ESTABLISHMENT OF PHARMACEUTICAL SERVICES WITHIN THE EMERGENCY DEPARTMENT

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of the requirements for the award of

Doctorate in Pharmacy

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Dedicated to:

Tricia, Giuseppe, Petra, Sarah, Julia and Chiara.

May your paths in life take you to great heights and successes;

May you always remember how life without failure is not living;

And most of all, may you all find your true propose in life

to live in tranquillity, happiness and love.

ABSTRACT

The essential role of the pharmacist in Emergency Department has been documented to support the delivery of safe and effective medication use processes within this fast pace clinical setting governed by high decision density taken promptly for the critical patient. The aim of this study was to establish a holistic pharmaceutical service tailored to the need of the Adult ED at Mater Dei Hospital. Initially, observation of ED dynamics and completion of gap analysis exercise on the medication use process were conducted. Two validated questionnaires were completed in order to capture the perception of ED physicians and nurses on a proposed pharmaceutical service. Gold standard international guidelines were incorporated with findings from the gap analysis and questionnaires to delineate a blueprint for the service categorised into operational, clinical and other services. The pharmaceutical service started on March 2017 by one pharmacist operating within the department weekdays from 07.30 to 15.00. Operational services were primarily set up through management of ED centralised medication floor-stock. Non-automated medication cabinets were reorganised according to formulation and high alert drugs (60% of total drugs) were identified with generic labelling using *Tall-man-lettering*, aiming to increase safety by optimising the speed versus accuracy trade off. The need to update the Government Formulary List in order to add certain drugs for use within the ED and to remove others so as to decrease inadvertent risks of errors was recognised. Clinical services provided ranged from medicine information to participation in resuscitation cases. Cases were attended to according to their priority with over 300 inputs documented over a 3 month period. Other services involved compilation of departmental policies and pathways, review of MDH official antidotes list, delivery of pharmacology updates to nursing staff and participation in major national events. Through the active participation

of a pharmacist, essential pharmaceutical services of the Emergency Department have been established over a one year period. As part of the multidisciplinary team, the pharmacist can improve the safety and quality in the overall medication use process within a fast paced scenario such as the ED resulting in optimised patient care.

Keywords: Emergency medicine, pharmaceutical care, clinical pharmacy, pharmacist intervention, high alert medicines

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

Abbreviations

cpKPI: Clinical Pharmacy Key Performance Indicators

DDA: Dangerous Drug of Abuse

DPA: Directorate for Pharmaceutical Affairs

ED: Emergency Department Mater Dei Hospital

ESI: Emergency Severity Index

GFL: Government Formulary List

IV: Intravenous

MDH: Mater Dei Hospital

ORS: Order Requisition System

RRV: Rapid Response Vehicle

CHAPTER 1
INTRODUCTION

1.1. Emergency medicine

Emergency medicine and pharmacy practice in the ED are rather unique in that there is little knowledge about the patient on arrival. The ability to obtain a high quality history is more important than in any other area in healthcare set-ups. Such information is essential for effective ED management and will follow the patients' hospital visit, whether it leads to admission or discharge back to the community.

Emergency medicine resolves about taking care of a critically ill patient[1] who is presenting with an acute, life threatening medical condition or trauma, in an environment that is most often than not chaotic, with limited resources, staffing, task overload and fatigue and time constrains (Vincent, 1998). It is a speciality where patients from various clinical specialities are attended to in a timely manner within the same clinical area (McConnel, 2007). In the Emergency Department (ED), diagnosis is not the mere aim that a physician would arrive to, but rather the management of the critical health situation that a patient is presenting with. Patients are managed without a confirmed diagnosis. If a diagnosis is made, it is helpful but if not, decisions and actions are taken accordingly and treatment is given irrespective if a diagnosis is confirmed or not. This notion intensifies the requirement for pharmacists to be involved in usage of medications within such environment (Wears, 2001).

[1] West Melbourne, Australia. Definition of Emergency Medicine. Australasia College for Emergency Medicine. 1999.

The ED is epitomized by unpredictability, surges in potential chaotic activity, with variability in complexity of acutely ill patients. Treatment of patients can be challenging on its own merit. The treatment order and delivery involves five processes namely prescribing, transcribing or ordering, dispensing, administration and monitoring (Cohen, 2009). In ED, treatment tends to be verbally prescribed because of the urgent and high-stress situations since the dosing and administration decisions need to happen in a very timely manner for the high volume of patients (Paparella, 2004). Patients in the ED are not always given the undivided attention from the medical staff, as it is a common scenario that a healthcare professional is treating multiple patients simultaneously and is frequently interrupted (Chisholm, 2000). The variety of patients' backgrounds put under one roof, poses another challenge where in a typical ED scenario a multiple fracture trauma, palliative care patient, a multiple co-morbidity case, a geriatric patient and a social case with limited healthcare access (hence not a true emergency) are being taken care of simultaneously.

Another unique facet to emergency medicine is the need of empathy towards a patient who is acutely ill, in an unfamiliar environment and in the hands of an unknown doctor. At the ED, diagnosis and management of the patient without effective communication with the patient, without assuring them that they are being taken care of, delineating a plan and translating it to the patient and/or the accompanying relative results in the patient being unsatisfied and unnecessarily concerned.

These characteristics make the ED practice both unique and challenging. The myriad complex activities of ED in addition to overcrowding, lack of resource, high decision density, excessive cognitive load and flawed thinking in the decision-making process

predict vulnerability to a multitude of errors, inadvertently making the ED the ideal laboratory of error (Peth, 2003).

1.2. Medication errors in the ED

In 2001, approximately 2000 medication errors in the ED were reported in the United States Pharmacopeia's (USP's) MedMARx.[2] This same study compared the level of detection of these medication errors in in-patient setting ("at the patient's bed side") versus that in the ED setting. It highlighted the higher detection rate in the in-patient setting (39%) versus the ED (23%). There was a higher risk for medication errors in the ED versus the in-patient setting. The notion of medication errors in the ED within the healthcare setting has been known for over two decades, where as early as 1991, it was noted that the ED is the third most likely place for error following the operating room and the inpatient setting (Leape, 1991). In a more recent study comparing the reported adverse drug events errors occurring in inpatient setting versus the ED settings (reported to a national database) results showed that in the ED more than twice the medication errors resulted in harm versus the inpatient setting (Santell *et al*., 2004). A study carried out in 2005 in the US showed that 38% patients experienced and reported at least one concern relating to error (Burroughs, 2005). A medication error can occur along the way of the five stages of drug ordering and delivery in ED (Figure 1.1) which increases the complexity of potential errors within ED (Peth, 2003).

[2] Rockville, 2003. United States Pharmacopea news release. USP identifies leading medication errors in hospital emergency departments.

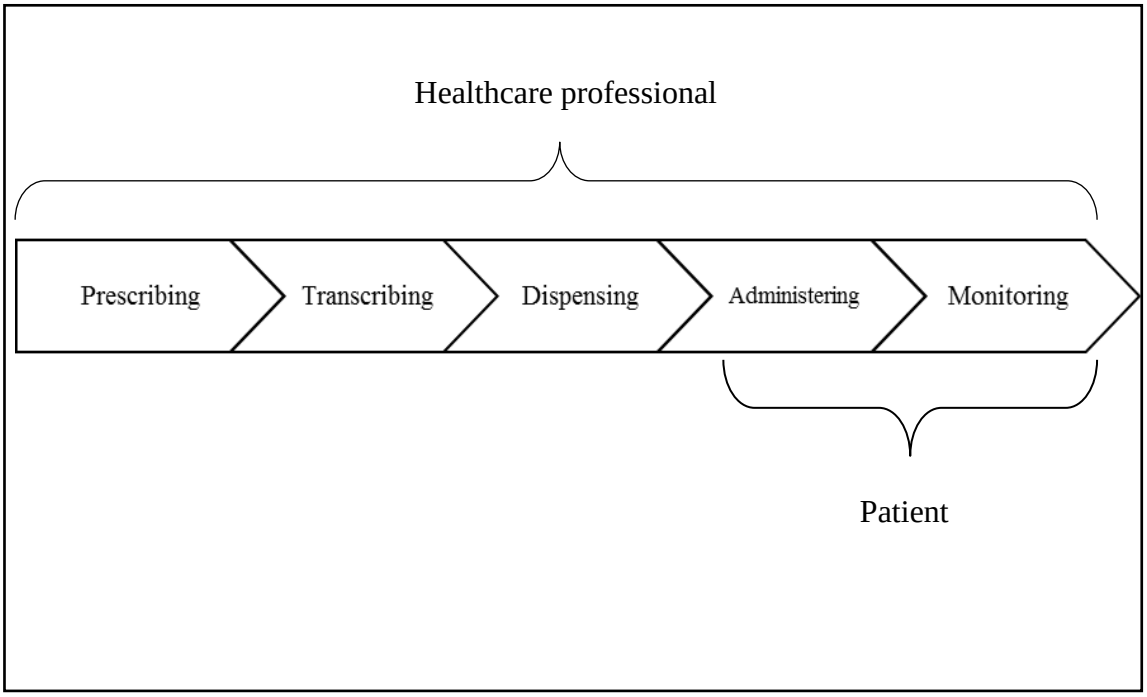

Figure 1.1 The order and delivery of medications in hospital setting including the emergency department

The five processes prior to treatment administration and the respective concerned individuals throughout the process. All the processes, which are undertaken directly or indirectly, may harm the patient who is the receiver of these processes. Any medication error at any stage can result to harm to the patient. In the ED, the five processes outlined tend to be merged increasing risk to patients

The high error rate can be attributed to three factors; namely 'first-time meeting' between patient and physician, verbal ordering of treatment and the choice of route of treatment such as parenteral drugs. The lack of physician-patient familiarity, where the physician is mostly unlikely to be familiar with the patient's past medical history, inaccessibility to the full and actual patient's medical record as well the current list of medications that the patient is on, including any known drug allergies, may play a role. Moreover, medications most of the time, are administered following a verbal order from the physician to nurse, which can be easily misunderstood. Medications are administered directly in an unpredictable and fast manner without prospective review of prescribed drug order. Furthermore, in practice once a patient leaves the ED, there is not a direct follow up of the patient thus allowing a window open for overlooking an adverse effect at ward level that would have resulted from interactions between medications prescribed in the ED (Heininger-Rothbucher, 2001). Another factor contributing to error is the nature of the drugs used in ED and the route of administration i.e. parenteral formulations administered intravenously via central line (Peth, 2003). The Institute for Safe Medication Practices (ISMP) classified three lists of High Alert Medications, where a high-risk medication is defined as an agent that has "a heightened risk" resulting in patient harm if used erroneously. One of the three High Alert Medications lists is dedicated to medications used in the Acute Care Setting[3] (such as adrenergic agonists and antagonists, antiarrhythmic and ionotropic agents). This highlights the extent of precaution needed when handling the intravenous drugs used in the ED.

[3] Institute for Safe Medication Practices. http://www.ismp.org/Tools/highalertmedications.pdf

Most of the errors might have serious outcomes but the majority are preventable (Croskerry and Sinclair, 2001). In 1999, in the report issued by the Institute of Medicine (IOM), *To Err is Human* it was reported that amongst the clinical environments studied, the ED has the highest rate of preventable adverse events (Brennan, 1991). At this stage, one must look into feasible ways to prevent cognitive errors such as by decreasing the cognitive load through shared decision and consultations about pharmacotherapy. The direct participation of pharmacists at the Emergency Department contributes to mitigation of the risk of medication errors.

1.3. The Pharmacist in the Emergency Department

The practice of hospital pharmacy over the years has expanded from medication dispensing towards direct patient care. This practice is now concerned with optimal evidence-based medication management, monitoring for adverse drug events, educating patients and caregivers on medication use, and collaborating with physicians and other health professionals in the management of acute and chronic diseases (Brushwood, 2001). Published literature shows how benefits of clinical pharmacy services vary from avoidance in drug cots, prevention of adverse events as well as reduction in hospital and emergency room visits as well as reduced lengths of stay (Anderson and Schumock, 2009). Literature shows how the inclusion of a pharmacist as part of the multidisciplinary team can also result in antimicrobial policy adherence with overall optimisation of antimicrobial use, pain and anticoagulation management, and the detection and control of hypertension (Carmichael and Cichowlas 2001).

The presence of the pharmacist in the ED has been in practice since 1970s in the United States of America (USA) where, since then, the involvement and key roles in ED have expanded drastically from dispensing to providing evidence-based medication management (Lada and Delgado, 2007). At the beginning of the 1970s, the main task of

pharmacists in the ED revolved around inventory and cost control, with the start-up of a pharmacy satellite that works 24 hours to ensure that the right medications are present at the right time in the needed quantities (Spigiel and Anderson, 1979). Published data on the clinical function of the pharmacist in the ED was first documented in 1976, with the main tasks being primarily management of drug therapy of the acutely ill patients, medication information on poisons, as well as research and education to healthcare professionals working in ED (Elenbaas, 1977). The pharmaceutical services in the ED continued evolving when the pharmacist was involved as drug order clarification, provision of drug information, and recommendations for alternative therapy. The roles expanded further when the pharmacists assumed increased responsibility for monitoring patient outcomes, supervising drug distribution services as well as management of drug costs and reductions in morbidity and mortality. The establishment of emergency medicine (EM)-based pharmacy services based on the concept of clinical pharmacy is still evolving where, until 2007, 1% of hospitals in the United States of America had a clinical ED pharmacist (Lada and Delgado 2007). A more recent study, a national survey conducted in the US in 2014, found that 16.4% (68 out of 414 hospitals) reported dedicated clinical pharmacists within the ED (Pederson, 2013).

The advancement of the pharmacist's involvement and role in the ED is not only because of the actual contribution to clinical decision making resulting better patient safety, but also because of proven cost reduction from less medication error and from cost effective analysis carried out. The benefits of outcomes when a pharmacist is part of the ED team was emphasised, notably from both the regulatory agency the Joint Commission (TJC) on medication reconciliation and prospective order review, and the Institute of Medicine

(IOM), which published a report that recognized the need for pharmacists as part of the ED team to improve safety[4].

At the time, the IOM pointed out the lack of pharmacists as part of interdisciplinary ED teams at most institutions. Assignment of clinical pharmacist to ED is not common, despite more than five decades of literature on the role of the pharmacist in ED. This role is still perceived as a new addition to the healthcare team and to the pharmacy world in general (Cohen, 2009). A survey carried out in the USA of academic healthcare facilities with ED residencies showed that only 30% had ED pharmacist service and 8% had 24/7 coverage (Szczesiul, 2009). Another study concluded how many institutions do not utilize their ED pharmacist resources to their full potential; namely in the provision of drug therapy recommendations, patient education and counselling and drug therapy cost effectiveness advice to physicians (Thomasset and Faris, 2003). This array of practice variations underlines that there is a significant opportunity and need to develop further the specialty of ED pharmacy, to increase the access of EM pharmacy services among a greater number of EDs, as well as set optimal standards of performance and excellence in practice (Rudis and Attwood, 2011).

The American College of Emergency Physicians[5] (ACEP), the largest professional organization of emergency medicine physicians, advocates the role of a pharmacist in the ED within a healthcare system. This organisation highlights how the pharmacist has a critical role to assure the safe, efficient and effective medication use in the ED. With these professional competences, the pharmacist can effectively function in a multidisciplinary team as a well-integrated member to actively participate in decisions on patient care, such

[4] Institute of Medicine. To Err is human: building a safer health-system. Washington, DC: National Academy press, 2001.
[5] ACEP. Policy Statements. Clinical Pharmacist Services in the Emergency Department, 2015.

as medication history taking, choice of agent for resuscitation, effective transition of care as well as optimisation of pharmacotherapy. ACEP supports the presence of pharmacist in the ED through a policy statement endorsed in 2015[5].

The development of a professional relationship with both the nurses and physicians is essential to ensure a successful ED clinical pharmacy service. This cooperation facilitates communication on patient's information by sharing clinical information. This increases the likelihood participation by the pharmacist as part of the team contributing towards efficient clinical pharmacy services (Cohen, 2009).

1.3.1. The contribution of the pharmacist in emergency department

The roles of the ED pharmacist are vast and differ from one setting to the other and may require adaptation from one set up to another. One of the roles that is most recognised includes medication reconciliation upon patient arrival. Studies show that diagnosis of various conditions has been estimated to be based 76% on history, 12% on physical examination, and 12% attributed to diagnostic ancillary studies (such as radiographic studies and laboratory data) (Thomasset and Faris, 2003). Apart from the fact that good medical history is time consuming for the physician and nurse, who have other primary roles to attend to, medications' issues are the realm of the pharmacist (Kent, 2009). Non-prescription medications and food supplements (including herbal medicines) tend to be over looked during history takin and their usage underestimated. Formal history in the ED can be limited (i.e. no existing medical record, consultation notes, or laboratory data), and tremendously time consuming in the absence of electronic records in place (Cohen 2009). The pharmacist can resort to other means and ways; example gaining access to the patient's electronic medication history, such as the Schedule V entitlements in the local scenario. Given that in Malta, patients are registered with a private community pharmacy for their chronic medications through the POYC scheme, the pharmacist can

communicate directly to the pharmacist at the community pharmacy to retrieve further information. In addition, certain situations typical of ED make medication history taking a true challenge, such as during CPR cases.

Medication reconciliation upon presentation to ED could highlight medicines-related issues that are then immediately resolved, such as adverse drug reactions (ADRs), which might have led to patient admission to A&E (Safdar, 2016). Identification of adverse drug reaction is another task which a pharmacist is competent to undertake following medical reconciliation. Active prevention of adverse medication events in the ED can also be done by prospecting screening the prescription or physician 'orders' through review of for correct dosing (dosage and rate), screening for drug interactions and contraindications (including allergies) prior to treatment administration (Rudis and Attwood, 2011). This is of most relevance for high-risk medication order review, since the ED is a clinical area condensed with use of such drugs administered via the parenteral route. Review of high alert medications, is a crucial responsibility that ED pharmacist should undertake. Moreover, certain medications are administered against a verbal order, which implies that the ED pharmacist must not only review the medications written on the patient's file but also be attentive and alert to review the medication once the physician verbally orders it.

Polypharmacy is a recent notion resulting from an increasingly ageing population with chronic conditions and comorbidities (Mahet *et al.*, 2014). This puts the role of the pharmacist in managing medicines in urgent care settings even more critical since no other healthcare professional has the necessary knowledge regarding pharmacokinetics and pharmacodynamics as does a pharmacist.

Medication reconciliation in ED should be considered upon patient discharge (Kwan, 2013). Treatment overview of chronic medication through effective communication with the patient and/or caregiver's patient-specific medication teaching should be provided. This becomes especially important if the patient is admitted to the ED due to an ADR or a drug interaction. This service can be varied from setting to setting and the information given has to be tailored to the individual depending on the situation of the patient. For example, for the polypharmacy cases, write up of the dosing regimens of all the medications would be of utmost benefit, whilst for the patient who had a new drug added to the treatment, the necessary prescriptions and any paperwork for new medication entitlement should be provided.

The pharmacist can facilitate the necessary paperwork medication for ordering from the pharmacy, medication approval by pointing out the necessary prescriptions, paperwork and signatures, which tend to be seen as a mundane task from the physicians' and nurses point of view; yet it is unavoidable. This is especially valuable upon the introduction of a new medication on local formulary or change in the brand of medication available at the hospital. Advice on the proper dilution and administration, and crucial pharmacology points (side effects, any cautions and monitoring parameters mode of action) would be discussed with the physicians and nurses (Cohen, 2009).

The ED pharmacist would watch out for latest trends and international guidelines as well as keep up to date with drug investigations and clinical research conducted internationally with active participation in inter-professional meetings, institutions, and seminars. The gaining of such information is necessary to ensure the continuous development services, resulting in procedures being in line with the latest up-to-date practices.

The tasks mentioned above are the most crucial roles that the ED pharmacist should undertake. The pharmacist must always adapt to the need in the specific hospital setting. The ACEP describes how the critical service cannot be homogenous in all hospitals based on the reality that hospitals are not identical and differ in level of care, size, and financial resources. Notwithstanding this, ACEP encourages the rotations for pharmacy students to include the ED clinical area and also supports research in the field of pharmacist's role in ED[5].

1.4. Advantages of pharmacists within the emergency department

The financial advantage brought along with pharmacist participation in avoidance of waste and cost savings in medication use in the ED has long been proven in the past two decades (McMullin, 1999). Practices that reduce errors include shared responsibility and accountability through team-work approach (Cohen, 2009). For example, cost avoidance has been demonstrated with the pharmacist as part of multidisciplinary team for patient education programs as part of emergency services (Schumock *et al.,* 2003). Another major advantage for the healthcare system is significant reductions in adverse drug events (ADEs) and length of stay. Over the years, this was tested and demonstrated in trials when pharmacists assume responsibility for pharmacotherapy as part of a multidisciplinary healthcare team (Kohn *et al.,* 2000). Traditionally, error reduction in medicine has focused on the responsibility of the individual health professional and less on the system (Schenkel, 2000). Safety experts agree that such a system is not only outmoded, but also is a counterproductive method of improving patient safety over time (McNutt, 2004). Studies nowadays suggest that a multidisciplinary systematic approach including the pharmacist, to the reduction of adverse events can create multiple layers of protection that greatly reduces the effect of hazards, before they reach the patient (Sanders *et al.,* 1993).

Other advantages include participation in the professional development and competency of clinical staff, functioning as an educational resource for pharmacy staff, assisting in the development, implementation, and evaluation of critical care and emergency medicine pharmacy residency programs (Cohen, 2009).

1.5. The setting

This study was carried out at Mater Dei Hospital (MDH), a public acute hospital within an emergency department that covers the geographical area of Malta and operates on a twenty-four hour basis. Both adult and paediatric emergency cases were seen under one roof until 2015 when subsequently paediatrics were moved to a new ED section dedicated solely for the paediatric (children up to the age of 15) emergency cases. Nowadays the ED within MDH consists of two departments; the Paediatric ED and the Adult ED. This study was set in the adult ED and for the scope of the write of up of this thesis; ED MDH implies the adult section of ED MDH.

The ED within MDH consists of the hospital perimeter i.e. the 'in-patient setting' and is also responsible for pre-hospital medical attendance including stand-by attendance on site of major national events. The department hospital setting is composed of:

- *The main Shop-Floor*

  Twenty-nine cubicles spread over three main areas (Area 1, Area 2 and Area 3 respectively) where patients are seen. The Clean Utility (where the majority of drugs are stored) is found in the middle of this area, together with a mini-theatre room, plaster room and phlebotomy room.

- *3 Resuscitation Rooms*

  The most critical cases (European Severity Index 1 cases) are attended to in this designated area. One these is fully equipped for paediatric resuscitation cases.

- *Triage room*

  An area where walk-in patients are triaged by an ED nurse.

- *Control Room*

  A designated ED nurse receives 112 calls and dispatches ambulances accordingly.

- *Ambulance Bay*

  An ambulance parking area, which is in close proximity to resuscitation rooms.

- *Minor Care Clinic (MCC)*

  This clinic is run by a general practitioner where ESI 4 and 5 cases are attended to.

1.6. Aim

The aim of this study was to establish a pharmaceutical service tailored to the need of Adult ED within MDH. The proposed service consisted of three categorical services, namely operational pharmaceutical services, clinical pharmaceutical services and other pharmaceutical services, which do not fall directly within either of the other mentioned sections and yet are part of an integrated pharmaceutical service (Figure 1.2).

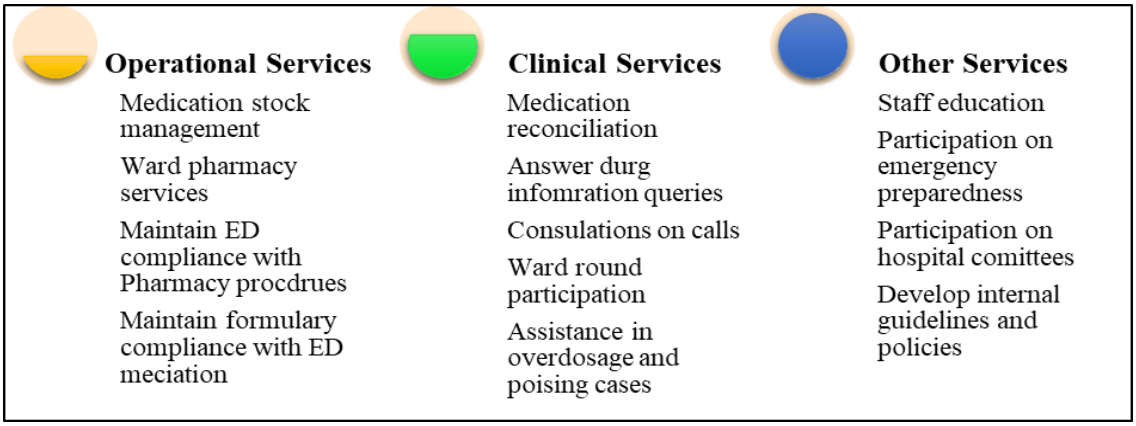

Figure 1.2 Categorical services comprising an integrated pharmaceutical service

These are the three categorical services comprising an integrated pharmaceutical service, which forms the basis of the development and implementation of pharmaceutical services at adult ED of MDH within this study.

CHAPTER 2

GENERAL METHODOLOGY

2.2. Study design

The study had three sequential phases namely the observation phase of the dynamics which govern the ED within Mater Dei Hospital. Subsequently the novel pharmaceutical service was designed and planned based on these observed dynamics. Finally, the service was implemented (Figure 2.1)

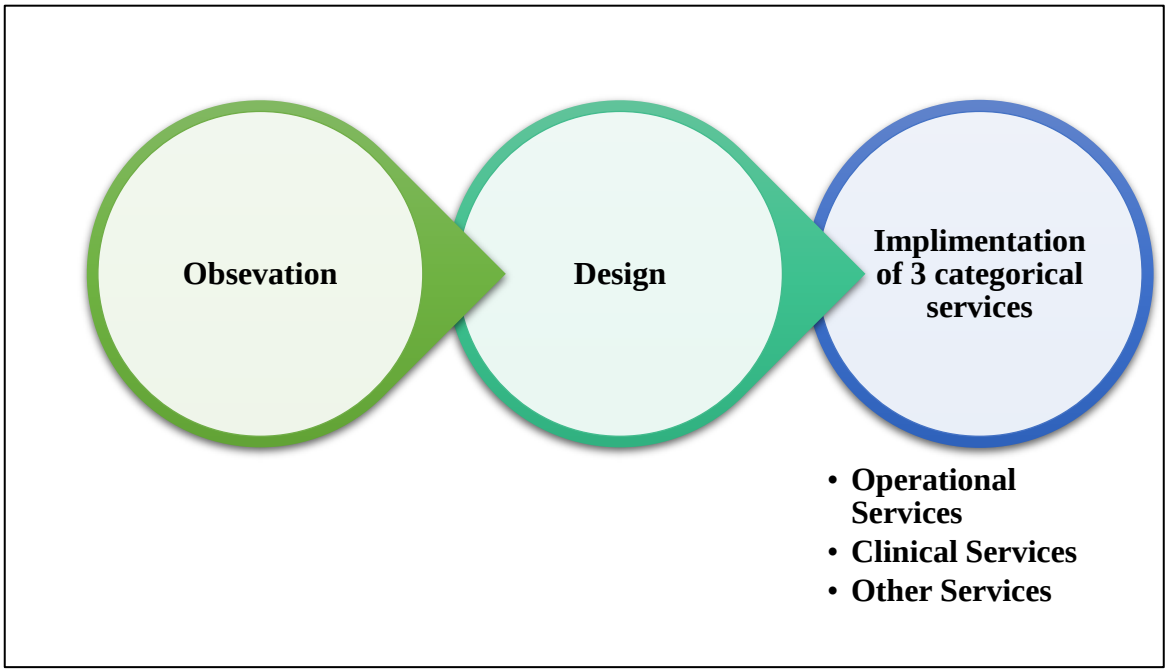

Figure 2.1: Overview of study design

Study design consisted of three sequential interlinking phases in order to ultimately establish an innovative pharmaceutical service designed specifically for the logistics within ED MDH.

This chapter describes the first two phases namely the observation of dynamics within ED MDH and overall design phase. Chapters 3, 4 and 5 detail how the three categorical services namely operational services, clinical services and other services were implemented respectively.

2.2 Observation and Design of Pharmaceutical Service

The initial stage was concerned with direct observation of the dynamics that ED MDH operated prior to the start of the study. Through this observation, the interventions of the pharmacist required to deliver the service were identified to outline the most adequate and holistic pharmaceutical service and to ensure a smooth implementation of practice within this setting.

2.3 Objectives

- to analyse the dynamics that govern the ED; the daily procedures and processes that operate within the ED
- to identify the perception of the ED healthcare professional team, namely ED physicians and ED nurses with respect to the expected roles of a pharmacist within their team
- to review international guidelines concerning the role of the pharmacist within ED

2.4 Methodology

Observation was carried out by the pharmacist researcher being present within the ED area for 75 hours over a span of 3 weeks. The in-patient and pre-hospital dynamics were closely observed as well as the medication management process. The necessary introductions to the management team were conducted with explanation of the study's aim.

Introduction and collaboration with the ED healthcare professional team was initiated during this observation phase. Expectations of a pharmacist's role at ED as expected by both teams of physicians and nurses were captured by means of two pre-service surveys namely one for physicians (Doctors Pre-Service Survey Appendix 1) and one for nurses

(Nurses Pre-Service Survey Appendix 2) created using Google Forms[6]. The survey for nurses consisted of drug logistical issues grouped in terms of clean utility and resuscitation room. The survey for the physicians tackled working hours and allocation of pharmacist within the area and focused on issues regarding the contribution (roles) and clinical input of the pharmacist within the ED. The nurses' survey was distributed to 87 ED nurses and the physicians' survey was distributed to 55 ED physicians. Both questionnaires consisted of Likert scale (1 poor – 5 excellent) and a few close ended questions (Yes- No). The surveys were sent via a link in attachment to an email through the work email domain. Responses were not obligatory. The latest guidelines (to date) issued by the American Society of Health-System Pharmacists (ASHP) on the role of the Emergency Medicine Pharmacist[7] and The Society of Hospital Pharmacists of Australia (SHPA) Standards of Practice in Emergency Medicine Pharmacy Practice[8] were referred to and served as blueprints for the roles of the ED pharmacist. These gold standards were adapted on the findings from the two surveys for outlining a service tailored to meet the needs of MDH ED (Figure 2.2). Job description proposals for an ED Pharmacist put forward by ED clinical chairpersons (both current and previous) and ED charge nurses were also taken into consideration. These findings and determined roles were then discussed with management teams from both Pharmacy and ED departments of MDH (Figure 2.3).

[6] Google Forms. https://www.google.ca/forms/about
[7] ASHP. Guidelines on Emergency Medicine Pharmacist Services. Available from http://www.ashp.org/doclibrary/bestpractices/specificgdlemergmed.aspx
[8] SHPA Standards of Practice in Emergency Medicine Pharmacy Practice. Available from https://www.shpa.org.au/resources/standards-of-practice-in-emergency-medicine-pharmacy-practice

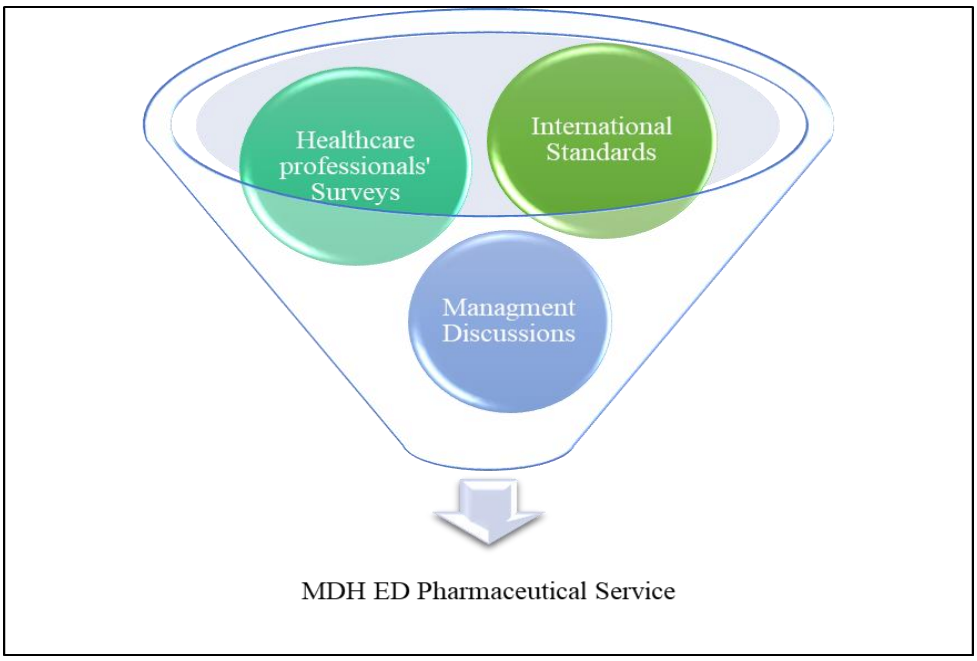

Figure 2.2 Establishment process of blueprint for ED Pharmaceutical service

Two surveys targeting ED physicians and nurses respectively were developed with the aim of capturing the interventions expected of the ED pharmacist. International guidelines were reviewed and used as blue prints to develop the preliminary job description and role of the ED pharmacist within MDH.

