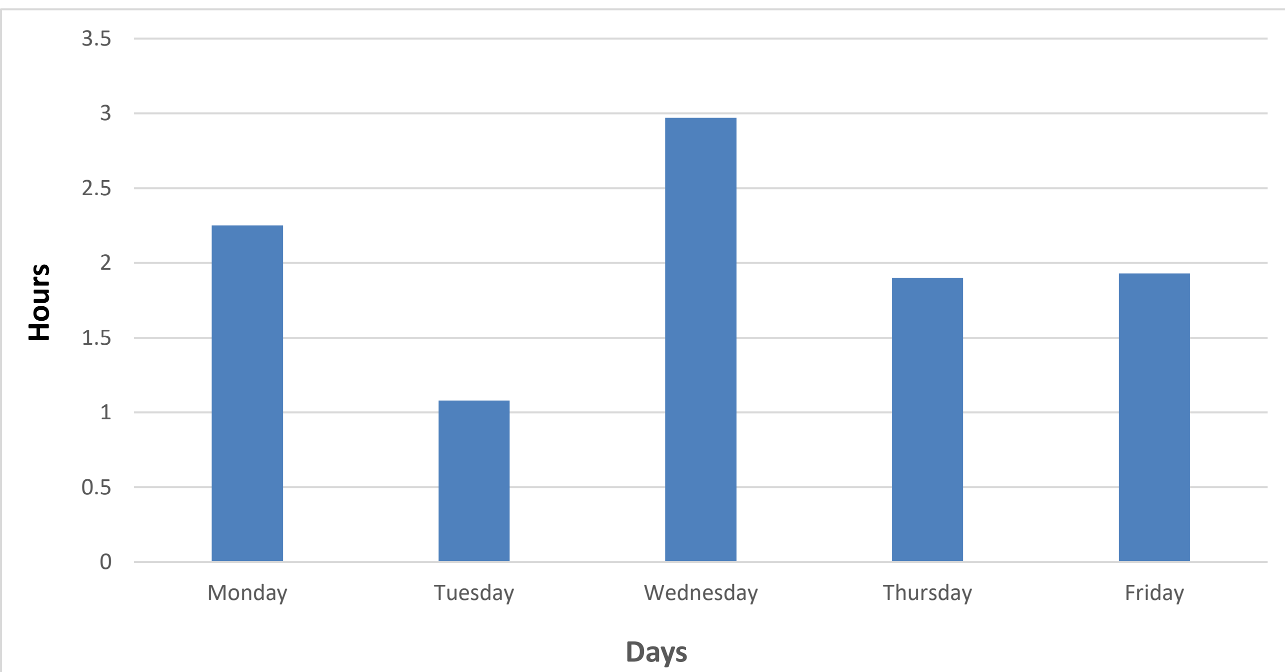


Figure 6-6: Average daily time (hour) taken by the allocated ACPT to complete the final check requests from different wards over weekdays.

6.5 Discussion

CPTs are vital members of the clinical pharmacy workforce. Expanding their contribution in clinical settings will support the clinical pharmacy team in improving the level and efficiency of patient care and the delivery of clinical pharmacy services (Gernant, 2018). When CPTs roles and responsibilities are optimised and their skills properly utilised, patient outcomes can be enhanced and also pharmacists will be able to allocate more time to focus on more complex clinical related approaches (Frost and Adams 2017; Bryan 2018).

Within the first element of the trial, two senior ward-based CPTs were released from their ward duties at allocated times to focus only on completing medicines histories for newly admitted patients within different hospital wards as part of the MedRec process. This is thought to be one of very few studies evaluating and measuring the service delivery and outcomes of a new implemented CPT enhanced clinical pharmacy service model during patient hospital admissions.

Results of the study showed that CPTs spent an average of about 20 minutes to confirm the medicines history of one patient during hospital admission; this time ranged from 5 to 50 minutes throughout the study, with each patient having an average of eight medicines. The time was used to verbally interview patients and document the patient medicines list to be ready for the ward pharmacists to reconcile. These findings were different from that of *Cater et al* (2015) who concluded that ward pharmacy technicians spent an average of 30 minutes per patient to confirm a medicines history and this time ranged from a minimum of 10 minutes to a maximum of 3 hours. The study justified the length of time taken by the numbers of the different information sources with which technician needed to communicate, including that more than 25% of all histories gathered involved long time telephone communications with community pharmacists (Cater *et al.* 2015).

Another study (Tam 2005) reported that the verification of a comprehensive medicine’s history for one patient by a technician usually takes between 9 to 30 minutes; however, this study involved only pre-operative patients within surgical wards and some patients attending pre-operative surgery clinics. While the time spent by technicians in *Tam`s* study is relatively close to the findings of the curret trial, it was different in the type of wards and patients included, as within the current study medical, surgical, cardiology and long stay wards were all included.

One more Danish study reported an average of 29 minutes per patient spent by the ward pharmacy technicians for verification of medicines history (Grønkjær and Rosholm 2013). Although the *Grønkjær* and *Rosholm* study involved geriatric medical wards, the patients medicines history verifications did not include patient or carer interviews and relied only on comparing the patient electronic medical record with the admission medicines list written by doctors.

Although there are some differences reported in the total time spent by the pharmacy technicians to complete the medicines history, all these studies agreed that the involvement of the pharmacy technician in the MedRec process expanded the scope and range of CPTs activities achieving better use of their kills, competencies, and better match with the future skill mix of the hospital pharmacy workforce to enhance the efficiency of clinical pharmacy services (Tam *et al.* 2005; Benavides and Rambaran 2013; Cater *et al.* 2015; Nguyen *et al.* 2019).

The results of our study also showed that an average of four patients from different wards were interviewed and got their medicines history confirmed by each CPT during the allocated time period, which took two to four hours each afternoon. This facilitated the ward pharmacist to implement more clinical-related activities, and also to proceed with the MedRec process during patient hospital admissions; these findings are compatible with the findings of other investigators (Cater *et al.* 2015; Gernant, S. A. 2018; Borchert *et al.* 2019).

Within this study, releasing of senior trained CPTs to complete medicines history during the afternoon matched with the findings of chapter III of this thesis which demonstrated that the time availability for the pharmacy technicians to take on other tasks and responsibilities without affecting their normal daily ward duties, was the afternoon period. Measuring the time spent by the pharmacy technicians over different weekdays gave consistent results which reflected the reliability of the findings of the current study.

Results also demonstrated that a similar amount of time was spent by CPTs and junior (band 6) clinical pharmacists to verify the medicines history for each patient on hospital admission, which was around 20 minutes. Moreover, accuracy of the completed medicines histories by CPTs were confirmed as ward pharmacists did not need to re-interview any patient or carer for any missed or incomplete information from the verified list of medicines by CPTs for any missed or incomplete information. These findings were in harmony with *Markovic et al* (2017) who stated that competent and well trained CPTs are capable of collecting a patient`s medicines history as accurately as pharmacists without the need for any additional time. *Markovic`s* study also reported that the obtaining medicines histories by CPTs was much more accurate than those obtained by ward nurses.

These results were also in agreement with *Johnston et al* (2010) who reported that no significant difference existed in time and level of accuracy between CPTs and pharmacists when both collected patients` medicines histories during hospital admissions.

Additionally, the results of the current study demonstrated that the CPTs were not only able to obtain an accurate and timely medicines history similar to the ward pharmacist, but also they were able to priortise the newly admitted patients for the ward pharmacist to facilitate reconciliations according to the level of urgency and risk. About one third of all patients interviewed by CPTs were classified as high-risk and were considered as top priority referrals to the ward pharmacist to be reconciled first, while about 50% of the patients were not urgently required reconciliations. This finding considered an additional value of using competent CPTs in advancing clinical pharmacy service delivery.

The second element of the study was tested by releasing up to one ACPT from ward duties during the afternoon to focus only on the completion of discharge prescription final check requests from all medical and surgical wards.

Final checks have been previously identified as one of the significant reasons for delayed discharge process within OSD and ward-based clinical pharmacy services as not all ward technicians were accredited checkers (Scullin *et al.* 2007; Scullin *et al.* 2012; Ashfield 2013).

Completing accuracy checks enables ACPTs to demonstrate a higher level of competency and also helps to release more time for the ward pharmacists to do more clinical related activities. This has been demonstrated to be a useful and acceptable skill mix that can achieve workforce efficiency and improve patients` safety (Snoswell 2019). The aim of this potential element within this trial was to try and reduce the workload attributed to final checks and accelerate the discharge process in order to reduce the time taken between the clinical check and accuracy check of the discharge prescriptions.

