MEDICATION ERRORS IN MALTA: IS THERE A CAUSE FOR PUBLIC HEALTH CONCERN?

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August 2011
To my loving family,
and my wonderful son Dale.
I, the undersigned declare

that this dissertation is my own original work and was carried out under

the supervision of Dr Miriam Camilleri

Signature:

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In my opinion this Dissertation is good enough to be awarded at least a

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Executive Summary

Internationally, medication errors are considered to be a burden in hospitals and in the community, causing significant morbidity and mortality and increased healthcare costs (Phillips & Bredder, 2002; Ferner & Aronson, 2006; Bar-Oz et al., 2008). The aim of this research was to gain understanding of the local situation on medication errors to determine if they are a public health concern.

After a comprehensive literature review, a mixed method consisting of four different approaches was used to achieve this aim. (1) The use of a pharmacovigilance database in the identification of medication errors has been established (Alj et al., 2007; Kunac & Tatley 2011), so a retrospective analysis of the 600 reports within the national pharmacovigilance database was undertaken. (2) Questionnaires, on the causes and prevention of prescribing and dispensing errors were distributed. (3) Key players in the field were interviewed and (4) inquiry reports from the medical and pharmacy councils were looked at for medication error related litigation.

Results showed that 17.9% of all adverse drug reactions were associated with medication errors and could have potentially been prevented. Medication errors occurred most often at the stages of prescribing (52%), therapeutic monitoring (26%), patients' management of their own care (12%), dispensing (7%) and administration (3%). Increasing age was a risk factor with most medication errors occurring in the 80-89 year old age group. Distribution of results was similar to other studies but not for administration errors. (Bates et al., 1993; Leape et al.1995; Kaushal 2002, Alj et al., 2007; Kunac & Tatley, 2011). This may be due to differing methods and operational terminology or due to a less developed culture of reporting of ADRs within the hospital.
setting. Most medication errors in this study originated from the community (65%) and the medication classes most likely to be in error were the anti-inflammatory (28%) and anti-bacterial medications (10%). When errors were classified using the psychological theory most errors were likely to be knowledge-based and memory-based errors or rule-based errors. For the questionnaire 48 doctors and 71 pharmacists responded to the questionnaires. For both professions, human factors prevailed as the perceived cause of errors and included overwork (doctors=29/43, pharmacists=37/69), high patient volume (doctors=29/43, pharmacists 36/69) and fatigue from any cause (doctors=28/43, pharmacists=38/69). System factors included medications with similar and confusing names (21/43) for doctors and illegible handwriting (55/69) for pharmacists. For both professions, reducing interruptions (doctors=20/43, pharmacists=56/68) and for doctors lack of availability of resources to consult with were identified as risk-reducing factors. Both professions thought that keeping knowledge of medicines up to date (doctors=41/41, pharmacists 54/69), reducing workload (doctors=36/48, pharmacists=54/69) and having medicine names that are distinctive (doctors=34/48, pharmacists=53/69) were perceived as important to prevent errors. 2 key players were queried through a series of open ended questions and information pertaining to patient safety and incident reporting locally was obtained which contextualised the study. From the regulatory council inquiry report it was established that litigation related to doctors and pharmacists for medication error was very low (3 court cases from 154 inquiry cases).

The objectives of this study have been met. This study has shown that medication errors do occur and are an emerging challenge to public health. A number of recommendations to address this issue have been made.
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Chapter 1 - INTRODUCTION
1.1 Background

Medical errors continue to be a considerable public health burden in hospitals and in the community, causing significant morbidity and mortality (Phillips & Bredder, 2002; Ferner & Aronson, 2006; Bar-Oz et al. 2008). Patient safety is now high on the healthcare agenda in Europe, North America and other developed countries (Expert group on safe medication practices, 2007; AHRQ, 2005; ACSQH, 2008). Medication error research gained public acclaim in the year 1999, with the pioneering report by the Institute of Medicine (IOM) "To Err is Human: Building a Safer Health System" (Kohn et al., 1999). This report declared that as many as 98,000 people in the U.S alone die each year needlessly because of preventable medical harm, including healthcare-acquired infections and medication errors. In comparison, kidney diseases accounted for 25,000 deaths per year. The IOM report estimated that medical errors cost the U.S $17-$29 billion a year, and called for sweeping changes to the health-care system to improve patient safety (Kohn et al., 1999). This report also suggested a list of strategies for the improvement of the overall quality of patient care in the U.S. and recommended the establishment of several agencies to collect information on patient harm, including; the Food and Drug Administration’s MedWatch, the Institute for Safe Medication Practices’ Medication Errors Reporting Program (ISMP-MERP), and the MedMARX program (Harvard School of Public Health, 2004).

Medication error is arguably the most prevalent type of medical error in both primary and secondary care (Expert group on safe medication practices, 2007) and there is evidence that morbidity and mortality due to medication errors has become an increasingly serious public health problem (Phillips, Christenfeld & Glynn, 1998; Phillips & Bredder, 2002). Although most health problems associated with the use of
medicines are relatively minor, some serious adverse events have lead to hospitalisation, disability and death. In a study by Jonville-Bera et al., it was shown that when medications were used incorrectly, they were more likely to cause an adverse drug event (Jonville-Bera, 2005). Since exposure to medications is so high, even a very low rate of adverse events caused by incorrectly used medications can lead to a large number of serious injuries or death (Expert group on safe medication practices, 2007).

1.1.1 Clarification of Terminology

There is a myriad of terminology that defines medication errors and their consequences and this is discussed in detail in Chapter 2, section 2.2. However it is important that the meaning of each term is clarified at the beginning.

![Diagram of medication error terminology](image)

**Figure 1.1** Medication error terminology. (Created by this author for this study)
A medical error is an adverse event that could be prevented given the current state of medical knowledge (Encyclopaedia of Surgery, 2008).

A medication error, is a subset of medical errors, and simply put, is a preventable event related to medicines that either caused patient harm, or could potentially have lead to patient harm. See Chapter 2 section 2.2 for a more detailed definition.

An adverse drug event (ADE) is patient harm resulting from the use of a drug (Nebecker et al., 2004) and includes harm caused by the drug when used correctly (adverse drug reactions which are not preventable) and harm from the misuse of the drug. Those medication errors that do become clinically manifest are termed preventable adverse drug events. As per definition, medication errors may not systematically result in an adverse drug event (see Figure 1.1). The preventable subset of ADEs (pADE) is where corrective interventions can be targeted. A potential ADE is one that reached the patient but did not result in harm while a near miss is an error that was captured or corrected before reaching the patient (ISPM, 2009).

1.2 The public health impact of medication errors

1.2.1 The extent of the problem

Figure 1.2 shows the number of medical errors (a proportion of which is caused by medication errors) compared to other leading causes of death in the U.S. According to a consultation report on patient safety in E.U. in 2008, the most frequently experienced medical errors causing adverse events in Europe are medication-related events (Report on the open consultation on patient safety in the E.U, 2008). In the U.S. medication errors account for nearly 1 in 20 hospital admissions and are a leading cause
of death (Bond et al., 2001; Barber et al., 2003). In Europe, the incidence and consequences of medication error in secondary care seem to be similar to those in the U.S. (Expert group on safe medication practices, 2007)

Figure 1.2: Estimated death associated with medical errors compared to leading cause of death in the U.S (Adopted from Leatherman et al., 2002)

![Graph showing estimated deaths associated with medical errors compared to leading causes of death in the U.S.]

The reported incidence of preventable adverse drug events in European hospitals ranges from 0.4- 7.3% of all hospitalisations (Green et al., 2000, Emerson et al, 2001; Mjorndal et al., 2002; Hardmeier et al, 2004; van der Hooft et al., 2006). There is also evidence that one month after discharge from hospital around half of all patients are not taking the right medication in the right way (Omori et al., 1991). Given these figures it is not surprising that the UK’s NHS plan for patient safety, "Building a safer NHS for

*For a full list of European studies on adverse drug events see Appendix 4 (pg 205-218) from the Council of Europe’s report of 2007; Creation of a better medication safety culture in Europe.
patients" (Department of Health, 2004) has the reduction of harm from medication error as two of its four firm targets. Based on the IOM report the U.S congress called for the reduction of medication errors by 50% over 5 years.

1.2.2 Cost of medication errors

From an economic perspective, studies on medication safety highlighted that the costs associated with medication errors in Europe and the U.S. have a major impact on health care budgets (Expert group on safe medication practices, 2007). Several studies carried out in the U.S. have investigated ADEs in hospitalised patients and their impact on hospital costs. Four out of the five studies that specifically analysed the average excess hospital costs in the United States resulting from ADEs, estimated $1,939 to $2,595 per case (Evans et al., 1994; Classen et al., 1997; Bates et al., 1997; Senst et al., 2001). Another study reported average ADE costs of $US 783 per case (Schneider, 1994). The admissions caused by ADEs averaged $6,885 to $7,857 per event. By extrapolating the findings about ADEs to all hospital patients in the U.S, the additional hospital costs were estimated $US1.56-4 billion per year (Evans et al., 1994; Classen et al., 1997). A recent estimation revealed that in the United States the costs of problems linked to medicines use in primary care exceeded $US177 billion in the year 2000 (Rodriguez-Monguio, 2003). Although not all ADE were preventable, the costs of preventable and non-preventable ADEs are the same.

In Europe, studies carried out in Spain have indicated that the 4.7% of hospital admissions caused by preventable ADEs caused on average costs of €3,000 per event (Alonso & Hernandez, 2002). In Germany, a study on medicine related hospitalisations on the basis of an average length of stay of 13 days at a reimbursement level of €287,
estimated the drug related hospitalisation cost to €3,700 and the annual direct cost for Germany to €400 million (Schneeweiss et al. 2002). The UK estimated the annual cost of such admissions to the NHS to €706 million on the basis of a medium bed stay of 8 days, accounting for 4% of the hospital bed capacity at average costs per medical bed day) (Pirmohamed et al., 2004). In France, the direct costs of ADEs admitted to emergency units to the French public hospital system is estimated about €636 million, i.e. about 1.8% of the annual budget in 2002 (Trinh-Duc et al., 2006). To date, there have been no published studies in Malta on the local costs of ADEs.

On the basis of the available European data (summarised in Table 1.1), the European health authorities have been urged to recognise the high incidence of preventable adverse drug events and the important increase of health care costs associated with these preventable adverse drug events (Expert group on safe medication practices, 2007).

Table 1.1: The cost of preventable adverse drug events in European countries (adopted from the report by the Expert group on safe medication practices, 2007)

<table>
<thead>
<tr>
<th>Country</th>
<th>Additional hospital cost per preventable adverse drug event</th>
<th>Estimate of the national annual cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>€3 000</td>
<td>€400 million</td>
</tr>
<tr>
<td>German</td>
<td>€3 700</td>
<td>€706 million</td>
</tr>
<tr>
<td>(72% preventable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United-Kingdom</td>
<td></td>
<td>€636 million</td>
</tr>
<tr>
<td>(38% preventable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is of note, that these figures do not include the unknown cost of errors in primary and community care, and also indirect costs such as those arising from lost income, lost household production and disability with associated health care costs. The
public health gain from these potential resources saved by reducing serious medication errors is considerable.

1.3 **International efforts for improving patient safety**

The IOM report 'To Err is Human; Building a Safer Health System' published in November 1999 by Kohn and colleagues, had galvanized a suddenly expanded level of concern about patient injuries and safety in health care both in the United States and abroad (Expert group on safe medication practices, 2007).

Over the last years, the awareness of politicians and health professionals about patient safety has been raised in many countries all over the world through important reports such as the UK's Department of Health report in 2000; -“An organisation with a memory” and “Building a safer NHS for patients” in 2001, the Canadian’s “National strategy for improving patient safety in Canadian Health Care” (Canadian National Steering Committee on Patient Safety, 2002) and the Swiss; “Towards a safe healthcare system.” (Brunner et al., 2001). In other countries national professional initiatives for improving patient safety have been reactivated or started (Lustig, 2000; Alonso-Hernandez, 2002; Alj et al., 2007; Bar-Oz 2008).

In May 2002, the World Health Assembly adopted a resolution urging World Health Organization (WHO) and member states to pay the closest possible attention to the problem of patient safety (WHO, 2002). In October 2004, the WHO launched the World Alliance for Patient Safety to raise awareness and political commitment to improve the safety of care and to facilitate the development of patient safety policies and practice in all WHO member states, as stated by the London Declaration published on 17 January 2006 (World alliance for patient safety, 2006).
In 2003, the Council of Europe Committee of Experts on Pharmaceutical Questions established the Expert Group on Safe Medication Practices to review medication safety and to prepare recommendations to specifically prevent adverse events caused by medication errors in European health care. The emergent report of this expert group in 2007 has enhanced awareness of medication errors across European countries and recognition as an important system-based public health issue (Bencheikh & Benabdallah 2009).

1.4 National context; efforts for improving patient safety

National recognition and activity in the field of patient safety aquired drive in recent years.

In February 2007 a Commonwealth conference took place in Malta entitled ‘Patient Safety 2007 – Developing Strategic Approaches, where his Excellency the President of Malta stated that; ‘It is recognised that there is a need to provide accessible care of high quality, which is financially sustainable but which is also designed to decrease any risk of harm coming to patients.’ The concept of utilising a systems approach in healthcare and its improvement within a complex adaptive system was described within this conference, as well as looking at different facets of care. At the time the local emergent issue from this conference was the lack of structure for clinical incident reporting. Recommendations from this conference were the setting up of a national reporting system in two parts i) Learning system, which would be voluntary, fostering improvements, and covering a wide scope of events. ii) Accountability system, which would be mandatory and restricted to adverse events.
An already established means of monitoring the safety of medicines for patient safety is the national pharmacovigilance system. In Malta, the Medicines Authority is responsible for the co-ordination of the national Adverse Drug Reactions (ADRs) reporting system, which was officially launched on 4 May 2004. Following implementation of the Medicines Act, both Marketing Authorization Holders of medicinal products, doctors, dentists and pharmacists have specific obligations with regards to pharmacovigilance (Medicines Act, 2003).

Healthcare professionals are legally obliged to report all suspected ADRs to the Medicines Authority and requested to submit ADR reports using the freepost ADR report card or the on-line equivalent that can be accessed through the Medicines Authorities’ website http://www.medicinesauthority.gov.mt/phvigilance.htm (Adverse Drug Reaction Reporting & Pharmacovigilance Guidance Notes For Healthcare Professionals 2010). The staff of the Post-Licensing Directorate is responsible for the scientific evaluation of the ADR reports received and for the communication of the outcome of data evaluation through Safety Circulars and a Drug Safety Bulletin. Moreover, the Pharmacovigilance Section operates within a wider international framework, including the EU and the WHO International Drug Monitoring Programme as full members. Following the identification of a new ADR, the Pharmacovigilance Section liaises with pharmaceutical companies for the dissemination of this new information to Healthcare Professionals and the update of the product information of the medicinal products for which a new ADR has been identified (Post-licensing directorate: Pharmacovigilance webpage). Importantly, these ADRs are maintained with a database. The core functions of this database are (1) the collation of local adverse drug reaction information for analysis and signal detection and (2) communication of this information to European and international vigilance bodies. The
intended use of this data is for post-marketing signal detection of unknown, or underestimated side-effects of medication available on the market.

Stimulated by efforts from the World Alliance for Patient Safety, in recent years, (WAPS, 2006) pharmacovigilance databases have been recognised as a potential resource for medication error data. Studies have been conducted by Jonville-Béra, Bera & Autret-Leca in 2005, Alj. et al. In 2007 and by Tatley & Kunac in 2011, where adverse drug reactions databases have been used as a source of information for elucidation of the frequency and characterisation of the cause of medication errors. These studies have established the usefulness of pharmacovigilance databases in the detection of medication errors specifically that subset of preventable adverse drug events that manifests as adverse drug reactions pADRs (Figure 1.1).

In September 2007, the Department of Health Care Services Standards (DHCSS) was established with the aim of raising the quality standards of health care in Malta. One of its main objectives is to promote a patient safety culture within public and private service providers.

Since 2008, the Department of Healthcare Services became the contact point for the collaboration of Malta within the EUNetPaS; European Union Patient Safety Network. EUNetPaS unites representatives of the European medical community such as doctors, nurses, pharmacists, managers of healthcare organisations and patients' associations. The EUNetPaS is responsible for; (1) Promoting a culture of patient safety (2) Structuring education and training in patient safety (3) Implementing reporting and learning systems (4) Pilot implementation of medication safety - Improve medication safety in hospitals by identifying good practices, translating them into tools and testing these tools in selected hospitals.
In 2009, a study by Baldacchino aimed to measure patient safety culture and reveal patient safety culture strengths and weaknesses in practise at four high dependency patient care areas, at Mater-Dei hospital. The study population comprised of 133 nurses and 22 doctors, who completed the Hospital Survey on Patient Safety Culture. The main findings identified ‘teamwork within units’ as the main area of strength (72% positive response) but 7 patient safety culture composites where identified as having a potential for improvement. These composites had a positive response in less than 50% of responses and included: ‘non-punitive response to errors’ also known as the blame-culture (19%) and ‘frequency of event reporting’ (31%), ‘hospital handoffs and transitions’ (35%). The author suggested that these scores are indicative of gaps in management support for patient safety and communication throughout the organisation (Baldacchino, 2009).

During 2010, the Department for Health Care Services Standards DHCSS engaged in measuring and benchmarking the rate of adverse events in Mater Dei Hospital. The aim of this initiative was to establish an effective process for the detection of adverse events that could cause harm to patients. The Global Trigger Tool for Measuring Adverse Events (UK version) (see Chapter 2, section 2.5.1 ) was used for measuring the incidence and types of adverse events occurring within Mater Dei hospital and for measuring the rate of these events over time (Institute for Healthcare Improvement project, 2009). Adverse events were defined from the perspective of the patient and were distinguished from those resulting from the disease process. This project is still in a piloting phase but upon its completion the outcomes are to be presented as adverse events per 1,000 patient days, and adverse events per 100 admissions.
In 2010, an exercise carried out at Mater-Dei dispensary was performed to bring to attention labelling and packaging issues involving several medicinal products as Mater-Dei hospital. The potential for error due to confusing drug names was confirmed from the presence of various medications on the shelves bearing the same corporate livery material with minimal distinguishing features, within both intra and inter product range. According to the 2004 report 'Building a safer NHS' and as described later on in Chapter 2, the single largest contributor to dispensing errors is attributable to look-alike and sound-alike medicines.

Throughout 2010-2011 the Medicines Authority has been involved in ongoing European discussions on the recently published European Pharmacovigilance Directive 2010/84/EC. This directive has set-out the need for the incorporation of medication errors within the obligations of healthcare professionals Adverse Drug Reaction reporting requirements. The Medicines Authority has been involved in discussions and is overseeing the local implementation of this new Pharmacovigilance Directive which is expected to strengthen patient safety and pharmacovigilance through direct patient reporting of ADRs and medication errors. Through directive 2010/84/EC there may be a more harmonised and solid framework with respect to medication error reporting in Malta as well as increased utilisation of the system through this patient involvement.

1.5 The purpose of the study

National efforts in the field of medication errors are becoming more pronounced, yet compared to the vast international knowledge base on medication errors, national research in the field of medication errors is still at its infancy and lags
behind in pace. Keeping in mind the considerable public health impact in terms of morbidity, mortality and monetary terms, this area should be prioritised locally to develop evidence-based strategies for the prevention of medication errors. Apart from an earlier study of ‘Nurses Perceptions on Medication Errors’ by Petrova in 2005, which sheds some light on nurses’ perceptions of medication errors and reporting barriers, no other studies directly measuring or analysing medication errors or perceptions in Malta have been identified to the best knowledge of this author. It is anticipated that the information presented in this dissertation on medication errors within the national context will generate new knowledge to help narrow the local research gap on the topic, as well as to ultimately serve as a stepping stone for the improvement of patient safety.

The aim of this study was to analyse the situation with respect to medication errors in Malta and suggest strategies for improvement. However, this study alone with its time and budget constraints cannot possibly cover the multitude of dimensions and processes involved in the detection and prevention of medication errors throughout the entire healthcare system. Therefore this study attempted to delve into aspects of medication errors in Malta through a multifaceted approach. The following objectives were formulated as a means to this aim;

(1) Compiling a descriptive and analytical literature review with respect to international studies on medication errors, focusing specifically on prescribing errors and dispensing errors

(2) Identifying the most common types of medication errors in Malta using the national pharmacovigilance database
(3) Identifying the medication classes that are associated with the highest risk of being in error through the analysis of the national pharmacovigilance database

(4) Using an existing questionnaire to identify the perceptions of pharmacists on the causes and prevention of dispensing errors

(5) Adopting and piloting a questionnaire based on an existing questionnaire on the perceptions of doctors on the causes and prevention of prescribing errors

(6) Acquiring knowledge on the issues surrounding medication errors and their reporting through meetings with local key players in the field.

1.6 Conclusion

Medication errors cause considerable morbidity, mortality and cost. The increasing use of medicines, the growing fragmentation of health care delivery, and the often overburdening of health care delivery system accentuate problems with medication errors. It is therefore a necessity that through this study error-prone situations within the medication use system are identified and interventions that help in the reduction of medication errors are suggested in order to provide safer healthcare systems.
Chapter 2 – LITERATURE REVIEW
2.1 Introduction

The purpose of this chapter is to review the literature on research exploring the issues concerning medication error definitions, classifications, epidemiology, detection, reporting and prevention with particular reference to prescribing and dispensing error. In this literature review, the reference database PubMed as well as EBSCO were searched for journal articles up to January 2011. In addition, national and international governmental and other organisation websites were searched for relevant articles, influential reports, guidelines and recommendations using Google search engine. Key words included medication errors, medication error in pharmacovigilance database, spontaneous reporting and medication error questionnaires. Free-text search yields were also included, and in addition the bibliography in retrieved studies was searched by hand. Several studies aimed at defining, measuring and providing recommendations on medication errors were systematically analysed.