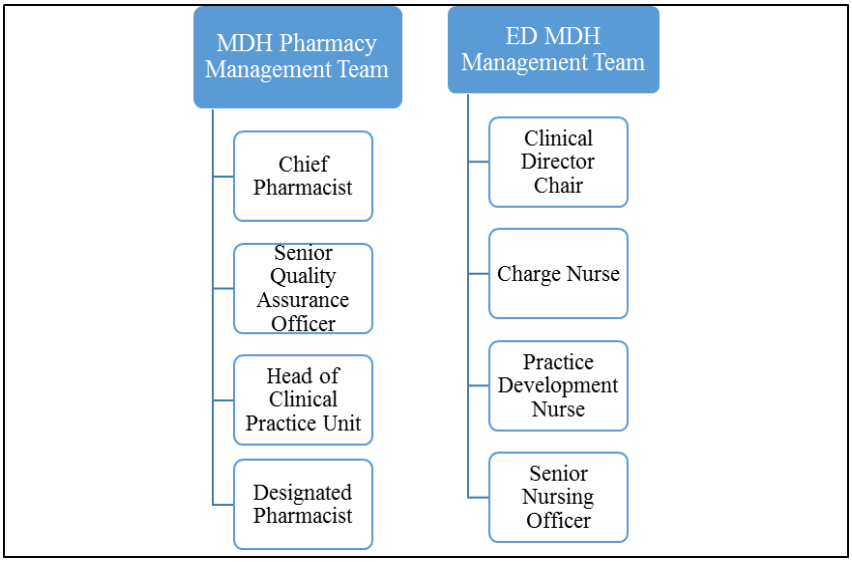

Figure 2.3 Stakeholders discussions to establish ED pharmacist role

Discussions with the MDH Pharmacy Management Team and the ED MDH Management Team were held in order to compile the final role of the ED pharmacist to offer the innovative pharmacy service within MDH.

2.5 Results

The results describe the dynamics of the local scenario at ED MDH i.e. logistics and operations with respect to the overall medication use process, the ED healthcare professional teams and their respective duties as well as the results obtained through the two Pre-Service Surveys (Appendix 1 and 2).

2.5.1 In- patient operational dynamics

Patients enter the ED either via ambulance stretcher or walk-in and register at the reception area. Upon arrival, patients are assessed by triage nurses, either in the triage room following registration if patient is a 'walk-in' or in Area 1 if the patient entered via ambulance) by a nurse upon arrival. Triage nurses, assess patients' acuity, assign an Emergency Severity Index[9] (ESI) level and patient is allocated within ED MDH accordingly (Table 2.1).

[9, 12] Gilboy N, Tanabe T, Travers D, Rosenau AM. Emergency Severity Index (ESI): A Triage Tool for Emergency Department Care, Version 4. Implementation Handbook 2012 Edition. AHRQ Publication No. 12-0014. Rockville, MD. Agency for Healthcare Research and Quality. November 2011.[Internet] Available from: https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/esi/esihandbk.pdf

Table 2.1 Patient allocation following triage

ESI Level	ESI Patient Description	Patient allocated at ED
ESI 1 (Most urgent)	Immediate life-saving intervention required or is unresponsive	Resuscitation room (one of 3)
ESI 2	High alert situation or confused/lethargic/disoriented or severe pain (>7 on pain score)/ distressed	Case passed to Lead Nurse who allocates patient to a medical team in one of the 3 main areas in the in-patient setting
ESI 3	(Patient neither of the above) requires many resources such as labs, CT/MRI, IV fluids, etc.	First assigned to SFMC, then to a team on shop-floor
ESI 4	(Patient neither of the above) requires one resource such as labs, CT/MRI, IV fluids, etc.	MCC and patient attended to by a general practitioner
ESI 5 (Least urgent)	No resources are required	

The ESI triage system[12] for categorising and assessment of patients' urgency and which determines the patient's allocation within ED is used locally.

The staff at the ED are allocated in four teams (Team A-D) covering the three shop-floor areas. Teams A and B cover area 1, team C covers area 2 and team D covers area 3 respectively. This allocation takes place daily according to the number of staff on duty. Each team consist of nurses and physicians, which fall under the direct responsibility of the Lead Nurse and the Lead Consultant.

2.5.2 Pre-hospital dynamics

ED MDH is also responsible for the pre-hospital section of emergency medicine, where ambulances are dispatched following 112 call intakes. This section of ED is governed by principles of co-ordination between MDH, Emergency Ambulance Respondents (EAR) and Primary Health Care.

A senior nurse assigned to the Control Room receives 112 calls, asses the severity of the case and co-ordinates the team that goes on site according to dispatch codes where a Red code requires one EAR, one nurse and one Primary Health Care physician, an Orange code requires an EAR and one nurse and a Blue code requires only one EAR. Two lead consultants are on call 24/7 to attend on site of fatal accidents. This procedure is referred to as Rapid Respond Vehicle (RRV) under the responsibility of the two lead consultants who are notified by the control room nurse to go on-site of the accident.

2.5.3 The healthcare professional team

During the study, ED MDH medical team consisted of 80 physicians grouped into 5 shifts each composed of Basic Specialist Trainees, Higher Specialist Trainees and Resident Specialists, overseen by 7 Consultants (2 of whom are responsible of the RRV service) under the leadership of one clinical chairperson . The team of nurses is composed of 87 nurses grouped on four main shifts, each shift under the responsibility of one deputy nurse and a practice development nurse who are all under the management of one charge nurse. An in-house phlebotomist is available during the peak hours. A physiotherapist is available three times a week.

2.5.4 Medications Management Process in the Emergency Department

A non-automated dispensing medicinal system following a decentralised medication storage process is in place at ED MDH, where all medications used within ED are kept in a designated room, referred to as the clean utility. This serves as the main medication

storage room in the ED, which also includes the dangerous drugs of abuse (DDA), stored in designated lockable cabinet, fridge items stored in the designated medical graded fridge and blood products. This serves as a store for the medications stored in medicinal cabinets of the three resuscitation rooms and the drugs used for prehospital. Each resuscitation room has a medicinal cabinet for storage of medicines. The frequently prescribed medications at the ED (referred to as Weekly Order List) are ordered electronically (via the online request system ORS) on a weekly basis (termed as scheduled order) which is the responsibility of the Charge nurse. Any extra orders are done urgently (termed urgent orders) according to demand (Figure 2.4).

Issues arise when there is an urgent need for drugs that have prescribing restrictions or are regulated by a protocol and therefore are not readily available on the ORS. Protocols and order books have to be filled in manually and signed by an ED physician. Moreover, in certain critical cases such bureaucratic processes for medication procurement can be a waste of time. The ED also contains a Chemical, biological, radiological and nuclear (CBRN) cabinet where antidotes are stored. Major incident stand-by stock is stored in MDH Pharmacy Store, which is under the supervision of a designated pharmacy technician who is responsible for stock rotation.

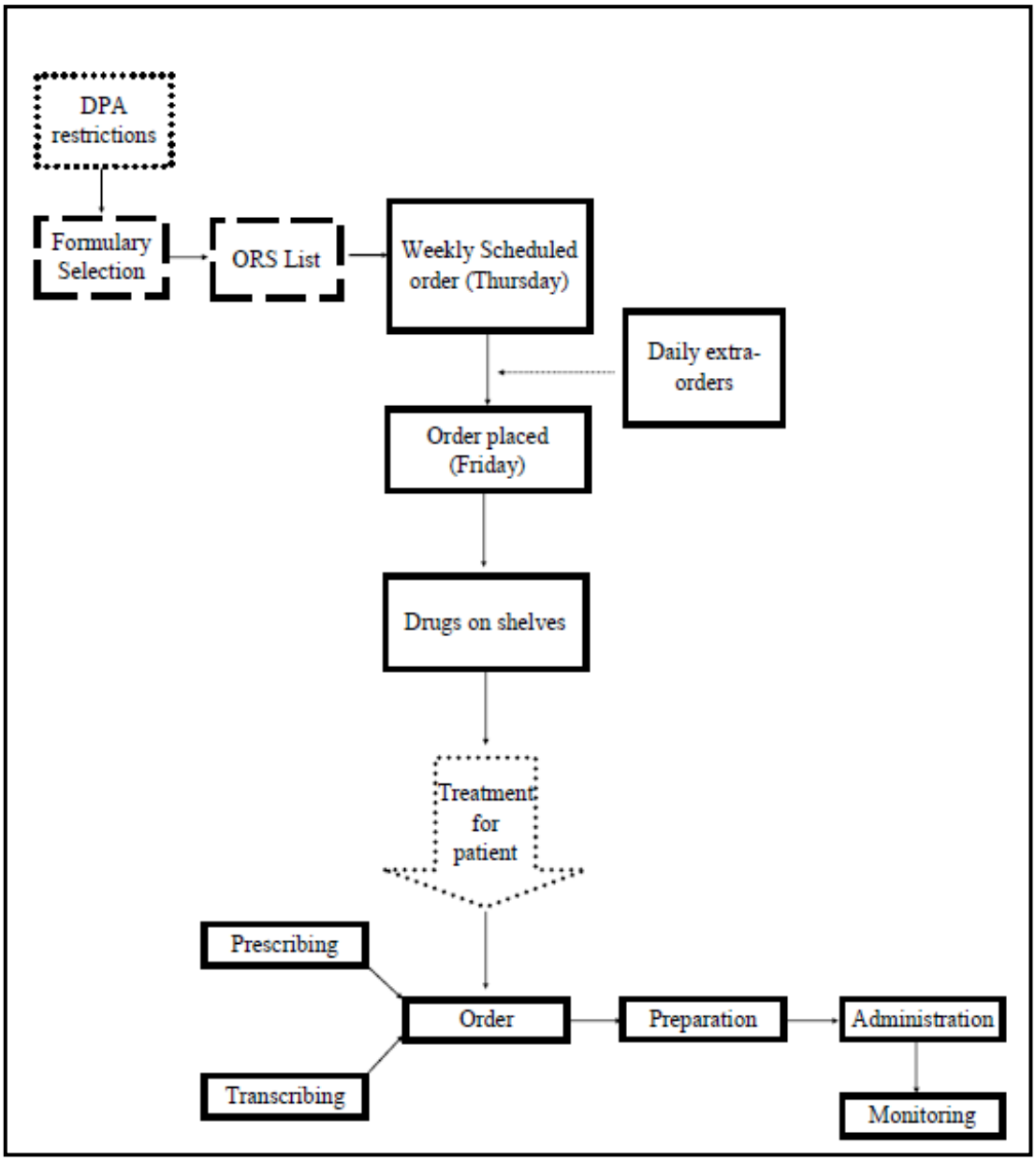

Figure 2.4 Medication Use Process of ED MDH

The pathway of drugs used within ED, from ordering to administration, composing the overall medication use process.
DPA: Directorate for Pharmaceutical Affairs
ORS: Oral Requisition System

2.5.5 The pre-service surveys

The expectations of staff were captured by means of two pre-service questionnaires (Appendix 1 and 2). Forty-nine (56%) nurses and 15 (27%) physicians answered the surveys. Out of the total respondents 46 (72%) were females and more than half of the respondents (n=64, 53%) fell between the 20-30 year age category.

Out of the nurses cohort, 23 (47%) gave a score of 3 to the overall layout of the Clean Utility and 17 (35%) scored 3 to the layout of medication storage and shelving (35%). 14 nurses rated the labelling of medication shelves with a score of 2.[10] Overall, the nurses were satisfied with the availability of medications. Twenty-four (49%) felt the directions for dilutions and administration of drugs were poor (score of 1) and 15 (30%) felt that the space available for dilution and reconstitution of medications within the ED was not adequate. Thirty-three of the nurses cohort responded that they did not feel that their current knowledge was enough for their line of work in ED.

With respect to the resuscitation rooms, the majority of the nurses (n=31, 63%) felt more satisfied in all aspects when compared with results for the Clean Utility with higher scores overall. Thirty-one nurses (63%) scored 4 for the overall layout of the resuscitation rooms. Equal scores of 3 and 4 were given by 40 nurses (41%) for shelving layout, 19 (39%) allocated a score of scored 4 for the labelling of medication shelves, 24 (49%) allocated a score of 4 for the availability of medicines, and 19 (39 %) nurses allocated a score of 2 for dilution and reconstitution directions. In the open-ended questions section, the most nurses (n=38, 78%) complained about the lack of dilution guidance for administering

[10] The score ranged from 1 to 5, 1 being poor to 5 being excellent.

intravenous medication. The majority of nurses (n= 30, 61%) rated the importance and relevance for the presence of a pharmacist within the ED department with a score of 5.

Fifteen (30%) survey responses were collected from physicians. The majority 7 of respondents were Basic Specialist Trainees followed by Consultants (n=3) and higher Specialist Residents (n=3). Of the total respondents the majority (n=13, 88%) had previously worked with pharmacists in other clinical settings. Thirteen (88%) felt that the current MDH pharmacy service was not enough for the ED Department with 12 (80%) stating that the presence of a pharmacist at ED was highly important. Thirteen (88%) preferred the pharmacist to be departmental based versus team based. The majority (8%) preferred a pharmacist to be present on a 24//7 hour basis with working hours between 8 am to 4 pm as being the second most preferred option.

The services that the respondents felt are most important to be carried out by the pharmacist were responding to drug queries within the ED in-patient setting, participation in drafting of guidelines and policies; assistance in local audits and participate in direct patient bedside review. The majority (n=14, 93%) agreed that medicine reconciliation can be improved by the pharmacist and they preferred this intervention to take place either once patient is discharged or once admitted. More than half of the physicians (n=8, 53%) responded that medication reconciliation should be done to all patients. When asked about the pharmacist's presence in resuscitation rooms, the majority (n=11, 73%) felt that a pharmacist can be of benefit during medical cases and poisoning cases.

2.5.6 Proposed contribution of the emergency department pharmacist

The latest guidelines issued by the American Society of Health-System Pharmacists (ASHP) on the role of the Emergency Medicine Pharmacist[11] and The Society of Hospital Pharmacists of Australia (SHPA) Standards of Practice in Emergency Medicine Pharmacy Practice[12] were the main guidelines used as blueprints for the roles of the ED pharmacist. A detailed job description describing the role of the pharmacist within the ED MDH was compiled, discussed and agreed upon (Table 2.2). Job description proposals made by previous and current ED chairpersons and ED charge nurses were also collected (Appendix 3).

[11] ASHP. Guidelines on Emergency Medicine Pharmacist Services. Available from http://www.ashp.org/doclibrary/bestpractices/specificgdlemergmed.aspx

[12] SHPA Standards of Practice in Emergency Medicine Pharmacy Practice. Available from https://www.shpa.org.au/resources/standards-of-practice-in-emergency-medicine-pharmacy-practice

Table 2.2 Suggested pharmaceutical roles within the ED

	ASHP	SHPA
Patient related	*Essential* • Direct patient care rounds • Medication order review • Medication therapy monitoring • Patient care involving high-risk medications and procedures • Resuscitation • Medication procurement and preparation • Medication information • Documentation of interventions • Care of boarded patients *Desirable* • Medication histories and medication reconciliation	• Contribute to ward rounds • Review of patients • Medicine incident monitoring and reporting
Administrative	*Essential* • Medication and patient safety • Quality-improvement initiatives • Leadership duties and professional service • Emergency Preparedness *Desirable* • Education • Research and scholarly activity	• Ensure effective communication between ED and Pharmacy • Review of medicine guidelines/protocols specific to the ED • Medicine incident monitoring and reporting • Evaluation of high-cost medicine use in ED • Membership on ED and hospital-wide committees • Policies and procedure drafting

Assembled roles for pharmacist working at ED as suggested from international guidelines, namely ASHP and SHPA, categorised into those being patient directed and those administrative.

2.6 Discussion

Through the observation phase, the need for a pharmaceutical service that governs the overall medication use process was recognised and supported by the ED physicians, nurses and pharmacy management. A detailed job description for the role of the ED pharmacist was compiled. The novel pharmaceutical service at ED MDH is defined by three categorical services namely operational, clinical and other services (Figure 2.5). .

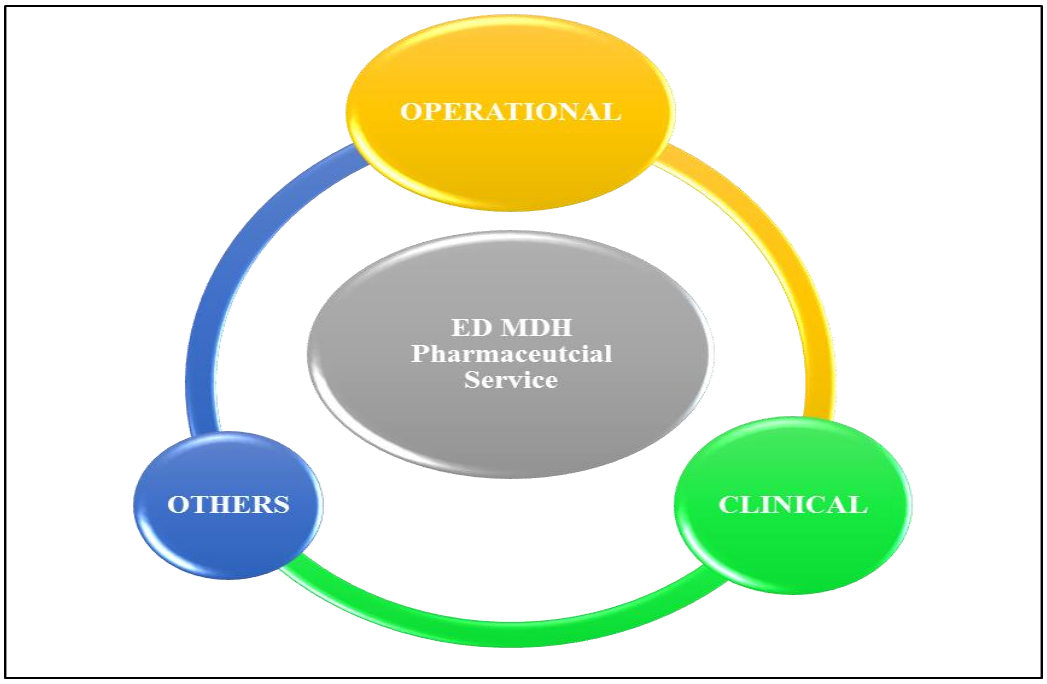

Figure 2.5 Categories of the Pharmaceutical Services at ED MDH

The innovative implemented pharmaceutical service at ED MDH comprises of operational, clinical and other services.

CHAPTER 3

OPERATIONAL PHARMACEUTICAL SERVICES

The designing and implementation of an integrated medication management process is essential to provide safe and effective medication use. Medication management process encapsulates all the aspects of medication management, starting from the selection, procuring, storing, ordering, prescribing, administering and monitoring of medication. Implementation of procedures that make up this process necessitates a coordinated effort of the healthcare professionals within the ED MDH. Establishment of an operational framework optimises a typical ED scenario where the setting up of operational procedures, serves as the foundation and paves the way for the development of other services (namely clinical) needed to create a holistic pharmaceutical service.

3.1 Objectives

The objectives of the development of the operational pharmaceutical services were to:

- assess the current medication system and identify risk within this system
- improve the identified weakness and reduce medication errors
- optimise and balance the speed-over-accuracy trade off.

3.2 Methodology

The methodology study consisted of a gap analysis exercise, management of medication stock control process within the ED as well as the pre-hospital stock selection. The current medication management practices were measured against a gap analysis benchmark audit tool namely the ED Medication Management Quality Analysis Tool (Appendix 4) developed with the aim of identifying weaknesses, faults in the system and identify areas of improvement. The developed tool was based on standards set by the Joint Commission

International Accreditation (JCI) Standards for Hospitals[13]. This tool was set on the Aseptic Special Interest Group (ASIG) tool layout. The ASSIG tool layout was chosen since it is the validated tool used as a standard by Quality Assurance at MDH[14]. Consultations with Quality Assurance (QA) section within the pharmacy department at MDH were carried out and subsequently the gap analysis audit was performed in collaboration with the same section. The ED Medication Management Quality Analysis Tool (Appendix 4) audited six criteria namely the overall premises, stock control (including medication storage), handling of high alert medications and multi-dose vials, temperature control and cleaning procedures. The clean utility and the medication cabinets of the three resuscitation rooms were audited using the ED Medication Management Quality Analysis Tool. These findings were discussed with the ED charge nurse and the clinical chairperson, where the identified changes for improvement of the system were brought forward, approved and then implemented. Prior to implementation, all changes and new procedures were communicated with ED physicians and ED nurses to ensure smooth transition in practice changes.

[13] Joint Commission International. 6th Edition. Joint Commission International Accreditation (JCI) Standards for Hospitals. 2017. Available from https://www.jointcommissioninternational.org/jci-accreditation-standards-for-hospitals-6th-edition/

[14] Pharmacy Quality Assurance. Pharmaceutical Quality Assurance Services Audit Schedule - Microbiology Services for Mater Dei Hospital Pharmacy Reconstitution Unit. Internal schedule developed from a document issued by a working group on the Scottish Quality Assurance Special Interest Group (2014) ed.; 2014.

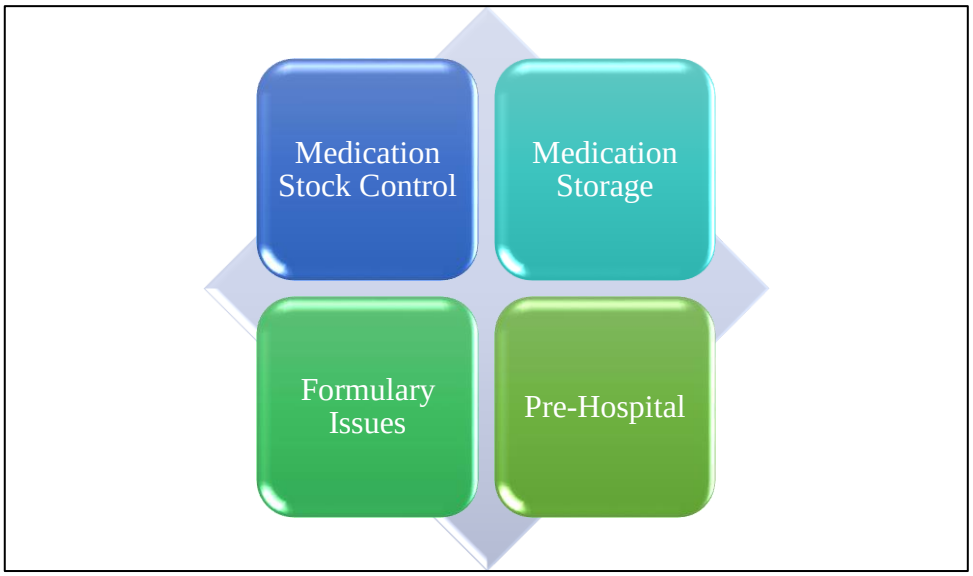

Figure 3.1 Operational services audit tool by the gap analysis tool

The developed ED Medication Management Quality Analysis Tool was used to carry out a gap analysis tool targeting medication stock control, medication storage, formulary issues at the ED MDH and the pre-hospital aspect. These processes form part of the operational services of the innovative pharmaceutical service at ED MDH, which required optimisation prior to the subsequent development and implementation of other services resolving around a clinical pharmacy service at ED MDH. Pre-Hospital: RRV service lead by two lead consultants who administer first medical attendance upon site of incident

Standardisation in reorganisation of the overall medicinal storage premises included labelling of medicinal products adopting Tall-Man-Lettering (in accordance to FDA and ISMP Lists of Look-Alike Drug Names with Recommended Tall Man Letters[15]) and judicious use of coloured drug labels; red for high alert drugs, yellow for parenteral antibiotics and white for the rest of parenteral drugs. High-alert medications were identified as indicated by the ISMP High-Alert medication Acute Care Settings[16] . The reorganisation was implemented first in the clean utility then into the resuscitation rooms for which a designated focus group (consisting of eight nurses, two from each shift) was created to assist in implementing the changes. The fridge storing the blood products was relocated from the clean utility to one of the resuscitation rooms, since blood products are mostly administered there due to the nature of the cases. An air conditioner unit was installed in the clean utility to achieve room temperatures below 25℃ whilst temperature monitors were installed. The narcotics and psychotropics register[17] booklet was altered to facilitate its usage by means of dividers segregating the DDAs according to formulations (Appendix 5).

Medication stock control, was done by the researcher pharmacist doing the weekly medication order. The then weekly order list, used as an order sheet for the weekly schedule order of drug was acquired from the charge nurse. This list is then transcribed on the ordering programme Online Requisition System (ORS), the online programme through which the scheduled medication orders are done. Access for the ORS programme

[15] Institute for Safe Medication Practices. https://www.ismp.org/Tools/tallmanletters.pdf
[16] Institute for Safe Medication Practices. http://www.ismp.org/Tools/highalertmedications.pdf
[17] A register for DDA drugs where the patient's details (name and ID card), dose and prescriber have to be filled once these are administered, against a signature of nurse and co-signed by other nurse. This procedure is mandatory by law

was applied to allow medication order processing. The weekly order list consisted of the drugs available in the clean utility and for each drug, the quantity needed to be stocked within the clean utility. Medication appropriateness exercise was applied to this list, were this was reviewed in terms of drug selection and the quantities. Factors such as practice and prescribing changes, hospital guidelines and seasonality changes were taken into consideration. Certain drugs were excluded and removed from the clean utility and other drugs not previously stored in ED were added. Some drug inclusions on this list necessitated changes in the Government hospital's drug formulary list (GFL)[18] to allow prescribing rights to ED physicians. The individual drugs that necessitated addition to ED medication stock were brought forward with the Directorate for Pharmaceutical Affairs (DPA), the department responsible for the GFL. Once GFL formulary changes were approved, the drugs were added on ORS and to the weekly order list.

Reorganisation of the medicinal cabinets of resuscitation rooms involved more changes and development of new procedures. The list of drugs then present in the resuscitation rooms was compiled and reviewed through a medication appropriateness exercise (Table 3.1). The aim of this exercise was to standardise the medicinal cabinets of the three resuscitation rooms and to ensure that all the three resuscitation rooms are continuously equipped with the necessary drugs needed during critical cases whilst minimising stock wastages.

[18] The Hospital Formulary List. Government Formulary List [Internet] available from: http://deputyprimeminister.gov.mt/en/pharmaceutical/Pages/formulary/formulary.aspx

Table 3.1 Medication appropriateness exercise

Category	Criterion
Drug indication	Is it needed in resuscitation room?
	Is it needed in a timely manner?
	How often is this used?
Storage requirements	Is it a fridge item?
	Is it light sensitive?
Nature of drug	Is it a High alert medication?

The medication appropriateness exercise aimed at identifying which set of drugs are required to be available and accessible within the three medication cabinets f each resuscitation room at the ED MDH. The exercise took into consideration the indication of the drug, storage requirements and whether the drug is a high alert drug against a scenario of resuscitation cases.

The minimum quantity of drugs to be stocked at all times within the resuscitation rooms was established. This was done by calculating the maximum dosage needed for an average seventy kilo-gram patient, calculating the number of vials/ampoules depending on present drug concentration and multiplying it by three since every resuscitation room is equipped for three consecutive resuscitation cases. The same labelling system with Tall-Man-Lettering[17] and categorical colour labelling used for the clean utility was implemented for the medicinal storage containers (holding the drugs within the medicinal cabinets). The drugs in the resuscitation rooms were further categorized into ‘common drugs’ and ‘uncommon drugs’ in order to minimise stock wastage. Drugs were assigned to either category on their usage frequency; if used frequently in ESI[11] 1 cases necessitated them to be at hand in all resuscitation rooms versus those used less frequently but needed at hand due to their urgent indications. This categorisation of was consulted with an expert panel of three senior nurses with more than fifteen years of experience in MDH ED. ‘Common drugs’ were to present in the three resuscitation rooms, whereas

'uncommon drugs' were stored only in resuscitation room two since strategically this was within reach from the other resuscitation rooms.

A weekly drug checklist was created for every resuscitation room, to be used for daily top-up system to ensure that the resuscitation rooms' medicine cabinets are always stocked with the needed quantity of non-expired drugs. A weekly dated checklist was drafted (Appendix 5) that specify the quantity needed for each drug and a baseline expiry date of the individual medications present. The expiry dates of the then current stock were recorded and added to the checklist, to serve as base-line expiry date. The expiry date of any drugs that were topped up were compared against this baseline and noted if this expires prior to the assigned expiry date. The daily checklist was intended for use by the nurse assigned to each resuscitation room whose responsibility was to stock the medication on a daily basis. This procedure resulted in stock control with continuous non-expired medication minimal expiration from overstocking expiring and thereby minimise costs.

A discussion based medication review exercise was conducted for the drugs used at pre-hospital, with the two consultants responsible for the RRV. Guidelines issued by The Joint Royal Colleges Ambulance Liaison Committee (JRCALC)[19], the professional body that provides most recent clinical robust data on ambulances services in the United Kingdom were referred to. Aspects of the medical devices and resources available locally for the pre-hospital were taken into consideration for the drugs' inclusion or exclusion criteria. For every identified required drug, the dosage for the average 70kg patient was

[19] JRCALC. UK Ambulance Services Clinical Practice Guidelines 2016.

calculated and converted to number of ampoules/vials needed of the current formulation (depended on concentration) of the product available on GFL[17]. Every item was stocked for the maximum allocated five patients[20]. A new DDA register was set-up specifically for pre-hospital, separate from those stored within the clean utility and the resuscitation rooms. Three extra drug pouches (with all the drugs except the DDAs) were set up as a reserve and placed in the RRV cars whilst the proper pouches are being topped up, to be ready for use, in case an incident occurs in this interim phase. An excel sheet was created listing the drugs in the pouches and the expiry dates of the items to allow stock rotation prior to expiry dates. This document was to be checked on a monthly basis in order to allow stock rotation with the medication stock stored at the clean utility in order to save medications form expiring hence and minimising cost.

3.3 Results

From the gap-analysis audit tool gap-analysis the changes identified related to storage premises which needed reorganisation, namely the clean utility and the medicinal cabinets of the resuscitation rooms and ownership of overall medication stock control needed to be owned including the drugs used at pre-hospital.

3.3.1 Gap Analysis findings of storage premises

Findings from the gap analysis audit of the clean utility room showed that the overall, storage space was not utilised to its maximum resulting in an overall disorganised premises and minimal working bench space mainly because the bench was being utilised for storage. The shelves where medications were stored were not labelled. Different medications were stored in front of each other and medications were not organised

[20] Incidents where more than 5 patients are involved are classified as a national major incident for which national hospital wide procedure would come into force.

according to their formulation. Not all medications were stored in their original container and certain light sensitive medications such as parenteral prochlorperazine (Stemetil®), diclofenac and paracetamol were not stored according to these specifications.

There was no concept of high alert medications as identified by ISMP High-Alert medication Acute Care Settings[21]. These drugs were stored in close proximity to non-high alert medications increasing the risk of errors. Multi-dose vials and syrups were not labelled according to the date of opening and during audit conduction, it was noted that aseptic techniques were not always followed. There was lack of ambient temperature control, where temperature-mapping exercise showed that in some parts of the room, temperature exceeded 25°C (maximum temperature for medications to be stored at). Table 3.2 summarises the gaps identified in the medication storage within the clean utility room.

