UNIVERSITY of BRADFORD

Library

University of Bradford eThesis

A study of the prescribing, dispensing and administration of medicines with reference to medication errors in the Armed Forces Hospital, Kuwait.

Fahad M. Al-Hameli

PhD

2010

A study of the prescribing, dispensing and administration of medicines with reference to medication errors, in the Armed Forces Hospital, Kuwait.

An experimental investigation to determine the accuracy of the prescribing process, dispensing process and nurse administration of medication as compared with the prescriptions of physicians in the Armed Forces Hospital in Kuwait

Fahad M. Al-Hameli

submitted for the degree

of

Doctor of Philosophy

Department of Pharmacy

University of Bradford

2010

ABSTRACT:

Introduction: Medication errors are a major cause of illness and hospitalization of patients throughout the world. This study examines the situation regarding medication errors in the Armed Forces Hospital, Kuwait since no literature exists of any such studies for this country. Several types of potential errors were studied by physicians, nurses and pharmacists. Their attitudes to the commission of errors and possible consequences were surveyed using questionnaires. Additionally, patient medical records were reviewed for possible errors arising from such actions such as the co-administration of interacting drugs.

Methods: This study included direct observations of physicians during the prescribing process, pharmacists while they dispensed medications and nurses as they distributed and administered drugs to patients. Data were collected and compiled on Microsoft Excel spreadsheet and analyses were performed using SPSS. Where applicable, results were reported as counts and/ or percentages of error rates.

Nurses, pharmacists and physicians survey questionnaires: From the 200 staff sent questionnaires a total of 149 respondents comprising nurses (52.3%), physicians (32.2%) and pharmacists (16.1%) returned the questionnaires a total response rate of 74.5%. All responses were analyzed and compared item-by-item to see if there were any significant differences between the three groups for each questionnaire item.

All three groups were most in agreement about their perception of hospital administration as making patient safety a top priority with regard to communicating with staff and taking action when medication errors were reported (all means ≥ 3.0 and $p > 0.05$). Pharmacists were most assured of administration support when an error was reported whereas nurses were least likely to see the administration as being supportive ($p < 0.001$), and were more afraid of the negative consequences associated with reporting of medication errors ($p = 0.026$). Although nurses were generally less likely to perceive themselves as being able to communicate freely regarding reporting of errors compared to pharmacists there was no significant difference between the two groups. Both however were significantly different from physicians ($p< 0.001$). Physicians had the most favorable response to perceiving new technology as helping to create a safer environment for patients and to the full utilization of such technologies within the institution in order to help prevent medical errors.

Scenario response - Responses to two scenarios outlining possible consequences, should a staff member commit a medication error, tended to be very similar among the three groups and followed the same general trend in which the later the error was discovered and the more grievous the patient harm, the more severe would be the consequences to the staff member. Interestingly, physicians saw themselves as less likely to suffer consequences and nurses saw themselves as more likely to suffer consequences should they have committed a medication error. All three groups were more likely to see themselves as facing dismissal from their job if the patient were to die.

RESULTS OF ALL THREE OBSERVATIONS:

Result of Nursing observations: For 1124 doses studied, 194 resulted in some form of error. The error rate was 17.2% and the accuracy was 82.8%. The commonest errors in a descending order were: wrong time, wrong drug, omission, wrong strength/ dose, wrong route, wrong instruction and wrong technique. No wrong drug form was actually administered in the observational period. These were the total number of errors observed for the entire month period of the study.

Result of Pharmacist observations: A total of 2472 doses were observed during the one month period. Observations were done for 3 hours per day each day that the study was carried out. The study showed that there were 118 errors detected which were in the following categories respectively: 52 no instructions, 28 wrong drug/unordered, 21 wrong strength/dose, ignored/omission 13, shortage of medication 3 and expired date 1.

Result of Prescribers in Chart review for drug-drug interactions: The analysis of the drug-drug interactions showed that out of a total of 1000 prescriptions, 124 had drug-drug interactions. None were found to fall into the highest severity rating i.e. 4 (contraindicated). Only twenty-one interactions were rated 3 (major), 87 interactions were rated moderate and 15 interactions were rated minor according the modified Micromedex scale.

Patient education: All health care such as physician, pharmacist, and nurses have a responsibility to educate patient about their medication use and their health conditions to protecting them from any error can occur by wrong using drugs.

Conclusion This study has contributed to the field of medication errors by providing data for a Middle Eastern country for the very first time. The views and opinions of the nurses, pharmacists and physicians should be considered to enhance the systems to minimize any errors in the future.

Key word: Prescriber- Pharmacist- Nurse- Prescription- Patient- Medication- Potential- Cause- Medication errors- Physician.

Dedication

I would like to thank my god (Allah). I dedicate this thesis to every part of my family, especially my lovely parents, my brothers, my wife and my children who supported me throughout all the time it has taken to complete my thesis. In addition, I would special need to thank the people who really deserve both the love and respect for helping me in my work by their advice, Prof. Robert Naylor and through my supervisor Dr. Ian Naylor. This thesis is also dedicated to only those who believe in the richness of learning.

Acknowledgements

Firstly, I would like to thank Allah (God) for giving me the health and the patients to complete my thesis. Then I need also to thanks my Supervisors Professor Robert Naylor and Dr. Ian Naylor, for their help and consistent support during the preparation of this thesis. Secondly, I appreciate my immediate family, my father and mother who were always there to encourage me to continue my PhD. Thirdly, I also need to thank my colleagues for their co-operation with me and I would especially like to thank my direct manager, Brigadier Dr Zohair, who allowed me to carry out my research in the Armed Force Hospital, Kuwait.

Finally, I would like to acknowledge all the health care professionals in this hospital for their kind contributions to my study, as without their help this thesis would have been impossible.

Table of Contents

page

CHAPTER ONE

CHAPTER TWO

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

CHAPTER SIX

CHAPTER SEVEN

CHAPTER EIGHT

CHAPTER NINE

List of figures

List of Tables.

Abbreviations used in this thesis

ADEs	Adverse drug events
AFH	Armed Force Hospital
AHAHR	American Hospital Association Health Research
AMA	American Pharmaceutical Association
APTT	Activated partial thromboplastin time
BCMA	Bar-Coded Medication administration
BP	Blood pressure
CCU	Coronary Care Unit
CPOE	Computerized physician order entry
D/C	Discharge / discontinue
DOT	Deodorized tincture of iodine
ENT	Ear, nose and throat department
ECG	Electrocardiogram
ED	Emergency department
EMARs	Electronic medication administration records
FDA	Food and drug administration
G.I	Gastroenterology
H MG- COA	hydro methyl glutamyl-Coenzyme A reductase
HS	Bed time
ICU	Intensive Care Unit
IM	Intramuscular
ISMP	Institute for Safe medication practices
IV	Intravenous
JACHO	Joint Commission on the Accreditation of Healthcare Organization
MAR	Medication administration record
MER	Medication reporting errors
MERP	Medication Errors Reporting Programme
MIME	Mitoguazone, ifosfamide and methotrexate
MINE	Etopside, mesna, ifosamide and mitoxntrone
NCCMERP	National Coordinating Council for Medication Error Reporting and Prevention.
NCGNP	National Conference of Gerontological Nurses Practitioners
NIOSH	National Institute for Occupational Safety and Health
NPO	nothing by mouth
PILs	Patient Information Leaflets
QD	One/once daily
QID	Four times daily
SPSSV12	Statistical Package for Social sciences
TID	Three times daily
U	Unit
USP	United State Pharmacopoeia

Chapter One

1.1 General introduction

All men are liable to error; and most men are, in many points, by passion or interest, under temptation to it.

(Source -John Locke (1632-1704) - An essay concerning Human Understanding)

A research project to investigate the occurrence and types of hospital medication errors is from the very beginning fraught with many theoretical problems and actual practical difficulties. Alexis Carrel in his book '*Man the unknown'* wrote that 'because something is difficult it does not mean it should not be attempted'. This thesis was conducted in the light of this Nobel prize winner's suggestion and it did in the end prove to be both extremely difficult but also rewarding as the findings below will hopefully illustrate.

It is worthwhile to consider very briefly one of the major problems of this type of study as it is unlike many other areas of science because if somebody makes a medication error then this has potentially serious implications for the individual, the organisation and of course the patient. The problems themselves are not always the same as some errors may cause a range of reversible problems whereas others produce permanent effects and some even cause the death of the patient. Consequently, a study to find out what errors are actually occurring causes people at all levels of the healthcare system to be very 'cautious' about their behaviour, co-operation and comments.

Another aspect is that no system likes to be seen to have problems associated with it as this reflects poorly of the organisation and management of the system. They feel, perhaps very reasonably, that if such problems are highlighted then the patients will lose faith in the system and these causes serious problems for the authorities who 'run' the system. The concept that it is important to know what errors are actually occurring so that steps can be taken to reduce them is still considered by many people to be too threatening rather than informative. In this thesis several ways were developed to try and minimise the perceived 'threat' to individuals so that accurate data was obtained which could be used to formulate a better and safer system.

Another difficulty was that the literature about actual original studies as compared with many other areas of Pharmacy is somewhat limited. Whilst it is true there are a range of textbooks available all of these seem consider the few primary studies in a review style rather than adding to the fundamental knowledge base about such problems. This thesis is different, as whilst considering the primary and secondary literature it also adds some fundamental findings to the subject areas carried out 'in the field' in a large hospital in Kuwait. This is very unusual and is perhaps the first time such a study has been carried out in an Arabic country as no published study exists.

Against this background it has been a major challenge to investigate the problems of medication errors in a system where such a study has not been previously carried out. Very fortunately there was superb co-operation from all levels of the staff of the hospital and this has resulted in data which is both original and informative. The chapters which follow will I hope enable the reader to understand the breadth of the problem, the hospital in which the study was undertaken, the methods which were used to obtain the data – some overt and some by necessity covert and the major findings which were made. It is hoped this thesis has made an original contribution to the subject area of 'medication errors'.

1.2 Background information on Kuwait.

In the West little seems to be known of Kuwait, its structure and organization, and so in order to help the reader put the pharmaceutical considerations described in this thesis into some sort of perspective this chapter will consider the type of society found in Kuwait in terms of a very brief history, population, educational system, health care system, types of hospitals with especial reference to the Armed Forces Hospital (AFA) where this study was carried out.

a) History

Kuwait's modern history began in the early 18th century, when several clans from the Al Aniza tribe migrated to the northern shore of the Gulf from the Najd, their famine-stricken homeland in central Arabia. These settlers combined to create an oligarchical merchant principality, whose economic prosperity was based on fishing, pearling and trade. Eventually the Al Sabah emerged as the dominant clan, and they were formally established as rulers in 1756. Before the 17th century Kuwait was known as "Qurain" which means 'hill' or "Kout" meaning 'fort.' In 17th Century maps it is called "Kuwait" meaning 'little fort.'

One hundred and forty years later under an 1899 agreement with Great Britain, whilst Kuwait maintained control over its internal affairs, Great Britain assumed responsibility for the country's security and foreign relations. The British also provided advisers to staff the country's nascent modern bureaucracy. Another British legacy is the present borders of

Kuwait which were established in 1922 and 1923. Iraq affirmed its border with Kuwait in its 1932 application to the League of Nations for membership as an independent state.

On June 19th, 1961 Kuwait gained full independence from Britain. Iraq initially refused to accept Kuwait's independence and threatened to annex its neighbour, falsely alleging that Kuwait had once been part of Iraq. Iraq's military threats resulted in a deployment of British troops, which were soon replaced by an Arab League force, and the crisis subsided. In 1963 Kuwait became a member of the United Nations and later that year Iraq agreed to abandon its threats and recognize Kuwait's independence and borders in a treaty signed by both governments, although there were border clashes later in 1973. Today Kuwait is officially known as the State of Kuwait

. **b) Geography-** Kuwait is a small state located in the north-western corner of the Arabian or Persian, Gulf-referred to hereafter simply as "the Gulf". The country covers an area of approximately 17,818 sq kilometres (6,880 sq. miles). At its widest points, Kuwait is 200 kilometres (124 miles) from north to south and 170 kilometres (106 miles) from east to west. The country's most prominent geographical feature is Kuwait Bay, a large natural inlet that extends 40 km into the mainland. Shaped roughly like a triangle, Kuwait shares borders with Iraq in the north and northwest and Saudi Arabia in the south and southwest; the Gulf bounds Kuwait on the east.

Figure 1: Map of Kuwait showing the major population centres, mountains and its borders with adjacent states. (Taken from Lonely Planet Guide, 2007)

Offshore of the country but still in the country's territorial waters are nine islands which are called: Warbah, Bubiyan, Maskan, Failaka, Awhah, Umm Al-Naml, Kubbar, Qaruh, and Umm Al-Maradim.

c) Topography - Most of Kuwait is made up of a flat sandy desert. Although there are no rivers or mountains, the sandy soil gradually slopes to sea level where coastal marshes, mud flats and salt depressions exist around the northern part of Kuwait

d) Climate - Located between the latitudes 28.45' and 30.05' north and between longitudes 46.30' and 48.30' east, Kuwait is in the desert zone of the Sahara geographical region. The summers are intensely hot and dry, with daily average highs ranging from 42°C to 46°C (108°F-115°F) and occasionally reaching over 50ºC (125ºF) in the shade. The highest ever recorded temperature was 51.5°C (125°F). The summers are long, lasting from late May until early October.

e) The People - The people of Kuwait are widely referred to as peace loving and generous. Although diverse in their make-up, Kuwaitis are strongly united as one entity and form a definite national grouping. Their principal activities revolve around family life, which is the building block and centerpiece of Kuwaiti society.

f) Language - The official language of Kuwait is Arabic. All members of the government are required to have a working knowledge of Arabic in order to be eligible for the post. English is also widely spoken and is the country's official second language. It is the language commonly used in the business, banking, investment and academic communities. English is widely used within all levels of the educational system. Consequently, currently English is taught alongside Arabic in both public and private schools, from elementary school through to the university level.

g) Population - On June 30, 1999 the Public Authority of Civil Information reported that the total population of Kuwait was approximately 2,274,000, of which 798,200 were Kuwaiti citizens. A very recent population census held on the 1st July 2008 found that there are now 1, 200,000 Kuwaiti citizens.

h) **Education -** In 1993 Kuwait's population was highly educated, both in comparison to other states in the region and in comparison to its pre-oil education levels. The impressive education system was brought about by a conscious government decision, made possible by revenues from oil that began in the 1950s, to invest heavily in human resources and until now it is the priority of the government is education. This is freely available for all Kuwaitis and has ensured a very high level of educational attainments.

1.3 Health care system of Kuwait.

Against this country background it is now important to consider how the health care systems are structured in Kuwait, so that the structure of the organizational systems currently in place and the pharmaceutical systems which operate can be seen in context.

As in many other countries health care is provided by both hospitals and clinics in the community. Kuwait has one of the most comprehensive health care systems and one of the most all-encompassing social service systems in the world. Although the origins of a modern system of health care in Kuwait can be traced back to the first years of the twentieth century, it was not until the 1950s that the government introduced an extensive health care programme, in which all medical services, and even veterinary medicine for livestock, became free to the entire population. The precursor to this remarkable movement was the dramatic increase in Kuwait's development after oil revenues brought wealth to the country in the 1940s. Kuwait has continued to experience a gradual and steady growth in the fields of medicine and welfare. However, in order to fully grasp the extent of the country's expansion, a brief history of health care in Kuwait may be useful for the reader of this thesis.

1.4 A Brief History of the Health Care System.

The first medical clinic in Kuwait was established by a group of doctors from the Arabian Mission of the Dutch Reformed Church in the United States, upon the request of the Amir Sheik Mubarak Al-Sabah. The group organized a hospital for men by 1911, and followed this project with a small hospital for women in 1919. In 1934, the Olcott Memorial Hospital opened to the public. In 1949, after the government began receiving oil revenues, the government took the first step to expand the health care system by opening the Amiri Hospital, still one of the leading hospitals in Kuwait. In the 1950s, socialized medicine was introduced for all Kuwaiti nationals, paid for by increasing oil revenues; expenditures on health ranked third in the national budget.

After this consideration of the system it is now appropriate to consider the hospital system in more detail.

1. 5 Hospital names and distribution in Kuwait.

Kuwait is divided into five health regions, with one main government-run hospitals in each: the Amiri Hospital is in Kuwait City (see Figure 1), the Jahra Hospitalis in Jahra, the Farwaniyah Hospital in the Farwaniyah, Mubarak Al-Kabir Hospital in Jabriya, and Adan Hospital in Fahaheel and Military Hospital. Each hospital provides full outpatient services and 24-hour emergency services for both Kuwaitis and expatriates. Other hospitals can be found in Kuwait, including specialist hospitals covering chest and heart diseases, neuro-surgery, pediatrics, radiology, and many more. In addition to the hospitals provided for the civilian population some others exist such as Kuwait Military Hospital (KMH) which specifically provides for the needs of persons who are in the armed forces. Furthermore, private and public dental services are available and there are about a hundred medical clinics which serve each area. Private clinics and hospitals are also available in Kuwait, although these are not free of charge. The government monitors and regulates standards and fees in these private clinics. However, some private clinics have limited facilities and specialists, and often patients are referred to government hospitals for special procedures.

1.6 Background of Armed Forces Hospital (AFH).

The Ministry of Defence in Kuwait has a policy for the provision of health care services to its military and civilian personnel. These services were identified and include preventive, treatment and rehabilitation services to the above mentioned personnel. The AFH became the focal point for the provision of these services and was thus developed as "crowning point for the policies of the Ministry of Defense". This healthcare facility has therefore been designed to provide healthcare services of the highest quality comparable to those offered by the most modern health centers in the Middle East region. The hospital was inaugurated on the 27th of February, 1990.

The Ministry of Defence has thus committed to raising the health standards of those under its care and has allotted the necessary funds and supplies to equip this hospital with the latest medical equipment and technology. It has also recruited a highly qualified medical and technical staff from among Kuwaiti nationals and expatriates with the aim of ensuring the availability of the most up-to-date diagnostic procedures and treatment for the patient.

The Armed Forces Hospital is a 250-bed institution that employs 400 nurses and 200 doctors in addition to other professional, technical and support staff. Each floor has both general and private rooms. The staff levels reflect the intensity and provision for the organization within the hospital. In order for the reader to understand how the system actually works, because this is central to the thesis, more details will be given as to structures and personnel involved in the system.

The administration is headed by military personnel led by a direct manager who holds the rank of brigadier and who is also a qualified doctor. Under him then comes the hospital manger who has the rank of colonel. He is always a doctor and under him comes the assistant manager which he has rank colonel, who is not a doctor. Then under him comes the assistant technician manger who is 'connected' and responsible for all the doctors and technicians in the hospital.

The hospital management always has focused on the idea and necessity of 'the team'. Based on the proposals made by Management consultants organizational restructuring so as to encourage work and so motivate the health care professionals which in term would promote a good provision of all the health services to the patients and can minimize medication errors has also been carried out.

1.7 Introduction of the Armed Forces Hospital.

In any complex process there are always a number of stages involved which have to be integrated together in order that the process is both safe and successful. Many examples exist of complex processes for example, airlines, industrial processing, chemical plants, oil refineries and shipping. All of these require people to have a knowledge base, capable of being able to interact together as a team so that the end result is both safe and predictable. Examples of complex teamwork include a safe and success flight or fractionation of crude oil both of which are usually achieved in a safe and predictable way. Another complex process for which little data exists is the safe and effective supply and use of drug.

It is the purpose of this thesis to investigate in a large hospital, the AFH, in Kuwait the scale of the problem of errors which may exist in the stages of prescribing, dispensing and administration of the drugs in the hospital. It is of course necessary for the reader of this thesis to have a detailed understanding of this hospital and the health care system as it is currently practiced in Kuwait. The next section which follows will hopefully achieve such a purpose.

1.8 Description of the Armed Forces Hospital.

The AFH is located in Kuwait city in an area called Sabhan A large, relatively newly built hospital is under the organization and control of the Kuwait Ministry of Defence. It is responsible for the provision of the health care to all members of the armed force and their civilian dependents.

The hospital provides a large and diverse number of services which is perhaps only to be expected in a modern, large and newly built facility. The hospital opened as on the 27th February, 1990 and has been up to date ever since. There are services which deal with preventive medicine and those that provide both medical and surgical treatment and those that facilitate the rehabilitation of an individual after their medical and surgical treatment. The services provided by the hospital have been called the crowning point for the policies of the Ministry of Defence as the services it provides are the very highest quality and compare most favorably to any of the other modern health care systems in countries throughout the Middle East region.

Throughout the last eighteen years the Ministry of Defence has been absolutely committed to a consistent drive to always ensure that the health standards this hospital provides are of the very highest quality. To do this requires a great commitment of financial resources so that both the equipment and staff are of the highest quality and standard. It is true that even with the provision of all the most recent equipment their successful use still requires an educated and able work force and so it is appropriate to now consider the staff in some detail.

1.9 Staffing of the AFH.

The AFH is a 250 bed institution which currently employs approximately 400 nurses a number which is always increasing and 200 physicians. There are of course an appropriate number of other health care professionals, included in which are pharmacists- plus their technical and support staff. The staff levels reflect the organization within the hospital Now that the staffing structure has been described, a more comprehensive description if the hospital is both useful and informative so that the material which follows especially the use of medicine can be seen in the overall perspective.

The hospital is divided in to surgical and medical specialties, the first one to consider in the department general surgery and specialist surgery. This is a very large unit and carries out a large volume of work. This division undertakes surgery for its own section of general surgery and also specialized surgery for example in the area of vascular surgery, neurological and endocrine more highly specialized facilities exist for new surgery and uro-surgery. Specialized dedicated services which are also available for the treatment of burns patients and other wards are dedicated to those requiring plastic surgery. These last two of course have their own unique problem in terms of medicine use and the use of highly specialized equipments. In summary this large section of the hospital provides a comprehensive service, requires many medicines for its successful achievements.

Another large section of the hospital is the one which deal with internal medicine. As perhaps would be expected, the department is subdivided into sections which deal with - cardiology, dermatology, diabetes, gastroenterology, immunology, endocrinology, psychiatry, pediatrics, rheumatology and venereal disease. All these sections are well provided for in terms of facilities and staffing

1.10 Departments of Armed Forces Hospital where this study was to be performed.

The hospital includes several departments that constitute the various medical and technical specialties currently these departments are as follows:

A. General surgery department and the specialized sub- units comprises of 1. urosurgery, 2. burns and plastic surgery and 3. neurosurgery

Others departments then include:

B. Orthopaedic surgery department

C. ENT department

D. Ophthalmology

E. Internal medicine disease department

F. Pulmonology unit

G. Gastroenterology and G.I. Endoscope unit

H. Endocrinology and diabetes unit

I. Neurology unit

J. Psychiatry department

K. Dental department

L. Accident and emergency department.

M. Nuclear medicinal department

The hospital has a number of Technical sections which includes:

- Nursing department
- Radiology
- Laboratory
- Pharmacy Department
- Physiotherapy department
- Medical Records

Other Sections include:

- Mosque
- Medical Records
- Library and Audio-visual Aids
- Seminar Centre
- Nutrition and Hotel Services department
- Engineering & Technical. Section
- Studio
- Central sterile supply department(CSS)
- Medical Stores

1.10.1. Department Of General Surgery and Specialized Surgery:

Now the overall organizational structure has been described a more comprehensive description of the hospital now follows as it is both useful and informative especially so that the use of medicines can be seen in the overall perspective.

The hospital is divided into surgical and medical specialties, the first one is consider in the department general surgery and specialist surgery. This is a very large unit and carries out a large volume of work.

This division undertakes surgery for its own sections of general surgery, and also specialized surgery for example in the area of vascular surgery, neurological and endocrine more highly specialized facilities exist for new surgery and uro-surgery. Specialized dedicated areas exist for the treatment of burns patients and other wards are dedicated to those requiring plastic surgery. These last two areas of course have their own unique problem in terms of medicines used and the use of highly specialized equipment. In summary this large section of the hospital provides a comprehensive service, requires many medicines for its successful achievements.

Another large section of the hospital is the one which deals with internal medicine. As perhaps would be expected the department is subdivided in to sections which deal with - cardiology, dermatology, diabetes, gastroenterology, immunology, endocrinology, psychiatry, pediatrics, rheumatology and venereal disease. All these sections are well provided for in terms of equipment to aid diagnosis, Imaging and treatment of all the disease requires specialty equipment. There are in this section two specialized laboratories which are solely dedicated for a) pulmonary function tests and b) homological testing procedures. The cardiology section also has a very highly specialized coronary care unit; the gastroenterology section also has facilities for endoscopy examination. And to show the present breadth of cases the cardiology unit treats it may be useful to provide a full description of this unit as being representative of all of the divisions of the internal medicine division.

1.10.2. Internal Med: Diseases Department

This Department has a highly qualified medical and technical staff of specialists in the various branches of Internal Medicine. Moreover, it is supplied with the latest medical equipment and technologies to raise the standard of diagnosis and treatment. There are two labs in this department. One is for the pulmonary function tests and the other for neurology. There is also a unit for gastroenterology and G.I endoscopy. The cardiology department is provided with the most modern medical equipment especially so in the coronary care unit.

In addition to the above mentioned, the department has other specialties such as Dermatology, Venereal Diseases, Rheumatology, Immunology, Psychiatry Pediatrics Clinic, Diabetes and Endocrinology.

1.10.3. Cardiology Unit

This section includes the most advanced investigation techniques for diagnosis and treatment of different cardiac diseases using both non-invasive and invasive techniques.

Firstly: non-invasive technique**.** In addition to resting electrocardiogram, there are:

1. a. Holter monitors 24 hrs ECG recording.

   b. Delmar Holter monitor ECG analyzer and recorder.

   c. Oxford Holter monitor ECG analyzer and recorder.

2. For the analysis of either congenital or acquired diseases. Condition Treadmill exercise test machine: Connected to its monitor, multiple channels to evaluate chest pain with the help of nuclear medicine Thallium, stress test and gated blood pool tests can be also done.

3. Echo cardiogram: Used for evaluation of ventricular functions and pressures order is investigate any other cardiac organic abnormalities

Secondly invasive techniques: For measuring cardiac output and cardiac pressures.

1.10.4. Coronary Care Unit (CCU)

This section is provided with the most advanced or in some cases up dated machines for use in intensive care of different cardiac diseases and their complications. This includes four separate rooms provided with bedside monitor for measuring cardiac rhythm, blood pressure and venous pressure for each patient. All these four beds are connected with central station outside the rooms. Also there is external & internal temporary pacemaker. Additionally, there is telemetry system present in the ward linked to the monitors in central station of the CCU

1.10.5. Anaesthesia:

Another very special area and one which uses large volumes of very specialized drug is the anaesthetics department. This of course is essential for any type of surgery and so the personnel interact with many other personnel in the hospital.

- The anesthetics section in the AFH is characterized by the following available systems.
- Highly equipped induction room for every operating theatre with the following qualities.
- Achievement of three professional levels for each patient.

Highly sophisticate monitoring system for each patient with fully automated printout recording all he vital signs timed with full alarm conditions all through operation.

- Computerized Anesthesia Information System (CAIS) transferring data from all operating rooms while occurring to a central screen in the consultant anesthesiologist office allowing for ‘ in time’ consultation through the keyboard.
- Two highly equipped recovery areas for five transport trolleys under separate anesthetic supervision.

1.10.6. Intensive Care Unit -Another area extensively using medicines is the intensive care unit (ICU) In the AFH there are four single bedded rooms, these rooms are equipped with**.**

- The most up-to-date equipment and sophisticated patient monitoring system ready to accept critical cases from all specialties.
- In addition to the two main follow up central stations, each peripheral bedside UN acts in the same time as central station for all other beds.
- Panoramic viewing windows to allow visitors to communicate with patients without actually having direct contact so as to reduce the potential risk of spreading infections

1.10.7. Dental Department

This Department consists of six clinics to admit and treat patients as well as a Dental Laboratory for the manufacture of prosthetic devices. Sometimes for cases need long treatment they will be referred from casualty physician to the dental clinic for examination these cases ensure and promote a good services for the patients, Then give appointment for these patients to return back for follow the treatments.

Alongside the other auxiliary services. Through the qualified Cadre, the Department puts forward instructive services such as filling, major oral and Maxillo-Facial surgeries, e.g. the orthogenetic and maxillofacial traumatology, oral oncology and T.M.J. problems.

The Dental Lab. produces and constructs Acrylic and Chromcobalt removable, partial and full dentures In addition the Crown and bridge Department has equipment to provide more specialized extra-oral panoramic and cephalometric views. There is also a specialized clinic for periodontal conditions and diseases affiliated to this Department.

Just to show the reader the range of activity of this one department. The Dental Department has the following regular clinics:

1. **Examination and Diagnosis Clinic:** the casualty clinic is examine the patient condition if it required surgery or root canal then casualty dentist will transfer the patient, to diagnosed from one of the specialist doctor.

2. **Oral Hygiene Clinic:** it is used for cleaning and hygienically removing either teeth or plaque/tartar.

3. **Oral and Maxillo-Facial Surgery:** can be used for both oral and face surgery.

4. **Prosthetics Clinic**: this specialty deals with reconstruction of destroyed and missing teeth to rehabilitate patient back to normal life for cosmetic and function reasons.

5. **Endodontic clinic:** it is treatment for keeping the teeth for as long as is possible. It consists of different treatment of the decayed teeth when the caries reach the pulp of the teeth. What are they?

a) Pupectomy: Removal of the pulp tissue from teeth.

b) Instrumentation and shaping the canals.

c) Obsturatation: Filling the dental canal by gutta percha.

d) The final filling of the tooth either amalgam filling or full crown coverage.

6. **Peridontics:** it the field of studying the gum in relation of diagnosis and treatment of the diseases of the gingival. This specialty divided to three sections:

a) Resection: Getting rid of the necrotic and disease soft and hard tissue.

b) Regeneratic: it used to replace the missing soft and hard tissues.

c) Plastic**:** it is cosmetic and esthetic of gum and oral cavity.

Some specialized laboratories exist which enable the correct environment for the clinics these are:

7. Dental Laboratory:

It is lab that receive cases from orthodontic and prostheticdontics departments to fabricate different dental appliances.

8. Radiology room:

It is used to check the dental problems.

9. Sterilization room: It is used for sterilizations equipment finished from clinics.

10. Officer dental clinic which serve the military officer only.

All These clinics are providing services for patient for five days per week. A special case of dentistry is related the ministry defense nature of the hospital

1.10.8. Dental casualty:

This clinic provides service for military personnel and National Guard and civil personnel for seven days per week intended to offer an immediate pain relief service and for treatment long cases such as root canal or surgical cases, casualty physician will transfer these cases to the clinic doctor for giving his opinion. Then comes a nursing department details of which are given below.