An average of about half an hour was demonstrated to be the time taken between finishing of clinical check and starting the final check after applying the second element of the study. It has shown also that the ACPT spent about 10 minutes for the final check of each prescription with an average of 13 items.

Results also showed that, the release of a single ACPT during the afternoon could result in completion of between 12 and 17 final checks for discharge prescriptions from between 5 and 10 medical and surgical wards every day, with the total time daily taken on this activity ranging from 2 and 2.5 hours. The released ACPT also accepted almost all (97%) daily requested bleeps from different wards which reflected the capacity of work that could be achieved. The other 3 % were rejected because the request was less than 10 minutes from the end of the working day (05:00pm), which was an accepted cut-off time.

This efficiency of ACPT to support clinical pharmacy services within hospitals has been investigated and highlighted by many other studies, frameworks and reports (Education NHS Pharmacy 2013; Quigley and Watts Public Health Specialists 2014; Hickman *et al.* 2018; Snoswell 2019). However, this study considered one of very few ones which quantitatively measured and analysed this expanded supportive role.

6.6 Strengths / Limitations

This is one of very few studies which has quantitatively measured the time and accuracy of CPTs on confirming patients` medicines histories in secondary care as part of the medicines reconciliation process and also reallocation of the accredited CPTs for best use of their competencies and skills. However, as this study was conducted during the normal hospital working environment there are a few limitations which might be considered, such as a small sample size, an inability to measure the interviewed patients level of satisfaction with the service and also the presence of a self- reporting bias.

6.7 Conclusion

Accurate and complete medicines histories can be efficiently completed by senior CPTs with a similar accuracy and amount of time taken as junior pharmacists. Also, ACPTs could be freely rotated during the afternoon to focus on the final checks needed within different hospital wards and so reduce the time taken between clinical and final checks of the discharge prescriptions and also facilitate and accelerate the discharge process. The two potential elements involved in this study could help in suggesting optimum skill mix models for the clinical pharmacy workforce that ensure optimal use of staff grades and resources.

Chapter VII

General discussion and conclusion

7. General thesis discussion

7.1 Analysis of clinical pharmacy services

Advancement of clinical pharmacy services to focus on more patient-centred approaches is significantly affected by time availability for clinical pharmacy workforce, pharmacy staff resources and the appropriate level of staff grade required for completing the required tasks. For these reasons, this study was designed to identify, measure and analyse the different clinical pharmacy services throughout the patient`s hospital journey and also develop and suggest a skill mix model for the clinical pharmacy workforce for the best patient outcomes and cost effectiveness.

Chapters III to V analysed different clinical pharmacy services supported by both clinical pharmacists and clinical pharmacy technicians during patients` hospital admission, in-patients stay and discharge. This analysis included daily types of activities, time required to undertake each activity and the level of staff grades to complete such activities. **Chapter VI** tested the implementation of specific roles for certain staff to optimise the skill mix of the clinical pharmacy workforce.

The essential and integral supporting roles of CPTs were highlighted and described within **Chapter III**. Daily roles and responsibilities of CPTs within different surgical, medical and long stay wards with relatively equal patient numbers were measured and analysed. The results showed that CPTs completed seven different clinical and technical related tasks which supported the role of medicines optimisation, medicines management and patient care. These tasks distributed between morning and afternoon hours and included patients` medication lockers check, medication lockers supply, patients` medication charts review, referral of patients to the pharmacists for further clinical check, assessment of the patients own drugs (PODs), labeling and dispensing of medications for discharge, and final checks for the dispensed discharge medicines. The main task of all CPTs within all wards was reviewing the patients` medication chart to top up their bedside medication lockers and refer patients prescribed high-risk medicines to the ward pharmacist for further clinical assessment. The results of **Chapter III** analysed the CPTs workloads over the daily hours from Monday to Friday that will help inform decision-makers on how to make optimum use of the available CPTs workforce. The analysis of CPTs workloads and time revealed that although CPTs completed more than seven clinical and technical related tasks, there is still possibility for them to be assigned new tasks during the afternoon which will help release more time for the pharmacist to focus on more clinical and therapeutic issues. Within the results of **Chapter III**, some senior CPTs were able to respond to and answer some of the ward medical staff queries about medicines and this helped release pharmacist time for other activities. The results of **Chapter III** also highlighted the importance of the numbers, grades and competency level (such as ACPTs required for the discharge prescriptions final checks) when allocating CPTs within different wards which will help optimise utilisation of the staff resources in the right skill mix.

Different clinical pharmacists` activities throughout the whole patients` hospital journey were presented in **Chapter IV** and **Chapter V**. Results of **Chapter IV** illustrated the main clinical pharmacists’ activities during both hospital admission and discharge while results of **Chapter V** outlined numbers and grades of clinical pharmacists` interventions during in-patient hospital stay.

Within **Chapter IV**, results showed that completing MedRecs was the main clinical pharmacists` activity during both patients` hospital admission and discharge. During admission, clinical pharmacists within different medical and surgical wards were able to complete about 88% of the daily-required MedRecs within the same day. This represented an average of four daily-completed admission MedRecs within each ward and required approximately two hours of the ward pharmacist`s time each morning. These two hours spent in the morning to complete the required admission MedRecs were distributed between confirmation of patients` medication histories (about 45 minutes) followed by reconciliation of the medicines (about 75 minutes). This suggests that if the patients` medication histories were completed by a competent CPT, this will save 37.5% of the pharmacists time spent on admission MedRecs. Also the results of this chapter showed no significant difference in daily numbers completed or time taken by different clinical pharmacists` grades to complete the required MedRecs on admission which suggest that it would be cost-effective assigning junior (band 6) pharmacists to complete admission MedRecs and release higher grades` pharmacist time for more in-patient and discharge clinical duties.

During patients` hospital discharge, the numbers and time taken to complete the daily discharge MedRecs by the clinical pharmacist in each ward varied between different ward specialties and also between different pharmacists` staff grades, ranging between two and six daily discharge prescriptions and requiring half an hour to two and half hours every day to be completed. However, on average four daily discharges were shown to be completed by the pharmacist daily in each ward which took about one and half hours mainly during the afternoon. This did not include time of final checks or time for patient counseling. The results of **Chapter IV** also illustrated that approximately 78% of all discharged patients required counseling on their discharge medications which was usually completed by the ward pharmacist. Time saving for pharmacists could also be achieved if some of the patients counseling was delivered by competent well trained CPTs. It has also shown within **Chapter IV** that the clinical pharmacist in each ward spent more than half of his/her daily working hours completing patients` MedRecs on admission and discharge without considering the time for counseling or final checks of the discharge prescriptions. This time was used daily to support about 15 % of newly admitted patients in each ward and 15 % of patients on discharge from the ward with clinical pharmacy services, an overall of 30 % of the patients within each ward received clinical pharmacy services on a daily basis.

Clinical pharmacist interventions made by the pharmacist in each ward during in-patient hospital stay were analysed in **Chapter V**. The analysis of the interventions included daily numbers made by the pharmacists, grade of the interventions according to the Eadon scale and the grade of the staff made the intervention were measure and analyses. The results of **Chapter V** showed that an average of eight clinical pharmacist interventions were made every day by the pharmacist in each ward during the in-patient stay. These eight interventions varied from grade 3 to grade 6 on the Eadon scale, however most of these interventions (84.58%) were classified as grade 4 which means that the interventions were significant and resulted in an improvement in the standard of care. The results of **Chapter V** also showed that about 50% of all in-patient interventions within all wards were made by the senior clinical pharmacists (band 7) while 30% completed by junior pharmacists (band 6) and 20% completed by consultant pharmacists (band 8a). Consultant (band 8a) pharmacists were the only staff grade who made grade 6 interventions and no grade 3 interventions were made by them while the majority of junior (band 6) and senior (band 7) pharmacists` interventions were graded 4 and represented 80% and 90% respectively of their overall interventions. Although the interventions were measured only during the in-patient phase, it has been shown to be cost effective and reflected cost reduction equated to at least three times the amount of a monthly salary for only one clinical pharmacist. The daily preventable medicines related problems through grade 4 clinical pharmacist's interventions during in-patient hospital phase in each ward reduced monthly cost between £11,440 and £26,400 which reflect that one clinical pharmacist was able to save this cost through only a part of his daily working routine and during only one patient hospital phase.