The gap analysis audit of the medication cabinets in the resuscitation rooms showed that the storage space was utilised quite fairly though an element of disorganisation was present, since the medications were not stored in the same order within the three different medication cabinets. Moreover, not all drugs were stored in the three different medication cabinets. This was identified as a risk of error since ease of usage within the three resuscitation rooms was minimal due to lack of standardisation. The working bench space was not an issue given that there was ample space for reconstitutions and dilutions. All the different parenteral drugs were stored in dedicated medicinal storage containers (every active ingredient in a designated medicinal storage container) some still in outer

[21] Institute for Safe Medication Practices. http://www.ismp.org/Tools/highalertmedications.pdf

package. Only few medicinal storage container were labelled, and labelling was not according to the generic name. The light sensitive medications were not stored according to their specifications. Fridge items such as the digoxin antidote DigiFab® vials (10 vials amounting to €5207.30) and prochlorperazine (Stemetil®) ampoules (30 vials amounting to €27.60) were kept at room temperature instead of being properly stored in the fridge. A monthly expiry date checking system was in place, but was not standardised and numerous medications were expired (such as digoxin, salbutamol nebulised solution, ethomidate).

Similar to the findings of the clean utility, the high alert medications in the three resuscitation rooms were not separately stored; multi-dose vials and syrups were not labelled according to the date of opening and aseptic technique was not always followed and expired drugs were found stored in the medication cabinets. In the three resuscitation rooms, the ambient temperature did not exceeded 25℃ although temperature loggers were not put in the rooms. Table 3.3 summarises the gaps identified in the medication storage within the 3 resuscitation rooms.

Table 3.2 Gaps identified within the clean utility room

Criteria	Finding	Proposed change
Overall premises	Lack of organisation No working space	Premise re-organisation Removal of fridge containing O' negative blood units
Medication storage	No labelling No formulation segregation Light sensitive drugs not properly stored Fridge items stored at room temperature	Labelling of storage shelves Storage according to formulation Identification of light sensitive and fridge item drugs
High alert medications	Not stored in a separate area	Segregation of high alert drugs Education of staff
Multi-dose medicines	Not appropriately labelled No aseptic technique	Education of staff
Temperature control	No temperature control Temperatures above 25℃	Install AC Temperature mapping

Table 3.3 Gaps identified within the resuscitation rooms

Criteria	Diagnosis	Needed improvements
Overall Premises	None	None
Medication Storage	Lack of standardisation Lack of labelling Light sensitive drugs not properly stored Numerous expired drugs	Standardise layout of medicinal storage containers Labelling of storage shelves Identification of light sensitive drugs
High alert Medications	No idea	Identify and indicate high alert drugs Educate culture
Multi-Dose Medicines	Wrong handling practice	Educate techniques
Temperature Control	No temperature control	Temperature mapping

3.3.1.1 Reorganisation of clean utility

Drugs were categorised according to their formulation namely parenteral (n=98), oral tablets (n=25), nebulised solutions (n=2) suppositories (n=3) and others (n=16). Fridge products (n=13) and Dangerous Drug of Abuse (n=16) were automatically selected as a category on their own (Figure 3.2). Medical items which are not drugs, such as blood test medicinal storage containers, were removed from medicinal cabinets and put into designated storage units. The working bench space was cleared to its maximum allowing up to four simultaneous working stations.

The most common drugs stored are parenteral drugs such as ondansetron, esomeprazole, ranitidine, and adrenaline. Paracetamol and diclofenac, followed by codeine are amongst the oral tablets commonly used. The narcotics and psychotropics drugs termed as Dangerous Drugs of Abuse, which are stored in the clean utility room within the ED, include diamorphine, morphine, pethidine, lorazepam, diazepam. The Fridge items include insulins, terlipresin and adrenaline with lidocaine 1%. Nebulised solutions of salbutamol and ipratropium, analgesic suppositories and laxatives were classified as others.

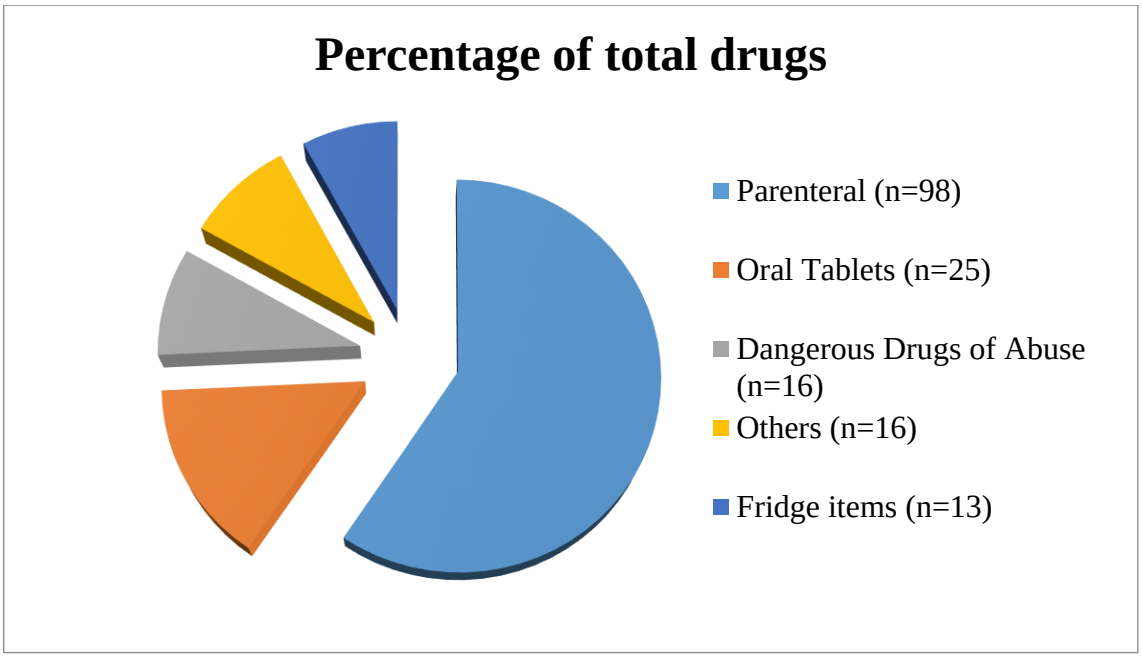

Figure 3.2 Drugs' Stock Percentages in Clean Utility

The most frequently used drug formulations are parenteral which amount to more than the total of all the other formulations.

During this organisation process, a total of 691 drug products were found to be expired, amounting to a total of €7130, whilst 1533 drug products were returned since the quantities exceed the needed quantities risking stock expiration from unused products. The extra stock was returned to the pharmacy stores and eventually added back to pharmacy stores stocks for redistribution elsewhere. The expired drugs were discarded according to the internal MDH hospital policy.

The intravenous high-alert medications were identified (n=56) and segregated on separate shelves. For ease of use the intravenous antibiotics (n=11) were also segregated and stored on a separate shelf designated for antibiotics. All the drugs were stored alphabetically according to the generic name and labelled accordingly. Labels were colour-coded according to formulation and drugs' inventories were printed near each section, corresponding to the particular section. The front page of the DDA register booklet was changed to facilitate usage (Appendix 6). Nurses were notified via email regarding the new layout and storage system (Appendix 5).

3.3.1.2 Reorganisation of the resuscitation rooms

The then current layout of medication cabinets of the three resuscitation rooms posed potential errors during resuscitation cases which are governed by speed-over-accuracy trade-off. Also from the gap analysis exercise, it was realised that the resuscitation rooms tend to be equipped with expired items. The medicinal cabinets were reorganised and a daily top-up system was implemented in collaboration with the resuscitation-working group, where this system was put on a trail test for three months prior to official implementation. All nurses were notified by email with an explanation of the pilot project prior to starting date, followed by a ten-minute explanation on site.

From the medication appropriateness exercise total of 77 drugs were identified to be needed as part of medication stock, the majority of which were all parenteral except for 2 tablet drugs (aspirin and clopidogrel needed for acute coronary syndromes) and 2 nebulised solutions (salbutamol and ipratropium). These 77 identified drugs were segregated according to assigned classification; common or uncommon. Fifty-two drugs were identified as 'common drugs' which had to present in all three resuscitation rooms whilst, 25 drugs were identified as 'uncommon drugs' and were placed only in resuscitation room two. From the common list, the drugs used for anaesthesia (such as ethomidate, vecuronium) and antidotes (such as flumazenil, doxaparam, naloxone) were identified from the common drugs (n=16). Medicinal storage boxes were placed in alphabetical order in the medicinal cabinets according to this classification, that is, common drugs (minus the anaesthesia drugs and antidotes), anaesthesia and antidotes and uncommon drugs. Each category was allocated a separate shelf, the order of which was replicated in all the three resuscitation rooms. Resuscitation room two had an extra shelf for the uncommon category. Another shelf was allocated solely to diluents (0.9% sodium chloride in various volumes, glucose 5% in various volumes) to ease practicality for preparing intravenous drug infusions and intravenous paracetamol. All the drugs available within the resuscitation rooms were put in an inventory list, in alphabetical order indicating the corresponding shelf number where the drug is placed (Appendix 5) and put on the medication cabinet, as a reference for faster drug allocation.

The new daily top-up procedure was implemented which made use of the top-up check list (Appendix 5). The drugs on checklist were listed in the same order found on the shelves. At the beginning of the morning shift, the allocated resuscitation nurse topped up the drugs (from the clean utility) according to the indicated quantity, record the expiry

date of the item to be topped up if this expires prior to the baseline date and signs. This top-up checklist is issued by the pharmacist on a weekly basis, where the expiry dates written by the nurses are updated, resulting in a weekly updated expiry dates checklist. Prior the end of every month, the expiry dates of the checklist was referred to; where it would be made sure that, the orders for the drugs that are expiring are placed with the weekly order. On the last day of the month, those drugs, which expired as noted from the checklist, would be replaced. This avoided the weekly expiry date checking of all the medication cabinets within the resuscitation rooms.

3.3.2 Medication stock control

The different drugs available at ED and overstocking of certain drugs were issues identified through the gap analysis. The medication appropriateness exercise undertaken to standardise the medication cabinets in the three resuscitation rooms resolved the issue of overstocking in that area. In this section, actions taken to regulate medication stock control and resolve the overstocking within the clean utility room is described.

The overstocking in the clean utility room was mainly due to lack of ownership of medication stock. As part of the operational services, the pharmacist undertook to regulate medication stock control within the ED with the aim of ensuring that the necessary medications required as part of ED medication stock are always available and to minimise the urgent daily orders in order to save time for both ED staff to be able to attend to other needed daily tasks. Cost-minimisation was a key notion, which governed medication orders done through ORS. The Weekly Order List (Appendix 7) on which the quantities of the needed drugs are written (and then transcribed to ORS) was reviewed, with 7 drug additions (such as 20% Intralipid, IV metoprolol, IV levetiracetam, IV phenylephrine, oral ibuprofen, oral GTN) and 20 changes in quantities needed namely for IV paracetamol, IV ciprofloxacin, and IV calcium gluconate.

3.3.2.1 Changes in government formulary list

Parenteral levetiracetam used in the management of epileptic fits in an emergency scenario where time is of essence, was not easily available to the ED since it was not stocked as part of ED medication stock due to prescribing restrictions on the GFL. Secondary to these restrictions the ED physicians did not have prescribing rights and signatures of consultant neurologist had to be sought for use of this drug within ED. The need for extension of prescribing rights to ED physicians was brought forward to the Directorate for Pharmaceutical Affairs (DPA), the department responsible for the GFL. The request put forward by the pharmacist-researcher was backed up by clinical chairperson for neurology. The request was approved subsequently a request was filed to the DPA department so that parenteral levetiracetam is added on the Online Requisition System thereby facilitating both ordering and procurement of this drug to be made available on within the ED as part of the medication stock.

From the antidote risk assessment exercise, (discussed in detail in Chapter 5) intravenous octreotide and intravenous pyridoxine were two antidotes for which ED physicians had no prescribing rights. A request was put forward to the DPA and subsequently approval for both drugs was achieved.

3.3.2.2 Addition of drugs to emergency department medication stock

Intravenous lorazepam required in emergency scenario for status epilepticus amongst other indications, was not part of the ED medication stock. Intravenous lorazepam is a dangerous drug of abuse requiring storage under double lock and key with the added inconvenience of a fridge storage requirement. A lockable fridge with a lockable cabinet was not available at the ED. Against this scenario, the nursing staff ordered intravenous lorazepam from the pharmacy upon request in cases when patients do not respond to

midazolam or diazepam. This logistical inconvenience was a detriment to the patient and the practice not evidence based since guidelines suggest intravenous lorazepam is the first line treatment in status epilepticus[22,23]. Furthermore waiting for the drug to arrive at patients' bedside during this acute time resulted in waste of time. The need to stock intravenous lorazepam at ED was recognised. A lockable compartment in a lockable fridge was set up in order to conform to the local DDA policy. A new page in the DDA register for intravenous lorazepam was created.

Intralipid (20%) was not part of the ED medication stock. However, being an antidote, it should be part of the ED medication stock and in fact was added. The procurement of intravenous ondansetron preparation was changed from the 8mg/4mL formulation to the 4mg/2mL formulation since the most commonly prescribed dose is 4mg, hence minimising waste and cost and potential errors which may occur in a fast pace environment such as the ED.

3.3.2.3 Removal of drugs from emergency department medication stock

Two drugs were removed from ED medication stock, namely the 50% dextrose in 500mL bags and 8.4% sodium bicarbonate in 250mL bottle formulation. The decision to remove both items was based on a safety perspective. The dextrose bag looked very similar to the heparin sodium in 0.9% normal saline in 500mL bag. Both the 50% dextrose in 500mL bags and the heparin sodium in 0.9% normal saline in 500mL agents are high alert

[22] Nice clinical guideline. Epilepsy: Diagnosis and Management. https://www.nice.org.uk/guidance/cg137/Chapter/appendix-f-protocols-for-treating-convulsive-status-epilepatienticus-in-adults-and-children-adults-published-in-2004-and-children-published-in-2011

[23] Evidence-Based Guideline: Treatment of Convulsive Status Epilepticus in Children and Adults: Report of the Guideline Committee of the American Epilepsy Society https://www.aesnet.org/sites/default/files/file_attach/PressReleases/2016/CSE%20Treatment%20chart-final_rerelease%20%282%29.jpg

medications stored in close proximity to each other within the resuscitation rooms and clean utility. The pharmacist suggested that the 500mL dextrose 50% bags are removed since the primary indication for this drug is hyperkalaemia regime treatment where only 50mL of Dextrose 50% is needed. This required volume is conveniently available in glass bottles (i.e. 50mL of Dextrose 50% per glass bottle) and is the formulation required within ED. The removal of 250mL 8.4% sodium bicarbonate bottles was a decision taken following an inadvertent over dosage incident. Instead, 50mL mini-jets were procured together with the 10mL ampoules, to limit the risk of over dosage of this high alert drug.

Both suggestions put forward by the pharmacist were agreed upon following discussions with clinical chairperson and charge nurse. A notification email was circulated through the ED nursing staff. The stock of both products were removed from the clean utility and resuscitation rooms and returned to pharmacy stores for redistribution to other clinical settings.

3.3.3 Pre-hospital Rapid Response Vehicle medication

The two consultant physicians responsible for the pre-hospital RRV service are equipped with a limited number of medications, which they take on-site (in an allocated drug pouch) for immediate treatment of patient during the pre-hospital medical attendance. Pre-hospital drugs' stock of the two lead consultants responsible for RRV service 'on-site' of a major incident required stock management control.

Twenty-five different drugs were identified as required for pre-hospital RRV medication following the medication review exercise. These were prepared in the identified quantities and strategically placed in designated pouches for the RRV. Medications were stored in the pouches according to their pharmacological class and usage. For example, drugs used

for ALS were strategically placed to be easily taken out of pouch, DDA drugs and naloxone (the antidote to opioid OD) were placed opposite ALS drugs. This layout was standardised for the 2 drug pouches to facilitate usage.

Each medication was labelled with the product trade name. The DDA drugs (n=6) were identified with a highlighted tag placed next to the label name.

The standardisation measures undertaken for the pre-hospital RRV were essential since the acuity of cases and the ambiance pose additional risks of error. The standardisation of the pouches for the RRV meant that the doctors could use each other's drug pouches, making the pouches interchangeable and user-friendly.

3.4 Discussion

The setting up of standards as part of the operational services is an important pillar on which the clinical service of the pharmaceutical model can be implemented. The fast pace of the ED and the high number of parenteral and high alert drugs used (56% of total parenteral drugs) make it necessary that storage systems can function in the safest yet fastest possible ways.

Given that the operational part functions without an automated medicinal cupboard system and is used by a large cohort of healthcare professional sustainability of practice changes can be tricky. The corrective action for the identified gaps in the system was recognised as a critical phase requiring multidisciplinary co-ordination and communication internally within the ED staff and with the pharmacy stores. These operational changes resulted in new procedures that require continuous maintenance to ensure sustainability some of which can easily be handed directly to pharmaceutical technologists; for example ensuring correct medication storage, expiry date checking, daily medicinal top up (urgent orders) and notification in change of brand of medication. The pharmacist would overlook the overall process and focus more on processing and delegating the overall operational dynamics within the ED. This phase also highlighted other areas which need to be looked into the future namely medication use process and appropriateness exercise for pre-hospital drugs used during orange and red codes by nurses, the use of automated medicinal cabinets, implementation of appropriate computerized physician order entry (CPOE)systems that would work within ED MDH and detailed stock costing studies.

CHAPTER 4

CLINICAL PHARMACETUICAL SERVICES

By definition, clinical pharmacy is "a health science discipline in which pharmacists provide patient care that optimises medication therapy and promotes health, wellness, and disease prevention" Clinical pharmacists provide routine evaluations of pharmacotherapy and where necessary put forward evidence-based recommendations to both patients and healthcare professionals. They act as a primary source of scientifically valid information providing advice regarding the safe, appropriate, and cost-effective use of medications[24].

4.1 Objective

The objective of this phase was to establish a clinical pharmacy service, which is effective and tailored to the need of the adult ED at MDH.

4.2 Methodology

Once the contributions of the ED pharmacist were identified, the implementation of the clinical pharmacy services was undertaken. The methodology required the setting up of a system of review of patients and subsequently the documentation of the actions taken by the pharmacist within a pharmaceutical care model at ED MDH.

4.2.1 Patient review by the pharmacist at ED

The typical consultant-led ward round does not take place at ED but rather the patient is attended to by a physician who is assigned to that same clinical area (Area 1, 2, 3 or Resuscitation room) of the patient. Following the patient's review by the physician the treatment is verbally communicated to one of the nurses assigned to that same area and the treatment is administered to the patient. The absence of Computerised Physician

[24] ACCP. Clinical Pharmacy Defined. https://www.accp.com/about/clinicalPharmacyDefined.aspx

Order Entry (CPOE) makes it unattainable for one pharmacist to be do prospective treatment reviews, given that at any given point in time multiple patients are reviewed by physicians and treatment is administered accordingly. Patient cases consultations and medication review were flagged up for verbal discussion by physicians and nurses. A pager for the pharmacist ensured that the pharmacist was within reach at all times from all areas, when not physically available within the ED in-patient setting (Area 1, Area 2, Area 3 and resuscitation rooms).

During a three-month period, cases were attended to by the pharmacist and consulted in accordance to their acuity, with resuscitation cases given priority over ESI 2, which in turn was given priority over ESI 3. When no patient cases were brought forward for review, medication reconciliation of admitted patients treatment chart was done whilst patients were awaiting ward transfer. Attention was given to the list of patients registered from triage to identify potential polypharmacy cases for which medication reconciliation would be mostly needed. Patients above 60 years of age were identified and medication reconciliation was done whilst patient was waiting for a review by the physicians. This saved the physician time from writing the current medication on the ED admission sheet. The lack of patient's knowledge when asked about the current medications was limiting an accurate and complete medication reconciliation often leading to incomplete medication history taking and wasting time contacting relatives to try and get a good medication history. This issue was brought forward to the Clinical chairperson whereby access to the list of the patient's free medicines entitlement was obtained through liaison with another government entity namely the Pharmacy of Your Choice (POYC) who is responsible for the entitlement documentation records. The necessary programmes were installed in 4 computer stations within the department and access was granted to the

pharmacist and the senior ED physicians given that the pharmacist does not cover night shifts. The pharmacist trained the senior ED physicians into using the system.

4.2.2 Documentation of pharmaceutical interventions

The pharmacist's interventions and recommendations were categorised into Key Performance Indicators (KPI). KPI are quantifiable measures of quality, which when applied to the practice of clinical pharmacy KPI (cpKPI) measure the positive outcome a specific clinical practice has upon a patient. Eight consensus cpKPI have been identified process through a Delphi study carried out by Fernandez *et al*., (2015) (Table 4.1). The aim of these 8 consensus cpKPIs is to support improvement of patient quality care and to have evidence-based clinical pharmacy practice (Lo *et at.*, 2016). Application of these quantitative indicators was a means of measure of the developed clinical pharmacy services within ED MDH.

Table 4.1 Clinical pharmacy Key Performance Indicators

	cpKPI	Changes and adaptations of the cpKPI
1.	Performing Admission Medication Reconciliation (including Best-Possible Medication History)	Adopted
2.	Participating in Inter-Professional Patient Care Rounds	Excluded
3.	Completing Pharmaceutical Care Plans	Adopted
4.	Resolving Drug Therapy Problems	Adopted
5.	Providing In-Person Disease and Medication Education to In-Patients during their Hospital Stay	Excluded
6.	Providing Discharge Patient Medication Education	Merged into Performing Discharge Medication Reconciliation and Education
7.	Performing Discharge Medication Reconciliation	
8.	Providing Bundled, Proactive Direct Patient Care Activities	Adopted

Five out of the eight cpKPI were chosen as quantitative indicators for the application of the service at ED MDH.

Adapted from Fernandes O, Gorman SK, Slavik RS, Semchuk WM, Shalansky S, Bussières JF, *et al*. Development of clinical pharmacy key performance indicators for hospital pharmacists using a modified Delphi approach. Ann Pharmacother. 2015;49(6):656–69.

Out of the eight consensus cpKPI, two cpKPI namely ‘Participating Inter-Professional Patient Care Rounds’ and ‘Providing In-Person Disease and Medication Education to Patients during their Hospital Stay’ were excluded since these do not apply to the local ED setting. The cpKPI ‘Providing In-Person Disease and Medication Education to Patients during their Hospital Stay’ did not apply to the ED setting since ED patients are not classified as ‘in-patients’ during their visit at the ED. At ED the ‘Inter-Professional Patient Care Rounds’ are not practiced. ‘Providing Bundled, Proactive Direct Patient Care Activities’, governs the practice of direct patient care in-collaboration with the ED physicians and nurses. “Providing Discharge Patient Medication Education” and “Providing Discharge Patient Medication Reconciliation” were put under one category as education was given along with the reconciliation upon discharge.

For the purpose of this study, ‘Execution and Implementation of pharmaceutical care plans’ (PCP) implied the evaluation of treatment charts of the admitted patients whilst awaiting ward transfer, where these treatment charts were reviewed. The treatment charts included the medications administered during the ED visit (both those administered once only (STAT) Medications and those started at ED to be continued at ward level) as well as any chronic medications that the patient takes daily. The once only (STAT) Medications i.e. the treatment given at ED was analysed retrospectively since treatment would already be administered. Any changes in the treatment charts were categorised in these following criteria seen in Table 4.2

Table 4.2 Pharmaceutical care plan

CPKPI	PHARMACEUTICAL CARE PLAN
A.	Review without changes
B.	Dose adjustment
C.	Not receiving an indicated drug
D.	Experiencing a drug interaction
E.	Complete treatment chart correction
F.	Wrong route of administration
G.	Receiving a drug for which there is no valid medical indication

The types of PCP interventions.

Resolving drug therapy problems capped the interventions that the pharmacists' was involved in once flagged up by physicians or nurses (i.e. not proactively taken). Electronic sources of references were utilised for this task. These were categorised as summarised in table 4.3.

Table 4. 3. Resolving Drug Therapy Problems

CPKPI	DRUG THERAPY PROBLEMS
A.	Dilution instructions
B.	Dosage instructions
C.	Formulary interchange
D.	Administration issues
E.	Drug information
F.	Change to alternative drug treatment
G.	Compatibility Issues
H.	Unknown Medication identification

Categories of interventions that necessitated changes in the PCP.

'Providing Bundled, Proactive Direct Patient Care Activities' documented the patient cases attended by the pharmacist along with the physician, which in ED setting is equivalent to a 'ward round'. This cpKPI documented those cases in which the pharmacist functioned as part of the multidisciplinary team with overall patient case review. This function involved various clinical tasks from medication reconciliation, to writing up of treatment charts, liaison with the patients' Pharmacy Of Your Choice and others, including the A-D stipulated cpKPI for this study (Table 4.4).

Table 4.4 Bundled, Proactive Direct Patient Care Activities

CPKPI	BUNDLED, PROACTIVE DIRECT PATIENT CARE ACTIVITIES
A.	Resuscitation cases
B.	CPR cases
C.	Toxicology Cases
D.	Medical cases

Types of interventions that were classified as Bundled, Proactive Direct Patient Care Activities

Clinical interventions were documented on Google Forms[25]. A separate document was prepared for each of the five cpKPIs and the respective subcategories. For DTP the concerned drug was recorded and enquirer (physician or nurses) was recorded. Clinical interventions were recorded daily and inputted in Google Forms on a weekly basis for 12 consecutive weeks; from November 1st 2017 to January 30th 2018.

[25] Google Forms. https://www.google.ca/forms/about

4.3 Results

A total of 309 accepted interventions were documented for the 3-month data collection period. Ninety-five percent of the clinical interventions involved three out of five cpKPIs namely, Resolving Drug Therapy Problems (55%), Direct Patient Care Activities (22%) and Pharmaceutical Care Problems (17%). The majority of clinical interventions were resolving drug therapy problems (55% of total clinical interventions), namely Dilution Instructions, Medicine Information and Administration Issues, 35%, 29% and 23% of 172 interventions respectively. Nurses requested 90% of dilution instructions interventions whilst physicians requested 80% of medicine information interventions (Table 4.5).

Table 4.5: Drug Therapy Problems Resolved

Resolving Drug Therapy Problems	**Clinical interventions** (N=172)		
Intervention	Enquirer		Number of Interventions
	Physician	Nurse	
Dilution instructions	56	6	60
Dosage instructions	10	0	10
Formulary interchange	4	1	5
Administration issues	38	2	40
Medicine information	40	10	50
Compatibility Issues	0	2	2
Unknown Medication Identification	4	1	5

The most frequent intervention from this category involved dilution instructions followed by medicines information and administration issues.

A total of 72 direct patient care activities were carried out over a three-month period, the majority being resuscitation cases and medical cases (25 cases each, amounting to 69%). Out of the 25 resuscitation cases, 10 were Cardiopulmonary Resuscitation cases. During these cases the pharmacist's activities involved preparation of intravenous drugs,

dilution and dosage advice, complete medication treatment chart and communicate with relatives for medication reconciliation and best possible medication history taking.

Medical cases were seen in the main ED in-patient setting (Area 1, 2 or 3) along with the physicians, with effective communication of nurses regarding treatment and monitoring parameters. Interventions during toxicology cases involved mainly dosage consultations with the physicians and dilution instructions directed with nurses. An incident report was filled for 3 of these cases and sent to alert the hospital Patient Safety and Quality Team.

Medication reconciliation was completed for 10 patients. The POYC database program was used for these patients. In addition in 3 cases the community pharmacist of the respective patient was contacted for further clarification. Medication education was done for 2 patients. In both cases, a patient specific medication chart indicating the medication, dosage and dosage frequency as well as indication was compiled and given to the patients.

Table 4.6 summarises the results documented for the clinical pharmacy service implemented according to the cpKI system adopted.

Table 4.6 Collected cpKPI directed Interventions

Thematic cpKPI	**cpKPI**	
Patient-Directed	**Admission Reconciliation and Best Possible Past Medication history n= 10**	
HCP-Directed	**Pharmaceutical Care Plans n= 53**	
	Treatment Chart Reviews without Changes	20
	Dose adjustment	6*
	Not receiving an indicated drug	1*
	Experiencing a drug interaction	7*
	Treatment chart correction	11*
	Wrong route of administration	10*
	Receiving a drug for which there is no valid medical indication	5*
HCP-Directed	**Resolving Drug Therapy Problems n=172**	
	Dilution instructions	60
	Dosage instructions	10
	Formulary interchange	5
	Administration issues	40
	Medicine information	50
	Compatibility Issues	2
	Unknown Medication identification	5
Patient-Directed	**Discharge Medication Reconciliation and Education n=2**	
Patient-Directed	**Direct Patient Care Activitiesn= 72**	
	Cases seen in Resuscitation Rooms	25
	CPR Cases	10
	Toxicology Cases	12
	Medical Cases	25
Total number of Clinical Interventions n = 309		

** Alterations in PCP reviews HCP= Health Care Professional i.e. Physician or Nurses*

4.4 Discussion

One of the major limitations of this phase was the lack of pharmacist backup. It was difficult for one pharmacist to give the full clinical service whilst also supplementing the other services required from the pharmacist such as participation and collaboration in major events and drafting of policies and guidelines which meant less time spent within the ED in-patient setting. The fact that the local ED dynamics do not operate on a 'ward-round' basis but rather patients are attended to implies that the pharmacist, if possible more than one pharmacist, needs to be present within the main in-patient setting (Area 1, Area 2, Area 3 and resuscitation rooms) and available during case review for effective interventions. The lack of CPOE was another disadvantage as it made it futile for the pharmacist to be able to validate the prescribed medications for the respective patients which are very often attended to by various physicians at the same point in time. Interventions given to non-ED physicians were not documented. Furthermore, the working hours (from 07:30-15:00) of the pharmacist meant that clinical pharmacy service could only be given for a relatively short number of hours. Another limitation is that the number of clinical interventions documented does not reflect the actual number of interventions seen within this data collection period, as at times, the pace of the ED does not permit proper documentation.

In conclusion, despite the limitations of the logistics of the ED environment, over a three month period, the pharmacist put forward 309 pharmaceutical care issues, attended to the direct physician-pharmacist pharmacotherapy review of 72 patients and offered medication reconciliation to 10 patients. In addition through the implantation of the clinical pharmacy service two gaps were identified further namely the need for dilution guidance for nurses to prepare intravenous drug treatments and a knowledge gap with

respect to certain drug classes; namely vasopressors, antidotes and anaesthetics. These issues highlighted the need of other services (such as education to ED staff) as required to be undertaken by the pharmacist.

CHAPTER 5

OTHER PHARMACEUTICAL SERVICES

During the initial observation, various gaps and weak points were observed that necessitated pharmaceutical input to optimise overall safe medication use system. These gaps do not fall directly under the operational or clinical pharmacy services but needed to be addressed to ensure optimal holistic pharmaceutical service within the ED. These services included the compilation of pathways, guidelines and policies, review of the toxicology and major incident preparedness medication use process, pharmacist participation in national major events and educational modules for ED staff (Figure 5.1).

Figure 5.1 Other Pharmaceutical Services offered

5.1. Compilation of pathways, guidelines and policies

A proven strategic manner to reduce errors in the ED is the development and simplification of diagnostic and treatment protocols and practice guidelines (Cosby 2003).

5.1.1. Objectives

The objective of this study was to identify and prioritise topics necessitating standardisation in practice and to collaborate in the issuing of required protocols

5.1.2. Methodology

Topics necessitating the drafting of protocols were identified through detection of weak points in medication use processes and errors observed from presence within ED in-patient setting, outcomes of audits carried out, verbal discussions with healthcare professionals including ED nurses and resident ED physicians. Pathways, guidelines and policies were drafted as necessary. Each document was discussed with respective concerned personnel, recommendations taken into consideration and subsequently finalised through approval from clinical chairperson.

5.1.3. Results

Six internal guideline documents including pathways and policies were developed (Table 5.1).

Table 5.1 Compiled pathways, guidelines and policies

Pathway/ Guideline/ Policy	Rationale	Objective
Acute Adult Pain Prescription Guideline (Appendix 8)	Overuse of IV paracetamol highlighted from MDH audit Incidence of acute pain as presenting complaint of patients who register in ED	Develop a prescription policy for administering analgesia for acute pain of nociceptive origin in adults at ED Decrease the unnecessary use of parenteral paracetamol.
Dilution Cards For Vasopressor Infusions And Other Parenteral Drugs (Appendix 9)	Lack of standardisation in dilution of parenteral drugs	Standardise dilutions of intravenous drugs and implement a weight based sliding scale for the use of vasopressors during resuscitation cases
Antidote Administration Of Hydrofluoric Acid Toxicity (Appendix 10)	Unavailability of readily prepared antidote locally required preparation on site (for RVV use in closing down of power station)	Formulate a guideline for treatment of hydrofluoric acid toxicity using the parenteral formulation of calcium gluconate as an antidote.
IV Administration Of Lorazepam Guideline (Appendix 11)	Additions of drug to ED medication stock	Compile dilution and administration guidelines to minimise risk of preparation, administration and storage errors.
IV Administration Of 20% Intralipid Guideline (Appendix 12)		
Policy For Carbapenem Prescribing (Appendix 13)	Change in carbapenem prescribing policy of MDH	Compile the indicated infections for which carbapenems are indicated from the MDH antibiotic guidelines to comply with antimicrobial stewardship in the ED

5.1.3.1. Pain and analgesia Protocol

Acute pain is a common presenting complaint at ED (Keating, 2001). This burden on the emergency department is recognised on an international scale and is acknowledgement by international bodies including The Joint Commission on Accreditation of Healthcare Organisations (JCAHCO) and ACEP[26].