1.10.9. Nursing & Nursing personnel.

It goes without saying that the nursing staff has an absolutely vital role to play in the functioning of a hospital and the AFH is no exception to this statement. In recognition of this the Ministry of Defence gives nursing and nursing personnel special consideration and in some cases provides as a motivating stimulus of a financial bonus on top of their normal salary as they carry out their duties in a competent and safe way. The AFH has over 400 male and female nurses who are all highly qualified in all the specialties the hospital offers. The range of duties includes those from the conventional clinical procedures such as measuring blood pressure- body temperature - blood sugar - heart rate to administering drugs which have been prescribed using a unit dose system for the patients. Many times the quality of the nurses is reflected by patients comparing them to “angels” a nice complement for their nursing skills.

1.10.10. Radiology (X-Ray Department)

The Radiology Department in the Armed forces Hospital illustrates a wide variety of the most advanced and highly sophisticated equipment which cover the needs of different specialized department For example: CT-Scanning examination including a spinal scanning and CT and angiography

MRI unit; the currently two MRI scanner are able to perform large number of examination. Mucous skeletal, neurological and body imaging and there is another MRI scanner on currently there is another scanner being installed.

BMD (bone mineral densitometry) this unit serves large number of patients with condition such as osteoporosis, determines their bone condition, and shows the risk of having fracture for osteoporosis patient.

Mammography; this unit provides service for breast imaging.

PACS (patient archive – communication system).This allows the doctors to view and manipulate patient’s image, as well as for archiving purposes.

a) **Ultrasonography**: It is study of different body structure with ultrasound waves and it is can be used to diagnosis pathology or disease in abdominal in the small part of the body for example, study of the Thyroid and Testis.

b) **Angiography:** It is used for examination of vessels with I.V contrast to look for pathology in the vessels.

c) **Fluoroscopy:** In the fluoroscopy the x-ray are used to do dynamic study for example (Barium study)

d) **Tomography:** In tomography x-ray are used to take section of the body part at different level such as (Kidney in I.V.U examination).

The department also has X-Ray machines for routine radiological examination and emergencies and Portable X-Ray machines serving both in wards and operating theaters used as mobile machines.

1.10.11. Nuclear Medicine Department

The Nuclear Medicine Department in the Armed Forces Hospital is well equipped to receive and use various radiopharmaceuticals for medical use. The department has the best digital gamma camera systems available in the world, linked with modern and powerful computers capable of doing quick and efficient data acquisition and processing. Radiopharmaceuticals are used for medical imaging – where Radiopharmaceuticals concentrate in the patient's body, in an organ of concern, and emit X rays captured by gamma camera and provide images of tissue deposition.

The department is able to conduct all Nuclear Medicine diagnostic and therapeutic procedures as well as providing modern research facilities.

1.10.12. Medical treatment;

Radiopharmaceuticals can also be used to concentrate an isotope in the disease organ/tissue and so destroy the disease tissue. Radiopharmaceuticals which are used include: Technetium - 99m , Thalluim-201 , Galluim-67 and Iodine-131

Diagnostic studies in the nuclear medicine; department are used for detecting a variety of conditions.

1- Bone and venous infections and Detecting tumors and Detecting heart and kidneys and glands function efficiency. Detecting bone fractures. Detecting brain death in a patient

The department has contributed significantly in raising the standard of medical services to all the personnel of the Armed Force

1.10.13. Laboratory department - Units & Activities:

This department has many component parts and carries out many activities. It provides a full histopathology services with all the functions that involves.

These include especially the field of histopathology, Immunology and Blood Banking. Meanwhile the other pre-existing units Military Hospital Laboratories comprise several specialized units. Some of these units were not available until recently and have been broadly prepared and supplied with recent and advanced technology as well. The aim is to present an ideal service to all patients and Military personal. The following is a brief of the laboratory units & activities.

Haematology: this is divided into the type of tests carried out which include - Coagulation profile- FDP-seclell-CBC-ESR- electrophoresis)

Hematology Laboratory: It is study for human blood component (disease) the component which consist four main type of component :(CBC-RBC, WBC-hemoglobin-platelets) it provides a full Hematology Unit for the diagnosis and to verify treatment for a full range of conditions.

The Biochemistry Unit: It is supplied with a group of advanced Automated and computerizes equipments. The unit is subdivided into specialized **Sub -units:** a) General Chemistry and laboratory b) Special Chemistry Lab.

3. Microbiology Unit: Comprises several specialized sub-unit:

a) Bacteriology Lab: it is studies of pathogenic bacterial which perform two main tests are identification test type to check of micro-organisms and antibiotic sensitive test to treat this disease.

b) Parasitological Lab: it is studies of pathogenic parasites which perform one test are identification test type to check of parasites.

c) Serology: it is study to find out the cause of the infection of pathogenic type by using the blood serum through anti-body antigen reaction.

d) Immunology: it is study for human to find immune system immunity.

e)Fluorescent Study Lab: it is test to check anti-body and antigen reaction by fluorescent which include pathogenic micro-organisms or immune type.

4. **Histopathology Unit**:

5. **Blood Bank** unit: it is used for different cases if patient donate or need some blood from the blood bank for any emergency. The unit carries cross matching tests and all transfusion services. It is equipped with an aphaeresis system.

6. **Duty Lab**: the role of the lab can receive all tests which are transfer from different department and to give all result for all departments of the hospital.

7. **Lab. Reception**, Sampling, Sample preparation and out-patient Laboratory Unit.

1.10.14. Department Of Physiotherapy: After the complexities of the surgical, medical and diagnostic departments it is now appropriate to consider a department which provides a vital postoperative function – namely the physiotherapy department.

The Physiotherapy department at the AFH is one of the largest of its kind. Its building occupies a large part of the total hospital area and is divided into four main sections: The first is for children, the second for females, the third for males and the fourth is for VIPs.

The Ministry of Defence has provided this department with both specialized Kuwaiti and non-Kuwaiti professional staff to ensure a high standard of its medical services. This department is also equipped with the most modern equipment which makes it one of the modern centers of its kind in the world.

The methods of treatment used in the Physiotherapy Department.

These are numerous and include patients suffering from diseases of the circulatory system, respiratory, nervous and motor systems, as well as the treatment of military injuries and during physical training. They can also transfer cases from an orthopedic specialist by request written all detail of patient and diagnose to promote right treatment and there is a separated section for the treatment of female which has more than ten qualified technicians and two physiotherapy specialist this promotes all health care services.

The methods used by the physiotherapy department include:

1. Hydrotherapy: it is used of water to treat patients suffering from musculoskeletal problems for which the technician uses hydrotherapy and also can used the pressure of water and water buoyancy techniques to treat such conditions.

2. Heat therapy: this is divided in to two types of heat - dry and moist. They are used for the treatment of muscle skeletal problems for example, low back pain and arthritis.

3. Electrotherapy: uses electricity to either decrease pain or to stimulate muscles. There are three different frequencies used , low - for muscle stimulation, middle - for analgesia such as TEMS and the high - for local production of heat.

4. Mechanotherapy: this uses machines which exercise the patient usually who has musculoskeletal disease such as post of fracture or post operative orthopedic surgery to facilitate rehabilitation therapy.

5. Occupational therapy: is used to improve a patient's ability to function, according to their ability; so as to train them to be able to cope with the activities of daily life.

In addition, work is currently under way for establishing a method of treatment with laser therapy.

1.10.15. The department of dermatology: Another department which for the purpose of this thesis will only be briefly mentioned is the dermatology department. This department has five major sections these are:

1- **Photo therapy unit:** It is used as treatment for vitiligo, psoriasis and other types of dermatitis. There are 3 different types of photo-therapy, namely: A)UVA , B) UVB-Narrow band and C) UVB for various skin diseases.

A. UVA uses ultra violet A: it can be used either alone or combination with psoriasis tablets for treatment of patients and the duration of treatment are various for each patient depend of the patient condition and severity of the disease.

B).UVB- Narrow band UVB: they are used for various skin diseases such as psoriasis

C) Ultra Violet B rays used for atopic dermatitis .

The duration of treatment for each patient are complex and depend on the patients condition and severity of the disease.

2- **Laser Unit:** This unit is divided into three different sections, namely;

a) Excimer laser: is used for treatment patient with localized forms of psoriasis.

b) Pulse dye laser: it is used for various vascular lesions in the skin for example telangiectasias, hemangioms and naevi.

c) ND.YAG: These are types of laser are used for treatment of patients with pigmentation disorder and also for hair removal.

3- **Mycology Unit:** it is used for investigation of various fungal infections such as Tenia Versicolor, Tenia corporis, and dermatophytosis)

4- **Out-patients clinic:** An evening clinic for families is held three times a week. This can serve the army families at evening time if there is a rush time in the morning or sometimes people cannot come in the morning time or a physician has a full schedule. Officer clinics are held three time a week and then only in the morning. Attached to this clinic are procedure rooms for routine treatment such as cryotherapy, electrocauteny, intra-lesional injections. This can serve all patients civilians or army personals with appointments and also the out-patient clinic can accept any emergency condition transfer from the casualty department.

5- **Dermatology inpatient ward:** admitting patients with serious skin disease such as exfoliative dermatitis and also imuno-bullous disorders.

1.10.16. Nutrition and Hotel Services Department

The Armed Forces Hospital offers special services for all patients who are treated in the hospital for all patients, no matter what their type of treatment. Every possible effort is exerted to create good atmosphere that ensures a comfortable stay for all patients.

1.10.17. Accident and emergency department:

The final department in the hospital is that of that of the accident and emergency department. It is subdivided into many branches or sections. It has many rooms for the examination of emergency cases by an emergency doctor. Some rooms are used specifically for the ENT doctor and orthopaedic doctor and one room also for dental emergencies, there is also a specific room for ECG and injections. Two operating theatres for surgical emergencies and for minor cases also exist.

1.10.18. The accident department also contains different type of rooms:

This department has different type of room for different specialist such as, X-ray room for any emergency transfer by a casualty doctor. There is casualty pharmacy to supply medications to the patient written from any doctor and also there is a casualty doctor who will transfer any case into the hospital should that be necessary. The Observation Unit for emergency cases for male and females separately promote a high standard of services and there is newly casualty department for serving the officers and their families. There is also Ambulance Unit for any emergency cases occur which may occur anywhere in any of the military branches.

Pharmacy department

Of central importance to this thesis is the pharmacy department within the Armed Forces hospital. A description of this department now follows which will be followed by more details later in the thesis.

Perhaps a few general comments about the role of the Pharmacist in the Kuwaiti system would be helpful to the reader so that what follows can be put into perspective rather than expect what happens in their country to be necessarily the same as in Kuwait.

The role of the pharmacist in Kuwait is what some people may consider to be the very traditional one in the West of being mainly a dispensing function rather than providing clinical based skills. The concept of an active clinical pharmacist aiding decision on the physicians on the wards to facilitate prescribing and use of medicines so as to achieve optimal medication use simply does not exist at the present time. Since no clinical pharmacy exists at present then the normal pattern experienced in other countries of clinical audits, peer review of prescribing patterns, comprehensive governance systems and so an ability to learn from error reporting cannot take place. There is also a lack of the use of standard operating procedures which would help to try and ensure that as far as the dispensing process is concerned then steps would exist to try and minimize the dispensing errors which could occur. The use of standard operating procedures could also help both the nurse to avoid administration errors and to check the physicians prescribing so as to avoid some of the well known problems encounter in the administration and prescribing of medicines. As this thesis will show, and latter go on to explain, there was at the time this study was carried out, a lack of a computer system which could make some of these functions of clinical pharmacy possible.

Overall the lack of a clinical pharmacy system may reflect both the culture of the ‘system’ as it has developed over the years and the limited availability of pharmacists in Kuwait who are available to work in the hospital system. There is the further complexity that as this is a military hospital then other constraints of recruitment are also in place.

1.10.19 Structure of the Pharmacy department in the AFH:

This department consists of four pharmacies and their role is to be responsible for distributing all types of medicines and pharmaceutical forms for patient from all type of situations ranging from the emergency clinic to ward supply. The pharmacy functions twenty four hours daily through a system of dispensaries which are located in a number of pharmacies.

1. **Central pharmacy.** This is the main pharmacy which is responsible for the departmental management, ordering, storing and distributing medicine to other pharmacies and medical units and for the distribution of all kinds of medicines to CCU and ICU. It supplies medicine to in-patients through ward pharmacists according to a unit dose system. It also functions as a drug information centre. In this central pharmacy is also found the Drug Compounding Laboratories. This unit is responsible for compounding a range of internal and external formulations and also preparing parenteral solutions under sterile conditions according to Kuwait National formulary and other approved pharmacopoeias. There is also a Ward pharmacist; who acts between the doctor and patient ensuring the safety of using the medicine

and potentially reduces the mistakes involved in medication use and also tries to decrease the wastage of medicines.

2. Out-patients Pharmacy. This pharmacy is responsible for daily distribution for out patients who have been transferred from specialized clinics such as: internal medicine a surgical clinic, an ENT clinic, bone clinic or a dental clinic. This pharmacy dispenses medication for one a month at a time so the patient has to return at monthly intervals. This pharmacy contains six pharmacists and six technicians. The latter mainly function to receive prescriptions, give them to pharmacists and also to act as a double check for all dispensed items. This pharmacy operates in the morning only and only on normal working days.

3. Casualty Pharmacy. This pharmacy is responsible for distributing medicines for emergency conditions. This pharmacy has one pharmacist and one technician and operates twenty four hours a day so are able to dispense all prescriptions which are prescribed from casualty doctors whenever the need arises. They only dispense quantities sufficient for a period of three days so that transfer to specialist's doctor for chronic cases such as diabetic or hypertension is facilitated as quickly as possible.

4. Officers' pharmacy. This pharmacy is only responsible for distributing medicines to patients who are military officers.

Hopefully at this stage of the thesis the reader will have an idea of the size and complexity of the AFH. The last section finished with a description of all the types of pharmacy services which are provided and since the topic of this thesis is medication errors it is now thought appropriate to describe in detail how medications are actually prescribed and dispensed. This is the purpose of the next section.

1.11. What is the actual process of getting a medication to the patient?

1.11.1. **Figure 2**. The Process of Obtaining File From Medical Records Department for casualty

File Section

↓

Casualty

↓

If any file is needed in casualty or in emergency or for any admissions in the ward the clerk from medical records department (available 24 hours) will take the file from medical record department.

The process of getting a medication to the patient can be long and involved. It starts with the patient realizing that he or she needs a medication to treat a specific acute complaint such as a cold, flu or infection, or the patient may have a chronic condition such as hypertension, diabetes or angina. Each of these cases needs a different approach in treatment but the prescribing process follows the same steps. At the AFH if the patient attends the casualty department they are first seen by general doctor where he/ she receives a casualty prescription after their consultation and diagnosis by the doctor. The casualty prescription will have details of the patient including the name of patient - sex - rank - unit - occupation - hospital number - diagnosis and signature of the physician. This prescription is only given in the casualty department and only dispensed in the casualty pharmacy. Sometimes if the medication is not available then the patient can receive a prescription from the central pharmacy or out-patient pharmacy. These medications are usually dispensed for a period of only three days. The physician will write a prescription medication for patient for three days only if the patient's condition is not chronic but an acute case. But if the patient has a chronic condition, for example, if the patient has diabetes or hypertension and needs to be admitted to the observation room to try and stabilize in case of someone with hypertension, their blood pressure, or blood sugar in the case of diabetic, then the physician will, because of being unable to control their condition, request the patient be admitted to the correct ward. To do this the physician would have to fill out a form from the record department. Patient files and records are central to this system. It may be useful to describe how the system of records actually works.

To stabilize a patient's blood pressure or blood sugar sometimes needs the physician to admit the patient to the ward. This requires an order for the patient file to be obtained from the record department so as to write all the information – including diagnosis in the file. Sometimes the condition of patient does not necessitate their admission and only needs the physician to give the patient medication for three days. If the patient does improve after three days then the patient will return back to the physician and explain that he/she is not improving and then the physician will transfer the patient to the department of registration of appointments so as to have appointment in the outpatient clinic where a 'specialties unit doctor' would diagnose their condition. In the out-patient clinic the nurse can order the patient file from the records department to be ready for the specialist before they come from their ward round. The specialist then checks the patient and asks them some questions about their condition. If the patient complains about diabetic or hypertension etc. details are recorded as to when the condition started, any family history of the same condition and has any other physician seen your condition. The physician may also want to see if the patient is taking any medication for any past or current chronic condition or to establish a family history of disease. Once the specialist has a complete overview of the patient, then the physician will make his written recommendations for the patient's condition. They will then write the patient a prescription for the appropriate medication(s). The process of dispensing any prescribed medication occurs at the out patients pharmacy.

Patient files and records are central to this system. It may be useful to describe how the system of records actually works.

1.11.2 <u>Figure 3. The Process of Obtaining File From Medical Records Department for an out patient</u>

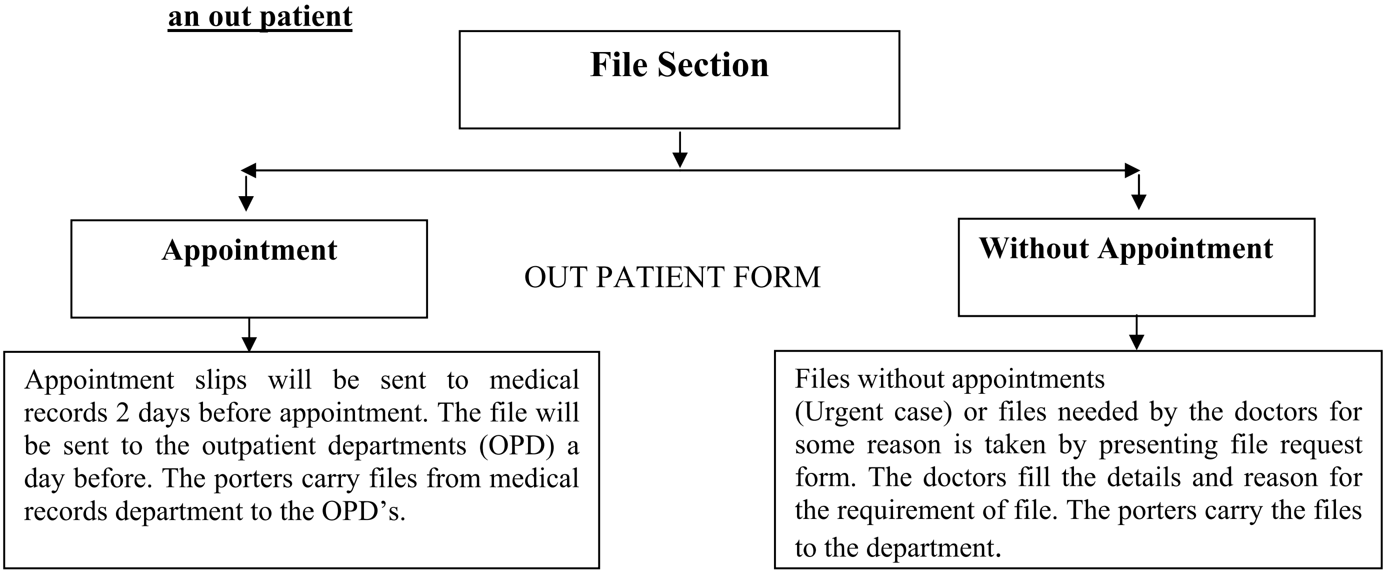


Table (1): The list of patient's appointments

Patient name	
Rank	
File number	
I D number	
Unit	

After this first consultation then the physician may write a prescription for some medication(s) for a period of one month after which the patient must return back to the hospital for follow-up by his specialist. This process has a specific form for use in the outpatient clinic. But if the patient relapses, then, there is another form called ‘urgent form without appointment’. Only physicians have the authority to order the patient file, see figure 3 - outpatient form.

If the patient is not improving after a month, then specialists will try changing one or more medications, or he will increase the dose for patient until the patient responds to the medication and patient is satisfied with his medication.

If the patient still does not respond to the medication then a specialist will admit the patient to the hospital to make full investigations to discover where the problem is (see figure 4 inpatient form). One such problem could be that some patients are simply neglectful and do not follow the instructions on prescribed drugs or advice regarding their health. An example of such a case is for a hypertension patient who must not eat foods rich in salt which can of course increase their blood pressure (BP). Similarly, a patient who is diabetic must not eat any foods high and rich in sugar, which can increase their blood sugar. Such cases must follow the instructions of the specialty physician if they want to optimize their treatment and avoid suffering from any complication of the medication.

1.11.3 Figure 4. The Process of Obtaining File From Medical Records Department for an inpatient

File Section

Inpatients

Files for inpatients are obtained through admission and discharge office during the admission. Adm/Dis office sends the admission slip to medical records department. And then the file will be dispatched to Adm/Dis office,

Patient name	
Rank	
File number	
I D number	
Unit	

Table 2: The list of patient's appointments

1.12 General Introduction

So far, this thesis has been descriptive of the Armed Forces Hospital, its departments with the latter sections having an emphasis on the function of the pharmacy. It can be seen that the hospital is at the leading edge of medical care and compares with any hospital facility in the world. One problem which is faced by all such hospitals is the problem of medication errors which is the topic of this thesis. This universal problem is a major concern to all health care systems whenever they may be and it should be stated that it is a very difficult topic to investigate since reporting errors in a meaningful way is a very recent development. It is true that this recent development has had to overcome very major problems, the biggest one being that nobody likes to admit their system can allow errors to occur.

There is a popular misconception that the topic is one which only attempts to find out who has caused such errors and then punish them. This is simply not the case. The primary purpose of any study about medication errors should not be to simply lay blame on an individual, or ridicule an individual but rather to discover why such errors occurred and how to develop steps to ensure they do not occur again. It should not be a 'witch hunt' for the guilty but rather a constructive and productive exercise for the benefit of the both the staff and the patient – especially the patient. It is against this background this thesis was undertaken.

1.12.1 General background for the topic of Medication Errors.

The aim of any health care organization is to provide a high quality and safe medical service to patients and provide them with medicines that are both effective and safe. Medicines are like a two-edged sword the first edge is that they are a vital element in helping patients to overcome the effects of their condition by perhaps causing relief of the symptoms of their condition, whilst at the same time trying to modify their disease. The other edge to the sword is the potential harm caused by adverse events and medication errors.

No medicine is completely safe, since any medicine may cause adverse drug reactions (ADRs) even when used correctly. These ADRs are defined as non-preventable errors which can and do occur during the medication process (Naylor, 2002). Most health care professionals have learned the "five rights" of safe medication use, these are - the right patient, right dose, right route, right time, and right drug of administration. If the five rights are not implemented together in practice, medication errors will occur (Cohen, 2007). The safety of the patient is the responsibility of all the members of a health care team, for example - physician, pharmacist and nurses. Despite their collective and individual expertise and expectations of quality, medication errors still occur and sometimes cause actual human suffering (Cohen, 2007). However, a remarkable enhancement in patient outcomes is achievable when drugs are used in correct and safe ways and when health care team members cooperate in methodically managing outcomes.

A few words on medication errors may provide a useful introduction to this topic.

1.12.2 Introduction: Definition of a medication error?

Medication errors occur in all countries of the world where they have been studied and are an expected consequence of the modern pharmaceutical 'process' which includes prescribing, dispensing and administration. This is not a new phenomenon. The potential for errors has always existed from the time when drugs were first used to treat patients. Today however the potential of creating more errors and more serious types of errors is widely increasing since medicine and the drugs it uses has become more complicated. These complications include the factors that more medicines are available, more drugs are used and there is the complexity of the same drugs existing in both branded and generic name products which if given together may give rise to an overdose. Also more people are suffering from very complex diseases and so more patients are taking a combination of medicines to alleviate such conditions.

1.12. 3 Definitions medication errors

There is no one simple definition of ‘medication error’. For example, Barker and his colleagues in 1966 gave the following:

> ‘a deviation from the physician’s medication order as written on the patient’s chart’. (Barker et al.,1966)

In contrast, and more recently in 2008, the National Coordinating Council for Medication Error Reporting and Prevention. (NCCMERP, 2008a) gave the following definition:

> ‘any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is under the control of the health care professional, patient or consumer. Such events are complex and may be related to professional practice – procedures and systems including prescribing, order communication, product labeling to areas such as packaging and nomenclature, compounding, dispensing distribution, administration, education monitoring and use.’ (NCCMERP, 2008a)

This definition whilst being more comprehensive is simply perhaps too complex and another definition which was previously suggested in 2004 is perhaps more ‘manageable’. This was made by Ferner & Aronson in 2004 who suggested that a medication error was:

> ‘A failure in the treatment process that leads to, or has the potential to lead to, harm to the patient’ (Ferner & Aronson, 2004).

Whatever definition is used, the usual system to classify medication errors is to ascribe them to the three areas of - prescribing, dispensing or administration. If this system is used then medication errors can occur in all three stages of the medication use process, by physicians, pharmacists, nurses or patients where some form of harmful effect is produced. It is claimed in several studies that prescribing errors constitutes the majority of medication errors which occur (Cohen, 2007; Ferner & Aronson, 2004; Naylor, 2002; Williams, 2007)

It may be useful to just consider one of these areas. Dispensing errors, which include dispensing the wrong drug or the correct drug but at the wrong strength. This type of problem has been said to occur at a rate of 1-24%. In contrast, it has been claimed by others that administration errors occur at a rate of 50% due to either the preparation or the administration of the medication to the patient. Recently, medication errors have been classified according to whether they are mistakes, slip or lapses and that it may or may not produce adverse drug events (ADEs) (Williams, 2007). There are also some other definitions made by other authors which provide definitions for useful terms in the overall 'field' of medication errors.

For example if the words error, mistake, slip and lapse are considered then it was Reason who in 1990 suggested that the following definitions of these keys words were:

Error - the failure of planned sequence of mental or physical activities to achieve its intended outcome when these failures cannot be attributed to chance.

Mistake - a euphemism for which could be 'unintended injury' or 'suboptimal prescribing' occurs when an action proceeds as planned but fails to achieve its intended outcome it is a failure of planning.

A slip or lapse - occurs when the action performed is not what was intended. It is an error of execution - slip is observable, whereas lapses are not observable.

Clearly, the exact language which is used is extremely important to define as this makes the topic area of medications errors perhaps more understandable.

Subsequent to the work of Reason (1990) and Sender (1993) the general definition of medication errors was:

> 'an error is a failure to perform an intended action that was appropriate given the circumstances ' (Sender, 1993)

One year later, Barker (1994) provided another definition of a medication error which was:

> 'any error that may occur anywhere from the time the doctor picks up the pen or turns on the computer to write a prescription until the patient gets the drug'. (Barker, 1994)

Six years later, Dean et al. (2000) provided yet a further definition:

> 'Prescription of drug can be divided in to an intellectual part-decision making i.e. knowledge of diagnosis, interaction and contraindication, and a technical part including communication of essential information, i.e. drug name, dose form of administration' (Dean et al., 2000)

I hope that from the examples given above it can be seen that the topic of medication errors is complex and very challenging – even from a perspective of language. However it is the occurrence and science of such errors which is the focus of this thesis.

1.12.4 Why is there concern about medication errors?

In the past 15 years the number of errors has been reported to have increased due to a number of different causes such as incorrect prescribing, selecting the wrong drug, dispensing the wrong drug or the administration of the wrong drug to the patient. Ten years ago, Cohen et al. (1999), stated that medication errors were the most common type of medical error in all health care organizations. In addition, they identified that medication errors in hospitals, when considered in terms of their incidence, were a major cause of death in USA. They ranked among the leading causes of death along with different condition such as cancer, stroke and heart disease. Consequently, their study showed that medication errors caused thousands of deaths and the cost incurred in the USA, where Cohen's studies were carried out, needed millions of dollars to reverse the short and long term effects of these adverse effects. So, over the last decade, such problems have caused an increasing awareness about medication errors and this has lead to trying to identify the problems of causes and factors to find possible solutions to minimize their occurrence in the future.

In developed countries, it is interesting and informative to consider some real numbers about the problem, where in the USA, more than 7,000 deaths (Cohen et al., 1999; Naylor, 2002) were reported. In Australia, potentially more than 9,000 deaths were suggested with an estimated 16,830 patients suffering a permanent disability. In the UK 16,320 deaths and 12,240 patients with permanent disability have resulted each year from medication errors. (Naylor, 2002). These numbers have been progressively increasing until in 2006 in the USA they reached approximately 1.5 million people injured, and $3.5 billion extra medical cost every year due to medication errors. There is a more recent study by Maidment et al. (2006) where it was calculated that 1-2% of patients who were admitted to general hospitals suffered from some type of the medication error.

1.12.5 How do medication errors occur?

Clearly, medication errors are not a new problem and are faced by all staff who work in healthcare institutions. In order to solve the problem of medication errors, it is important for any institution to understand <u>how</u> they occur and <u>what</u> causes and factors may have led to such errors. One very suitable guideline for all staff involved in any form of healthcare must be to follow the ‘five rights’ so as to ensure safe medication use. These ‘five rights’ are in sequence - the right patient - right route - right dose - right time - and right drug administration. If these five rights are not implemented altogether in a practice setting, medication errors will inevitably occur. So, it is absolutely essential to recognize the causes of medication errors in all the different stages of prescribing, dispensing, and administration of medication use, in order to find possible solutions to reduce their occurrence. These causes/factors/solutions will be considered below and to start the analysis the problems of drug administration by the nursing staff is the first topic which will be considered.

1.12.6 How medication errors are classified.

Medication errors can be broadly classified through the processes of prescribing, dispensing or drug administration. The chapters which follow in this thesis will investigate the different types of errors which occurred in each of these stages in a hospital setting and so provide an insight into the current incidence and significance of medication errors in a hospital which has never before carried out such an investigation. The causes which have led to such errors will be presented and discussed in detail in later chapters.

1.12.7 Types of medication errors.

Medication errors can occur at any point during the process of using drugs. They do not occur only in the pharmacy. They also occur when the physician writes an order i.e. a prescription, to the nurse or pharmacy staff through the prescribing/dispensing process. They can also occur when nurses administer medications to their patients. Errors do not have a ‘special stage’ at which they occur, but rather, they can occur even when a clerk/secretary is transcribing the instructions from a physician or patient information and they do this incorrectly. A focus on some types of errors will be given below which clarify the points made above.

1) **Prescribing errors:** Following an inappropriate drug selection, or dose, or dosage form, or route of administration. For example this may include ordering duplicate therapies for a single indication, prescribing a dose that is too high or too low for a particular patient, writing a prescription illegibly, prescribing an inappropriate dosage, dosing interval or ordering a drug to which the patient is allergic.

2) **Unordered or unauthorized** drug: is defined as the administration of a dose of medication that was never ordered for that patient.

3) **Extra dose error**: is counted if a dose is given in excess of the total number of times ordered by the physician.

4) **Omission error**: is noted if a patient fails to receive a dose of medication that was ordered by the time the next dose is due. However, if the patient refuses the medication, an error is **not** counted and it does **not** count as an opportunity for error. If no attempt was made to administer the dose, then an omission error is counted.

5) **Wrong dose error**: occurs when any dose given that contains the wrong number of dosage units - such as tablets, or was more than 17% greater or less than the correct dosage -as with oral liquids.

6) **Wrong route errors**: are defined as those situations where medication is administered to the patient using a different location / site than actually ordered.