7.2 Potential elements for skill mix modeling

The implementation of some anticipated elements of potential skill mix models for clinical pharmacy workforce were tested and analysed within **Chapter 6**. The results showed that accurate and complete medicines histories could be efficiently completed by CPTs with similar accuracy and equal amount of time as junior (band 6) pharmacists. Also, ACPTs could be freely rotated during the afternoon to focus on the final checks needed within different hospital wards and so reduce the time taken between clinical and final checks of discharge prescriptions which is expected to facilitate and accelerate the discharge process. Those two potential elements involved in this study helped suggesting an appropriate skill mix models for the clinical pharmacy workforce that ensure optimal use of staff grades and resources.

7.3 Suggested skill mix model for the clinical pharmacy workforce

Based on the findings, analysis and conclusion of the clinical pharmacy services during the patients` hospital journey and also the analysis of anticipated elements of potential models tested within the study, the following model was suggested to ensure best utilisation of clinical pharmacy staff resources, patients outcomes and cost-effectiveness.

7.3.1 CPTs

Senior CPTs after successful completion of the required competency-based training could be released during part of the afternoon to complete the medication histories part of the MedRecs and also can deliver patient education and counseling activities during patient discharges from the hospital. This will ensure best use of the senior CPTs competencies and skills and also help save more time for clinical pharmacists to complete more advanced clinical pharmacy services.

7.3.2 ACPTs

Rotating ACPTs during the afternoon within different hospital wards to focus only on the required final checks for the discharge prescriptions could help reduce the time difference between clinical and final check of the discharge prescriptions and also ease and accelerate the discharge process.

7.3.3 Junior Pharmacists

Junior (band 6) pharmacists could be freely rotated every morning to complete the required MedRecs during patients` hospital admissions. This will save time for more senior clinical pharmacists' staff grades to focus on daily clinical reviews of the patient during their in-patient hospital stay and complete discharge prescriptions. During the afternoon, the junior pharmacist should rotate to help higher grade staff pharmacists in both the clinical reviewing and counseling of patients. The rota should be task based rather than ward based.

7.3.4 Senior Pharmacist

Senior (band 7) pharmacist should be the only ward-dedicated pharmacists who will be concentrating on completing admission MedRecs for high-risk patients, daily clinical reviewing of the ward patients during their in-patient stay and clinical check and writing of the discharge prescriptions in addition to the counseling of the patients on high-risk medicines. Senior (band 7) pharmacists should also rotate every 6 months within different specialties to allow them to gain more experience and increase their levels of competency.

7.3.5 Consultant Pharmacist (band 8a)

Consultant band (8a) pharmacists should not be ward-dedicated and should be responsible for high level tasks such as training of junior pharmacists in their specialist clinical areas, review of the highly complicated patients within their areas of specialism (e.g diabetes, anticoagulants and others), development of the referrals criteria which priortise patients according to their urgency to be reviewed, manage clinical pharmacy out-patients clinics (eg. anticoagulants, diabetes, surgery), development/updating of guidelines and policies within the Trust and clinical commitments to their specialised wards to review the highly complicate patients during in-patient phase.

7.4 Overall strengths and Limitations

This study is one of very few which quantitatively measured and analysed different types and workloads of CPS undertaken by both CPTs and clinical pharmacists over the entire patient hospital journey (from admission to the discharge) taking in consideration staff grades and ward-specialties. The findings of this study highlighted how tasks and duties could be divided throughout the working day or a week. Many findings and recommendations within this study were used by the NHSCT Trust to allocate pharmacy staff more efficiently and some of the study recommendations were used and reproduced within other several hospital/Trusts in many European countries such as Spain, Switzerland and Netherland. Moreover, many of these findings were used to assist with the development of an algorithm for clinical pharmacy staff deployment through an electronic allocation system. Based on the findings from this study, pharmacy staff allocation became task-based rather than ward-based which is the principle of the skill mix and also some of unnecessary task were removed. The recommendations of this study supported development of an appropriated skill mix model for the clinical pharmacy workforce for the best patient outcomes and cost effectiveness.

Limitations of each individual study were discussed within the relevant chapter however there were limitations associated with the overall study.

The analysis of the findings outlined the different clinical pharmacy services supported by both clinical pharmacists and CPTs which after testing the implementation of potential elements suggested an appropriate skill mix model for the clinical pharmacy workforce. However, this study was conducted within only one hospital (Antrim Area Hospital) and for such a reason the conclusions may not be generalisable and should be considered as preliminary. A larger multi-center study and for a longer duration should be conducted to ensure generalisation and accuracy of the conclusions. Also, although the testing of the implementation of some potential elements for skill mix modeling gave an overview on the appropriate suggested model, full implementation and testing this model was not possible to be conducted due to the daily high working loads and duties of the pharmacy workforce within the hospital and within the timeframe of this study.

7.5 Conclusion

Different clinical pharmacy services were delivered by pharmacists and pharmacy technicians throughout the patient hospital journey. The main activities of clinical pharmacists in each ward was completing MedRecs on patient`s admission and discharge which required more than half of each ward pharmacist`s daily working hours and reduced the opportunity for other patients to be reviewed by a clinical pharmacist during their in-patient stay. CPTs are an integral part of the clinical pharmacy team and their roles can be enhanced to release more time allowing pharmacists to focus on more therapeutic issues and use their prescribing skills as well as increase the time available for in-patient pharmacist review. Reallocation of numbers, staff grades and competency level within an appropriate skill mix model will ensure the best use of staff resources and improve the provided clinical pharmacy services, patient outcomes and cost-effectiveness. The findings within this research will facilitate optimal allocation of resources in a timely manner. The allocation of resources should become more task focused rather than ward focused allowing staff to concentrate on one task at a time. This should ensure that the right patient is being seen by the right member of pharmacy staff grade at the right time.

7.6 Future work

Many technical activities currently supported and completed by CPTs will be replaced with the introduction of the electronic prescribing and this encourages and recommends more enhancement of CPTs to take part in more clinical roles. Also, there is a big potential for a specialist CPTs such as anticoagulation CPTs as an advanced new scope of practice currently suggested within NHS England. Knowledge, training and qualifications required together with impact of the expanded role on the patient safety and outcomes could be a further future work. Moreover, the registration of pharmacy technicians working within Northern Ireland with a regulatory body such as the Pharmaceutical Society of Northern Ireland may impact the development of the clinical pharmacy workforce, measurement and analysis of this impact could be a further work.

In addition, electronic/technical solutions to workload allocation such as electronic whiteboards allocating prioritised tasks to individuals depending on their competencies could facilitate ensuring that the right grade complete the right task. Digital solutions providing real time data with regards to discharges/admissions which is readily accessible Trust wide could also facilitate working practices. The supported electronic /technical solutions for clinical pharmacy services could be researched further to measure the clinical and cost impact on the delivered clinical pharmacy services.

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Appendices

Appendices

- **Appendix A:** Project data collection forms

- **Appendix B**: Ethical approval and NHSCT honorary research contract

- **Appendix C**: MedRec NHSCT SOPs And discharge procedure summery

- **Appendix D**: NHSCT SOPs for prioritising patient for MedRec on admission (Traffic light referral)

- **Appendix E**: NHSCT SOPs for Prioritising of Clinical Pharmacy Services to a ward

- **Appendix F**: NHSCT Discharge process

- **Appendix G**: NHSCT PODs algorithm

Appendix A: Project data collection forms

Clinical pharmacy services and skill mix model

(Data collection forms)

Pharmacist / Technician

Antrim Area Hospital

Ward no.			Date :				Notes	
[redacted]			No. of Technicians / band				Completd by pharmay staff and researcher	
Total no. of Patients			No. of Newly admited patients					
Total no. of medications reconciled / day for all patient			Note					
No. of newly patients with high risk condi		PH Abn	Hemo	Elect Abn	ECG abn	Renal	Age	
		Liv	Chem/Radi	Immuosupp	A* resist	Resp	Others	
No. of patients with high risk medications			No. of high risk Mediactions					
No. Of specific activity In each ward with staff grade / day								
No.	Band 6	Band 7	Band 8			others		
Medicin Reconcilliation needed								
Patients need counseling								
No. of Discharges completed								
Medicin History interview								
Discussing Medication with staff								
Information/advice to HP								
Counselling done								
Training of junior staff								
MedRec completion								
Rx Screening/monitoring (Queries)								
No. of kardex reviewd (other than for admission or discharge								
Others								