A recent audit (indirectly linked to pain and analgesia) highlighted the excessive overuse of intravenous paracetamol. Another issue concluded from this audit is the time lag from when the patient is triaged until the patient is seen by the doctor and an analgesic is prescribed and administered during. This burdens both the patient as well as the doctors and nurses; as the patient becomes more distressed, onset of analgesia is delayed resulting in more distressed patients hence more difficult patient reviews. These issues justified the need for a local protocol on pain and analgesia.

International guidelines namely guidelines by the Royal College of Emergency Medicine[27] and guidelines issues by Medecins Sant-Frontieres.-Guidelines (which forms integral part of the WHO Health Emergency Kit[28]) clinical guidelines were used as the main reference for drafting up this policy in collaboration with an ED level one Higher Specialist Trainee. A prescription format was adopted for this guideline to facilitate and encourage its usage on the ED in-patient setting, including SFMC (Appendix 8). This

[26] ACEP. Pain and Palliative care. Clinical. [Internet] 2018. http://www.acepnow.com/tag/pain-and-palliative-care/
[27] Management of Pain in Adults [Internet]. London. Royal College of Emergency Medicine; 2014. Available from: https://www.rcem.ac.uk/docs/College%20Guidelines/5w.%20Management%20of%20Pain%20in%20Adults%20(Revised%20December%202014).pdf
[28] Broek *et al.* [Internet]. Clinical Guidelines. Diagnosis and Treatment. Medecins Sant-Frontieres. Guidelines, 2013. https://medicalguidelines.msf.org/viewport/MG/en/guidelines-16681097.html

incorporated a colour coded numerical pain scores which matched the indicated treatment options according to the pain scores in order to promote the analgesia ladder step-wise approach. Analgesic agents and dosages stocked at the ED were given as treatment options. In order to emphasise the importance of patient re-evaluation after 30 minutes, two signature sets of both the prescribing physician and the nurse administering the treatment were included, one prior to administration and one after administration. Most important side effects, cautions and contraindications of the analgesic classes were added at the back of the prescription-policy.

5.1.3.2. Antidotes for Hydrofluoric acid

Hydrofluoric acid is one of the most potent inorganic acids used as mainly in industrial purposes (Wilkes, 2016). This product is corrosive and penetrates skin and tissues if it comes in contact. Systemic side effects result in severe hypocalcaemia (as a result of fluoride ions binding to calcium) which can be precipitated with hydrofluoric acid exposure to skin or ingestion of any quantity with fatal arrhythmias possibly occurring within 90 minutes (Chan and Duggin, 1997).

A cleaning operation of the Delimara Power station necessitated usage of large volumes of hydrofluoric acid as the main decontamination product. Pre-hospital consultants were asked to be stand-by on site as part of a major accident preparedness in case of a major incident. International guidelines on hydrofluoric acid decontamination, namely

Honeywell Guideline[29] served as a reference for setting up this guideline. ToxBase[30], the main toxicological online database used at MDH ED was also referred to during the drafting of this protocol.

Calcium gluconate is the antidote to hydrofluoric acid which is available on the formulary only as a 10mL solution for infusion at a concentration of 10% weight per volume. Two guidelines (Appendix 10), one for first aid on-site treatment (using 10% Calcium gluconate) as well as in-hospital admission treatment (using 5% Calcium Chloride) were developed. Both protocols supplied reconstitution or dilution, and administration guidance.

Since topical calcium gluconate gel was not available on the GFL, the topical gel had to be prepared on site in case of hydrofluoric acid toxicity using parenteral formulation of 10% calcium gluconate (10mL plastic ampoules Braun) and water based lubricant. The necessary calculations were carried out for achieving 2.5% calcium gluconate gel from 10mL solutions of 10% calcium gluconate and 82 g of K-Y Gel®. The branded K-Y Gel® water-base lubricant was procured specifically for this exercise (through communication with Central Procurement and Supplies unit) as other brands of water-based lubricant (namely Optilube®) precipitated upon admixture of calcium gluconate.

Calculations for preparation of 2.5% nebulised calcium gluconate as antidote to inhalation of hydrofluoric acid was similarly calculated. The necessary off licence forms were filled

[29] Recommended Medical Treatment for Hydrofluoric Acid Exposure. Honeywell Hydrofluoric Acid [Internet] 2012. Honeywell International. Available from https://www.honeywell-hfacid.com/?document=hf-medical-book&download=1

[30] ToxBase [Internet]. Edinburgh: National Poisons Information Service; 2017. Hydrofluoric Acid; updated 2012 July: [cited 2017 March 03]. Available from https://www.toxbase.org/Poisons-Index-A-Z/H-Products/Hydrofluoric-Acid/

for both formulations and passed on to QA section of Pharmacy MDH. Co-ordination with other sections within MDH was necessary for preparation of boxes to be taken on site. Quantities were calculated on the probability of 5 patients (the number of persons performing the cleaning operation). The designated pharmacist also co-ordinated and prepared the 'hydrofluoric acid antidote box' together with the necessary drugs, diluents and equipment to be taken on site.

This issue highlighted the need to stock dermal antidote for hydrofluoric acid i.e. either proprietary Calcium gluconate gel or else sterile K-Y Gel® as part of major incident stock in the event of even a minor industrial incident with hydrofluoric acid. The latter option was preferred since it is cheaper and the components may be used for other purpose and not wasted when close to expiry. A case justifying the need of branded water based lubricant gel K-Y Gel® was presented to the CPSU for permanent procurement of K-Y Gel®.

Recent hospital wide burns guidelines by the Plastics Surgery Department at MDH adopted this protocol for hydrofluoric acid burns' treatment. Its rationale was explained to the Basic Specialist Trainee co-ordinating these guidelines through liaison between the two departments.

5.1.3.3. Guideline for administration of Intravenous Intralipid

The inclusion of this antidote as part of the shop-floor medication necessitated the development of dilution guidelines. An administration guideline incorporating the dosage (weight based) and rate of administration was prepared (Appendix 12). Specific

Product Characteristic sheets accessed from the Malta Medicines Authority[31] Data Base were referred to. Other references used regarding dilution and administration guidelines were Injectable Drugs Guide[32] accessed through Medicines Complete and Medusa[33]. Reference to ToxBase[34] for 20% Intralipid as an antidote to local anaesthetic toxicity since this was the main toxicological online database used at MDH ED. ED nurses and physicians were notified with this guideline (parallel to notification of addition to this agent as part of ED medication stock). The guideline was approved by the clinical chairperson and the MDH QA in line with hospital policy.

5.1.3.4. Guideline for administration of Intravenous Lorazepam

The addition of IV lorazepam to ED medication stock necessitated dilution instructions. A guideline indicating the dose, dilution and administration rates for IV lorazepam was prepared (Appendix 11). Storage and shelf life were determined from SPC since its storage necessitates temperature between 2-8℃ and highlighted in the guideline. Reference to the NICE guidelines on treating prolonged or repeated seizures and convulsive status epilepticus[35] was made, to give the latest evidence based practice guidance. The guideline was approved by the clinical chairperson and the MDH QA in line with hospital policy.

[31]Malta Medicines Authority. Medicines Database. [Internet]. Malta: [updated 2017; cited April 2017]. Available from http://www.medicinesauthority.gov.mt/medicinesdatabase

[32] Gray *et. al.*, Injectable Drugs Guide. [online] London: Pharmaceutical Press <http://www.medicinescomplete.com/> (accessed on 02/02/2018)

[33] Medusa. [online] NHS Injectable Medicines Guide group. Imperial College Healthcare NHS Trust. http://medusa.wales.nhs.uk (accessed on 03/02/2018)

[34] ToxBase [Internet]. Edinburgh: National Poisons Information Service; 2017. 20% Intralipid; updated 2012 July: [cited 2017 March 03]. Available from https://www.toxbase.org/General-Info/Antidotes---doses-and-sources/Intralipid-doses/

[35] NICE Guidelines. Treating convulsive status epilepticus in adults. [Internet]; NICE; 2004. Cited May 2017. Available from https://www.nice.org.uk/guidance/cg137/Chapter/appendix-f-protocols-for-treating-convulsive-status-epilepatienticus-in-adults-and-children-adults-published-in-2004-and-children-published-in-2011#treating-convulsive-status-epilepatienticus-in-adults-published-in-2004

5.1.3.5. Carbapenems Prescribing Guideline

A new prescribing guideline for carbapenem administration was issued within MDH during this study. Carbapenems are indicated in 5 different infections out of the 14 MDH Antibiotic Guidelines, accessed from Kura[36]. The 5 indicated infective diseases for which carbapenems namely, imipenem, carbapenem and meropenem could be prescribed were identified. These were compiled in a table-like policy where for every carbapenem, the dosage and dosage regimen for that specific infection was specified. The contact numbers of the physicians forming part of the antibiotic were included in this table. The table was printed and a version put in all 3 main areas and resuscitation rooms.

5.1.3.6. Intravenous Infusions of Vasopressors

The need for dilution guidelines was highlighted from the initial pre-service questionnaires. This was resolved by creating set of dilution cards. These documents contained directions on dilution (and where applicable reconstitution), administration and rate for parenteral drugs. For every drug, an individual dilution card was created, for every indication for which the drug is used within ED. The product description was also included namely the formulation appearance, concentration and brand name. The dose, monitoring parameters and additional notes were included for completeness sake.

The inotrope and vasopressor drugs used at ED MDH were identified namely adrenaline, noradrenaline, dopamine, dobutamine, phenylephrine and epinephrine and tackled differently. For the infusions of these high alert medications, a change in practiced was sought after by means of introducing weight based dosing according to dose sliding scale.

[36] Kura. http://www.kura.gov.mt/infocentre/circulars/show.asp?id=8541

It was realised that this necessitated liaison with both ED physicians and nurses, since implementation of weight based inotrope infusion dosing is a change in practice and implementation requires collaboration of both physicians and nurses; the former for rate prescribing and the latter for inputting rate of against the prescribed dose for the identified patient weight following dilution.

Specific Product Characteristic sheets for these drugs were referred to and accessed from the Malta Medicines Authority Data Base[37]. Dilution and administration guidelines for each agent were also referred to from two online secondary resources namely Injectable Drugs Guide accessed through Medicines Complete[38] and Medusa[39].

Layout of initial draft was discussed with MDH Medical Illustration Department which aimed to give clear guidance for dilution and administration. A brief presentation to regarding layout and usage of such dilution cards to nurses tackling was conducted.

These dilutions cards (Appendix 9) were reviewed by the clinical chairperson and approved by the MDH QA in line with hospital policy.

5.2. Major Incident Preparedness in Antidotes and Toxicology

MDH is the main trauma hospital within the Maltese island, and subsequently the only facility stocking major incident medicinal stocks and the main antidote armamentarium. The need for updating the current antidote stocks and procedures in line with latest evidence based international guidelines was discussed with the clinical chairperson.

[37] Medicines authority. http://www.medicinesauthority.gov.mt/medicinesdatabase

[38] Gray et. al., Injectable Drugs Guide. [online] London: Pharmaceutical Press <http://www.medicinescomplete.com/> (accessed on 02/02/2018)

[39] Medusa. [online] NHS Injectable Medicines Guide group. Imperial College Healthcare NHS Trust. http://medusa.wales.nhs.uk (accessed on 03/02/2018)

5.2.1. Objective

The objective of this phase was to:

- carry out risk assessment exercise with respect to antidote usage and their timely availabilities within MDH ED analysis
- update the current antidote list of MDH and maintain this list up to international standards
- ensure adequate stocks are kept at MDH and procedures are in place for immediate stock access
- ensure that all concerned sectors are in-line and conform to the same procedures
- educate ED staff regarding the updated list of antidotes, indications, dosing and ordering procedures

5.2.2. Methodology

An antidote hazard vulnerability assessment was undertaken by comparing the list of antidotes available at ED and those stored at pharmacy against an international gold line standard. The landmark paper "Expert consensus Guidelines for Stocking of Antidotes in Hospitals that provide Emergency Care" was chosen as the main source of reference for establishing a baseline list of antidotes needed in the ED (Dart *et al*.,2009). These comparison results were discussed with an expert panel consisting of the ED Resident Specialist with special interest in toxicology who is an active member within European Association of Poisons Centres and Clinical Toxicologists (EAPCCT), the hospital pharmacist who is responsible for antidotes stock control and order processing and a principal pharmacist at the government hospital stores who is currently Secretary General of EAPCCT. For each antidote the following criteria were reviewed namely:

i. approximate amount of stock needed at all times

This was calculated based on the dose needed for the average weight person, the amount of product required depending on the concentration of the current brand, the likelihood of the actual risk of poisoning in Malta and the number of cases that presented in the past.

ii. storage of the antidote

The storage of the antidote depending on whether it should be stored directly at ED for ease access or at the pharmacy was established.

iii. prescribing specifications of the antidote

The current prescribing criteria as specified on the Hospital Formulary List[40] were reviewed, with the cost of each antidote was also taken into consideration.

5.2.3. Results

This antidote exercise lead to the collaborative formation of an expert antidote focus group, intended to continue meeting for continuous discussion, maintenance as well as improvements in the system. Following the expert focus group discussions five antidotes out of the total 45 antidotes specified by the consensus antidote stocking (Dart *et al.*, 2009), were eliminated since these do not apply to the local scenario. The 5 antidotes were: Antivenin *Latrodectus mactans* antidote for black widow spider; Antivenin *Micrurus fulvius* antidote for Eastern and Texas coral snake, *Centruroides* (scorpion) antidote for Scorpion envenomation in paediatrics, Crotalidae polyvalent immune Fab (ovine) antidote for North American crotaline snake envenomation and Calcium

[40] The Hospital Formulary List. Government Formulary List [Internet] available from: http://deputyprimeminister.gov.mt/en/pharmaceutical/Pages/formulary/formulary.aspx

trisodium pentetate (calcium DTPA) antidote for internal contamination with plutonium, americium, or curium.

The remaining list with 40 antidotes were compared against the 25 antidotes listed on the MDH antidote list. Four antidotes namely dantrolene, octreotide, protamine, and pyrodixine were not listed in MDH antidote list but were stocked at the pharmacy. Subsequently these were included on the MDH antidote list. Furthermore in the case of pyrodixine and octreotide a request was sent to the DPA to extend the prescribing rights for these items to cover the ED physicians. Approval for both agents was granted for ED physicians to be able to prescribe these agents. An off-licence form for administration for intravenous glucagon (product name Glucagen® Hypokit) as an antidote to beta-blocker and calcium channel blocker overdose was completed and sent over QA Pharmacy MDH for approval.

An issue was raised with two agent regarding Fomepizole and Praxbind. Fomepizole is not available locally while Praxbind is available on the private market. Both were not on the MDH antidote list. Fomepizole as an antidote to methanol or ethylene glycol poisoning and the only treatment choice in paediatric methanol poisoning, since dehydrated alcohol is not contraindicated in paediatrics. Praxbind is the antidote to dabigatran. The importance of their inclusion on the GFL was acknowledged by the expert group. Subsequently a request to include these two antidotes on the GFL was put forward to the DPA and approved.

The expert panel suggested that the following 3 antidotes namely Cyanide Antidote kit (Cyanokit®) (antidote to cyanide poisoning); phentolamine antidote for digital ischemia

precipitated by vasopressors ephedrine and chlorpromazine instead of cyprohepatientadine (this is not available locally) as indicated for serotonin syndrome were to be added in the resuscitation room to be readily available when poisoning cases arise. Following discussion with the clinical chairperson and the ED charge nurse a designated cabinet specifically for these agents was installed.

5.3. Pharmacology updates

Education modules covering principles of pharmacology of most commonly used drug classes would aid in knowledge-practice skills of nurses when administering drugs. This service was initially suggested by the ED management people, flagged up by nurses during the observation phase and highlighted furthermore from the pre-service questionnaire (60% of nurses suggested further education sessions).

5.3.1. Objective

The objectives of the educational sessions were to:

- identify the drug classes mostly used at ED to optimise education session output
- deliver a series of education sessions governing pharmacology principles of drug classes
- quantitatively analyse the impact from these education sessions

5.3.2. Methodology

Five major topics were identified and agreed upon with the clinical chairperson as requiring prioritisation. For the purpose of this study and due to time constraints in relation to the study the educational sessions targeted the issue of analgesics in acute pain in Adults. This was chosen based on the fact that pain is a common presenting complaint

at the ED and in order to further substantiate the education required in line with the newly developed pain protocol.

Pharmacology textbooks were used as the main source of reference for the mechanism of action of drugs. The products' summary of product characteristics were used for explanation on the drug dilutions. The pharmacology updates were mandatory for the nurses to attend, where four educational sessions were given to cover all shifts, at the conference room at ED (Appendix 14). A set of ten questions (Appendix 15) were prepared targeting knowledge. The same set of questions were answered pre and post the lecture to test the insight that the nurses gained. True-false question answers were chosen to statistically assess the impact of the lecture using Independent sample t-test statistical test. The Independent Student t-test was used to compare mean knowledge scores before and after lecture intervention. The Independent Student t-test was specifically chosen to allow the respondents to answer freely according to their knowledge rather than have them assessed, hence reflect true knowledge gained. For every right answer, a respondent got a score of 1, whilst a no score (i.e. a 0 score for wrong answers), where the higher the score the higher the knowledge.

The Null Hypothesis for the Independent Student t-test specifies that that there is no change in knowledge so intervention is not effective. This is accepted if p-value exceeds 0.05 level of significance. The alternative hypothesis specifies that there is a significant increase in knowledge i.e. intervention is effective and is accepted if p-value is <0.05 criterion.

5.3.3. Results

With respect to the questionnaire aimed at studying the educational impact of the pharmacology update, the overall knowledge score ranged from 5 to 10. The mean knowledge score after the education session (8.9) exceeded the mean knowledge score before intervention (7.5). This increment was statistically significant since the p-value was less than 0.05 level of significance (Table 5.2).

Table 5.2: Independent Student t-Test

	Phase	N	Mean	Std. Deviation	P-value
Knowledge score	**Before intervention**	44	7.50	1.592	0
	After intervention	29	8.90	0.900	

H_0= There is no change in knowledge and intervention is not effective.
H_1= There is significant increase in knowledge and intervention is effective.

Statistical values for the Independent Student T-Test indicate a p-value which is <0.05. The null hypothesis is rejected and the alternative hypothesis is accepted meaning that the educational session had a statistically significant improvement on the knowledge score of the ED nursing staff.

5.4. Major national events

All major national events require ED physicians and nurses to be present on-site (as stand-by) in the eventuality of an emergency. By extension, drugs prepared and used during these events are ED medication stock, hence under the responsibility of the designated pharmacist at ED.

5.4.1. Objective

The objectives of this service were to:

- participate as an active member of the organisation team
- facilitate medication preparedness for these events
- advocate necessary steps and paperwork needed to be put for medication preparedness
- ensure safe and effective medication use-processes on site

5.4.2. Methodology

Debriefing meetings in relation to major national events and which were held with various concerned organisers were attended to by the pharmacist. During these meetings information on each respective event was discussed following which the pharmacist determined the corresponding component to drug usage in the respective national events on site of the event. For this reason the pharmacist developed an events preparation checklist to be used while setting up medications required for such events (Table 5.3).

Table 5.3 Events' Preparation Checklist

Event criterion	Drug issue
A. Duration of event	Quantities of drugs
B. Type of event	Selection of drugs
C. The crowd or number of designated guests (including VIPS/VVIPS and high alert)	Selection of drugs
D. The number of clinics on site	Quantities of drugs
E. The number of physicians and nurses	Selection of drugs
F. The competencies of non-ED medical staff	Selection of drugs
G. Funding; government or private event	Billing of drugs used

Table summarising the criteria that determined the selection and quantities of drugs to be prepared and present on site for each event. This list assisted in creating the type and number of drugs needed to be present at the event.

Ordering of medications (including medical oxygen) on a timely manner was done via liaison with pharmacy stores. The drugs were prepared strategically according to the clinic and physician-nurse teams. A drug list including the quantities was prepared for every set up. DDAs were always ordered directly from pharmacy and a portable register (Appendix 16) was created to document the administered DDA and the patient's details (Name, ID card number) against the signature of the physician and nurse. These were stored in sealed pouches and the handing over of such DDA from one shift to the next was done against nurse's signatures. Co-ordination for delivery of drugs (from MDH ED to clinics on site), return of unused medications (from the clinics back to pharmacy) and transfer of stock or billing process was also carried out by the pharmacist. Figure 5.2 summarises the role of the pharmacist in overseeing medication use process within the planning and during a major national event.

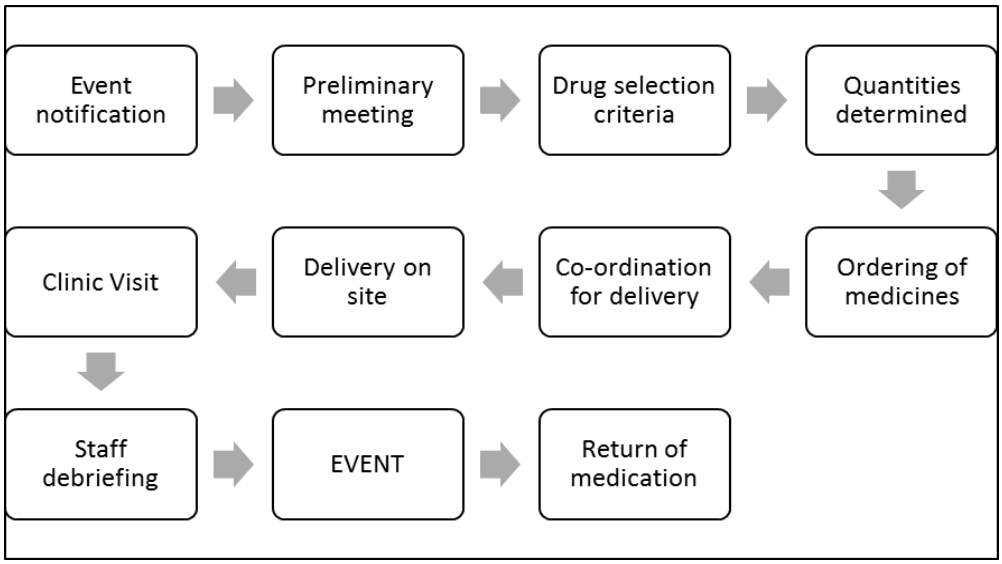

Figure 5.2 Pharmacist Roles in Major National Events

The pharmacist plays an important role in overseeing the medication use process involved in the organisation and running up of major national events within an ED interdisciplinary team

5.4.3. Results

Six national events were overseen by the designated pharmacist. The main role during the planning of these events was the drug selection process and co-ordination for procurement of drugs and clinics set up. All anticipated possible casualties that could arise were catered for by ensuring the right medication treatment would be available and administered in a timely manner. All the necessary precautions were taken to ensure the same standard of medication use process practiced in the in-hospital setting was translated on-site in the eventuality that these are used. Explanation and overview of the drugs available to nurses and physicians was given prior to event to ensure an eventual smooth medication use process.

Table 5.4 National Major Events

Event	**Date and approximate duration**	**No of clinics; No people catered for**	**Hours dedicated**	**No of different drugs**	**Other NGOs involved**
Isle of MTV 2017	27th June 2017	3 clinics for 70,000 people	25 hours	37	MRC
Arriolas 2017	20th-23rd September 2017	4 Stationary Clinics, 3 roaming for 20 head of states	80 hours	47	None
Ocean conference	5th-6th October 2017	1 stationary for 50 people	20 hours	47	None
Notte bianca 2017	6th October 2017	4 clinics, 3 roaming teams for 70,000 people	10 hours	37	MRC
V18 Capital of Europe opening Ceremony	18th – 20th January 2018	5 stationary clinics, 3 roaming teams for 100,000 people	100 hours	43	MRC
Malta marathon (Private funds)	25th February 2018	2 stationary clinics, 3 roaming teams for > 4000 runners	60 hours	32	MRC & SJA

MRC= Malta Red Cross, SJA= St John Ambulance

5.5 Conclusion

This chapter gave an overview of the non-operational and non-clinical services which were developed and undertaken by the ED pharmacist in order to offer a holistic pharmaceutical service. The services ranged from drafting of pathways, policies and guidelines, the updating of major incident preparedness, the educational sessions delivered to ED nurses and the overseeing of the medication use process for organisation of major national events. The pharmacist's overall service improved the quality and safety of the ED service.

CHAPTER 6

DISCUSSION

6.1. The essence of an ED pharmacist at MDH

The international medical scene has accepted the concept of a pharmacist based in the Emergency Department. The ED is governed by unique dynamics. The most significant are the fast pace, the variety and complexity of clinical presentations and the high decision density. These factors can all increase the potential for inadvertent medication errors and all the consequent serious implications. In the ED numerous high alert drugs are administered intravenously and their prescription is usually verbal. The end user is an unfamiliar patient who is being managed for the first time without the benefit of a thorough medication and personal history files or information, like for example the history of any previous allergic or other untoward reactions, by an unfamiliar medical healthcare professional team. In addition, multiple patients are managed simultaneously by physicians and nurses and at peak working times it is not unusual for an unexpected interruption in an individual's treatment because of other more critical patients presenting to the department at the same time (Figure 6.1).

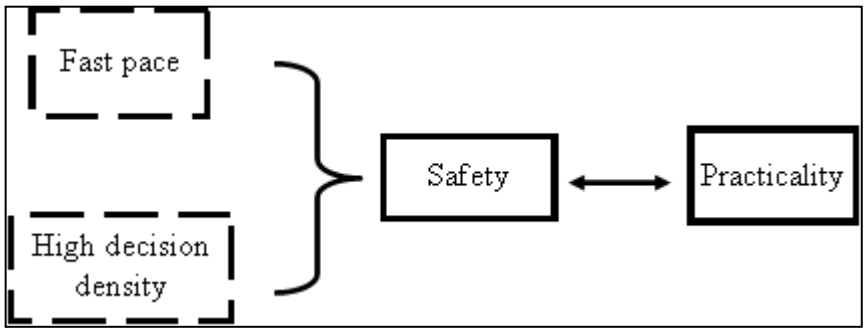

Figure 6.1 Characteristics of emergency department

Dynamics which govern ED practices.

The ED at MDH had raised the demand for an "in-house pharmacist" for a number of years recognising that the pharmacist has a vital role to contribute and improve the overall patient care mainly by optimising safety and efficacy from a pharmaceutical perspective and by supervising the overall medication use process.

This research study was undertaken to establish the intervention of a pharmacist at ED at MDH. The duties of the ED pharmacist identified from this study were:

1) Assisting the Emergency Physicians with the patient's medication reconciliation including where when necessary liaising with the patient, family, community pharmacy and other sources.
2) Review and finalisation of treatment charts and medication requirements in patients' medical history files prior to ward admission or discharge from hospital.
3) Patient education and counselling.
4) Assistance in over dosage, poisoning cases or other pharmaceutical emergencies.
5) Pharmaceutical education of medical and nursing ED staff.
6) Serve as the lead for the stocking of medication in the department and at the same time ensuring proper store management and availability of all the necessary medications.
7) Joint pharmacy-medical protocol developments especially for the preparation of intravenous infusions.
8) Advice regarding guidelines, formulary issues and protocols.
9) Preparation of medications and double checking of drugs in emergency situations especially for drugs that are not routinely used.
10) Assisting in Major Incident Emergency Preparedness which will have to cater for mass casualties and even unconventional medical situations.

During the initial observation phase of this study, the need for each of the above potential contributions by the ED Pharmacist within MDH was evaluated. International standards were referred to in order to establish the blueprint roles for this service and plan the main pillars of this service namely the operational, the clinical and relevant others. Knowledge and practice skills required by the ED pharmacist are summarised in Figure 6.2.

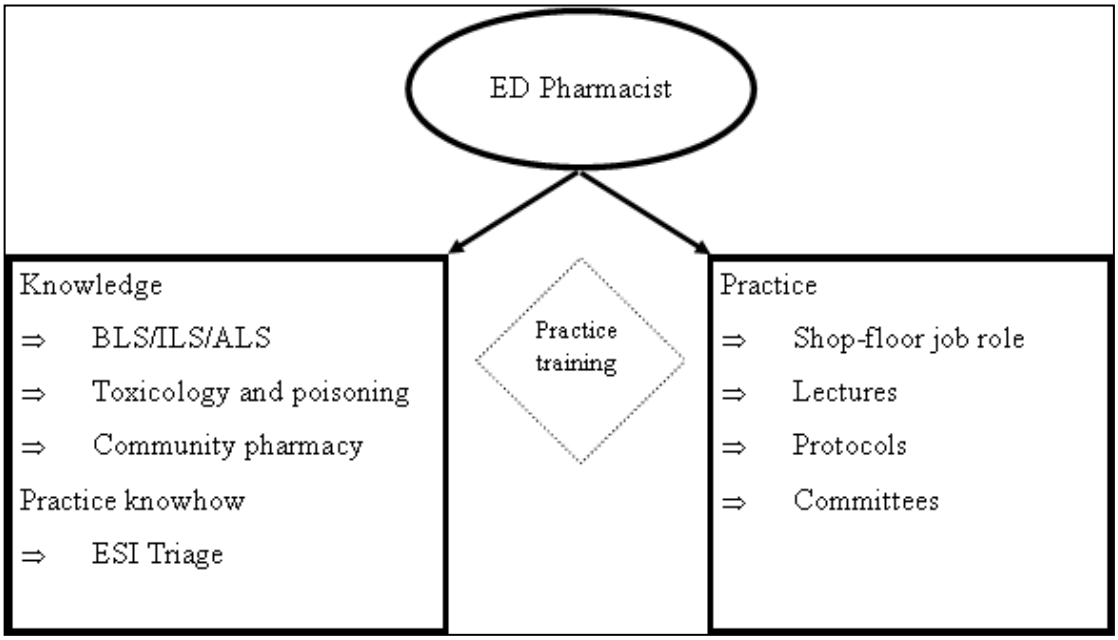

Figure 6.2 Characteristics of ED Pharmacist for ED MDH

The knowledge and practice skills that a pharmacist should adopt in order to function effectively in ED.

BLS; Basic Life Support, ILS; Intermediate Life Support, ALS; Advanced life support

The developed pharmaceutical service was initiated in this research study with the setting up of a benchmark operational framework. Since the pharmaceutical services within ED were absent prior to this study, it was decided that the clinical service will be based on the analysis of the current medication use system and addressed any inadvertent shortcomings. Identification of present issues related to medication process was followed by a thorough analysis of the practices. It was imperative to set out a basic framework

onto which clinical service could be based. This gap analysis resulted in an objective list that needed to be addressed, some of which aimed to achieve a baseline standard (such as temperature regulation) whilst others to improve the system (for example, the reorganisation).

The pharmaceutical service necessitated both the clinical and operational services for effective delivery of such patient-cantered service. During the initial setting up of the operational phase the pros and cons of the concept of "speed versus accuracy" was considered. Procedures were changed or started in order to increase safety in the most practical and timely way possible. The fast pace dynamics on which the ED operates dictates that everything needs to be done in a timely manner but not at the expense of a medication error. Minimising any probable or possible medication error was one of the most important practices to be initiated. This process necessitated long hours over many days dedicated for the reorganisations of all the ED medication stock stocked in different areas that served as a 'satellite pharmacy'. In these areas prescribed medications are picked off the shelves, prepared and administered to the patient on the spot. This medication preparation and administration process had to be improved in such a way so as to increase its safety without inhibiting the rapid need for its availability which is a must for the efficient functioning of ED and which would have otherwise been met with opposition from the ED staff.

The workload that both emergency nurses and physicians have on their shoulder must be taken into consideration when setting up a safe environment. Service efficiency is one of the attractions for any entity to accept a new service. The emergency service was accustomed to operate without pharmacy presence and any concerns that the new service might slow down the overall ED process had to be ironed out. The ED remains the

department where decisions are made quickly since any loss of time in the patient care pathway will bear a definite impact.