This chapter begins with some definitions and a classification of medication errors followed by an epidemiological review including methods for detecting medication errors.

2.2 Definitions

2.2.1 Medication Errors

The lack of harmonisation in the working definitions of medication errors has been well documented (Dean et al., 2000, Ferner & Aronson, 2006). A systematic review of the literature focusing on the working definitions of medication errors by Lisby and colleagues in 2010 confirmed “an inconsistency in defining medication errors
as well as lack of definitions.” The results of this review verify that compared with other epidemiological fields in health care, no single definition is currently being used to determine medication errors although attempts to develop an international definition have been made e.g. by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP, 1996). Lisby and colleagues state that ‘inconsistent use of definitions has not provided clarity or consistent findings with respect to medication errors’ and go on to suggest that this inconsistency has contributed to the substantial variation in the reported occurrences of medication errors.

In the review by Lisby et al., 38% of the reviewed articles used the NCC MERP definition although the methodologies employed differed. This definition was more frequently utilised with studies using reporting systems and because of this, it was chosen to be the operational definition for the work presented in this dissertation. The NCC MERP definition of a medication error is as follows:

‘Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in control of the health-care professional, patient or consumer. Such events may be related to professional practice, health-care products, procedures and systems, including prescribing; order communication; product labelling, packaging and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.’

Yu, Nation & Dooley in 2005 used the Delphi method to identify the most robust of definitions, and found that the Ferner & Aronson (2006) definition categorised all error scenarios and only error scenarios. They had proposed that a medication error be defined as ‘a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient’. In this definition the use of the term failure signifies that the process has fallen below some attainable standard (Leape et al., 1991). Therefore
by this definition, a medication error is preventable because it evidences what should have been done and what was not done during the medicine therapy of a patient (Expert group on Safe Medication Practises, 2007). Hence, the U.S NCC MERP definition which classifies medication errors as ‘any preventable event’ is fundamentally equivalent in this aspect. The NCC MERP definition was initially developed for medication error reporting and, therefore, is an obvious choice for studies using reporting systems, which was the case for almost all the studies done in this category. For the study on medication errors in Malta the NCC MERP definition was used.

2.2.3 Definition of Adverse Drug Reactions

While in the vast majority medicines are used without any harm, some patients may experience unwanted side-effects to their therapy. Many side effects or adverse drug reactions (ADRs) are predictable and accepted risks of treatment which can be minimised by careful prescribing, advice, use and regulatory control of medicines. The World Health Organisation (WHO), defines an adverse drug reaction as: “Any response to a drug which is noxious, unintended and occurs at doses used for prophylaxis, diagnosis or therapy of disease, or for the modification of physiological function.” (WHO, 2000) Whereas the legal definition of an adverse reaction as stipulated in S.L. 35 of chapter 458 of the laws of Malta (as throughout Europe) is;

“Any response to a drug which is noxious, unintended and occurs at doses used for prophylaxis, diagnosis or therapy of disease, or for the restoration, correction or modification of physiological function.” While both definitions are widely accepted and used, the European definition has a wider scope since it includes those ADRs arising from medicinal products that re-establish normal body functions.
Some ADRs are unpredictable and unavoidable. Unpredictable reactions may be described as those ADRs that did not emerge in clinical trials and are not found in the medicinal product's literature. It is now an accepted fact that not all ADRs will be defined in the controlled environment of a clinical trial. In the authorisation process of medicinal products, documentation such as the Summary of Product Characteristics (SPC) and Product Information Leaflet (PIL) would be evaluated to check which adverse drug effects are to be expected and in which frequency. Although medication safety comprises both medication errors and adverse drug reactions, a clear distinction has to be made between them and as stated by the WHO ‘medication errors are linked to the safety of healthcare services whereas adverse drug reactions are linked to product safety’ (WHO, 2002). Pharmacovigilance systems monitor the inherent unavoidable pharmacological side-effects of medicines when these medications are used as intended. In contrast, medication errors occurring when medicines are prescribed, dispensed or used in a manner that is not in line with what was intended – are avoidable. Most medication errors do not result in harm to the patient. However, the use of any medicine carries an inherent risk within its intended use, and this risk is pronounced when a medication is used in error. A study by Jonville-Bera et al., determined that "incorrectly" used drugs were more often causally linked to ADR than correctly used drugs (P<0.0001). In this study the comparative standard used was the products' SPC (Jonville-Bera et al., 2005).

2.2.4 Prescribing error

The operational definition of a prescribing error used for this study was the one formulated and tested by Dean, Barber & Schachater in 2000. A prescribing error was defined as;
‘A prescribing decision or prescription-writing process that results in an unintentional, significant: (i) reduction in the probability of treatment being timely and effective or (ii) increase in the risk of harm, when compared to generally accepted practice ’

This definition is accompanied by lists of events that should and should not be included as prescribing errors and includes errors originating in both prescription writing and the prescribing decision. While deviations from policies or guidelines were not included as prescribing errors, the list of prescribing errors specified by these authors does include deviations of prescribing against those recommended by the British National Formulary or medication data sheet (Dean, Barber & Schachater, 2000). Here the authors do not specify whether the data sheet is the core data sheet or a summary data sheet (informally known as the summary of product characteristics). Nonetheless, according to the World Health Organisation’s guideline on the compilation of a national formulary such as the British National Formulary one of the recommended evidence-based information sources to be used within a formulary is the medicinal products licensed literature (WHO, 2004). Therefore, in this study, non-adherence to the medicinal products licensed literature was considered to be a prescribing error. The medicinal products’ licensed literature includes the Summary of product characteristics, package inserts and labelling information. The Dean et al., definition has been used in numerous studies (Haw et al., 2003; Lawler et al., 2004) and cited in many others.
Off-label prescribing

Since the late 1960s, legislation, which followed the thalidomide disaster, has required that medicines must not be marketed without a license, and that the license should stipulate for what the product should be used (Collier, 1999). The thrust of the legislation was directed at drug manufacturers, and expressly permitted doctors and dentists the right to prescribe unlicensed products, or licensed medicines outside their licensed indications (off label). Despite these exemptions, it has always been expected that unlicensed or off-label prescribing should be the exception rather than the rule (Collier, 1999). Collier also states that for adults, such prescribing is probably unusual although for children prescribing outside a licence is relatively common. This statement is confirmed through a review report by Impicciatore & Choonara (1999) who suggests, that off-license prescribing is a problem in paediatric medicine but not for adult prescribing.

2.2.5 Dispensing error

A dispensing error has been defined by Beso et al., in 2005 as:

'A deviation from an interpretable written prescription or medication.' Any deviation from professional or regulatory references or guidelines affecting dispensing procedures is also considered as a dispensing error.

This definition was adopted by the 2007 report 'Creation of a better medication safety culture in Europe' and was the operational definition for this study (Expert group on safe medication practices, 2007).
2.3 Classification of Medication Errors

To understand medication errors and to identify preventative strategies; a good understanding of how to classify them and define the terms that describe them is crucial.

Three types of classification systems have been identified in the literature; (1) Contextual classification (2) Modal classification (3) Psychological classification (Ferner & Aronson, 2006; Mc Dowell et al., 2009). Contextual classification deals with the specific time, place, medication and people involved. Modal classification examines the ways in which errors occur (e.g. by omission, or commission) but fails to account for the context around the error (Aronson, 2009). Classification of medication errors based on psychological theory is to be preferred as it explains events rather than merely describing them (Aronson, 2009). Its disadvantage is that it focuses on human rather than system error.

James Reason (1990) developed the well-recognised psychological system for human error classification based on observations from other industries such as aviation and nuclear power that have become highly reliable. Reason states that errors arise for two reasons: active failures and latent conditions see Figure 2.1 (Reason, 1990).

Active failures are unsafe acts committed by people who are in direct contact with the patient. They take a variety of forms: slips, lapses, and mistakes. Slips and lapses are skill-based behaviour errors, when a routine behaviour is misdirected or omitted. The person has the right idea but performs the wrong execution. Mistakes are knowledge-based errors (perception, judgment, inference, and interpretation) and occur due to incorrect thought processes or analyses. Moyen et al. (2008) defined and classified medication errors based on Reason and Pronovost's work as in Table 2.1.
Most studies in the patient safety literature focus on errors of commission such as wrong drug or wrong dose (Aronson, 2009). Problems with effectiveness and access to drug therapy have been studied much less frequently (Kanjanarat et al., 2003). Frequently, the application of more than 1 type of classification system has been observed within the same study. This area too, is lacking in harmonisation.

<table>
<thead>
<tr>
<th>Definitions</th>
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<tbody>
<tr>
<td>Slip</td>
<td>A failure to execute an action due to a routine behavior being misdirected [Reason, 1990].</td>
</tr>
<tr>
<td>Lapse</td>
<td>A failure to execute an action due to lapse in memory and a routine behavior being omitted [Reason, 1990].</td>
</tr>
<tr>
<td>Mistake</td>
<td>A knowledge-based error due to an incorrect thought process or analysis [Reason, 1990].</td>
</tr>
<tr>
<td>Error of omission</td>
<td>Failure to perform an appropriate action [Pronovost, 2005].</td>
</tr>
<tr>
<td>Error of commission</td>
<td>Performing an inappropriate action [Pronovost, 2005].</td>
</tr>
</tbody>
</table>

Latent conditions can be considered as stimuli to active failures. Latent conditions can affect the rate at which employees execute active failures and the risks associated with active failures. Latent failures occur when individuals make decisions that have unintended consequences in the future (Reason, 1990). Policies are an important area which could be searched for identification of latent conditions. For example, hospitals that use staffing models that depend on providers to routinely perform clinical duties above and beyond their regular responsibilities have created many latent conditions such as time pressure, fatigue and low morale (Moyen et al., 2008). Hence policy is an important tool in the reduction of latent conditions that affect the rate and risk of active failures.
An elaboration of the Reason theory by Ferner & Aronson in 2006 resulted in medication errors being classified into four broad categories: knowledge-based errors, rule-based errors, action-based errors and memory-based errors as in Figure 2.1.

**Figure 2.1** The classification of medication errors based on a psychological approach (reproduced from Ferner and Aronson, 2006 on elaboration of Reason’s Theory)

This classification can help one understand how errors can be prevented. According to Aronson (2009), knowledge based errors can be improved by improving education and knowledge, e.g. by enhancing education on therapeutics (Maxwell & Walley, 2003; Likic & Maxwell, 2009) and tested on practical application (Langford et al., 2009) that prescribers are kept up to date. Computerised decision –support systems can also train prescribers to make fewer errors (Anton et al., 2004; Agrawal, 2009). Rule-based errors can be prevented by improving the rules or enforcing the rules. Training can help in preventing technical (action-based) errors. Memory-based errors are the most difficult to prevent. They are best tackled by putting in place systems that
detect such errors and allow remedial action such as checklists and computerized systems (Aronson 2009; Agrawal, 2009).

2.4 Epidemiology of Medication Errors

There is evidence that medication errors occur in all health care settings with some errors occurring repeatedly within different healthcare systems worldwide. Medication errors should be amenable to epidemiological analysis, giving insights into the causes of error and the effects of interventions to prevent them or reduce harm from them (Aronson, 2009).

2.4.1 Incidence

The Adverse Drug Event Prevention Study that formed part of the Institute Of Medicines (IOM) report, reported that harmful medication errors occurred in 1.8% of admissions (Leape et al., 1995) while 3.7% of hospitalized patients experienced clinically important adverse events, of which 20% were considered preventable (Kohn et al, 1999). Subsequent studies by Bates et al., in 1995 discovered similar ADE rates and, on assessment, deemed that 28% of ADEs were preventable. Studies in Australian hospitals show that about 1% of all admissions suffered an adverse event as a result of a medication error (Wilson et al, 1995; Runciman et al., 2003). In European hospitals the incidence of preventable adverse drug events was 0.4-7.3% (Expert group on safe medication practices, 2007). Primary care data on medication errors is extremely low but adverse drug events in Europe that lead to hospital admissions were considered preventable in 23.1% to 79.6% of cases (Beijer & DeBlay, 2002). In the UK, 216 claims against GPs handled by the Medical Defence Union between 1995 and 2001 were directly related to errors in prescribing, monitoring or administering medicines.
(Medical Defence Union. 2001). Of 1000 consecutive claims reported to the Medical Protection Society from 1st July 1996, 193 (19.3%) were associated with medication and prescribing (Medical Protection Society. 2001).

According to the European Report on Safe Medication Practices by the expert working group in 2007, medication error rates should be considered as quality indicators of the different processes of the medication use system. For preventable ADEs in the U.S Bates et al. in 1993 determined the frequency of errors at various stages of the medication use process during which the error occurred, which were as follows: prescribing stage (56%), administration (34%), transcription (6%), and dispensing error (4%). Leape et al. in 1995 found that 39% of these errors occurred at prescribing, 38% at administration, 11% at dispensing and 12% at transcription; Kaushal in 2002 found a similar pattern with prescribing and administration stages most often associated with preventable adverse drug events. The incidence of prescribing, dispensing and administration errors in European settings is given in Table 2.2.

**Table 2.2**: The incidence of medication errors in Europe (adopted from 'Creation of a better medication safety culture in Europe: building up safe medication practises, 2007')

<table>
<thead>
<tr>
<th>Stage in the medication use system</th>
<th>Ambulatory care</th>
<th>Hospital Setting</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescribing</td>
<td>7.5%</td>
<td>0.3-9.1%</td>
<td>% of medication orders</td>
</tr>
<tr>
<td>Dispensing</td>
<td>0.08%</td>
<td>1.6-2.1%</td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>Not available</td>
<td></td>
<td>Direct observation studies</td>
</tr>
<tr>
<td></td>
<td>49.3%</td>
<td></td>
<td>Intravenous medicine doses prepared on wards</td>
</tr>
<tr>
<td></td>
<td>5.1-47.5%</td>
<td></td>
<td>Traditional floor stock or ward stock systems</td>
</tr>
<tr>
<td></td>
<td>2.4-8.6%</td>
<td></td>
<td>Ward stock system with daily ward visits by pharmacist</td>
</tr>
<tr>
<td></td>
<td>7.2-9.1%</td>
<td></td>
<td>Patient prescription distribution system</td>
</tr>
<tr>
<td></td>
<td>10.5%</td>
<td></td>
<td>Unit dose drug distribution manual system</td>
</tr>
<tr>
<td></td>
<td>2.4-9.7%</td>
<td></td>
<td>Unit dose drug distribution computerised or automated system</td>
</tr>
</tbody>
</table>
Over a single year in a U.S hospital 2,103 clinically significant prescribing errors were identified and averted by pharmacists, representing an overall prescribing error rate of approximately 0.4% (Chen et al., 2001). Forty-three of these were classified as potentially fatal or severe – corresponding to about 1 in 10,000 of all prescriptions. In a study of 550,000 prescriptions written by GPs in the UK pharmacists identified and averted potentially serious errors in 54 cases (1 in 10,000, 0.01%). In one UK hospital, potentially serious errors which were identified and averted by pharmacists occurred in 0.4% of prescriptions. The majority of errors (54%) were associated with choice of dose and most serious errors originated in the prescribing decision (Department of Health UK, 2004). Considering that the prescribing denominator is so large (nearly 927 million prescription items were dispensed in 2010) an error in 0.4% results in a significant number of preventable events (NHS UK survey, 2010). Based on international experience, it is evident that placing focus on prescribing errors is a worthwhile target in reducing medication errors.

2.4.2 Causes of Medication error

2.4.2.1 Prescribing errors

Prescribing errors may arise in the decision making process or in prescription writing. Errors in decision making may be due to; (1) lack of knowledge about the patient or (2) lack of knowledge of the drug or (3) both. Monitoring of treatment may be inadequate or lacking because of the same reasons. Errors in prescription writing may be due to poor communications, inaccurate transcription, or unsigned or illegible prescriptions. Errors may be due to person or systems factors or a combination. Typically, many factors contribute to any prescribing error.
A UK hospital based study investigated the causes of 44 prescribing errors where forty-one doctors were interviewed to assess the reasons for the prescribing error. A questionnaire was used to investigate the factors which may have contributed to the error. Mistakes were made because of slips in attention, or failure to apply relevant rules. Risk factors identified included work environment, workload, whether they were prescribing for their own patient, communication with the team, physical and mental well-being, and lack of knowledge. Organisational factors including inadequate training, low perceived importance of prescribing, a hierarchical medical team and an absence of self-awareness of errors were also identified (Rand research, 2002).

**Lack of knowledge about the patient**

In hospitals junior doctors who have the least experience do most prescribing and they often face complex clinical situations which they have never seen before. They may be working in new surroundings with unfamiliar systems as part of their rotational training and, like people in all occupations, are subject to stress, tiredness and distractions. Decisions are made based on the information available to them at the time - their own knowledge of the disease and its treatment, and their knowledge of the patient. In many instances, doctors are unable to quickly access information from case notes. Where admission to hospital is unplanned there may be delays in retrieving patients' case notes from storage in medical record libraries. Therefore, important information about the patient's previous medical history may not be available until the case notes are available (Department of Health UK, 2004)

Errors may similarly occur within primary care, including health centres and nursing homes. When a patient is admitted to a nursing home there is a possibility that the medical care will be transferred to a new doctor who may face the dilemma of being
asked to prescribe without adequate information about the patient or their clinical condition. Sometimes errors may occur due to prescribing decisions being inadequately recorded from for example from a General Practitioners’ (GP) visit to a nursing home and so are propelled in the patient’s everyday treatment. Decisions made by the GP during a visit to a care home may not be incorporated into the patient’s records in a timely manner. Drug toxicity is a well recognised risk if clinical information relating to disease and physiological status of the patient are not available for review at the prescribing stage (Department of Health UK, 2004).

*Lack of knowledge and information about the drug*

Lack of drug knowledge can lead to prescribing of drugs that are contraindicated or combinations that may cause harmful drug interactions. Lack of knowledge of drug metabolism and elimination may result in failure to adjust a dose in line with the patient’s condition and concomitant medication.

Miscalculation of doses is a major source of prescribing errors especially in paediatric patients. In an American study more than 1 in 6 errors involved miscalculation of doses, wrong decimal point placement (10 fold error), incorrect expression of unit of measurement or concentration, or incorrect administration rate (Lesar et al., 1997). In a British study 150 doctors in a teaching hospital were asked to complete a questionnaire about drug dilution and concentration. About half were unable to convert doses correctly from a percentage concentration or dilution to a more conventional mass concentration. Recognising this as a cause for concern, the authors suggested that standard hospital procedures dictate that all drugs be measured and prescribed in a standard way (Rolfe & Harper, 1995).
Medicinal products with similar sounding names and drug names that look alike when hand-written may result in prescribing or transcribing errors. In the UK and the U.S, some institutions conduct a formal risk assessment when new drug products are introduced into practice to ensure that risks from drug name confusion or other characteristics of the new drug are identified and addressed (Reason, 1990; Barber et al., 2006). Medicines with similar names sometimes have totally unrelated uses and the risk for error is increased if these are placed adjacent to each other in drug indexes, computer systems and dispensary shelves (Vincent et al., 2001).

Dosage formulation may also be the cause of inappropriate use of medication and cause potential harm to patients. Errors associated with dosage forms account for up to 15% of prescribing errors (Cohen et al., 1994). Cohen found that injectibles are generally more apt to be associated with medication errors.

Illegible prescriptions

Illegible prescriptions are a major cause of medication error. A study in the U.S assessing the quality of written inpatient prescriptions found that of 4,536 prescriptions 4-10% were illegible or ambiguous (Phillips, Christenfeld & Glynn, 1998). If the interpretation of an unclear prescription is wrong then a medication may be incorrectly transcribed by another doctor, incorrectly dispensed by a pharmacist or incorrectly administered by a nurse. The prescription should always be clear, unambiguous and leave no doubts of the prescriber’s intentions.
Repeat prescribing

Repeat prescribing in primary care may be a source of error, especially in the absence of a protocol. The UK’s Medical Protection Society recommends that all practices have a repeat prescribing protocol in place, which should be validated by external sources, or by a clinical governance lead in the practice. All staff should be trained to use the protocol, which should be dated and regularly reviewed. In this regard Guidance Notes by the General Medical Council in the UK (GMC, 2006) and Australia (NPS, 2006) have been compiled to aid good prescribing practises. In Malta, there is no formal guidance on prescribing but in 2010 the Medical Council of Malta issued a note, reminding physicians of the need to abide by Article 3 of the Medicines Act (Cap 458) when writing repeat prescriptions (Medical Council Malta circular 07/2010, 2010). A study in general practice (UK) in 1996 found that 66% of repeat prescriptions showed no evidence of authorisation by a doctor, and 72% of repeat prescriptions showed no evidence of having been reviewed in the previous 15 months (Zermansky, 1996). Repeat prescribing systems may make it difficult to ensure that therapy is adequately monitored or reviewed and patients may continue to be prescribed medicines which are no longer necessary. This study’s recommendations included that administrative staff involved in repeat prescribing should receive appropriate training and should work to clearly defined procedures.