7) **Wrong time errors**: are defined as the administration of a dose more than 60 minutes before or after the scheduled administration time. Unless there is a valid reason, such as if the patient was ordered not to consume anything by mouth or if the patient is temporarily missing from the ward – 'off the floor' - perhaps at a diagnostic test or in surgery - these will be counted as an error.

8) **Wrong dosage form**: involves an administration of a dose in a different form than that ordered by the physician.

9) **Wrong administration technique errors**: Doses that are administered using an inappropriate procedure or incorrect technique. For example instead of giving the patient an IM injection she gives it IV.

1.12.8 A brief account of the causes of medication errors

After a consideration of the types of errors it is appropriate to consider the causes of medication errors.

1) Prescribing errors.

An inappropriate drug selection, at an inappropriate dose or dosage form, or route of administration can all be classed as a prescribing error. For example, this may include ordering duplicate therapies for a single indication, prescribing a dose that is too high or too low for a particular patient, writing a illegible prescription, prescribing an inappropriate dosage, interval or ordering a drug to which the patient is allergic (Coleman, 1999). A definition specifically for prescribing errors includes an example cited in 2001 of a reference made in 1993 was made by Zellmer (1993) who defined such errors as:

'as physicians selecting an incorrect drug for a patient when the drug was not suitable for the condition of the patient or the drug was selected without determining if the patient was allergic to this drug'

This definition was made 17 years ago and surprisingly did not cover other problems involved in prescribing errors also being subject to using the correct route for the drug, a correct dose and drug interactions and not merely if the patient was 'allergic' to the drug.

Consequently, these other factors may include wrong dose or dosage form which is not suitable for the patient and also sometimes physicians selected the wrong strength or the wrong route which may be very harmful to the patient. An example of this would be if a patient was given a medication by the wrong route such as intramuscularly (IM) instead of intravenously (IV). Prescribing errors also can include giving patients medication without any indication or any instruction for patient to tell him about contraindications of medication (Zellmer, 1993). Prescribing errors also include failure to comply with the legal requirements for prescription writing. The prescriber sometimes does not specify the information such as dose, strength, time of taking the medication or total quantity of medication to be dispensed which the pharmacist needs to know to be able to dispense safely (Ferner, 1999).

It should be stressed that the occurrence of medication errors can compromise patient confidence in the healthcare system and in addition, increase healthcare costs. These economic consequences may include the award of damages to the patient, an extension of a patient's stay in hospital and the potential financial support required for long term care of a patient who suffers a permanent injury (Allan & Barker, 1990). In the USA, it has been estimated that the cost of adverse drug events, due to medication errors, was $5.6m per year for a single 700 bed teaching hospital (Bates et al., 1997).

The studies of Lesar et al., (1997) in a hospital setting found an error rate of 4 per 1000 medication orders. These errors could be classified into four groups, namely-

1. Drug allergies, accounted for 12.1%
2. Wrong drug name, dosage form or abbreviations, accounted for 11.4%
3. Incorrect dosage calculation, accounted for 11.1%
4. Incorrect dosage frequency, accounted for 10.8%.

There is also another cause of error by a prescriber when they prescribe a wrong drug to the patient because of a lack of knowledge or confusion about the medication due to confusing brand or generic names. If the physician does not know both the brand names and/or generic names he may repeat the same medication and so the patient receives twice the dose so causing a potential overdose.

In an earlier study by Leape et al., (1995) they examined the reasons for the occurrence of errors and concluded that it was mostly caused by multiple system failure as 29% of errors were caused by insufficient drug knowledge by the health care professionals. More examples of the complexity of this area of medication errors will be given in the relevant chapters below.

2) Dispensing errors.

Dispensing errors may occur at any stage of dispensing a medication starting when the pharmacist receives the prescription from the patient until he supplies the medication to the patient. If the five rights are not strictly adhered to throughout the dispensing process - for example - right drug - right dose - right patient - right route - right time then errors will occur (Vere, 1965). A simple reason for such errors is that the pharmacist is sometimes overloaded with work and this can cause errors. The pharmacist can pick up the wrong drug container when the physician writes two drugs on the prescription that have similar names. Drug names that look-alike can be mistaken for each other and the patient ends up receiving the wrong drug. In a similar way, sound-alike errors can also occur especially when items are given over the telephone. Problems can also arise when picking up the wrong package because it has the same overall color and design as a different strength of the same medication. The pharmacist can therefore select the wrong strength of the drug, for example 25mg instead of 15mg strength, simply because they come in a virtually identical packing, the only difference being that the strength of the preparation, although numerically different, may not even be in a different colour or size of print.

Pharmacists can also dispense medications to the wrong patient because the case may arise that two patients are in the same ward as inpatients at the same time or are outpatients at the same time and have the same first name. A simple case of an easy point of confusion causing problems.

Errors can also occur through the pharmacists using a wrongly printed label if they are dispensing a medication and do not check that the correct label for the item is used rather than just taking a label from the printing machine and using it, without carefully checking that it is the correct one. This inattention to detail could be due to being distracted through interruption from one of the pharmacy staff whilst in the process of preparing a patient's prescription. Noise levels in the pharmacy can also affect the pharmacist attention to detail during the process of dispensing prescriptions which does not allow them to concentrate throughout the dispensing process and may also distract the pharmacist from being able to read the full instructions about the medication for the patient as it was written by physician.

Pharmacists sometimes do not request help from other colleagues, to check what they have dispensed – a failure in the basic concept of using a double checking system. The lack of checking can occur if the 'pharmacy window' through which dispensed items have to pass on their way to the patient is very busy due to the time of the day especially when there is a very heavy load of prescriptions to dispense. During this 'rush hour time' a failure to double check prescriptions before dispensing, can easily occur and so errors go unnoticed.

If a Pharmacist does not concentrate throughout all the preparatory stages of dispensing for prescription, it could be the following scenario could occur. If the physician had written a medicine as 2.0 mg for a patient, instead of 2 mg, the pharmacist may read it as 20mg and so dispense the wrong strength. Pharmacists' confusion can also occur with the name of one drug with another which has a very similar name, for example, Losec with Lasix and Daonil with Danol (Ferner, 1999). Unfortunately, to make matters worse some Pharmacists have a lack of knowledge about the indications of new medicines from different companies, since they have failed to keep up to date, and so cause an error to the patient through a simple lack of knowledge. Pharmacists sometimes do not follow the recent market trends and so do not keep themselves updated in new medicines. They then find it difficult to know which medicine is good for a specific type of condition or type of disease or any potential interactions they may have. Pharmacists should always be reminded that they must not use outdated or incorrect references as these can also contribute to errors.

There are many other and varied factors which can contribute to medication errors such as an unreasonable workload, a poor housekeeping standard and inadequate checking of all dispensed items. Distraction during the dispensing process for example interruptions due to telephones, mobile phones or other members of staff can lead to performance errors (Flynn et al., 1999). Furthermore, some pharmacists throughout the dispensing process for a prescription depend solely on their memory without actually seeing a new written order or instructions from a physician. This is extremely dangerous because human memory can easily fail and so lead to errors.

3) Administration error.

Errors happening around the time of administration of drugs do occur and perhaps reflect the fact that the 'five rights' that is, administering the right drug, to the right patient, with the right dose, by the right route, and the right time have not been met (O'Neal, 2000). These errors are usually associated with health personnel most involved in administering drugs to patients which are to all intents and purposes the nursing staff. An administration error has been defined as:

> 'a deviation from a prescriber's valid prescription or the hospital's policy in relation to drug administration, including failure to correctly record the administration of a medication' (Barker et al., 2002).

Administration of a medication to the patient is associated with errors that can occur at any stage of the process (Bemt, 2000). Drug administration errors usually involve errors of omission where administration is omitted due to a variety of factors, the most extreme example perhaps is a drug given to the wrong patient. An omission error is noted if a patient fails to receive a dose of medication that was ordered by the time the next dose is due. Another factor which may cause errors is simply due to a lack of the stock on the ward of the actual medication which is required and they borrow a quantity from an adjacent ward. This may lead to a patient not receiving their medicine(s) on time.

Another problem which can occur is centered around using the wrong administration technique for a specific drug. This can occur when the nurse administers an injection incorrectly for example when they wrongly administer an injection IV rather than IM. There is one comprehensive study which explains the wrong administration of medication carried out by nurses. This study was carried out in Colorado, USA, where three nurses were indicted on charges of criminal negligence after a medication administration error killed an infant in their care (Cohen, 1997).

The essential details of the case were as follows. A one day old baby was prescribed a long acting penicillin. Because his mother had an infection and she was being treated with an IV antibiotic, the medication to the baby was erroneously administered IV to the infant instead of IM resulting in death of the infant. To make matters worse it was also found that the pharmacist had actually dispensed **10 times** the appropriate dose.

Nurses are not always knowledgeable regarding the nature and volume of diluents, administration techniques, rates and schedules of administration. All healthcare professionals share a responsibility for identifying contributing factors to medication errors and for using that knowledge to reduce their occurrence. It is also worth mentioning that both experienced and inexperienced staff may both be responsible for medication errors.

Wrong dose errors occur when any dose which is given is greater or less than the prescribed dose. These can occur in nurses through the 'rush time' when they forget to write the actual dose which has been given on the drug chart and that could leave another nurse to repeat the dose which would then result in an overdose.

Some nurses through having to carry out a lot of routine work on checking the patient can forget to weigh the patient or measure their height and also forget to write their age. All these simple factors may cause errors because when drugs are prescribed as such data are essential to be in the files so as to avoid medication errors especially for potentially potent drugs.

Some nurses administer the wrong dosage forms such as doses which are administered or dispensed in a different form from that actually ordered by the prescriber. For example dispensing or administration of a liquid formulation without a specific prescription to a patient who has difficulty swallowing tablets might be an acceptable dosage form change. Sometimes exchanging one dosage form with another is not that easy since they may contain different quantities of the active drug and this is not known or understood by the nursing staff. Consequently, the patient could receive the wrong dosage.

Nurses sometimes dispense items without checking the expiry date of the drug and this will lead to a potentially difficult situation. Nurses must be somehow encouraged not to used expired drugs and checking the expiry date is the simple way to avoid such errors.

During the process of drug reconstitution error can occur due to the necessity of adding a diluent to the powder in a vial or bottle. Dilution is dependent of the volume of a diluent added and if this is not adhered to then this will causes a drug preparation error. For example, reconstituting a cephalexin oral suspension with an incorrect volume of water, or using bacteriostatic saline for injection instead of sterile water for injection to reconstitution a lyophilized powder for injection (Kessler, 2004).

Nurses lack of knowledge in the correct indication or uses of drugs can result in wrongly administered medication before meals or after meals. If the physician has not written precise details in the patient file then the nurse can administer the prescription wrongly. Nurses are not always knowledgeable regarding the nature or volume of diluents and the schedules of administration medications if the physician does not write the full information for the nurse can cause an error.

Each healthcare professional shares a responsibility for identifying contributing factors which result in medication errors and for using that knowledge so as to reduce their occurrence. If a safe system is in place then there is a greater chance to 'catch' any error before it can reach the patient. One aspect of a safe system is to reduce the problem of a system transcription error - faulty dose checking - inadequate monitoring - preparation error - lack of standardization - lack of knowledge of drug - drug stocking and delivery problems (Leape et al., 1995). All causes and factors and solutions of health care professional errors will be explained in more detail in later chapters.

Chapter Two

From the information given in Chapter One the overall problem of medication errors clearly has posed and still poses a problem for all countries where drugs are used and so that is every country of the world. It is surprising therefore that the literature about this topic is mainly to be found in that of the last 20 years. Why should this be the case?

2.1 Literature review.

Although there are a limited number of texts which review the problem of medication errors is it thought appropriate to provide a literature review based on those and other references which are necessary for the topic of this thesis, namely hospital medication errors.

From the outset it should be stated that medication errors are not new. An 1857 British regulation mandated that bottles of poisons had to have a specific color and also tactile letters cast into the glass. This it was hoped would minimize the risk of either giving or picking from a shelf by mistake drugs contained in similar bottles or colors (Leape, 1999).

For many years, medication errors have usually happened because of a 'breaking down' in the systems that have been developed for handling and processing drugs from prescribing and ordering to distribution and administration. Pharmacists have always been warned to read any label three times before picking the medication from the shelf. Also, when he or she wants to dispense any prescription for patients they must read the prescription extremely carefully and check and re-check all stages of the dispensing process. Pharmacist must also develop systems to replace items in specific locations to try and reduce subsequent 'picking problems'.

The strategy of a pharmacist reading any label three times before actually dispensing an item, attempts to ensure that the process of dispensing is as safe as possible. This attention to detail does not only apply to pharmacists as nurses have also been warned to be aware that any medication she or he has to administer to the patient must follow the five 'rights' of medication administration. These are - all drugs should be administered to the right patient - using the right route - of course with the right drug - at the right dose - at the right time. Whenever one or more of these 'five rights' are not met, a medication error is likely to occur.

Over the last ten years research has started which has concentrated on trying to determine the cause and steps which can be taken to minimize or to prevent medication errors occurring. Attributing a common cause for such problems is very difficult due to the complexity of the subject and there are two major viewpoints – namely that errors are caused by 'systems'- i.e. systems error or by 'people' – i.e. human error (Peterson, 2004). What is not in doubt is that medication errors are a very serious problem. For example the New York state department of health has a mandatory reporting programme for medication errors and the data from such reports when they are extrapolated shows that up to 1000 deaths occur every year from medication errors (Cohen, 2000). This it should be emphasized is just in one state of the USA. A major milestone in medication errors occurred in 2000 when 'The Institute of Medicine' published a book which was entitled 'To err is human – building a safer health system.'(Kohn et al., 2000) which brought both medical and consumers attention to the problem of medication errors. The book contained chapters written by experts in their relevant fields which stated that in the USA at least 44,000 and possibly as many as 98,000 patients were killed each year as result of medication errors. In this text another statistic was given which suggested that when errors occurred in hospitals this extended their stay in hospital, so as to allow recovery from the drug induced problem, by nearly 5 days. The excess cost for each patient was calculated to be nearly $ 6000. This translates to an estimated annual cost of nearly $ 3 million for a single 700 hundred bed hospital (Bates et al., 1997).

The problem of medication errors is something that will not simply disappear as medications are more commonly used today than ever before and are the mainstay of treatment for most chronic conditions. Since these chronic conditions, for example arthritis, affect primarily the elderly they take numerous medications on a daily basis. The number of drugs such people take has been calculated to be an average of eight per day in the ‘nursing facility setting’ (Monette et al.,1995). As the text ‘To err is human’ suggested, medication errors can lead to serious patient morbidity or mortality and because drugs are used so frequently, the number of what should be preventable injuries is substantial. The American Society of Consultant Pharmacists (ASCP) recognizes that medication errors can be minimized by carefully assessing the overall medication use process, identifying inadequacies within the systems which are used and developing intervention strategies to correct the recognized deficiencies. A Consultant Pharmacists, in the pharmacy and in the long-term care facility, have a responsibility to develop and participate in this continuous quality improvement (CQI) programme. The benefits of such a system include increased patient safety, improved quality of care, decreased liability and reduced costs.

After a very brief overview it is appropriate to consider a range of real examples of the problems which can occur to give the reader an idea as to the range and types of medication errors which have occurred over the last 30 or more years.

In 1975 Simborg, carried out a study of medication errors in hospitals, which were using the system of Unit Dosing. The change to this system consequently reduced medication errors by 82%. Unit dosing was therefore suggested as being an affective approach to achieve a reduction of medication errors. Despite this success, its widespread adoption in other countries has not occurred.

In 1984 Perrowe (1984) published a book on human error(s) and the accidents they caused. He suggested that accidents can happen anywhere in home or hospital or industry. The major factor, 60-80%, contributing significantly to most accidents he attributed to the problem of human error. This probably is equally true in health care. Although medicines are generally considered by many people to be absolutely safe in use because they have undergone strict testing, problems in actual use can still occur. For example, a safe drug when given in an inappropriate dose can cause major problems and even death of the patient. A very useful comparison is that of the knife which has many useful properties such a preparing food but also potential dangers if used improperly. In the same way drugs therefore have to be used properly to avoid their potential dangers.

In the same year, 1985, Dearden and Rutherford (1985) published a study carried out in Israel where they reported, a serious error rate of 58% in the treatment of severe trauma patients in an emergency room. The problems of providing adequate care arose and errors occurred simply through the lack of experience of the physicians in the emergency room and their lack of relevant experience was said to be the root cause of errors.

Two years later in 1987, Girotti et al.,(1987) determined the frequency of medication administration errors, so as to identify the classes of errors and also to identify patient characteristics and staffing situations that may serve as predictors of medication errors in intensive care units. Their results suggested that in their ICU there was a low medication error rate 2.2% as compared with a reported value of 13% to 18% previously reported by Jessee, (1981). How such a major difference could be explained was not attempted, but even an error rate of 2.2% still suggested serious problems. The most frequent type of medication error was giving a drug at the wrong time. There were no significant differences between full-time and part-time employees and length of shift worked that might contribute to medication errors. This was surprising as a previous study had suggested the shift length was the major causes of error.

In a similar way, but in a completely different setting, compliance to medication schedules, alternatively known as treatment adherence, was attempted in 1987 by Meichenbaum (1987). This study showed that non-adherence, in part a consequence of poor prescribing, affected 30-50% of patients taking medications for chronic conditions. This problem of non-adherence to treatment schedules may reflect a lack of patient awareness of their medication. Such a proposal is also reinforced by the studies of McMahon et al., (1987) who found that although 74% of 154 patients visiting an out-patients clinic would have liked to have been provided with written information about their treatments, whereas in fact, only 14% actually received it. In any case, the fact that patients do not specifically ask for information does not necessarily imply that this requirement does not exist. This study was carried out before patient information leaflets (PILs) were routinely available. When such leaflets became available a study carried out by Gibbs et al. (1990), in a community rather than the hospital setting, found that the benefits of patient information leaflets (PILs) added further support for the routine use of PILs in general practice in the UK. These studies found overwhelming public support for the use of PILs. Introduction of the leaflets improved the level of patient satisfaction, their knowledge of the purpose of prescribed medication and their awareness of side-effects. Furthermore, they found that patients of both sexes and of all age groups and social classes benefited from the leaflets.

In the same year but this time in a hospital setting, Wolf (1989) reviewed situations leading to medication errors and identified several situation that preceded medication errors. He found errors in transcribing medication orders, a failure to 'absorb' or act on information on drug packaging labels, confusion over similar packaging labels and container sizes, use of defective equipment and selection of the wrong medication container. Other factors included poor handwriting, selection the medications from memory without checking medication administration record, leaving medications at the bedside, scheduling medications during the change of shift report.

In 1989 two furthers studies with a rather specialist focus were published. Raju et al.,(1989) studied neonatal and paediatric ICU where a reported 315 medication errors, were detected by using the incident-report technique, from among 2147 administrations during a 4-year period. On analysis of these errors, it was found that 60.3% were attributed to nurses and 57% of 190 nurses' errors were due to a) omission, b) wrong rate of administration or c) wrong time of drug administration.

The final example from 1989 is the study of Manasse, (1989) who published a study on drug incidents highlighting the fact that the use of these drugs is not perfect throughout the whole sequence of actions and decisions that cover the drug-use chain of events. Medication errors were considered to occur in prescribing, dispensing and delivery, all of which may unfortunately increase the harmful potential of drugs. These errors may be caused by both experienced or inexperienced staff, including pharmacists, medical doctors, nurses, assistants, patients, or their careers. (Manasse, 1989). Clearly all personnel involved with any stage of the prescribing/dispensing/administration process can cause the problem of medication errors.

In this topic many studies repeat previous findings. For example in 1991, Omoria (1991), produced a study which showed that around half of the patients were failing to take the right medicine, correctly, a month after discharge from the hospital.

The influence of workload and the potential to make errors.

In the study of errors, excessive workload is generally considered to be a serious problem. This was highlighted in a paper by Ukens (1992). His study used a survey technique and 68% of pharmacist rated work overload as a major contributory cause of committing dispensing errors. These findings of this survey also agrees with experts in medication errors as both agree that work overload the most significant factor contributing to medication error.

One aspect of excessive workload is the inability of a pharmacist to check every item dispensed in a thorough way. In the Ukens survey, 42% to 46% of pharmacists stated that the reason for the occurrence of errors were the failure of both the pharmacists and nurses to check the drug before dispensing or administration to the patients. This simple stage is significant factors in dispensing errors because these care professional do not adherence to the principles of the five ‘ rights’ given above.

Patient demand for information has been identified in a number of studies. Although patients would like information about their medication, there is an inconsistency between what they request and what they receive.

Another study in the same year, Whyte (1992), also highlighted a previous concern about providing information to patients. This need for more information about the prescribed medicine was also supported by other studies such as McMahon et al., (1987) which has previously been mentioned. In essence they found that although 74% of 154 patients visiting an out-patients clinic would have liked written information, only 14% actually received it. An important consideration is that although patients do not actively ask for information does not necessarily imply that they would not like to be provided with such information - especially by a healthcare professional such as a Pharmacist.

Examples of the failure to carefully check an item which has been dispensed is also another recurrent theme in error medication studies**.** Early, in 1993 the FDA received a medication error report about a patient who died because "20 u" of insulin was misinterpreted as 200 u. Another fatal accident occurred in 1995 when a prescription for "furosemide 40 mg O.D" was misinterpreted as furosemide 40 mg QID. One interesting conclusion from these two studies could be that the failure to check reflects the volume of prescriptions dispensed in any given time in a specific set of circumstances.

Two examples which suggest the vital nature of an adequate checking procedure were reported by Kistner et al., (1994). Perhaps surprisingly, they found that there was no evidence to suggest that the risk of errors increased when a pharmacist filled more than 10 to 20 prescriptions per half hour. This is a very high volume, 20-40 per hour, and translates to 160-320 items per average working day.

Wou (1994) reported studies concerned the problem of the confusion with drug names which may be exacerbated by an excessive workload. These studies of Wou reported that in one case almost $14,000 medical costs was incurred to treat a patient who experienced recurrent hypoglycemia because of a prescription error. The pharmacist inadvertently dispensed glyburide – (Diabeta), an orally active hypoglycaemic agent instead of diazepam, an anti-anxiety medication.

In the same year, Cook and Woods (1994) reported that the greatest advantages of computer technology was that it could enhance human performance by questioning the action of the operator and providing advice through different alternative possibilities which were beyond the scope of human memory. Such systems would be an advantage for discriminating between drugs with similar names but would not help in the two cases listed above. Computers could be an advantage in look-alike names and in one study carried out in 1995 by De Michele (1995) a study examining look-alike or sound-alike drug names concluded that a major factor in causing errors was the use of similar product names or almost identical packaging from pharmaceutical companies may have an extensive impact on the committal of errors with particular drugs. Examples for this problem include examples such as celebrex, citalopram and celexa. These drugs are very good examples of sound-alike names and have the potential to cause errors and this problem has been reported to be involved in 37% of medication errors in this 1995 study. Such a high percentage or error has serious economic consequences.

In a comprehensive study by Johnson & Bootman in 1995 they evaluated the cost of drug-related morbidity and mortality in the ambulatory setting. It was estimated that in the USA $76.6 billion is spent annually to manage those drug-related occurrences some of which were due to medication errors.

If the studies in the same year by Leape et al., (1995a) are any guide the reasons for such errors are due to multiple system failure with a major contributory factor being insufficient drug knowledge by health care professionals causing 29% of all errors. Another study by Leape et al., in the same year (Leape et al., 1995b) found that medication errors cannot be attributed to human error alone. Errors are frequently due in part to defective or inadequate systems. For example, stocking dangerous drugs in patient care area such as floor stock increase the chances of an error because the drugs are available to nurses without a pharmacy check. An example with potential fatal consequences is a mix up involving floor stock of potassium chloride injection instead of normal saline. This can result in at best, a serious error and at worst a fatality.

At the same time that Leape was producing these studies Bates et al., (1995a) were examining the actual charts of patients to determine drug medication problems. Their chart-review study of medication errors in adult in patients found that, for 530 errors identified on three medical units over a 51-day period, missing doses accounted for 53%, dosage errors for 15%, frequency errors for 8%, and route errors for 5%. In total, 10,070 doses were reviewed. The 530 medication errors represented an overall rate of 5% or 1.4 errors per admission. Thirty-five errors had the potential to actually harm a patient and five actually did cause real harm. Another study by Bates et al. (1995b) examined medication errors in adult patients admitted to 11 units over a six month period at two teaching hospitals. All patients admitted to one of these units over a six-month period were included. A rate of 6.5 ADEs per 100 admissions was found and 28% of the ADEs were on analysis said to be preventable. There were three non-preventable ADEs for every preventable ADE. Almost two thirds of the errors occurred at the ordering and transcription stages. Another study by O'Hare et al., (1995) used a different technique to assess the accuracy of actually dispensed medicines was to use the technique of 'disguised observation' in a hospital setting**.** A total of 291 errors were detected in 168 of the observed doses. On analysis these were classified as: 140 wrong time errors, 114 wrong rate, 24 incorrect volumes, 9 wrong techniques and in one case an incorrect diluent was used. Wrong doses were actually quite rare and one duplication and two dose omissions were observed. However, it was found that 80% of doses were given at an incorrect time. Many factors could possibly account for such errors and in the same year a short but an interesting study was carried out by Bates et al., (1995a) who found that even one's subjective impression of workplace lighting could increase the risk of a medication error. This is a surprising finding and one which shows perhaps the complexity of the whole process of dispensing and prescribing medicines.

A further study by Leap and Bates in 1995 returned to the subject of analyzing errors in a Boston hospital. It analyzed medication errors both by a) type, for example, wrong dose or wrong drug and by b) the stage of process at which the error occurred. The important conclusion from this study was that most errors were due to four main factors. Firstly, a lack of knowledge about drugs. Secondly, mistakes about identifying drugs because of 'look-alike' packages. Thirdly, 'sound-alike' names and fourthly, a lack of information about the patients' condition.

The final study to be considered for the year 1996 was that made by Abood (1996) who reported a study in community pharmacy where errors committed were determined to be of the order of 89%. Many of these were detected during patient counseling and so could be corrected before the patient used their medications.

In 1997 a major study was produced by Leasar et al. (1997) who examined prescribing-medication errors in a 631-bed tertiary-care teaching hospital. He found an error rate of 3.99 per 1000 medication orders. This study was broadly similar to the reported rates in previously reported studies by Lazarou, where the rate was 6.7%, Schneitman- McIntire et al., with a rate of 1.7% and Einarson, with a rate of 4.0% (IOM 2000).

A different sort of analysis was carried out by Mottram and Reed (1997) who performed a survey of 80 members of the general public in the UK. They found that the majority of this sample group expressed the view that;

'A leaflet facility would affect their choice of pharmacy and that they would be prepared to wait an additional short time to receive such a leaflet'.

(Mottram & Reed , 1997)

These findings reflect the earlier findings of McMahon et al. (1987), who sampled 154 patients visiting an outpatients clinic. They reported that although 74 percent of the sample would have liked to receive written information only 14 percent had been given any such material. It is also worthy of note that printed materials are less costly to produce than audio-visual teaching programmes and they have the added advantages of being more easily updated, are easily portable and are easy to use as a reference.

The year 1997 produced papers of a great variety. A study by Bontemps et al. (1997) analyzed 678 prescriptions and out of these prescriptions, none was said to be complete. Prescription legibility was and still is a great problem; an analysis in the same year confirmed the problem according to the studies of Winslow et al (1997). They found that 4% of prescriptions were illegible and 16% were difficult to read.

Another paper showing the great variety of problems was that reported in 1997 by Flynn et al.,(1997). This is a very interesting paper as it contains details not normally reported in such studies. They carried out a study in five different hospitals in USA to find the rates of errors in IV admixture compounding. The study was conducted by Elizabeth Flynn, Robert Pearson, and Kenneth Barker. They actually observed the pharmacy staff members during the time of compounding sterile products in order to record the medication doses, base solution and other details. Observations took place for five days at each pharmacy. The observers' notes were checked with the labels used to prepare the doses and any deviation was considered an error. The significance of each error was assessed for its potential to affect a patient adversely. The mean error rate for the five hospitals combined was 9% (145 errors for 1679 doses), excluding ready to use products. The mean error rate for individual pharmacies ranged from 6% to 10%. Wrong dose errors were the most common type of error. Parenteral nutrient solutions had the highest error rate - 37% for manual preparation and 22% for preparation that was partly automated. Of every 100 errors, 2 were judged to be potentially clinically important.

As compared with this extremely comprehensive study some of the reports in 1998 were much less ambitious. For example, Fitzgerald & Wilson (1998) concluded that errors may occur not only from a lack of counselling, but also from providing incorrect information during patient counselling which can cause errors to the patients. In 1999 Bates et al., (1999) analyzed in more detail than had been previously done the impact of computerized physician order entry on medication error prevention. The American experience of the use of such technology in drug ordering/ prescribing for over a decade in reducing errors provides one of the best examples. Computerized order entry as pioneered by the Brigham and Womens' Hospital in Boston showed a meaningful reduction in serious medication errors as well as reduction other errors.

Further studies in this year included those of Osborne et al (1999) who study found problems with name-band checks, fatigue, exhaustion and distraction as the major causes of medication error reported by nurses. In the same year, Tissot et al (1999) reported the medication errors at the administration stage in an intensive care unit in a University hospital. 2009 medication administration were observed. 132 errors were detected. Their distribution was as follows: 41 dose errors, 29 wrong rate, 24 wrong preparation, 19 physicochemical incompatibility, 10 wrong administration technique and 9 wrong time errors. No fatal errors were observed, but 26 of 132 errors were potentially life-threatening and 55 were potentially significant. They also concluded that these errors were due to deficiencies in the overall organization of the hospital medication tracking system, in patient follow-up and in staff training.

As the new millennium occurred drug medication errors studies continued**.** Dean and her colleagues (2000) made a study with a team of pharmacists at a UK teaching hospital to identify the causes of prescribing errors. The pharmacists identified 88 potentially serious prescribing errors. After interviewing the prescribers, the results suggested that most mistakes were made because of slips in attention, or because prescribers did not apply the relevant rules. Doctors identified many risk factors-such as work environment, workload, whether or not they were prescribing for their own patient, communication within their team, physical and mental well-being, and lack of knowledge. Organizational factors were also identified, and included inadequate training, low perceived importance of prescribing, a hierarchical medical team, and an absence of self-awareness of errors.

Another study by Institute for Safe Medication Practices (ISMP) concerned the problems of insulin doses and its consequences. Such errors may be further complicated by illegible prescriptions or unclear oral orders and the fact that some prescribers designate the type of insulin by using the one-letter abbreviation on the commercial vial, in this case, the letter L for both Lantus and lente. Therefore, the pharmacist, patient, and health care worker must have a thorough understanding of the difference between these medications, Lantus, Lente or Lispro to avoid confusion that may compromise a patient's safety and overall clinical status (White, 2003).