The objectives for the proposed changes and implementation procedures and pathways such as stock medication management and reorganisation of medications storage premises were presented and discussed with ED management for the necessary approvals. This also lead to the co-ordination and liaison with various other departments within MDH (such as Engineering Department and Biomedical department). Moreover these proposals were discussed with ED Nurses and Physicians, by means of presentations, emails and other social media platforms, to ensure a correct procedure and a smooth transition in these changes and to decrease the likelihood of opposition or misunderstanding from the end users. This communication approach resulted in the pharmacist joining various nurses working groups (an ED MDH work practice implemented during this study) and becoming an advisory person to other working groups whilst assisting doctors in the planning of an audit study.

The 'sole pharmacist' role in the ED with its many clinical jobs presented a number of challenges for various reasons. It was not physically possible for one person to cover all areas of the ED MDH which are namely three distinct in-patient setting (Area 1, Area 2 and Area 3) and three resuscitation rooms. There is also the challenge that in the ED MDH patients are attended to by different doctors in parallel and at the same time rather than in a sequential manner by the one same multidisciplinary team like what happens during hospital ward-rounds. A CPOE system is not yet in place and this was a disadvantage since the prescribed treatment could not be vetted by a pharmacist in real time.

Notwithstanding such limitations the identified clinical inputs were successfully delivered. The majority of interventions were done once a case was flagged up for consultation by ED physicians and nurses. Other interventions were proactive participation by pharmacist, such as participation in resuscitation cases. The clinical inputs were most successful when the pharmacist was present on within the ED areas (Area 1, 2 and 3) and working as an integral member of the team. This direct input provided an added advantage in comparison to working at a distance from another hospital base since direct consultation on pharmaceutical issues results in improved quality of medical care and safety. Presence within the department also ensures monitoring of the processes for their continuous maintenance and improvement.

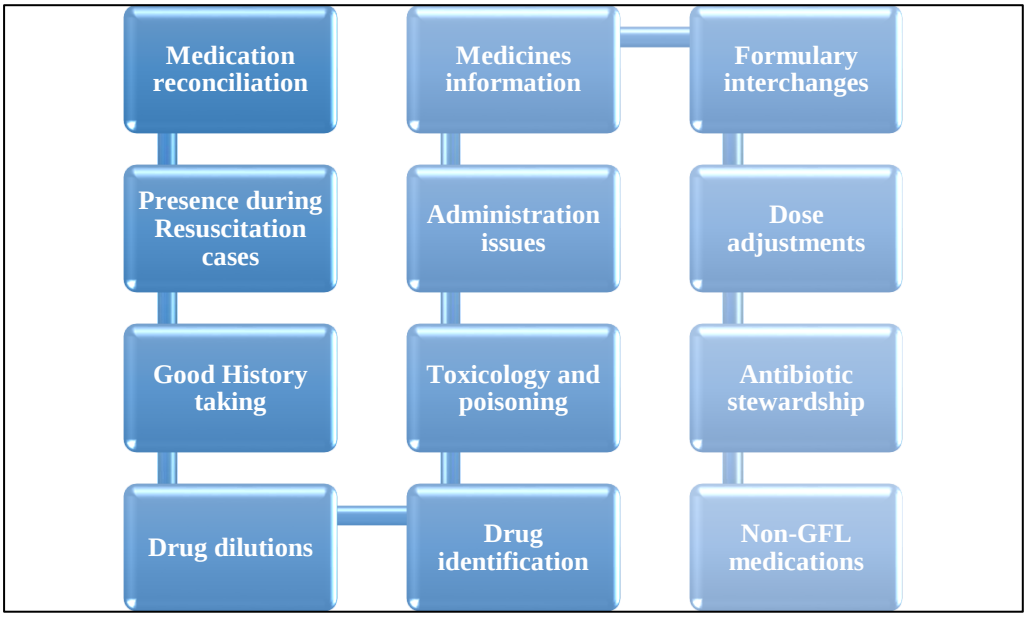

Figure 6.3 Clinical Interventions Provided

Summary of the various clinical interventions provided

Other services, albeit non-typical for ED setting, were identified, addressed and initiated accordingly to deliver a more holistic service. This had to happen since ED MDH is also responsible for all the prehospital emergency services and oversees all national major events and incidents in Malta. These two specialty branches make use of many and various medications and hence fall under the realm of the overall pharmaceutical care in ED MDH.

This holistic pharmaceutical care service at ED MDH should be provided 24/7 and should be delivered by a team of pharmacists. Ideally there should be three pharmacists: one allocated to the resuscitation cases and the other two covering the three areas of the ED (Area 1, Area 2 and Area 3). Inclusion of CPOE would surely aid the pharmacist into seeing the prescriptions prospectively and allowing any necessary prescription corrections and adjustments prior to medication administration to patient. However, with the current resources, the most important duties for the ED pharmacist are: medication reconciliation, patient counselling upon discharge, participate during resuscitation cases, assistance in poisoning and toxicology cases, offer medicine information on shop-floor.

Medication reconciliation should be entrusted in the hands of the pharmacist prior to the patient being seen by the physician. Elderly patients should be a priority, since with increase in age the likelihood of polypharmacy increases and polypharmacy is directly proportional to potential interactions. Logistically this would save time to the physician since an accurate and thorough medication history is time consuming. The ward admission treatment chart written in the ED follows the patient throughout the hospital stay, is most likely to be included in the hospital discharge letter and may end up on the long term medication list. Therefore, a medication error started upon the filling of the initial treatment chart could be of detriment not only throughout the hospital stay but also

later once patient is back in the community. This can actually lead to a hospital readmission and increased morbidity and mortality and costs. Medication reconciliation upon patient discharge transcribed into a dosing chart should be given to those patients who had any alterations to their medication following the visit to the ED. This would ensure that the patient would have understood the new dosing regimen of the medications and also allows an opportunity for any queries regarding their treatment. To carry out the role of medication reconciliation successfully, the ED pharmacist must be familiar with medicines available in the private market (not only those offered free of charge) including the over the counter medications present in the community pharmacies. Medication reconciliation on its own merit keeps the pharmacist's hands full. However this priority should not overshadow equally important roles like the presence and participation in resuscitation cases, especially CPR and poisoning. These acute and critical cases tend to be intense with respect to medical treatment and require all the extra helping hands that can be made available. For this role, the pharmacist must be competent with BLS/ILS and ALS guidelines and familiar with trauma cases. These cases tend to packed with various and at times complex human factors and a pharmacist taking on this role needs to be psychologically prepared to witness and participate in these emotionally laden situations including fatalities.

These services need preparation and office work that will take the pharmacist off from the in-patient ED setting. However, this office work is essential in order to support and sustain the in-patient work. Therefore time invested in the office work, is time invested in the clinical service (Figure 6.4).

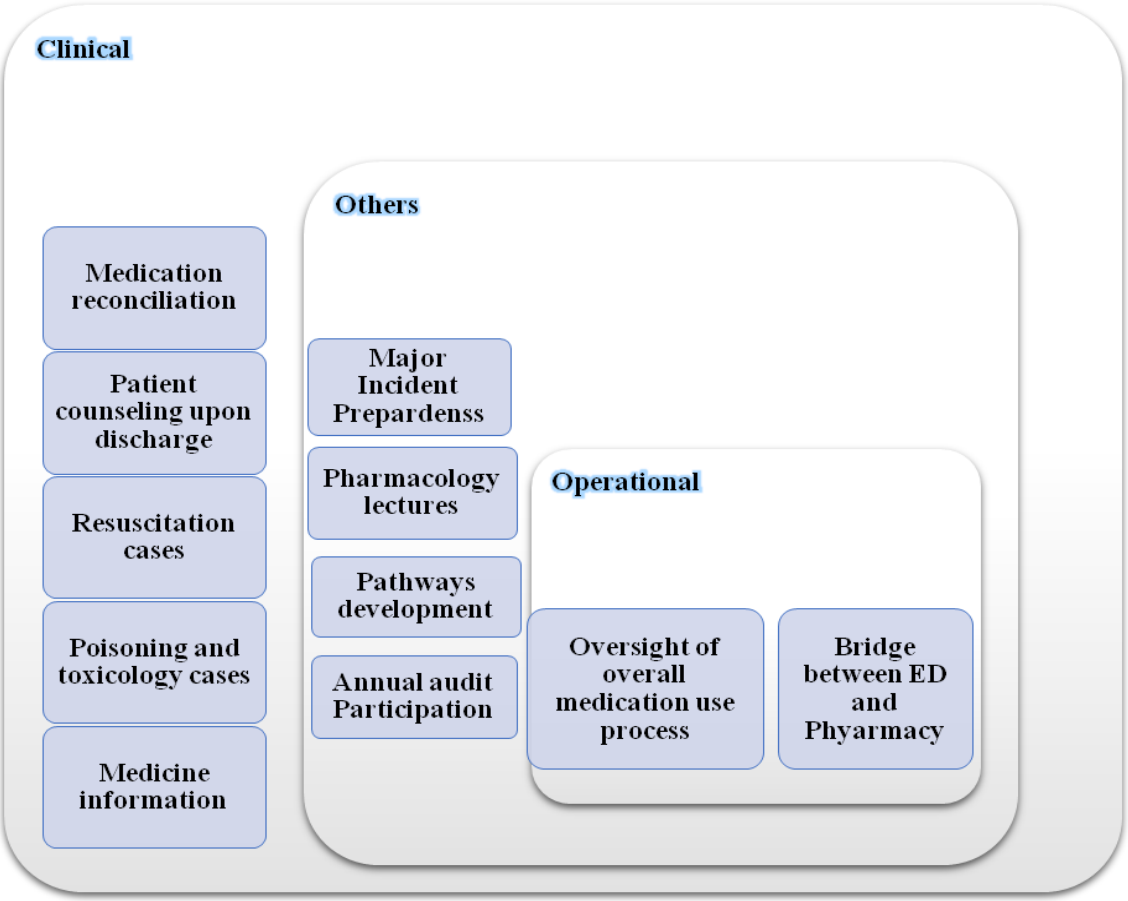

Figure 6.4 Emergency Department Pharmacist Services
The roles that ED MDH pharmacist should have in the categorical respective services.

The way forward for this service has to ensure the maintenance of the already established systems through this research study, whilst planning the next operations. Routine operational services should be ideally delegated to a pharmaceutical technologist who can execute the tasks given under the supervision of the pharmacist whilst the latter can focus more on the hands-on clinical services. For these reasons and to ensure a consistently adequate medication stock availability a pharmaceutical technologist should be allocated to the ED (Figure 6.5).

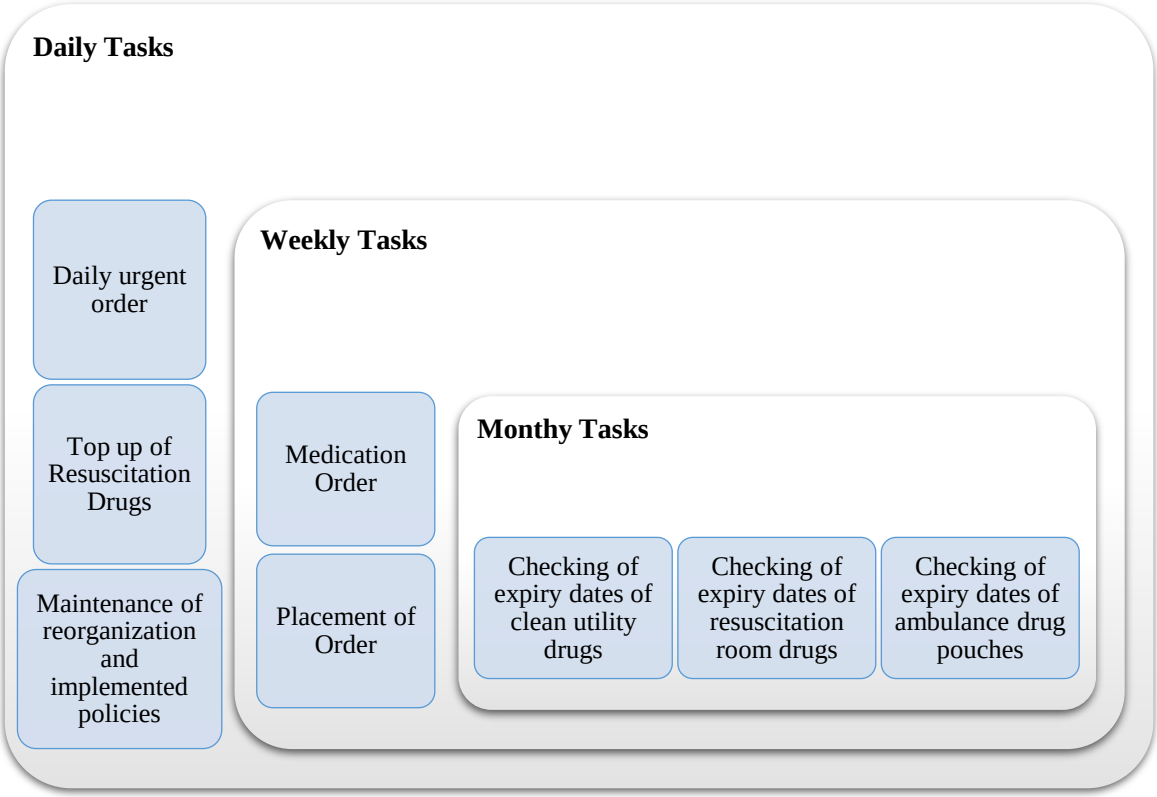

Figure 6.5 Emergency Department Pharmaceutical Technologist Services

The roles that ED MDH pharmaceutical Technologist should have

6.2. Innovation in practice and contribution to pharmacy

Although globally pharmacists have been participating and specialising in emergency medicine since the late 1970s, only a few hospitals have pharmacists dedicated to emergency care. This study put MDH on the forefront in terms of clinical pharmacy services since the ED now has a dedicated pharmacist providing a pharmaceutical service. Prior to this study, this service was absent.

This study delineates how a holistic pharmaceutical service was established, starting with the identification of services needed followed by the actualisation in the ED. At the writing of this thesis, the current available guidelines focussed mainly on the clinical aspect of a pharmaceutical service which needed to be tailored accordingly. However a

clinical pharmaceutical service cannot be delivered successfully before other underlying pharmaceutical issues are addressed (for the scope of this thesis termed operational services) in order to establish standard basic practices. Furthermore, it might be the case that other unconventional duties would be necessary, depending on the individual setting of practice.

Two important attitudes necessary for the successful establishment of a pharmaceutical service, irrespective of the setting are;

- Identification of the requirements and prioritising according to the urgency .The latter is determined by the setting. For example in the ED urgency is directly related to the safety of the patient, and thus tasks need to be performed accordingly.
- Effective communication with the involved healthcare professionals including the department's management team, the physicians and the nurses

The starting point of this study was the direct observation of local dynamics. This gave a direct overview of what goes on at the ED hence enabling a plan for a new service (Figure 6.6).

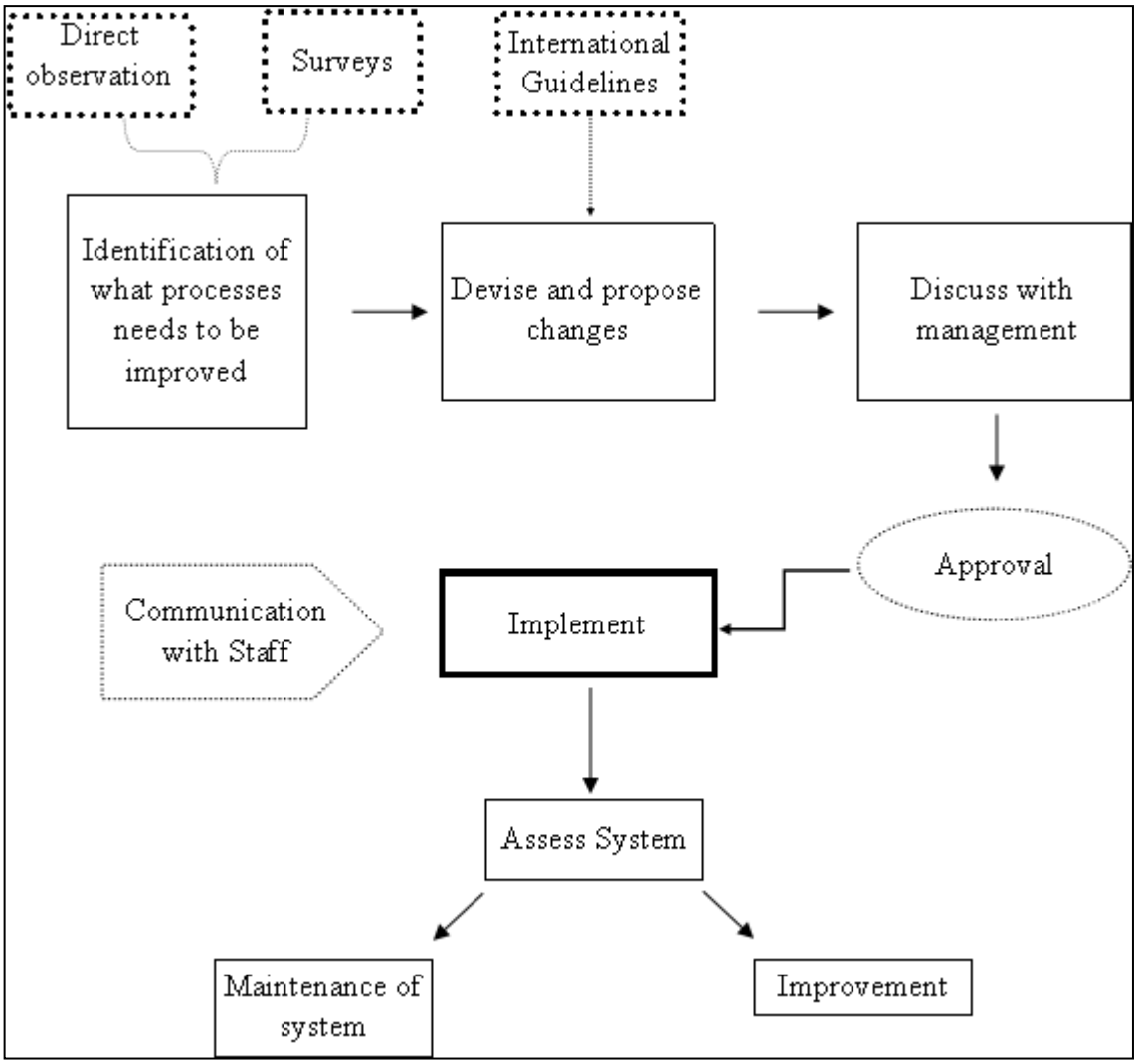

Figure 6.6 Setting up of a service within a healthcare system
An example of a step-wise approach for setting up a service within a healthcare system

A crucial characteristic needed for this successful service initiation was the co-operation and integration with the ED healthcare professional team. A teamwork based approach was adopted throughout, where for example, during the initial observation phase introductions were made and the ideas and perspectives of the ED physicians and nurses were explored (through surveys). This approach was essential to ensure the seamless successful implementation of the service. Information about the new procedures or any changes in the already established procedures was given to the ED team prior to their

implementation. This ensured a smooth transaction in the implementation and change in practices and ensured a higher success for the maintenance of the improved systems. All the new services were devised in a dovetail manner and in line with the already established procedures.

6.3. Limitations

The main limitations of this study were the working hours of the one allocated pharmacist, from 07:30 to 15:00 (24/7 coverage was not given). Considering the magnitude of the department, roles and services had to be selected according to demand and departmental need. For example, planning of major events meant time away from in-patient setting hence clinical services.

The data for this study was collected during a specific period of time which regrettably did not capture all of the services that were initiated since some of these had already started before the data collection. For example, during the setting up of operational services, clinical interventions were still performed and during the 3 month period collection of clinical interventions, medication stock control (operational service) was still done.

For this study, data capturing and presentation was mostly descriptive since some interventions were difficult to measure statistically. The importance of some interventions could not be measured due to lack previous data collection. Thus comparison before and after implementation is not possible.

Other important factors, such as patient satisfaction with the communication with the pharmacist or how other medical specialities and firms perceived the inclusion of the

pharmacist as part of multidisciplinary team, were not measured due to the restricted time frame of the study.

6.4. Further research

From this study, a list of topics was identified for further research. These include:

- The effect of the ED pharmacist participating in CPR cases aiming to mainly identify the roles and overall impact in these clinical settings
- The effect on safety and efficacy of the ED pharmacist preparing the medications at patients' bedside
- The effect of medication reconciliation upon patient discharge and any effect on patient readmission
- The role of the ED pharmacist within the paediatric ED
- Patient satisfaction from ED pharmaceutical services
- Healthcare professional satisfaction from ED pharmaceutical services.

6.5. Conclusion

In conclusion, the ED pharmacist is a vital component of clinical service provision, contributing to the overall medication safety from the time of patient's entry into the hospital via the ED and the subsequent hospital activity. The aim of this study has been met since the pharmaceutical service within ED has now been established. The importance of this role was acknowledged by the current chairperson by the addition of the role of an ED pharmacist in the department's capacity building plan for 2019. This approval is proof that the established service has been tailored according to the needs of the ED MDH (Figure 6.7).

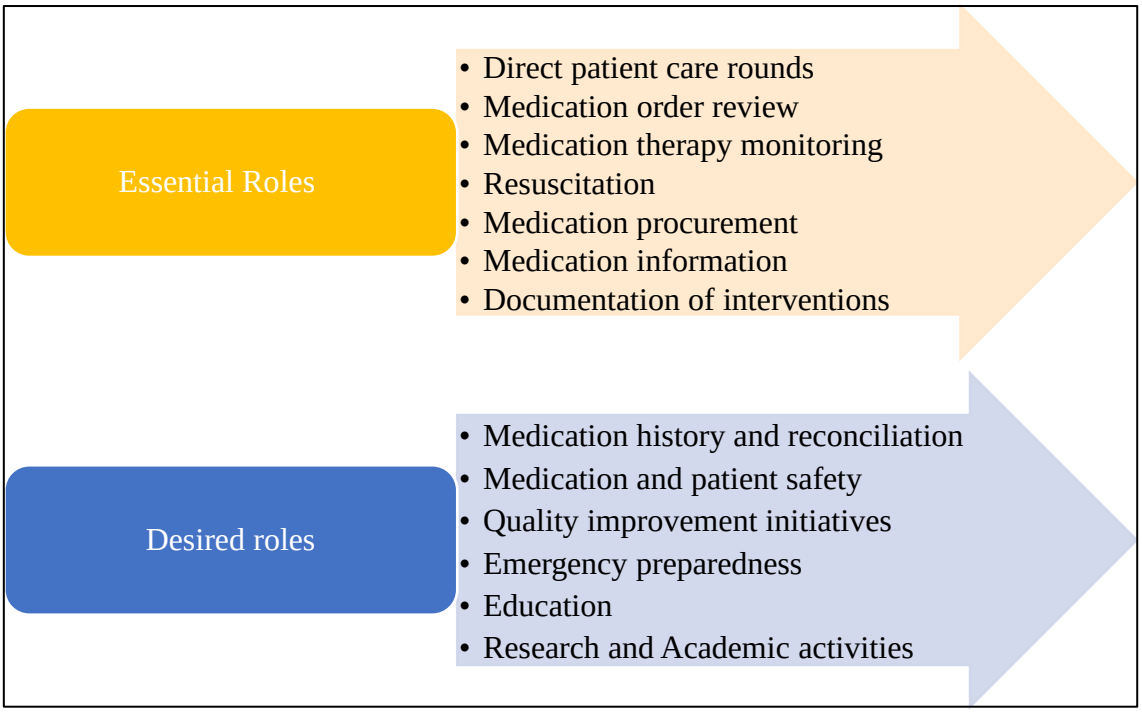

Figure 6.7 Roles met from guidelines

A list of the essential and desired roles of pharmacist that were successfully started during this study

A focus of the ED pharmacist is to decrease the potential harm to patients presenting at ED by preventing medical errors and moreover, correct identified errors before any harm to the patient occurs. The pharmacist practicing within ED has the responsibility of ensuring appropriate prescriptions and therapeutic administration of correct medicine is given to the right patient at the appropriate dose via the proper route. Moreover, for the successful establishment and maintenance of a pharmaceutical service within the ED, both the administrative and the clinical presence needed to be felt by both the physicians and nurses. Pharmacists share the same commitment and responsibility with the ED specialists, that is, to provide safe and effective patient care. Working together, this team can ensure that medication use in the ED is evidence-based, cost effective and provided in a timely manner to the ED patients.

The innovation of this research is the establishment of pharmaceutical service that embraces a patient safety focus by merging operational and administrative interventions and responsibilities with clinical practices. The impact of deliverables of the research include optimisation of medicine use processes in the ED, clinical pharmacist interventions in patient management, pharmaceutical policies implementations and formulary lists changes applicable to ED.

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Appendix 1

Doctors Pre-Service Survey

Pre-Service questionnaire

ED Physicians Demographics

* Required

1. **Position** *
   Mark only one oval.
   - ◯ Consultant
   - ◯ Resident Specialist
   - ◯ Higher Specialty Trainee
   - ◯ Basic Speciality Trainee
   - ◯ Foundation Year 2

2. **Gender** *
   Mark only one oval.
   - ◯ Female
   - ◯ Male

3. **Have you trained or worked in hospitals abroad Malta?** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No *Skip to question 7.*

Abroad training/working experience

4. **Kindly specify the county** *

5. **Name of Hospital**

6. **For how long?** *
   Mark only one oval.
   - ◯ 0-1 years
   - ◯ 1-3 years
   - ◯ 3-5 years
   - ◯ >5 years

Past Working Experiences in Interdisciplinary Team Approach

7. **Do you have any experience in working with pharmacists as part of an interdisciplinary team?** *
Mark only one oval.

- ◯ Yes *Skip to question 8.*
- ◯ No *Skip to question 12.*

Past Working Experiences in Interdisciplinary Team Approach

8. **Was this team-based approach in Emergency medicine or in other medical specialties? Kindly specify**

_____

9. **Did you experience this approach in Malta or abroad?**
Mark only one oval.

- ◯ Malta
- ◯ Abroad
- ◯ Both in Malta and abroad

10. **Was the pharmacist/s team based (working as part of a particular medical team and not the whole department) or departmental based ?**
Mark only one oval.

- ◯ Team based
- ◯ Departmental based

11. **How many pharmacists were part of this interdisciplinary team?**
Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ >4

Logistics of proposed Pharmacist's Services

Your perspectives and ideas of how and what should be the pharmaceutical services provided

12. **Are the services of MDH Pharmacy enough for the ED?**
Mark only one oval.

- ◯ Yes
- ◯ No

13. **In your opinion, is there a need for an in-house pharmacist/s at ED of MDH?** *
Mark only one oval.

	1	2	3	4	5	
Can do without	◯	◯	◯	◯	◯	Essential

14. **What would be the ideal hours for a pharmacist to be present at shop floor? Assign your order of preference for the proposed times** *
Mark only one oval per row.

	1 (Least preferred)	2	3	4 (Most Preferred)
08:00-16:00				
16:00-12:00				
12:00-08:00				
24 hours				

15. **Should the service be Team based or Departmental based?** *
Mark only one oval.

- Team based
- Departmental based

Roles

Rate the impact that the proposed roles undertaken by a pharmacist can have at ED

16. **Direct patient rounds and attendance i.e. review of patients at bed side** *
Mark only one oval.

	1	2	3	4	5	
Not essential						Essential

17. **Offer medicine information servies on the shop floor**
Mark only one oval.

	1	2	3	4	5	
Not essential						Essential

18. **Involvement in in-hospital guidelines and policies**
Mark only one oval.

	1	2	3	4	5	
Not essential						Essential

19. **Review of essential drug classes' pharmacology** *
Mark only one oval.

	1	2	3	4	5	
Not essential						Essential

20. **Medication stock selection, procurement and control** *
Mark only one oval.

	1	2	3	4	5	
Not essential						Essential

21. **Involvement in Toxicological Antidotes available on site**
Mark only one oval.

	1	2	3	4	5	
Not essential	◯	◯	◯	◯	◯	Essential

22. **Involvement in inadvertent medical incident flagging, investigation and monitoring**
Mark only one oval.

	1	2	3	4	5	
Not essential	◯	◯	◯	◯	◯	Essential

23. **Involvement in pre-hospital medication procedures and policies**
Mark only one oval.

	1	2	3	4	5	
Not essential	◯	◯	◯	◯	◯	Essential

24. **Conduct internal departmental audits**
Mark only one oval.

	1	2	3	4	5	
Not essential	◯	◯	◯	◯	◯	Essential

25. **Involvement in emergency preparedness strategies and planning**
Mark only one oval.

	1	2	3	4	5	
Not essential	◯	◯	◯	◯	◯	Essential

Medication Reconciliation

26. **Do you think medication reconciliation could be improved if a pharmacist in on board?** *
Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

27. **At what phase would it be most adequate? Assign your preference** *
Mark only one oval per row.

	1 (Most important)	2	3 (Least important)
Patient's arrival at Emergency Department	◯	◯	◯
Once a patient become admitted to MDH	◯	◯	◯
Once patient is discharged home	◯	◯	◯

28. **To which patients should this be done?**
Mark only one oval.

- ◯ Elderly patients
- ◯ Poly-pharmacy cases
- ◯ All patients

Presence in Resuscitation Rooms

29. **For which cases would you prefer this service?** *
Mark only one oval per row.

	1 (Most relevant)	2	3	4	5 (Least relevant)
Medical cases	◯	◯	◯	◯	◯
Trauma cases	◯	◯	◯	◯	◯
Poisoning/Over-dosage cases	◯	◯	◯	◯	◯
Pediatric cases	◯	◯	◯	◯	◯

30. **This service can be**
Check all that apply.

	Yes	No
Documentation of administered drugs	☐	☐
Assistance in drug preparation	☐	☐
Clarification of verbal orders	☐	☐
Assistance in drug selection	☐	☐

Any other suggestions or comments for this service?

Kindly share your comments and opinions about this service :)

31. _____

_____

_____

_____

_____

Appendix 2

Nurses Pre-Service Questionnaire

Pre-Service Questionnaire

Nurses demgraphics

* Required

1. **Age** *
   Mark only one oval.
   - ◯ 20-30
   - ◯ 30-40
   - ◯ 40-50
   - ◯ >50

2. **Gender**
   Mark only one oval.
   - ◯ Female
   - ◯ Male
   - ◯ Prefer not to say

3. **For how long have you been working as a nurse? Specify the years** *

4. **For how long have you worked in A & E? Specify the years** *

5. **Was A&E the first department you have worked in?** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No

6. **Do you or have you worked in other departments in MDH? Kindly specify** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No

7. **Have you worked in other hospitals/ health care entities apart from MDH?**
   Mark only one oval.
   - ◯ Yes
   - ◯ No

8. **If you answered Yes above, have you worked in Malta or overseas?**
   Mark only one oval.
   - ◯ Malta
   - ◯ Overseas

Education

9. **Initial nursing course**
   Mark only one oval.
   - ◯ Degree
   - ◯ Diploma
   - ◯ Other: _____

10. **Other Qualifications (please specify)**

    _____

11. **During your nursing course, were you given lectures about pharmacology?**
    Mark only one oval.
    - ◯ Yes
    - ◯ No
    - ◯ I do not know

12. **If yes, do you feel the knowledge was sufficient for your line of work in A& E?**

    _____
    _____
    _____
    _____
    _____

13. **If no, have you ever been given training after your nursing course? In your opinion, are they necessary? Explain your views.**

    _____
    _____
    _____
    _____
    _____

14. **Did you do any other courses following your initial nursing course?** *
    Check all that apply.
    - ☐ Yes
    - ☐ No
    - ☐ Other: _____

C. Treatment Room

Ask yourself whether any of the mentioned below aspects are correct or otherwise, in regards to the Treatment Room

15. **1. Overall layout of the room** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

16. **2. Layout of medication storage and shelving** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

17. **3. Labeling of medication shelves/trays** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

18. **4. Availability of medications in the treatment room**
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

19. **5. Directions for dilutions and reconstitution of IV treatment** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

20. **6. Adequate space for drug dilution and reconstitution** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

21. **7. Disposal of expired/broken medications** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

22. **8. Correct handling of multi-dose vials** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

23. **9. Are there any other issues not mentioned above or any other suggestions for improvement ?** *

D. Resuscitation Rooms

Ask yourself whether any of the mentioned below aspects are correct or otherwise, in regards to the 3 Rescuscitation Rooms

24. **1. Overall layout of the room**
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

25. **2. Layout of medication storage and shelving** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

26. **3. Labelling of medication shelves/trays** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

27. **4. Availability of medications in the Resuscitation rooms** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

28. **5. Directions for dilutions and reconstitution of IV treatment** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

29. **6. Adequate space for drug dilution and reconstitution** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

30. **7. Disposal of expired/broken medications** *
Mark only one oval.