2.4.2.2 Dispensing errors

A study of more than 1 million dispensed items in British hospitals identified 178 errors (0.018%). The error rate was 0.01% when the dispensing of pharmacists and technicians was double-checked, compared with 0.035% when there was no double-check (Spencer & Smith, 1993). According to this study, most dispensing errors
resulted from drug name confusion, failure to clarify an ambiguous or badly written prescription, similar packaging or lack of a check by a second person. When a dispensing error is made in primary care and is not immediately detected, the patient may continue to take the incorrect medicine for the entire duration of that prescription and. Dispensing errors may therefore result in serious harm. Compared to studies on prescribing and administration of medication, there is less published data on the type, frequency and causes of dispensing errors identified in this literature review. It was also hard to identify studies where the quality of dispensing advice given to patients was evaluated.

A variety of factors can predispose to dispensing errors including personal and environmental issues which have been termed the 'socio-technical' aspects of work by Tulip and Campbell in 2001. Their findings indicated several characteristics of participants' work settings that were potentially related to medication safety. These were broadly classified as relationships involving the pharmacist, demands on the pharmacist and management and governance of pharmacists (Tulip & Campbell, 2001).

Other studies found that the factor highest associated with dispensing errors include similar sounding and looking drug names, inexperienced staff, low staffing, transcription errors and high workload. In Australia, Peterson et al (1999), conducted a study on attitudes of pharmacists towards dispensing errors where they found that the unavailability of technical resources and non-professional activities occurring in the vicinity of dispensing area where additional factors associated with dispensing errors. Peterson and colleagues suggested that quality assurance programmes be developed, and that these that should involve the filing of incident reports. These reports should be handled non-punitively and be backed up by twice yearly evaluations of personnel who
handle medication. Other causes of dispensing errors include misreading the prescription, similar packaging and applying an incorrect dispensing label. Inexperienced staff, including staff who work infrequently in the dispensary, were found to be more prone to making dispensing errors (Peterson et al, 1999).

According to James et al. (2008) in recent years the use of automated dispensing systems has been widely advocated to improve efficiency, maximize storage capacity and minimize dispensing errors. Consequently, automated dispensing systems are becoming increasingly commonplace in hospital and community pharmacies across the world.

2.5 Methods used in detecting Medication errors

A very wide range of methods (see Table 2.3) have been used to collect data on medication errors, each with advantages, disadvantages and imprecisions (Dean-Franklin et al., 2005). However even relatively limited studies can provide valuable data, despite not always being strictly comparable (Schachter, 2009).

Medication error studies may be prospective or retrospective. Prospective studies are used to calculate incidence rates of medication errors in either a cross-sectional or cohort study. In a hospital setting, prospective studies may either be looking at all admissions to see how many where caused by adverse drug reactions (Poyanne et al., 2000) (either in a cohort or representative sample).

Alternatively adverse drug events encountered by all admissions or a representative sample over a period of time within a particular hospital(s) is measured. Other prospective studies have looked at medication errors arising out of look-alike and sound-alike brand name confusion (Joshi et al, 2007) or administration errors by direct
observation. Prospective studies are usually costly and require highly trained personnel to undertake. Retrospective studies are limited by their lateness and may not truly reflect current practises.

Table 2.3: Detection methods used to investigate medication errors and adverse events (adopted from Montesi & Lechi, 2009)

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Limitations</th>
<th>Efficacy</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart review</td>
<td>Data readily available</td>
<td>Difficult, time consuming, labour intensive, poor at capturing latent failures</td>
<td>Gold-standard for detecting adverse effects, less medication errors detected</td>
<td>Reviewers training and time</td>
</tr>
<tr>
<td>Claims Data</td>
<td>Local data (captures specific prevalent traits), captures latent failures</td>
<td>Litigation based, legal implications</td>
<td>Adverse events and medication errors detection</td>
<td>Reviewers training and time</td>
</tr>
<tr>
<td>Incident reporting (sentinel events)</td>
<td>High quality data, captures active and latent failures</td>
<td>Only detects severe, unexplained events/deaths, underestimated rates, blame, fear of punishment</td>
<td>Detects adverse events, less medication errors</td>
<td>Root cause analysis</td>
</tr>
<tr>
<td>Administrative data examination</td>
<td>Disposable and retroactive data, easy, standardized data</td>
<td>Absence of clinical data</td>
<td>Statistical</td>
<td>Routine evaluation</td>
</tr>
<tr>
<td>Computer monitoring (CPOE)</td>
<td>Multidata source integration; real time, adverse event prevention</td>
<td>Inserted errors, poor software, poor triggers, underdetermined future risks</td>
<td>Prescribing faults, prescription errors and dispensing errors all detected</td>
<td>High costs for software and implementation</td>
</tr>
<tr>
<td>Direct observation</td>
<td>Accurate, captures active errors</td>
<td>Time-consuming, training difficult</td>
<td>Good quality data about dispensing and administration errors</td>
<td>Training</td>
</tr>
<tr>
<td>Patient Monitoring</td>
<td>Data from outpatients; wide impact</td>
<td>Not standardized tools (interviews, questionnaires, focus groups, etc)</td>
<td>Future development</td>
<td>Training</td>
</tr>
<tr>
<td>Voluntary reporting</td>
<td>Variety of sources, structured simple form, captures active and latent failures, promotes a culture of safety</td>
<td>Variable quality, underreporting, blame culture, problem of data integration</td>
<td>Reports and alerts; feedback and corrective actions, medication errors detected</td>
<td>Time for feedback and analysis</td>
</tr>
</tbody>
</table>
2.5.1 Chart review

Chart review is retrospective and based on practice sources (medical charts and laboratory data, prescription data and administrative data) (DeVries et al., 2008; Morimoto et al., 2004; Hogan et al., 2008). It can be improved by using computerized data, such as electronic medical records, computerized physician order entry (CPOE) and computer-integrated triggers or use of paper-based trigger-tools (Tam et al., 2008). Good planning is required for definitions, inclusion criteria, and triggers. The downsides of this method are the difficulty in training reviewers and the resources needed, both fiscal and human. Furthermore, the results depend on the quality of documentation and the reviewer's abilities to capture triggers (Montesi & Lechi, 2009). Computer-integrated triggers can give many false positives (Barber et al., 2006). Despite advances in the science of medical record review, (Ashton et al., 1999) there are many flaws in this methodology. Judgments about the presence of adverse events by chart reviewers are known to have only low to moderate reliability (precision) (Localio et al., 1996) but standardisation techniques as done in Barber's study ameliorated this bias to a degree (Barber et al. 2006). Another limitation of chart review is incomplete documentation in the medical record (Luck et al., 2000). Through many researchers' experience, incomplete documentation affects the ability to detect both latent errors and active errors that may lead to adverse events, a weakness that may be addressed by combining chart review with error reporting (Thomas et al., 2003).

2.5.2 Electronic Medical Record Review

Reviewing the electronic medical record is a prospective process and may improve detection of errors and adverse events by monitoring in "real time" and by integrating multiple sources (Thomas et al., 2003). Use of computers to search the electronic medical record can find errors data and adverse events not detected by
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traditional chart review or error reporting (Jha et al., 1998). While more complete than
hand written records (because of the ability to integrate multiple data sources), the data
in the electronic medical record are still entered by humans and can still contain error
and bias. Also, no standardized method exists to search for errors and adverse events.
The reliability and validity of such measurement tools is unknown and deserves further
study (Thomas et al., 2003). The initial cost of these systems remains another
significant limitation but as hospital medication delivery systems and laboratory
reporting systems become more integrated with computers, structured review of the
electronic medical record is likely to be an important method for measuring errors and
adverse events and has the potential to be both accurate and precise (Montesi & Lechi,
2009). Electronic medical record review has the advantage of intercepting medication
errors before adverse events occur and if CPOE is in use, prescription and dispensing
errors may be readily detected (Bonnabry et al., 2008). Advanced software
implementation supports integration of laboratory and clinical data with Clinical
Decision Support Systems (CDSS), providing detection and prevention of adverse
events. (Montesi & Lechi, 2009). Implementation of information technology is costly
but necessary for safety. However it can also give rise to new, unknown risks (Montesi
& Lechi, 2009).

2.5.3 Administrative databases

Administrative databases can be screened for International Classification of
Disease codes (ICD) representing ADE. Adverse event-adjusted rates can be extracted
from a combination of discharge data. However, the adverse events detected through
the ICD codes lack clinical data related to the event so this method is not very useful for
anything else other than ADRs/discharges. (Montesi & Lechi, 2009).
2.5.4 **Claims data**

The value of screening of claims data is limited by the underlying reasons for the report, which are sometimes frivolous, and by the involvement of a small number of local claims. Events often take long to be confirmed and often lack evidence of errors (Studdert et al., 2006).

2.5.5 **Direct observation**

Direct observation is the best error detection method in terms of accuracy (Allen & Barker, 1990). Direct observation includes the disguised-observation (used for capturing dispensing errors) and participant observer techniques (used for administration errors).

In Thomas et al. 2003, they describe observing or filming actual patient care as a means for measuring active errors. Observation has been used in operating rooms (Helmreich & Schaefer, 1994), intensive care units (Donchin et al., 1995), surgical wards (Andrews et al., 1997) and to assess errors during medication administration. These studies found many more active errors and adverse events than previously documented, again highlighting the limitations of the other measurement methods described above. Direct observation is limited by practical issues. First, confidentiality is a concern. Second, direct observation requires time-intensive training of observers to ensure reliability (precision). Finally, the Hawthorne effect, which occurs when individuals alter their normal behaviour because they are being observed, is also a limitation (Thomas et al., 2003).

2.5.6 **Incident reporting**

Incident reporting is frequently used as a general term for all voluntary and mandatory patient safety event reporting systems. Incident reporting is a passive form
of surveillance for in contrast to more active methods of surveillance such as direct observation, chart review or using trigger tools. While traditional event reporting systems have been paper based, technological enhancements have allowed the development of Web-based systems and systems that can receive information from electronic medical records (AHRQ, 2011). Specialized systems have also been developed for specific settings, such as the adverse drug reaction reporting system used in pharmacovigilance, intensive care unit safety reporting system and systems for reporting surgical and anesthesia-related errors. In a study that was done to determine the frequency with which adverse drug events result in an incident report (IR) in hospitalized patients it was found that only 6% of adverse drug events resulted in a corresponding incident report (Cullen et al., 1995). Many reasons have been postulated for underreporting but the literature reviewed points to (1) lack of awareness that an error has occurred (2) belief that the patient has not been harmed, and (3) reluctance to report because of fear of disciplinary action (Haw et al., 2005) as the most common causes of underreporting. Other studies suggest that lack of feedback on error reports submitted is also a cause for underreporting (Pronovost, 2007). Hence incident reporting when used alone may not be a good source for capturing medication errors in hospitals, unless an absolute no-blame culture is in place and good mechanisms for giving feedback to reporters are in place.

Incident reporting need not be confined to a single hospital or organization. Many developed countries have several event reporting systems, most of them voluntary. The United Kingdom's National Patient Safety Agency maintains the National Reporting and Learning System, while the Medicines and Healthcare Regulatory Authority co-ordinates the ADR yellow-card reporting scheme. The U.S. has the MedMARx voluntary medication error reporting system as well as the AERS
(Adverse Event Reporting System). In Malta, Mater Dei hospital, the main general teaching hospital has an incident reporting system which includes reporting on medication errors. The Department of Health Information and Research also keep a database on incidents within Gozo General Hospital. The advantages of voluntary event reporting systems include their relative acceptability and manageable costs. Their role in capturing medication errors is that information from event reports highlights specific concerns that are worthy of attention. However, event reports alone do not provide insights into the epidemiology of safety problems. In a sense, event reports supply the numerator (the number of events of a particular type—and here, this number only reflects a fraction of all such events but do not supply the denominator (the number of patients vulnerable to such an event) or the number of "near misses" (AHRQ, 2011).

Event reports therefore can provide a snapshot of safety issues, but on their own, cannot be used to provide concrete incidence rates or be used as a quality indicator of a healthcare system. An increase in reporting rates should be seen as a positive attitude towards patient safety culture rather than an indication that errors are becoming more frequent.

2.6 Pharmacovigilance centres in medication error detection

Pharmacovigilance is the science relating to the detection, assessment, understanding and prevention of adverse effects, particularly long term and short term side effects of medicines (WHO, 2002). Spontaneous reporting is the core data-generating system of international pharmacovigilance, relying on healthcare professionals (and in some places consumers) to identify and report any suspected adverse drug reaction to their national pharmacovigilance centre or to the manufacturer
(ICH, 2010). Spontaneous reports are almost always submitted voluntarily. In many parts of the world these are submitted electronically using a defined message standard (Andrews & Mann, 2002). One of this system's weaknesses is under-reporting, although the figures vary greatly between countries with the number of reports submitted to the WHO database increasing incrementally each year by about 250,000 (UMC, 2009). Overworked medical personnel do not always see reporting as a priority especially if the symptoms are not serious and even if the symptoms are serious, they may not be recognized as the effect of a particular drug.

As part of a project initiated by the World Alliance for Patient Safety in 2007, some countries have tapped into their pharmacovigilance databases to see whether these databases can be used as a source of information on medication error related adverse drug events. A study by Alj and colleagues in 2007 found that 14% of all ADRs submitted to the national Moroccan pharmacovigilance database were due to a medication error and so were preventable. A study on the New Zealand pharmacovigilance database found that 4.3% (61/1412) of reports were deemed preventable and 65.5% (40/61) of these errors were deemed to have been associated with some degree of patient harm (Kunac & Tatley, 2011). Both these studies used the NCC MERP definition of medication errors. In both studies preventable events were mostly related to the prescribing and administration stages of the medication use process, with the majority of errors deemed to have originated in the community setting. Through this method the identification of the classes of medication that were most involved in preventable adverse reactions and the stage at which the errors occurred during therapy and the types of errors involved were identified. These two studies, retrospective analysis of a pharmacovigilance database formed the basis of the local studies approach to studying medication errors.
Despite giving limited information on incidence of medication errors, pharmacovigilance databases were found to have a role in detecting and preventing medication errors. Pharmacovigilance centres are also in a position to disseminate information regarding the most frequent medication-related problems to healthcare professionals (Bencheikh & Benabdallah, 2009) within a multidimensional approach to medication error capture.

**Other methods**


2. Attending medical rounds to listen for clues that an error has occurred (Andrews et al, 1997).

3. Doses returned to pharmacy (Gift et al., 1996).

4. Urine testing as evidence of omitted drugs and unauthorized drug administration (Ballinger et al., 1974).

5. Examination of death certificates (Phillips et al; 1998).

6. Examination of nurse’s change of shift report (Baker, 1997).

7. Medication administration record comparison to physician orders (Cunnigham et al., 1996).

8. Computerized analysis to identify patients receiving target or tracer drugs that may be used to treat a medication error (Shuttleworth & Ruelle, 1996).

9. Comparison of drugs removed from an automated drug dispensing device for a patient to physician orders (Shuttleworth & Ruelle, 1996).
2.7 Conclusion

Patient safety has become an international priority with major research programmes being carried out in the U.S, UK, and elsewhere. The challenge is how to organize research efforts that will produce the greatest effect in making health care safer for patients. Medication error research initiatives can be considered in three different stages: (1) epidemiology of the risks and hazards; (2) design, implementation, and evaluation of medication error reduction strategies; and (3) maintaining vigilance to ensure that a safe environment continues and patient safety initiatives remain in place. No single method can be universally applied to identify and quantify risks and hazards of medication errors. Rather, multiple approaches using combinations of these methods should be used to increase identification of risks and hazards, reduce the risks to patients and maintain a continuous process of evaluating the safety of the healthcare environment. In this study, the chosen approaches to studying medication errors were the analysis of the national pharmacovigilance database of the Medicines Authority due to: (1) this data source having been used successfully before and so (2) being free and readily available. Questionnaires to doctors and pharmacists were chosen over the focus group approach due: (1) to this approach being undertaken before and therefore comparisons can be made. These methods will be described in full in the next Chapter.
Chapter 3 - METHODOLOGY
3.1 Introduction

This chapter describes the methodological description of the four approaches that were undertaken to achieve the aims and objectives that were set to answer the research question described in chapter 1. These four approaches are the following:

(1) An analysis of the national pharmacovigilance database in order to attempt to identify, quantify and describe medication errors.

(2) Questionnaires querying the attitudes and perception on prescribing and dispensing errors amongst the medical and pharmacy profession.

(3) Analysing reports from the national regulatory councils in relation to medication errors.

(4) Interviewing selected key players in the healthcare field.

3.2 Research design

Descriptive, non-experimental designs where used. Both qualitative and quantitative data was collected through a mixed methods approach. Considering the strengths and weaknesses of both quantitative and qualitative research methods it was decided that both techniques would be required to give as rich a description as possible on medication errors in Malta. The first three listed approaches gave mostly quantitative information but also some qualitative information through open ended questions in study 2. Study 4 generated mostly qualitative information. Data collection and analysis took place between December 2009 and July 2011.
3.3 Analysis of the national pharmacovigilance database

The Medicines Authority pharmacovigilance database contains all the locally reported adverse drug reaction reports submitted by healthcare professionals and pharmaceutical companies. Permission for this study was obtained from the Chief Executive Officer at the Medicines Authority and a soft copy of the dataset was given to the researcher by the post-licensing department of the Medicines Authority. These reports were devoid of reporter details since archived reports within the database display the Medicines Authority's Awtorita' Dwar il-Medicini address as the reporting address, or the pharmaceutical company's headquarters for pharmacovigilance (abroad) as the reporting address. The dataset contained 600 reports. Each report, with its suspected medication(s) and adverse drug reaction(s) is called an Individual Case Safety Report (ICSR).

This study is a retrospective analysis of the ICSRs located within the archive inbox of the Medicines Authority for the years 2006-2010. Inclusion criteria for reports where all ICSRs originating in Malta. Duplicate reports, reports having insufficient information to be analysed for medication errors, reports where the event occurred before the medication was started, reports from clinical trials and reports not from Malta were excluded from this analysis.

Reports were either initial or follow up reports. Follow up reports where analysed and the information was incorporated with that of the initial report. The ICSR source was broadly classified as (1) industry reports (2) healthcare professional reports. When specified, the information on who reported the ADR was documented. It is standard practise to mention in a general manner that a case was reported by for ex. a pharmacist or physician within the free-text field of an ADR report without giving any
reporter identifiers. From the ADR report it was mostly possible to identify whether the ADR had occurred in primary care or hospital and this was documented.

The methodology for analysing each medication-ADR pair was as follows;

i. Deriving expectedness

The Summary of Product Characteristics (SPC) for each medicinal product in each ICSR was located through the Malta Medicines List (www.maltamedicineslist.com). This list contains SPCs of all medicines which have a marketing authorisation in Malta. The summary of product characteristics on which the marketing authorisation is based includes information on: clinical indications, contraindications, adverse effects (frequency and seriousness), special precautions for use, recommendations on use in pregnancy, recommendations on use in lactation, interactions, dosage schedule and route of administration (discriminating between children, adults and the elderly), special warnings, any effects on the ability to drive or use machines, pharmaceutical incompatibilities, and legal category. Once the SPC for that product was located section 4.8 (Undesirable effects) as well as other information within section 4.0 (cautions, post-marketing data) where used to identify whether the ADR was known (expected) or unknown for that product. This method is explained in section iv below. All expected ADRs within an ICSR were included in the study.

ii. Determining causality

Those ADRs that were unknown to the product, and hence where not listed in the SPC were included or discarded depending on whether a causal relationship between the medication and the ADR could be established (see Figure 3.1). A number of pharmaceutical company reports contain causality assessments. When a company had already assessed causality, then that causality assessment was used as a basis for
inclusion or exclusion of that product-ADR pair. ADRs that had a company causality assessment of 'possible', 'probable' or 'highly probable' (or other equivalent terms) related to the suspect medication were included in the study. ADRs that were unexpected and did not have a causality assessment, were analysed for causality using the French tool of causality assessment (Appendix A).

Figure 3.1: ADRs and causality assessment

ADR not listed in SPC
- Is there a company causality assessment?

No - The French tool for causality assessment is used.
ADR is included if result is possible, probable or highly probable and excluded if result is uncertain or unlikely.

Yes - ADR is included or discarded according to the companies assessment

The French tool of causality assessment is the only imputability system to have legal status and is probably the most widely used imputability method (Andrews & Mann, 2002). The basic principles of the French method for assessing causality are described in Andrews & Mann and entail:

- That the causality be judged only on the data present in the case, in abstraction of all published data concerning the drug-reaction association. Each case is judged on its own merits to ensure maximal identification of possible new reactions.
• That the causality be assessed on each drug-reaction pair presented by the patient at the time of the event, or that could be involved (such as previously stopped medication that could result in unidentified withdrawal symptoms).

The system uses 6 main criteria, three for chronology (time-sequence), and three for semiology (signs and symptoms). The time sequency analysis criteria include challenge, dechallenge and rechallenge. The signs and symptoms criteria are pharmacological plausability, other causes for event and laboratory test results.

The scores are:

- **Highly probable**: a clinical event occurring in a plausible time relative to drug administration and which cannot be explained by concurrent disease. The response to withdrawal of the drug (dechallenge) should be clinically plausible, with a satisfactory rechallenge procedure if necessary.

- **Probable**: is a clinical event with a reasonable time sequence to administration of the drug, unlikely to be attributed to concurrent disease, and which follows a clinically reasonable response on withdrawal (dechallenge).