Another study in 2000, this time by Barker et al., (2000), identified the problem of similar packaging and labeling of different drugs as a major cause of error in a US study that cited pharmacy technicians as having made the initial error. They found that 22% of errors occurred as a result of similarity in names, labels and packaging of drugs. The remaining 78%

were ascribed to various other causes, such as calculation errors and confusing communications.

In 2001, Thomas et al., (2001) reported that the FDA received 273 reports of medication errors. Excluding duplicated reports, 265 cases were identified for review and classification. Among this number, 129 cases were serious and 136 were not serious. The FDA defines serious as:

'any adverse event that is fatal, life-threatening, associated with disability, hospitalization, or congenital anomaly, or which required intervention to prevent permanent impairment.'

Out of the 129 cases that were classified as serious, 18 were fatal, 12 were life-threatening, 56 required hospitalization, 8 were disability reports, and 35 required interventions to prevent permanent impairment/damage. The analysis of the 265 problem cases revealed that the most common causes were human factors (42%), followed by labeling problems (20%) and communication problems (19%) (Thomas et al., 2001).

Also in 2001, Phillip et al (2001), discussed the report of the Committee on Quality of Health Care in America which was actually issued in 1999 about medication errors. The report stated that medication errors caused over 7,000 deaths per year and resulted in adverse effects in 2% of in-hospital patients. The report also suggested that medication errors increased the cost of each hospital stay by $4,700 resulting in an annual cost of billions of dollars if these values were extrapolated to the entire country. In a book entitled 'Medication errors' published in 2002 Naylor suggested that over 50% of all medication errors were attributed to the prescribing stage of medication and over 30% were attributed to the administration of the drug. The single most frequent factor for causing error was lack of knowledge of the drug. Which gave rise to fundamental errors of wrong dose - wrong route - wrong drug - wrong patient - wrong frequency-drug allergy.

In the same year Dean et al., (2002) investigated the incidence of prescribing errors as one of the major causes of medication errors in one of UK hospitals. The results showed that about 36, 200 medication orders were written during the study period and a prescribing error was identified in 1.5%. A potentially serious error occurred in 0.4% of the reported cases. Most of the errors (54%) were associated with the choice of dose. Error rates were significantly different for different stages of a patient's stay with a higher error rate for medication orders written during the inpatient stay than for those written on admission or discharge. Previously, Jick, (1984) had studied outpatient drug toxicity and had recorded cases which were about 3% of all hospital admissions in the USA. In a previous evaluation of complications associated with medications among patients at 11 primary care sites in Boston, 18% of 2258 patients who had had drugs prescribed, reported having experienced drug-related complication (Gandhi et al., 2000).

Barker et al (2002) evaluated the number of errors occurring in the drug administration phase in 36 hospital and skilled nursing facilities and found that 19% of all doses were not administered correctly. The largest group of errors, 43% were found to be due to the wrong time of administration.

Another two studies, (Berkowitz, 2002; Cohen, 2001) published during 2002, brought attention to the similarity of drug names which previous studies had also mentioned**.** An alert from the Institute for Safe Medication practices has drawn the attention to the name similarity between lantus and lente (an intermediate-acting insulin preparation) as a potential source of error during the filling of oral or written orders for Lautus.

In a similar way there has always been the problem of abbreviations and their capability of being misunderstood. Mahmud et al., (2002) reported about the misinterpretation of the abbreviations and acronyms which led to medication errors. For example, the abbreviation DTO was misinterpreted for 13-day-old infant. DTO, or deodorized tincture of opium, which was incorrectly referred to as diluted tincture of opium, which actually contains 4% the amount of opium. This mistake could have cost the patient her two-week-old life. Another example which so clearly makes the point is the example of chemotherapy protocols the abbreviation MIME refers to a chemotherapy regimen which comprises - mitoguazone, ifosfamide, methotrexate, and etoposide. This is similar to MINE protocol, which consists of mesna, ifosfamide, mitoxantrone and etoposide.

Around this time there were other studies which were concerned with the problems with insulin. Miles and Sweeney (2001) and Santell et al., (2003) found that insulin prescribing is the top of the list of drugs involved in the medication errors in the UK and in the USA. Indeed insulin is classified as ‘high alert medication’ that is associated with significant morbidity and mortality when ordered and/or administered incorrectly. Insulin was involved in 9% of the errors that resulted in actually patient harm, which include serious potentially life-threatening complications, for example severe hypoglycemia. In a related study Taxis & Barber (2003) carried out a study involving ten wards in a hospital in the UK using the *Disguised Observation Technique* (DOT) and showed that one or more errors occurred in 57 of 430 intravenous doses. The lack of training, the design of the technology itself, poor communication and workload were factors which were said to contribute to this high error rate.

There is a study by Bell (2004) which stated that the data collected from January 2003 through to August 2004 from the U.S. Pharmacopeia's MEDMARX and Medication Errors Reporting (MER) programmers 'proved the feeling' that drugs shortage are a danger to patient safety. In 832 records submitted to MEDMARX, the third most frequently reported categories of errors caused by drug shortage were prescribing errors, improper dose/ quantities and omission errors. The alternative medication sometimes can cause errors, if a physician is not familiar with substitutions of other medications in terms of its mechanism of action, side effect and drug-drug interactions.

More recently, insulin has again been the focus of medication errors. Levandoski, (2005) produced a paper which included several reports of insulin related medication errors involving confusion between Lantus and lente insulin.

In the same year, in the USA, Phillips et al., (2005) reported medication dosing errors in outpatient pediatrics. They found that approximately 15% of children were dispensed a medication with a potential dosing error, 8% were potential overdoses and 7% were potential under-doses. Analgesics were most likely to be potentially overdosed (15%), whereas anti-epileptics were most likely potentially under dosed (20%). Potential error rates were not reduced even with an electronic prescription writer being used.

In the same year there was study in Australian by Dean (2005) who identified and described the incidence of medication errors among registered nurses, the type and causes of these errors and the impact that administration of medications had on the professional practice of registered nurses. Medication errors were mostly attributed to documentation issues, including: illegible handwriting, misunderstanding abbreviations, misplaced decimal point, misreading and misinterpreting written orders. Several human factors were attributed to potential causes of medication errors, including: stress, fatigue, knowledge and skill deficits. Environmental factors, interruptions and distractions during the administration of medications, also contributed to potential errors. The study found newly qualified nurses through administration of medications had a strong education, patient and ethical focus. Over a quarter of the respondents indicated that further training in medication administration would positively impact on their nursing practice. The registered nurses also highlighted they would spend more time to administering medications to the patient

Again in 2005, Thomas et al., (2005) carried out a study in children on the topic of medication errors. These errors were studied because they frequently occur in children and neonates and have been known for long time to be the most expensive events causing claims (Physician Insurers Associate of America, 1993). For example, a seven month old infant with a chief complain of vomiting was brought to the triage desk for assessment and weighing. The baby's nurse tells the mother the baby weighs is 8 Kg. The mother of the baby wants to know what that equals in pounds. So the nurse switches the scale to display pounds and then tells her that the weight of baby equals 17.6 pounds. So the nurse hurriedly documents the weight on the triage notes. There is space for weight on the chart in kilograms and whilst she is distracted, she writes in '17.6'. Failing to recognize her mistake that she did not switch the baby's weight back to kilograms she entered the wrong weight. So the parents took the baby from the triage room to the treatment suite. Then the physician wrote a fluid bolus of (20ML-

KG) and so 352 ML which was ordered based on the weight documented on the chart. The nurse gave the baby a bolus of 352ML, more than twice that which the baby should have received. The error was not detected - but after a physician wrote an order form for an IV antibiotic - the second nurse noted that the dose seemed high for the baby. She then checked the weight on the chart and the nurse reweighed the baby and she discovered the error and corrected it. Clearly, all nurses must double check all the relevant measurements before giving or administering any medication to the patient to protect them from any error occurring.

Next, we can discuss the benefits of bar code technology and computerized systems as has been briefly mentioned above to minimize the error occurring due to an incorrect administration.

Bar code technologies target the administration phase of the medication process. Used in combination with CPOE, bar code labels for the medication, the patient, and the provider administering the medication are scanned, reconciled, and documented electronically. Bar code technologies helps to ensure that the correct patient gets the correct dose of the correct drug by the correct route at the correct time (Ash et.al., 2002) and administration errors have been documented to be reduced by 60%.(Cummings et al., 2005) Computerized intravenous infusion devices allow incorporation of CPOE and bar code technology for intravenous medications such that standardized concentrations, infusion rates, and dosing limits can be provided to help prevent intravenous medication errors. (Hussin et.al., 2004)

In the same year Shulman et al., (2005) contributed a very thoughtful study on medication orders at an intensive care unit that shifted from handwritten orders to a computerized physician order entry (CPOE) system. They examined whether errors were intercepted or not, and the frequency, severity and types of those errors. They explored the role of the CPOE system in preventing and perhaps facilitating errors and commented on their results and findings being complex. When they combined intercepted and non-intercepted medication errors, potential and actual errors, the CPOE system was associated with fewer errors, a finding they repeatedly stressed. When they examined major medication errors, however, or even moderate errors that were not intercepted by the pharmacists, their data showed that all of these more serious errors occurred only via the CPOE system. This study provides an insight about the consequences of a CPOE system. Their analysis offers an uncommon balance, addressing both the benefits and dangers of a CPOE, and highlighting the differences in the types of errors prevented and perhaps improved through their use. CPOE system can help to reduce error occur through bad hand writing.

Another study again in 2006 (Hicks et al., 2006) carried out a mixed methodology study using a 5-year (2000-2004) review of 73,769 IV-related medication errors from a national medication error reporting programme. The study revealed that the percentage of errors resulting in harm ranged from 2.92% (2004) to 5.03% (2000). Although the percentage of harmful IV-related medication errors has steadily declined, it remains greater than the percentage of harmful errors reported overall during the same periods. The three most commonly reported types of IV-related medication errors were omission error (28.5%), improper dose/quantity (22.9%), and prescribing error (16.2%).

From the 25th Annual Meeting, of the National Conference of Gerontological Nurses Practitioners (NCGNP) held in 2006, Chilton reported that there were between 44,000 and

98,000 individuals who died every year in hospitals due to preventable medical errors. It has also been reported that this is only part of the problem, as thousands of other patients are adversely affected by medical errors and suffer injuries that are non fatal. These medical errors not only cost the loss of lives, but carry a financial burden, that is estimated to be in a range of $ 17 billion to 29 billion annually. Additionally, there is physical and psychological pain and suffering related to these errors. Another very important consequence is that medical errors diminish trust and satisfaction in the healthcare system and in the healthcare professionals.

According to USP 6th annual MEDMARX Data Report, the report Chart book of 2000-2004 findings from intensive care Units and Radiology services, MEDMARX announced on January 18th 2006 that medication errors occurring in radiological procedures caused the highest percentage of human error, 7 times that normally reported for all medication errors. Analyzed 40,403 records collected from hospitals and health care institutions across the country over a 5 year period. From 2000-2004, 12% of 2,032 medication errors reported were for radiological serious errors. These errors signal a hidden risk for patients undergoing radiological procedures. Because most people are not aware that high risk medications are being used before, during and after a radiology procedure this could lead onto serious problems. The study defined radiological error as the occurring in, or as a result of imaging performed in inpatient and outpatient services including the radiology department, cardiac catheterization laboratory, and nuclear medicine (Santell, 2006).

Returning to pharmaceutical examples, Kuiper et al. (2006) investigated medication errors in inpatient pharmacy. They stated that, ‘the inpatient pharmacy component of the medication-use process is complex and error prone. Its functioning relies on interactions among providers, patients, information, and technology and the majority of medication errors are a direct result of the intrinsic complexity of these interactions. In addition to these functions, pharmacy is responsible for controlling the dispensing of drugs; communicating with physicians, nurses, and other staff; and ensuring rational and safe drug use. These tasks are rarely segregated within inpatient pharmacies and are often performed by the same individuals at the same time as they prepare medications for patient use. Drug preparation and dispensation have been implicated in 11-21% of all medication errors. Accordingly, many solutions have to be proposed to change faulty processes.

The following year Haw et al., (2007) investigated the frequency and nature of medication administration errors in old-age psychiatry by cross-sectional study technique using direct observation, medication chart review and incidents reports. The results showed that using direct observation 369 errors in 1423 opportunities for errors (25.9%) were detected versus chart review which detected 148 errors whilst incident reports resulted in none being filed. Most errors were of doubtful or minor severity. The pharmacist intervened on four occasions to prevent an error causing actual patient harm. The commonest errors observed were unauthorized tablet crushing or capsule opening (111/369, 30.1%), omission without a valid reason (100/369, 27.1%) and failure to record administration (87/369, 23.6%). Among the nurses observed, the error rate varied widely from no errors to one error in every two doses administered. Of the seven nurses who completed the post-observation questionnaire, all said they would be willing to be observed again.

In June, 2007, the American Nursing Association (ANA) released a survey on injectable medication errors. Not surprisingly, the vast majority of nurses were worried about medication errors, with the busy work environment, poor or illegible handwriting and missed or mistaken physician's order cited as the top three reasons for those errors. Referring to syringes, the survey revealed significant difficulties associated with syringes and welcomed the addition of a write-on stripe that would allow critical information to be recorded directly onto the syringe barrel.

Another study published the same year provided an opportunity to see data from a country where reports of medication errors are very rare. Knudsen et al., (2007) carried out a study to investigate the frequency and seriousness of medication errors occurring at 40 randomly selected Danish community pharmacies. The data were collected for a defined period and included four types; prescription correction, dispensing near misses, dispensing errors and adverse drug events. The results were 976 cases of prescription corrections, 229 cases of near misses, 203 cases of dispensing errors and 198 cases of adverse drug events. The error rate was 23/10,000 prescriptions for prescription corrections, 1/10,000 for dispensing errors and 2/10,000 for near misses. These results clearly showed that prescribing errors were the most frequent type of error reported, and errors that actually reached the patients were not frequent, but most of them were potentially harmful. Patient safety could be further improved by optimizing the opportunity to learn from the incidents described.

From the Danish perspective we return to California where in the same year a study was published from the Cedars-Sinai Medical Centre in California. This was produced against a background of the annual numbers of medication errors injuring over 1.5 million people. Even in hospitals a lot of medication errors were reported. In November 2007, three infants were reportedly the victims of a medical error involving an overdose of heparin while at Cedars-Sinai Medical Center in California. In 2006, also three infants died after the same mistake was made in an Indiana hospital. In other hospital insulin-heparin mix-ups have been reported. Perhaps the nurses grabs a vial of insulin thinking it is heparin and adds it to an IV solution without further checking. Moreover, two cases infants died after receiving insulin mistakenly added to parenteral nutrition infusions. Another study showing the problems of intravenous administration is that of Maria et al. (2007). In their study, in three Brazilian hospitals, they verified the frequency of errors in the preparation and administration of intravenous medications a central activity in Brazil by the nursing staff. They found that the wrong dose and omission of doses were the most frequent errors that occurred in three hospitals when administering the medication to the patients in the ward.

Another 2007 study by Lesar (2007) medication errors were considered in relation to dosage formulation. He showed that errors related to dosage forms accounted for up to 15% of the prescribing errors and errors related to dosage forms were reported in 3% of the error reports to MedMARX. He also stated that from the available literature there is a wide range of problems and errors related to medication dosage forms. These errors can occur at all steps in the medication use process and have involved each of the primary individuals involved in the medication process - prescribers, pharmacists, nurses, and patients.

Again in 2007 Paolleti et al. (2007) published a study about the implementation of a multidisciplinary approach to systematically decrease medication errors through the use of observation methodology and the deployment of electronic medication administration records EMARs and bar-coded-medication administration BCMA. A consistent and reliable approach to data collection, a direct-observation technique was used. The measurement of medication errors using the observation process occurred in two phases-pre-implementation and post implementations were carried out. Three inpatient nursing units participated. The control group was a 20-bed cardiac telemetry unit. Intervention group 1 was also a 20-bed cardiac telemetry unit. Intervention group 2 was a 36-bed medical-surgical unit. During the first phase of the study, all three study groups participated in evaluating the medication administration process associated with a manual five-day medication administration record MAR. A total of 188 errors were reported. The pharmacy, nursing, and information services departments collaborated on the design and deployment of the EMAR and BCMA systems. The systems were implemented in one nursing unit in August 2003, with full implementation on all inpatient units by July 2004. During the second phase of the study, the control group continued to use the manual five-day MAR without a change in the process. Intervention groups 1 and 2 were measured to evaluate the medication administration process using EMAR and BCMA technology. The direct-observation accuracy rate before BCMA was 86.5%; after BCMA, the rate rose to 97%. They found a 54% reduction of medication administration errors was observed following implementation of a multidisciplinary, collaborative approach to medication safety.

Finally in this section of the thesis it is appropriate to finish with a study published by Chiche et al., in 2008. They reported about a harmful medication error in which severe hemorrhagic syndrome occurred due to similarity of drug names. This problem has been commented on in some of the previous examples give above. In this specific case a 68-year-old man was admitted to the emergency department because of severe, spontaneous hemorrhagic syndrome with diffuse ecchymosis of the skin, hematoma of the right thigh, and macroscopic hematouria. This patient had previously been treated for mild gastritis with proton pump inhibitors and for benign prostatic hypertrophy with permixon - a plant extract. A brief interview with the patient's pharmacist revealed that the patient had been given previscan (vitamin K antagonist) instead of permixon because of their similarities of their names – another problem of which examples are given above - and possibly complicated by the prescribing physician's poor handwriting. This led to severe, spontaneous hemorrhagic syndrome.

Not all awareness and medication error studies originate in the USA.

From the literature which has been cited above it can be seen that many references have come from an American medical perspective, especially in the hospital setting, but in truth that is not the complete story about the problem of medication errors. It has not been a problem exclusively investigated by physicians in a specific country as Pharmacists have had a long history in trying to determine the scale of the problem and possible solutions in a number of different countries.

As long ago as 1962 two American pharmacists published a study about errors and used the direct observation of nurses to determine their incidence (Baker and McConnell, 1962). In the UK in 1999 the Chief Pharmacist at the time Dr J Smith, who was later to become a Professor of Pharmacy Practice, was closely involved in a national report, entitled ' Controls Assurance Framework' which had a section in it concerned with reducing the risk associated with the use of medicines. In 2000 a further report was issued entitled 'An organisation with a memory' (Department of Health, UK, 2000.) Then in 2001, the hospital trusts assessed their services against the Medicines Management Framework and this highlighted several areas of concern. Finally against this background of all these official reports another report was then produced by the Audit Commission, which was entitled ‘A spoonful of sugar: Medicines management in NHS hospitals.’ (Audit Commission, 2001)

This final report was of major significance as it had recommendations to the Department of health and NHS Trust boards. Essentially there were to be for the very first time, national standards for the definition and categories of medication errors and also ‘near-misses’ which is was suggested should be a major concern of the organisation which was being set up at the same time namely, National Patient Safety Agency. Each hospital had to have policies on prescribing practices, medication administration practices and incident reporting. So, for the first time data would be available on the scale of the problem as would be the areas where advice could be given to stop any errors occurring in the future. Perhaps the best example of this is in the case of the correct way to administer vincristine since the problems this caused were of such great importance. So, in the UK hospital service, the awareness and systems to measure and attempt to correct the problem of medication errors is now in place and is an active process.

The UK was also aware that medication errors could occur in the community with errors being made in community pharmacies by Dr Gill Hawksworth and colleagues. (Hawksworth et al.,1999). The results of this study proved that pharmacists were both aware and interested in developing contact between the pharmacist and prescriber, one of the outcome measures being the number of hospital admissions for medication related problems. The study showed that errors had been made and their removal certainly saved a significant number of patients from being admitted to hospital because of their drug regimes. It is interesting to note that this was also in 1999 the year the Controls Assurance Framework was suggested. This year seems to have been of major importance in this field of study.

Very similar studies were later carried out in 2004 in Vermont (Kennedy &Littenburg, 2004) and Holland in 2001 (Buurma et al., 2001) with similar overall conclusions that community pharmacists must be aware of the risk of medication errors.

All the examples given above shown the large, diverse range and types of medication errors which have occurred for a diverse variety of causes. The following sections will provide additional background material and the objectives for this study.

2.2 Background about reporting medication error in Kuwait:

There is no information in the literature on medication errors in Kuwait and especially in the Armed Force Hospital (AFH). For this reason the aim of this study was to investigate the status of medication errors and how they may be handled in this institution in Kuwait. From personal experience, there are no reporting or documentation systems in place in the military hospital and the Ministry of Health. As a result, errors if they exist can persist because there is no way of discovering them or of following them up to correct the systems so as to abolish or minimize medication errors. Establishing a system to discover and document medication errors would go a long way to help identify problems that may persist in the health care system in Kuwait and this would need to involve all health care professionals involved in health care delivery. Thus, pharmacists, nurses and physicians can help to identify causes and sources of medication errors in the medication use process, and help to solve the problems of medication errors in patient care.

2.3 There are ten possible reason for conducting these studies

Rationale for doing medication error studies**:**

1- To prevent the occurrence of mistakes. The rationale behind investigating the problem of medication errors is to prevent future mistakes from happening in the dispensing and prescribing processes which could possibly cause serious harm to the patient.

2- To correct a wrong ‘work situation’. Medication errors have been shown to be inherent in many health care professionals and to identify the risk factor(s) which exposes the medical staff to make errors in the work place. Some common “stresses” which cause errors include: and consist of distraction, environmental and work load that the health care professional has to under take and also structural factor that involved the design of the procedure which can affect the doctor s diagnosis or weaknesses in the system. The work place can also be a cause of an error due to busy working environment, hence this can and in some places has lead to the proper use of standard operating procedures. The communication protocols involve a means of passing the right instruction to the patient on the proper use of medication.

3- If the reasons for errors can be determined then steps can be taken is educate others- ‘a teaching process’. So that errors are minimized.

4- To transfer information and experience to all health care team members. There should be a clear link between all health care professional to share their information and experiences to implement a clear way in dealing with medication errors and also to avoid errors happening in the future.

5- To stimulate all members of the health care team to search about information or even doing research on the topic of errors. In addition, current research has enabled all health care professionals to actively get involved in the search for information or to motivate them to under take a research in managing the risk factors which exposes the health care professional to make an error in the work place environment. As result of this research it may facilitate updating information and also gaining the skills which will reduce or eliminate the risk factor s which cause errors.

6- To maximize benefits to the patient. Patient education has helped in preventing error which has been made by the health care professional. This involves giving accurate information on the use of medication(s) by the patient. Thus, the patient derives maximum benefit from using the medication with the minimum of risk.

7- To give all the health care team a chance to revise their mistakes so as not to repeat them which promotes a high quality of the medical services to the patients. Also perhaps we should try and persuade people to look after their prescribing/ dispensing as they would any gold they had. Human beings value any gold they have and also take steps to protect it - Health care professional must do the same.

8- To increase the awareness about medication errors that may occur.

9- To suggest interventions to reduce or prevent these errors.

10- To provide measurement and suggest strategies for future research studies.

2.4 Objectives of the research in this thesis.

1) Questionnaires will be designed for all health care professionals to find out their attitudes regarding patient safety practices at the Kuwait Armed Force Hospital and also for reporting errors.

2) To identify the accuracy rate of the medication distribution system by comparing the actual medicine administrations given to the patient with the order of physicians. This should then be able to identify the errors which actually occur during the 'nurses phase' so that the factors that can affect the role of nurses through the administration of medications can be determined and suggestions made as to how to minimize these errors in the nurses' stage.

3) To identify the accuracy rate of dispensing of medications in the pharmacy by comparing the medication dispensing with the actual prescription written by the physician and contained in the patient file so as to be able to determine what sort of errors are made by the pharmacy staff. Furthermore the factors that can affected the role of the pharmacist and suggestions how to minimize these errors in through the dispensing stage may be determined.

4) To identify the errors caused by physicians when writing their prescriptions to the patient. Also what are the factors that can affect the role of physicians throughout the process and suggestions as to how to minimize errors at this stage of the process. In addition, using the observation study technique it may be possible to identify the errors made by physicians by checking the file of patient from the record department.

This is especially so when physician writes more than five drugs on one prescription without the knowledge of drug-drug interactions that may possibly occur.

5) To identify opportunities which may help devise a better system of patient education.

Chapter Three

3.1 Attitudes regarding patient safety practices at the Kuwait Armed Forces Hospital:

3.2 Objectives.

To investigate the attitudes and perceptions of healthcare professionals regarding committing medication errors and their views on the possible consequences to the employee at the Military Hospital in Kuwait subsequent to the reporting of errors.

3.3 Introduction.

Patient safety has emerged as an issue of primary concern in health care delivery due to inherent dangers associated with the use of drugs and devices to manage or prevent disease conditions. In spite of extensive checks and safeguards built into health care systems to minimize harm to patients, it is estimated that in the USA alone up to 44,000 to 98,000 and people die annually as a result of medical care that has gone wrong (ISMP, 2000). A significant proportion of this harm results from the use of medications and is thus termed 'medication errors'. A safe healthcare environment should promote safe medication use while reducing the likelihood of error occurring. The Institute for Medication Safety has taken a lead in efforts to find or devise ways through which this can be accomplished. In their seminal document published in 1999, the ISMP provided not only statistics showing the alarming rate of medication errors, but also suggested ways of minimizing or attempting to abolish medication errors. A key identified step in this process was the elimination of the blame or punitive culture when dealing with those who may have committed a medication error. In a system where healthcare staff may be fearful of possible consequences resulting from making a medication error, it may be particularly important for staff to be reassured that when an error does occur they will be treated fairly and with respect.

The objective of this part of the thesis was to investigate attitudes and perceptions of healthcare professionals regarding possible consequences when medication errors occur at the Military Hospital in Kuwait.

3.4. Methods.

There are a number of ways in which peoples' attitudes, perceptions and practices can be measured and studied.

The traditional ways to assess attitudes and perceptions is the use of questionnaires with either open and closed questions being used or a mixture of the two types of questions. Criticisms can be found in the literature about either type.

The biggest problem that is made in such literature is that open type of questions can give rise to answers which may be very difficult, if not impossible, to analyze in a statistical meaningful way as they do not conform to rigid groups as do the answers to the closed type of Likert scale questions. A major problem for the later type of closed questions may be criticized for not allowing people to express their opinions in ways which they think would be the most informative and this is a serious and difficult problem. Here question design is absolutely critical and fortunately in this area of research previous studies have been made, which are described below, which have gone to great lengths to formulate very clear and specific questions. Their use is therefore proven and trialed in many areas of medicine which for this study was a proven advantage.

For this study the problem is made worse by many nationalities being involved in the study, especially the nursing staff, where their first language was not English. It should be stressed that English is used as the language of the hospital so all respondents will have a good knowledge of the language but like other areas of life - some are better than others. In arabic countries it is sometimes a cultural problem to interview female members of staff but in this study thanks to the co-operation of the Chief Nurse this was not a problem and enabled the nurses to participate in the study which was extremely useful.

The use of interviews was initially considered but it was felt that since medication errors had never been studied in Kuwait it would perhaps be better to first all establish views and opinions through traditional questionnaires before interviews were considered. The use of open forum groups was also read about in other studies but again was kept as a reserve position if the data obtained required to be clarified.

Four of the ISMP survey questionnaires on healthcare professionals' attitudes and perceptions were adopted and used to gather data from nurses, physicians and pharmacists at the Armed Forces Hospital in Kuwait. The specific ISMP questionnaires used in this study are presented below.

a. Survey to Solicit Information About the Culture of Reporting

b. Nursing Staff Questionnaire Regarding Error Reporting

c. Pharmacist Questionnaire Regarding Error Reporting

d. Medical Staff Questionnaire Regarding Error Reporting

In order to allay respondents' fears regarding their confidentiality, surveys were distributed at their work units within the hospital, and respondents were requested to complete them anonymously and return them to pre-designated boxes for collection by the investigator. Reminders were issued two weeks after the first distribution and again two weeks later in order to allow more respondents time to complete and return the questionnaires. The questionnaires were then collected and the data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS v12).

To facilitate interpretation of results responses for each item in the last three questionnaires(b-d) the answers were transformed to a 5 point Likert-type scale (1-5) as follows:

Score	**Meaning**
1	Very unlikely or strongly disagree
2	Unlikely or disagree
3	Neutral
4	Likely or agree
5	Very likely or strongly agree

Using this method for comparison of responses allowed the means of each group to be compared against the other groups and the value of the mean reflected the degree of agreement or disagreement with the statement such that a larger mean value i.e. closer to 5 showed stronger agreement or likelihood of occurrence of suggested consequence in the medication error scenarios, and conversely a smaller mean value, closer to 1, reflected stronger disagreement with the stated consequence in the scenario.

The scores therefore reflected how strongly each respondent agreed with each statement with the lowest score,1, indicating the strongest degree of disagreement or least likelihood of the stated outcome, and the highest score, 5, reflecting the most positive outcome or greatest degree of agreement with the statement. This conversion therefore simplified data interpretation such that positive results or opinions on each questionnaire item would be associated with higher values i.e. mean closest to 5, and conversely negative consequences or opinions would be associated with lower values i.e. closest to 1

Survey to request Information about the Culture of Reporting Medication-Related Problems (Nurses, Doctors & Pharmacists)

Please answer the following questions honestly and to the best of your ability, indicating your choices by ticking the box that most appropriately corresponds to your answer.

	Strongly agree	Agree	Disagree	Strongly Disagree	N/A
1- Senior administrators/managers at my hospital communicate to me that patient safety is a high priority					
2- My department/unit acts on reported information related to medication errors (actual or potential) to improve patient safety.					
3- Administration is supportive of individuals reporting medication errors.					
4- My department/unit puts blame on individuals when an error is reported.					
5-I fear there will be negative consequences associated with reporting medication errors.					

6- My workload interferes with my ability to practice patient safety.					
7- I feel comfortable reporting medical errors made by co-workers.					
8- The medication protocols in my hospital are too complex.					
9- The process of reporting errors at my hospital is cumbersome.					
10- I believe that a medication error is the result of a failure of a complex system.					
11- New technologies, such as electronic medical records or automated drug dispensing equipment are creating a safer environment for patients in my hospital.					
12- New technologies available in my hospital are fully utilized to help prevent medical errors.					
13- I work in an environment where I can openly communicate my opinions about patient care practices.					

Nursing Staff Questionnaire Regarding Error Reporting

Scenario #1

You misread a doctor's prescription, written for a 50 year old man who has been admitted with congestive heart failure. You mistakenly prepare for administration Inderal 10 mg TID instead of Isordil 10 mg TID.

Please indicate your opinion by circling a number 1 to 5 for each of the following questions.

A. Another nurse detects the error before you administer the wrong medication to the patient.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. **How likely do you think that you will receive disciplinary action due to *this* error?**

(Unlikely)				(Likely)
1	2	3	4	5

3. **How likely do you think that you will lose your job because of *this* error?**

(Unlikely)				(Likely)
1	2	3	4	5

B. The error is detected by fellowing nursing staff after the patient receives the wrong medication for 24 hours. The patient suffers <u>no adverse</u> outcome resulting from this error.