	1	2	3	4	5	
Poor	◯	◯	◯	◯	◯	Excellent

31. **8. Are there any other issues not mentioned above or any other suggestions for improvement ?**

Overall

What are your thoughts about the following?

32. **Within your practice what are the main issues encountered when preparing and/or administering medication/s?** *

33. **When you encounter problems with medication/s, who do you refer to?** *

34. **Would you see the presence of a pharmacist helpful in A & E?** *
Mark only one oval.

	1	2	3	4	5	
Can do without	◯	◯	◯	◯	◯	Very helpful

35. **Any other comments/suggestions**

Appendix 3

Suggested roles for the emergency department pharmacist

ASHP[1] Pharmacist Roles in ED 'essential vs desired' & 'pt related vs administrative'
Essential & Patient related Roles
1. Direct patient care rounds • Create a triage system to see people according to critical illness/urgent needs/high risk populations
2. Medication order review • Review of appropriateness of dose, medication, potential interaction, pt specific factors medication prior to administration • Triage according to high-risk meds (prospective review), high-risk pt populations, emergency
3. Medication therapy monitoring • Monitoring of drugs following administration (Agents used in ED are fast acting; hence pt can be monitored shortly afterwards) • Objective and subjective monitoring parameters • Suggest revisions of medication regimens based on such parameters and established goals of therapy.
4. Patient care involving high-risk medications and procedures • Assisting during administration of high risk medications • Improve safety procedures
5. Resuscitation • To be present during resuscitation • Prepare medications, ensuring appropriate medication selection, dose, route of administration • Answering medication information question • Completion of resuscitation documentation • Inventory of toxicologic antidotes is available in the institution

[1] ASHP Guidelines on Emergency Medicine Pharmacist Services. Available from http://www.ashp.org/doclibrary/bestpractices/specificgdlemergmed.aspx

6. Medication procurement and preparation- procurement and preparation of medications used in ED

- Work hand in hand with central pharmacy to ascertain that medications are always available at the ED and if not delivery of medication is rapid
- Ensuring turnaround of medication in a timely manner
- Involved in decision-making regarding the medications continuously available at the ED, taking into consideration prescribing changes, seasonality changes
- Involved formulary issues and policy making of ED medications
- Ideally there is a sterile room for preparation of IVI's. in its absence, a laminar flow hood should be used
- Review of medications used in ED annually
- Assist and evaluate the management of these ED medications; inventory levels, storage conditions, appropriate usage

7. Medication information

- Information that covers various clinical scenarios in a timely manner
- Questions likely to arise are on selection, dose, administration, SE, IV compatibility, interaction
- Access to primary, secondary and tertiary references needed at hand

8. Documentation of interventions

- All types of interventions should be documented; both patient oriented and others such as educational
- Electronic documentation is suggested
- Review of these documentations are necessary to review trends; which can lead to identification a need to educate health care professionals working in ED, change in policies, etc
- Cost avoidance documentation would also be beneficial- for justifying the further expansion of this practice

9. Care of boarded patients- boarded patients are those in the interim phase awaiting transfer to another level of care (in patient or home)

- At minimum this the ED pharmacist should review the medication profile of critical patient

Desired & Patient related
10. Medication histories and medication reconciliation • Multiple sources are to be contacted; family, community pharmacies, residential homes • Implementation of risk-stratification protocol for identifying patients that need ED history taking • Most important are for known/suspected toxicologic, Adverse Drug Reaction emergencies
Essential & Administrative role
11. Medication and patient safety • Advocate in reporting medication errors • Identification of error trends • Involvement in establishing safety medication practices • Implementation of system improvements • Provide staff education
12. Quality-improvement initiatives • Development of medication-use guidelines and pathways
13. Leadership duties and professional service • Involvement with pharmacy organisations and health care organisations for collaborative initiatives
14. Emergency Preparedness • Knowledge of local policies • Involvement in planning and participation of planned disaster drills • Education pharmacy staff and ED staff • Education, training and certification
Desirable & Administrative role
15. Education • Education to fellow pharmacist and health care providers

• Education to students and residents • Education to patients, families
16. Research and scholarly activity • Establishment of ED pharmacy-based research projects • Establishment of ED networks for sharing of practices bases and knowledge
SHPA[2]
Optimise patient outcome and continuity of care
1. Contribute to ward rounds • Identify medication related problem • Initiate discharge planning process • Communicate medicine-related problem
2. Review of patients* • Drug history and reconciliation within 24hrs of hospital admission • Initiate a medication management plan • Establishing of a model of ED patients' prioritisation • There are currently no validated models
3. Ensure effective communication between ED and Pharmacy • Ensure that all necessary medicines and information are readily available
4. Review of medicine guidelines/protocols specific to the ED • complicated regimens for intravenous drugs, antidotes, and disaster kits • ensure that these reflect current best practice and
5. Medicine incident monitoring and reporting
6. Evaluation of high-cost medicine use in ED
7. Membership on ED and hospital-wide committees • Disaster Planning, Quality and Audit, Pre- Hospital Care and Resuscitation Committees

[2] SHPA Standards of Practice in Emergency Medicine Pharmacy Practice. Available from https://www.shpa.org.au/resources/standards-of-practice-in-emergency-medicine-pharmacy-practice

Policies and procedures
8. Pre-hospital treatment: • participation in the development and implementation of pre-hospital medication protocols used by ambulance services • participation in development of protocols for the rational inclusion, storage and maintenance of the medication in the transportable medication kits for use by ED staff within and outside the hospital.
9. Post-exposure immunisation and prophylaxis treatment protocols: • advise on immunisation and occupational and nonoccupational prophylaxis treatment protocols in line with local guidelines • participate in the development of post-exposure immunisation and prophylaxis protocols
Local Requirements
1. Good medication history taking; Liaison with patient, family, community pharmacy, residential home, etc.
2. Patient counselling on medication upon discharge ; advice on dosing, administration time, ADR
3. Assistance in Averse Drug Reporting by advising patients and prescribers
4. Assistance in Over Dosage and poisoning
5. Educational sessions to medical and nursing staff with regards to new medications/protocols and method of drug administration

6. Development of protocols • Continuous update
7. Ensuing all medications needed in the A&E are available • Maintain drug cupboards • DDA cupboards • Procurement of new drugs
8. Assisting in emergency situations • Preparation of infusions • Drawing up of medications • Double checking drugs
9. Assisting in drugs formulary selection
10. Participation in major accident/disaster

Appendix 4

ED Medication Quality Assurance Tool

Emergency Department Medicinal Cabinets of Resuscitation Rooms

Acceptance Criteria	Method of monitoring	Result - Yes/No	Comments/Suggestions
Premises-in General			
Access to Unit - allowing only authorised people	Observe	N	
Sufficient Capacity for stock	Assess/Examine	Y	
Organised premise	Assess/Examine	Y	Needs re-organisation
Clean and Clutter-free Working bench	Assess/Examine	Y	
Adequate Lighting	Observe	Y	
DDA Cabinet - double lock & key	Observe	NA	Not in use
Room is free from Clutter	Assess/Examine	Y	
Stock Control			
Shelf labelling	Assess/Examine	N	
Shelf labelling in generic name	Assess/Examine	N	Trade names used
Shelf organisation	Assess/Examine	N	Needs improvement
Rotation of stock - FEFO	Observe	Y	Only done when they have time
Withdrawal of broken/damaged stock	Observe/Assess	N	
High alert stock segregated look alike medications	Assess/Examine	N	
Look alike medications segregated	Assess/Examine	N	
Stock storage according to formulation	Assess/Examine	NA	All were IV drugs
Storage in original container	Assess/Examine	N	

Emergency Department Medicinal Cabinets of Resuscitation Rooms

Proper storage of light sensitive medications	Assess/Examine	N	
Sufficient space in refrigerator for fridge items	Assess/Examine	Y	Can be organised better
Record of DDA medication usage	Record/Assess	N/A	
High Risk Medication			
Similar products and generic name not stored in close proximity	Assess/Examine	N	
Multi-dose Medications			
Ensure unused preservative free medication is discarded once opened	Assess/Observe	N	
Labelling with the date of first opening - without covering the product name	Observe/Assess	N	
Following of aseptic techniques	Assess/Observe	N	
Syrups - including reconstituted syrups			
Stored according to product specification	Assess/Observe	NA	
Protect from light	Assess/Observe	NA	
Tightly closed	Assess/Observe	NA	
Labelling of date of opening and expiry date according to product's specification	Assess/Observe	NA	
Cleaning			
Scheduled daily cleaning time table with records	Record/Assess	Y	At cleaner
Scheduled pest control with records	Record/Assess	Y	1 monthly recorded
Written procedures in line with spillages (spillage kits)	Record/Assess	Y	OOS

Emergency Department Medicinal Cabinets of Resuscitation Rooms

Temperature Control			
Storage of medication requiring ambient temperature of 2-8°C in fridge	Assess/Examine	Y	
Storage of medication requiring ambient temperature of 15°C in fridge unless ambient temperature is 15°C	Assess/Examine	Y	
Incorrect storage of medication in refrigerator and not requiring refrigeration	Assess/Observe	Y	
Daily temperature records	Record/Assess	N	Last records in 2012
Temperature record review	Record/Assess	N	
Room temperature control with monitor for temperature room monitoring	Assess/Examine	N	No monitor
Re-settable thermometer with recording of maximum and minimum temperature for refrigerator	Assess/Examine	Y	
Monitoring of refrigerator function	Observe/Records	N	The fridge beeps if the temperature is not 6°C
Scheduled refrigerator service: cleaning, defrosting, disinfection	Record/Assess	N	
Calibration of thermometers: one for refrigerator and one for premise	Record/Assess	N	

Quality Assurance Officer		
Name:	Signature:	Registration No:
Emergency Department Pharmacist		
Name:	Signature:	Registration No:

Date:_____

Appendix 5

Reorganisation Information Booklet

Antibiotics
Top shelf
Aciclovir
Amoxicillin 500mg
Benzylpenicillin/PenicillinG
Clindamycin
Flucloxacillin
Erythromycin
Fluconazole
Metronidazole
Bottom shelf
Ciprofloxacin
Co-amoxiclav
CefTRIAXone
Clarithyromycin
CefUROXime
Gentamycin
CefoTAXime

High alert
Top shelves
AdENOSine
AdRENALine (1:1000)
Adrenaline mini-jets
AdRENALine (1:10,000)
Alteplase
Amiodarone
Aminophylline
Atropine
Calcium chloride 10% B.P.
Bupivacaine 0.5%
Calcium gluconate 10%
Digoxin
DOBUTamine
Ephedrine
DOPamine
Etomidate
GTN
Glycopyrronium bromide 200mcg

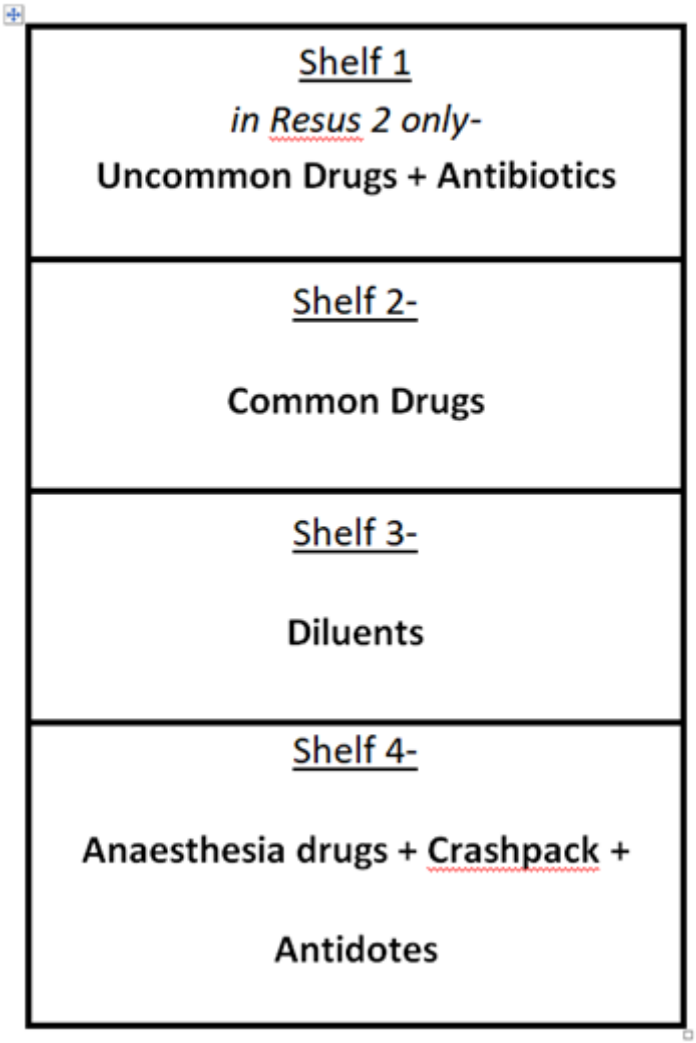
Bottom Shelves
Heparin 25,000/5mL
Labetalol
Heparin flush
Lidocaine 2%
Magnesium Sulphate 20% (200mg/mL) (0.8mmol/mL)
Metoprolol
NorADRENaline
Magnesium Sulphate 50% (500mg/mL) (2mmol/mL)
Lidocaine 1%
Nitroprusside
Phenylephrine
20%Potassium chloride
Propofol 20mL
Propofol 50mL
Salbutamol (Ventolin®)
Thiopental
Verapamil Hydrochloride (Securon®)
Vecuronium

Injections Drug Cupboard
Drawer 1
Enoxaparin 100mg
Drawer 2
Enoxaparin 20/40/60/80mg
Drawer 2
Acetylcysteine Bumetanide (Burinex®)
Drawer 3
Chlorpheniramine (Piriton®) Dexamethasone Furosemide
Drawer 4
Diclofenac (Voltaren®) Flumazenil (Anexate®)
Drawer 5
Esomeprazole
Drawer 6
Hydrocortisone Hyoscine bultylbromide (Buscopan®) Isosorbide Dinitrate (Isoket®)

Drawer 7
Haloperidol (at back)
Levetiracetam (Keppra®)
Methylprednisolone acetate (DepoMedrone®)
Metoclopramide (Maxalon®)
Drawer 8
Pabrinex ® Multivitamin Injections
Naloxone
Neostigmine
Phytomenadione/Vitamin K Adult 10mg/mL
Phytomenadione/Vitamin K Paediatric 2mg/mL
Drawer 9
Ondansetron (Zofran®)
Ranitidine (Zantac®)
Drawer 10
Promethazine (phenergan)
Phenytoin Sodium (Epanutin®)
Procholrperazine (Stemetil®)
Procyclidine
Sodium Valproate (Epilim®)

Drawer 11
Ipratropium bromide (Atrovent®)
Salbutamol Neb. (Ventolin®)
Drawer 12
Diclofenac Suppositories
Paracetamol Suppositories
Glycerol Suppositories
Drawers 13-14
Oral tabs

Resus Drug Cupboard Shelves



List of drugs according to shelves

Uncommon and Antibiotics - Shelf 1 in Resus 2 only

- Aspirin 300mg
- Clopidogrel 75mg
- Aminophylline
- Calcium Cl 10%
- Calcium Cl 10% mini-jet
- Dexamethasone
- Enoxaparin (Clexane®)
- Furosemide
- Haloperidol
- Labetalol
- Lidocaine 2%
- Metoclopramide
- Metoprolol
- Pabrinex® 1 & 2
- Vit K 10mg/mL
- Vit K paediatric
- Salbutamol IV
- CefTRIAXone (Rocephine®)
- Ciprofloxacin
- Clarithromycin
- Clindamycin (Dalacin-C®)
- Co-Amoxiclav 1g
- Gentamycin
- Metronidazole

Uncommon and Antibiotics - Shelf 1 in Resus 2 only

- Aspirin 300mg
- Clopidogrel 75mg
- Aminophylline
- Calcium Cl 10%
- Calcium Cl 10% mini-jet
- Dexamethasone
- Enoxaparin (Clexane®)
- Furosemide
- Haloperidol
- Labetalol
- Lidocaine 2%
- Metoclopramide
- Metoprolol
- Pabrinex® 1 & 2
- Vit K 10mg/mL
- Vit K paediatric
- Salbutamol IV
- CefTRIAXone (Rocephine®)
- Ciprofloxacin
- Clarithromycin
- Clindamycin (Dalacin-C®)
- Co-Amoxiclav 1g
- Gentamycin
- Metronidazole

Common Drugs- Shelf 2

- AdRENALine 1: 1000
- AdRENALine 1: 10 000
- AdRENALine minijet
- Actrapid (6 weeks from opening)
- Alteplase set (Actilyse®)
- AdENOsine
- Amiodarone
- Atropine vials
- Atropine mini-jets
- Bumetanide
- Calcium gluconate 10%
- Chlorphenamine (Piriton)
- Digoxin
- DOPamine
- 50% Dextrose 50mL
- DOBUTamine
- Ephedrine
- Esomeprazole
- Glycerine Trinitrate
- Hydrocortisone
- Heparin 5000 IU
- Ipratropium Br (Atrovent®)
- Isosorbide dinitrate (Isoket®)
- Lidocaine 1%
- Levetiracetam (Keppra®)
- Magnesium sulphate 20%
- Noradrenaline
- Ondansetron (Zofran)
- Paracetamol
- Phenylephrine
- Phentyoin Sodium (Epanutin®) & in-line Filters
- Promethazine (Phenergan®)
- 20% Potassium chloride
- Ranitidine (Zantac®)
- Salbutamol (Ventolin®) Nebs
- Sodium Valproate (Epilim®)
- Tranexemic acid- Cyklokapron

Diluents & Syringes- Shelf 3

Anaesthesia & Antidotes – Shelf 4

- Ethomidate
- Thiopental
- Vecuronium
- Propafol 20mL
- Propafol 50mL
- Activated charcoal
- Acetylcysteine
- Doxapram
- Flumazenil (Anexate®)
- Glucagon®
- 20% Intralipid
- Naloxone
- Neostigmine
- Procyclidine (Kemadrin®)
- Sodium Bicarbonate 8.4% in 10mL
- Sodium Bicarbonate 8.4% minijet

Resus Room 1 & 3

Shelf 2: Common Drugs									
Drug	QTY	Expiry date	Daily tops Expiry date						
			MON	TUES	WED	THURS	FRI	SAT	SUN
AdRENALine 1: 1000	3	10/18							
AdRENALine 1: 10 000	20	1/18							
AdRENALine minijet	4								
Actrapid (opening date written)	1	26/3							
Alteplase set (Actilyse®)	2	03/19							
AdENOsine	6	10/18							
Amiodarone	6	10/18							
Atropine vials	6	01/19							
Atropine mini-jets	4	4/19							
Bumetanide	6	2/20							
Calcium gluconate 10%	9	9/19							
Digoxin	3	4/20							
DOPamine	6	2/18							
50% Dextrose 50mL	2	1/20							
DOBUTamine	6	4/18							
Esomeprazole	2	12/18							
Glycerine Trinitrate	3	6/18							
Hydrocortisone	6	3/20							
Heparin 5000 IU	2	3/18							
Ipratropium (Atrovent®)	6	6/18							
Isosorbide dinitrite (Isoket®)	6	1/21							
Levetiracetam (Keppra®)	3	9/21							
Magnesium sulphate 20%	3	8/18							
Noradrenaline	5	5/19							
Ondansetron (Zofran)	8	5/20							
Paracetamol	6	5/19							
Phentyoin Sodium (Epanutin®) & in-line Filters	8	5/18							
20% Potassium chloride	3	5/19							
Ranitidine (Zantac®)	3	5/18							
Salbutamol (Ventolin®) Nebs	2	11/19							
Sodium Valproate (Epilim®)	6	11/19							
Tranexemic acid (Cyklokapron®)	6	9/19							

Resus Room 1 & 3

Shelf 4: Anaesthesia & Antidotes									
Drug	QTY	Expiry date							
CRASH PACKS	3 Packs								
Etomidate	3	5/18							
Thiopental	3	4/18							
Vecuronium	3	4/18							
Ephedrine	3	6/20							
Phenylephrine	3	3/18							
Propafol 20mL	3	7/19							
Propafol 50mL	3	7/20							
Activated charcoal	1	10/18							
Acetylcysteine	10	10/18							
Doxapram	2	10/19							
Flumazenil (Anexate®)	3	7/18							
Glucagon	1	8/19							
Naloxone	1 box	1/19							
Neostigmine	6	10/18							
Procyclidine	6	6/19							
Sodium Bicarbonate 8.4% in 10mL	5	6/19							
Sodium Bicarbonate 8.4% minijet	2	6/18							
Fridge									
Atracurium	3								
Pancuronium	3								
Rocuronium	3								
Suxamethonium	3								
		Date							
	Initials & Signature								

Resus 2

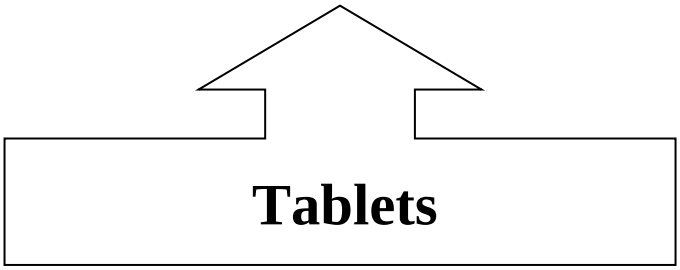
Shelf 1 : Uncommon & Antibiotics									
Drug	QTY	Expiry date	Daily tops Expiry date						
			MON	TUES	WED	THURS	FRI	SAT	SUN
Aspirin 300mg	1 sachet	6/20							
Clopidogrel 75mg	2 sachet	3/18							
Aminophylline	2	5/19							
Calcium Cl 10%	5	7/19							
Calcium Cl 10% mini-jet	2	1/19							
Dexamethasone	2	1/20							
Enoxaparin (Clexane®)	2	9/19							
Furosemid	3	5/18							
Haloperidol	3	12/18							
Labetalol	3	5/18							
Lidocaine 1%	2	11/19							
Lidocaine 2%	2	11/19							
Metoclopramide	6	3/19							
Metoprolol	6	6/19							
Pabrinex® 1 & 2	3 each	10/18							
Vit K 10mg/mL	3	11/19							
Vit K paediatric	3	1/20							
Salbutamol IV	1	5/19							
CefTRIAXone (Rocephine®)	3	9/19							
Ciprofloxacin	3	2/19							
Clarithromycin	3	5/20							
Clindamycin (Dalacin-C®)	3	9/19							
Co-Amoxiclav 1g	3	1/19							
Gentamycin	3	8/20							
Metronidazole	3	8/20							
Shelf 2: Common Drugs									
AdRENALine 1: 1000	3	1/19							
AdRENALine 1: 10 000	20	7/18							
AdRENALine minijet	5	7/18							
Actrapid (6 weeks from opening)	1	8/18							
Alteplase set (Actilyse®)	2	3/19							
AdENOsine	10	10/18							
Amiodarone	10	10/18							
Atropine vials	6	1/19							
Atropine mini-jets	4	4/19							
Bumetainde	6	1/20							
Calcium gluconate 10%	9	10/19							
Chlorphenamine (Piriton)	3	8/18							
Digoxin	3	11/21							
DOPamine	6	1/20							
50% Dextrose 50mL	4	5/19							
DOBUTamine	6	7/18							
Ephedrine	3	1/20							
Esomeprazole	6	12/18							
Glycerine Trinitrate	3	6/18							
Hydrocortisone	6	9/20							
Heparin 5000 IU	2	7/19							

Resus 2

Ipratropium Br (Atrovent®)	3	3/19							
Isosorbide dinitrite (Isoket®)	6	1/21							
Levetiracetam (Keppra®)	3	8/20							
Magnesium sulphate 20%	3	7/18							
Noradrenaline	5	5/19							
Ondansetron (Zofran)	8	5/20							
Paracetamol	6	5/19							
Phenylephrine	3	11/18							
Phenytoin sodium	8	5/18							
Promethazine (Phenergan®)	3	6/18							
20% Potassium chloride	3	5/20							
Ranitidine (Zantac®)	3	5/18							
Salbutamol (Ventolin®) Nebs	2	2/20							
Sodium Valproate (Epilim®)	6	11/19							
Tranexemic acid-Cyklokapron	6	5/20							
CRASH PACKS	3 Packs								
Ethomidate	3	5/18							
Thiopental	6	4/20							
Vecuronium	6	4/18							
Propafol 20mL	3	1/19							
Propafol 50mL	3	6/20							
Activated charcoal	1	10/18							
Acetylcysteine	10	10/18							
Doxapram	5	10/19							
Flumazenil (Anexate®)	3	7/18							
Glucagon	1	8/19							
20% Intralipid	1 bags								
Naloxone	1 box	1/19							
Neostigmine	6	10/18							
Procyclidine (Kemadrin®)	3	6/19							
Sodium Bicarbonate 8.4% in 10mL	5	1/20							
Sodium Bicarbonate 8.4% minijet	2	4/18							
Fridge									
Atracurium	3	1/19							
Pancuronium	3	11/18							
Rocuronium	3	11/18							
Suxametonium	3	6/18							
	Date								
	Initials & Signature								

Appendix 6

DDA Register Front Page with Layout



DDA Register

Start Date:_____ End Date:_____

Alfentanyl 1mg/2mL

Diamorphine 5mg

Diazepam (Valium) 10mg IV

Diazepam (Valium) 2mg tablets

Diazepam (Valium) 5mg tablets

Diazepam 5mg suppositories

Diazpeam 10 mg suppositories

Fentanyl IV 100mcg/2mL

Ketamine 100mg/2mL

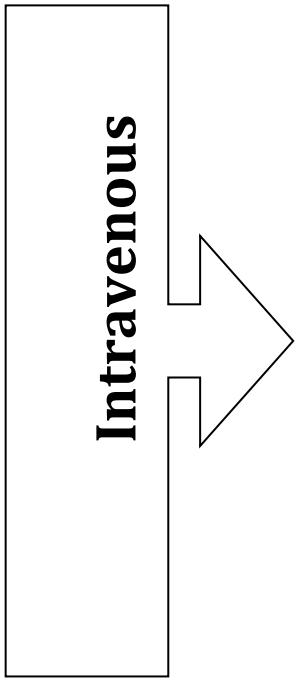
Lorazepam (Ativan) 1mg tablets

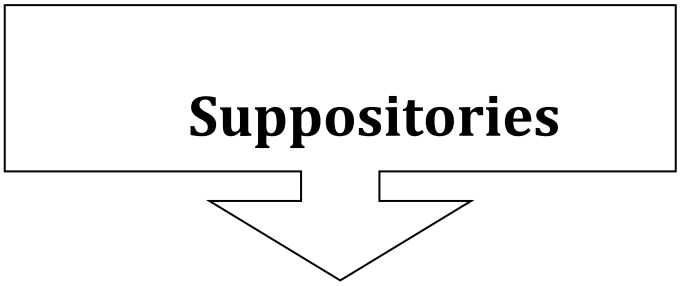
Lorazepam(Ativan) IV 2mg/1mL (in Resus 1 fridge 1)

Pethadine 50mg/1mL

Pethidine 100mg/2mL

Tramadol 50mg tablets





Appendix 7

Weekly Order List

		Order / /	Order / /	Order / /
INTRAVENOUS ANTIBIOTICS				
Aciclovir 250 mg **(Zovirax®)**	**10**			
Amoxicillin 500 mg	**20**			
Benzylpenicilin/Penicilin G 1000000 UI	**25**			
Clindamycin 300 mg/2mL **(Dalacin®)**	**20**			
Flucoxacillin 1g **(Floxapen®)**	**10**			
Erytromycin	**5**			
Fluconazole	**5**			
Metronidazole 500 mg	**40**			
Ciprofloxacin 200 mg/100 mL	**40**			
CoAmoxicilin 1.2g **(Augmentin®)**	**200**			
Ceftriaxone 2g iv	**25**			
Clarithromycin 500 mg **(Klacid®)**	**30**			
Cefuroxime 750 mg	**20**			
Gentamicin 80mg	**40**			
Cefotaxine 1g	**20**			
HIGH ALERT DRUGS				
Adenosine 6mg	**12**			
Adrenaline 1:1000	**40**			
Adrenaline minijets	**10**			
Adrenaline 1:10000	**80**			
Amiodarone 50 mg/mL **(Cordaron®)**	**12**			
Alteplase treatment set	**8**			
Aminophylline	**10**			
Atropine SO4 600mcg	**10**			
Atropine minijets	**10**			
Calcium chloride injections	**10**			
Calcium chloride minijets	**10**			

Bupivacaine 0.5%	**10**			
Calcium gluconate	**40**			
Digoxin 0.05 mcg	**25**			
Dobutamine	**10**			
Doxapram	**10**			
Ephedrine	**10**			
Dopamine	**10**			
Etomidate	**20**			
Glyceryl Trinitrate 1mg/mL in 50mL vial	**8**			
Glycopyrronium bromide	**5**			
Heparin 25000/5mL	**30**			
Labetalol 5mg/mL * 20 mL	**5**			
Heparin flushing solution	**20**			
Lidocaine 2%	**10**			
Magnesium sulphate 20%	**30**			
Metoprolol	**15**			
Noradrenaline 1:1000 2mg/mL	**10**			
Magnesium sulphate 50%	**30**			
Lidocaine 1%	**100**			
Phenylephrine	**5**			
Potassium chloride 20%	**20**			
Propafol 10 mg/mL*20mL	**20**			
Propafol 10 mg/50mL	**10**			
Salbutamol 5mg/ml iv **(Ventolin®)**	**5**			
Sodium bicarbonate minijet 8.4% ampoules	**20**			
Sodium bicarbonate minijet 8.4% minijet	**6**			
Thiopental 20mL	**50**			
Thiopental 50mL	**30**			
Tranxamic acid 500 mg/5 ml	**40**			
Verapamil 5 mg/2 ml	**10**			
Vecuronium	**10**			

IV DRUGS				
Glucose 50%	**20**			
Enoxaparin 20 mg **(Clexane®)**	**20**			
Enoxaparin 40 mg **(Clexane®)**	**20**			
Enoxaparin 60 mg(**Clexane®)**	**20**			
Enoxaparin 80 mg (**Clexane®)**	**20**			
Enoxaparin 100 mg(**Clexane®)**	**30**			
Acetylcisteine	**20**			
Bumetanide 0.5mg/ml*4mL **(Burinex®)**	**200**			
Chorpheniramine 10mg/mL **(Piriton®)**	**30**			
Dexamethasone 8mg/2mL	**20**			
Furosemide 20mg/2mL	**30**			
Flumazenil **(Anexate®)**	**10**			
Diclofenac 75mg **(Voltaren®)**	**120**			
Esomeprazole 40 mg	**200**			
Hyoscine Butylbromide 20mg **(Buscopan®)**	**100**			
Hydrocortisone 100mg	**120**			
Isosorbide Dinitrate **(Isoket®)**	**100**			
Haloperidol	**10**			
Levetiracetam **(Keppra®)**	**15**			
Methylprednisolone acetate 40mg IM depot	**15**			
Metoclopramide **(Maxalon®)**	**150**			
Naloxone 400mcg/mL	**30**			
Pabrinex® (Multivitamine B and C)	**20**			
Neostigmine 2.5mg/mL	**10**			
Phytomenadione/VitK adult 10 mg	**10**			
Phytomenadione/VitK pediatrics 2 mg	**10**			
Ondansetron 4mg **(Zofran®)**	**80**			
Ranitidine 50mg/2ml **(Zantac®)**	**200**			

Promethazine	**10**			
Phenytoin Sodium 250 mg **(Epanutin®)**	**10**			
Procholrperazine 12.5 mg/ml (**Stematil®)**	**50**			
Procyclidine **(Kemadrin®)**	**5**			
Sodium Valproate 400 mg **(Epilim®)**	**20**			
FRIDGE				
Neutral Soluble insulin (**Actrapid®)**	**3**			
Isophane Human Insulin **(Insulatard®)**	**1**			
Biphasic Isophane insulin (**Mixtard®)**	**1**			
Terlipressin acetate 0.12mg/ml	**2**			
Terlipressin acetate 0.2 mg/ml	**1**			
Suxamethonium chloride 100 mg/2ml	**10**			
Pancuronium	**10**			
Rocuronium	**20**			
Atracurium 25 mg	**25**			
Silver sulphadiazine cream 50 g **(Silverderm®)**	**10**			
Silver sulphadiazine cream 500 g **(Silverderm®)**	**2**			
Adsorbed tetanus vaccine	**10**			
Lidocaine e' adrenaline 1% injection	**2**			
TABLETS				
Amlodepine 10mg tablets **(Istin®)**	**112**			
Amlodepine 5mg tablets **(Istin®)**	**56**			
Aspirin 300mg tablets	**84**			
Aspirin 75mg tablets	**60**			
Bendroflumethiazide 2.5mg tablets	**14**			
Bumetanide 1mg tablets **(Burinex®)**	**60**			
Clopidogrel 75mg tablets **(Plavix®)**	**336**			
Ciprofloxacin 250mg tablets **(Ciproxin®)**	**20**			