- **Possible**: a clinical event, with a reasonable time sequence to administrations of the drug, but which could also be explained by concurrent disease. Information on drug withdrawal may be lacking or unclear.

- **Unlikely and uncertain**: clinical event with a temporal relationship to drug administration which makes a causal relationship improbable, and in which underlying disease provides plausible explanations.
ADRs that had a causality assessment of possible, probable or highly probably associated with the suspect medication where included in this analysis.

iii. Inputting the case-number, world-wide safety i.d., date and demographic data in Microsoft Excel.

Once reports was deemed valid for inclusion they were given a sequential case number for tracking purposes. The world-wide safety report i.d., gender, age and weight as well as the date of report and whether the case was an initial or follow-up report was inputted in the Microsoft Excel spreadsheet used for this study. The world wide safety report i.d. is a unique number within an ICSR denoting a case and its follow-up(s). This unique number was listed because it enabled the identification of duplicate reports and of follow up reports.

iv. Assessing the ADR report for medication errors and inputting data in Microsoft Excel

Included ICSRs were analysed for medication errors from the information that was within the ADR report, including the free text section. Medication errors were classified into pre-determined categories based on the information within the SPC and information within the ADR report. Some error categories where added throughout the process, since the free text section in the ADR report in some cases contained information that was not specified in SPC. The following error categories where used and given codes as in Table 3.2. Each data field within the ADR report was compared for correctness of use against the recommendations in the relevant section in the SPC for each medicinal product-reaction pair.
Table 3.2: Error categories and error codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Error Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>wrong duration of therapy</td>
</tr>
<tr>
<td>101</td>
<td>wrong duration of infusion</td>
</tr>
<tr>
<td>102</td>
<td>lack of monitoring</td>
</tr>
<tr>
<td>103</td>
<td>interaction between drugs with same metabolic pathways</td>
</tr>
<tr>
<td>104</td>
<td>interaction between drugs with negative synergistic effects</td>
</tr>
<tr>
<td>105</td>
<td>interaction between drugs with one enhancing effect of the other</td>
</tr>
<tr>
<td>106</td>
<td>wrong diagnosis</td>
</tr>
<tr>
<td>107</td>
<td>wrong dose for indication</td>
</tr>
<tr>
<td>108</td>
<td>no dose adjustment despite ADR</td>
</tr>
<tr>
<td>109</td>
<td>dose not revised from treatment dose to maintenance dose</td>
</tr>
<tr>
<td>110</td>
<td>posology error; over dose</td>
</tr>
<tr>
<td>111</td>
<td>posology error; underdose</td>
</tr>
<tr>
<td>112</td>
<td>treatment of ADR when dose reduction to lowest tolerated dose is recommended</td>
</tr>
<tr>
<td>113</td>
<td>wrong use of medical device</td>
</tr>
<tr>
<td>114</td>
<td>dispensing without valid prescription</td>
</tr>
<tr>
<td>115</td>
<td>lack of advice with dispensing</td>
</tr>
<tr>
<td>116</td>
<td>contra-indication</td>
</tr>
<tr>
<td>117</td>
<td>non-sterile techniques</td>
</tr>
<tr>
<td>118</td>
<td>non-precautionary use; initiation at higher dose than recommended in SPC</td>
</tr>
<tr>
<td>119</td>
<td>non-precautionary use; concomitant use with drugs of same effect</td>
</tr>
<tr>
<td>120</td>
<td>non-precautionary use; use in patients with predisposition for ADR</td>
</tr>
<tr>
<td>121</td>
<td>patient did not follow pre-treatment instructions</td>
</tr>
<tr>
<td>122</td>
<td>non-adherence to therapy resulting in ADR</td>
</tr>
<tr>
<td>124</td>
<td>no indication</td>
</tr>
<tr>
<td>125</td>
<td>patient initiated treatment against professional advice</td>
</tr>
<tr>
<td>126</td>
<td>accidental overdose</td>
</tr>
</tbody>
</table>

Interactions were derived by looking at the suspect medication list of interactions within the SPC and the list of interaction within the SPC of concomitant medications. When an interaction was found it was checked with the U.S database for drug interactions [http://www.drugs.com/](http://www.drugs.com/) which also describes the pharmacological pathway of this interaction. Drugs.com (including its interaction checker tool) is an independent and peer-reviewed, database with information on more than 24,000 prescription drugs, over-the-counter medicines & natural products.
v. Classification of ADRs and medication errors

ADRs were grouped in line with the Medical Dictionary for Regulatory Activities (MedDRA) Systems Organ Classification (SOC). The MedDRA terminology is the international medical terminology developed under the auspices of the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH) and is a registered trademark of the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA). The MedDRA SOC is the highest level of the hierarchy that provides the broadest concept for ADR classification.

Each adverse reaction term was assigned to one primary SOC. In all there are 26 SOC categories; Blood and lymphatic system disorders; Cardiac disorders, Congenital, familial and genetic disorders, Ear and labyrinth disorders, Endocrine disorders, Eye disorders, Gastrointestinal disorders, General disorders and administration site conditions, Hepatobiliary disorders, Immune system disorders, Infections and infestations, Injury, poisoning and procedural complications, Investigations, Metabolism and nutrition disorders, Musculoskeletal and connective tissue disorders, Neoplasms benign, malignant and unspecified (incl cysts and polyps), Nervous system disorders, Pregnancy, puerperium and perinatal conditions, Psychiatric disorders, Renal and urinary disorders, Reproductive system and breast disorders, Respiratory, thoracic and mediastinal disorders, Skin and subcutaneous tissue disorders, Social circumstances, Surgical and medical procedures and Vascular disorders. ADRs grouped by SOC are presented in the next chapter.

Medication errors identified were classified as serious or non-serious depending on whether the consequent ADR fell into the seriousness criteria described by the
International Conference on Harmonisation (ICH) Guidelines - Guidance for Industry: Post-Approval Safety Data Management: Definitions and Standards for Expedited Reporting. ICH defines a serious adverse event or reaction as;

'any untoward medical occurrence that at any dose: results in death, is life threatening, requires inpatient hospitalisation or prolongation of existing hospitalisation, results in persistent or significant disability/incapacity or results in a congenital abnormality.' (ICH E2A guideline, 2003)

At present, Maltese legislation specifies the mandatory reporting of only serious adverse drug reactions in line with this definition.

Finally, medication errors categories were then grouped into five classifications according to where they occurred in the medicine use chain. The broad classifications were as follows;

- Prescribing errors
- Dispensing errors
- Administration errors
- Therapeutic monitoring errors
- Patients’ own errors

vi. Statistical analysis

The data collected in the Microsoft Excel datasheet contained a list of active ingredients that were associated with ADRs and with medication errors. For grouping of active ingredients into significant groups, the Anatomical and Therapeutic Classification coding of the active ingredients was required. ATC codes were derived from the Malta Medicines List through the use of Microsoft Access. This could be
done because of the unique number that was given to each ICSR, since this unique i.d. distinguishes one record from another within a table. The active ingredient of each medicinal product within the Malta Medicines List is also a unique entry except for combination products (these ATC codes were manually inputted). Therefore, MS Access was used to match related records of active ingredients within the ADR reports with their corresponding ATC codes by running the appropriate queries. Descriptive statistics were then used to describe the main features of the data collected.
3.4 Methodology for survey on medication errors

The prescribing and dispensing stages are integral parts of the medication use process. The survey on medication errors focused on identifying factors, particularly those that are modifiable that doctors and pharmacists perceived from their own experience as contributing to the occurrence of prescribing and dispensing errors.

3.4.1 The Research tool

An extensive literature search was done to find a validated tool that fit the aim of this survey. However, to this author's knowledge there are no questionnaires that have been formally tested for their content reliability and validity when measuring perceptions on medication errors. This stance was backed up by a U.K expert in the field, Dr Alice Obourne who through personal communication was asked on whether she had encountered any validated survey instruments on the causes and prevention of medication errors. Although the importance of using a validated tool is not to be undermined, in this case, due to the fact that a validated tool was unavailable, and, because the construct under measure is an opinion, the importance of measuring with a valid tool was not considered to be detrimental to the results.

For the questionnaire distributed to pharmacists it was decided that the already utilised questionnaire by Peterson et al. was to be adopted. Permission was obtained (Appendix B) from the author Professor Gregory Peterson. Professor Peterson is a leader in the field of medication errors, having published extensively on medication errors and dispensing errors (over 600 publications). The author of the questionnaire confirmed that this tool (although not completely validated) had been piloted amongst
The questionnaire 'Pharmacists' Opinions on Dispensing Errors' was adopted with minor changes. A questionnaire with similar questions, but applicable to prescribers was then compiled for this study. After a draft questionnaire was finalised, it was tested for its face- and content validity. Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure (Black, 2003). Face validity refers to whether a measure superficially appears to measure the concept it is intended to measure (Black, 2003). Content validity is more systematic than face validity (Bowling, 2002) and concerns the extent to which a measure adequately represents all aspects of a concept (Black, 2003). Content validity was demonstrated by having the survey instrument reviewed by local physicians, some with extensive experience within the field of medication errors to confirm the relevance of its content to the research question and also its applicability in the local setting. Comments from reviewers were discussed and some changes were made to the questionnaire. Since the survey was carried out through the internet, the questionnaire was also sent to non-healthcare professionals to test whether different computer systems and operating windows versions would still be able to access and answer the questionnaire. Due to time constraints, validation of this instrument could not be completed. Other elements that required testing would be; reliability (through test-retest) and testing for the best medium through which the survey would be conducted (ex. paper-based, telephony, self-administration, on-line).

The questionnaires were kept as short and simple as possible. The aim of the survey was stated at the onset and the respondents were reassured about confidentiality.
of results, and anonymity of their responses. At the end of the questionnaire the respondents were asked if they wanted to receive a copy of the results.

The questionnaires were divided in two sections and are Appendix C. The first section dealt with demographics of the physician and pharmacist respondents. The second section dealt with doctors and pharmacists opinions on prescribing and dispensing errors respectively and could be subdivided into 5 sections:

(1) Opinions on whether the risk and actual number of errors are increasing
(2) Perceptions on the major factors contributing to incidence of errors
(3) Perceptions of measures to best minimize the risk of errors
(4) Awareness of errors at the workplace and any causative factors.

Open ended questions and comment boxes were introduced into the questionnaires when possible so that any possible answer that was not anticipated could still be captured. Both questionnaires were compiled keeping in mind that the answer format used allowed the respondent to answer the question asked. Questions consisted of multiple choice questions, matrix of choice within drop down menus, rating scales based on the 5-point Likert scale and open-ended text box questions.

3.4.2 Data collection

An invitation to participate in the survey was sent to all registered doctors and pharmacists through an online medical portal which hosts a database of health care professionals contact addresses (see Appendix D). This database belongs to ‘The Synapse ePortal’. ‘The Synapse’ is an online and paper-based resource for physicians and other healthcare professionals providing information through the communication of
the latest medical information. Permission was obtained in order that the invitation letter containing the links to the questionnaires could be circulated by a member of ‘The Synapse’ team. Therefore, no personal information (including contact information) about the respondents was available to the researcher. The target population for this study was a population of 1,200 doctors and 850 pharmacists who are registered with ‘The Synapse’. An initial invitation to participate was sent by ‘The Synapse’ team followed by a reminder to participate in this study after 2 weeks. It was unknown whether the online contacts database is updated regularly and if non-respondents differ from respondents.

3.4.3 Distribution medium

The distribution medium used for this questionnaire was the internet. Both questionnaires were hosted online through a survey designing program called SurveyMonkey. The reasons for this choice were; (1) faster fieldwork (2) lower cost (3) elimination of interviewer bias in the case of phone interviews and focus groups. Disadvantages of this method include (1) difficulty knowing exactly the size of the population (2) inability to ask follow-up questions and probe for more detail when an interesting tangent is introduced during a question (3) inability to know who is really answering your questionnaire. According to Robinson (2008) online surveys are the best method when the population mimics the internet population. Over time more of the general population is becoming part of the internet population.

The questionnaires consisted of straightforward self-explanatory questions. To complete the questionnaire approximately 10 minutes were needed, depending on the length of the comments, and the length of response to the open-ended questions. Once
the respondents filled in the questionnaire they were asked to submit, through a submit button. At no point within the questionnaire was there any request for identification, and therefore both questionnaires were kept completely anonymous.

Permission to conduct this survey was obtained from the University Research Ethics Committee (see Appendix E).

3.4.4 Data Analysis

After closing the data collection period, the collected survey data was prepared for the analysis. The first step was to examine the surveys for completeness. The following criteria were set to filter out those surveys that had too little information, or those whose answer on the point scale was always the same (ex. always strongly disagree). The questionnaires that were excluded were:

- Those that had no whole section that was completed
- Fewer than half the items were completed
- Every item had the same answer

The data collated through SurveyMonkey is downloadable as a Microsoft Excel Spreadsheet. The data is presented within tables and as figures and is presented in the next chapter.

3.4.5 Definition of positive, neutral and negative responses

Positive responses were considered to be those that were rated 4 or 5 ‘High association/ Very high association’ for question 8 and ‘Fairly important/ Very Important’ (Q9) for positively worded questions, or a 1 or 2 ‘Low association/ No
association’ (Q8) ‘of Low Importance/ of No Importance’ (Q9) for reverse worded questions.

*Neutral* is the percent of responses that were rated a 3 ‘Fair association’ (Q8) ‘Uncertain of Importance’ (Q9) for any question.

*Negative* is the percent of responses that were rated a 1 or 2 ‘No or Low association’ (Q8) and ‘Not important/ of Low Importance’ (Q9) for positively worded questions, or a 4 or 5 ‘High association/ Very high association’ (Q8) and ‘Fairly important/ Very Important’ (Q9)

### 3.4.6 Qualitative Data Analysis

Thematic content analysis as described by Burnard (1991) was carried out on the qualitative data derived from the open ended questions within the questionnaires. Data was assessed and categorized into several themes, following the method below;

(i) The data collected was read through and notes were made on general themes

(ii) The data was re-read and the themes were placed in categories

(iii) The list of categories where grouped together into higher -order headings to collapse some of the ones that were similair into broader categories

(iv) The list of categories was revised to remove repetitions and similair headings
3.5 Analysis of reports from the national regulatory council

The registrar for the medical council and the registrar for the pharmacy council were contacted and the reason and scope of this dissertation was explained. The medical council registrar provided information on how to access reports on medical case-inquiries which were conveniently located online. A total of 202 case enquires were downloaded from the website of the medical council, spanning a period of 2006-2010. Each of these reports has a unique case number that is used to identify reports over the years through which the inquiry may span (may be over 1 year). Through this case number pending inquires where located and removed. Reports related to medication errors or therapeutic monitoring were located and recorded. The pharmacy council does not publish complaints on pharmacists on-line so an appointment was set up with the registrar to discuss this issue.

3.6 Interviewing select key players in the field

These key people where selected since they play an important role in the assurance of quality services within the general teaching hospital Mater-Dei. Therefore these professionals where contacted and several aspects of medication error related activities where discussed. An open ended structured interview was prepared and given to the Director of Healthcare Services Standards (see Appendix F) and the Chief Pharmacist at MDH (Appendix G). This questionnaire consisted of a total of 36 open-ended questions divided into four sections;
Section 1: consisted of 11 questions on the incident reporting system at MDH which incorporates medication errors

Section 2: consisted of 17 questions on protocols, guidelines and other issues regarding medication errors

Section 3: consisted of five questions on the incident reporting committee

Section 4: consisted of 3 questions on practices of healthcare professionals at MDH

The face validity of these qualitative questionnaires was performed by having 2 pharmacists and 1 doctor reviewing these questions.

3.7 Collection of other related information

The Department of Health Information and Research (DHIR) was contacted to request data on their accidents & injuries in healthcare settings database. This form was located online at DHIR website. Details required where the time period over which the data was requested, the preferred form (cd, paper, e-mail) and an explanation of how this data will be used. The complete data set was requested from DHIR in soft copy and was subsequently received in a Microsoft Excel spreadsheet. In total, 26 accidents were received between 2006 and 2010. The results from this database, together with the regulatory council reports are presented in the next chapter.
3.8 Conclusion

This chapter described the methodologies used within this study using a multifaceted approach. The findings of the generated data are presented in the following chapter on results.
Chapter 4 - RESULTS
4.1 Introduction

The study findings are presented in this chapter which is organised in 4 parts. The first section contains the results from the analysis of the pharmacovigilance database of the Medicines Authority. The second part presents the results obtained from the questionnaires on prescribing and dispensing errors, the third section involves interviews with select key players and the final section deals with a description of findings from the regulatory council reports and accidents and injuries database at the Department of Health Information and Research. For the analysis of the pharmacovigilance database, it was felt necessary to present not only the results on medication errors, but also the analysis of how adverse drug reactions were found to be manifested within the reported cases, in order that the clinical consequences of medication errors may be realised.
4.2 Results of the analysis of the pharmacovigilance database

4.2.1 ICSR distribution

A total of 600 ICSRs were received in the Medicines Authority’s Awtorita Dwar il-Medicini (ADM) inbox over 2005-2010. Of these 600 ICSRs 34.3% (n=206) were excluded from the study (see Figure 4.1& Table 4.1). Of the included 394 reports, 53.2% (n=319) were initial reports and 12.5% (n=75) were follow-up reports. Follow up reports were analysed and the information was incorporated with that of the initial report.

![Figure 4.1: Distribution of ICSRs in the Pharmacovigilance Database (n=600)](image)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplicate reports</td>
<td>103</td>
<td>50</td>
</tr>
<tr>
<td>Reports not occurring in Malta</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Literature Reports</td>
<td>8</td>
<td>3.9</td>
</tr>
<tr>
<td>French Causality Assessment (FCA) negative result</td>
<td>22</td>
<td>10.7</td>
</tr>
<tr>
<td>SUSARs (ADR from clinical trials)</td>
<td>9</td>
<td>4.4</td>
</tr>
<tr>
<td>Unassessable for ME</td>
<td>60</td>
<td>29</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>206</td>
<td>100</td>
</tr>
</tbody>
</table>
4.2.2 Frequency of reporting by healthcare profession and healthcare setting

Physicians were the highest reporters of ICSRs (35%) although in 44% of cases, there was no information pertaining to which type of healthcare profession was reporting (Figure 4.2). More healthcare professionals reported directly to the manufacturer of the medicinal product (Figure 4.3) while most ICSRs involved ADRs that occurred in the primary care/ambulatory setting, (community and outpatient care) rather than in hospitals (Figure 4.4).
4.2.3 Frequency by age and gender

When stratified by age, 161 ICSRs had data on both age and gender. The largest frequency of ICSRs in males and females were reported on patients between 50-59 years of age followed by the 60-69 age group (Figure 4.5). In the 50-59 age group, more males experienced adverse reactions to a medicinal product than females while between the ages of 60-69 more females than males had an adverse effect (Figure 4.6). In paediatric patients, there is not enough evidence to show conclusive differences between male and female patients.

![Figure 4.5: Frequency of ICSRs stratified by age groups (n=319)](image)

![Figure 4.6: Frequency of ICSRs by Age Group and Gender (n=161)](image)

4.2.4 Frequency by Anatomical and Therapeutic Classification

The medication classes most frequently associated with adverse drug reaction morbidity and mortality were determined.
The top half of Figure 4.7 shows the number of ICSRs within the pharmacovigilance database per medicinal product Anatomical and Therapeutic Classification (ATC) code (also referred to within this text as therapeutic class). Each ICSR report may contain more than 1 ADR. The included 394 reports (319 initial + 75 follow-ups) contained a total of 559 ADRs. The ADR distribution by ATC can be seen in the bottom half of Figure 4.7. When the ICSRs were stratified according to ATC code 13.7% (n=44) of ICSRs concerned the anti-inflammatory and anti-rheumatic medicinal product group (M01), followed by 9.4% (n=30) by immunosuppressive agents (L04), 8.5% (n=27) by anti-bacterials for systemic use (J01); and 7.8% (n=25) by serum lipid reducing agents (C10).
The serum lipid reducing agents (C10), mostly the statins, were associated with the most ADRs per ICSR (and therefore the most patient discomfort) with an average of 2.28 ADRs/ICSR followed by the anti-bacterials for systemic use (J01) with 2.18 ADRs/ICSR.