	Ward no.			Date :			Complted by Pharmacy staff and researcher
	No. Of working pharmacists / Band			Tech/ band		Note	
	Total No of Patients						
	No. of patients with high risk medications		No. of high risk Medications				
	Time (min) of Staff Grade spent on specific activity / no. / day						
	Patient (HCN)	Medicin History interview	Med Reconciliation	Total No. of Medication	No. of high risk medications	others	Band
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
	Total						

	Ward no. Date :						Complted by Pharmacy staff and researcher
	Time (min) of Staff Grade spent on specific activity / no. / day ………… Continued						
	Patient (HCN)	Medicin History interview	Med Reconciliation	Total No. of Medication	No. of high risk medications	others	Band
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
	Total						

	Ward no.			Date :				Completed by pharmacy staff
	No. Of working pharmacists / Band				Tech/ band		Note	
	Total No of Patients							
	No. of patients with high risk medications			No. of high risk Medications				
	Time (min) of Staff Grade spent on specific activity / no. / day (discharge)							
	Patient (HCN)	Discharges	Admission date / age	No. of Mediaction for discharge	No. of high risk medications	Counseling (If needed)	Problem	Band
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
	Total							

	Ward no.			Date :				Completed by pharmacy staff
	Time (min) of Staff Grade spent on specific activity / no. / day (discharge) ……. Continued							
	Patient (HCN)	Discharges	Admission date / age	No. of Mediaction for discharge	No. of high risk medications	Counseling (If needed)	Problem	Band
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
	Total							

No. Of working pharmacists / Band	Tech/ band	Completed by Pharmacy staff and rsearcher
Total No of Patients	Total no. of medications	

Multidisplinary form

No. of patients with high risk medications	No. of high risk Medications

	Date	No.of medical Rec Completed within 24 Hrs	No. of Discharges before 1.00 Pm	No. of Discharges after 1.00 Pm	No. Of discharges not completed Before 05:00 Pm	Note
	Total					

	Ward no. Date :							Completed by pharmacy staff
	No. Of working pharmacists / Band			Tech/ band		Note		
	Total No of Patients							
	Different types of work / time							
	No. of patients with high risk medications		No. of high risk Mediactions					
	Date	time for the office based work /clinic/policies…etc	time for computer documentaion based wark	time of interactive based ward (patient, tech, health care …etc)	Total no. of medications for all Patients in the ward	No. of high risk medications	Medication history not confirmed by 5.00 pm	Medicine reconcilliation not started by 5.00 pm
	Total							

Ward no.			date		Completed by pharmacy staff								
No. Of working pharmacists / Band			Tech/ band										
Information Query 1 (pharmacist)							**Information Query 2 (pharmacist)**						
Time	**< 5min**	**05 - 10 min**	**10 - 15 min**	**15 - 20 min**	**> 20 min**	**Notes**	**Time**	**< 5min**	**05 - 10 min**	**10 - 15 min**	**15 - 20 min**	**> 20 min**	**Notes**
Receive Query							**Receive Query**						
Time taken To answer							**Time taken To answer**						
Information Source	**Off ward**	**Onward (Online)**	**Onward (BNF)**	**Guidelines**	**Others**		**Information Source**	**Off ward**	**Onward (Online)**	**Onward (BNF)**	**Guidelines**	**Others**	
Information Query 3 (pharmacist)							**Information Query 4 (pharmacist)**						
Time	**< 5min**	**05 - 10 min**	**10 - 15 min**	**15 - 20 min**	**> 20 min**	**Notes**	**Time**	**< 5min**	**05 - 10 min**	**10 - 15 min**	**15 - 20 min**	**> 20 min**	**Notes**
Receive Query							**Receive Query**						
Time taken To answer							**Time taken To answer**						
Information Source	**Off ward**	**Onward (Online)**	**Onward (BNF)**	**Guidelines**	**Others**		**Information Source**	**Off ward**	**Onward (Online)**	**Onward (BNF)**	**Guidelines**	**Others**	

Ward no.				Date :		Completed by pharmacy staff and researcher		Note (Tech band / ACPT)			
No. Of working pharmacists / Band			Tech/ band		Note						
Total No of Patients											
Technician Activities											
No. of patients with high risk medications			No. of high risk Mediactions								
Day											
Time	**No. Of Lockers Checked**	**No. Of Kardex Checked**	**No. of Lockers need Supply**	**No. of Patients Referred to Pharmacist**	**Types of referal to the pharmacist**	**No. of patients needs discharge**	**No . Of final check done**	**No. of Medicattions Labled/dispensed**	**No. of Assesed PODs**	**Addmission related Activities (e.g ECR)**	**Stock issues**
08:00 - 09:00											
09:00 - 10:00											
10:00 - 11:00											
11:00 - 12:00											
12:00 - 13:00											
13:00 - 14:00											
14:00 - 15:00											
15:00 - 16:00											
16:00 - 17:00											
17:00 - 18:00											
18:00 - 19:00											
Total											

Ward no.	date		
No. Of working pharmacists / Band	Tech/ band		

Information Query 1 (technician)							Information Query 2 (technician)						
Time	< 5min	05 - 10 min	10 - 15 min	15 - 20 min	> 20 min	Notes	Time	< 5min	05 - 10 min	10 - 15 min	15 - 20 min	> 20 min	Notes
Receive Query							Receive Query						
Time taken To answer							Time taken To answer						
Information Source	Off ward	Onward (Online)	Onward (BNF)	Guidelines	Others		Information Source	Off ward	Onward (Online)	Onward (BNF)	Guidelines	Others	

Information Query 3 (technician)							Information Query 4 (technician)						
Time	< 5min	05 - 10 min	10 - 15 min	15 - 20 min	> 20 min	Notes	Time	< 5min	05 - 10 min	10 - 15 min	15 - 20 min	> 20 min	Notes
Receive Query							Receive Query						
Time taken To answer							Time taken To answer						
Information Source	Off ward	Onward (Online)	Onward (BNF)	Guidelines	Others		Information Source	Off ward	Onward (Online)	Onward (BNF)	Guidelines	Others	

Medicines History Interview by qualified Pharmacy Technician							
		Date			Completed by		
atien	HCN	Time taken for interview (min)	No.of Medicines	Patient Priority	Ward	Notes	Does the pharmacist had to go back again to the patien for any missed information
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ACPT released for the FINAL CHECK								
Day	Ward	Time bleeped	Time required for	Accepted	Time started	Time completed	Time taken to complete final check (min)	Number of items

Appendix B: Ethical approval and NHSCT honorary research contract

Northern Health and Social Care Trust

PLEASE RETURN

Human Resources Department

20 January 2015

Mr Ahmed Abuelhana
C/o School of Pharmacy and Pharmaceutical Sciences
Room No Y144
Saad Building
University of Ulster
Cromore Road
Coeraine
BT52 1SA

Dear Mr Abuelhana

HONORARY APPOINTMENT

I am directed by the Trust to offer you a honorary contract within the Pharmacy Department to Research the study "Optimising the Skill Mix for Pharmacy departments in Secondary Care" effective from Monday 13 October 2014 to Thursday 13 October 2016. This appointment is subject to:-

(a) the provisions of the Health and Personal Social Services (Northern Ireland) Order 1972, and Regulations made thereunder;

(b) the terms and conditions of service appropriate to similar paid staff so far as they are applicable to honorary appointments;

(c) your conforming to any rules and instructions issued by the Trust or any authorised officer of any hospital or institution at which you may work;

(d) The Northern Health and Social Care Trust will provide full indemnity against any liability which may incur by reason of or arising out of such an appointment;

(e) The honorary appointment is subject to you confirming that your state of health is satisfactory and you must undertake to advise the Trust of any health issues which would impinge on your ability to carry out the appointment;

(f) In the course of your placement you will gather information about service users, their family members, friends, visitors and other members of staff. You have a legal duty to protect this information and you must not disclose it to anyone outside or inside

Human Resources Department, Holywell Hospital
60 Steeple Road, Antrim, BT41 2RJ
Tel No 028 9441 3221 Fax No 028 94413690

(g) the Trust unless you are authorised to do so and they are authorised to receive it. We will terminate your placement if you pass on information which you should not. If you are not sure whether to disclose information you must ask your manager in advance. If you pass on information you could be prosecuted under the Data Protection Act 1998.

During the period of your placement you are legally responsible for all records you hold, create or use as part of your work within the Trust. These include patient, client, corporate and administrative records, whether paper-based or electronic, including emails.
Members of the public and other organisations may apply for access to these records, and we will, in general, provide the information to such applicants. There are some exceptions which are detailed in the Freedom of Information Act 2000, the Environmental Information Regulations 2004 and the Data Protection Act 1998. You must not release any information without the prior agreement of your line manager. Where there is any doubt, advice must be sought from Trust headquarters.