1. How likely do you think that you will be blamed and criticized due to *this* error

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will lose your job because of *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

C. The doctor detects the error after the patient becomes hemodynamically unstable and is transferred to the ICU. The patient suffers no permanent adverse outcome resulting from this error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will lose your job because of *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

D. The doctor detects the error after the patient becomes hemodynamically unstable and is transferred to the ICU. The patient dies several days later resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will lose your job because of *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

Scenario #2

You misprogram an infusion pump for a heparin infusion. The misprogrammed dose is 10 times greater than the prescribed dose.

A. You detect the error prior to the patient receiving the wrong infusion.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

B. Same scenario, but a fellow staff member detects the error after the patient receives the wrong dose for 24 hours. The patient suffers no adverse outcome resulting from the error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

C. The error is detected when the doctor questions the nursing staff, due to the patient having a large gastrointestinal hemorrhage and increased APTT ratio. The patient is being transferred to the ICU. The patient suffers no permanent damage resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

D. The error is detected when the doctor questions the nursing staff due to the patient having a gastrointestinal hemorrhage and increased APTT ratio. The patient is transferred to the ICU. The patient dies several days later resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

Please briefly explain below whether or not you think medication errors should be gathered and investigated

……………………………………………………………………………………………………

Would you be "praised" by your peers for reporting errors?

Yes or No

Would you be "praised" by your hospital administration for reporting errors?

Yes or No

How long have you been employed as a nurse?

……….(in years)

How long have you been employed as a nurse in our organization?

………. (in years)

Do you work in: ❑ An inpatient nursing unit? ❑An outpatient nursing unit?

Do you work in: ❑ Adult services? ❑ Pediatric services?

Have you ever reported a medication error? Yes or No

If yes, please comment on any action that was taken regarding the error……

………………………………………………………………………………………………

Pharmacist Questionnaire Regarding Medication Error Reporting

Scenario #1

You receive a prescription, written for a 50 year old man who has been admitted with congestive heart failure. You mistakenly dispense Inderal 10 mg TID instead of Isordil 10 mg TID. (The correct label is placed on the box, but the wrong drug is placed inside the box).

Please indicate your opinion by circling a number 1 to 5 for each of the following questions.

A. The nurse administering the drug detects the error prior to the patient receiving the wrong medication.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				**(Likely)**
1	2	3	4	5

B. The error is detected by nursing staff after the patient receives the wrong medication for 24 hours.

The patient suffers no adverse outcome resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				**(Likely)**
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				**(Likely)**
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				**(Likely)**
1	2	3	4	5

C. The error is detected by the doctor after the patient becomes hemodynamically unstable and Is transferred to the ICU. The patient suffers no permanent adverse outcome resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				**(Likely)**
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

D. The error is detected by the doctor after the patient becomes hemodynamically unstable and is transferred to the ICU. The patient dies several days later resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

Scenario #2

You receive a telephone call on a Saturday morning to prepare a high-dose methotrexate infusion for a pediatric patient. In producing the labels and worksheet you choose the incorrect regimen and hence an incorrect infusion rate. The infusion rate is 10 times greater than the prescribed rate.

A. The error is detected by you prior to the patient receiving the wrong infusion.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

B. Same scenario, but the error is detected by a staff nurse after the patient receives the wrong dose for 30 minutes. The patient suffers no adverse outcome resulting from the error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

C. The error is detected by the doctor after four hours. The patient has gone into renal failure and is being transferred to the ICU. The patient suffers no permanent damage resulting from *this* error.

1- How likely do you think you will be blamed and criticized due to this error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

D. The error is detected by the doctor after four hours. The patient has gone into renal failure and is being transferred to the ICU. The patient dies several days later resulting from *this* error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

Please briefly explain below whether or not you think medication errors should be gathered and investigated.

……………………………………………………………………………………………
……………………………………………………………………………………

Will you be "praised" by your peers for reporting errors? Yes/ No

Will you be "praised" by your hospital administration for reporting errors? Yes/ No

How long have you been employed as a pharmacist? ……………**(in years)**

How long have you been employed as a pharmacist in our organization?........**(in years)**

Do you work in: ❑ adult services? ❑ Pediatric services?

Have you ever reported a medication error? Yes /No

If yes, please comment on any action taken regarding the error.

....

Medical Staff Questionnaire Regarding Error Reporting

<u>Please indicate your opinion by circling a number 1 to 5 for each of the following questions.</u>

Scenario #1

You are admitting in a 50 year old man who has been admitted with congestive heart failure. In transcribing from his list of drugs on admission you prescribe Inderal 10 mg TID instead of Isordil 10 mg TID.

A. The nurse administering the drug detects the error prior to the patient receiving the wrong medication.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely)				(Likely)
1	2	3	4	5

***B. The error is detected by your registrar after the patient receives the wrong medication** for 24 hours. The patient suffers no adverse outcome resulting from this error.*

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

C. The error is detected after the patient becomes hemodynamically unstable and is transferred to the ICU. The patient suffers no permanent adverse outcome resulting from this error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

D. The error is detected after the patient becomes hemodynamically unstable and is transferred to the ICU. The patient dies several days later resulting from this error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

Scenario #2

You wrongly prescribe the rate for administering heparin. The incorrect rate is 10 times greater than the correct dose.

A. The error is detected by you prior to the patient receiving the wrong infusion.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

B. Same scenario, but the error is detected by a fellow staff member after the patient receives the wrong dose for 24 hours. The patient suffers no adverse outcome resulting from the error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

C. The error is detected when the patient experiences a large gastrointestinal hemorrhage and increased APTT ratio. The patient is being transferred to the ICU. The patient suffers no permanent damage resulting from this error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

D. The error is detected due to the patient having a gastrointestinal hemorrhage and increased APTT ratio. The patient is transferred to the ICU. The patient dies several days later resulting from this error.

1. How likely do you think that you will be blamed and criticized due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

2. How likely do you think that you will receive disciplinary action due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

3. How likely do you think that you will be discharged from employment due to *this* error?

(Unlikely) **(Likely)**

1	2	3	4	5

Please briefly explain below whether or not you think medication errors should be gathered and investigated.

……………………………………………………………………………………………………
…………………………………………………………

Will you be "praised" by your peers for reporting errors? Yes /No

Will you be "praised" by your hospital administration for reporting errors? Yes/No

How long have you been employed as a doctor? ………… **(in years)**

How long have you been working as a doctor in our organization?.......... **(in years)**

Do you work as:
- ❑ **Medical staff member**
- ❑ **An attending physician or dentist**
- ❑ **A consultant physician**

Do you work in: ❑ adult services? ❑ pediatric services?

Have you ever reported a medication error? Yes/ No

If yes, please comment on any action taken regarding the error.

………………………………………………………………………………………………
………………………………………………………………………………………………

3.5 Results.

A total of 149 respondents comprising nurses (52.3%), physicians (32.2%) and pharmacists (16.1%) returned the questionnaires for a total response rate of 74.5%. Responses were analyzed and compared item-by-item to determine if there were any significant differences between the answers for the three groups for each questionnaire item. Results for the culture of reporting medication errors survey are presented in **Table 3.1 below**.

Questions in this section were divided into five general categories as follows:

i) Support and action on patient safety (questions 1, 2, 3, 11 & 12).

ii) Blame and consequences (questions 4 & 5).

iii) Causes of medication errors (questions 6 & 8).

iv) Communicating errors (questions 7 & 13) and

v) System for, and barriers to, reporting of errors (questions 9 & 10).

In all the three groups the point of most general agreement was about their perception of hospital administration making patient safety a top priority with regard to communicating with staff and taking action taken when medication errors were reported. Here all the means ≥ 3.0 and there was no difference between the groups, $p > 0.05$. Pharmacists felt that they were most assured of the administration's support when an error was reported, whereas nurses felt significantly least likely to see the administration as being supportive (item 3; $p < 0.001$). The nurses were also significantly more afraid of the negative consequences associated with reporting medication errors (item 5; $p = 0.026$). Although nurses were generally less likely to perceive themselves as being able to communicate freely regarding reporting of errors compared to pharmacists there was, on analysis, no significant difference between the two groups.

Both nurses and pharmacists were however significantly different from physicians who as compared with nurses & pharmacists were significantly less likely ($p < 0.001$) to report an error. Physicians had the most favourable response to perceiving new technology as helping to create a safer environment for patients and to the full utilization of such technologies within the institution in order to help prevent medical errors.

Responses to the two scenarios outlining possible consequences, should a staff member commit a medication error, tended to be very similar among the three groups and followed the same general trend in which the later the error was discovered and the more grievous the patient was harmed, then the more severe would be the consequences to the staff member. Interestingly, where differences were significant ($p<0.05$), physicians saw themselves as less likely to suffer consequences and nurses saw themselves as more likely to suffer consequences should they have committed a medication error. There was one point of totally agreement in all three groups, namely, that they felt they were more likely to see themselves facing dismissal from their job if the error they made resulted in the death of a patient.

Table 3.1 Culture of reporting medication errors in the AFH, Kuwait. The P value is a comparison of the lowest and highest score between the groups

Question	Group Mean (SD)			P value
	Nurses	Physicians	Pharmacists	
1. Senior administrators/managers at my hospital communicate to me that patient safety is a high priority	3.17 (0.71)	3.32 (0 .78)	3.46 (0.58)	0.179
2. My department/unit acts on reported information related to medication errors (actual or potential) to improve patient safety.	3.17 (0.96)	3.28 (0.93)	3.00 (0.72)	0.477
3. Administration is supportive of individuals reporting medication errors.	2.22 (0.86)	2.79 (1.31)	3.08 (0.78)	< 0.001
4. My department/unit puts blame on individuals when an error is reported.	3.08 (1.40)	3.09 (1.51)	2.83(0.76)	0.719
5. I fear there will be negative consequences associated with reporting medication errors.	2.99 (1.01)	2.62 (1.39)	2.21 (1.76)	0.026
6. My workload interferes with my ability to practice patient safety.	3.04 (0.82)	2.64 (1.13)	2.96 (1.62)	0.135
7. I feel comfortable reporting medical errors made by co-workers.	2.27 (0.64)	2.23 (1.07)	2.58 (1.14)	0.248
8. The medication protocols in my hospital are too complex.	2.44 (1.06)	2.68 (0.89)	2.92 (2.04)	0.206
9. The process of reporting errors at my hospital is cumbersome.	3.21(1.80)	2.72 (1.48)	2.25 (1.94)	0.046
10. I believe that a medication error is the result of a failure of a complex system.	2.69 (1.34)	2.81 (0.92)	2.92 (0.93)	0.68
11. New technologies, such as electronic medical records or automated drug dispensing equipment are creating a safer environment for patients in my hospital.	2.04 (1.45)	3.06 (1.11)	2.58 (1.47)	< 0.001
12. New technologies available in my - hospital are fully utilized to help prevent medical errors.	1.85 (1.49)	2.64 (1.22)	1.75 (1.32)	0.004
13. I work in an environment where I can openly communicate my opinions about patient care practices.	2.32 (0.86)	3.11 (0.91)	2.63 (0.97)	< 0.001

Footnote: comparisons have been made between all scores of healthcare professionals by using (SPSS V12) Student t test.

Table 3.2: Results for the scenarios regarding perception of consequences based on degree of harm to patient should a medication error occur. The P value is a comparison of the lowest and highest score between the groups

Scenario 1: Misread a written doctor's prescription and give the patient Inderal 10 mg instead of Isordil 10 mg.

	Nurses	**Physicians**	**Pharmacists**	**P values**
A. Error is discovered before patient gets drug				
1- Would you be blamed or criticized	2.19 (1.56)	1.81 (1.49)	2.33 (1.13)	0.256
2- Would you face disciplinary action	2.17 (1.57)	1.60 (1.48)	1.65 (1.23)	0.084
3- Would you lose your job	1.63 (1.24)	1.15 (0.93)	1.13 (0.69)	0.026
B. Error discovered 24 hours after patient gets drug; there is no harm to patient				
1- Would you be blamed or criticized	2.69 (1.56)	2.17 (1.59)	2.08 (1.44)	0.097
2- Would you face disciplinary action	2.94 (1.34)	1.74 (1.45)	1.83 (1.34)	0.000
3- Would you lose your job	1.99 (1.35)	1.62 (1.07)	1.67 (1.05)	0.214
C. Error discovered after patient becomes hemodynamically unstable and is transferred to ICU; no permanent harm to patient				
1- Would you be blamed or criticized	3.40 (1.11)	2.64 (1.42)	3.13 (1.15)	0.004
2-Would you face disciplinary action	3.40 (1.13)	2.40 (1.36)	2.92 (1.31)	0.000
3-Would you lose your job	2.69 (1.47)	2.30 (1.37)	1.83 (1.55)	0.033
D. Error discovered after patient becomes hemodynamically unstable and is transferred to ICU; patient dies several days later.				
1- Would you be blamed or criticized	3.72 (0.68)	3.32(1.48)	3.54 (0.88)	0.112
2- Would you face disciplinary action	3.55 (1.05)	3.45 (1.35)	3.67 (0.92)	0.733
3-Would you lose your job	3.38 (1.37)	2.94 (1.58)	3.29 (0.99)	0.215

Footnote: comparisons have been made between all scores of healthcare professionals by using (SPSS V12) Student's t test.

Scenario 2: You misprogram an infusion pump giving patient ten times the dose.

	Nurses	Physicians	Pharmacists	P values
A-Error discovered before patient gets drug				
1- Would you be blamed or criticized	1.95 (1.40)	1.87 (1.55)	1.75 (1.36)	0.836
2- Would you face disciplinary action	2.00 (1.32)	2.00 (1.35)	1.46 (1.22)	0.184
3- Would you lose your job	1.71 (1.31)	1.36 (0.89)	1.13 (0.85)	0.054
B- Error discovered 24 hours after patient gets drug; no harm to patient				
1-Would you be blamed or criticized	2.36 (1.67)	1.98 (1.65)	2.25 (1.51)	0.453
2- Would you face disciplinary action	2.31 (1.83)	2.36 (1.52)	2.58 (1.14)	0.549
3- Would you lose your job	2.01 (1.58)	1.43 (1.38)	1.46 (1.25)	0.060
C- Error discovered after patient becomes hemodynamically unstable and is transferred to ICU; no permanent harm to patient				
1-Would you be blamed or criticized	3.29 (1.22)	2.70 (1.44)	2.96 (1.30)	0.048
2-Would you face disciplinary action	3.33 (1.40)	2.79 (1.32)	2.79 (1.50)	0.062
3-Would you lose your job	2.58 (1.47)	2.32(1.32)	2.33 (1.37)	0.549
D- Error discovered after patient becomes hemodynamically unstable and is transferred to ICU; patient dies several days later.				
1-Would you be blamed or criticized	3.54 (1.17)	3.43 (0.93)	3.25 (1.26)	0.528
2-Would you face disciplinary action	3.64 (0.89)	3.26 (1.17)	3.21 (1.41)	0.080
3-Would you lose your job	3.40 (1.55)	3.43 (1.54)	3.04 (1.36)	0.556

Footnote: comparisons have been made between all scores of healthcare professionals by using (SPSS V12) Student's t test.

Table 3.3 Attitudes toward the investigation and reporting of errors.

	Nurses	Physicians	Pharmacists	P values
1- Medication errors should be investigated.	4.71 (4.01)	2.19 (2.88)	1.00 (0.00)	0.000
2- My peers would praise me for reporting a medication error.	1.72 (0.97)	1.91 (1.93)	1.17 (0.38)	0.073
3- My administration would praise me for reporting errors.	1.96 (1.22)	1.83 (1.95)	1.42 (0.50)	0.263
4- I have reported mediation errors in the past.	1.96 (0.87)	1.85 (0.36)	1.33 (0.72)	0.001

Table 3.4 Attitudes toward error investigation and perception of view by others

		Nurses	Physicians	Pharmacist	Total	P values
		N (%)	N (%)	N (%)		
investigated?	Yes	41 (52.6)	40 (85.1)	24 (100)	105 (70.5)	< 0.001
	No	36 (46.2)	7 (14.9)	0 (0)	43 (28.9)	< 0.001
eers for reporting errors?	Yes	29 (37.2)	25 (53.2)	20 (83.3)	74 (49.7)	< 0.001
	No	48 (61.5)	19 (40.4)	4 (16.7)	71 (47.7)	< 0.001
r hospital administration for	Yes	17 (21.8)	29 (61.7)	14 (58.3)	60 (40.3)	< 0.001
	No	59 (75.6)	15 (31.9)	10 (41.7)	84 (56.4)	< 0.001
ation error?	Yes	10 (12.8)	7 (14.9)	16 (66.7)	33 (22.1)	< 0.001
	No	67 (85.9)	40 (85.1)	8 (33.3)	115 (77.2	< 0.001

Footnote: comparisons have been made between all scores of healthcare professionals by using (SPSS V12) Student's t test.

Discussion.

3.6 Discussion of the attitudes of the nurses, pharmacists and physicians to medication errors

All the three groups were most in agreement about their perception of the hospital administration as making patient safety a top priority with regard to communicating with staff and taking action taken when medication errors were reported. The pharmacists group felt assured of the support of the administration when an error was reported whereas nurses felt least likely to see the administration as being supportive and they were very afraid of the negative consequences that would follow. These two groups expressed views significantly different from the views expressed by the physicians.

Physicians perceived that new technology was helping or would be able to prevent errors occurring. Physicians saw themselves as less likely to suffer negative consequences but all groups saw themselves facing dismissal from their job if the patient died. The physicians did however seem complacent about the overall problem of errors. Only 40% thought that erors should be investigated and there was a clear perception that their colleagues would not thank them for reporting such errors. They did how ever think the hospital would commend them for their actions but still only 15% had actually ever report an error as taking place. The last finding is very worrying and central to this thesis since if errors are not reported then steps to make sure the system is safer and errors are less likely to occur cannot progress. Perhaps it is their fear of being blamed or professionally criticized, which the results of many of the questions in the questionnaires clearly shows, which prevents them from carrying out the essential reporting role. This perhaps remains a topic for further research as to how this worrying lack of reporting can be improved.

This survey showed that studying the ‘perception culture’ for healthcare professionals was very useful and could give some ideas as to how to rectify potential errors. The major finding was that the hospital administration must give motivation to all healthcare professionals, especially perhaps to the nursing staff, to report medication errors rather than simply being a ‘blaming and punitive’ system.

3.7 Conclusion: Professional perception of the consequences of medication errors could be influenced by the area in which an employee works and the relative standing of the employee in the hierarchy of the organization.

Chapter Four

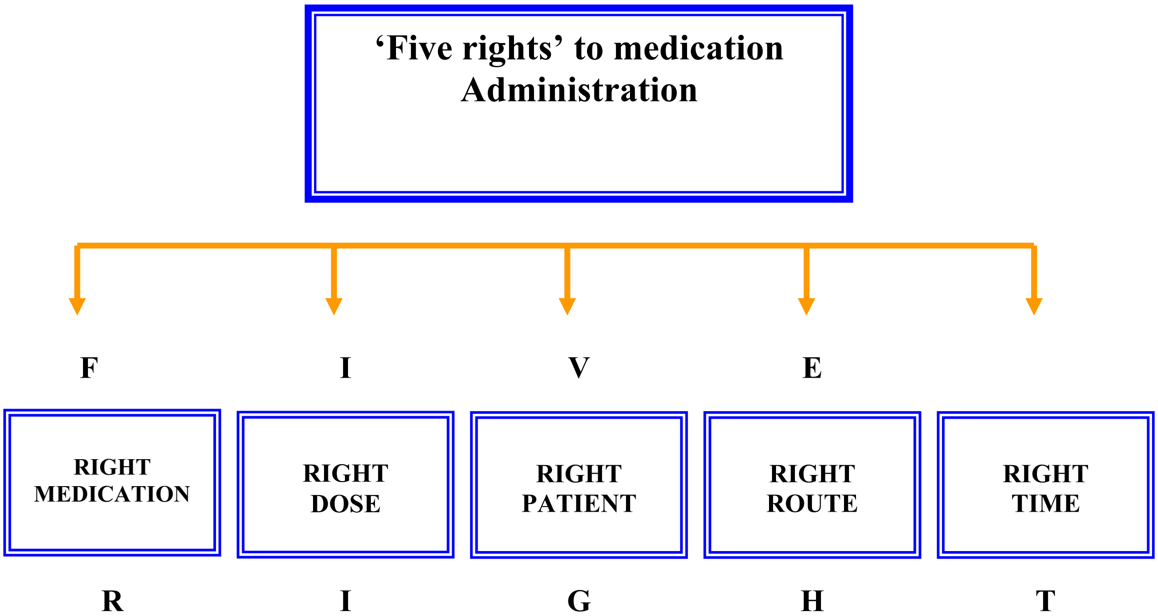
Nurses error study

4.1 Introduction:

Health care systems around the world have been disease oriented systems. In contrast, the current trend is to emphasize health and its promotion. Health has been define by "WHO" as a "state of complete physical mental and social well being and not merely the absence of disease and infirmity". Today, health is considered more than a basic human right and it has become a matter of public concern, national priority and public action.

The nursing professional exists to meet the health needs of the people. Nursing is a professional that is entrusted with care of sick. It carries out many duties - both medical and surgical preparatory routines, active caring of patients, and encouragement of individuals. This profession facilitates interventions which both promotes health and tries to prevents illness or help with actions that contribute to achieving improvement from illness or in the final stages of care achieves for an individual a 'peaceful death'. Nurses' care for individual at all stages of their life cycle and in all state of health from normal functioning to acute and severe crises. Nobody would dispute that Nursing is a caring, honourable, beneficial and 'good 'profession**.**

Figure 4.1 The' five rights' for medication administration.



Drug administration errors on the hospital ward is an ever-present and worldwide problem and their occurrence is too frequent. Administering medications is probably the highest-risk task a nurse can perform, and accidents can lead to devastating consequences for both the patient and for the nurse's career. In addition to their highly visible role of administering patients' medications, nurses in healthcare organizations perform many other duties and tasks ISMP (Mosby, 2005). These tasks form the content of the next section.

4.2 The other important nursing functions that support safe medication use.

- Obtaining and documenting the patient's medication history.
- Transmitting orders to the pharmacy so as to create a therapeutic environment needed by the patient.

- Transcribing orders and verifying orders on the medication administration record (MAR).
- Documenting medication administration and to be able to manage necessary emergency health services in case of emergency.
- Assessing patients' responses to medications and notifying prescriber of any necessary effects
- Education of the patient and families about correct medication use.
- To be aware of the availability of all the material and equipment needed in the unit.

Also, a nurse may have to provide other information such as helping other members of the healthcare team to choose a patient's drug therapy. She may evaluate orders and prepare medication to a large number of patients and also prepare patients for the operating theatre. These complex interactions among nurses can led to many potential errors, especially if the nurse is inadequately qualified and trained.

The purpose of this chapter is to provide the reader with a picture of the phenomenon of making medication errors through the process of medication administration by nurses. It should be stressed that the literature on this topic is sparse and fundamental research about the topic extremely rare. The diagram above Figure 4.1 gives the idea to the reader, that when any of these "five rights" are not meet with, alone or separately, then an error will definitely occur during the administration process as described above.

The actual reporting of medication errors is very difficult in many countries because of the consequences to all the healthcare professionals. There are a lot of medication errors made by all health care professionals in developing countries, but all of them are still very afraid of the consequences and the action(s) that may follow, if such errors are actually reported. For example, in some countries the individual may lose his/her job when he or she actually reports errors. The problem is made more complicated by the lack of a simple system which could be imposed to report errors.

This is surprising since everyone in this world can make errors ranging from the educated people to those who have lower educational abilities. They both can make errors in their house, for example by leaving the oven gas flaming inadvertently without any purpose, or in their employment by leaving the water boiling in the kettle and finally even in the street by thoughtlessly throwing a banana skin on the road so that an old man could slip on it and fall down and have a fracture or worse. Simply stated, because we are human beings we make errors.

To achieve safe practice and so prevent errors from occurring and to avoid them happening in the future, as they may be repeated again in the similar situations which caused them to occur in the first place, it is essential that we all take lessons from our mistake. This is the most important lesson to learn - not just trying to punish people who make the mistakes. This is perhaps the most important consideration about all types of error analysis.

In medicine the role of nurses is extremely important when everything goes well they can promote a patient's good health as their entire drug administrations are safe and checked because they have used and followed the 'five rights'. This should help or actually prevent patients from suffering any errors. In Kuwait, there was not at the time this thesis commenced any reporting system for medication errors which could motivate the nurses to report errors so as to improve the overall healthcare services. Most of nurses were too afraid to report errors in the hospital because of two major factors. The first is that it can lead to serious consequences being taken against them by the hospital management. Secondly, her colleagues would consider her actions - unacceptable and effectively ignore and marginalize her in the team of nurses. This is most unfortunate since her actions instead of threatening them could actually help them avoid the same errors in the future which could affect a patient's life and also their careers.

This chapter builds on the definition of nurses and their activities which were defined in the introduction and a) what types of causes can led to errors before - during - after the drug administration process, b) what factor(s) can affected the nurses' work during the administration of medications with different examples and c) to how to minimize these errors in nurses work will all be considered below.

4.3. Definition of administration error and an introduction to this part of the thesis:

Two definitions for such event were made by O'Neal (2000) and Leape (1995). The first author defines it as -

> 'Errors happening around the time of administration of drugs, are usually a result of problems with adherence to the 'five rights' of drug administering, namely the right drug, to the right patient, with the right dose, by the right route, and the right. Any problems with any one of these may be defined as an administration error' (O'Neal, 2000)

Such errors are usually associated with the health personnel most involved in administering drugs to patients, which to all intents and purposes, is the nursing staff.

Leape uses a different definition –

‘Drug administration error may be defined more specifically as any difference between the drug therapy actually received by the patient and the drug therapy intended by the prescriber.’(Leape, 1995).

If the ‘five rights’ are not met together throughout the entirety of the administration of medication(s) to the patients then it is more than likely that errors will occur at any stage of the process (Malone et al., 1999). Drug administration errors usually involve errors of omission, where actual drug administration is omitted due to a variety of factors. The most extreme example of omission is perhaps to give a drug to the wrong patient. An omission error is not always so severe and is recorded if a patient fails to receive a dose of medication that was ordered by the time the next dose is due. Another factor which may cause errors is simply a lack of the stock on the ward of the actual medication which is required and they borrow it from an adjacent ward. This may lead to a patient not receiving their medicine on time and so causes omission.

Another problem which can occur is centered a round using the wrong administration technique for a specific drug. The most obvious example is when the nurse incorrectly administers an injection. For example, they wrongly administer an injection IV rather than IM. There is one comprehensive study which explains the wrong administration of medication carried out by nurses. This study was carried out in Colorado, USA, where three nurses were indicted on charges of criminal negligence after a medication administration error killed an infant (Cohen, 1997). The essential details of the case were as follows. A one day old baby was prescribed a long acting penicillin. Because the baby’s mother also had infection at the same time the child and was being treated with an IV antibiotic, the medication to the baby was erroneously administered IV instead of IM, resulting in death of the infant. To make matters worse, it was also found that the pharmacist had actually dispensed **10 times** the appropriate dose.

Nurses are not always knowledgeable regarding the nature and volume of diluents, administration techniques, rate and schedules of administration. All healthcare professionals share a responsibility for identifying contributing factors to medication errors and for using that knowledge to reduce their occurrence. It should be emphasized that both experienced and inexperienced staff may be responsible for medication errors.

A wrong dose error can occur when any dose given is greater or less than the actual prescribed dose. These can occur in nurses through the ‘rush time’ - times at which the staff are extremely busy - when they forget to write the actual dose which has been given on the chart and that could leave another nurse to repeat the dose which would then result in an overdose.

Some nurses because they have to carry out a lot of routine work on checking the patient can forget to weigh and record the weight of the patient or measure the height of the patient and also forget to write their age. All these simple factors may cause errors because when drugs are prescribed such data are essential to be in the files so as to avoid medication errors.

Some nurses administer the wrong dosage forms such as doses which are administered or dispensed in a different form from that actually ordered by the prescriber. For example dispensing or administration of a liquid formulation without a specific prescription to a patient who has difficult swallowing tablets might be an acceptable dosage form change. Sometimes, exchanging one dosage form with another is not that easy since they may contain different quantities of the active drug and this is not fully known or understood by the nursing staff. Consequently, the patient could receive the wrong dose.

Nurses sometimes also dispense items without checking the expiry date for the drug and this will lead to a potentially difficult situation. Nurses must be somehow encouraged not to used expired drugs and checking the expiry date is the simple way to avoid such errors.

During the process of drug reconstitution, an error can occur due to the necessity of adding a diluent to a powder in a vial or bottle. Dilution is dependent of the volume of diluent added and the thoroughness by which it is mixed and if this is not adhered to then this will causes a ‘drug preparation error’. For example, reconstituting a cephalexin oral suspension with an incorrect volume of water, or using bacteriostatic saline for injection instead of sterile water for injection to reconstitution a lyophilized powder for injection (Kessler, 2004).

Nurses lack of knowledge in the correct indication or uses of drugs can cause a drug to be wrongly administered before meals or after meals. If the physician has not written precise details in the patient file then the nurse can administer the prescription wrongly. Nurses are not always knowledgeable regarding the nature of the schedules of administration of medications if the physician does not write the full information for the nurse and this can cause an error.

All healthcare professional shares a responsibility for identifying contributing factors to medication errors and for using that knowledge to reduce their occurrence, from both experienced and inexperienced staff. There is an economic impact due to the consequences of medication administration errors because in many cases this result in extended hospital stays additional treatment and malpractice litigation. Schneider and colleagues in 1995 comprehensively reported about the mean costs of medication-related problem medication errors and adverse drug reactions (ADRs). They ranged from $95 for extra laboratory test to $2,640 for intensive care. The total cost of medication- related problem in that one hospital in 1994 was $1.5 million. That means that medication administration errors have a 'cost' to both the individual and to the health care system.

Errors can potentially have many different causative factors and these can affect a nurse's practice in the administration of medication(s) and they occur according to the degree of 'work stresses' imposed on an individual. An example of such discrimination is when the head of the department of nurses discriminates unfairly between two nurses by giving one of them more incentives than the other to achieve their roles on the ward. This can led to a bad 'environment' between staff and also make the other nurses less motivated in their work.

Insufficient staffing can leave some nurses to perform more than one task. For example a nurse who does not normally write orders for the physician or write reports is asked to do so and in the process make an error about a medication. This can result in problems with late supply to the ward from the pharmacy and this result in late dose administration to patient. Typing a report for some physicians for their patients can lead the nurses to be distracted and they do not concentrate enough on the process of administration of medications. When such a 'distracted' nurse prepares such a medicine, due to being called away by a physician, she stops preparing the prescription, and when she returns so as to continue her preparation, she forgets some part of medication as she thought it was already prepared (Gomes & Reis, 2000). Another study has actually estimated that nurses sometimes spend about 25% of their time checking inventory or filling requests or separate drug in the various units and also transcribing prescriptions.