**Table 4.2:** Full classification name of the ATC codes encountered in this study

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A02</td>
<td>ANTACIDS, DRUGS FOR TREATM. OF PEPT. ULC. AND FLATUL.</td>
</tr>
<tr>
<td>A03</td>
<td>ANTISPAS. AND ANTICHOLINERGIC AGENTS AND PROPULSIVES</td>
</tr>
<tr>
<td>A06</td>
<td>LAXATIVES</td>
</tr>
<tr>
<td>A07</td>
<td>ANTIDIARR., INTESTINAL. ANTIINFL./ANTIINFECT. AGENTS</td>
</tr>
<tr>
<td>A08</td>
<td>ANTIOBESITY PREPARATIONS, EXCL DIET PRODUCTS</td>
</tr>
<tr>
<td>A10</td>
<td>DRUGS USED IN DIABETES</td>
</tr>
<tr>
<td>Code</td>
<td>Category</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>A12</td>
<td>MINERAL SUPPLEMENTS</td>
</tr>
<tr>
<td>B01</td>
<td>ANTITHROMBOTIC AGENTS</td>
</tr>
<tr>
<td>B05</td>
<td>PLASMA SUBSTITUTES AND PERFUSION SOLUTIONS</td>
</tr>
<tr>
<td>C01</td>
<td>CARDIAC THERAPY</td>
</tr>
<tr>
<td>C02</td>
<td>ANTIHYPERTENSIVES</td>
</tr>
<tr>
<td>C03</td>
<td>DIURETICS</td>
</tr>
<tr>
<td>C05</td>
<td>VASOPROTECTIVES</td>
</tr>
<tr>
<td>C07</td>
<td>BETA BLOCKING AGENTS</td>
</tr>
<tr>
<td>C08</td>
<td>CALCIUM CHANNEL BLOCKERS</td>
</tr>
<tr>
<td>C09</td>
<td>AGENTS ACTING ON THE RENIN-ANGIOTENSIN SYSTEM</td>
</tr>
<tr>
<td>C10</td>
<td>SERUM LIPID REDUCING AGENTS</td>
</tr>
<tr>
<td>D01</td>
<td>ANTIFUNGALS FOR DERMATOLOGICAL USE</td>
</tr>
<tr>
<td>D03</td>
<td>PREPARATIONS FOR TREATMENT OF WOUNDS &amp; ULCERS</td>
</tr>
<tr>
<td>D04</td>
<td>ANTIPRURITICS, INCL. ANTIHIST, ANESTHET, ETC.</td>
</tr>
<tr>
<td>D07</td>
<td>CORTICOSTEROIDS, DERMATOLOGICAL PREPARATIONS</td>
</tr>
<tr>
<td>D11</td>
<td>OTHER DERMATOLOGICAL PREPARATIONS</td>
</tr>
<tr>
<td>G03</td>
<td>SEX HORMONES AND MODULATORS OF THE GENITAL SYSTEM</td>
</tr>
<tr>
<td>G04</td>
<td>UROLOGICALS</td>
</tr>
<tr>
<td>H05</td>
<td>CALCIUM HOMEOSTASIS</td>
</tr>
<tr>
<td>J01</td>
<td>ANTIBACTERIALS FOR SYSTEMIC USE</td>
</tr>
<tr>
<td>J05</td>
<td>ANTVIRALS FOR SYSTEMIC USE</td>
</tr>
<tr>
<td>J06</td>
<td>IMMUNE SERA AND IMMUNOGLOBULINS</td>
</tr>
<tr>
<td>J07</td>
<td>VACCINES</td>
</tr>
<tr>
<td>L01</td>
<td>CYTOSTATICs</td>
</tr>
<tr>
<td>L02</td>
<td>ENDOCRINE THERAPY</td>
</tr>
<tr>
<td>L03</td>
<td>IMMUNOMODULATING AGENTS</td>
</tr>
<tr>
<td>L04</td>
<td>IMMUNOSUPPRESSIVE AGENTS</td>
</tr>
<tr>
<td>M01</td>
<td>ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODUCTS</td>
</tr>
<tr>
<td>M05</td>
<td>DRUGS FOR TREATMENT OF BONE DISEASES</td>
</tr>
<tr>
<td>N02</td>
<td>ANALGESICS</td>
</tr>
<tr>
<td>N03</td>
<td>ANTIIEPILEPTICS</td>
</tr>
<tr>
<td>N05</td>
<td>PSYCHOLEPTICS</td>
</tr>
<tr>
<td>N06</td>
<td>PSYCHOANALEPTICS</td>
</tr>
<tr>
<td>N07</td>
<td>OTHER NERVOUS SYSTEM DRUGS</td>
</tr>
<tr>
<td>R05</td>
<td>COUGH AND COLD PREPARATIONS</td>
</tr>
<tr>
<td>R06</td>
<td>ANTIHISTAMINES FOR SYSTEMIC USE</td>
</tr>
<tr>
<td>R07</td>
<td>OTHER RESPIRATORY SYSTEM PRODUCTS</td>
</tr>
<tr>
<td>S01</td>
<td>OPHTHALMOLOGICALS</td>
</tr>
</tbody>
</table>
4.2.5 Frequency by gender and anatomical therapeutic classification

Figure 4.8 shows ICSRs stratified by gender. Interestingly more males were affected by the anti-inflammatory/anti-rheumatic therapeutic class (M01), anti-diabetic class (A10) and antivirals for systemic use (J05) than females, despite females having a higher overall frequency of ADRs.

Not surprisingly females were affected more by medications for the treatment of osteoporosis (M05), since female osteoporosis prevalence is higher than in males (Bonnick, 2006), and by anti-epileptic medications (N03) which show pharmacokinetic variations resulting in more ADRs in the presence of female reproductive hormones (Medscape review, 2000).

4.2.6 Frequency of affected System Organ Classification

The System Organ Classification (SOC) shows where ADRs are manifested at a broader level. The ATC classes that presented most ADRs were stratified by the SOCs they affected. If an ICSR contained more than 1 ADR which affected the same SOC
then that SOC was listed once. The results are presented in Figures 4.9-4.12. The abbreviations for SOC within the Figures presented in this section are the approved Medical Dictionary for Regulatory Activities (MedDRA) abbreviated terms (MedDRA-MSSO, 2011).

The anti-inflammatory and anti-rheumatic group (M01) as expected was mostly associated with (i) gastrointestinal side-effects (Gastr): mostly perforated ulcers and hematemesis, (ii) skin and subcutaneous disorders (Skin): exfoliative dermatitis and unspecified rashes,(iii) respiratory disorders (Resp): exacerbations of asthma

(iv) psychiatric disorders (Psych): convulsions, epileptic fit, (v) vascular disorders (Vasc); (vi) pulmonary, peripheral oedema’s, (vii) immune system disorders (Immun); anaphylactic reactions, delayed and at first dose, (viii) cardiac disorders (Card): angina, cardiac arrest, bradycardia, (ix) eye disorders (Eye): mostly conjunctival problems and pruritus.

The immunosuppressive agents (L04) (Figure 4.10), were mostly associated with general and administration site disorders (Genrl) and skin and subcutaneous disorders while the cytostatics (L04) were mostly associated with gastrointestinal and vascular
disorders. The psycholeptics (N05) had higher frequency of association with psychiatric symptoms (Psych) and nervous system disorders (Nerv) as well as gastrointestinal disorders. The anti-epileptics (N03) were associated with mostly respiratory and gastrointestinal disorders.

![Figure 4.10: Affected SOC frequency for medication classes L01, L04](image)

![Figure 4.11: Affected SOC frequency for medication classes N05, N03](image)
Not surprisingly, vaccines (J07) were mostly associated with general and administration site disorders, as well as some infections and infestations (Infec). The anti-virals (J05) were mostly associated with musculoskeletal disorders (Musc) while the anti-bacterials were associated mostly with nervous system disorders (Nerv) and gastrointestinal disorders.
4.2.7 Medication error frequency and classification

Out of 319 initial ICSRs included in the study, 18.8% (n=60) ICSRs were found to contain one or more medication errors, specifically 96 medication errors. 56 of these 60 ICSRs resulted in one or more ADRs while 4 ICSRs contained medication errors that did not reach the patient. In terms of medication errors, within the 60 ICSRs that contained medication errors, 93.7% of errors (n=90) resulted in harm to the patient (manifested as 100 ADRs) and 6.3% (n=6) were near misses. Therefore, out of a total of 559 ADRs included in this study, 100 of these were associated with medication errors and so are preventable. Consequently, the percentage of preventable ADRs found in this study was 17.9%.

4.2.7.1 Medication errors by age and setting

When medication errors were stratified by age, the age group that was found to be utilising most therapy in error was the 80-89 (21/96) year old age group closely followed by the 50-59 (18/96) year old age group. The 50-59 age group was within the majority of ICSRs, as could be seen in figure 4.5, therefore it is expected that many medication errors will also happen in this group.

![Figure 4.13: Medication errors by age (n=96)](image-url)
In the 80-89 year old age group however, when one compares the number of ICSR
to the frequency of medication errors, there were more medication errors per ICSR in this age group than in the 50-59 age group. Therefore there seems to be a
greater probability that ICSRs describing ADRs on patients in the 80-89 age groups will contain more medication errors.

Most medication errors (65% 62/96) originated in the community causing 79 ADRs. ICSR reports related to medications used in hospital and were associated with few medication errors and made up only 15 of reports.
4.2.7.2 Classification by Seriousness

In this study, the seriousness of each ADR within each ICSR was not recorded since ICSRs only contain an overall classification of seriousness of a case, and not the seriousness of each ADR within that case. In this study, the 56 ICSRs that showed patient harm because of medication errors were classified as serious, since at least 1 of those ADRs within that case was serious.

![Figure 4:14 Seriousness of ICSRs with medication error (n=56)](image)
4.2.7.3 Classification at the medication use system

Medication errors where stratified by the stage at which they occurred with Figure 4.13 showing the percentage frequency of identified medication errors within the medication use system. Prescribing errors were the most prevalent type of medication errors identified, totalling 52% of all errors (n=60), followed by patients' own errors, therapeutic monitoring errors, dispensing errors and administration errors. Table 4.3 shows how error categories were classified according to which stage in the medication use process they affected.

Figure 4.15: Classification of medication errors at medication use stage (n=96)
Table 4.3: Medication error class and frequency per category

<table>
<thead>
<tr>
<th>Class of Error</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prescribing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wrong dose for indication</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>posology error; underdose</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>posology error; over dose</td>
<td>6</td>
<td>6.3</td>
</tr>
<tr>
<td>contra-indication</td>
<td>6</td>
<td>6.3</td>
</tr>
<tr>
<td>no indication</td>
<td>10</td>
<td>10.4</td>
</tr>
<tr>
<td>non-precautionary use; concomitant use with drugs of same effect</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>non-precautionary use; initiation at higher dose than recommended in SPC</td>
<td>9</td>
<td>9.4</td>
</tr>
<tr>
<td>interaction between drugs with negative synergistic effects</td>
<td>8</td>
<td>8.3</td>
</tr>
<tr>
<td>interaction between drugs with same metabolic pathways</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>interaction between drugs with one enhancing effect of the other</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL-1</td>
<td>50</td>
<td>52.1%</td>
</tr>
<tr>
<td><strong>Dispensing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lack of advice with dispensing</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>dispensing without valid prescription</td>
<td>5</td>
<td>5.2</td>
</tr>
<tr>
<td>TOTAL-2</td>
<td>7</td>
<td>7.2%</td>
</tr>
<tr>
<td><strong>Administration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wrong duration of infusion</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>wrong use of medical device</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>non-sterile techniques</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL-3</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Therapeutic Monitoring</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dose not revised from treatment dose to maintenance dose</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>non-precautionary use; use in patients with predisposition for ADR</td>
<td>7</td>
<td>7.2</td>
</tr>
<tr>
<td>no dose adjustment despite ADR</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>lack of tests recommended in SPC</td>
<td>10</td>
<td>10.4</td>
</tr>
<tr>
<td>treatment of ADR when dose reduction to lowest tolerated dose is recommended</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>wrong duration of therapy due to lack of follow-up</td>
<td>4</td>
<td>4.2</td>
</tr>
<tr>
<td>TOTAL-4</td>
<td>25</td>
<td>26%</td>
</tr>
<tr>
<td><strong>Patient's own</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>non compliance to therapy resulting in ADR</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>patient initiated treatment against professional advice</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>patient did not follow pre-treatment instructions</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>accidental overdose</td>
<td>5</td>
<td>5.2</td>
</tr>
<tr>
<td>TOTAL-5</td>
<td>11</td>
<td>11.2%</td>
</tr>
<tr>
<td>TOTALs 1-5</td>
<td>96</td>
<td>100%</td>
</tr>
</tbody>
</table>

Within the prescribing error class, the most common cause of error were wrong dose errors (36%) (overdose, under dose, wrong dose for indication, non-precautionary initiation of treatment at higher dose than recommended). 28% of prescribing errors involved interactions, 20% involved prescribing against a licensed indication when other licensed treatments are available and 12% were prescriptions for a contra-indicated therapy.
In this study, no dispensing errors with wrong drug or wrong dose could be identified. 5% of dispensing errors were dispensing without a prescription, or dispensing without a date on a repeat prescription while 2% of cases mentioned lack of advice when dispensing. Dispensing without a prescription was often linked to a patient presenting with an ADR after being on a prescription medication for a profuse period of time. All the dispensing errors in this study happened in the community setting.

Administration errors identified in this study were inappropriate use of a medical device, wrong duration of infused chemo-therapy and hospital acquired infection while administering a renal-dialysis solution.

Therapeutic monitoring errors made up 26% of the identified errors. The highest error categories identified were lack of monitoring of physiological parameters (40%) and lack of monitoring for an ADR in patients predisposed to an ADR (28%). Other errors included; a therapy duration above that recommended in the SPC due to lack of follow-up (16%). No revision of treatment despite ADR (8%), treatment of ADR when dose reduction was recommended (4%) and no revision of treatment on improvement of condition (4%). Therapeutic monitoring errors were identified mainly within the ambulatory setting (community and outpatient care). It was impossible to know whether lack of follow-up testing or lack of therapy adjustment did not occur because no appointments for monitoring were scheduled for a patient or whether the patient never turned up for a scheduled appointment.

The patient errors most frequently identified from this study involved accidental overdose. Cases occurred both within the community and within hospital. Within the hospital outpatient setting, some therapies require pre-treatment by the patient prior to the intervention being performed and 20% of medication errors were the omission of
this pre-treatment by the patients themselves. Within hospital, a case of accidental overdose by a mother to her neonates was recorded.

**4.2.7.3 Classification of medication errors using the psychological theory**

This section groups the findings presented in 4.2.7.2 and then classifies them according to the Ferner and Aronson 2006 psychological classification of medication errors. In this classification, as may be recalled in chapter 2, errors may be of two types; errors in the planning of an action, or errors in execution of an action. The two categories of errors in planning are (i) knowledge based errors and (ii) rule based errors while the errors in execution may be (iii) action-based errors (slips) and (iv) memory based errors (lapses). This classification is important in order that the causes of error may be identified. Subsequently, through analysis of the cause, strategies for prevention can be devised. It is to be kept in mind that the exact cause of the error cannot be known due to the retrospective nature of the data.

From all the errors identified, 52% were prescribing errors

- 36% of these involved wrong dose of medications
- 28% interacting medications
- 20% prescribing for no licensed indication
- 12% prescribing when there is a contraindication
- 2% not following precautions

All of these errors could either have been knowledge-based errors or memory based errors, since the error occurred either in the planning of the action (prescribing) or else in the execution of the prescription.
26% of all errors were therapeutic monitoring errors

- 40% due to lack of monitoring of physiological parameters
- 29% due to lack of monitoring for an ADR in a patient pre-disposed to an ADR
- 10% therapy duration above that recommended
- 10% no revision of treatment despite ADR
- 10% treatment of ADR when dose reduction recommended

The first 2 therapeutic monitoring errors identified in this study can be classified as errors in executing correctly planned actions (i.e. slips and lapses), since the planned action (prescribing the medication) was correct, but carrying out the action of monitoring (part of the prescribing conditions) was not carried out. The last three therapeutic monitoring errors are better classified as knowledge based errors.

12% of all errors were patient's own errors, of which

- 47% accidental overdoses
- 20% lack of pre-treatment
- 18% initiation of treatment against professional advice
- 9% non compliance

Patient errors can be classified as both knowledge based errors (accidental overdose) and memory based errors (lack of pre-treatment, non-compliance). Initiation of treatment against professional advice cannot be categorised using Ferner and Aronson's classification system since their definition of error is 'when (good) actions are intended but not performed', whereas in this type of patient error, the patient is intentionally going against a good action.
7% of all errors were dispensing errors, of which

- 72% for dispensing without a prescription
- 18% for lack of advice

Dispensing without a prescription is a rule-based error, whereas lack of advice can be either knowledge based error or a memory-based error.

3% of all errors were administration errors, of which

- 33% wrong duration of infusion
- 33% wrong use of medical device
- 33% non-sterile techniques

The wrong use of a medical device can be classified as a knowledge-based error, however the rest of the administration errors identified in this study could fall under any of the 4 error types and from the data within the study, it was not possible to pin-point a cause.
4.2.8 Medication classes most likely to be in error

Of major importance within this study was the identification of classes of medicinal products that were associated with medication errors since error trends can be identified, and focused prevention can be performed.

In this study the frequency of association of some classes over others could be clearly observed. Figure 4.14 shows which therapeutic classes were most frequently found to be used in error. The non-steroidal anti-inflammatory drugs (NSAIDs) within the M01 anti-inflammatory and anti-rheumatic class were found to be most commonly used in error, followed by antibiotics (J01), psychoanaleptics (N06), immunosuppressive agents (L04), urologicals (G04) and drugs for the treatment of bone disease (M05).

Figure 4.16: Frequency of association of a therapeutic class with Medication Errors (n=96)
4.2.8.1 Anti-inflammatory and anti-rheumatic class

Within the M01 anti-inflammatory and anti-rheumatic class, etoricoxib, a selective cyclo-oxygenase-enzyme-2 inhibitor (COX-2) was associated with most errors, followed by diclofenac (sodium and potassium) as well as other COX-1 (aspirin) and COX-2 inhibitors (celecoxib, rofecoxib).

![Figure 4.17: Frequency of association of active substances within the M01 class with Medication Errors (n=27)](image)

44% of the M01 errors involved wrong doses, lack of therapeutic monitoring and drug interactions (Figure 4.19). Prescribing against a contra-indication and prescribing when there was no licensed indication were areas identified as requiring attention in prescribing practices of these medicines since they caused 30% of errors.

![Figure 4.18: Most Frequently Occuring Medication Errors within M01 (n=27)](image)
Inappropriate duration of therapy errors, probably related to improper dispensing were also identified as problematic with the anti-inflammatory class (26% of errors).

When one looks at the system organ class (SOC) manifestation of M01 medication errors it was found that there were some variations between ADRs due to the drug and ADRs due to drug misuse. Whereas ADRs caused by intended-use where predominantly gastro-intestinal disorders and skin reactions, ADRs caused by drug misuse where mostly gastro-intestinal disorders, respiratory problems and cardiac disorders. Gastro-intestinal disorders presented mostly as haematemesis and melaenia which through follow-up reports where diagnosed as perforated ulcers. In one instance concomitant dispensing of an NSAID with salbutamol resulted in exacerbation of asthma while prescription of the COX-2 etoricoxib at the highest dose (120mg) for 20 days also caused respiratory problems.

4.2.8.2 Anti-bacterials for systemic use

The semi-synthetic macrolide class of anti-biotics; azithromycin and clarithromycin were found to be associated with most errors in their use followed by the quinolone antibiotics (moxifloxacin and ciprofloxacin). Most of these errors were related to lack of therapeutic monitoring and where detected through hospital admissions after these antibiotics were prescribed in the community.
Ciprofloxacin was associated with a severe photo-toxic reaction where the patient was not advised to stay out of the sun while on this therapy while moxifloxacin caused tendonitis with rupture in 2 cases, one of which moxifloxacin was prescribed for an incorrect duration of time with no monitoring. Azithromycin was involved with clinically significant interactions such as bleeding when prescribed with warfarin while a patient’s own overdose error with clarithromycin resulted in hospitalisation due to collapse after profuse vomiting.
NSAIDs and antibiotics have been identified as the classes of medication most likely to be in error with almost 40% of errors occurring within these therapeutic classes. Nonetheless, other medication classes have been implicated with specific medication errors. The G04 class (of which sildenafil and tadalafil form part) were involved in two cases of hospital admissions. In both instances patients had obtained and self-medicated with sildenafil and tadalafil after physicians had refused to prescribe it, on the basis of history of heart disease. This points to dispensing without a prescription and could have been avoided. The anti-thrombotics warfarin and ticlopidine (B01) as well as the immunosuppressant (L04) class especially etanercept and rapamune were involved in prescribing concomitantly with other interacting therapy as well as lack of monitoring. Interestingly, the C10 serum lipid reducing agents group that was the 4th highest class to cause ADRs was not involved in any medication errors.

4.2.9 Conclusion

The major findings in this study have been;

(1) That medication errors can be identified from a pharmacovigilance database mostly those which happen in ambulatory care (primary and outpatient care)

(2) Of all reported serious ADRs, 17.9% are potentially preventable

(3) Prescribing errors, therapeutic monitoring errors, patient's own errors, dispensing errors and administration errors were detected with decreasing frequency from prescribing to administration.

(4) In this study, NSAIDs, antibacterials, psychoanaleptics, immunosuppresants, urologicals and medications for the treatment of bone disease were found to be most likely associated with error.
(5) Of the NSAID class, the active ingredients most likely to be in errors were etoricoxib and diclofenac,

(6) Of the antibiotic class the active ingredients most likely to be in errors were azithromycin, moxifloxacin and ciprofloxacin

(7) Errors were caused by all 4 classes of psychological error classification.

In this study, active failures have been described, quantified and then classified in different ways, one of which is using the psychological theory. Through this classification some causes of error and measures to prevent these errors can be formulated and will be discussed in the next chapter. However it is important to keep in mind that latent conditions are catalysts to active failures and much can be done for their prevention. The next section of the study aimed to explore the perceptions of doctors and pharmacists on the causes and prevention of prescribing and dispensing errors respectively in order to gain local insight into what measures would be more appropriate over others.
4.3 Attitudes and perceptions on the causes and prevention of prescribing and dispensing errors

The questionnaires on prescribing and dispensing were circulated between June and July of 2011 (Appendix C). The invitation letter to the questionnaires was sent twice through ‘The Synapse’ and in total 119 responses were received of which 48 were doctors and 71 were pharmacists. Of the 48 doctors that started the questionnaire, 85.4% completed all the questions, while 97.2% of all pharmacists completed the questionnaire. After analysing the completeness of each questionnaire, none were found to have less than half the responses and none of the questionnaires had all the same answers. Therefore all the responses were included in the study.