You must make sure that information systems, (both manual and computer based), either under your control or which you are required to operate, have security arrangements in place to maintain and protect confidentiality of personal and other information. You must familiarise yourself with Trust policies and procedures on confidentiality;

(h) For appointments which involve substantial access to children and vulnerable adults the trust will carry out POCVA checks. Therefore, in these situations, this offer will be subject to satisfactory clearance.

(i) Ethical behaviour in relation to standards and values is expected of all staff/volunteers working in Health and Social Care;

(j) If you are involved in research in the course of your appointment, any research will be considered to be an asset owned by the Trust however if you are involved with collaborative projects (i.e. in partnership with another organization like University of Ulster or Queens University Belfast) the NHSCT Innovation Policy will apply.

(k) You must take reasonable care for the health and safety of yourselve and the other people you come in contact with and obey health and safety rule and procedures

If you agree to accept the honorary appointment on the terms specified above, please sign the form of acceptance at the bottom of this letter and return that copy (completed) to Human Resources Department.

Yours sincerely,

S Steele

A Director of Human Resources

I hereby accept the honorary appointment mentioned in this letter to me and agree to the terms and conditions above.

SIGNED:______________________________ DATE:_______________________

Human Resources Department, Holywell Hospital
60 Steeple Road, Antrim, BT41 2RJ
Tel No 028 9441 3221 Fax No 028 94413690

Gmail

Ahmed Abuelhana <abuelhanaahmed@gmail.com>

FW: project ethical approval FCBMS-15-039

2 messages

Burnett, Kathryn <k.burnett@ulster.ac.uk> Mon, Mar 23, 2015 at 11:35 AM
To: Ahmed Abuelhana <abuelhanaahmed@gmail.com>

FYI

Ulster University

Dr Kathryn Burnett

Senior Lecturer in Pharmacy Practice

School of Pharmacy and Pharmaceutical Sciences

Faculty of Life & Health Sciences

T: +44(0)28 7012 3283

E: k.burnett@ulster.ac.uk W: http://www.science.ulster.ac.uk/pharmacy/

From: Hunter, Pat
Sent: 19 March 2015 14:52
To: Burnett, Kathryn
Cc: Magee, Pamela
Subject: project ethical approval FCBMS-15-039

Project FCBMS-15-039

Dear Kathy,

Thank you for your project proposal application to the School of Biomedical Sciences Ethics Filter Committee (FCBMS) which has now been considered.

The committee has classified this project as service evaluation and therefore ethical review is not required.

Please provide a copy of R&D Trust approval once this is obtained.

Best Wishes,

Pamela

Pamela Magee PhD RNutr

Lecturer Human Nutrition

Northern Ireland Centre for Food and Health (NICHE)

School of Biomedical Sciences

T: 028 701 24360

E: pj.magee@ulster.ac.uk **W:** www.ulster.ac.uk/niche

Social:

NICHE 'at the core of nutrition research'

Burnett, Kathryn <k.burnett@ulster.ac.uk> Mon, Mar 23, 2015 at 11:39 AM
To: "mary.mcdonald@northerntrust.hscni.net" <mary.mcdonald@northerntrust.hscni.net>
Cc: Ahmed Abuelhana <abuelhanaahmed@gmail.com>

Dear Mary

Please find attached another project proposal which has been reviewed by the School Ethics Filter Committee and classed as service evaluation.

Please let us know if we may proceed with this project

Many thanks and kind regards

Kathy

[Quoted text hidden]
[Quoted text hidden]

2 attachments

Skill mix Project Proposal.docx
26K

RG1a.doc
96K

Appendix C: NHSCT MedRec SOPs And discharge procedure summary

NORTHERN TRUST PHARMACY DEPARTMENT
STANDARD OPERATING PROCEDURE

Title **GUIDE TO COMPLETING MEDICINES RECONCILIATION**				SOP Ref **CLIN/05/01/A3**
Prepared By (type) **Linden Ashfield**	Validated By (type) **Maire McManus**	Approved By (sign) (print)	Equality Screen Template Completed by Approver and Forwarded to Head of Pharmacy and Medicines Management ☐ Not Applicable ☐	Effective Date 1 December 2014 1st Review Date 30 November 2016
Hard Copy File Name (if appropriate)				
REVIEW RECORD (To be used only if **NO** text changes)				
Date				
Approved By				
New Revision Date				

Within the text the following SOPs are referred to. You should also be familiar with these SOPs.

Title	SOP Section/Year/Number	Hard Copy File name
Prioritisation of Med. Rec. Guidance on the use of NIECR Procedure for Epics Med Rec NHSCT		

Pharmacy Site – please communicate with the following site(s) if core elements of this SOP are changed

Antrim	✓	Mid- Ulster	✓	Whiteabbey	✓	Holywell	✓	Causeway	✓

Location

Updated versions of this SOP must be available in the following work section(s)

Administration		Community		Patient Services	
Administration Secretarial		Emergency Duty		Pharmacoeconomics	
Aseptic		IMM		QA	

Chemotherapy		MI		Red/Amber	
Clinical	✓	Palliative Care		Training	

Guide to Completing Medicines Reconciliation

The first part of the medicines reconciliation process involves obtaining an accurate and up to date medication history.

Purpose:

A medication history is a key task in clinical pharmacy. It will ensure an accurate and up-to-date list of medication is available. This will then enable an assessment to be made of whether the admission is related to prescribing errors, adverse drug reactions or to patients not taking their medicines appropriately.

The Northern Ireland Clinical Pharmacy Standard recommends that ‘a medication history is documented or verified by a pharmacist/trained accredited technician as soon as possible after admission to hospital, ideally within 24 hours.’

Principles:

Medication histories may be compiled by pharmacists, or technicians who have successfully completed the NICPLD Drug History Taking course.

The information gathered in completing a medication history can be used to:

- Resolve discrepancies and reconcile medicines on admission.
- Verify medication histories taken by other staff and provide additional information.
- Document allergies and adverse reactions.
- Screen for interactions.
- Screen for adverse effects.
- Assess patient medication adherence.
- Assess the rationale for prescribed medicines.
- Assess the evidence for drug abuse.
- Appraise drug administration techniques.
- Examine the need for medication aids.
- Document patient initiated medication.

The medication history interview enables the pharmacist or technician to:

- Establish a direct relationship with the patient and /or carer and explain their role in patient care.
- Understand the patient’s pharmaceutical care needs and desired outcome.
- Obtain medicine related information.
- Commence preliminary education and reinforce the principles of the quality use of medicines. (pharmacist only)

- Use the information obtained to form the basis of an ongoing pharmaceutical care plan. (pharmacist only)
- Assess the patient's current medication in light of the presenting condition and recommend alterations if necessary. (pharmacist only)

The Northern Trust procedure divides the process into sections:

1. Selecting patients for medication history
2. Sources of information
3. Information obtained prior to patient interview
4. The patient interview
5. Obtaining information from GP if NIECR unavailable or information not on NIECR.
6. Patient's own Drugs
7. Medicines Reconciliation.

1. Selecting Patients for medication history:

The pharmacist must use his/her **professional judgment** to identify those patients who would benefit most from an accurate medication history. The following may be used as a guide to selection:

The SOP 'Prioritisation of Medicines Reconciliation' provides further guidance on selection of patients.
Doctors, nurses or other healthcare professionals may also request a pharmacist medication history for a named patient.

2. Sources of Information:

The pharmacist should consider the appropriateness of all possible information sources. For the majority of patients admitted from their own home the first two sources listed will be appropriate. It may however be necessary to augment these with further sources such as 3 or 10.

1. Patient and/or carer interview (should always be one of the sources used where possible).
2. ECR GP Medications Form (see 'Guidance on the use of NIECR').
3. Contact with GP practice (if NIECR unavailable or for further information).
4. Patients own drugs.
5. Medical notes admission history.
6. Admission notes from ED or GP.
7. Admission kardex.

8. Care Home prescription kardex. (document contact number)
9. Transfer documentation from other hospitals eg. Belfast Trust Cardiac Catheterization labs. (This may provide information on medication changes following investigation or procedures.)
10. Previous recent admission/discharge documentation (available in NIECR)
11. Outpatient/clinic letters (available in NIECR)
12. Community pharmacist if used at least 75% time.
13. Nursing notes. (patients weight should be documented in nursing notes)

! Remember to check the dates, DOB, name and address details on all documentation used.