Rotating nurses from one department to another department can also result in serious problems, such as when a nurse who has full training in surgical department is transferred, because the shortage of nurses, to another department such as X-ray or the dental department. Her skills and knowledge are not in the area to which she has been moved and this may lead to some errors committed simply because she or he has insufficient knowledge about the equipment of X-ray or dental machine. Sometimes nurses fail to check the physician's instruction for some conditions for different patients such as diabetic patients. These patients must not be given food rich in sugar, which may cause an increase of the blood sugar and so lead to serious problems. The reason for this error is because the nurse fails to check the instructions written on the prescription or on the chart by the physician and may give a preparation to a patient different than what was intended by the physician. Nurses must also not use outdated reference material as this can lead to errors.

Against the general background given above there are some errors which are caused by very specific problems at the stage of drug administration. There are many causes of such problems at the stage of drug administration and these are considered in detail below.

4.4.1 What are the causes of medication error at the nursing stages of the drug administration process?

4.4.2 Zeroes and decimal points:

Numbers containing decimal points are a major source of errors. They are easily missed, especially on a lined order sheet. If some form of carbon transfer is used the decimal point can simply be missed by the nurse, then an overdose may occur. Some physicians as they progress through their wards rounds in the hospital or in the clinic write prescriptions, with perhaps insufficient care, and so miss the decimal point. In the case of diabetic and cardioactive medications or chemotherapy this can lead to serious problems of disability or even death. This problem although simply due to adding a zero behind the number is a classical error especially when a nurse is busy at a 'rush hour time'. The decimal point for an inexperience nurse can cause confusion and so result in her administering the wrong drug or wrong strength. This problem is not restricted to the nurses. Pharmacists can also be confused during the dispensing process resulting in the dispensing of the wrong drug or wrong concentration to the patient especially when doses lower than a milligram are dispensed, for example, "125mcg" instead of "0.125mg" (ASHP, 1993).

Some physicians also write their orders extremely quickly during their ward rounds and that causes problems. Even if the name of the medication is clear, the decimal point may fall on a line of the order form. A real example of this is an order for vincristine 2.0mg which was misread by the nurses and she gave 20mg. The patient died after receiving this massive overdose.

Another case happened concerning decimal points when an infant received 0.17mg of digoxin instead of 0.017mg because a decimal point was misplaced during dose calculation and also 'trailing zeroes' are a frequent cause of 10-fold overdoses (Cohen, 2000). To help this problem a space should appear between the name of the medication and the dose, as well as between the dose and the unit for example “Inderal 40mg” may easily be misread as “Inderal 140mg” instead of “Inderal 40mg” Consequently, the role of the nurse must be to double check any medication before administration so as to avoid any error occurring which could be fatal for the patient.

4.4.3 Deficiencies in medication use system:

Medication errors cannot be attributed to human error alone and errors can happen through a part of a defective or inadequate system (Leape et al., 1995). Keeping floor stocks of drugs can be very dangerous as these stocks in a patient care area can increase the chance for medication errors. This is because drugs are available to nurses without a technician or pharmacist to check and so it is easy to make a mix-up between two drugs which have the same packaging but contain different drugs. Also if there are no technicians to provide checking for the nurses this can lead to errors. An example is the use of potassium chloride injection instead of normal saline injection for flushing IV tubing. Also the problem of floor held stocks can circumvent standardized procedures and so cause errors.

4.4.4 Abbreviations:

Medication errors often occur because of the failure of a nurse to read correctly an abbreviation made by the prescriber on the prescription. Sometimes an abbreviation with great potential to cause harm occurs if the nurse cannot read an abbreviation because of a lack of experience or misreads the symbol for something else. For example, misreading the abbreviation ‘U’ for ‘unit’ as a zero or even for the number 4 or 6. Another problem is that an abbreviation can have multiple meanings or be easily misread for example, D/C is commonly used to indicate both “discharge” and “discontinue”. A physician who wrote three medications for a patient when they were discharged from hospital, namely insulin - digoxin - Tenormine, was assumed by the nurse to indicate the physician’s intent that the order was to discontinue the three drugs. Consequently, the patient went home without any medication for three days. The error was only later discovered when a nurse noticed the discharge prescription clipped to the patient’s chart. The problem was caused by the nurse not doubling checking an abbreviation with her colleagues before the patient was actually discharged (Cohen, 2000).

Many errors can occur from physicians’ abbreviation/ expression and it is essential that nurses must double check before the administration of any medication to patients. Problematic abbreviations are shown below in **Table 5.1.**

Table 5.1 - abbreviations written by physicians which may potentially cause confusion in the nursing staff.

Abbreviation /dose Expression	**Intended Meaning**	**Misinterpretation**	**Correction**
Mg	Microgram	Mistaken for “microgram’’ when handwritten	Use “mcg”
o.d or OD	Once daily	Misinterpreted as “right eye” (OD-Oculus(Dexter)	Use “daily”
TIW	Three a week	Mistaken as “three time a day”	Do not use this abbreviation
Qn	Nightly or at bedtime	Misinterpreted as “qh” – every hour	Use “ nightly”

SC	Subcutaneous	Mistaken for sublingual	write “subcutaneous”
Uor u	Unit	Read as a zero(0) or a four(4) causing a 10-fold overdose	Use “Unit”
q.o.d or QOD	Every other day	Misinterpreted as “q.i.d - four time daily	Use “every other day”
IU	International unit	Misread as IV - intravenous.	Use “Units”

4.4.5 Ambiguous or incomplete orders:

Incomplete orders for nurses can cause a lot of medication errors such as in situations where the route of administration, dose, or dosage form is not specified. For example, there is one reported case where a physician wrote an order for a neonate for “digoxin 1.5 cc” he did not specify for the nurse of the concentration of the medication even though two concentrations were available, 0.5mg/2ml ampoules and 0.1mg/1ml ampoules, both specifically designate for pediatric patients. The nurse administered the wrong strength for the pediatric patient without doubling checking with the physician and because she did not actually check the baby’s weight this caused even more problems (Cohen, 2000).

There are some physicians that as they make their progress through the ward, write-up medications for their patients without being careful to provide full details of their selected medications. Time of dosing can be omitted and so no discrimination is made between one tablet a day or one tablet every four hours or the total duration of therapy.

‘End of shift errors’ can occur because essential details are omitted for a lack of time at the end of their allocated time. An example is for prescribing diclofenac tablets without stating the strength and this can confuse the nurses because there are three strengths, 25, 75 and 100mg. Some consultants train their junior medical staff by giving them some quick verbal instructions or a few key points. On this basis, they are expected to carry out their complex job and unfortunately wrongly understand their instructions.

Some physicians neglect to complete the patient notes and so a full history and full information of the patients are missing. As all nurses need such information, failure to fill it such simple details such as name and age, are absolutely essential to avoid administration errors. Also the full name of the patient is very important as only using the patients first name with no family name, may led to two patients in the same ward within the same room who have similar first name being confused and the nurse mixes-up their medications.

4.4.6 Calculation error:

Most nurses who work with infants are actually aware of the risk of dose miscalculations in such patients. Because many drugs used in pediatric patients are not licensed, any simple computation errors may have serious harmful effects. Some nurses who are inexperience in pediatric care, have administered a wrongly calculated IV dose which has caused increased morbidity and mortality (Row et al., 1998). Calculation of the correct dose is very important for all patients but especially so for pediatric/infant and elderly people because in children there is a three times greater risk of medication errors compared to adults. The reasons for such problems are well documented including the dose being critically dependent on the child's body weight and age. Kaushal et al., (2001) suggested that correct calculations enabled healthcare professionals to be safe, and this is facilitated if there is good training of such calculations as some are complex if the person has made them before..

4.4.7 Poor communication between nurses:

Like many people in all branches of life some nurses have poor communication skills. This can cause problems when a nursing shift changes as the shifts need to exchange information with those about to come on duty. For example, if the patient was to receive QD medication at 10:00am but who was NPO until after a radiological test had been carried out and patient did not return to the ward until 5:00pm. Consequently, because of the timing the correct dose was not given, and because the next shift arrived and changed over the nurse forget to tell her colleague, so the patient did not receive their dose of medication. Since she relied on her memory she did not record on the chart and failed to mention it to the new shift. Also, if such examples occur the next shift has not the full information about all patients in the ward before the shift leaves and instruction made by a physician for any patients may simply go unmentioned.

4.4.8 Wrong time of drug administration:

Some nurses through the 'rush time' or 'family visiting time' forget to give patients their medication at the correct time which can lead to errors such as missed or over doses. According to O'Hare et al., (1995**)** when they examined the errors in the administration of intravenous drugs using the disguised-observation technique in a hospital setting, found a total of 291 errors in 168 of the observed doses. This suggests not just a single problem for each administration and on analysis there were: 140 wrong time errors, 114 wrong rate, 24 incorrect volumes, 9 wrong techniques and 1 of the use of an incorrect diluent. Interestingly, a wrong dose was rare as only one duplication and two dose omissions were observed. **The** major problem was that 80% of doses were given at the incorrect time.

Also for the purposes of this thesis, through my observation in the medical ward which were carried out in a similar way to O'Hare et al., (1995) it was found that one of the nurses forgot to give the patient his medication at the correct time of 3.00 pm and only remembered at 6.00pm. She gave the 6.00pm dose but did not change the record so there was no signature for the 3pm dose. Clearly a dose was not given at the correct time which was the most common finding of O'Hare et al., (1995). When I ask her why she had carried this out she said she had simply forgotten the dose due to the pressure of work. This suggests that a nurse must develop strategies for dose reminders and also write the dose at the same time as administration to avoid any errors occurring.

4.4.9 Deteriorated medications:

Some nurses due to either simple neglect or inexperience fail to check the expiration date of medication in the stock room or in the refrigerator because such a problem can lead to the drug losing its potency and effectiveness. Nurses should take responsibility to ensure that take steps are in place to keep any expired medication out of the dispensing stock so as to prevent other nurse using them without knowing that the medication had expired. Nurses must be also familiar with the pharmacy regulations and procedures for checking medication within a store room for their date of expiry. Sometimes routine and regular checking for expiry dates are considered to be "boring" by some health care personnel, but it is extremely important to carry out such checks so as to reduce the risk from making errors of dispensing expired drugs. So technicians and nurses have a responsibility to ensure that all stock is carefully placed on the storage area so that the stock which will expire the soonest is at the front of the shelves so that it is used before it actually expires. A nurse on a ward must write in alphabetical order on a piece of paper which can be displayed for all the staff to see and read all the drugs which are about to expire so that all staff do not pick up any expired medication. This could avoid accidental errors occurring from expired stock.

4.4.10 Compounding – drug preparation errors:

Errors can easily occur during the compounding and preparation phase at the ward by some nurses whose knowledge about the preparation of medications is rudimentary. Such errors are difficult to 'catch' or detect by nurses or other healthcare professionals because a lack of knowledge about the preparation of two drugs which because they look alike can cause harm to patients. A lack of knowledge in the use of drug, may occur as nurses are not always knowledgeable regarding the nature and volume of diluents, administration, physicochemical incompatibility and specific dosage forms. In a study by Leape et al., (1995) they identified 16 causes of errors, the majority of which are a lack of knowledge of the uses of drugs. Sometimes these are for reasons of an inability to swallow tablet(s) or to make an unusual dose of a drug it is necessary to grind the required tablets in a mortar and pestle. If the nurses does not know the correct procedure for grinding such tablets so as to be able to produce medications say for a disabled patients the formulation may simply get stuck in the tube used for dosing via catheter into the stomach. This can produce an error which may harm the patient. So it is essential that nurses take steps to reduce the risk of making such errors when compounding and preparation drug products. It is very important that someone who does not understand how to prepare a medicine should always read the product information sheet three times before preparing such a formulation of unusual preparations for special patients or by double checking with pharmacy staff to explain the procedure to avoid an error.

4.4.11 Wrong doses and correct medication:

Sometimes a physician writes a prescription for medications or writes in a patient's chart in a correct way but sometimes forgets to write the correct dose and the nurse administers a dose in ignorance of the real dose. Nurses in such a situation must double check with the physician if she is not sure about the dose or about the drug rather than depending on her knowledge or memory that physician intends this dose for the patient because it may be the usual dose, this is can led to errors. However, many drugs have a range of doses which can be used and so this leads to the error of the wrong dose. Also some physicians write the correct medication but with the wrong dose such as for pediatric patient when 10ml is written for an antibiotic syrup. Nurses must be very careful before administering any dose to a patient even if the dose are actually given and must always double check with the physician or her colleagues to prevent a wrong dose error occurring.

4.4.12 Poor documentation:

Some nurses forget to write all doses which been given to a patient at the same time as they were administered. Failure to do this may cause an error by another nurse who comes in on the next shift and thinks that the dose was not given to this patient. She then will repeat the same medicine again to the patient and this can cause an overdose. Some nurses also forget to write the full information about patients condition through 'rush time' such as BM - weight - blood sugar - BP – heart rate - pulse rate all of which can confuse other nurses when they have to administer medications.

An example of the care needed to keep records is shown in the care of a diabetic patient who requires an insulin infusion to stabilize their condition. The patient is admitted to the medical ward in the evening. The plasma glucose is measured and found to be high. Insulin is then started to reduce the blood sugar level. The next morning the shift changes and the nurse measures the blood glucose level and finds it low but does not record this value on the patient's notes. She does not administer any further insulin. On the next change of shift the nurse reads the notes but there has been no value recorded except the value on admission which because she does not check the blood glucose she takes as the value for the next infusion and so administers a dose of insulin which could bring about a dramatic reduction in an already reduced level. Double checking the blood sugar routinely before administering any diabetic medication to the patient is essential so as to prevent the patient from suffering coma or brain damage. The full problems about insulin have been mentioned above.

4.4.13 Wrong medication given to the wrong patient:

Some nurses at 'rush time' are confused about the administration of medications and so give the wrong medication to the wrong patient. One factor in this can be the distraction caused by the family of the patients who are in the ward during the time when the nurse is preparing the medication for patients and they interrupt her by asking her some questions about their relative who is the patient. This distraction can cause her to prepare the wrong medication and give it to wrong patient although she thought it was the right medication for the patient. The patient relatives also sometimes ask the nurse a lot of question about medications, such as what this medicine is for and are there any side effects which can occur at the time of administration and all these types of questions can affect her attention/concentration to detail throughout the process of administering medications to the patient.

Nurses sometimes neglect to double check the patient prescription before they give the medications. This can lead to errors such as one given below by nurse through my own Observation Process (see below). A nurse was in a great hurry at the end of the day's work and mistakenly read the prescription that the drug, a baby aspirin tablet, was to be given to the patient in room 1. Actually the drug was for the patient in Room 2.

It is also possible for a nurse to give the wrong medication to the wrong patient, when he/she is caring for two patients prescriptions' who are in the same room with the same first name such as Michael, the risk of a mix-up is even higher, if one of these two patient has cardiac heart failure or angina or diabetic condition the consequence of such an error could be serious.

4.4.14 Independent double-checking:

Because there are many opportunities for error, the ideal medication administration system is one in which there is more than one practitioner between the drug and patient. Persons who prescribe, dispense and administer drug must rely on one another to detect and so prevent errors. For example when the prescriber makes an error on a prescription, a pharmacist may detect a prescribing error such as an inappropriate dose, duplicate therapy or drug interaction. Also nurses can also detect errors which come from the pharmacy through the system of double checking the medication as compared with the actual physician's prescription. The physician may detect the inadvertent discontinuation of a drug by nursing or pharmacy staff. Double-checking is also vital at the time of 'order transcription' as the nurse or unit clerk may be less familiar with medications and dosage forms than the pharmacist. It is less likely that the wrong dose or wrong drug will reach a patient when both pharmacy and nursing staff have reviewed the prescription or the order form before being dispensed or administered. For example, a physician wrote an order for a patient of “Rocephin 1gm IVPB q12” Because of the poor handwriting, the unit clerk and nurse interpreted it wrongly as “q12” as “qid “. The nursing staff due a lack of drug experience was unaware that Rocephin is usually given only once or twice daily. The nurse copied the order and sent it to the pharmacy. The pharmacist recognized the error and immediately called the nurse and caught the error before it reached the patient. That is why double checking is very important for all healthcare professionals so as to avoid errors occurring at any stage of the process (Cohen, 2000). An example of the failure by nurses to double-check a drug administration is the following. A one day old baby was prescribed a long acting penicillin. Because his mother also had an infection at the same time, the medication was erroneously administered IV to the infant instead of IM to the mother and this resulted in the death of the infant. Also it was found that to make matters worse that pharmacist had actually dispensed 10 times the appropriate dose (Philip et al., 1999).

4.4.15 Verbal order:

Some physicians through the ‘rush time’ in their offices or in the operating theatre room may give the nurses some verbal order to give some patients medication by increasing or decreasing the dose. The nurse may receive the order wrongly such as medication look-like or sound-like names, Losec may be give instead Lasix, which can cause an error to the patient. For another example, in an emergency room a physician gave a spoken order for “morphine 2 mg IV”. The nurse, however, heard the physician and thought he had said give “morphine 10mg IV”. The young patient received a 10mg injection and developed respiratory arrest. Clearly, nurses must not take verbal orders from a physician until they make absolutely sure of the spelling of a drug name or check the dose and route are correct.

4.4.16 An incomplete order:

This one of the most important reasons why errors occur, is simply because the nurse has a responsibility to question all incomplete or unclear orders before the administration of any medication. Even if the course of the action seems obvious, the nurse must not make any assumptions about the prescriber's intent. An example of this problem included that given by Cohen in 2000. A physician ordered a "mycostatin" suppository, with the instruction "one at bedtime" for a woman who was recovering from a cerebrovascular accident. The route of administration was not noted. A night shift nurse prepared the tablet according to the instructions on the package insert and placed it in the patient's vagina. The following morning the nurse learnt that the physician intended to dissolve the drug in the patient mouth. Such a simple error occurred because the nurses did not double check with the physician or with her colleagues so as to prevent a patient error

4.4.17 Interruption leads to Distraction:

Errors sometimes occur on the wards, because nurses are often simultaneously preparing doses for more than one patient. If a nurse is interrupted, say by one of the physicians or another member of staff while she is preparing the medications, for example to help the physician to take a patients temperature, she might be confused after coming back to the preparation area and so mix-up one patient medications with another. This makes it possible for a nurse to give the wrong medication to the wrong patient.

4.4.18 Lack of patient education: If nurses are to educate their patients they will play an important role in ensuring safe medication use. If patients know what a drug is for, how is should be taken, what it looks like, and how it works, they will be in an excellent position to help minimize the possibility of medication errors. It is very important for patients to be counselled by nurses about their medications at all point(s) of their care. Nurses must encourage patients to ask questions about their medication for example, if any side effect can be expected or any important instructions they can follow whilst they are taking their medicines. If a patient is aware of the medications they are receiving they can alert nurses to potential errors in medication administration. If a patient questions a dose of medication, that dose must not be administration unless the reason for refusal can definitely be determined to be invalid. For example when a patient with diabetes insisted that a dose of 85 Units of NPH insulin was too much, the nurse checked the order and the medical administration record (MAR). Both indicated that the 85Unit was correct. However, she took the patient's concerns very seriously and called the attending physician. The nurse actually learnt that the patient was in fact correct. The reason for the mistake was that another physician had relied on MAR records from the patient before admission. Patients must expect to receive satisfactory answers about their justifiable concerns from their health professionals (Cohen, 2000). A well educated patient is a strong defence against errors and educating patients can help all healthcare staff to discover any sort of error will could occur and will also give the patient an opportunity to explain their concerns before something actually goes wrong and so can catch the error before it happens.

4.5.1 What are the factors which can affect the role of nurses through the process of drug administration of medication to the patient?

4.5.2 Environmental work area: An unfavorable working environment is one of the most important causes which can increase the administration error rate. The designated area for drug preparation must have adequate space and appropriate lighting, temperature, and humidity for comfortable work Ukens (1997). Individual environmental factors will now be discussed below in some detail**.**

4.5.3 Noise:

Certain levels of noise and sounds have been found to affect the work of the nurse in the ward during the administration medication process to their patients. It was found that if level of noise was decreased then the rate of administration errors fell. It is thought that noise sometime leads to nursing errors simply by not allowing them in the preparation stage(s) to concentrate fully and likewise during the administration stage which may deliver inappropriate quantities of medication to the patient. To make a safe administration process you have to make the right environment for the nurses so as to promote good health care services to the patients. When we control the noise and the sound in the ward, then we can decrease the administration rate of errors. If the sound 'loudness' is increased then the rate of error will increase. Flynn et al. (1996).

4.5.4 Lighting:

The level of light- ambient brightness - is very important issues so that nurses can differentiate between two drugs in say the stock room, preparation room or ward which have the same name. A greater intensity of light can make a prescription clearer, but if the light is poor this can cause many problems. For example, there are many studies which explain the important of the level of light during the preparation of medicines. I need perhaps here only mention one of these studies albeit in a pharmacy setting but which is relevant to where any dispensing is carried out, which was extremely comprehensive, which was carried out by Buchanan et al. (1991).

They reported on the effect of the lighting level on dispensing errors in a high-volume outpatient pharmacy. A total of 10,889 prescriptions were evaluated. Three different lighting levels, 45-102-146 foot candles were compared. When the level of 45 was compared to 102 the latter produced a significant decrease in the dispensing error rate, from 3.9% to 2.6%. When the lighting level was increased from 102 to 146 foot-candles a further improvement was made. Most pharmacies are aware that correct lighting is important and so try and ensure a suitable level. The correct lighting level also makes it easy for the pharmacist to read prescriptions clearly, even with ambiguous hand writing. Also the nurses need similar lighting levels for the process of preparing doses for patients and reading the chart clearly on the wards.

4.5.5 Work Area:

A suitably designed work area is very important for nurses and all healthcare staff to be able to move freely without any problems. In contrast a poorly designed area can contribute to picking-up the wrong drug, from the wrong shelf and so cause errors. If the work area does not have proper lighting and adequate counter space and a comfortable temperature and humidity it can affected the medications or may actually spoil them. If the facilities are ‘smooth’ and there is big space which can let the nurses move freely for the process of preparing a patient’s prescription and they can pick up the medication from the location easily. In some wards the stockroom is in work area and provides ‘clutter’ of different medications, so that leads onto nurses picking up the wrong medication if there are two medications that have the same company packaging. Examples of this are shown in Chapter 5 p203 or they have the same package and strength but different name such as the examples which are shown in Chapter 5 p198. All these factors can produce errors. The room stock in a work area should be kept as free of ‘clutter’ as possible to avoid any errors occurring. For example, when a container is no longer in use, it must be returned to its proper storage area or discarded. Each medication should have an allotted adequate space and also each strength must have its own drawer/shelf space. But some nurses keep all strengths of medication near each other and this can easily cause the wrong one to be mistakenly picked up. Simple precautions are also important such as all prescription bottles must be stored with the label facing forward (Ukens, 1992). Medication should not be stored on shelves or in bins, or drawers that have an external storage label, because medication in similar packaging can easily mistaken one for another if only the label was used for identification (Ukens, 1992).

4.5.6 Stress in Work:

Some nurses due to long working hours in the hospital can make them tired also because the nurses have several patients to take care of this tiredness can decrease their ability and concentration at the time of drug administration. Interruptions of a nurse by another nurse(s), colleague, patients and patients’ family members may limit their ability to focus in their tasks which can lead to errors occurring, for example when a nurse has to prepare medications for two patients at same time. All these distractions and stresses of nurses' work can lead to a loss in their concentration. Another but more complex factor which can cause errors is the relationship between the nurse and their head of department. Some nurses are more motivated than others and they may receive a favourable report especially those who are close to head of the department whereas another nurse who carries out the same duties with the same degree of success but is not close to the head of department may not receive the same favorable reports. This will cause psychological stress to the second nurse but not the first. There are other complex factors which include the lack of incentives and absence of recreational facilities which cause stress and so all these things may produce errors

4.5.7 Shift work of nurses:

Seven reported studies have specifically focused on the length of shift nurses work - 8, 10, and 12 hours and the types of shifts nurses were scheduled to work - days, evenings, nights or a combination of times. Two recent studies have examined the work patterns of hospital staff nurses. A survey of nurses who were members of the ANA (n=393) (Rogers et al., 2004) and a randomly selected sample of nurses who participated in the National Institute for Occupational Safety and Health (NIOSH) Nurse Work life Survey (n = 2,273) (Trinkoff et al., 2006) . Both found that nurses were working long hours. In addition nurses actually worked, on average, 55 minutes longer than scheduled each day. In the study of Rogers et al., (2004) of the 5,317 shifts worked by the respondents during a 28 day period, 38.7 % of the shifts were 12.5 hours or more. This figure is very interesting in the context of this thesis, as in Kuwait the average hours worked is 5 hours.

One quarter of the respondents of the previously cited study worked 50 hours per week for two or more weeks of the 28-day period. More than half of hospital nurses were working 12 or more hours per day but half as likely to work 6-7 days a week, suggesting that more hospital nurses are working 12 hour shifts. Older nurses (>50 years) were less likely to work long shifts (Trinkoff et al., 2006). The likelihood of making medication and procedural errors, actual and near miss errors, increased with longer work hours and was three times higher when nurses worked shifts lasting 12.5 hours or longer. (Rogers et al., 2004) Age of the nurse (nurse factor), hospital size (hospital factor), or type of unit (unit factor) did not have any affect on errors or near errors. Among 687 RNs and LPNs surveyed in one hospital medication and procedural errors were associated with nurses that rotated shifts (Gold et al., 1992)

4.5.8 Shortage of Nurses:

Some hospitals have a shortage of staff which can affect the effectiveness of nurses' work. For example, sometimes a shortage of nurses will create problems for other nurses, because another department will borrow a nurse to do a task which she may not have any knowledge about. For example, to open some machine in the x-ray department or give a patient some IV color for preparation for City-Scan. A shortage of nurses can also cause the fatigue of the nursing staff a hospital actual has since they all have to do far more work. This could include more intensive preparation of medications for the patients and writing medications orders to the pharmacy department. Also the extra work could involve typing reports for physicians about the assessment of patients all of which could decrease the nurse's ability to concentrate. A shortage of registered nurses, in combination with an increased workload, has the potential to threaten the quality of care.

4.5.9 Floating nurses in different department:

Sometimes ‘floating nurses’ have advantages and disadvantages. The advantages include giving nurses more experience to learn about equipment in different departments and to experience more subjects from these different people in these different departments. The disadvantages include coping with different and difficult situations, for example if an emergency case came into the department for which the nurse has no experience about its equipment then she cannot help as much as those who have been specifically trained in that department and she could use the equipment wrongly and so cause error. Another disadvantage which can be serious, is if ‘floating nurses’ was working in the X-ray department but did not know the guidelines to follow for the X ray procedures to adopt for pregnant women the consequences could be very serious..

4.5.10 Absence of motivation:

Motivation is a very important factor in any hospital in the world as a lack of it can make the staff cause more errors and cause the staff to be ‘depressed’ if the motivation is absent. Some heads of department unfortunately lack a sense of creating motivation in their staff and this can reflected negatively on the entire staff. A simple example, but a relevant one, for encouraging motivation in the staff is by putting a photo of ‘good employee this month’ on the ‘board of departments’ as this will give the staff working hard recognition and so encourage all staff and hopefully promote a good level of care in all services for patients.

The staff only needs the encouragement from the head of nurse department to increase their aspiration for work.

4.5.11 Inexperienced Staff:

Inexperienced staff, such as new graduates and staff detailed to a unit they are not familiar with the procedures which the unit carries out, may contribute to medication errors. A new graduate nurse may be very nervous about giving injections to the patient and also with some of the simpler, but absolutely essential tasks, like completing checking the arm band of the patient. Some of new nurses also feel ‘shy’ when asked to prepare a medication and has to ask another nurse for double checking. Nurses must concentrated to the task in their hands and not to prepare two patients prescriptions at the same time, which she may think will save her time, but there may well be a mix-up between the two patients resulting in the administration of the wrong medication to wrong patient.

4.5.12 Lack of Time Documentation

If the nurse does not have the time to document an order another nurse may, in an attempt to help, repeat the same medication and this leads to error. Some medication dose may not be documented from the casualty department after admitting the patient to the ward. Here the ward nurse must ask the casualty nurse ‘did you give any medication and did you documented in the patient file’ so as not to repeat the dose again in the ward. Incidents have occurred in which a drug was given twice because one of the nurses forgot to ‘chart the drug’ after she had given it to the patient. The physician, thinking the drug was not given then asked another nurse to do it. The second nurse checked the chart and saw that it was not documented or not given, so gave the child another dose. She did not check with the patient first which would have been another way to prevent the error occurring (Thomas et al., 2005).

4.5.13 Verbal Orders:

Verbal orders and ‘language barriers’ by nurses may result in a wrong dose being given. When paediatric patients are discharged from hospital verbal instructions may sometimes be a problem for the parents, because if they do not speak English they can misunderstand instructions given to them. Nurses sometimes tell parents different instruction from the physician such as take this syrup once - does this mean one spoonful a day or one every hour? Nurses must double check with the physician for precise instructions. Nurses must not accept verbal orders except for an emergency case as verbal orders can lead to error. Through my observations for this thesis, one physician during the ward round told one of the nurses to give one of patients in room 3 insulin. Without double checking from the physician, the nurse thought that the blood sugar was high as it had been before. Unfortunately the blood sugar was low and so this course of events could have been very serious but very fortunately, another nurse discovered the error before actual administration of the insulin took place.

4.5.14 Distractions:

The USP indicated that distractions are a greater problem for nurses than for pharmacists, pharmacy technicians, and physicians (USP, 2003). Over a 5 year period (1998-2002), nearly 35,000 errors related to distractions were submitted to USPs MEDMARX database. Nurses were the most frequent category of personnel involved in these errors, and most of these errors occur during the stage of administering medications. Interruptions from the physician when the nurse is in the process of administering patient medications can cause confusion with another patient, because say after receiving a call from a physician to send a patient to physical therapy, she is interrupted and may because of a sequence problem administering medications incorrectly.

4.5.15 Unreliable Drug Information:

Continuous technological development has led to frequent changes in information relating to safe drug use and these changes have to be constantly monitored by health professionals and correctly applied in order that patients should benefit from them. So, it is a dangerous practice for nurses to use outdated traditional books and/or virtual books and also scientific magazines or some web sites because they are not reliable sources and all of these may yield incorrect information and so potentially cause errors.

4.5.16 Reasons for the choice of the Observational Method in this thesis.

I chose the Observational method for this thesis because it was thought it would ensure that the accuracy of the medication distribution system in Kuwait could be fairly assessed. The method has a number of advantages which are as follows:

1. It is very suitable to my ‘work culture’ so as not make any ‘problems’ for the nursing staff and/or the patients – which by themselves may introduce errors.

2. Effectiveness**:** the method has the ability to detect many more errors than other procedures. This is due to independence from the subject's knowledge of the occurrence of an error and also each error can be independent observed and reported.

3. Objectivity: a trained observer provides an objective and independent perspective. The observer provides a mechanism by which problems associated with the subject's willingness to report any error can be avoided, especially in hospitals where errors can result in serious disciplinary action(s).

4. The Observational technique does not rely on the reports of individual staff member but rather on the effectiveness of the Observer.