4.3.1 Demographic data on prescribers

From the responding doctors 54.5% were males (n=48). The median age was 43 years and the median duration from registration of speciality was in the range of 21-30 years of experience in their practice. The different specialities are outlined in Figure 4.22. The majority of respondents were specialists in family medicine (n=22), followed by specialists in public health (n=8).
When queried about hours spent in practice 28% of the responding doctors spend between 40 and 50 hours per week followed by a proportion of doctors that spend over 50 hours a week in practice as in Figure 4.23.

![Figure 4.23: Hours per week spent in practice](image)

4.3.2 Doctors opinions on causes and prevention of prescribing errors

The first question presented to doctors was on whether the risk of medication errors was increasing in the medical profession. Doctors answered strongly in the affirmative (69%) but when queried on the whether the actual amount of errors was increasing less than half (45.2%) think that the actual amount of medication errors is increasing.

When asked on which variables where associated with prescribing errors through the responses of the 43 doctors who answered this question a very strong association was identified for doctors overwork (29/43) high patient volume (29/43) and doctors fatigue from any cause (28/43), while a strong association was identified with having drugs with similar and confusing drug names (21/43), interruptions (20/43) and lack of availability of internet and/or electronic resources (17/43) insufficient time to talk to patients (17/43) and distractions due to administration/clerical requirements (15/43). Other variables identified to be associated with prescribing errors (through the open ended question) where; (i) lack of knowledge about the patient due to lack of
medical records (5/43) (ii) lack of knowledge about the medication (3/43) (iii) inadequate clinical evaluation (2/43) and children accompanying patient (1/43).

When doctors were asked to rate the importance of factors in order to minimise prescribing errors; keeping one’s knowledge of medicines up to date (41/41), checking the original prescription when writing repeats (36/41), reducing workload on doctors (35/41), having medicine names that are distinctive (34/41) and receiving information from the pharmaceutical industry (34/41) were considered to be very important. Fairly important variables in minimising prescribing errors were; avoiding interruptions (28/41) and privacy when seeing patients (26). Having electronic medical records (2 responses) and the availability of a formulary or/and other resources to consult especially when dealing with rarely used medications (2 responses) were also identified through the open ended text box.

The questionnaire then asked doctors to nominate an overall figure for what they perceived to be a safe number of patients to see per day. The median response was 23 patients/day (range 8-80). Doctors were then asked whether they thought there should be a regulatory requirement for the amount of patients that can be seen per day. 58.5% answered ‘no’ while 41.5% of respondents answered ‘yes’. Next doctors were asked if they were aware of any prescribing errors at their place of work in the past year and 56.1% answered in the affirmative. From the 26 respondents who answered ‘yes’, the median value of prescribing errors was 3 (range 1-10) while the total number of errors reported was 73 errors in the past year. Following this, doctors were asked whether there was any common causative factor that could be identified. Here, 2 respondents found no common cause. The rest of the respondents put forth the following underlying causes;
(i) Patient related causes; not knowing the patient, patient not knowing own medication, not knowing about allergies, patients having the same name

(ii) Medication related causes; similar sounding names, lack of knowledge on prescribed medication, incorrect dosing.

(iii) Human related causes; medics overworked, personal worries, inexperience, distraction, interruptions, rushing, illegible prescriptions and communication failure.

Finally doctors were asked to enter any further comments or suggestions on the issue of prescribing errors in an open text box. From this section, it could be strongly felt that doctors identified repeat prescribing especially with Schedule V medications as an area that is very prone to error. Furthermore, they strongly suggested that computerised systems would help in this matter. Along the same lines, others advised that electronic medical records would help to reduce errors, and that patient medical records should be made available to doctors in primary care. Lack of available resources for consultation, especially a local updated national formulary was another emergent issue that was believed to reduce prescribing errors.
4.3.3 Demographic data on pharmacists

The questionnaire to pharmacists was answered in majority by females (74.3%, n=71). The median age of respondents was 36 years and the median duration from first registration as a pharmacist was in the range of 11-20 years of practice. The different areas of practise for pharmacist respondents is outlined in Figure 4.24 but mostly consisted of community pharmacists (n=46) followed by pharmacists in regulatory affairs (n=7) and hospital pharmacists (n=6).

54.6% of pharmacists spend between 30 and 49 hours of practise per week with only 4.5% of respondents going over 50 hours per week (Figure 4.25). When asked whether the risk of dispensing errors is increasing, the majority replied ‘yes’ (55.2%) but when asked whether the actual numbers of errors were increasing a stronger majority (69.7%) thought that this was not so.
Figure 4.25: Hours a week spent in practice

4.3.4 Pharmacists' opinions on causes and prevention of dispensing errors

Pharmacists were then queried on identifying variables that pharmacists perceive as being associated with dispensing errors. Out of the 69 respondents who completed this question, the majority felt that there was a very strong association between doctors handwriting and dispensing errors (55/69). To a lesser degree but still a strong association, was felt between pharmacist fatigue of any cause (38/69), pharmacist overwork (37/69) and having a high patient volume (36/69) and having similar or confusing drug names (36/69). Differing views were noticed for interruptions and dispensing errors with 37/69 perceiving a strong association while 22/69 responded that there was a low or no association. Only a fair association was felt (neutral response) for distractions due to administrative or clerical duties (29/69), having a sole pharmacist compared with 2 or more pharmacists present at one time (27/69), distractions from the patients or other patients (24/69), having insufficient technical resources (24/69), lack of availability of IT services (23/69) and insufficient time to talk to patients (20/69). A fair or low association was felt between dispensing errors and
distractions from other staff (46/69) as well as lack of privacy for patient counselling (45/69). Variables that were considered as having a low or no association with dispensing errors were non-professional activity occurring in the vicinity (44/69) and design of work surroundings (low association=24/69, no association=14/69) although 13/69 said that there is a fair association. Finally, most respondents felt there was no association between dispensing errors and the existence of generic brands (49/63), job dissatisfaction (40/69) and noise (33/69).

Through the open ended question, other issues identified were; lack of information on the prescription that did not allow for communication of the pharmacist with the prescriber (3 responses), the additional strain of the pharmacy of your choice daily management (2 responses) and look-alike packaging (2 responses).

When pharmacists were asked to rate factors as being important in minimising the risk of dispensing errors avoiding interruptions (56/68), keeping one’s knowledge of medicines up to date emerged as the most important factor in minimising dispensing errors (54/69), reducing workload on pharmacists (54/69) as well as having distinctive names and packaging within the same corporate livery (53/69). Privacy in counselling (46/69), and getting information from the pharmaceutical industry (44/69) were all seen as being fairly important in reducing the risks for dispensing errors. Through the open ended question pharmacists suggested factors that are important in minimising the risk of dispensing errors mainly; writing generic names instead of trade-names to reduce mistakes and misinterpretations, having a dispensary layout which segregates dispensing from other activities such as cashing as well as organising the dispensary to store look-alike and sound-alike medicines away from each other. Having computer generated prescriptions as well increasing patient education to better manage their medical care was also suggested.
Respondents were then asked what they thought was a safe amount of continuous hours per day that could be safely spent in dispensing. The median hours suggested was 5 hours (range 1-10 hours). This wide range of answers suggests that the question may have been interpreted differently by different respondents. Further to this question, when pharmacists were asked whether there should be a regulatory requirement on the amount of continuous dispensing hours that can be done per day, the majority responded ‘no’ however a considerable portion (42.8%) thought that regulatory control is required.

The next question involved asking whether pharmacists were aware of any dispensing errors in their place of practise during the past year. To this question, 53.1% responded ‘yes’ with a median number of errors per year of 8 (range 1 per year– 2 per week). The total number of errors for 1 year were estimated at 263 errors per year. The respondents to this question were then asked to recall causative factors to these errors. The majority of responses where unclear prescriptions (10 errors) followed by similar packaging (7 errors) especially free-medicines packaging, interactions (4 errors), similar trade-names and generic names, doses prescribed over those recommended in summary of product characteristics and package leaflet, errors in calculating quantities to dispense in free medicines scheme, non-pharmacist dispensing, lack of communication, inexperience, over-work, fatigue, high workload, interruptions, distractions and insufficient time to counsel patient. Pharmacists could then leave suggestions or give comments on any issues involved in dispensing errors and through here, issues that have not been identified previously were; making internet in every pharmacy mandatory and providing patient information leaflets with all medicines including free medicines.
4.4 Results from the interviews with select key players

This part of the study was undertaken in order to gather information and place this study on medication errors in context. Due to time constraints, only 2 key players were selected for this study namely the present Director of Healthcare Services Standards and the Chief Pharmacist at Mater Dei hospital.

4.4.1 Director Healthcare Services Standards

The entire list of questions can be found in Appendix F. After an introduction of this dissertation on medication errors, the director was asked questions on patient safety and medication errors.

The first questions were set to gather information on the studies done on patient safety within Mater Dei hospital. Through personal mail communications the Director of Healthcare Services Standards (D-HSS) informed me that to date, a study relating to patient safety had been undertaken by the directorate. This study utilised a questionnaire derived from the NHS UK Inpatient Questionnaire developed by the Picker Institute. A telephone interview was conducted and 177 patients participated, giving a response rate of 61%. Overall, 80% rated the care received at MDH to be excellent or very good but gaps in service provision were identified mainly better communication of healthcare professionals with patients, long waiting times for admissions through the Accident and Emergency department and discharge delays due to delays in producing a discharge letter.

The director was then queried on reporting systems at local hospitals and government

As regards reporting systems at MDH, D-HSS said that the directorate is represented through a member in the committee and “the reporting committee is being
reconfigured to address medical problems differently and more effectively from other incidents." When the CEO was queried through personal communication on the strategic intent of this new committee, the CEO responded that this was in an "embryonic stage and information would be best sought at a later stage."

The rest of the questions which concerned medication errors were not attempted by the D-HSS.

4.4.2: Chief pharmacist at Mater Dei hospital

The list of questions that were presented to the acting Chief Pharmacist (CP) at Mater Dei can be found in Appendix G. After an introduction of the dissertation on medication errors the Chief Pharmacist was asked questions on medication errors and incident reporting.

The first set of questions related to the incident reporting scheme.

The CP outlined the main aspects of the system that is in operation at present which utilises an incident report form to be filled in by any patient or hospital personnel that encounter an incident. This incident report form in its present structure was introduced in 2009 by the health and safety officers at MDH and was circulated to all staff. The procedure for reporting entails filling in an incident report form and forwarding it within 24 hours of the incident to the senior principal of human resources or when the office is closed, within a box that lies outside the office.

The incident report form is appended (Appendix H) and consists of both ticking-type multiple choice questions and open ended questions. The types of events listed within this form as incident categories consist of: accidental injury, occupational ill-health, harassment and violence, incidents involving equipment, dangerous occurrences
or other near misses, theft or missing items, fire and alarm activation. Other incidents could be reported through an open ended sentence ‘other incidents’. The reporting form then asks which category best describes the cause of the incident/accident and here categories include handling of patient, fall from height, manual handling, striking against objects, contact with moving machinery/equipment, handling of chemicals, fall on stairs, handling sharps that are not contaminated by body fluids, road traffic accidents, exposure or contact with harmful substances, handling of chemicals, physical/verbal assault, electricity, contact with hot or cold substances, slipping tripping and falling, fire/explosion, injury from hand tools such as power tools and other. The rest of the incident form deals with when and where the incident happened and details of the person involved. The reporting of safety incidents is mandatory. These incident reports are then viewed by the incident review committee which processes them according to internal procedures and decides on what action is required. The incident review committee (IRC) meets on a monthly basis.

When the CP was queried about the frequency of medication errors within the incident reports received by the IRC, the CP answered that she will be appointed member within the IRC this year (2011), were she would be part of a sub-group that deals with medication errors. Therefore at the time of the interview for this study she could not give true figures of what portion of incident reports were due to medication errors since she was not part of the committee that reviewed the reports. However she went on to say that “to my knowledge not many incident reports were filed, and probably within these, the portion of reports involving medication errors is very small and does not give a true picture of how many errors really occur.”

Evidently, this incident reporting scheme is not specific for error reporting and when the CP was queried on whether she thought that medication error reporting
systems should be separate from incident reporting, CP stated that “setting up a hospital-wide medication error reporting system will be on the priority list for the subgroup on medication errors.”

On the other hand, for dispensing errors the CP mentioned that there is an internal standard operating procedure within the pharmacy department on how to report and deal with dispensing errors. Through training on this standard operating procedure (SOP), pharmacists were notified that “reporting of incidents and their subsequent analysis will help to identify areas of concern which may be conducive to the generation of incidents. Incident reporting will thus help to reduce the future occurrence of such incidents. It is unlikely that all incidents will be prevented before they reach the patient and therefore, making errors visible (flagging) is one way of preventing similar future errors.”

The CP explained that when pharmacists were educated about the patient benefits that are reaped from having a culture of learning from errors, more pharmacists were willing to report errors in the workplace. In this SOP the definition used for medication errors (within the dispensary) was “errors in the service provided e.g. dispensing of wrong medicine, dose or diluents, wrong labelling and using incorrect dispensing techniques.” Over the year 2010, 29 incident reports were filed from the pharmacy department. However it was unknown how many involved medication errors since the system is paper based and requires the review of all cases to see how many times medications were involved as a cause. Here the CP said that “without a strong hospital wide- Information Technology solution it will be difficult to move forward”. The CP went on to suggest that “adopting a hospital wide information technology system with electronic prescribing and ordering of medication would enable the review of prescriptions by the pharmacy and so allow for more errors to be detected and prevented. At the moment, only clinical pharmacists doing ward rounds can detect and prevent medication errors, and this is dependent on what the pharmacist thinks and decides at that point in time”
When the CP was asked about which medicines are particularly involved in medication errors, she replied that chemotherapy and other in-hospital compounded medicines, concentrated salt solutions, insulin and some antibiotics for intravenous use were the most problematic medications. The CP then mentioned that look-alike and sound alike medication had been identified as the root cause of many of the dispensing errors within the pharmacy. She suggested the use of tall-man letters (hydrALAzine 50mg and hydrOXYzine 50mg) within a prescription to reduce these errors as well as having a dispensary that accounts for look-alikes and sound-alikes and placing them far away from each other would ameliorate these problems to a degree. When the CP was asked whether protocols and guidelines for medicine use, were present at MDH, she replied that in some areas many good prescribing guidelines such as the national antibiotic prescribing guidelines had been compiled, but most often, internationally – published guidelines are used and have been collated within one website; Clinical Guidelines – the International Collection which can be accessed at [http://www.clinicalguidelines.org/](http://www.clinicalguidelines.org/). Information is also obtained through the Summary of Product Characteristics and the CP mentioned that the Summary of Product Characteristics is a valuable source of information within the pharmacy department. While the CP did not know if clinicians used the SPC for prescribing, the CP pointed out sometimes the marketing authorisation holders would have to be contacted to obtain more information on how that product is used since “sometimes the product information, especially when it comes to the administration of medicines is not enough”. Nonetheless, should pharmacists be in a position to review incoming prescriptions the CP said that the ‘SPC would be a good contributor for medicinal product information.’

Other questions to the CP involved incident reporting and the no-blame culture. The CP stressed that “medication reporting must be accompanied by a no-blame way of
management." The CP believes that informing healthcare professionals of the need to report incidents related to medications goes a long way to increasing the rate of reporting of incidents however the fear of blame is still very much present within MDH; "Still the culture of fear is still present, and this may be because in the past, error analysis has always been on the individual's error rather than system focused and that remains a barrier to incident reporting." The CP also mentioned that the department had tried making reporting anonymous, but this did not result in any tangible increase in reports, and also made follow up and root cause analysis very difficult. Therefore the opinion of CP is that "making reporting anonymous is not a recommendable option"

The CP also could not see how medication reporting at a national or international level could be useful, especially if root cause analysis establishes a purely human error rather than a system error. Nonetheless the CP stated that the first work to be tackled by the sub-committee on medication errors within the IRC will be formulating policy for root-cause analysis and a policy on decision making based on the outcome of the analysis. The CP pointed out that policies have to be formulated keeping the no-blame culture in mind, since the fear of litigation will result in lack of reporting, and the loss of valuable lessons.

In conclusion the CP highlighted that the way forward is an electronic prescribing and ordering system and the development of a hospital(s)-wide system for reporting medication errors which takes into account lines of accountability and actions for outcome.
4.5 Results of review of regulatory council reports and DHIR database

Review of the medical council inquiry reports and pharmacy council inquiry reports was partaken in order to see whether inquiries due to medicine misuse was a common event and a cause for public health concern. Out of a total of 202 complaints registered between 2006 and 2010, 48 (24%) were not used since they were cases carried over the years due to pending status. Of the 154 included inquiry reports, 5.1% (n=8) were related to medication misuse. 5 of these cases were raised by patients while 2 were raised by other healthcare professionals and 1 was forwarded by the Criminal Court. In total, 3 cases made it to Court. The rest were dropped by the medical council during the course of the council’s investigation and one case was dropped by the patient’s relatives upon his death. Overall, the number of cases that caused legal litigation was 3 cases within 4 years, making medication related error litigation very low.

From the pharmacy council meeting with the acting registrar, it was confirmed that very few cases come to the attention of the pharmacy council and none of these ever involved medication errors.

When the accidents and injuries database was obtained from DHIR, it resulted that only reports from Gozo general hospital are currently being recorded. Over a period of 4 years between 2006-2009, a total of 26 incident reports were filed, none of which involved medication errors.
4.6 Conclusion

Preventable adverse drug reactions have been associated with medication errors at multiple stages in the medication use process, including prescribing, dispensing, administration, monitoring and in patients management of their own care. The main causes of these problems are error-prone medication classes, knowledge gaps, human factors, system factors and communication failures. Although healthcare professional litigation is low with respect to medication errors in Malta, there is an increasing awareness of the importance of addressing medication errors especially through improving ways to detect them. These issues will be discussed in the next chapter.
Chapter 5 - DISCUSSION
5.1 Introduction

Careful review of the frequency, nature, costs and causes of medication errors was first highlighted through the literature review, in order that the study is placed into international and national context. The following discussion involves the most salient points that emerged from the four approaches that were taken to address the question under study.

5.2 Are medication errors a cause for public health concern?

Through the analysis on the pharmacovigilance database this study has shown that 17.9% of all reported adverse drug reactions between 2005-2010 in Malta, were associated with medication errors and could have potentially been prevented. Moreover this figure represents the tip of the ice-berg since adverse drug reaction (ADR) reporting in Malta is mandatory only for serious reports. Consequently the medication errors identified were associated with clinical consequences that were classified as serious since they lead to or prolonged hospitalisations, caused medically significant conditions, were immediately life-threatening or were associated with patient death. The results from this study were comparable to foreign studies that used pharmacovigilance databases.

When prescribers were asked in the questionnaires on how many prescribing errors they had encountered in a single year, the combined total from 48 doctors, the majority of whom have sole general physician/family medicine specialist practices reported a total of 73 errors in just 1 year. Likewise, 71 pharmacists reported a number
of errors in 1 year that amounted to 263 over 1 year. Notwithstanding that most of the
errors mentioned by doctors and pharmacists may have had no serious consequences or
were intercepted before reaching the patient (the near-misses), these errors represent a
rich and untapped source of knowledge that could considerably improve the quality of
care. Moreover these figures suggest that medication errors occur in higher frequencies
than established in this study. While it is not realistic to aspire to total prevention of
patient harm from medicines, since every medication carries an inherent safety risk,
those preventable adverse drug reactions may be adequately and effectively targeted in
order to be significantly reduced or eliminated.

This study has also looked at and found a very low frequency of medication
error related civil and criminal litigation in Malta for doctors and pharmacists by their
patients. On the other hand, a Eurobarometer survey on medical errors in 2006 reported
that 20% of the Maltese population has experienced a medical error and that 82% of the
population think that medical errors are an important problem on this island
(Eurobarometer 241, 2006).

Through research and interviews with key players in the healthcare field it is
evident that decision makers are becoming increasingly aware of the importance of
patient safety initiatives and have patient safety set as a high priority area for Maltese
healthcare.

This study has shown that medication errors occur in considerable numbers in
Malta and should be of concern to public health. Efforts in medication error
measurement, review and action for mitigation have been few to none. Health systems
and health policies across the E.U are becoming more and more interconnected. This
increased interconnection raises many health policy issues, including health care quality
Medication errors are the single largest preventable group of adverse events related to healthcare and the expert group on safe medication practices has recommended that medication error rates be considered as quality indicators of the different processes of the medication use system (Expert group report on safe medication practices, 2007). In this increasingly unified market of health across the E.U, quality will be measured and tagged to all healthcare systems making it an important area of consideration for public health.

5.3 Results in relation to objectives and compared to other studies

The use of medicines represents the most frequent health care intervention in developed countries. Thus ensuring medication safety is a worthwhile cause. Medication safety comprises pharmacovigilance (monitoring of the pharmacological safety of medications) and safety in medication use. Pharmacovigilance has come a long way both at a European level through the establishment and activity of the European Medicines Agency and also at a local level since its establishment in 2005 in Malta, thanks to its nurture by the Medicines Authority. Analysing medication use however was an unrecognised issue world-wide up to a decade ago and little is known on a national level so far.