3. Information obtained prior to patient interview:

The pharmacist should establish:

Information:	From:
The location of the patient.	Ward bed plan
Correct identification & correlation of the patient and sources of information.	Compare name, address, date of birth and HCN.
Social circumstances i.e. living alone, with family or carer. Who is main carer?	Nursing staff, Medical notes
If it is appropriate to interview patient	Nursing staff
Contact numbers for carers if inappropriate to interview patient. NB: Carer may be available at visiting time.	Nursing notes
Does the patient have hearing or sight difficulties, mental health problems or language barrier?	Medical notes, Nursing notes.
If there has been any history of drug or alcohol abuse/misuse. Check smoking status.	Medical notes, Nursing notes.
Diagnosis & if patient is aware of their diagnosis& treatment plan.	Medical notes Nursing notes

Copy of GP meds form	NIECR

The pharmacist should ensure confidentiality of patient information at all times.

4. Patient Interview:

The nature of the medication history interview will depend on the individual patient. Questions must be relevant to the specific patient and tailored to obtain the necessary information.
Refer to the Northern Trust Policy 'Accessing the Trust's Interpreting Services'

Environment	Ensure as much privacy as possible; pull curtains around bed space if you feel this is necessary but consider situations when this may not be appropriate. Comply with individual ward policy regarding interviewing patients at mealtimes.
Introduction	Speak clearly & note any hearing aids required by the patient. Introduce yourself. Explain your occupation & the purpose of the interview. Ask if it is an appropriate time to speak to them. Respect the patient's wishes if they decline the interview.
Social circumstances	Confirm with patient if they take their medicines unassisted or if a family member and/or carer assist. If the patient is not involved in the administration and management of their medicines ask for their permission to speak with the relevant person(s). Document this clearly on the EPICS med rec form.
Question style	Use open questions to obtain maximum information from the patient.
Medicines taken prior to admission*	Ask the patient to recall *the name, strength, form & dose* of medicines taken before admission to hospital. After each medicine, Ask *what do they take it for?* Ask *how often they take the medicine?* Ask *if the dose of the medicine has been changed recently?* Ask *how long they have been taking it for?* Ask *if there are any medicines that they have stopped recently?*

Types of medicines	Prompt the patient to recall **all** their medicines & supplements: • Medicines they obtain by prescription • Medicines they buy. • Herbal/ homeopathic/ Chinese remedies. • Vitamins/supplements • Medicines supplied from hospital (red /amber drugs). • Medicines administered in hospital eg ibandronic acid, denosumab. • A medicine other than oral forms i.e. enemas, sprays. • Oxygen therapy - including flow rates and mode of administration cylinders/ concentrator.
Illicit substances/ drugs of abuse	If appropriate and relevant ask about illicit substances or drugs of abuse they may be taking.
Allergy status or sensitivity	Ask *if they have ever experienced an 'unexpected' reaction/ allergy to any medicines? What was the name of the medicine?* Ask *what the nature and severity of the reaction was?* When did the reaction occur?
Vaccinations	Ask *if they have had any recent vaccinations?*
Adherence	Ask *if they have any problems taking any of their medicines? Examples: swallowing, opening containers or reading labels?* Ask *if they ever miss a dose, how often and what action is taken? Do they do anything to help them remember?* Ask *if they ever need to take more than the prescribed dose, how often does this happen & why?* Ask *if there are any medicines they have decided not to take & why?* Ask *if they have experienced any side effects with their medicines? Do they have any concerns about side effects?* *Ask what way do they get their medicines dispensed when not in hospital? (look out for* ***MDS*** *or* ***Repeat Dispensing****)*
Patients own drugs (PODs)	Ask *if the patient has any of his or her own medicines in hospital?* If **yes**. Ensure these have been located and assessed if appropriate. If **no**. Ask if they have sufficient quantities of each medicine at home and record 'PODs at home' in comments section of EPICS med rec form.
Community pharmacist	Ask *if the patient uses the same community pharmacy at least 75% of the time and if they have any objection to you contacting them if required*. Document name and contact number for pharmacy as this may be used as an additional

	source of information either at admission or when discharging the patient.
Questions	Ask *if the patient has any questions or anything else they would like to add.*

Always remember that it is the patient's right to make their own decisions about their medicines. As part of the medication history taking, the pharmacist can identify issues related to medicine taking and develop ideas with the patient to help address these issues.

4.1 Additional Information:

With regards to some medication it is advantageous to obtain additional information.

Eg. Warfarin. As well as obtaining usual dose record, ask who takes blood samples for INR and how often their INR is checked.

Parkinsonian medication: Actual times doses are administered should be recorded.

4.2 Monitored Dosage Systems (MDS)

When a patient has their medication dispensed in an MDS the pharmacist providing the system should be contacted to make them aware the patient is in hospital (having previously obtained consent from the patient). Document what day the MDS is normally replaced and if the pharmacy has any prepared in advance. In the EPICS med rec programme the comments section for each medicine provided in the MDS should be annotated as 'dispensed in MDS'. The pharmacist details should also be recorded.

If an accredited technician has completed the medication history all information relating to the medication history should be recorded on the EPICS Med Rec programme (see SOP 'Procedure for EPICS Med Rec NHSCT').

5. Obtaining information from GP if NIECR unavailable or information not on NIECR.

Risk management: *If GP Medication Form via NIECR is not available for any reason best practice for obtaining a GP medication history would include email or a faxed copy of the medicines list. If the practice cannot supply an email or a faxed list within a reasonable time, a verbal history is acceptable but additional checks should be carried out as detailed.*

Identify the GP from addressograph in the *correct* patient's medical notes and obtain the telephone number or email address.

<u>Email Medication History</u>
The practice should be contacted by telephone to ensure this method of transfer is still available before proceeding as below:

Use the pharmacy email account: *medication.history@northerntrust.hscni.net*

User name: medication.history password: mhistory
This uses a standard template to request repeat & acute medicines over the previous 6 months, allergies & vaccination status.
The email addresses for practices providing this service will be included in the account address book.
Enter 'medication history request', 'name of your ward' & 'patient name' on the subject line for the email, this will allow replies to be identified.
Enter the patient name, DOB, address.
Enter your name, ward, bleep number & correct fax number for the ward

<u>Telephone request for fax</u>

1. Telephone the practice and ask to speak to the appropriate receptionist.

2. Explain who you are, your occupation, what ward you are working on and the purpose of the request for information. The practice may wish to return the call to the pharmacist in order to verify identity before passing on patient information. Take a contact name for the receptionist.

3. Provide the practice with full patient details to confirm their identity:
   a. Name
   b. Address
   c. Date of Birth
   d. HCN

4. Ask if the practice is able to provide the information by phone &/or by fax within 1 hour in order to complete the admission kardex as quickly as possible.

5. Request information on:
   a. Allergy status
   b. All repeat drugs in the last 6 months.
   c. All acute drugs in the last 6 months.

   d. Vaccinations

   Specify that all medicines should be included (creams, appliances, prn's, eye drops)

6. For each item, request:
    a. Name
    b. Strength
    c. Form
    d. Dose
    e. Directions for use
    f. Quantity issued
    g. Date of last issue
    h. Any additional information.

7. Provide the practice with the fax number to send the information to, ask the practice to repeat this number back to you. Ensure that the fax machine is not in a public area and does not compromise confidentiality of the information.

8. Thank the practice for their help.

If the fax/email has not been received within the agreed time, contact the practice again to ensure that it has not been sent to the wrong number. The practice may request that you confirm receipt of the fax.

! Ensure that the fax/email received is for the correct patient before proceeding.

Some practices may direct the request for information to the GP in the first instance, after speaking to the GP, ask if the receptionist can follow up with a faxed list.

Telephone information

If information is provided verbally by telephone, listen carefully to the information being given. If necessary, ask the GP/receptionist to speak slowly or spell the name of medicines.
Always read back information given by the GP/receptionist and repeat back abbreviations such as TID as ‘three times a day’ to clarify.

6. Patient’s Own Drugs

Refer to the procedure for review of patient’s own drugs in the One Stop Dispensing Policy and ensure they have been assessed (if appropriate) by the pharmacy technician. Record as ‘PODs in hospital’ for each medicine.

7. Medicines Reconciliation

When you are confident an accurate list of medicines has been obtained the next part of the process can begin. This part must be undertaken by a pharmacist.

On the Right hand side of the NIECR GP Medications form there are three columns cont. / hold/ stop

Review each medication and decide if it is appropriate to continue on admission in light of the patients past medical history, current presentation, investigations and laboratory findings to date.