Co-amoxiclav 375mg tablets **(Augmentin®)**	**20**			
Codein phosphate 30mg tablets	**336**			
Diclofencac sodium 25mg tablets **(Voltaren®)**	**504**			
Dipyridamole 25mg	**168**			
Glycerin trinitrate sublingual tablets	**100**			
Ibuprofen 200mg tablets	**192**			
Levothyroxine sodium 100mcg **(Thyroxine®)** tablets	**28**			
Levothyroxine sodium 50mcg **(Thyroxine®)** tablets	**28**			
Metformine 500mg tablets	**28**			
Metoclopramide 10mg tablets **(Maxalon®)**	**28**			
Omeprazole 20mg capsules **(Losec®)**	**100**			
Paracetamol 500mg tablets **(Panadol®)**	**1900**			
Perindopril 4mg tablets **(Coversyl®)**	**30**			
Potassium chloride 600mg tablets **(Slow K®)**	**30**			
Prednisolone 5mg e.c. tablets	**28**			
Ranitidine 150mg tablets **(Zantac)**	**30**			
Ipratropium bromide nebuliser solution **(Atrovent®)**	**120**			
Salbutamol nebuliser solution **(Ventolin®)**	**10**			
Diclofenac 100mg supps	**110**			
Glycerol 4g adult supps	**144**			
Others				
Aqueous cream	**5**			
Calcium resonium powder	**1**			
Ethyl chloride spray	**12**			

Lidocaine 10% spray	**2**			
Lidocaine sterile gel 10mls **(Instilagel®)**	**100**			
Mag-alu-dim antacid mixture **(Malox®)**	**3**			
Oral rehydration salts **(Diorolyt®)**	**80**			
Povidone iodine aqueous **(Betadine®)**	**5**			
Povidone iodine scrub **(Betadine®)**	**5**			
Zinc and castor oil cream	**1**			
Glucagon 1mg injection	**10**			
White Soft Paraffin	**1**			
OTHERS				
Water for Injections	**1000**			
Sodium chloride 10 ml 0,9%	**1000**			
Paracetamol 10mg/ml x 100ml i.v.	**600**			
Chlorhexidine gluconate e' cetrimide	**500**			
Plasma expander	**40**			
Paracetamol sups 500 mg	**20**			
20% Intralipid	**5 bags**			

Appendix 8

Adult Acute Pain Prescription

Adult Acute Pain Prescription | Emergency Department

Patient name: _____ ID Card_____

Presenting complaint: _____

Drug allergies _____

1. Assess* pain and assign pain score value → _____

2. Treat STABLE patients according to pain score value

1-3 Mild pain	4-6 Moderate Pain	7-10 Severe Pain
Paracetamol and/or NSAIDS	As for 1-3 Mild pain and/or Codeine Phosphate 30-60mg t.d.s (240mg/24hrs)	IV Opioid (+ antiemetic) and/or PR Diclofenac 100 mg stat.
PO Paracetamol * ≥50kg→ 1g q.d.s. 40-49kg → 750mg q.d.s. 35-39kg → 500mg q.d.s. *Administer IV Paracetamol ONLY if: 1. PATIENT NOT TOLERATING ORAL INTAKE 2. PATIENT NEEDS TO BE STARVED PO Ibuprofen 400mg t.d.s. or Diclofenac: PO 50mg t.d.s. or PR 100 mg stat.		Morphine 2-10mg 4 hrly Pethidine 25-50mg 4 hrly Fentanyl 50-100micrograms stat. Dose titrated according to BP and Antiemetic Ondansetron 4mg or Metoclopramide* 10mg *Caution in elderly and young adults age 15-19

Drug/s Administered:_____

Time of administration:_____

_____ _____

Name and signature of Nurse Name and signature of Doctor

3. Re-evaluate pt with 30 min of analgesia administration- treat/escalate accordingly

_____ _____

Name and signature of Nurse Name and signature of Doctor

Notes:

- Use splints / Slings / Dressings etc. Consider regional blocks
- **In biliary colic NSAIDS are preferred treatment choice**
- **Elderly**
  - Paracetamol PO & IV are first line
  - NSAIDS; lowest dose due to increased risks of side effects
  - Opiates; lowest dose; high risk of interactions with CNS acting drug- increase risk of respiratory depression
- NSAIDS

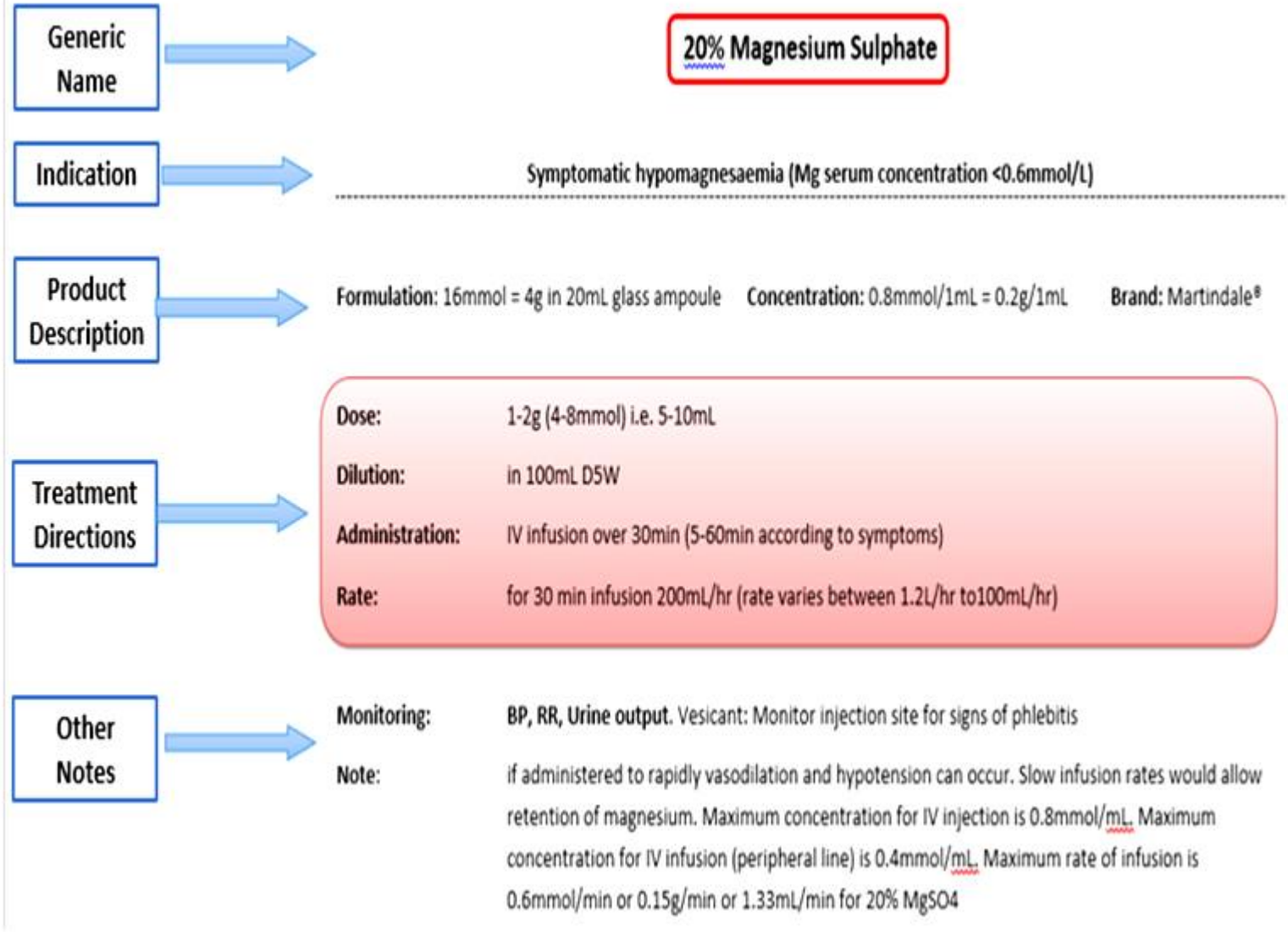
Cautions	Contraindications
– Elderly – Allergic disease – Coagulation defects – IHD/uncontrolled HT – Cardiac disease/impairment – Peripheral artery disease – Cerebrovascular disease – Oedema – Hepatic Impairment – Asthma – Renal impairment	– Hypersensitivity to NSAIDS – Active or history of recurrent GI bleed or ulceration – Severe heart failure – Pregnancy

- Opioids

Monitor	Contraindications
– Respiratory Rate – Blood Pressure – Consciousness / Sedation	– Acute Respiratory depression – Raised intracranial pressure

Appendix 9

Dilution Card Format


Generic Name
20% Magnesium Sulphate
Indication
Symptomatic hypomagnesaemia (Mg serum concentration <0.6mmol/L)
Product Description
Formulation: 16mmol = 4g in 20mL glass ampoule
Concentration: 0.8mmol/1mL = 0.2g/1mL
Brand: Martindale®
Treatment Directions
Dose: 1-2g (4-8mmol) i.e. 5-10mL
Dilution: in 100mL D5W
Administration: IV infusion over 30min (5-60min according to symptoms)
Rate: for 30 min infusion 200mL/hr (rate varies between 1.2L/hr to100mL/hr)
Other Notes
Monitoring: BP, RR, Urine output. Vesicant: Monitor injection site for signs of phlebitis
Note: if administered to rapidly vasodilation and hypotension can occur. Slow infusion rates would allow retention of magnesium. Maximum concentration for IV injection is 0.8mmol/mL. Maximum concentration for IV infusion (peripheral line) is 0.4mmol/mL. Maximum rate of infusion is 0.6mmol/min or 0.15g/min or 1.33mL/min for 20% MgSO4

Appendix 10

Antidote Administration of Hydrofluoric Acid Toxicity

Accident & Emergency Department

Recommended On-site Medical treatment for

Hydrofluoric Acid Exposure

- **Care for patients following decontamination**
- Wear surgical sterile gloves prior to mixing of antidotes and make sure they are worn throughout the procedure

Treatment Guideline

	Skin Burns	Inhalation	Eye exposure
Agents needed	1. 8 vials of 10mL Calcium Gluconate 10% 2. 3 tubes K-Y Jelly® 82g 3. Mixing bowls (500mL) 4. Sterile mixers	1. 1 vial of 10mL Calcium Gluconate 10% 2. 3 vials of 10mL Water for Injections 3. 5mL syringes	1. 1L Normal Saline 0.9% (NS) 2. Drip set
Dilution	• Empty all the K-Y Jelly ® into mixing bowl and add all the Calcium Gluconate vials • Mix rapidly with sterile mixers • Consistency becomes gel like with time	• Withdraw 1mL Calcium Gluconate 10% in the syringe • Withdraw up to 4mL with Water for Injections	• Attach the drip set to the NS bag
Application	• Apply gel and continuously message until pain/redness disappears or more definitive care is given • Reapply as frequently as needed	• Add the 4mL prepared solution to nebulisation cup • Administer with 100% Oxygen (oxygen driven nebulisation)	• Flush eyes for minimum of 15 minutes
	Pain should subside within 30-40min. Continue applying treatment for 2 hours	Repeat nebulised Calcium Gluconate every 4 hours	Remove any contact lenses if possible prior to the flush

Ver 1.2 March 2017

List of Medical supplies

1. 10mL Calcium Gluconate 10% vials → 120 vials
2. 10mL vials Water for injections → 40 vials
3. Salbutamol Nebulised Solution → 5 vials
4. Maalox ®→ 2 vials
5. 82g K-Y gel® → 50 tubes
6. Mixing bowls → 4
7. Sterile mixers → 3
8. Nebulizer masks →8
9. Surgical sterile gloves → 25
10. Medical oxygen→ 5
11. 5mL syringes →40
12. 1L NS →10 bottles
13. Drip sets → 8
14. Sterile swabs → 100
15. Sterile dressing → 25
16. Sterile eye dressing →10
17. 10mL vials Water for injections → 40 vials

Accident & Emergency Department

Hydrofluoric Acid Toxicity Treatment

In-Patient setting Treatment Guideline using

5% Calcium Gluconate injections

- To be used in large burns (>25 sq inches) and when 2.5% topical Calcium Gluconate gel did not provide pain relief within 30-40min
- Pain is the determinant factor when injections are to be stopped
- Do not use local anaesthetics as these mask pain
- If skin integrity is compromised by multiple injections, topical antibiotic creams should be applied; Silverderma Cream ®

Agents needed	1. 10ml Calcium Gluconate 10% vials 2. Normal Saline 0.9% NS 3. Syringes
Dilution	Add equal volume of Calcium Gluconate 10% with NS
Administration	Injection: inject beneath, around and surrounding the area

- Systemic consequences of HF exposure include

1. Electrolyte imbalance
    a. Hypocalcemia- risk with inhalations, ingestion, skin burns > 25 sq inches
    b. Hypomagnesemia
    c. Hyperkalemia
2. Respiratory failure
3. Cardio-depressing

- In severe systemic intoxication cases treat with haemodialysis

Appendix 11

Guideline for administration of IV Lorazepam

IV Lorazepam-Ativan® - 4mg in 1 mL ampoule|Fridge item

Routes	Dilution	Administration*
IV	• **Add 1mL 0.9% Normal Saline or Water for Injection**; resulting concentration of 2mg in 1mL • The solution should be clear and colourless. Inspect visually for particulate matter/discoloration prior to administration. Discard if present. • Do not mix with any other medications in the same syringe	• Diluted drug as **IV injection** over **3-5 m** into a large vein • In Status epilepticus administer diluted drug as **rapid IV injection** into a large v
IM	• **No dilution needed** • If desired, may be added with 1mL NS or WFI to ease administration	• Administer as **deep IM injection**

***Note: Administer IV injection with extreme caution** to avoid inadvertent intra-arterial injection (can cause arteriospasm possibly resulting in gangrene)

Indications	Dose and rate
Status epilepticus	**4mg** stat dose (weight based dose 0.1mg/Kg) as **IV bolus**. Can be repeated once after 10-20 min[1,2]
Acute panic attacks	**1.5-2mg** (0.025-0.03mg/kg) every 6 hr
Alcohol withdrawal syndrome**	**2 mg** every 6 hours for 4 doses, then 1 mg every 6 hours for 8 additiona doses
Alcohol withdrawal delirium**	**1 - 4 mg** every 5 to 15 minutes until calm, then every hour as needed to maintain light somnolence
Rapid tranquilization of the agitated patient**	**1 -3 mg** administered every 30 to 60 minutes

** Off-licence indications

Dosing notes

- IM injection is not recommended; oral administration works better
- Reduce Lorazepam dose by 50% with concomitant Valproic acid treatment
- In geriatric patients, doses are to be kept to lower end. Maximum single dose should be 2mg
- Avoid in acute pulmonary insufficiency, sleep apnoea syndrome, myasthenia gravis and severe hepatic insufficien

Monitor

- **Respiratory rate** every 15 minutes for 2 hours after the injection (can cause respiratory depression). Keep under observation for 8 hours after the injection and preferably overnight
- **Injection site** for extravasation

Storage

- Store at 2–8°C. Once removed from fridge, product is stable for **only 30 minutes** at room temperature. Do not freeze

Refer to product SPC for complete product information

[1] https://www.wsnet.org/clinical_resources/guidelines

[2] https://www.nice.org.uk/guidance/cg137/chapter/appendix-f-protocols-for-treating-convulsive-status-epilepticus-in-adults-and-children-adults-published-in-2004-and-children-published-in-2011#treating-convulsive-status-epilepticus-in-adults-published-in

Appendix 12

Guideline for administration of IV 20% Intralipid

Intralipid® 20%

as "lipid rescue" for Severe Local Anaesthetic Toxicity

Presentation: White emulsion in 500mL infusion bags

Indication[1]: Local anaesthetic induced cardiac arrest that is unresponsive to standard therapy. It should be used only after standard resuscitation methods fail to re-establish sufficient circulatory stability

Suggested Dosage regimen: **IV bolus** followed immediately by **IV infusion**

	Dose	Administration
1. IV Bolus	**1.5 mL/kg** over 1 min Repeat after 3-5min in persistent asystole. Maximum dose 3mL/Kg	Withdraw the equivalent volume of Intralipid® 20% in a syringe and administer as **IV bolus.**
2. IV Infusion	**0.25mL/kg/min** for 30-60min	Attach bag to administration set and administer via volumetric pump at rate of **15mL/hr**

Dosing notes:

- Infusion rate can be doubled to 0.5 mL/kg/min if BP remains low
- 10-12 mL/kg is the approximate suggested upper limit for the first 30 mins
- Once circulatory stability is attained, continue infusion for at least 10 mins then the infusion should be stopped.

Monitoring: BP, RR, HR

Storage: below 25°C- do not refrigerate. Discard any remaining unused solution

Note: Contains egg-yolk phospholipids – avoid in severe egg allergy.

Metabolic acidosis has been associated with severe over dosage of Intralipid 20%.

[1] Data is still extremely limited; there are no standard methods for lipid emulsion therapy

References:
Intralipid.Injectables Drug Guide. Medicines Complete. Available from https://www.medicinescomplete.com/mc/idg/current/I06- mn0001.htm?q=intralipid&t=search&ss =text&tot=2&p=1#I06-bib-0001
www.lipidresque.org http://lipidrescue.squarespace.com/if-you-are-resuscitating-a-pat/

Appendix 13

Policy for Carbapenem Prescribing

Tabled guidelines when Carbapenems are indicated (summarised from MDH Antibiotic guidelines)

Refer to the full Antibiotic guidelines (available on P Drive) for more details *

1. Suspected sepsis	
Patient had already received ≥3 days of pip-tazo **AND** ESBL/CRE negative at this admission/over the past year	**Meropenem 1g 8 hrly** **or** **Imipenem/cilastin 500mg 6 hrly**
> In severe sepsis (that fits such criteria) also **add Gentamicin**	
2. Suspected febrile neutropenia	
a. CRE rectal swab negative **AND** MASCC score ≤20 **AND** ESBL positive isolate at this admission	**Meropenem 1g 8hrly** **or** **Imipenem/cilastin 500mg 6 hrly** Dual therapy with **Gentamicin.**
b. CRE rectal swab positive **AND** ceftazidime resistant **AND** meropenem MIC (sensitivity test) ≤8mg/mL	**Meropenem 2g 8hrly** **or** **Imipenem/cilastin 1g 8 hrly** Dual therapy with **Amikacin**
> If atypical pneumonia is suspected add **clarithromycin.** > If pt has PVP/CVC lines or MRSA positive at this admission or over the past year add **glycopeptides- vancomycin/teicoplanin.**	
3. Intra-abdominal infections (w/o necrotising pancreatitis)	
a. Hospital acquired **with** severe infection markers 3 or more of the following present: - Significant peritoneal involvement/diffuse peritonitis - Delayed presentation (>24h) - Advanced age (>65 yrs) - Organ dysfunction - Poor nutritional status - Presence of malignancy	**Ertapenem 1g 24hrly** Multiple regimen with **Gentamicin** and **Teicoplanin**
b. Hospital acquired **without** severe infection markers but pt received broad spectrum quinolone (such as levofloxacin, ciprofloxacin)or cephalosporin in previous 3 months	
4. Suspected UTI	
Upper UTI who received cephalosporin or quinolone in the previous month **OR** ESBL isolated in the previous 6 months	**Ertapenem 1g 24hrly**
5. Suspected Cellulitis	
Suspicion of necrotizing faciitis/ Grade IV cellulitis in penicillin allergy (not immediate-type hypersensitivity)	**Meropenem 1g 8hrly** Multiple antibiotic regimen with **teicoplanin, clindamycin and gentamicin.**

Appendix 14

Pharmacology update- Pain Lecture Slides

ANALGESICS FOR ACUTE PAIN IN ADULTS AT EMERGENCY

BRIEF PHARMACOLOGIC PROPERTIES OVERVIEW OF ANALGESICS IN ADULTS

"Even though this isn't the maternity ward, Some times it can sure pass as one."

Note: This covers the basic and important information. It is not an exhaustive presentation - full drug profiles side can be found from respective drug SPC

TYPES OF PAIN

1. **Nociceptive** pain

   - originating from a pain stimulus. Further classified into **Somatic pain** and **Visceral pain**
   - In **somatic** pain, the location of pain is easily described (such as in muscles, joints, bones and upper GI tract) whilst in **visceral** pain pt has trouble describing or localising the pain (such as abdominal and thoracic pain).

2. **Neuropatic** pain: originating from nervous system

There are circumstances where these pains co-exit,

resulting in **Mixed pain**, *eg*. Cancer and HIV pts.

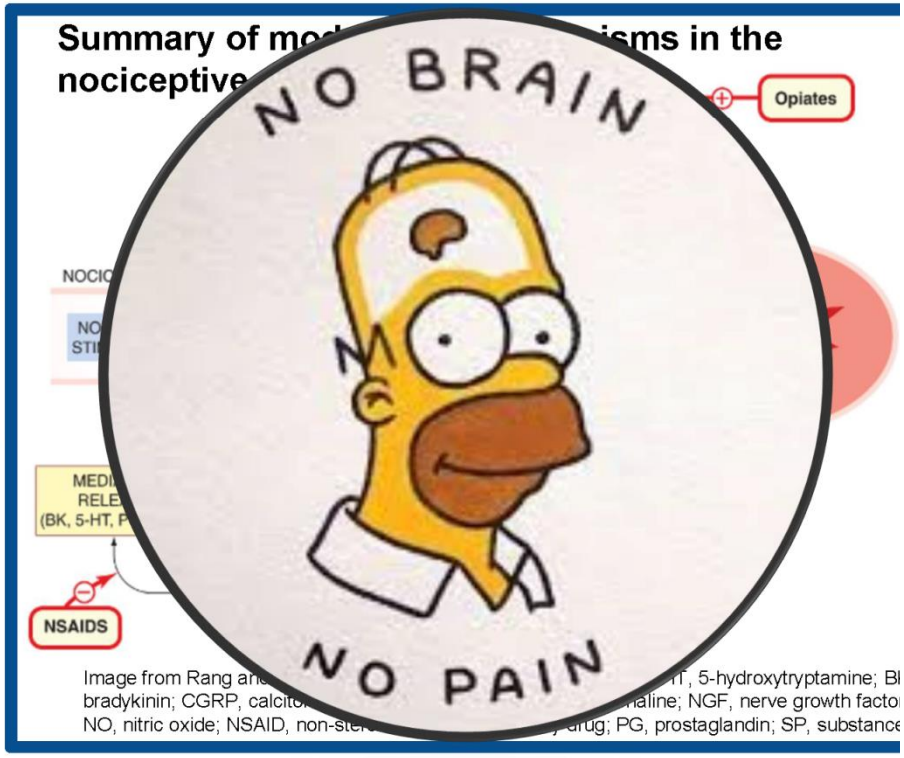
Such management is more complex.

DIFFERENCES

	Nociceptive pain	Neuropatic pain
Cause	Immediate painful stimulus; consider it as a protective mechanism that warns of damage- when you remove the cause, the pain tends to go away	Damage to nerves which takes days/months to develop for eg; diabetes, surgery, herpes zoster, injury, etc.
Pt's Description	Somatic; sharp, knife-like, aching, throbbing Visceral; crampy, aching, gnawing	Stabbing sensation, pins and needles, electric shock-like, burning, throbbing
Duration	Can be both acute and chronic	Chronic
Treatment	**Generally responds to analgesics**	**Difficult to treat**; usually requires other agents than analgesics such as Tricyclic antidepressants (eg. Amitriptyline) and Antipsychotics (eg. Pregabalin)

NOCICEPTIVE PAIN PATHWAY- BRIEF OVERVIEW

- In simple terms, once a sensory neuron is stimulated, neurotransmitters are released such as bradykinin and prostoglandins
- These neurotransmitters cause a pain impulse along nerve fibres, through the spinal cord which then projects to the higher brain centres
- Pain is felt once the stimulus reaches various parts of the brain (thalamus, pre-frontal cortex and more)



ANALGESICS

1) **Paracetamol**

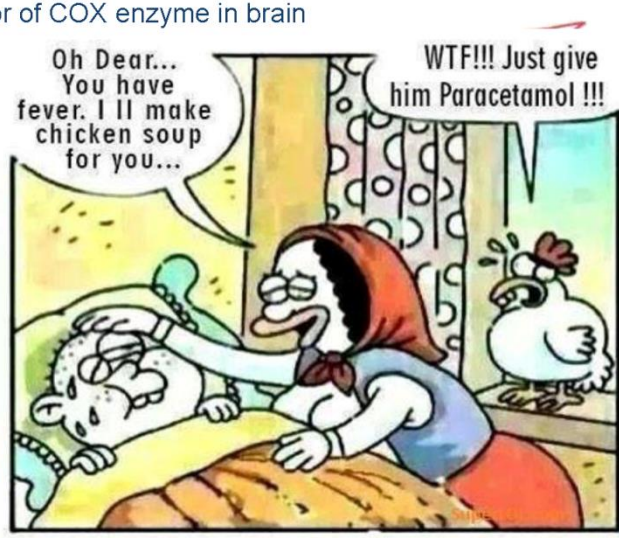
2) **NSAIDS**

3) **Opioids**

4) **Others**

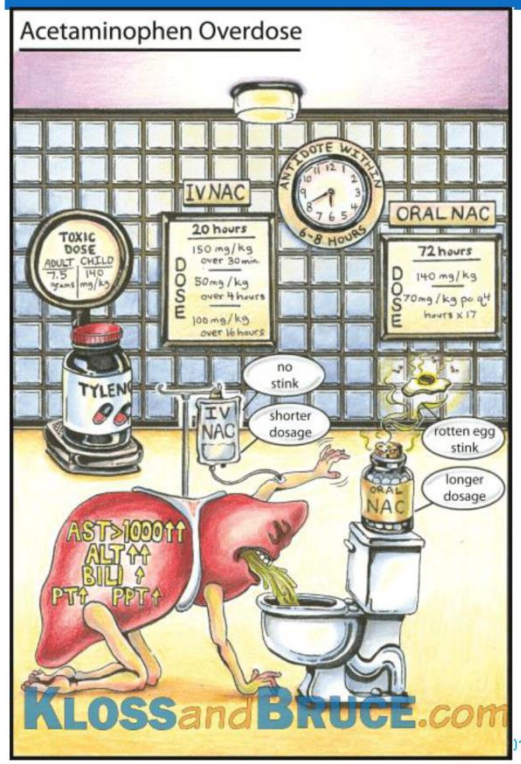
PARACETAMOL

- Mechanism of Action (MOA): still not fully understood but thought to be a weak inhibitor of COX enzyme in brain
- Both **analgesic and antipyretic** but **no** anti-inflammatory effect
- Dose:
  - ≥ 50 kg → 1g QDS
  - 40-49kg → 750mg QDS
  - 35-39kg → 500mg QDS
- Side effects (SE):
  - PO: mild and minimal (with normal dosages) skin reactions, blood disorders.
  - IV: tachycardia and hypotension have been reported
  - Over dosage: severe hepatic toxicity (first signs are nausea and vomiting). This to to the drug converted to a toxic metabolite that if not inactivated reacts with cell pr antidote as it increase the agent that inactivates the toxic paracetamol metabolite



- Caution: Hepatic impairment and renal impairment- adjustment needed to 6hrly dosage interval in eGFR <30mL/min
- Advantages over NSAIDS: No risk of GI bleeding and perforation, bronchospasms and asthmatic attacks, cardiovascular effects
- Preferred analgesic agent in elderly
- Drug interactions with hepatotoxic drugs such as statins which cause increased risk of hepatotoxicity

PARACETAMOL OVERDOSE



Treatment

- **Ac**
  - **<1hour & >150mg/kg**
- **ACE**
- Replenishment for a metabolite that prevents this cellular toxicity
- M… …hours of ingestion, after which effectiveness declines sharply
- ? adr… …still be considered

Immediate	Nausea and vomiting	Coma and severe metabolic acidosis- rarely extremely high plasma paracetamol [ ]
Later on ~12-36 hrs	Abdominal pain	
2-3 days	Right Subcostal Pain & Tenderness, N&V, Jaundice	AKI, hepatic encephalopathy

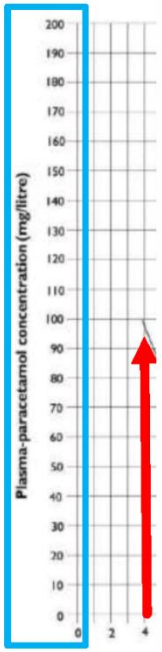
3 types of paracetamol OD

1) **Acute** - ≤1 hour→ >75mg/kg
2) **Staggered-** >1hour → >150mg/kg/24hrs.
3) **Inadvertent toxicity** → >75mg/kg/24hrs. Patients with clinical features of hepatic injury such as jaundice or hepatic tenderness should be treated urgently with acetylcysteine

PARACETAMOL OD – ACETYLCYSTEINE

Indications

- those presenting with a plasma paracetamol level on or above a line joining points of 100 mg/L at 4 hours and 15 mg/L at 15 hours
- those who have taken a **staggered overdose** irrespective of plasma paracetamol level
- where there is **any doubt over the time** of the overdose, irrespective of plasma paracetamol level



Guideline for the Management of Adult Paracetamol Overdose in A&E

AES01Guide2013v01.0

Overview

- Paracetamol poisoning is the one of the commoner drug Overdoses (OD)
- It is the commonest cause of Fulminant Liver failure (and indication for Liver Transplantation) in the UK
- Survival is 100% if N-acetyl Cysteine (NAC) treatment is started within 8 hours of ingestion

RISK ASSESSMENT:

Careful assessment is required. **Risk assessment** consists of (1) **Drug Factors** - history and timing of paracetamol dose ingested, (2) **Clinical Features** suggestive of paracetamol toxicity, and (3) **Laboratory Findings** - results of blood tests.

1. Drug Factors

- **Risk** of Hepatotoxicity from Paracetamol OD occurs with:
  - Acute single ingestion
    >75 - 150 mg/kg over a period of less than 1 hour
  - Staggered Ingestion
    >75 - 150 mg/kg ingested over a period > 1 hour but less than 24 hours
  - Repeated supratherapeutic ingestion
    75 - 150 mg/kg/day over 24 hours or more
- **Obesity** – In Adult patients weighting > 110 kg, the toxic dose in mg/kg should be calculated using a maximum weight of 110 kg, rather than the patient's actual weight
- **Pregnancy** – The toxic dose should be calculated using patient's pre-pregnancy weight while the antidote dose should be calculated using the patient's actual pregnant weight (up to 110 kg as for Obese patients)

2. Clinical Features of Symptomatic Paracetamol Poisoning

(0 – 24 hours)
- Sub-clinical – nausea, vomiting, malaise
- Hepatotoxicity in early stages
- In Severe poisoning – ALT/AST are abnormal earlier (at 12 - 16 hours)

(24 – 48 hours)
- Nausea and vomiting resolve
- Liver tenderness and RUQ pain
- LFT start to deteriorate (↑ALT/AST, INR, bilirubin)
- Loin pain, haematuria and proteinuria suggest incipient renal failure

(48 – 96 hours)
- In severe cases only - Centrilobular hepatic necrosis with recurrence of nausea and vomiting, jaundice, coagulopathy and hepatic coma
- Aminotransferases peak at 72 – 96 hours
- Elevated creatinine, metabolic acidosis, and hypoglycaemia

Other: Coma and severe metabolic acidosis in patients who have extremely high plasma paracetamol concentrations (usually > 800 mg/L)

PARACETMAOL OD- ACETYLCYSTEINE DOSE (TOXBASE)

- Given in **3 sequential infusions- No breaks in between**
- **Pregnant patients:** the toxic dose calculated using the **pre-pregnancy weight** and the acetylcysteine dose should be calculated using the **mother's actual pregnant weight**
- **Obese adults** >110 kg: both the toxic dose and the acetylcysteine dose calculated using a maximum of 110 kg, rather than the patient's actual weight
- Risk of **anaphylaxis** in up to 30% of patients, usually during or soon after the first infusion, when **large amounts are given rapidly**
  - more likely in patients with lower paracetamol concentrations
  - more likely in women
  - in patients with a family history of allergies and asthmatics
- BUT! **A history of anaphylaxis is still NOT a contra-indication to IV acetylcysteine when antidote treatment is clinically indicated**
  - Stop infusion, chlorpheniramine IV +/- nebulised salbutamol →**Restart once reaction has settled**
- Consider 1st infusion over 2 hours, pre-treatment with parenteral clorpheniramine and ranitidine +/- salbutamol nebs

Dosage should be calculated using the patient's actual weight.