The Council of Europe in its report on medication safety suggested that reporting of medication errors may be done in a collaborative and complementary way with pharmacovigilance systems, and this suggestion has been taken up by other countries, who have evaluated their own data within their pharmacovigilance or poison centres to gain insight on medication errors. With this in mind, the first part of this
study was successfully devised and implemented to study the situation with respect to medication errors in Malta.

**5.3.1 Preventable adverse drug reactions**

The national pharmacovigilance database of reports was obtained with permission from the Medicines Authority and used to identify how many of all the Adverse Drug Reactions (ADRs) reported in Malta over 5 years were associated with medication errors. The proportion of ADRs (17.9% 100/559) associated with errors was similar to that of other studies. In a study by Alj and colleagues in 2007 it was found that 14% (187/1300) of all ADRs submitted to the national Moroccan pharmacovigilance database over a 3 year period were due to a medication error and so were preventable. A significantly lower percentage of preventable ADRs was reported in a study on the New Zealand pharmacovigilance database which found that 4.3% (61/1412) of reports were deemed preventable and 65.5% (40/61) of these were deemed to have been associated with some degree of patient harm (Kunac & Tatley, 2011). The difference in the frequency of preventable ADRs in this study may be due to different inclusion criteria of reports since the authors eliminated vaccination reports and pharmaceutical company reports. Another reason may be the use of differing definitions which could have narrowed the capture of medication errors. On a more positive note, the reason for this is may be an earlier awareness that this country has had on the topic of medication errors through an international collaboration study with recommendations on avoiding and fixing medical errors in general practice in 2005 (Tilyard et al., 2005)
5.3.2 Medication errors by age, setting and medication class

Most medication errors (70.8%) originated in the community which reflects the stronger portion of ICSRs that were received from the community (50%) rather than from hospitals (33%) similar to the New Zealand study by Kunac and Tatley which reports that the majority of errors 82.0% (50/61) deemed to have originated in the community setting (Kunac & Tatley, 2011).

Identifying which age groups are more likely to be associated with medication errors is useful, since age then becomes a risk factor. When medication errors were classified according to age it was found that the 80-89 age group was associated with most medication errors. This could be explained by the increasing number of medications that are used by this age group, as well as the requirement for dose adjustments to account for concomitant conditions. A Finnish study that involved the analysis of reports that were made to the Finnish poison centre over twelve years found that incorrect use of medications involving the administration of an incorrect drug occurred most often in nursing homes for the elderly, mentally challenged and/or dementia patients. Consequently, the age group of patients most often the subject of such calls was the elderly between 60 and 99 years of age (364/776; 46.9%) (Kuitunen et al., 2008). Additionally in the New Zealand study the majority of preventable ADEs (62.5% 25/40) occurred in adults aged 65 years and older (Kunac & Tatley 2011).

Another objective of this study was identifying the medication classes that are associated with the highest risk of being in error. It was found that the M01 anti-inflammatory and anti-rheumatic class were found to be most commonly used in error with the active ingredients etoricoxib and diclofenac mostly implicated. This group was followed by antibacterials (J01) of the macrolide and quinolone type as well as psychoanaleptics (N06), immunosuppressive agents (6%) (L04), urologicals (6%)
(G04) and drugs for the treatment of bone disease (5%) (M05). Likewise, in the New Zealand study, the medication classes most involved in preventable ADEs were antibacterials for systemic use and anti-inflammatory agents, with gastrointestinal and respiratory system disorders the most common adverse events reported (Tatley & Kunac, 2011). In the Finnish study the ATC-groups of medicines most often involved were central nervous system drugs (N code) (80.1%), cardiovascular drugs (C code), (20.8%) systemic anti-infectives (J code) (16.3%) and drugs with an effect on the gastrointestinal tract or metabolism (8.8%) (Kutunen et al., 2008). In this last study it was not specified as to which exact drugs had these gastrointestinal tract or metabolism effects, but anti-inflammatory medications could very well fall into this group. In an Israeli study, anti-infective drugs were the most prevalent class of drugs associated with errors (38.7%), followed by total parenteral nutrition preparations (21.8%) and antineoplastics (15.6%) (Lustig, 2000).

The majority of medication classes identified in the literature as being associated with medication errors have also been detected in this study. The anti-inflammatory and the anti-bacterial classes are considered as particularly problematic. This leads to the questions on (i) what stage of the medication use system are medication errors occurring in and (ii) the locally perceived causes behind these errors.

5.3.3 Medication errors at stages of the medication use system

Medication information passes through many stages before it actually reaches the patient. The most common types of medication errors were identified and classified in terms of the stage of the medication use system in which they occurred. This study has shown that medication errors are prevalent at every stage of medicine use.
When compared to other studies, some of the results of this study tie in with the U.S findings for preventable adverse events (the majority of which are medication errors) by Bates et al. in 1993 who determined that the various stages of the medication use process during which the error occurred, were as follows: prescribing stage (56%), administration (36%), transcription (6%), and dispensing error (4%) while Leape et al. in 1995 found that 39% of errors were prescribing errors, 38% occurred at administration, 11% at dispensing and 12% at transcription. Kaushal in 2002 found a similar pattern with prescribing and administration stages most often associated with preventable adverse drug events. In a study where pharmacist reviewed orders by physicians the most common types of error detected were incorrect dosage of drug ordered (27.5%), interaction between drugs (20%) and incorrect name of drugs (12.5%) as well as excessive length of treatment (1.3%) (Lustig, 2000). In a study on the UK’s NHS the majority of errors (54%) were associated with choice of dose and the most serious errors originated in the prescribing decision (Building a safer NHS, 2004).

As discussed in chapter 2, the differences in working terminology and definitions partly explains epidemiological variations in the percentages used to describe medication error frequency. Nonetheless, the prescribing and dispensing errors fall into similar categories of the figures given in the studies above. Of note however is the small number of administration errors captured in the local study when compared to the above studies. When matched to the two U.S studies which were both hospital based this is understandable since they used chart review and were hospital based studies. However, even in the Alj et al. study it was reported that medication errors associated with preventable adverse drug effects and related to the medication use system occurred most often at the stages of prescribing (36%) and administration (34%) (Alj et al., 2007). Even the Kunac and Tately study identified administration
errors as the second highest type of error after prescribing errors (Kunac & Tately 2011). Like in the local study, these two studies were not hospital based but studies on pharmacovigilance databases. Possible reasons for the differences in administration error prevalence rates may be; variations in the national report card for adverse drug reactions which allowed them to pick up more administration errors, a larger proportion of hospital reports and/or differences in reporting cultures between healthcare professional groups with more nurses reporting ADRs than physicians or pharmacists.

In the Alj et al. study, patients own errors (referred to as auto-administration errors) were found to be a significant portion of all errors (44/182; 23.5%) and the authors explain that in Morocco, due to socio-economic factors, lack of social cover and laxity of pharmacists concerning prescription medications, self medication by patients is a major problem. In the local study, patient errors in the management of their own care constituted 12% (11/96) of all errors. In the New Zealand study, Tately and Kunac do not include patient errors in their own care as errors within this study probably because the social factors described by Alj do not apply to the New Zealand context. Malta seems to lie midway between these two contexts, with this study showing that laxity in dispensing still occurs, and being the cause of 5.2% (5/96) of all errors and 72% (5/7) of total dispensing errors. This explains how in 2 instances patients obtained and self medicated with the urologicals tadanafil and sildenafil when they had a history of heart disease and suffered hospitalisation due to cardiac-related symptoms. In these ICSRs it was stated that physicians had refused these patients treatment due to their contra-indicating history but they had still managed to obtain and self-medicate with these medications. Another factor that may be relevant in patient errors may be the lack of initiative that patients take in managing their own medical care. Healthcare professionals should empower patients to become more involved in their care. Some
good initiatives have been taken in this area with the Medicines Authority launching the 
*Know your Medicines* Campaign and the Health Promotion and Disease Prevention 
Department carrying out the campaign against unnecessary use of anti-biotics.

The next most common error type identified in the local study was the area of 
therapeutic monitoring which comprised 26%. In a French study on ADR related 
hospital admissions, 158 ADRs were directly related to hospital admission. 
Characteristics associated with these ADRs included inadequate monitoring of a 
patient's drug therapy in 67% of the cases and patient noncompliance in 33% of cases 
amongst others. The authors recommended a multi-disciplinary approach to be taken 
among physicians, pharmacists, other healthcare professionals and patients that focuses 
on communication and education in order that therapeutic monitoring and patient errors 
are reduced (McDonnell & Jacobs, 2002). This author is in strong agreement with this 
multi-disciplinary approach and is of the opinion that therapeutic monitoring and 
follow-up of patients is the shared responsibility of physicians, pharmacists and nurses 
alike. Physicians have the obligation to set out an appropriate action plan for 
medications which they prescribe, ensuring the patient understands the importance of 
follow-up tests and visits. Partnership with pharmacists in this aspect will enable 
stronger reinforcement of the action of therapeutic monitoring, be it on the ward, or in 
community. Pharmacists are in a position and should be vigilant toward detecting 
symptoms that may be ADRs due to therapy and recommend that follow-up visits or 
tests are performed with the initial prescriber. All healthcare professionals should take 
every opportunity to remind patients of the importance of following-up their treatment. 
The use of reminder techniques such as telephony, SMS, letters and e-mails to patients 
at timed intervals, is one aspect of improving therapeutic monitoring which should be 
more widespread even outside the local private sector.
In conclusion, to a large extent, similarities in the distribution of prescribing, dispensing, therapeutic monitoring and patients' own errors can be seen across studies. Medication errors in Malta seem to be occurring in similar frequencies as elsewhere except for administration errors which require a different approach for detection locally.

### 5.4 The causes and prevention of medication errors

#### 5.4.1 Prescribing errors

In line with the psychological classification of errors discussed in chapter 2, the prescribing errors identified in this study may have been knowledge-based errors or memory based errors and could have occurred either in the planning of the action (prescribing) or else in the execution of the prescription. For example, not knowing that NSAIDs are contraindicated in asthmatics is a knowledge-based error. Knowing that NSAIDs are contra-indicated in asthmatics but forgetting while writing the prescription for example because of a distraction is a 'lapse' or memory-based error. Errors classified by the psychological theory point to human causes of errors (Aronson, 2009) and do not deal with the system or environmental factors. Due to the vast numbers of different medications, some with increasingly complex specifications to their use, knowledge-based errors (human factor) are an expected risk to medicine today. This is collaborated by the results of the questionnaire in which 69% of prescribers think that the risks of errors are increasing although fewer believe that actual errors are (45.2%).

The questionnaire to prescribers aimed to capture both human and system causes of prescribing errors. When asked on which variables were associated with prescribing errors doctors identified a very strong association with human factors such
as doctors overwork (29/43), high patient volume (29/43) and doctors fatigue from any cause (28/43). In a study by McArdle and colleagues in 2003, based in a UK university hospital, 15 physicians from 4 clinical specialties were interviewed on the causes and methods to reduce errors. When asked what leads to medication errors, all doctors felt that being overworked and understaffed was the greatest factor contributing to the high rates of medication errors. Considering budgetary restraints and an increasing burden on health care it is difficult to see how this problem can be dealt with effectively but one measure could be a regulatory requirement on the number of patients that can be seen per day. In the local study 41% of doctors agree to this (17/41). Doctors in the local study then identified a strong association to system factors, such as having medications with similar and confusing names (21/43), interruptions (20/43) and lack of availability of internet and/or electronic resources (17/43) as well as insufficient time to talk to patients (17/43) and distractions due to administration/clerical requirements (15/43). These results are comparable to other studies (Allardet et al., 2002; McArdle et al., 2003; Haw et al., 2005). Two of these three studies (UK based) suggest increasing the number of British National Formularies (BNFs) available on the wards, and increasing the availability of electronic internet resources. This could be a useful suggestion within the local hospital context. In the local study, most respondents had sole practices in community based clinics. The situation here is equally precarious since there is often no opportunity to consult with other professionals as within a hospital. As described through an open ended question it can happen that doctors in primary care find themselves in a clinic with no BNF or internet resources, with a busy pharmacist that may be a floor below, and doctors may only feel safe to prescribe what they were absolutely sure about. Others may feel the need to take a 'guess' on doses or dosage regimens or other important information. This means that the best therapy for
the patient is not selected, and may lead to unnecessary complications or adverse drug reactions.

**Reducing medication errors through improving knowledge on medications**

It is strongly felt by this author that each physician, pharmacy or clinic should be at least in possession of the latest BNF, and every clinic and pharmacy should be equipped with a working internet connection where the summary of product characteristics of all medications approved locally can be accessed through the Malta Medicines List www.maltamedicineslist.com. Of note is the suggestion by some doctors and pharmacists for an updated local national formulary but considering the human resources required, this may not be on the national priority list. Nonetheless a supplementary issue that covers medicinal products over and above those in the BNF may be considered. This could be especially useful if it is fortified by critical appraisals of new therapies. One way of obtaining good quality information could be through health technology assessment reports that resulted in an approved product. In keeping with the above, when doctors were asked to rate the importance of factors in order to minimise prescribing errors; keeping one’s knowledge of medicines up to date (41/41), having medicine names that are distinctive (34/41) and receiving information from the pharmaceutical industry (34/41) were considered to be very important.

Healthcare professionals should be aware that much is being done by regulators and the pharmaceutical industry in this aspect. The flow, quality and timeliness of delivery of information to prescribers and pharmacists is controlled and ensured locally by the Medicines Authority through its communications with the pharmaceutical industry and healthcare professionals. Knowledge is imparted and constantly updates through educational materials provided by pharmaceutical companies such as;
prescribers’ brochure within risk-management plans. These risk management plans obligate pharmaceutical companies to regularly remind prescribers and dispensers about risks and risk-reducing factors that are associated with a particular medicine. These are often sophisticated audio-visual training and educational tools on how to prescribe, monitor and educate the patient as well as highlighting identified risks which can be mitigated for the safest possible use of a medication. Other means of communicating new knowledge are the ‘Direct Healthcare Professional Communications’ that are sent to those whom the competent authority and the pharmaceutical company decide should be notified, informing of changes to indications and other medication safety-related information. Updates to the summary of product characteristics are relayed through this means, so that every registered doctor or pharmacist receives the update at home. Safety circulars may also be sent to healthcare professionals to communicate new and remind of old but still valid safety information. In this aspect, the importance of identifying and communicating risks, from the safety of the medicine itself is well recognised locally. The next step forward is extending it to identify risks from the use of the medicine. To this effect, an area that could be tackled by companies is the risk from similar drug names and medication labels. This was identified as a factor associated with the risk of error by both doctors (21/43 49%) and to a lesser extent by pharmacists (21/63 33%). In some countries, reporting of medication errors has lead to the identification of specific risky packaging or inadequate labelling which gave regulators grounds to demand change in labelling, package and even change in product names. With a European-wide system that collates and shares medication error reports, this can be reality in Europe and implementation of the pharmacovigilance directive in 2012 as described in chapter 2 is an essential first step towards this.

Reducing medication errors through improving knowledge on patients
Lack of information particularly around the time of patient admission and not having an accurate medication history from the general practitioner or from the patients themselves was identified as a high risk for medication errors in the local study. Through the open ended question having electronic medical records, and making these available to primary care doctors were strongly suggested as means of reducing prescribing errors. Replacing inpatient paper medication orders and medical notes with electronic records is widely seen as the key step to improve patient safety in many countries (Kohn et al; 1999, National Audit office, 2008; Lium et al., 2008). Electronic medical record keeping is the first step towards more sophisticated information technology that supports medical practice such as Computerised Physician Order Entry (CPOE).

Computerised Physician Order Entry coupled by Clinical Decision Support systems have been described as a powerful technological tool that can help address the problem of medication errors. Not only can real-time decision-support systems intercept errors, such as interactions between incompatible medications but it also addresses patient knowledge errors since for example, it would alert to a prescription of drugs to which the patient's electronic medical record notes an allergy. Patient factors relevant to the dosing of particular medications can also be evaluated electronically; drug overdosing or underdosing can be corrected by accounting for a patient's age, weight, and kidney function. Taken further, better choices of medications for a particular condition can be recommended, such as the most diagnosis-appropriate antibiotic. A U.S report by the Quality Interagency Coordination Task Force outlined how health care organizations can more easily and reliably aggregate their electronic records to look for trends and provide data for research on patient safety issues without relying on costly chart
reviews. Provider profiles can be used to provide helpful feedback to clinicians and to identify needs for training and system changes. (QuIC, 2000)

A more recent literature review on the safety of CPOE systems by Sengstack in 2010 also concluded that CPOEs have the potential to reduce medication errors but that the success is dependent, on how each individual organization configures their system. In this review, the author mentions one qualitative study by Campbell et al., were researchers attempted to identify the types of unintended consequences seen with the implementation of CPOE systems (Campbell et al., 2006). This study involved an expert panel using an iterative process that took a list of adverse consequences of CPOE, and sorted them into categories. The category labelled “Generation of New Kinds of Errors” included organizational culture and business process or workflow problems, but also indicated that new kinds of errors appear when CPOE is implemented. Examples of items in this category include juxtaposition errors when users select an item next to the intended choice; a wrong patient being selected; desensitization to alerts (alert overload); confusing order option presentations; system design issues with poor data organization and display, users get frustrated trying to find the right spot to enter a particular data element and end up entering orders on generic screens and bypassing any rules and alerts configured, behaviours which can all potentially lead to medication errors. Another study by Koppel et al., a year before had found similar findings (Koppel et al. 2005). This review emphasised the fact that good evidence on CPOE is still evolving and that organizations should strengthen their evaluation programs and use themselves as a control or baseline from which to measure success. Nonetheless, the transition from paper to electronic which has penetrated many industries today should be extended to Maltese healthcare as a means of
facilitating administrative burden, improving communication between hospital and community and improving access to knowledge on patients and medications.

5.4.2 Dispensing errors

In the results from the analysis of the pharmacovigilance database, dispensing errors made up a small portion of all medication errors identified in this study, with only 2 types of error identified; dispensing without a prescription and lack of advice. It is felt that this may not truly reflect dispensing error rates in current practice. Confirming this, is the much higher reported total of yearly dispensing errors (n=273) by pharmacists themselves through the questionnaire. Dispensing without a prescription is a rule-based error, whereas lack of advice can be either a knowledge based error or a memory-based error. Some studies have found that non-prescription dispensing (of prescription only items) is partly due to online purchasing of medications (Bloom, 1999; Constance 2004). While some internet pharmacies are legitimate reputable websites, in these two studies it was found that 19.6% (9/46) and 13% (25/190) of internet pharmacies did not require a prescription before dispensing medications. From a patient safety perspective, patients who obtain prescription medications in this manner may expose themselves to dangerous interactions and dangerous adverse effects as well as the possibility of receiving counterfeit medicines. Healthcare professionals should always provide education to patients about dangerous on-line practices (Constance et al., 2004).

In the case of real community pharmacy dispensing with no prescription, these rule-based errors may be overcome by increasing awareness of patient incurred health damage due to non-prescription dispensing and by enforcing the rules. Many
pharmacists will rightly argue that most dispensing is of items that have previously been prescribed and require repeat dispensing. It is difficult to suggest how the rules can be changed to adequately fill this gap. Here it is important that prescribers and pharmacists remember that each time a patient gets their prescription renewed is an opportunity for re-evaluation of the patient and the patients' treatment. In fact, lack of patient evaluation was mentioned by prescribers through the open ended question. Public schedule V prescribing systems were identified as a risk factor for error with respect to repeat prescriptions.

In this study several variables were perceived by pharmacists as being associated with dispensing errors. In decreasing order of importance were doctors' handwriting (55/69), pharmacist fatigue (38/69), pharmacist overwork (37/69) and high patient volume (36/69). The first problem of illegible prescriptions can be solved by improving computer access and implementing mandatory printed prescriptions. The last three variables are clearly interrelated to a degree and are comparable to other studies (Abood, 1996; Peterson et al., 1999, Haw 2005). In the study by Abood errors have been reported by pharmacists who regularly work twelve hours or more every day, who do not have a meal or other break during the day, or who go without holidays and recreation for months or years on end (Abood, 1996). In his study Peterson identified that pharmacy owners were generally more apt to working long continuous hours when compared to non-owners. In the local study this trend could not be picked up since no question was asked to pharmacists as to whether they were owners or not. This could render useful information in future studies on dispensing errors in community practice. Regulatory control on patient volume for example regulation on how many patients can be accepted within the Pharmacy Of Your Choice scheme per dispensing pharmacist could be an option.
Abood states that workplace procedures represent an occupational health and safety risk and goes on to say that patients should be educated that it is for their safety and well being that dispensing is allowed a reasonable amount of time. Illegible prescriptions are a well known dispensing hazard which may be rectified with greater effort on the part of physicians. Nonetheless, in the Abood and Peterson studies illegible prescriptions were not identified as the strongest factor contributing to dispensing errors unlike in the local study suggesting that pharmacists locally are unhappier with the prescribing practices of local physicians, or that they tend to over-emphasis this issue. However when pharmacists were asked to identify a common causative factor for the dispensing errors they had encountered the majority of responses were unclear prescriptions (10 errors) followed by similar packaging (7 errors) especially free-medicines packaging. Having computer generated prescriptions would resolve the issue of illegible prescriptions for good and would facilitate the goal of having all prescriptions bearing contact details of prescribers. Similar to prescribers, pharmacists thought that knowledge of medicines up to date emerged as the most important factor in minimising dispensing errors as well as having distinctive packaging within the same corporate livery and these issues have been discussed in detail in the previous section. Having a dispensary layout which segregates dispensing from other activities as well as organising the dispensary to adequately store look-alike and sound-alike medicines away from each other were recommendations from the questionnaire and also by the Chief Pharmacist that should be kept in view when approving new pharmacy licenses.
Hospital pharmacy distribution system

Several studies (Runciman et al., 2003, McArdel et al., 2003, Beso, 2005; James et al., 2008) have highlighted that pharmacists within the hospital setting have been considered as a safety net, checking prescribing, medication histories, highlighting drug interactions and in this way removed the need of some aspects of the doctors role. As discussed with the Chief Pharmacist at Mater Dei hospital review by pharmacists is limited due to the floor stock method used in our hospital and limited patient data available to assess the appropriateness of prescriptions. In the floor stock system, all but the most unusual medications are stocked on the nursing stations in all patient care areas. Medications which require especially strict control are often omitted from floor stock, such medications are sent to the ward upon receipt of a prescription order for the individual patient. The disadvantages of this system are that pharmacists are under-utilised and nurses time is used inefficiently. An alternative system is the Unit Dose System (UDS) which is a pharmacy-coordinated method of dispensing medication in hospital settings (ASHSP, 2005). Medications are contained in, and administered from single unit packages and are in ready-to-administer form to the extent possible. A patient medication profile is concurrently maintained in the pharmacy for each patient. (ASHSP, 2005). In the floor stock method therapeutic orders that may be inappropriate or contraindicated, such as prescribing medication at the usual dose, route and frequency, but for inappropriate indication or when contraindicated, may go undetected. Studies have shown that a higher interception of errors has been reported in hospitals in which the reviewing pharmacist has greater access to patient specific files. (Dobie & Rascati, 1994; Lustig, 2000).