The pharmacist should then compare the form with the medicine kardex and investigate any medication not reconciled and have any inaccuracies corrected either by a Doctor or an Independent Prescribing Pharmacist.

When reconciling always be mindful of INTENTIONAL versus UN-INTENTIONAL changes to medications.

COMMUNICATION – clarification should be sought from medical staff when there is no documented reason that a medicine has been intentionally ‘stopped/held’. The reason must then be documented on the form to aid reconciliation of these medicines throughout patient journey and at discharge

If the medication has been continued (at the same dose, frequency and strength) on the medication kardex and this is appropriate tick the ‘cont.’ column.

If a medication has been held appropriately eg. Because patient is admitted with AKI, enter a tick in the ‘Hold’ column and record reason.

If a medication has been stopped appropriately enter a tick in the ‘Stop’ column and record reason. (Reason should have been documented in medical notes)

Two other options not documented on the ECR GP medication form are:

- ‘dose altered’ – this should be recorded as ↑ dose or ↓dose with a reason.

- ‘not needed in hospital’ – these are medications that the patient has been prescribed but only takes occasionally if required eg. Many nursing home ‘prn’s’, medicines for erectile dysfunction.

Don’t forget to check that allergy status has been documented correctly on the medicine kardex.

7.1 VTE prophylaxis

Ensure that a Venous Thromboembolism risk assessment has been completed and enoxaparin has been prescribed/ omitted appropriately.

7.2 Completion of process:

When all medication is reconciled transfer the information onto the EPICS med rec programme as outlined in the ‘Procedure for EPICS med rec NHSCT’. The information documented will be subsequently used as the basis for discharge so it is important that all relevant information is recorded. This will assist the pharmacist generating the discharge and minimize delays searching for information required.

Print the Admission Medicines Reconciliation form and file in the medical notes (at beginning of patient’s current admission) along with the ECR GP medication form.

To complete the process document in the patient notes that Medicines Reconciliation has been completed.

TRUST PROTOCOL FOR CLINICAL PHARMACIST TO PREPARE AND AUTHORISE IMMEDIATE DISCHARGE SUMMARY, PHARMACY MEDICATIONS, FOR GENERAL PRACTITIONERS

OBJECTIVE:-

To enable Clinical Pharmacists to transcribe accurately discharge medications from the patient's medicines Kardex onto a computerised medication record (immediate discharge, pharmacy medications section) and provide details of changes to medicines during hospital stay.

PERSONNEL INVOLVED:-

Clinical Pharmacists working in NHSCT who have the clinical knowledge and expertise to perform the task competently and who have been trained and assessed by the Teacher Practitioner (TP) Pharmacist or person authorised to act on their behalf. The Pharmacists must have been given a copy of the protocol and have signed to confirm that the protocol has been read and understood. The TP pharmacist must keep an up to date list of Clinical Pharmacists who have been authorised to perform this task and provide a copy to the Deputy Head of Pharmacy and Medicines Management – clinical services. A copy of the protocol must be available on each ward where the service is being provided.

The Clinical Pharmacist will be authorised to transcribe and sign for all Prescription Only Medicines (POM), Pharmacy (P) and General Sales List (GSL) Medicines with the exception of the following:

Controlled Drugs (CDs) - a separate CD prescription must be completed and signed by a doctor or an Independent Prescriber (IP) where a supply of a CD is required.

CRITERIA FOR COMPLETION OF DISCHARGE MEDICATION RECORD BY CLINICAL PHARMACISTS:-

(1) The Clinical Pharmacist has been trained to generate computerized medication records (immediate discharge summary, pharmacy medications section) and has been approved by the TP Pharmacist (or other nominated trainer).
(2) The Clinical Pharmacist has sufficient clinical knowledge to assess discharge medicines.
(3) The Clinical Pharmacist must have direct access to Patient's Medical Notes.
(4) The Clinical Pharmacist must understand confidentiality of Patient Information.
(5) All Clinical Pharmacists must have been given a copy of the protocol and have read, understood and signed it.
(6) Clinical Pharmacists will only prepare prospective discharge medication records.
(7) All medicines on the immediate discharge summary, pharmacy medications section, **must** be prescribed on the Kardex and signed by a Doctor or non-medical prescriber.

(8) The pharmacist should attach the printed immediate discharge summary, pharmacy medications section to the section of the immediate discharge summary completed by a doctor. The Clinical Pharmacist must sign and date the pharmacy medications section.

(9) The Clinical Pharmacist must ensure that all copies of the Immediate Discharge Summary are sent to the one stop dispensing room or pharmacy.

All Clinical Pharmacists’ immediate discharge summary transcriptions will be checked by a trained member of the pharmacy team. (11)

SCOPE OF INFORMATION TO BE INCLUDED IN THE DISCHARGE MEDICATION RECORD:-

The Clinical Pharmacist will perform a professional check for the following:-

(1) significant drug interactions
(2) duplication of pharmacologically similar drugs
(3) possible drug/disease incompatibilities e.g. renal, hepatic
(4) patient allergies/sensitivities
(5) review of medicine changes
(6) review of route of administration eg nebule → inhaler switches
removal of ‘prn’ medications not currently needed by patient ie antipyretic, antiemetic, analgesic or laxative medication that have not been required by the patient within the last 48 hours (7)
removal of night sedation if for hospital use only (8)
removal of hospital only injectable medication (9)
identification of patient group exceptions to the Trust 21-28 day Dispensing Policy eg overdose patients (10)
Red/Amber medicines (11)
Oral cytotoxic medicines (12)
Controlled Drugs. (13)

The Clinical Pharmacist will ensure the following relevant information is given:-

(1) the correct patient identification details and details of allergy/sensitivity status
(2) the correct drug, formulation and device if appropriate
(3) the correct strength/dose of medicine
(4) the frequency of administration and where applicable, appropriate timing of doses,
(5) route of administration
(6) appropriate generic/brand name
(7) details of products switches as per the Trust Product Standardisation policy
(8) appropriate pack size/presentation
(9) appropriate flavouring e.g. nutritional products
(10) administration details
(11) duration of treatment and where applicable, patient group exceptions to the Trust 21-28 day Dispensing Policy
(12) details of changes to medicines during hospital stay and advice on further monitoring if appropriate
(13) additional discharge documentation is completed if applicable, eg additional kardex for hospital diversion teams

(14) details of medication counselling provided to the patient by the pharmacist/technician
(15) appropriate details for reducing courses of medicines
(16) any further special supply arrangements
(17) home oxygen
(18) relevant laboratory results related to medicine changes/monitoring or medicines

MANAGEMENT OF THE PROTOCOL:-

(i) Deputy Head of Pharmacy and Medicines Management – clinical services
(ii) Medicines Governance Committee

OUTCOME OF THE PROTOCOL:-

(i) Accuracy of immediate discharge summary
(ii) GP satisfaction through the provision of detailed information (as per GAIN guidelines June 2011)
(iii) Patient satisfaction as the discharge process should be timelier
(iv) Release of Junior Doctor's time

TRAINING PROGRAMME:-

Initial accreditation:-

There must be a verbal and written programme followed by a supervised period of application in practice. Assessment of understanding of the protocol will be by practical and written assessment.

Reaccreditation:-

All trained pharmacists will be subject to reaccreditation every two years and on-going peer review. Earlier reaccreditation will be arranged at the request of either the clinical pharmacist, their Line Manager or if there has been a period of six months or more during which the clinical pharmacist has not generated an immediate discharge summary pharmacy medication record.

AUDIT:-

A random sample of peer reviewed discharge letters prepared by the Clinical Pharmacists will be audited at least every two years.

Review Date:	The Protocol must be reviewed every two years
Reviewed by:	Medicines Governance Committee

Chairman: **(Medicines Governance Committee)**	**Signature:** ____________________ **Date:** ____________________
Deputy Head of Pharmacy and Medicines Management – clinical services	**Signature:**_____________________ **Date:** ____________________
Medical Director	**Signature:** ____________________ **Date:** _____________________
Northern Prescribing Forum (Primary Care Representative)	**Signature:** ____________________ **Date:** _____________________
Clinical Pharmacist	**Signature:** ____________________ **Date:** ____________________

Appendix D: NHSCT SOPs for prioritising patient for MedRec on admission (Traffic light referral)

NHST (Antrim Area Hospital)

Title **PRIORITISING OF MEDICINES RECONCILIATION**				SOP Ref **CLIN/11/49**
Prepared By (type) **Linden Ashfield**	Validated By (type)	Approved By (sign) (print)	Equality Screen Template Completed by Approver and Forwarded to Head of Pharmacy and Medicines Management ☐ Not Applicable ☐	Effective Date **1st December 2014** 1st Review Date **30th November 2016**
Hard Copy File Name (if appropriate)				
REVIEW RECORD (To be used only if **NO** text changes)				
Date				
Approved By				
New Revision Date				

Within the text the following SOPs are referred to. You should also be familiar with

Title	SOP Section/Year/Number	Hard Copy File name
PRIORITISING OF CLINICAL PHARMACY SERVICES TO A WARD	**CLIN/11/48**	
GUIDE TO COMPLETING MEDICINES RECONCILIATION	**CLIN/05/01/A3**	

these SOPs.