Adult N-acetylcysteine prescription (each ampoule = 200mg/mL N-acetylcysteine)										Please circle appropriate weight, dose an volume.
Regimen	Dose 1			Dose 2			Dose 3			
Fluid	200 mLs 5% glucose or sodium chloride 0.9%			500 mLs 5% glucose or sodium chloride 0.9%			1000 mLs 5% glucose o sodium chloride 0.9%			
Duration of infusion	60 minutes			4 hours			16 hours			
Drug dose	150 mg/kg N-acetylcysteine			50 mg/kg N-acetylcysteine			100 mg/kg N-acetylcysteine			
Patient Weight[1]	Dose	Ampoule volume [2]	Infusion Rate	Dose	Ampoule volume[2]	Infusion Rate	Dose	Ampoule volume[2]	Infus Rat	
kg	mg	mL	mL/h	mg	mL	mL/h	mg	mL	mL	
40-49	6750	34	234	2250	12	128	4500	23	64	
50-59	8250	42	242	2750	14	129	5500	28	64	
60-69	9750	49	249	3250	17	129	6500	33	65	
70-79	11250	57	257	3750	19	130	7500	38	65	
80-89	12750	64	264	4250	22	131	8500	43	65	
90-99	14250	72	272	4750	24	131	9500	48	66	
100-109	15750	79	279	5250	27	132	10500	53	66	
>110- Max dose	16500	83	283	5500	28	132	11000	55	66	

[1] Dose calculations are based on the weight in the middle of each band.

[2] Ampoule volume has been rounded up to the nearest whole number.

PARACETAMOL DOSAGE FORMS AVAILABLE AT MDH

	PO	IV	PR
Formulations & concentrations	500mg tablets 120/5mL syrup	100mg/10mL in 1000mL intravenous solution	500mg, 250mg, 125mg suppositories
Absorption	30-60min	10-15min	Erratic
Administration notes		• To be administered over 15 min • No known incompatibilities • Tachycardia and hypotension were at times reported. • **LIGHT SENSITIVE!!!**	Takes longer time to reach systemic circulation hence to be effective (vs PO)

IV has faster onset of action vs PO.....But concentrations systemically (bioavailability) are the same for both formulations

Guidelines suggest the **IV to be used for moderate pain (vs mild pain) and ONLY If: PATIENT NOT TOLERATING ORAL INTAKEPATIENT NEEDS TO BE STARVED**

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS- NSAIDS

NSAIDS

- MOA: inhibit the enzyme Cyclo-Oxygenase (COX) that lead to production of prostaglandins inflammatory markers
  - There are more than one type of COX enzyme exits, namely COX-1 and COX-2
  - Some NSAIDs are selective towards COX enzymes inhibition – this reflects in their indication and SE profiles
- **Have analgesic, antipyretic and anti-inflammatory effect** (vs Paracetamol)
  - Especially effective in colicky pain; renal colic's, biliary obstruction and dysmenorrhea

CHARACTERISTICS

- **Class SE**: GI discomfort dyspepsia, nausea, vomiting, GI bleeding & ulceration (elderly are at a higher risk), exacerbations of asthma, fluid retention, hypertension and thrombotic events, skin reactions, renal impairment
  - COX-2 less GI SE versus non-selective inhibitors.
    However COX-2 have more risk of CVD SE
  - The GI SE are not only due to physical contact of the drug with the stomach
    This is because COX enzyme is involved in production of mucus layer that protects the gastric mucosa from gastric acid. Hence eating prior to oral administration of NSAIDs only partially decreases the risk of GI SE.

- **Class Caution**: Renal and hepatic impairment, CVD, allergic disorders, elderly
- **Class Contraindications**: severe Heart Failure, active or 2 previous episodes of peptic ulcer/GI bleeding, asthmatic attack due to previous NSAID intake, uncontrolled hypertension

NON-SELECTIVE NSAIDS AVAILABLE AT ED

	IBUPROFEN	DICLOFENAC	NAPROXEN
Formulations and concentrations	200mg Tablets	1. 25mg Tablet 2. 75mg deep IM injection or IV injection (see notes below) 3. 100mg Suppositories	250mg tablets
Maximum daily dose	2.4g	150mg	1.25g
SE profile comparison	Lowest risk of GI SE	Most potent of these 3 NSAIDs. Indicated in renal colic pain	Least risk of thrombotic events. Similar potency to ibuprofen
Administration notes		**IV administration** needs a buffer; first add 0.5mL of 8.4% sodium bicarbonate to100-500mL NS or D5W **and** then add the diclofenac. During IV administration keep an eye for any signs of hypersensitivity reactions. It should be discontinued at first signs of skin reactions.	

NSAIDS COMMON INTERACTIONS

Drug class	Interaction
ACE/ARB, spironolactone, enoxaparin, heparin	Hyperkalemia
Enoxaparin, heparin, warfarin, rivaroxaban, dipyridamole, aspirin	Bleeding
SSRI, SNRI	Hyponatremia
SSRI, SNRI, steroids	GI bleeding
Levofloxacin (Quinolones)	↑ risk of seizure
Antihypertensive drugs	Decreased antihypertensive effect

FINAL NOTE ON NSAIDS

- Lowest effective dose of NSAID should be prescribed for the shortest period of time
- Consider gastro-protective agents PPIs (e.g. **omeprazole**) for long term treatment
- Alcohol increases the risk of GI toxicity

OPIOIDS

OPIOIDS- MOA

- Act on the opiates receptors; namely 4 opioid receptors; **μ, δ, κ and ORL**
- Each receptor produces a different physiological effect once activated
  - **μ receptors-** analgesic effects of opioids, and for some major unwanted effects (respiratory depression, sedation and dependence). **Most of the analgesic opioids are μ-receptor agonist**s.
  - **δ receptor-** analgesia but also can be proconvulsant.
  - **κ receptors-** analgesia at the spinal level and may elicit sedation, dysphoria and hallucinations. Some analgesics are mixed κ agonists/μ antagonists.
- Opioids are both **selective** to which receptors they bind (most bind to more than 1 receptor) and with respect to efficacy (**to how much they bind** to receptors hence elicit a desired response) which explains the different opioid profile

Opoid Receptor

Physciologic Response	μ (Mu)	δ (Delta)	K (kappa)	OR
Analgesia				
Supraspinal	+++			-
Spinal	++	++	+	++
Peripheral	++		++	
Respiratory depression	+++	++		
Euphoria	+++			
Sedation	++		++	
Hallucinations			+++	
Physical dependence	+++			
Reduced gut motility	++	++		

EFFECTS OF OPIOIDS

1. **Analgesia**→ elevate pain on a receptor level (physically) & as on psychologically
2. **Euphoria** → sense of contentment and well-being→ abuse
3. Respiratory depression
4. **Cough suppression** → **Codeine** suppress cough in subanalgesic doses

OPIOIDS CLASSES

1. **Morphine*** and morphine-like analogues; **Diamorphine, Codeine**
2. Synthetic analogues: **Pethidine, Fentanyl, Alfentanyl**
3. Others: **Tramadol**

*Morphine is the standard drug against which other opiates are compared

OVER ALL COMMON OPIOIDS CLASS SIDE EFFECTS

- **Nausea & vomiting**→ antiemetic needed , transient and disappear with repeated administration
- **Constipation**→ result from reduced motility of GI. Gastric emptying is also delayed which can considerably **retard the absorption** of other drugs
- **Dry mouth**
- **Biliary spasm → mostly with morphine…..?**administer with an anti-spasmtoic
- **Respiratory depression** → most *worrying* side effect, with larger doses
- Muscle rigidity and coma
- Itching and rash → Histamine release (**hypotension**). This histamine release is not seen with **pethidine** and **fentanyl**
- Bradycardia or tachycardia, palpitations
- Drowsiness and confusion → to be kept in mind as it might affect skilled tasks
- Tolerance and addiction → rarely with therapeutic doses

PATIENT MONITORING **FOR ALL OPIOIDS**

1

SEDATION

- most frequent at start of therapy **and** with dose increase; tolerance occurs over time
- Excessive sedation occurs **before respiratory depression**.
- **Sedation is the most important predictor of respiratory depression in patients receiving opioids**

2

Respiratory Rate + Pattern + Quality

- RR alone, is **not** a reliable indicator of ***degree*** of respiratory depression
- Most troublesome unwanted effect. **Occurs at therapeutic doses**
- The commonest **cause of death** in acute opioid poisoning. In weak and elderly for up to 30min post administration

3

Blood pressure- hypotension might be precipitated

4

Pain-to ensure and assess therapeutic response

Risk Factors for Opioid-Induced Sedation& Respiratory Depression

- **Patient comorbidities**
  - Obstructive sleep apnea, sleep disordered breathing, BMI ≥35
  - Pulmonary disease (asthma, COPD, etc.)
  - Renal and hepatic disease
  - Coronary artery disease, CHF, HTN, arrhythmias, etc
- **Elderly (≥ 65 years of age)**
- **Concurrent CNS depressants**
  - Gabapentin, spasmolytics (muscle relaxants), benzodiazepines, histaminergic drugs, anitepileptics, etc.

Reduce dose or avoid in hepatic impairment and renal impairment; elimination in decreased hence higher risk of CNS toxicity and coma

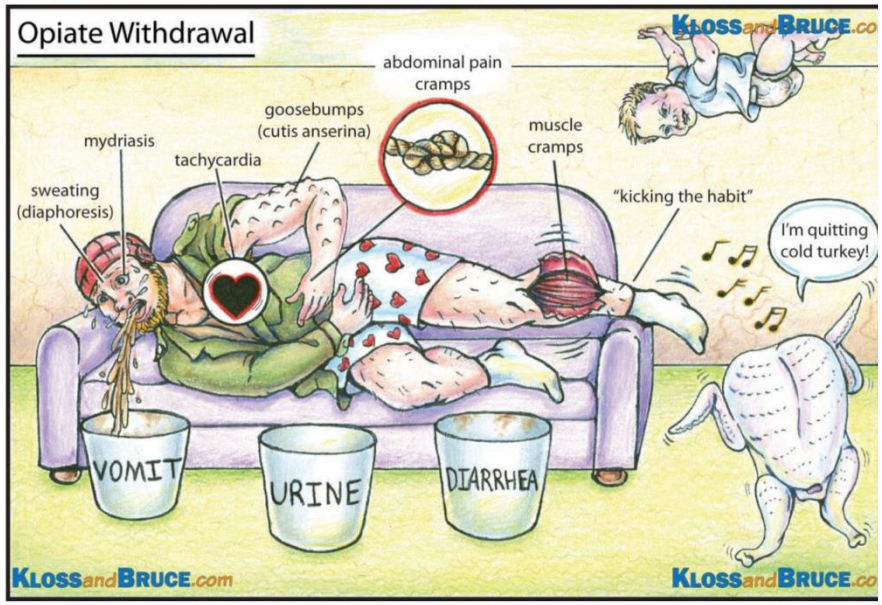
Pasero Opioid-induced Sedation Scale (POSS) with Interventions
Journal of PeriAnesthesia Nursing 2009; 24(3), 2009:18

S = Sleep, easy to arouse **Acceptable, no action necessary, may increase opioid dose if needed**
1 = Awake and alert **Acceptable; no action necessary; may increase opioid dose if needed**
2 = Slightly drowsy, easily aroused **Acceptable; no action necessary; may increase opioid dose if needed**
3 = Frequently drowsy, arousable, drifts off to sleep during conversation **Unacceptable; monitor respiratory status and sedation level closely until sedation level is stable at < 3 and respiratory status is satisfactory; decrease opioid dose by 25 –** **50%; notify MD; ask patient to take deep breaths every 15 to 30 minutes**
4 = Somnolent, minimal or no response to verbal and physical stimulation **Unacceptable; stop opioid; consider administering naloxone; stay with patient, stimulate and support respiration if indicated; notify MD; monitor respiratory status** **and sedation level closely until sedation level is stable at < 3 and** **respiratory status is satisfactory**

OPIOIDS TOLERANCE AND DEPENDENCE –A COMPLEX PHENOMENON

- Tolerance → dose no longer produce the desired effect hence requiring an increase in dose. Develops rapidly (within a few days) with repeated administration

- 2 components of dependence :
  1. Physical Dependence; associated with **withdrawal syndrome**.
     - The withdrawal syndrome is precipitated by μ-receptor antagonists i.e. Naloxone. Long-acting μ-receptor agonists such as methadone and buprenorphine may be used to relieve withdrawal symptoms.
  2. Psychological Dependence; associated with craving . Lasts for months or years. Rarely **occurs in patients takingopioids as analgesics**



- **Codeine** and **tramadol** are much less likely to cause physical or psychological dependence

MORPHINE

- Erratic absorption with oral administration hence why parenteral administration is preferred for immediate effects.
- Parenteral routes of administration give different peak effects;

  SC route: 50–90 min, IM route: 30–60 min, IV route: 20 min
- IV injection administration:
  - **Dilute neat drug with minimum of 5mL D5W or NS**
  - **Administer via slow IV (ideal rate of 2mg/min)**
- Alternatively can be given as IV infusion via IV infusion pump
- IV solution should be protected from light as upon repeated exposure to light this product darkens

IV Concentration at ED: 10mg/mL solution for injection

Other formulations on GFL

- IV injection:15mg/mL, 20mg/mL, 30mg/mL
- PO tablets: Modified relese 10/30/60/100mg
- PO solution: 10mg/5mL

Morphine sulphate formulation

Ξ

Morphine hydrochloride formulation

DIAMORPHINE

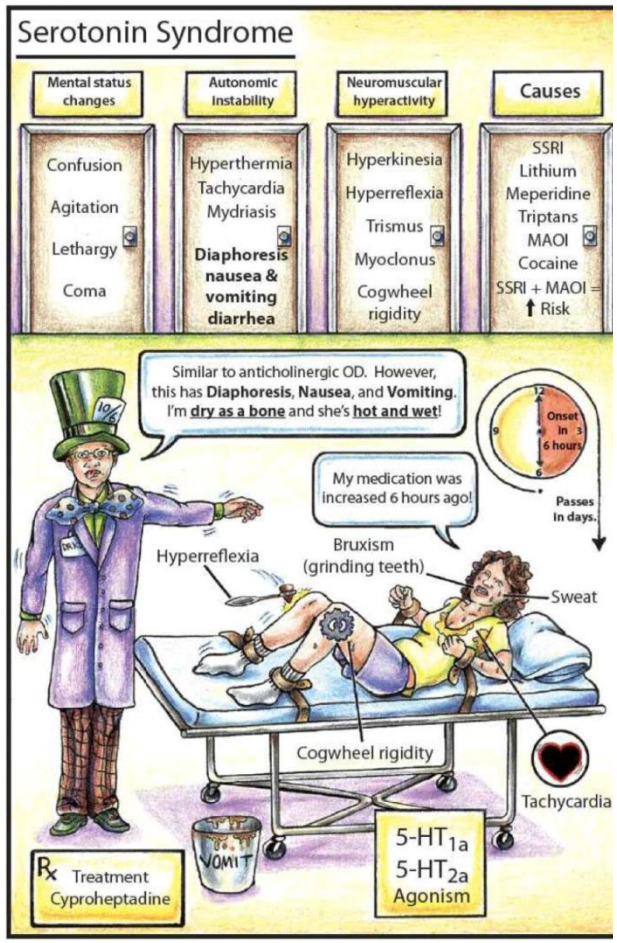
- When compared with morphine, it has faster onset of action because passes the blood-brain-barrier more. Also why less dosages are needed vs. morphine
- May cause less nausea and hypotension than morphine
- **IV injection administration:**
  - **Reconsitute 5mg powder with 1mL WFI**
  - **Further dilution with NS or D5W to facilitate slow IV administration**
  - **Rate 1mg/min hence over 5min**
- Monitor also injection site since this is a vesicant
- Can be given via IM and SC routes

CODEINE

- Susceptible to **genetic variation** for its activation hence effect; in a certain % of population this is not effective
- More reliably absorbed by mouth than morphine, but has only 20% or less of the analgesic potency
- It is therefore used mainly as an oral analgesic for **mild types** of pain (headache, backache, etc.)
- Unlike morphine, it causes little or no euphoria and is rarely addictive
- Dose: 30–60 mg every 4 hours. Max: 240mg over 24 hours
  - Suppresses cough at lower dosages needed for analgesia
- Formulation at ED **30mg PO tablets**
- **Fluoxetine** decreases efficacy of codeine

SYNTHETIC OPIOIDS

- **Do no cause histamine release** hence no itch, rashes and hypote experienced with these agents
- **Pethidine**
  - Less potent, rapid onset but shorter action (lasting for about 2-4 hours)
  - Causes restlessness rather than sedation
  - It has anti-muscarinic action, hence it can cause dry mouth and blurring
  - The metabolised drug (norpethidine) can cause **seizures**. Not indicated
    - chronic pain because of its short duration of action and ↑risk accumulation of it
    - renal impairment due to accumulation
- Risk of serotonin syndrome with **SSRI, TCA, (Effexor®), Zolmitriptan (Zomiles®/Zomig®)**
- .....and **Ondansetron**!



SYNTHETIC OPIOIDS

Fentanyl and **Alfentanil**→ more potent and shorter acting agents hence make it ideal for break through pain

Fentanyl:

- Mostly widely used as an anaesthetic during operations. It is also used as a respiratory depressant in the management of mechanically ventilated patients under intensive care
- Administration via slow IV injection over 3-5 min (Can also be given as IV infusion with glucose)
- Causes extravasation hence monitoring of injection site is important
- **Concentration at ED Fentanyl IV 100mcg/2mL**
- Serotonin syndrome risk with SSRI, TCA, Clarithromycin (on paper)
- Risk of bradycardia with : Metoprolol, metadone, esmolol

Alfentanil:

- Less lipid soluble than Fentanyl
- May be given neat
- Administration via IV bolus or IV infusion only if patient is on assisted ventilation
- **Concentration at ED Alfentanyl IV 500mcg/mL in 2mL**
- Risk of bradycadia with: Amiodarone, betablockers, digoxin, donepezil, ivabradine, verapamil,

TRAMADOL

- Dual mechanism for analgesia
  - Weak opioid agonist at **μ** receptor
  - Inhibits serotonin and norepinephrine reuptake
  - Can cause serotonin syndrome with **SSRIs, Venlafaxine (Effexor®), Bupropion (Wellbutrin®), TCA, Lithium, Fentanyl, Pethidine, Zolmitriptan (Zomiles®)**
- Effectiveness varies amongst patients (as the active metabolite is activated once it is metabolised)
- **Dosages**: 50-100mg as starting dosages going up to 400mg/24 hours
- Used mostly for moderate to severe pain and usually neuropathic pain
- Adverse effects; dose related
  - Most common GI: Nausea, vomiting, constipation, CNS (drowsiness, dizziness, headache). Psychiatric side effects have been reported as well as lethargy
- Fewer risks of respiratory depression, constipation and addiction

Formulation at ED: 50mg tablets

Other formulations on GFL
- IV injection:100mg

ANTIDOTE- NALOXONE

- **Naloxone** -antagonist (which binds to all 3 opioid receptors). Its main effect is rapid reversal of respiratory depression
- Onset of action:
  - IV injection (**preferred route**): 1–2 minutes
  - IM injection: 2–5 minutes
- Failure to respond to naloxone suggests a cause other than opioid poisoning for the comatose state
- .....or brain damage is present

32

ANTIDOTE- NALOXONE DOSAGE

- 400micrograms (1 ampoule) and wait 1 min for response → If no response give 800micrograms and wait for response → repeat another dose of 800micrograms→ If still no response give 2mg dose BUT review diagnosis. Further 2mg boluses may be given, to total maximum IV boluses of 10mg
- Aim for reversal of respiratory depression, not full reversal of consciousness
- Naloxone, has a shorter biological half-life (lasting about 2-4 hours) than most opioid agonists owing to its metabolism by the liver
  - Hence given repeatedly or continuously to avoid the respiratory depressant effect of the opioid agonist which would still be available endogenously
- Consider starting **Naloxone IV Infusion** in pt with partial response or unstained response
  - 10mg (25 ampoules) up to 50mL with D5W
- Severe withdrawal symptoms may be precipitated on patients physically dependent on opioids

33

OPIOIDS FINAL POINTS

- Though opiates are strong analgesics indicated for severe pain, these are not as effective for **neuropatic pain**!
- In PCA pumps an opioid drug (usually morphine) is delivered in a pump system which delivers a pre-set dose on activation. The beauty of it is the psychological effect this has on the patient since the patient feels is in control of the pain. A safety feature (lock-out time) ensures that the patient does not reactivate and get release of drug immediately after an activation. The pump delivers the drug by subcutaneous injection.

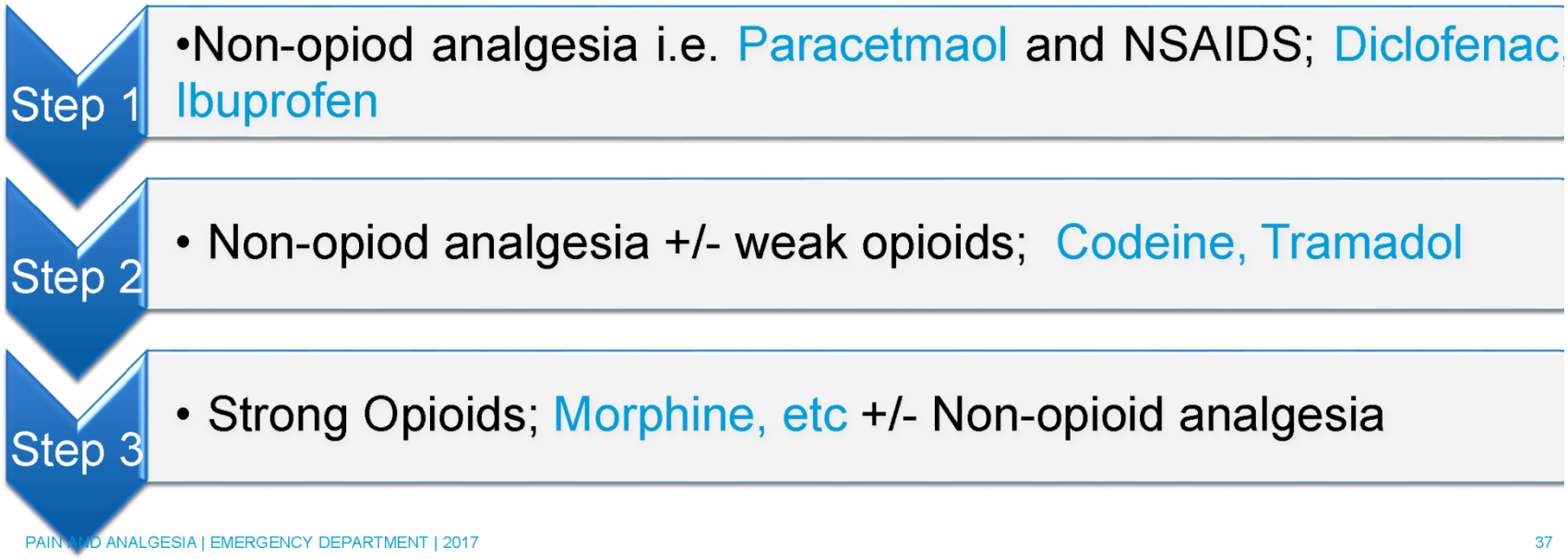
Ketamine

- Technically an anaesthetic not analgesic; produces dissociative amnesia
- Not as first line; when traditional analgesics were not effective
- Can cause emergency reactions (in recovery following anaesthesia); vivid unpleasant dreams, confusion, hallucinations, irrational behaviour- pre-medication with diazepam
- Has effects on blood pressure and cardiovascular system ; increase in BP and HR. This risk of SE is attenuated by diazepam
- Contraindicated in: Hypertensive PT, severe cardiovascular disease, cerebrovascular trauma/accidents
- Incompatible with diazepam; administer separately

Analgesic	Formulation	€ per unit	€ per treatment
Paracetmaol	500mg tablet	€ 0.005	€ 0.02
Ibuprofen	200mg tablet	€ 0.01	€ 0.02
Diclofenac	25mg tablet	€ 0.01	€ 0.02
Diclofenac	100mg suppository	€ 0.26	€ 0.26
Paracetamol	1000mg IV solution	€ 1.20	€ 1.20

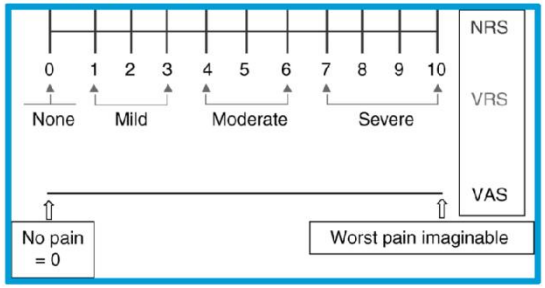
WHO ANALGESIA LADDER FOR **NOCICEPTIVE PAIN**

- WHO analgesia ladder is gold standard guideline for Nociceptive pain
  - Neuropatic pain has a different pathway



GOLD STANDARD PRACTICES

- First things first…assessing the severity pain
- **Pain Scores**



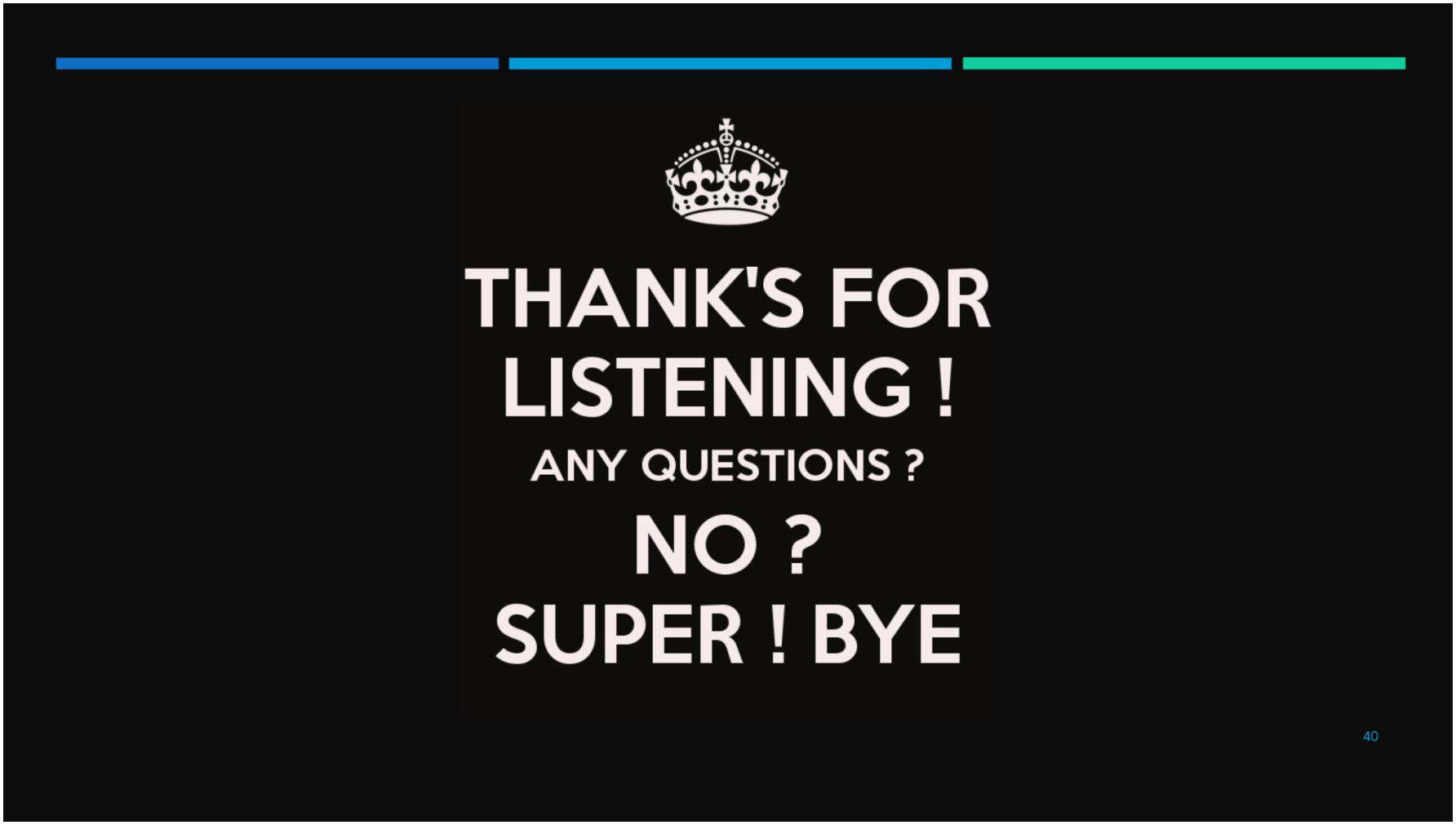
- Patient communication: assure them they are in good hands and are being cared for, their pain
- **Good past health and medication history. Evaluate** change in pain pattern, current pain control, sleep and daily functioning activities
- Patients reassessment: 60 min after given the analgesia in mild-moderate pain and after 30 min in severe pain
- The choice and route of administration of analgesic drugs depends on the nature and duration of the pain not straight IV paracetamol
- A progressive approach should be used, i.e. starting with non-steroidal anti-inflammatory drugs (NSAIDs), supplemented first by weak opioid analgesics and then by strong opioids. Combining analgesia is effective.

38

…..IN CONCLUSION

- Early pain intervention is key because if pain is left untreated, it becomes more difficult to manage….it can even become chronic
- Certain conditions such as cancer patients, STEMI, renal colic are not considered and treated as those patients presenting with 'normal' pain
- Elderly; Paracetamol PO & IV are first line. NSAIDS; lowest dose due to increased SE risks (GI/Renal/CV). Opiates; lowest dose; high risk of DDI with CNS acting drug and increase risk of respiratory
- Do not forget the use of splints / slings / dressings/ regional blocks
- Chronic neuropathic pain is less responsive to opioids and can be treated with tricyclic antidepressants (e.g. **amitriptyline**) or anticonvulsants (e.g. **pregabalin**, **gabapentin**)

PS a new local protocol for Pain Evaluation and Treatment is coming soon- STAY TUNED!


THANK'S FOR
LISTENING !
ANY QUESTIONS ?
NO ?
SUPER ! BYE
40

Appendix 15

Pharmacology update- Pain Lecture Questionnaire

Pain & Analgesia

Post Lecture

* Required

1. **I.V. Paracetamol is stronger than paracetamol P.O.** *
   Mark only one oval.
   - ◯ True
   - ◯ False

2. **Paracetamol is both an analgesic and anti-inflammatory** *
   Mark only one oval.
   - ◯ True
   - ◯ False

3. **Paracetamol overdose causes hepatic and renal impairment** *
   Mark only one oval.
   - ◯ True
   - ◯ False
   - ◯ Other: _____

4. **If given rapidly, paracetamol IV can cause tachycardia and hypotension** *
   Mark only one oval.
   - ◯ True
   - ◯ False

5. **Parenteral diclofenac solution can be given as neat I.V.**
   Mark only one oval.
   - ◯ True
   - ◯ False

6. **Morphine is more potent than diamorphine** *
   Mark only one oval.
   - ◯ True
   - ◯ False

7. **Diamorphine has a faster onset than morphine**
   Mark only one oval.
   - ◯ True
   - ◯ False

8. **In colicky pain, opioids are preferred over NSAIDs**
Mark only one oval.

- ◯ True
- ◯ False

9. **The preferred analgesic for elderly is** *
Mark only one oval.

- ◯ Ibuprofen
- ◯ Paracetamol
- ◯ Codeine

10. **Diclofenac has same risk of cardiovascular side effects as ibuprofen** *
Mark only one oval.

- ◯ True
- ◯ False

Appendix 16

Events DDA Register

Administered DDAs

1. **Morphine 10mg IV x2**
2. **Diazepam 10mg PR**
3. **Metoclopromide IV**
4. **Diazepam 10mg IV**
5. **Midazolam IV**
6. **Ketamine 100mg in 2mL**

Date	DDA and Dose	Name of Patient	Name of Prescriber	Signature of administrator	Counter signature