4.5.17 Pilot study procedure for the observational method was undertaken before the full study was made to explore the reaction/behaviour of the nurses on the ward:

Exploratory visit:

I introduced myself to the Head of the Nurses that I would be performing a research study for developing the system of distributing drugs to the patients and how the administration of medications to the patients could be optimized. Then I asked her some questions that I thought would help me in carrying out direct observations and I recorded the answers for all of these questions. Some answers were from the nurse whereas others were from my own direct observation.

Some of these questions were:

• What is the time frame for distributing medicines at the unit (peak time)?

• Who is responsible for distributing and administering the medications?

• How many nurses will distribute the medications on the ward?

• Is it possible for me to follow one nurse during the distribution time? If so, how many doses can report or how many patients could I cover?

•Is there an alternative way-such as following one nurse for an hour and then following another nurse for another hour?

The lessons learned from this visit were as follows:

I noticed that the medications were distributed sometimes at 12:00pm, others at 2:00pm after lunch. This variability depended upon when the drugs trolley arrived from the Pharmacy department. In addition I noticed that 5 nurses on the ward were responsible for distributing the medications and each nurse distributed drugs for 5, 6 or 7 patients. Sometimes, if a particular nurse was busy with other work for the ward then another nurse would have to distribute all medications to patients that the nurse should have done and so a nurse can distributes drugs to more that 7 patients.

On the basis of these questions/observations from the pilot study then the Head of Nursing allowed me to carry out the observations necessary for this thesis.

Pilot visit:

After developing the procedure and the forms for data collection, a visit was made to conduct a pilot study to explore whether further changes in the method were needed. All observations were conducted from 11am to 3pm on the designated ward. Data was collected according to the designed methods. From this pilot, several improvements were made.

1. Several of the columns of the data collection forms were updated to match the hospital ways of displaying medication data.
2. After noticing that nurses were very busy during the time at which medicines were administered, I felt I might be somehow interrupting and causing problems for the

process. Therefore, I worked on my observational method to be less intrusive and to make myself as ‘invisible’ as possible.

4.6.1 Methods:

Data collection technique

The setting of the study was the Military Hospital in Kuwait. Only the medical wards were included which comprised nine private rooms and twenty beds in five general rooms.

The technique used for data collection was based on the direct observation method of Barker and McConnell (1962). This technique has proved to be reliable and has been used to measure the accuracy of medicine distribution system in hospitals. The study was carried out on a group of nurses in one medical ward. It was carried out over a period of 30 days with observations made for 4 hours on each of the observational days. It was done anonymously with different shifts of nurses and the nurses were not informed that this study was done to find errors that may occur. They were only told that I was a pharmacy research student doing a study in a medical ward to develop the system of distributing the drugs to the patients and making it easier for them.

The specific objective of this section was to identify the accuracy of the medication distribution system by comparing medicines actually administered to the patient with those on the physicians’ orders.

Sampling: Barker and McConnell recommended the sample size for this type of study to be from hundreds to thousands of doses to be observed. For this thesis the sample consisted of one thousand one hundred and twenty four (1124) doses which were observed during a period of one month.

The specific steps involved observation of administration of medication in medical wards and observing any errors that occurred in the process. All nurses were informed of the study and its purpose by the team leaders at each nursing station.

The medication process used at the ward level began with the writing of the prescription on a standardized form by the physician. The prescription was then sent to the pharmacy for filling. Observations were done six days of the week excluding Friday which is a religious holiday in Kuwait. They were carried out at three different times each day although there were four possible times for medication administration by the nurses. These times were twelve - 12.00pm, six - 6.00pm and ten - 10.00pm.

The earliest time (6.00 am) for medication administration was excluded because it was not practical for the observer to be routinely present at the hospital at that time whereas for the other times it was always possible to obtain comparable data. Observations were carried out over a period of one month. The actual observations began when the trolley with the medication came up from the pharmacy with the patient prescriptions. A nurse about to go on a medication administration round would be randomly selected and would be accompanied by the observer when she went to prepare the medications for administration to patients from the preparation room which contained the medication stock. This was held in a trolley containing cards for each patient and individual drawers for each patient on the ward. Each drawer contained the unit doses received from pharmacy, every three days for each patient. In addition, there is a refrigerator in the preparation room to keep drugs that were needed to be stored under 25 ºC such as insulin, suppositories and syrups**.**

The observer was as unobtrusive as possible so as not to interfere with the nurse as she administered the medications to the patients on her round. The nurse would start by copying the prescriptions for each patient to whom she was going to administer medication and select those medications from the trolley and put them on her own trolley. For some medications the nurse would have to alter the dosage form e.g. crush tablets for administration to patients who had problems swallowing, such as a disabled patient, and the observer would note or record this information on the observation sheet **called the patient observation form** (see below).

When the nurse finished gathering the medications for her patients on that round the observer would then follow her room to room to observe her actions as she gave each patient his or her medications.

The observer would write down the following information for each patient as the nurse went about her job:

- Patient identification (file) number
- Patient's room number
- Scheduled time for the medications
- Each mediation the patient received including the dosage form and strength
- The actual time at which the medication was administered.

All the information for each patient was written down by the observer on three forms (see below) called

1) **Nurse observation form (Form A)** compared with order of the physician
2) **Patient prescription form (Form B)** to see if there were any changes in the doses time or strength of medication and omission by nurse. If the observer noticed any error in the process it was recorded at that time on a
3) **Medication error form (Form C)** and this included information such as the type of error. Errors had been pre-classified as follows: omission, wrong drug, wrong route, wrong technique, wrong time, wrong instruction, wrong strength/wrong dose and wrong form. This allowed the calculation of error rates.

4.6.2 The three forms which were actually used through the observation period are shown below:

Form A: Nurse Observation Form

Date:…………………..

Obs. No.	Nurse Unit	Patient ID or Bed/unit	Time of Adm.	Description of dose administered (name, shape, strength, dosage form, route)	Notes (e.g., method of preparation, or administration)

Form B: Patient Prescription Form

Patient ID:…………………………… **Unit/Room/ Bed:………………………**
Date:…………………

Date, and time of order	**Medication , strength, amount, form, instructions**	**Times dose due**				
		6	**12**	**6**	**8**	**10**
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10
		6	12	6	8	10

Form C: Medication Error Form

Patient ID, Room	Medication error description		Extra dose/dose	Omission	Unordered/ wrong drug	Wrong dose or strength	Wrong form	Wrong time	Wrong route	Other
	Ordered	Observed								
	Totals									

Total Errors =

Total Opportunities for error =

Error rate =

Accuracy rate =

The following terms and definitions were used for determining (calculating) error rates.

- Total errors (TE) = number of errors that were observed during medication administration.
- Total opportunity for error (TOE) = total number of doses observed during the administration period.
- Error rate (ER) = Total number of errors observed (TE) divided the opportunity for error (TOE) x I00%.
- Accuracy rate equation = 100 - ER %.

4.7.1. **RESULTS**

Table 4.1 below summarizes the number of opportunities for errors, which were observed plus omissions and the number of those in error. The next value is for the percentage rate of error for all observations and the accuracy rate. Data was collected from one medical ward which contained 20 beds and 9 private rooms. Five nurses were observed for the study period. Each nurse was usually responsible for 4 to 5 patients and the total number of patients was 29. Sometimes due to staff shortages, a nurse was sometimes left by herself to perform more than one task such as for preparing medications for more than seven patients and ordering medications from the pharmacy.

Table 4. 1 Accuracy of administration of medication observed for nurses.

Opportunity for error	Number of errors	Error rate %	Accuracy rate %
1124	194	17.3%	82.7%

A total of 1124 doses were observed during the observation period. A total of 194 errors were detected during this time. The observed errors were categorized as: 156 were drugs given at the wrong time, 11 unordered or wrong drug, 7 omission, 6 wrong strength, 3 wrong route, 3 no instruction and 2 wrong technique. The wrong time category had the highest rate of error, while the wrong technique had the lowest rate of error. An additional 90 doses were excluded because they were left on bedside and I was not confident if they were actually received by the patient or not.

After the results were calculated, then a figure was plotted on a chart for the day of the week actually studied for the calendar month. On these charts the error type was plotted against frequency of occurrence throughout the process of administration of medication by nurses for each day per week. The types of errors were plotted for each day of the week enabling and total errors are shown **in Figure 4. 2 below.**

Figure 4. 2 Number of errors observed per day of the first week of the study.

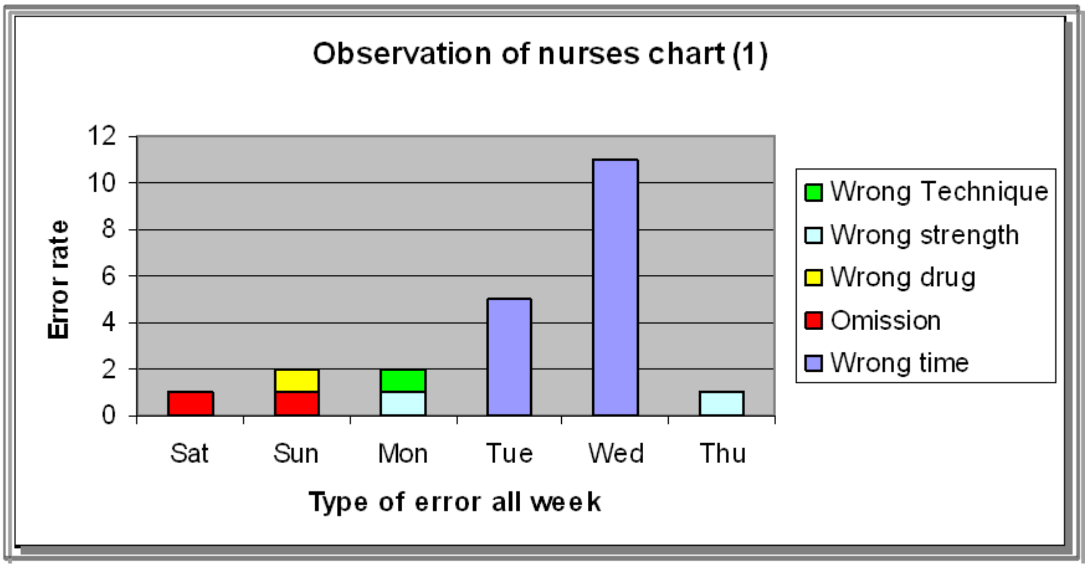


Figure 4. 2 This bar chart shows the rate of different types of errors which occurred in the administration of medication in the AFH. Also shown is the error rate against the number of error types per day of the week. After analyzing the figure, it was found out that of the total number of observed errors 22, the wrong time error achieved the highest number of occurrences, i.e. 11. In contrast, the wrong drug error type achieved the least number of occurrences, 2, along with wrong technique.

Table 4.2: Numerical results from the observation of nurses during week one where the opportunities for error(O.E), number of errors, error rate, and the accuracy rate for every day of the week in the hospital are shown.

No. of day.	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Total
O.E	30	42	35	40	47	28	**222**
No. of errors	1	2	2	5	11	1	**22**
Error rate	3.3%	4.7%	5.7%	12.5%	23.4%	3.5%	**9.9 %**
Accuracy rate	96.7%	95.3%	94.3%	87.5%	76.6%	96.5%	**90.1%**

The data shown in Table 4.2 indicates that the highest error of the week was on a Wednesday and the lowest error rate occurred on Saturday and Thursday.

Figure 4. 3 Number of errors observed by day of the week in the second week of the study

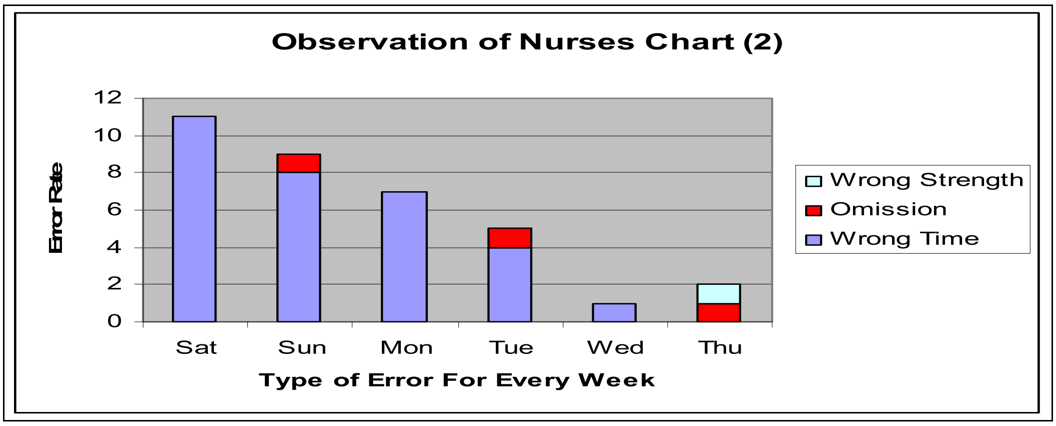


Figure 4.3 This bar chart shows the rate of different errors occurring in the administration of medication in the AFH and also show the error rate against the number of error types per day of the week. After analyzing the figure, it was found out that from the total number of observed errors was 35, the wrong time error achieved the highest number of occurrences, i.e. 31. On the other hand, the wrong strength error achieved the least number of occurrences, 1. The administration of the wrong drug and technique never occurred.

Table 4.3: Numerical results from the observation of nurses during second week where the opportunities for error, number of errors, error rate, and the accuracy rate in every day of the week in the hospital are shown.

No of day.	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Total
O.E	33	24	28	42	33	59	**219**
No. of errors	11	9	7	5	1	2	**35**
Error rate	33.3%	25.7%	25.%	11.9%	3.3%	3.3%	**17.1%**
Accuracy rate	66.7%	74.5%	75%	88.1%	96.7%	96.7%	**82.9%**

Table 4.3 : This table shows that the highest error in the week was on a Saturday and the lowest error occurred on the Wednesday and Thursday.

Figure 4.4. Number of errors observed per day of the third week of the study.

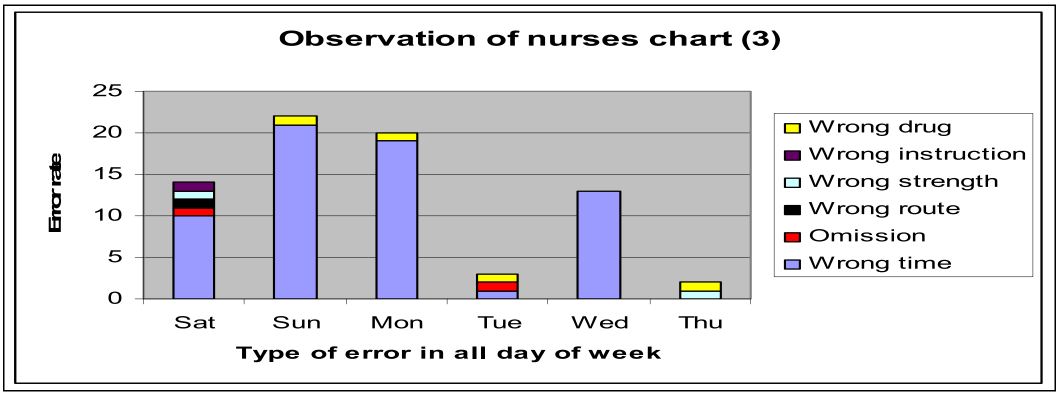


Figure 4.4 shows the rate of different errors which occurred in administrating medication in AFH in the third week of the study. The error rates and the number of error types for each day of week are shown. It was found that the total number of observed errors was75, the wrong time error achieved the highest number of occurrences, i.e. 65. The next most on 4 occasions was the wrong drug followed by omission and wrong strength. Finally the wrong instruction was recorded for the first time in the month of analysis where one occasion was recorded as was the occasion of the wrong route. On other hand, the no instruction error and wrong route types achieved the least number of occurrences.

Table 4.4 Numerical results from the observation of nurses during third week where the opportunities for error, number of errors, error rate, and the accuracy rate in every day of the week in the hospital are shown.

No of day.	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Total
O.E	39	53	48	47	48	39	**274**
No. of errors	14	22	20	3	13	2	**75**
Error rate	35.8%	41.5%	42.7%	6.3%	27.1%	5.1%	**27.3%**
Accuracy rate	64.2%	58.5%	56.3%	93.7%	72.9%	94.9%	**72.7%**

Table 4.4: show that the highest number of errors was recorded on a Sunday and the lowest errors occur were in the Tuesday and Thursday.

Figure 4.5 Number of errors observed per day of the fourth week of the study.

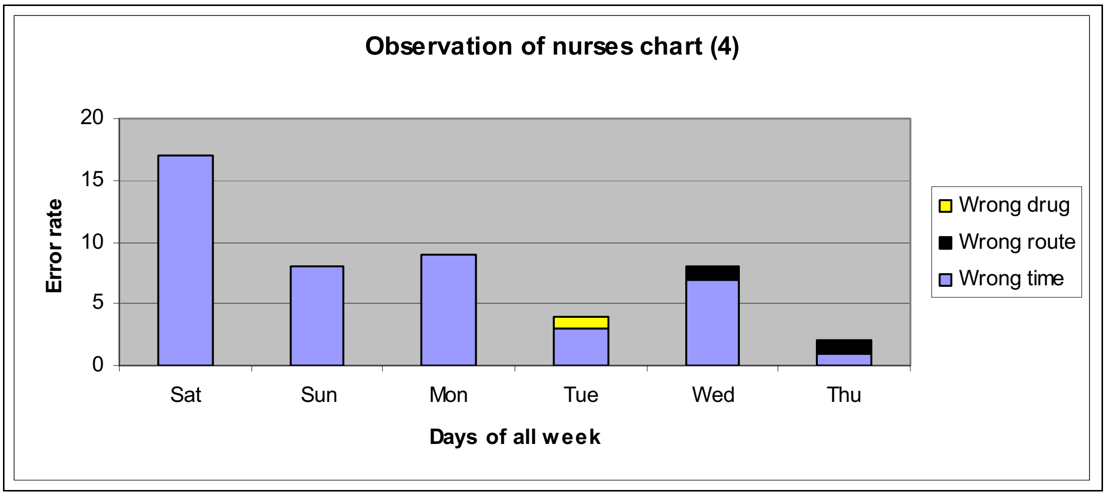


Figure 4.5 shows the rate of different errors occurs in administration medication in AFH and also shows the error rate against the number of error types for each day of week in the fourth week of the study. After analyzing the data, it was found that the total number of observed errors was 48. The administration of a drug at the wrong time error achieved the highest number of occurrences, i.e. 45; On the other hand, the wrong drug error type achieved the least number of occurrences, namely one. The wrong strength, administration and wrong form were never recorded.

Table 4.5 : Numerical results from the observation of nurses during fourth week where the opportunities for error, number of errors, error rate, and the accuracy rate in every day of the week in the hospital are shown.

No of day.	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Total
O.E	46	60	50	57	62	29	**304**
No. of errors	17	8	9	4	8	2	**48**
Error rate	36.9%	13.3%	18%	7.1%	12.9%	6.8%	**15.7%**
Accuracy rate	63.1%	86.7%	82%	92.9%	87.1%	93.2%	**84.3%**

For Table 4.5 the data shows that that the highest error in the week was on a Saturday and the lowest error occurred on the Tuesday and Thursday.

Figure 4.6. Number of errors observed per day of the fifth week of the study.

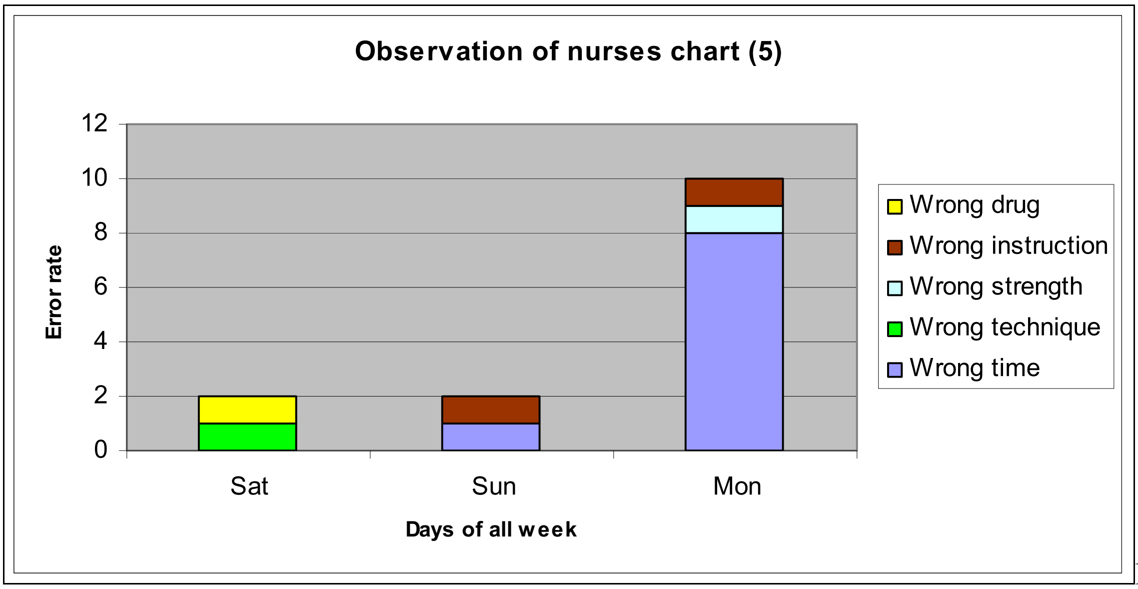


Figure 4.6 show the rate of different errors occuring in administration in the AFH for just three days during the fifth week of the study. Also shown is the error rate against the number of error types for all three days. After analyzing the data, it was found out that the total number of observed errors was 14, the wrong time error achieved the highest number of occurrences, i.e. 10, On the other hand, the errors such as wrong drug (n=1), wrong technique (n=1), wrong strength (n=1) all were found to be identical in number.

Table 4.6: Numerical results from the observation of nurses during fifth week where the opportunities for error, number of errors, error rate, and the accuracy rate in every day of the week in the hospital are shown.

No of day.	Saturday	Sunday	Monday	Total
O.E	20	41	44	105
No. of errors	2	2	10	14
Error rate	10%	4.8%	20.4%	13.3%
Accuracy rate	90%	95.2%	79.6%	86.7%

Table 4.6: Shows that the highest error in the three day period was Monday and the lowest errors occurred on Saturday and Sunday.

4.8.1 Observations made during the administration of drugs by the nursing staff to seek clarification for the reasons why the errors which were made actually occurred.

During the observational period, I had nine chances to ask for clues about the reasons for errors.

Case one: An error was identified as an unordered drug. 10ml of Albumin 20% was given to the patient at 1:00pm without an order from the physician. I approached the nurse and asked for her opinion. I asked the following: “do you know why Albumin is being given to the patient? It is not written in the patient's chart”. She replied: “it was sent from the pharmacy with the patient's prescription".

Case two: An error was identified as a wrong time error. The drug was received by the patient two hours late. I asked the nurse about the reason for that error. The following was asked: "Please, can you tell me why the patient received this medication two hours later than it should be?" She replied "That is because the trolley came late from the pharmacy”.

Case three: An error was identified as giving medication to the wrong patient by one of the nurses because he took a wrong verbal instruction from a physician. The verbal order to the nurse from the physician was to administer to a patient a dose of insulin because of high blood sugar. This was at the end of the shift for the nurses. When the next shift arrives the nurse who had received the verbal order gave the order to the next nurse who was to take over from his duties. However this nurse, the new shift nurse, was careful and checked the patient’s blood sugar before she attempted to administer the insulin. She found that the blood sugar level was below normal and then asked why the patient needed insulin when the blood sugar was below normal. So her careful approach to drug administration avoided an error which because it was for insulin could have been very serious as has been outlined above.

Case four: An error occurred with a disabled patient. Through my observation a nurse was giving a disabled patient his medication through a peg tube. To do this she had to grind the tablets into a fine powder so that it could pass down the tube. However, when she filled the medicine into the peg tube and then added water to the ground medicine, so as to help its passage down the tube, unfortunately the particles of powder stopped in the middle of the tube. Then the nurse squeezed the tube to encourage it passage but to no use. Eventually she had to remove the peg tube because the particles simply would not move and replace the tube with a new tube and re-administer the medicine this time in a finely ground suspension which I was able to help her achieve.

Case five: An error of the incorrect route of drug administration. One of the nurses through my observation was recorded as wrongly giving a patient injection of the anti-coagulant heparin. She was about to give it IM instead of subcutaneously and I stopped her before giving the medication. This occurred simply because of a lack of experience and so stopped potential intramuscular haemorrhage from occurring which may have caused severe problems for the patient.

Case six: An error due to similar drug names. One of the nurses through my observation wrongly gave one of the patients a tablet of Zyrtec which is normally used as an anti-allergy preparation instead of Zantac used as an H2 antagonist for gastric ulceration. Fortunately, the patient was not harmed by this error.

Case seven: An error due to trying to do two prescriptions at the same time. One of the nurses was in a hurry so he dispensed two prescriptions at the same time for two different patients. He picked up one of medications wrongly and so administered baby aspirin instead of the correct drug to the patient in room 1 whereas it should have been given to the patient in room 2. The error was discovered only after he had administered the medicine and as a consequence had to wait and monitor the patient for any complications. The aim to save time in the long run was not achieved as he had to wait a long time to see if his actions resulted in any problems for the patient.

Case eight: An error through an interruption of the administration process. Through my observation I also recorded the following problem. One of the nurses involved in the process of administrating medication to one of the patient, was interrupted by one of the physicians as he was finishing his ward round by asking the nurse for some information about the condition of one of the patients. The nurse simply forgot to give the last dose for a diabetic patient thinking she had already given and did so without double checking.

Case nine: An error of the incorrect use of a medicine due to a breakdown in communication. A patient was from the Bangladeshi army. Through my observation performed in the medical ward, a physician prescribed a suppository for reliving haemorrhoidal pain. During the process of administration medication the nurse was shy to explain the actual way to use the medicine thinking that the patient should know how to use it and so did not explain the exact way to use it. Then she went to administer another medication to another patient and the first patient wrongly administered his own medicine. He ate it!

4.9.1 Discussion:

The purpose of this discussion is to consider the results and to try and perhaps understand some of the examples of medication errors which occurred. Against this background the factors that may contribute to medication errors may give ideas as to how they could be prevented and so reduce the overall number of errors in the future.

The present study was carried out to identify the accuracy of the medication distribution system in a military hospital in Kuwait using the technique of direct observation. This was achieved by observing and noting the drug's names, doses, strengths, formulations, times, routes and drug forms that were administered to patients by nurses. The medicines administered to the patient were then compared with the actual order of the physician. This final point is very important since it is the only way in which real errors can be recorded on an objective basis and independent basis.

The study found that on a medical ward of Armed Force Hospital the overall error rate was 17.3 %. It was of interest to note that the most frequent error was administering a drug at the wrong time. For some drugs with relatively short half lives this may be very important for others perhaps less so. The results also showed that wrong dosage form was the least frequent error. This is a very useful finding to have made and since this error was the least common suggests that the nursing staff and physicians dispense/prescribe the correct dose of a drug but it may simply be administered at the wrong time. Consequently, problems of over/under-dosing are fortunately rare which gives some assurance that the practices in the AFH are very competently carried out. These results indicate that like many other studies reported from around the world there is a critical problem in the accuracy of the medication administration system in the Kuwaiti hospital used for this study. This therefore requires further studies to improve the quality of the system. However, from this study a comparison is possible with other figures from around the world. If the error rate from a number of hospitals over a number of years is examined the table shown below (Table 4.7) can be constructed.

In this table the AFH hospital rate is compared to a variety of hospitals from different parts of the world including the USA, Canada and France. It should be stressed that the references used below are those which are like the AFH in Kuwait and use the Unit Dose System of drug medication and so the direct comparison is a valid one since identical systems are being compared which makes the procedure valid.

4.9.2 Table 4.7. A comparison of the error rate in a variety of hospitals and health care facilities over the previous four decades from around the world which used the Unit Dose system of dispensing. The results in this thesis are included to provide a figure for comparison.

Date	Hospital, Facility or Type of Unit	TOE	Error Rate
1962	University of Florida	576	16.2%
1966	General Hospital, University of Arkansas	9789	15.0 %
1976	Canadian Hospital	4445	23.1%
1982	Skilled Nursing Facility	417	18.0 %
1986	Pediatric Intensive care	231	35.1%
1991	Pediatric Hospital	241	21.1%
1995	Teaching Hospital	873	16.9%

1999	Intensive Care Unit in Besancon University hospital in France	2009	6.6%
2001	Medical admission ward in UK	107	25.2%
2002	36 hospital care Facilities	3216	19.0 %
2003	Geriatric & Cardiovascular Thoracic Surgery Units, University Hospital, France	523	14.9%
2005	Two elderly long-stay in UK psychiatric hospital	1423	25.9%
2006	Public- private in Brazilian hospital	638	32.9%
2007	**Armed Force Hospital, medical ward**	**1124**	**17.3%**

From this table several interesting facts emerge. It is clear that the total opportunity for error (TOE) is best calculated when a large number of doses are examined. This is perhaps as would be expected since it enables a better data set to be obtained and so does not over or under estimate the problem. The highest number of errors in these studies was 9789 surprisingly carried out as long ago as 1966. The 15 % TOE was comparable to and earlier study in Florida of 16.2% and overall the figure is similar to those which have been recorded over the next four decades. In 1976 the Canadian results of 23.1% were possibly in line with the earlier American studies and the next two studies in the United Kingdom firstly in a medical admission ward, 25.2% in 2001 and secondly a study in a psychiatric hospital, 25.9% in 2005. Another study in both public - private hospital in Brazil in 2006 found 638 doses error rate 32.9%. Finally in the next decade, in 1986, the results from a Pediatric Intensive care unit in the USA were 35.1% which suggests two things. Firstly that perhaps the intensive care units have a special problem with errors which may be the case or that the complexity of total opportunities is much greater in such a field of medicine. The studies reported by Naylor, 2003 would seem to suggest both these factors are involved in the type of medicine.

In the last decade three studies were found in the USA, France and the studies from this thesis, in Kuwait. The studies in this thesis show a similar error rate to the French study, 14.9%, and comparable to the study by Barker et al (2002) in the USA where a figure of 19% was recorded. In Kuwait the figure was found to be 17.3%. This suggests that Kuwait has a similar error rate to at least the USA and France and so makes the results of this study to have implications for not only the Arabic countries but also other countries of the world. It therefore follows that Kuwait has no special problems of its own but follows a world wide trend which because the medicine practiced in the AFH is the same- as has been explained in Chapter 1 - this might not be too unexpected.

4.10.1 Suggestions and possible guidelines to reduce nurses' errors.

Based on the error rate and also on the observations made for this thesis several positive suggestions and possible guidelines can be formulated so as to prevent medication errors in the nurses' stage of drug administration can be made. These are:

1) A clinical pharmacist should be included in Kuwait hospitals to work with doctors and to help supervise nurses. He will be a link between doctors and nurses so as to ensure that the proper medication has been taken by or administered to the patient.