Pharmacy Site – please communicate with the following site(s) if core elements of this SOP are changed

Antrim	✓	Mid- Ulster		Whiteabbey		Holywell		Causeway	✓

Location

Administration		Community		Patient Services	
Administration Secretarial		Emergency Duty		Pharmacoeconomics	
Aseptic		IMM		QA	
Chemotherapy		MI		Red/Amber	
Clinical	✓	Palliative Care		Training	

Updated versions of this SOP must be available in the following work section(s)

Prioritising of Medicines Reconciliation (Med Rec):

Objectives

1. To provide guidance to clinical pharmacists on prioritisation patients for medicines reconciliation.
2. To minimize the risk of medication errors at the admissions stage.
3. To optimise the provision of medicines reconciliation to the most appropriate patients.

Introduction:

Considering the high turnover of patients in hospital it is necessary to have some method of prioritising patients for medicines reconciliation.

The current target in NHSCT is that 95% of patients should have their medicines reconciled within 48 hours of admission to hospital. We would propose to screen the GP medication list available on the NIECR and categorise the medication reconciliation priority for the patient as high, medium and low depending on the medications the patient is taking. This is based upon the risk stratification originally used in the 'Integrated Medicines Management' project and also recent guidance from the NPSA 'Reducing harm from omitted and delayed medicines in hospital.' This is not an inflexible list. eg. a specific problem where patient safety is compromised may be identified which necessitates immediate action to resolve. This SOP should be used in conjunction with the SOP prioritisation of clinical services to a ward ie. a patient who is going to be discharged will require their Med. Rec. completed as a priority.

Procedure:

Prioritising patients for Med. Rec.

The following priority list is to be used as a guide to provide the safest and most efficient medicines reconciliation service in the time available to the pharmacist.
Once the list of medicines is obtained from NIECR it should be screened for any of the listed medicines. The patient's medical history may also provide valuable information eg. diabetic, transplant patient.

Patients should then have their medicines reconciled in sequence from red to green with red being the highest priority patient.

Prioritising Medicines for Med. Rec.

On occasions it may still not be possible to complete a full Med. Rec. for each patient on a high risk medicine within the allocated time. In this scenario the high risk medicines should be prioritised for reconciliation by the end of the working shift.

Scenario: You have 30 minutes to complete Med. Rec. for four patients all on high risk medicines.

Select the high risk medicines eg. insulin for each patient and make sure this is reconciled. The full Med. Rec. can then be completed the next day.

High priority (Red):

- Patients taking one or more of the following medicines
  - Anticholinesterases
  - Anticonvulsants
  - Antiparkinsonian medication
  - Antiplatelet (post MI or stroke)
  - Antiretrovirals
  - Clozapine
  - Corticosteroids
  - Insulin
  - Immunosuppressants
  - Opioids (prescribed regularly)
  - Oral anti-cancer medication
  - Oral cytotoxics
  - Oral antidiabetic drugs
  - Warfarin (or any other anticoagulant)

Medium priority (Amber):

- Patients taking 4 or more regular medicines

- Patients taking one or more of the following medicines.
  - ACEi / ARB antagonists
  - Antidepressants (including lithium)
  - Beta blockers
  - Digoxin

- Diuretics
- NSAIDs
- Potassium supplements

- Patients who have been readmitted to hospital within 6 months of previous discharge.

Lower priority (Green):

All other patients will then be in the lower risk category.

Appendix E: NHSCT SOPs for Prioritising of Clinical Pharmacy Services to a ward

Title **PRIORITISING OF CLINICAL PHARMACY SERVICES TO A WARD**				SOP Ref **CLIN/**
Prepared By (type) **Linden Ashfield**	Validated By (type)	Approved By (sign) (print)	Equality Screen Template Completed by Approver and Forwarded to Head of Pharmacy and Medicines Management ☐ Not Applicable ☐	Effective Date **1 January 2015** 1st Review Date **30 December 2016**
Hard Copy File Name (if appropriate)				
REVIEW RECORD (To be used only if **NO** text changes)				
Date				
Approved By				
New Revision Date				

Within the text the following SOPs are referred to. You should also be familiar with these SOPs.

Title	SOP Section/Year/Number	Hard Copy File name
'Prioritisation of Medicines Reconciliation'		

Pharmacy Site – please communicate with the following site(s) if core elements of this SOP are changed

Antrim	✓	Mid- Ulster		Whiteabbey		Holywell		Causeway	✓

Location

Updated versions of this SOP must be available in the following work section(s)

Administration		Community		Patient Services	
Administration Secretarial		Emergency Duty		Pharmacoeconomics	
Aseptic		IMM		QA	
Chemotherapy		MI		Red/Amber	
Clinical	✓	Palliative Care		Training	

Prioritising of Clinical Pharmacy Services to a ward

Objectives

4. To provide guidance to clinical pharmacists on prioritisation of clinical pharmacy services in a ward environment when clinical pharmacy resources are limited.
5. To minimize the risk of medication errors.
6. To optimise the provision of the clinical pharmacy service to a ward.

Procedure

The following priority list is to be used as a guide to provide the safest and most efficient clinical service in the time available to the pharmacist. Medication incidents have been shown to occur in greater frequency at interfaces of care hence discharge and admission are highlighted as high priority areas. This is a flexible list. eg. a problem where patient safety is compromised may be identified which necessitates immediate action to resolve. Also other unscheduled duties such as teaching students, Controlled drug checks or ad hoc audits may alter priorities.

On arrival to the ward the clinical pharmacist should first ascertain the number of new patients admitted since a pharmacist last visited the ward, the number of patients requiring medicine reconciliation and the number and expected time of discharge of patients that day. There should be ongoing discussion throughout the day between ward staff and the pharmacist regarding confirmed discharges.

Using this information and taking into account the time they have available to provide a clinical pharmacy service to the ward, the pharmacist should prioritize their work in the following order

1. Ensure all Immediate Discharge Summaries (part 2) are verified from the previous day discharges.

2. All confirmed discharges for that day should be completed. (This will include counselling the patient if required.)

3. Attend to any outstanding/new clinical queries or issues which require immediate follow-up or review. (This will include referrals from your pharmacy technician following their kardex review).

4. Medicines Reconciliation for all new and outstanding patients should be performed. The SOP 'Prioritisation of Medicines Reconciliation' should be consulted.

5. Attend to any outstanding clinical queries or issues which require follow-up or review.

6. All new medications identified on the clinical technician daily Kardex review are clinically checked, prioritising those patients on high risk medicines.

7. Patients should receive counselling on new or changed medication at all stages of their hospital stay. Priority should be given to patients commenced on high-risk medication e.g. NOACs, methotrexate.

8. All other inpatient drug kardexes should be monitored and reviewed as laid out in Standard 2 of the Northern Ireland Clinical Pharmacy Standards.

9. Where you are covering discharges for more than one ward discharges for both wards take priority over other activities on either ward.

Appendix F: NHSCT Discharge process

DISCHARGES

Date: ___________________ Hospital number: ___________________ Patient name: ___________________ Age / gender.

Person who requested: _____________________ __________ Time of request: _________________________ Ward: _____________

Proposed date of discharge: ______________

Was discharge completed as requested: Y/N If no, why ____

If not completed, was discharge delayed as a result next day: Y/N/NA

Did discharge prescription have to be amended from time it was written: Y/N

If yes, how ____

No. of items on discharge prescription: _____________ No. of discharges to be completed for current day: ________

	Date	Time (start & finish)	Who by
Clinical check			
Preparation on CIS System			
Dispensing			
Final check			

Patient discharged before 1pm ☐

Patient discharged before 1pm ☐

Appendix G: NHSCT PODs algorithm

POD ALGORITHM
(Patient's Own Drugs)

Northern Health and Social Care Trust