The results of this study do not adequately point to medication administration errors, and hospital prescribing errors since most errors were generated in the community, and
a low rate of administration errors was identified. However the need for rethinking of
the hospital distribution system might be put forward to support safer medication
practices as suggested by the Chief Pharmacist and international studies (Dobie &
Rascati, 1994; Lustig, 2000).
5.6 Strengths and limitations of the study

5.6.1 Strengths

a. A mixed method approach that incorporated both quantitative and qualitative methods was used.

b. The main study findings were comparable to other studies in the field.

c. Although the information generated may be limited in aspects as outlined in the next section, the subject under study was one where little local information exists.

d. The study was done at a time when patient safety culture is high on the priority list of the healthcare agenda.

e. The pharmacovigilance database is a ready available source of data that is free and could be regularly tapped into for future comparative studies of the same type.

f. The Summary of Product Characteristics (SPC) that was used as the comparative standard is a legal document that is readily available and compulsory through European Directive 2001/83/EC for all marketing authorisations.

g. The information within the SPC on how to use the product safely and effectively is evaluated rigorously with the authorisation process and subsequently thereafter.

h. The French tool of causality assessment is the only causality tool to be given legal status and is the most widely used tool for causality assessment.
i. The questionnaires on perceptions of doctors and pharmacists on the causes and prevention of medication errors were tested for face and content validity.

5.6.2 Limitations

a. When the issue of medication errors was identified as a topic of research, complete national data on total prescriptions and total dispensed medications to find out incidence rates of medication errors was searched for. However to date, there is no readily available nationwide collation of records on prescriptions and dispensing. Because of this lack of denominator data the analysis of the pharmacovigilance database does not give incidence rates of medication errors.

b. The study was also limited through an underestimation of the time required for analysis of the database which did not take into account the time for data clean up and time taken to perform the causality assessment.

c. Retrospective bias might be present because the outcome of the error was known.

d. A proportion of ADR reports were incomplete and introduced unknowns in the analysis.

e. No analytical statistics were done, due to time constraints and the way the data was collected.

f. The response rate for the questionnaires was very low.
Chapter 6 - RECOMMENDATIONS
Recommendations

1. The lack of local information on medication errors pertains the establishment of a recognised national entity for safe medication practices in Malta with the designated role of:

   (a) Cultivating a culture of medication safety

   (b) Co-ordinating a medication error reporting system that involves all sectors of healthcare including: public and private community and hospital care and old person’s homes

   (c) Taking action to quantify, reduce and prevent identified risks

2. In light of the near imminent implementation of the pharmacovigilance directive, with mandatory medication error reporting, a system that is collaborative and complementary to the national system for pharmacovigilance is to be considered.

3. Decision makers should discuss and decide upon the best medication error terminology to be used by local researchers, healthcare professionals, manufacturers, and regulators in order that at least local communications on the subject may be understandable and studies are comparable.
4. The classification of medication errors on the basis of the underlying psychological mechanisms, based on how errors occur, can suggest strategies that help to reduce their occurrence. Therefore a medication error reporting system should take this into account.

5. Doctors, pharmacists and nurses must learn to detect medication errors, actual or potential, to understand their causes, and to propose system wide changes to reduce the risks to patients. Since they have the best knowledge of the health setting they work in, they are in an ideal position to give practical solutions to prevent and remedy medical errors. Therefore, training of health professionals on safe medication practices should be considered in undergraduate and postgraduate curricula, as part of continued professional development/continued medical education and as induction training for new employees.

6. Human resources departments should focus on the issues of doctors and pharmacists overload and fatigue. Reconciliation of Human Resources policies should be done accordingly. Policies for the control of self-imposed overload by doctors and pharmacists should be considered.

7. Healthcare professionals should have ready access to relevant medicine information and patient information. The starting point would be mandatory computer systems with a printer and internet access in all clinics and pharmacies.
8. Hospital floor stock method should be reconsidered or reduced to a minimum number of medications.

9. Decision makers should contemplate on the implementation of health system wide IT systems that are integrated and enhance communication between different settings of healthcare professionals. As in all other fields, the medical field should aim to become paperless with the first step being the transition to electronic medical records.

10. Community pharmacies should contribute to therapeutic follow up and patient education. In addition to oral information, patients should be provided with up-to-date, useful written information.

11. It should be remembered that it is simply impossible for a patient to learn all facts related to his/her condition during one single appointment with a doctor or another health professional. It is often a long learning process that needs to be supported by the professionals by dialogue-based communication that enhances problem solving skills of the patient and assist with proper management of medical condition and the effective use of medicine. Healthcare professionals should seek to empower patients to actively manage their medication plans.
REFERENCES
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References


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Peterson G, Wu M, Berkin JK (1999) Pharmacists’ attitudes towards dispensing errors; their causes and prevention; Journal of Clinical Pharmacy and Therapeutics; 24: 57-71


Report on the open consultation of patient safety in the EU; website. [Accessed 2010]


REFERENCES


The official French method of causality assessment

**Intrinsic Imputability Score**

**Chronological criteria**
- Time to onset
  - Very suggestive
  - Compatible
  - incompatible
  - Suggestive
  - Inconclusive
- Reaction course
  - Not suggestive
  - Positive (R+)
  - Negative (R-)
- Readministration
  - Inconclus. (R0)

**Semiological criteria**
- Semiology
  - Favorizing factors
  - Other cases
  - Positive (L+)
- Specific lab test
  - Absent (L0)
  - Negative (L-)
- Non-drug cause
  - Absent
  - Not searched for
  - Possible

**SEMILOGY**

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<th>SEMIOLOGY</th>
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<td>S3</td>
</tr>
<tr>
<td>C2 (possible)</td>
<td>S2</td>
</tr>
<tr>
<td>C1 (uncertain)</td>
<td>S1</td>
</tr>
<tr>
<td>C0 (incompatible)</td>
<td>S0</td>
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</tbody>
</table>

0: Unlikely  1: Uncertain  2: Possible  3: Probable  4: Highly probable
Hi Amy

No, only pilot testing.....
I am not quite sure how you would do validation for this sort of survey instrument when one is looking at attitudes rather than factual knowledge

Regards

Greg

On 17/05/2011, at 10:27 PM, "Tanti Amy at Medicines Authority" <amy.tanti@gov.mt> wrote:

Dear Dr Peterson,

As you may recall, I had asked your permission to use a questionnaire you had developed to find out the opinions of pharmacists on dispensing errors. I thank you again for your kindness in accepting that I use it for my dissertation on Medication Errors. I have a question on the tool however. By any chance do you remember if you had done any validation testing on the tool, for example, on content validity, test-rest or anything of the sort?

While I congratulate you on your prominence in the area of medication errors, and the great work you have produced, I also extend my thanks.

Yours sincerely

Amy Tanti
B.Pharm (Hons.)
Pharmacists' Opinions on Dispensing Errors

1. WE APPRECIATE YOUR HONEST OPINIONS. THE RESPONSES WILL BE TREATED ANONYMOUSLY AND CONFIDENTIALLY, AND DATA FROM ALL RESPONDENTS WILL BE POOLED.

The first set of questions relates to demographic information.

1. Gender

2. Age

3. Years of experience

4. Area(s) of practise (ex. community pharmacy, hospital pharmacy)

5. On average, how many hours a week do you spend in practise?

THE REMAINING QUESTIONS RELATE TO PHARMACISTS' OPINIONS ON DISPENSING ERRORS

6. Do you believe that the RISK of errors in dispensing is increasing in pharmacy practise?
   - Yes
   - No

7. Do you believe that ACTUAL errors in dispensing are becoming more common?
   - Yes
   - No
Pharmacists’ Opinions on Dispensing Errors

8. I am interested in identifying variables that pharmacists perceive as being associated with dispensing errors. Do you believe that each of the following factors is associated with the occurrence of errors in dispensing? Answer each by marking the scale provided.

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<th>Fair association</th>
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<td>(c) The existence of generic brands</td>
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<td>(g) Pharmacist overwork</td>
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<td>Pharmacist's Opinions on Dispensing Errors</td>
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<td>activities occurring in the vicinity</td>
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<td>(s) Insufficient time to talk to patients</td>
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<td>Other (please specify)</td>
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</table>
### Pharmacists' Opinions on Dispensing Errors

2.

1. Which of the following factors would you nominate as being important in minimising the risk of dispensing errors? Please rate the importance of each by ticking on the scale provided.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Not important</th>
<th>Of low importance</th>
<th>Uncertain of importance</th>
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<td>(d) Having drug names that are distinctive</td>
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<td>(e) Having distinctive packaging within the same corporate livery</td>
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</table>

2. Approximately how many continuous hours per day do you think can be safely spent in dispensing?

3. Do you think there should be a regulatory requirement on the amount of continuous dispensing hours that can be done per day?
   - Yes
   - No
### Pharmacists' Opinions on Dispensing Errors

3.

1. Are you aware of any dispensing errors in your place of practise during the past year?
   - [ ] Yes
   - [ ] No

   If yes,

2. Approximately how many errors in your place of practise are you aware of?

   

3. Was there a common causative factor that you can identify? If yes, please list

   

4. Do you have any further comments or suggestions on the issue of dispensing errors?

   

   

   

   

   

   

Page 5
Pharmacists' Opinions on Dispensing Errors

4.

If you would like to receive a copy of the results of this once you submit this questionnaire, please send a request to amyta@012@yahoo.co.uk and a copy will be e-mailed to you.

Please note that the questionnaire will remain anonymous since your email address cannot be associated to the submitted questionnaire.

***THANK YOU FOR YOUR TIME...***
WE APPRECIATE YOUR HONEST OPINIONS. THE RESPONSES WILL BE TREATED ANONYMously AND CONFIDENTIALLY, AND DATA FROM ALL RESPONDENTS WILL BE POOLED.

The first set of questions relates to demographic information.

1. Gender

2. Age

3. Years since graduation

4. Specialty(ies)

5. Site of practice (ex. hospital, primary care, community clinic)

6. On average, how many hours a week do you spend in practice?

THE REMAINING QUESTIONS RELATE TO DOCTORS’ OPINIONS ON PRESCRIBING ERRORS

7. Do you believe that the RISK of errors in prescribing is increasing in medical practise?
   ○ Yes ○ No

8. Do you believe that ACTUAL errors in prescribing are becoming more common?
   ○ Yes ○ No
9. We are interested in identifying variables that doctors perceive as being associated with prescribing errors. Do you believe that each of the following factors is associated with the occurrence of errors in prescribing? Answer each by marking the scale provided.

<table>
<thead>
<tr>
<th>Factor</th>
<th>No association</th>
<th>Low association</th>
<th>Fair association</th>
<th>High association</th>
<th>Very high association</th>
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</thead>
<tbody>
<tr>
<td>(a) Similar or confusing names of medicines</td>
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<td>(b) The existence of generic brands</td>
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<td>(c) Distractions due to administration/clerical requirements</td>
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<td>(o) Insufficient technical resources for consultation</td>
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</table>
Doctors' Opinions on Prescribing Errors

(r) Insufficient time to talk to patients

Other (please specify)
1. Which of the following factors would you nominate as being important in minimising the risk of prescribing errors? Please rate the importance of each by ticking on the scale provided.

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<td>(g) Checking the original prescription when writing repeats</td>
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</table>

2. Approximately how many patients do you think you can safely see per day?

3. Do you think there should be a regulatory requirement for the amount of patients that can be seen per day?
   - Yes
   - No
Doctors' Opinions on Prescribing Errors

3.

1. Are you aware of any prescribing errors in your place of practice during the past year?

☐ Yes  ☐ No

If yes,

2. Approximately how many errors in your place of practice are you aware of?


3. Was there a common causative factor that you can identify? If yes, please list


4. Do you have any further comments or suggestions on the issue of prescribing errors?


If you would like to receive a copy of the results of this study, once you submit the questionnaire, please send an email to amytanti012@yahoo.co.uk and a copy will be e-mailed to you. Please note that the questionnaire will remain anonymous since your email address and the submitted questionnaire cannot be associated.

**** THANK YOU FOR YOUR TIME ****
Dear Doctors and Pharmacists,

I am currently conducting a study on Medication Errors as part of an Msc. in Public Health Medicine. As part of this study I would like to find out your opinions on issues surrounding errors done in the chain of medicine use; specifically errors in prescribing and errors in dispensing.

While I appreciate how busy you, and how frequently you are asked to participate in ongoing research, this survey will not take more than 7 minutes of your time.

If you are a doctor by profession, please access the link below. The survey is completely anonymous.

Doctors' Opinions on Prescribing Errors Survey

If you are a pharmacist by profession, please access the link below. The survey is completely anonymous.

Pharmacists' Opinions on Dispensing Errors Survey

I thank you in advance

Best Regards

Amy

Amy Tanti B.Pharm (Hons.)
amytanti012@yahoo.co.uk
Appendix E
Protocol Ref No: 20/2011

11th May 2011

Ms Amy Tanti
Salina Flats, Flat 1
Salina Bay Road
Naxxar NXR1101

Dear Ms Tanti,

Please refer to your application submitted to the Research Ethics Committee in connection with your research entitled:

MEDICATION ERRORS: IS THERE A CAUSE FOR PUBLIC HEALTH CONCERN?

The University Research Ethics Committee granted ethical approval for the above-mentioned Protocol.

Yours sincerely,

[Signature]

Dr Mario Vassallo
Chairman
Research Ethics Committee
Open-ended questionnaire for the Director, Department of Health Care Services Standards

The following is an extract from the annual report of government departments compiled by your goodself and your team.

Culture of Safety

'Cognisant that local research is needed in this sector, DHCSS during 2008 conducted for the first time a survey to measure and benchmark patient safety culture in Mater Dei. The term culture of safety refers specifically to the contextualisation of the concern for patients' safety which needs to be embedded at every level of the organisation. A culture of safety is one that seeks to analyse and thereby anticipate adverse events including errors and, in the light of that analysis, to organise systems and practices which, as far as possible, prevent them. Barriers or defences can be built into systems so as to help avert them, or to contain and mitigate their potential for harm. Approximately 400 face-to-face interviews with staff at all levels from Mater Dei were conducted using an internationally standardised questionnaire specifically addressing 12 patient safety culture composites. Whilst the gathered data via this survey is still being analysed, there are emergent trends of strengths and key performance indicators that differentiate Mater Dei as best in class amongst other hospitals, when the local data is benchmarked with the comparative databases of international hospitals.

These are all positive indicators of a good platform to transform Mater Dei into a learning organisation and a centre of excellence as regards patient safety. The main challenge, as the results indicate, is an element of under-reporting which needs to be addressed. An open and non-punitive environment in which it is safe for health care professionals to report adverse events, safe to admit error, is essential to explore the root cause analysis and transform such events into an organisational learning opportunity.'
Section 1: The MDH study

In the 2008 annual report of government departments, it was mentioned that the DHcSS conducted 400 face to face interviews with staff from Mater Dei to measure and benchmark safety culture in MDH.

1. What were the 12 patient safety culture composites that were used as guidelines for the questionnaire?

2. Where Medication Errors (ME) included in this questionnaire?

3. If yes, was there a set definition of a ME used for this form?

4. If yes, what is the definition used and by whom was it set?

5. Did the study pick up any trends/identifiable patterns of reporting i.e. any identified high risk areas?

Section 2: Medication Errors

1. Do you think ME are a problem at MDH and other hospitals (government and private?)

2. Do you think ME are a problem in primary care, private hospitals and nursing homes?

3. What in your opinion, are the high risk areas within the medicine chain (ie. prescribing, dispensing, distribution, preparation and administration

4. Do you know of any actions that have been taken in the past, to learn from ME or medical errors in general to prevent them from happening again? Did the study in 2008 go into that issue?
5. Do you think enough is being done re. ME?

6. Do you think there is a blame-culture or a culture of sharing of errors?

7. Do you think reporting is outcome focused rather than process focused?

8. What do you think are the barriers to reporting?

9. What are the consequences of whoever reports?

10. Do you think that incident reporting and medication error reporting should be combined or separate? Do you have any recommendations on setting up a ME reporting system?

11. Should information on ME be shared on a national level, European level, international level?

12. Do you think healthcare professionals are aware of the SPC? Do they use it as a guide to their work especially when prescribing/dispensing and administering medicines? Is prescribing outside the SPC common at MDH and other hospitals?

13. What, in your opinion can be done to minimise errors, and maximise patient safety?

14. Do you think targets should be set on this issue?
Open-ended questionnaire for the meeting with the Acting Chief Pharmacist at Mater-Dei Hospital (MDH):

After introducing myself and the thesis . . .

Section 1: Policy

What I know of the system at MDH so far is that there is an incident-reporting scheme which incorporates medication errors (ME). Could you expand on this system?

1. Is there any written policy regarding the accident reporting system?
2. How does it work?
3. Who can submit reports?
4. Is there an obligation to report?
5. What does the form look like (request a specimen)?
6. Is it a fixed tick-box data sheet (structured) or open ended type of report form?
7. Who devised this report and when did it start operating?
8. Is there a set definition of a ME used for this form?
9. If yes, what is the definition used and who set the definition?
10. What is the rate of reporting? Are there any trends/identifiable patterns of type of accident reported or type of person reporting?
11. Do you think the number of reports gives a good picture of the real incidence of accidents/ME?

Section 2: Medication Errors

12. Do you think ME reporting should be separate from accident reporting?

13. What are the prevalent stages were there are most ME, within the medicine chain (ie. prescribing, dispensing, distribution, preparation and administration) that have been reported?
14. What medicines are particularly involved in ME?

15. Do you think look-alike packaging and corporate livery issues are potentiating dispensing errors?

16. Are there any written guidelines/protocols with respect to medicine use at MDH?

17. Are these protocols/guidelines easily available to anyone who needs to refer to them?

18. Are recommendations/guidelines taken up/observed at MDH?

19. What actions have been taken in the past, to learn from ME and prevent them from happening again?

20. Do you think ME are a problem at MDH?

21. Do you think enough is being done re. ME?

22. Do you think there is a blame-culture or a culture of sharing of errors at MDH?

23. What are the consequences of whoever reports?

24. Is there an established system for dealing with incidents, medication errors in particular?

25. Do you think reporting is outcome focused rather than process focused?

26. What do you think are the barriers to reporting?

27. Should information on ME be shared on a national level, European level, international level?
28. Should all reports be shared nationally, at a European level and then internationally? or just those with serious consequences?

Section 3: The incident reporting committee

29. What was the rationale behind the setting up of an incident reporting committee?

30. When was it established?

31. Who forms part of this committee?

32. What does it discuss?

33. What are the outcomes of this committee?

Section 4: HCP practice

34. Do you think doctors are aware of the SPC? Do they use it as a guide to prescribing? Is prescribing outside the SPC common at MDH?

35. Do you think pharmacists are aware of the SPC? Do they use it?

36. Do you think nurses and complementary professions are aware of the SPC? Do they use it?
Additional comments on any issue related to ME?

Additional comments on any issue related to the below?

Errors in children

Need for training in root cause analysis and failure mode effects analysis

Targets may be set for the common errors e.g. vincristine wrong route errors, and errors with administration of concentrated potassium solutions
Part of body affected:
(Head, neck, back, lower / upper Extremities)

Describe injury / Occupational ill health
(e.g. cut, bruise, burns, fracture etc)

WHAT HAPPENED? (Summarise the circumstances including causes)

WITNESSES (give names, I.D. numbers and contact details)

IMMEDIATE ACTION / PRECAUTIONS TAKEN

REPORTED FOR FURTHER ACTION? TO?

DETAILS OF PERSON COMPLETING THE FORM

NAME ........................................ Position ................................ Signature ........................... Date ........ ..

Endorsed by:

NAME ................................... , Position ............... Signature ................ .

OHSD – Incident Report Form, Version 001/2009