2) A Medication Error Reporting Scheme (MERS) should be established in the hospital. This will help to highlight problematic drugs or practices thus enabling awareness of medication errors to be highlighted in accordance with the procedures outlined by Flynn & Barker, (2006).

3) Clinical lectures should be given to the medical staff to increase their knowledge about drugs and how and when to use them and to keep everybody as up-to-date as possible.

4) A computerized system should be introduced into AFH Kuwait hospitals. By entering a doctor's order into a computer, it will be more obvious and easier for both the pharmacist and the nurse to access and would avoid the necessity to try and recognize/identify written drug names and their doses. This suggestion is based on an earlier study made by Flynn & Barker (1998) which it is of interest to note is now ten years ago and still in many countries computer systems are not widely available.

5) Unit doses in their final form should be dispensed to the wards so that the nurse does not have to carry out any further preparation. This should avoid any errors of preparation and follows the recommendation of Schnell in 1976.

6) Junior nurses should be carefully supervised by expert and experienced nurses to ensure that the proper and correct medication is given at the correct time.

7) The drug should be labelled clearly and printed by machine and should be affixed to the container. Again this is a recommendation made by Schnell (1976). It is of some concern that this simple step recommended 33 years ago still is not widely carried out. Furthermore, any information about the medication that is important for the nurse to know in order to facilitate correct administration should also be written clearly on the label.

8) In a more simple way - nurses should be instructed to always check that if drugs were left on bedside for the patient to self administer that the patient had actually taken them.

9) Medication administration time and location should be documented by the nurse and this should take place at the bedside. This suggestion is made after reading the recent studies of Tissot et al., (2003) and provides for a documentary check as to drug administration

10) The lighting level throughout the preparation area and the rooms should be increased to facilitate correct reading of the prescriptions and so ensure correct distribution of any medication. This is based on the very recent suggestions of Flynn and Barker in 2006.

11) Nurses should always be encouraged to follow the 'five rights' for safe administration. Consequently, before a nurse administers any medication to a patient they must follow the 'five rights' - right patient, right dose, right route, right time and right drug and this perhaps should be part of the normal drug administration process. If these 'five rights' are always met then hopefully there is a beneficial reduction in the chance an error can occur through administration of medication to the patients.

12) A nurses must check the patient's identity. Nurses before the administration of any medication to the patient must check the hand/wrist band and also check the patient's full name by saying a simple 'Hello Mr. Michael ' to make sure this is the right patient.

13) If a nurse has to carry out a dosage calculations it must be checked independently by another healthcare professional before the drug is actually administered to the patient. Nurses throughout the process of calculation of dosage(s) must make sure that the calculation is correct by double checking it with another colleague so as to prevent the patient and nurses themselves from any possible error due to miscalculations. They could also double check with the pharmacy staff so as to ensure a safe as possible process.

14) A nurse must check the prescription and drug and the patients name actually in front of the patient to make sure any medication is given to the right patient not another one who has same name. Nurses before giving the medication to the patient must first check the first name of patient and the family name because in Kuwait many people have the same first name but a different family name. If there is more than one patient in a room, steps should be taken to ensure that if two patients who have the same first name, they must not be put into the same room/ward but placed in different rooms/wards so as to avoid any potential error(s).

15) A nurse must ensure that any medication is given at correct time stated on the prescription. Nurses must make sure of giving medications to patients at the correct time so as to prevent a patient suffering an overdose. If doses are late through the late arrival of the trolley from the pharmacy or late from being given by nurses because of staff shortages these can affect the performance of carrying out another task such as ordering or writing verbal order prescription. In this thesis the wrong time of drug administration was the most common error which was found.

16) A nurse must not undertake another task whilst preparing the medicine for a patient. Nurses must concentrate to the task in-hand if she is preparing a prescription for patient. If any interruption(s) occur from her colleagues or by going to help another colleague, even for short periods of time, this may cause an error simply due to a memory lapse. This was clearly shown by the results in this thesis.

17) A nurse must not prepare medication in front of the patient. Nurses before preparing any medication must be away from the patients. This is because some patients feel anxious or psychological stressed if they see the nurse prepare their injection and they feel apprehensive about its administration. Also, some patients do not like if he sees the nurse prepare a syrup or tablet without her wearing medical gloves. Again adverse psychology occurs and the pateint becomes upset by thinking that the nurse has not washed her hands after seeing another patient and fears cross contamination. There is a study by McGuckin et al. as long ago as 1997 which clearly highlights the great importance of hand washing by staff.

18) A nurse should minimize interruptions during a drug round. Nurses must not be interrupted by another healthcare professional when they are preparing the prescription for a patient. Also, when the nurse is trying to write an order for the pharmacy and also any interruption must be minimized by nurses throughout the process of administration medication to the patients This must be the case, because if the nurse wants to write the medication on the chart so as to 'inform' other healthcare professional that this prescription for this patient was actually given at the stated doses so as to avoid another nurse repeating the same dose for the patient.

19) A nurse must not give recommendations different than what a physician tells a patient as this can reflected negatively by the patient. Nurses must follow the instruction(s) of physician so as to avoid errors may occur to the patient such as a diabetic patient whose physician restricted him to not eat food(s) rich in starch or not to eat sweets such as "desserts" as this will lead to increases in blood sugar and the nurse tell must him you can eat, but you must take your medication(s) for diabetes. Another similar example is when the physician tells the patient to use this medication after a meal, but the nurse says it is no problem to use it at any time.

20) A nurse must check the order as it is written**.** A nurse must make sure that they have a written order for every drug given. Nurses must only use verbal orders in an emergency. If this is impossible, then let the physician write it down as soon as is possible.

21) A nurse must always check the label. A nurse must always check the label three times before giving the drug to the patient so as to comply with the ‘five rights’. If the drug is ordered by trade name, but dispensed by the pharmacy using the generic name it should be verified that there is no discrepancy or change. A nurse must also make sure throughout the process that the labeling of the name of drug is clear on the container.

22) A nurse must check the route of drug administration. Nurses must make sure from the physician’s order that the designated route of administration is specified. If the route of administration is missing, the physician should be consulted for clarification and the nurse should never guess by themselves what they think it may be.

23) A nurse must make sure of the purpose(s) of the medication. Nurses must make sure of the purpose(s) of the medication so as to be able to understand why a patient is getting this medication and if this medication is fit for this type of condition. If not, then a nurse must try to seek clarification from the prescriber.

24) A nurse must have the right documentation. Nurses must make sure that they document the medication immediately after it has been given to the patient and not to wait for another time as this could cause error with another nurse giving the patient an extra dose. Nurses must make sure writing all information in the right place in the file of the patient. Nurses must make sure to write all drug patients’ allergies and a nurse must make sure any parenteral medications must be recorded as well noting the site of the actual injection.

25) A nurse must not use abbreviations. Nurses must make sure from any order that any abbreviation(s) written by the physician is both clear and understandable and not simply to rely on memory for administering any medications. A nurse must always double check with another colleague if an abbreviation is unclear or to return the order to the prescriber for clarification to prevent any error(s) occurring.

26) A nurse should never use 'old' liquids. A nurse must not use any liquid medication(s) that are cloudy or medications which have changed color from their baseline state. A nurse must also not use medications which have been opened to avoid problems of drug expiry.

27) A nurse must not give medications prepared by someone else**.** A nurse must make sure not to order another colleague to prepare medications for her, when she is in a hurry such as finishing her shift time. This may cause an error occurring by the other nurse. For example, by filling the wrong drug or wrong dose in the tray to give it to the first nurse to administer to the patient without actually double checking against the original prescription.

Guidelines may reduce the possibility of errors associated with spoken orders:

• Limit spoken instructions to emergency or urgent situations which means not every time the physician can use the verbal order but only when absolutely needed, such as below.

• Do not allow spoken orders, when the physician is present and a patient chart is available.

• Do not accept spoken medication requests in the pharmacy unless a written order is simultaneously faxed or otherwise seen before the medication is dispensed.

• Limit the number of personnel who may receive spoken orders.

•When any spoken orders are given by a physician, possibly have another person listen to the conversation to prevent any error which can occur from his colleague or some nurses who are distracted through the workload.

• Record the order directly onto the order sheet of the patient's chart. Because preventing the nurses from a 'memory lapse' through any interruption from another colleague when she finishing preparing the prescription for patient she does not mark the medication in the chart, and may leave another nurse to repeat the dose which can cause an error .

• Do not use an abbreviation as this may confuse the nurse's understanding of the spoken order and may result in giving another medication. This is especially so if the first name of abbreviation is the same name as another medication when it may cause confusion and so the wrong drug may be given by the nurse to patient. There are a lot of guidelines for decreasing the risk of spoken orders and only a few have been chosen. If the reader wishes to, they can further pursue this interesting problem by reading the work of Cohen (2000).

4.11.1. Conclusion

Conclusion for the nurses section of this thesis

From the results of this part of the thesis I conclude that the majority of the medication errors which were observed occurred, because of a failure of some part of the 'system'. Errors can occur if there is a failure to adhere to the 'five rights' for whatever reason. For example, one such systems failure, is the insufficient attention to detail in one case of the aspects of the administration to one patient, but by no means all patients, in the failure to grind a tablet sufficiently small to allow its passage through a peg tube. This is clearly a failure of a system which would have provided more training in the skills necessary to carry out such a task.

Another example in this part of the thesis which it should be stressed concentrated exclusively on the practices of the nurses, some of them did not follow the ‘five rights’ to promote safe medication for patients. This is illustrated by the example of drug names when trade name and generic names were confused and a repeat of the same medication occurred because there was no system in place to differentiate between trade and generic names, say some form of computer database, which would allow such names to be quickly checked.

Doubling checking is also a system which uses a second person to verify the calculations or checking of another member of staff after preparing the medications for the patients. This is usually a very robust system in which an error can usually be discovered before the patient is actually treated. It is a system which has universal application and has resulted in the minimization of many medication errors.

On a personal level I think that nurses perhaps do not have enough information about medication errors and what are their consequences. A solution to this problem could be to have an error reporting system in place which would, rather than punish an individual, be used to stop errors occurring in the future. For example, alert medication in diabetes and cardiovascular medicine, where errors if they do occur can be very serious, could profit from such a system. Cooperation between the pharmacy and the wards about request medications, should try and ensure that they are dispensed and sent to the ward as quickly as possible as delays may cause problems for the nursing staff time and so may improve the error rate especially as regards to the time of drug administration which it will be remembered was the commonest problem found in this part of the study.

Finally, there are no specific training courses for nurses to promote an agreed standard for good patient safety and the hospital is still not using a computer system at ward level and so errors can easily occur through the administration process. I think the system is like many in world but the problem may be that the people who have to use do so incorrectly and so sometimes the ‘five rights’ are not adhered to.

Chapter Five

Pharmacist errors

5.1 Introduction:

Pharmaceutical care is a philosophy of practice in which the patient is the primary beneficiary of the pharmacist actions (Hepler and Strand, 1990). Although it can be thought of as a simple concept in reality it is complex. The care focuses on the attitudes, behavior, commitments, concerns, ethics, functions, knowledge, responsibilities and skills of the pharmacist in the support of drug therapy with the goal of achieving successful therapeutic outcomes for the patient as well as trying to improve standards in public health and an individual's quality of life. Kuwait is no exception to this and it has its own professional rules and regulations. Dispensing is carried out against such professional ethics and duties and these can best be summarized in the following way.

5.2 Key responsibilities of a pharmacist:

1. Pharmacists should understand the nature and effect of medicines and medicinal ingredients when they react with each other, how drug interactions can be minimized and how medicines can also treat illness, relieve symptoms or assist in the diagnosis of disease. Pharmacists in all branches of professional practice use their knowledge for the well-being and safety of patients and the public by responsible and safe dispensing.

2. At all times pharmacists must act in the interests of patients and other members of the public, and seek to provide the best possible health care for the community in partnership with other health professions such as physicians or nurses and hospital staff. Pharmacists

must treat all those who seek their professional services with courtesy, respect and confidentiality. Pharmacists must respect patients and give them the correct instruction(s) and encourage them to participate in any decisions about their care and must also provide patients with suitable information that is important to them and to their lives.

3. A pharmacist can potentially avoid any error through any healthcare professional by double checking.

4. A pharmacist must ensure that their skills and knowledge and performance are of a high quality. And pharmacist also up to date, evidence based and relevant to their field of practice.

5. A pharmacist must be ‘nice’ with patients throughout the dispensing process from collecting the prescription to its final dispensing to the patient as, psychology can affect a patients condition for example when a patient has hypertension pharmacist must not angry if patient say move the queue please.

6. A pharmacist must give advice to any prescriber and/or patients and nurses about using a new drug may have a different generic name from the trade name and also a pharmacist must be able to provide information about any drug supplied by him

7. A pharmacist must ensure that they behave with integrity and probity, adhere to accepted standards of personal and professional conduct and do not engage in any behavior or activity likely to bring the profession in to disrepute or undermine public confidence in the profession Townsend (2001).

After this refreshment about the duties and roles of the pharmacist how do these relate to dispensing errors. This was the next part of the investigations carried out for this thesis.

5.3. Definition of a pharmacy dispensing error:

Perhaps it would be useful to start off with a few definitions about concepts which are relevant to this thesis.

A wrong drug error occurs when a medication different from that named in writing on a prescription is used to fill the prescription.

A wrong-strength error occurs -

> 'when a dosage unit containing an amount of medication different from what the prescriber specified is used to fill a prescription'. (Cohen, 2007).

Cohen's definition is not the only one which is available in the literature. In 2005 Roy provided the following definition:

> 'Error of wrong interpretation of doctor's prescription and inaccurate calculation of doses especially in children'

The dispensing process has been very comprehensively summarized by Cohen (2000). Essentially, he suggests pharmacists are responsible for dispensing in an accurate way from receiving the prescription until it is dispensed to the patient. Any pharmacist must also be knowledgeable whilst dispensing prescriptions in order to 'catch' any error which may occur in the prescribing stage. Pharmacists must, just like the nurses, follow the 'five right' procedures to prevent patients from suffering any potential dispensing error and to ensure that the drugs are safely dispensed. Pharmacists are also responsible for safe and effective and appropriate use of medication in all pharmacy practice settings. He is usually, in a hospital setting at least, part of a multi disciplinary health care team. The pharmacist's role is as defined by Kessler:

> 'to cooperate to establish patient – specific drug therapy regimens designed to achieved predefined therapeutic outcomes without subjecting the patient to undue harm' (Kessler, 2004).

In a hospital the pharmacist has become more involved in patient specific care and also has many duties to carry out both it in the pharmacy or at ward level where routine tasks such as checking the level of a store room medications to undertaking patient counselling. Recently, technicians have been asked to perform some of the tasks that previously were restricted to pharmacists and through expanded training and responsibilities the technicians can perform many of the stages of dispensing medication to the wards and also dispensing prescriptions for patients in the out patient pharmacy (see above for details of this system). But technicians must be made aware of the significance and causes of medication errors and must recognize their role in preventing those errors (Kessler, 2004).

In Kuwait, in the Armed Force Hospital technicians are currently doing many tasks, under supervision, that were previously done by pharmacists for all types of pharmacies in the hospital. Technicians were previously restricted in our pharmacy rules to just prepare medicines but not actually dispense them but because of a shortage of pharmacists, technicians can perform the dispensing task. However sometimes the system fails and they cause many errors by a simple lack of knowledge about pharmaceutical matters in general and sometimes for specific reasons such as generic names of drugs and/or calculation of doses.

Not all problems can be attributed to the technicians as sometimes pharmacists do not clarify with the physician prescription problems before dispensing a medication to the patient. This clarification must be written on the prescription if there is any doubt of the dose or strength or any potential drug interaction the prescription should be returned to the physician for clarification. Double checking is always done but is vital for 'serious drugs', for example those used as 'Alert Medications'. They must be read the prescription three times before dispensing because misuse of these drugs is potentially life-threatening. Memory should not be relied on and if in any doubt it should either be returned to the physician or should be checked in the standard reference drugs information books (Kessler, 2004).

From all the studies which have been reported it emerges that the majority of medication errors occur in the prescribing and administration stages. (Cohen, 2007; IOM, 2007; McDowell, 2008; Naylor, 2003; Williams, 2007)

Thirteen years ago, Leape et al, (1999) recognized that 11% of medication errors occurred in dispensing stage. In new more recent study made by Flynn and colleagues in 2003 they recognized 98.3% accuracy in the dispensing stage. So, it can be concluded that only 1.7% of medication errors occur in the dispensing stage. This would suggest a marked reduction of approximately 85%, of medication errors which have occurred in dispensing stage in this period 1995-2003. Reasons to account for such a marked change include the developments in the pharmaceutical industry sector providing better and better information to an increasing awareness in the healthcare institutions of the absolute necessity for achieving patient safety.

5.4 Different type of medication errors:

Medication errors can occur at any stage or any point during the process of medication use. They do not occur only by the action of pharmacists, but can also occur due to the actions of other healthcare professionals. The errors can start from the moment a physician start to write a prescription for the patient, to when the nurse administers the medicine to the patient. Errors can also occur after it has left the hands of a healthcare professional, say in the home of a patient, when they do not take their medication as directed – this is usually described as a lack of patient compliance (Kessler, 2004).

Pharmacists sometimes forget to give patients full directions about how to use their medication(s) such as before or after meals and consequently they can be used incorrectly. Some pharmacists forget to ask their patients if they are allergic to any medications. If so they can return them back to the physician for a change in their medication and so this promotes patient safety.

5.5 How such safety can be promoted has been the focus of some studies which has resulted in the Institute for Safe Medication Practice (ISMP) recognizing 10 key elements for safe medication use. Any weakness or failure in these key elements could be recognized as a cause of medication errors. They recognized the key elements were the following:

1. Patient information.
2. Drug information.
3. Communication of drug information.
4. Labeling, Packaging and Nomenclature.
5. Device Acquisition, Use and Monitoring.
6. Drug storage, Stock and distribution.

7. Environmental Factors.
8. Staff Competency and education.
9. Patient education.
10. Quality Processes and risk management.

These complete elements are related in one form or another to the role of the pharmacist whether in causing or actually preventing medication errors. The next stages will consider important key for explaining the most causes and factor can affect the role of pharmacist in dispensing.

5.6.1 The Causes of errors which can affect the role of the pharmacist at the dispensing stage in the pharmacy.

5.6.2 The factors which are generally held to cause problems will now be considered in turn.

Processing more than one prescription at same time because of the 'pressure of a long queue' in the pharmacy dispensary.

Errors can occur by pharmacists who process more than one prescription at same time. It is easy to add one drug from a different prescription or to put the wrong drug into a labeled bottled for another patient especially if the patients stand in a long queue directly in front of the pharmacy window in the out-patient pharmacy. Pharmacists can easily be distracted when there is a crowd of people front of a pharmacy window all wanting to be served immediately and something so simple as picking up the wrong medication from the wrong shelf can easily occur. Many people waiting very close to the actual dispensing window prevents any type of privacy for people to ask the pharmacist about any information relevant to the prescribed drug. The crowd of people also may cause the pharmacist to try and do more than one task at time. The photographs shown below in Figure 5.1 illustrates how severe this problem can be and it is easy to see how errors could occur through processing more than one prescription at the at the same time when pharmacy has such a long queue, especially if double checking by another pharmacist is not carried out.

Figure 5.1

Also in figure 5.1 we can see there is no available space for confidentially counselling patients by the pharmacist or technicians and to ask any question about using medication. This may affect patients by using medications wrongly. Errors can also occur in the pharmacy department because subjected to the same pressures as the pharmacy technicians who are carrying out similar tasks as the pharmacists perform their task sometimes without full knowledge and experience of a specific drug and because of the rush do not always get their dispensed items ‘double checked’. This is especially true about dose calculations or some important information physicians need to ask about some side effect of a drug or any drug-drug interaction(s). Technicians must first read the prescription extremely carefully before dispensing or should be double checked by a pharmacist to protect both the health care personnel and patients from any errors happening.

5.6.3 Calculation Errors

Some reports have show that numerous medication errors are caused by problems in mathematical calculations. In some cases patients have died as a result of such miscalculation errors made on the basis the prescribers’ original dose (Phillip et al., 2001). One special problem area for calculations is in the area of pediatric doses which are frequently made on a mg/kg basis. Such pediatric doses need to be very carefully calculated using the weight of child and their age because many drugs are simply not available in specific pediatric formulations. So, an adult formulation is usually diluted or manipulated in some cases multiple times to get the appropriate dose for the pediatric patient. At every stage of dilution an error can potentially occur.

Another problem which can happen in the out patient pharmacy is when the prescriber writes a prescription for a tablet formulation but the patient refuses to take it as it is difficult for the patient to swallow the tablet. So the pharmacist changes the medication to a syrup without asking the prescriber, and this transcription error may result in using the wrong dose being taken because memory was relied on rather than checking in the conversion book.

5.6.4 Use of outdated and incorrect references:

Medication errors can occur, if a pharmacist uses out of date textbooks. Because new information is always 'surfacing', the use of old medical texts is potentially dangerous and it is helpful to discard old reference books – for example a past edition of Martindale so as to avoid this problem. This is a simple step to take but a very effective one.

5.6.5 Look-alike and Sound-alike Drug Names

Pharmacists potentially have to deal with medication errors caused by confusion of similar sounding drug names (Davis, 1993). For example in the United States, look-alike and sound-alike are responsible for thousands of deaths and millions of dollars in cost each year. Up to 25% of all medication errors are attributed to name confusion and 33% to packaging and labeling confusion. Thousands of medication name pairs have been confused based on similar appearances or sounds when written or spoken, or have been identified as having the potential for confusion (Berman, 2004). Approximately 15% of all medication errors are said to involve similar drug names and more than one hundred drugs have either a sound or look-alike in either trade or generic drug names (Jt Comm persp. 2001**).** These difficulties result in errors or could potentially lead to one. Because these drug names look-alike and sound-alike and may even be used to treat a common condition - an example if Lasix is given instead of Losec both have a look-alike drug name but clearly they are for completely different uses. Another example is Amrinone (Inocor), a cardiac agent which was inadvertently administered to a patient instead of Amiodarone (Cordorone), which is an antiarrythmic agent. Both drugs are used to treat cardiovascular conditions and their generic names sound somewhat alike **(**Cohen, 1996). Both the brand and generic names are in similar packaging which increases the risk of confusion. Sloppy handwriting or misspelling can also contributed to drug name confusion (Raffalli et al.,. 1997).

Confusion occurs when the strength of tablet is not very obvious. **Figure 5.2** shows warfarin tablets of three strengths from the same manufacturer. The packing is identical except where the actual strength expressed as mg is printed in slightly different shades of a pink color, but of such a small size that confusion can easily occur.

Figure 5.2 An example of three strengths of the same drug, warfarin, in almost identical packing.

Confusion with sound-alike or look-alike names is a growing issue with increasing numbers of drug products being available in a similar spelling and sound-alike names. Pharmaceutical manufactures should be responsible for carefully selecting drug product names which are clear and distinct, always keeping patient safety in mind. It is of interest to note that approximately 30% of new drug names are rejected by (USP- FDA) because they may lead to confusion. The table below (Table 5.1) shows the changes suggested eliminating the problem for some drugs (Kessler, 2004).

Table 5.1. Drugs product names that have recently been changed to reduce the risk of prescribing error.

Trade name	Confusion with	New trade name
Losec	Lasix	Prilosec
Larocin	Lanoxin	Larotid
Clonopin	Clonidine	Klonopin

Source : Kessler (2004)

5.6.6 Product color packaging:

Some health care personnel rely on the color of the product packaging to identify a product and this is simply not a safe practice because different manufactures can change their color packaging schemes at any time. Furthermore, another product of a similar color packaging, or a misplaced or cluttered item can easily cause an error especially when the pharmacist is extremely busy such as when they is a crowd of patients standing in front of the dispensary window. Putting two different dosage forms of a product in virtually the same packaging shape, size and color from the same company but which have different uses are shown in Figure 5.3, below, Cozar (losartan) and Zocor (Simvastatin) & Lopresor (Metoprolol) and Tegretol (Carbamazepin). This problem can very easily lead to errors by inadvertently picking up the wrong medication. So a pharmacist must be sure to read any box label three times before processing an order to help minimize potential errors.

Figure 5.3: Corporate packaging which may lead to dispensing errors.

5.6.7 Unclear Labeling:

Pharmacist and pharmacy technicians should be familiar with the labeling requirements for any prescription from their pharmacy. In Kuwait he/she must write the label very clearly for patient with full instructions in legible hand writing. In other countries where drugs carry printed labels from the pharmacy there is usually a policy which includes instructions that technicians or pharmacists to remove the last label which has been printed to avoid any mix-up of labels. A label which is difficult to read may result in patient confusion and ultimately a medication error. Labels must be free of smudges and the printing should be aligned on the label. It should also be placed carefully on the drug container before dispensing and must not cover up other information such as the batch number or the expiry date.

5.6.8 Medications which have expired.

Some pharmacists due to either neglect or inexperience fail to check the expiry date of medications in the stock room or in the refrigerator and if a drug goes out of date then the problem of the drug losing its potency and effectiveness may occur. Pharmacists should take responsibility to ensure that they take steps to keep any expired medication out of the dispensing stock so as to prevent others, for example the other pharmacists and technicians, using them without knowing that the medication had actually expired. Pharmacists must be also familiar with the pharmacy regulations and procedures for checking medication within the store room for expiry dates. Sometimes, regular checking for expiry date are considered to be “boring” by some pharmacists and technicians, but it is extremely important to carry out such checks so as to reduce the risk of making errors. So technicians have a responsibility to rotate the stock so as to ensure that the stock which expires the soonest is at the front of the shelves so that it is used before it actually expires. A pharmacist must write in alphabetical order on a piece of paper which can be displayed for all the staff to see and read all the drugs which are near to expiry so that they can be used first and so ensure the maximum use of resources. This could also avoid accidental errors occurring from expired stock.

5.6.9 Compound – drug preparation errors:

Errors can easily occur during the compounding and preparation phases. These errors are difficult to ‘catch’ especially during the preparation of two drugs which look-alike names which can cause errors. It is important that for any technicians they their dispensed items must be confirmed by a pharmacist, who must compare the label from where the items originally came from, with the original prescription order. Checking cannot be achieved simply by checking tablets in a bottle or box without the original item from which they came. So it is essential that pharmacists and technicians take such simple but essential steps of reading the label of the original item three times before preparing anything from it.

5.6.10 Establishing the identity of the patient:

Some pharmacists throughout the dispensing process do not make sure of the full name of the patient so as to verify that the correct patient receives the correct medication.

This error may occur because the pharmacy calls out a name, the first name only, and fails to check their full identity because potentially another patient may have exactly the same first name. So the identity of the patient is extremely important to the pharmacy staff to avoid any error. This problem can be reduce by using individual numbers for each patient, a little like the ‘deli counter ‘at a local supermarket, which should avoid this problem.

5.6.11 Drug-drug- interactions

Some pharmacists lack knowledge about drug interactions and this is compounded when a physician prescribes on one prescription multiple medications. For example some prescriptions can include more than five drugs for the patient where the potential for interactions is extremely high. So pharmacists must double check in the relevant drug information books if he is not sure about the interactions of a drug or possibly he can double check with another colleague who has more experience so as to avoid any potential error(s).

5.6.12 The problem of failing to give the full quantity of medication and not giving the patient advice on how to use their medications.

Some pharmacists do not give the patient the full course of medication simply due to stock availability and also some pharmacist are perhaps lazy and fail to tell the patient about the full instructions as to the use of their medication(s), which may lead the patient to incorrectly use their medication say, twice a day instead of three times a day**.**

5.6.13 Exact strength or concentration:

Some pharmacists do not follow the physician’s order such as when a physician prescribes syrup because patient finds it hard to swallow tablets, so the pharmacist changes the order from syrup to tablet. Another example is when a prescription for 50mg medicine was presented but this strength is not available as only a 100mg form is available. So, the pharmacist tells the patient 'you can break it half', but some patients break it wrongly because of a lack of experience and so obtain the incorrect dose.

5.6.14 Assessing prescription:

Some pharmacists do not verify each medication prescription before the dispensing process, so effectively 'second-guessing' the prescriber. Pharmacists must not dispense any prescriptions written in illegible handwriting or with incomplete information and they must ask the patient to return to the physician to clarify the prescription and any such clarification must be documented in writing (Davis & Cohen, 1995).

5.6.15 The problem of dispensing prescriptions for long periods of time without adequate breaks:

Tiredness, for example, caused by long periods of standing at the dispensary bench, can be one of the most important causes of errors which can affect a pharmacist's performance. Working all day preparing and dispensing prescriptions without taking any break or rest, say every 1-2 hours to drink a cup of tea or smoke a cigarette, can lead to serious tiredness. Tiredness leads to errors, because a pharmacist is not able to adequately concentrate during the dispensing stage. In addition, standing for long periods of time can lead to a lot of health problems such as back pain and varicose veins.

5.6.16 Abbreviations:

The use of abbreviations has been found to contribute to medication errors in both manual entry and computerized systems (Ulrich, 2007).In Kuwait a manual system is currently used although a computerised system is being designed for a future system in the AFH. Using abbreviations in the AFH is common practice, and there can be differences in the abbreviations used because different physicians come from many different countries such as India, Bulgaria and Pakistan. Their backgrounds increase the risk of error in the pharmacy due to a lack of knowledge of some pharmacist and technicians about different drug abbreviations. Medication errors potentially can occur more often because of a failure to standardize the abbreviations which are used by the healthcare professionals. Sometimes an abbreviation with the greatest potential to cause errors is written by a physician who sends the prescription to the pharmacy where it is read by a technician who has limited experience about abbreviations. For example a physician writes a prescription for a patient using the abbreviation q.o.d. i.e. every other day, and technician misinterprets this as q.i.d i.e. four time daily, and so because of the lack of experience causes an overdose to occur.

5.6.17 'Cluttering medication'

'Cluttering medication' on a work surface or carousel (see Figure 5.4 below)can cause errors because when a person is rushed it is difficult to recognize the correct package to use and an item may be picked up which has same package color and same strength.

Figure 5.4

5.6.18 Lost of trust:

Patients may lose faith and so lose their trust in their health care professionals – physician - pharmacist – nurses, by hearing or reading about adverse events or medication errors occurring to patients which have caused some disability and even death. Consequently, they have lost their trust in both the people and the system. This is very difficult to re-establish. This lost of trust may be reflected by patients choosing to switch their pharmacies or physicians or even to hesitate in seeking medical help for a fear of not receiving quality care. Sometimes a patient may seek non conventional treatment from outside the medical community so as to avoid the personnel who they think are responsible for causing responsible medication errors that can result in significant patient injury (Kessler, 2004) This perhaps is an extreme set of circumstances as fortunately most medication errors are detected before they reach the patient. However, medication errors do occur and may result in irreversible negative patient outcome.

5.6.19 Shortage of medicines:

Sometimes a shortage of medicines is a very important problem as there may not be any suitable alternatives for a drug in short/not available supply. Therefore, a pharmacist and technician can find themselves purchasing an alternative agent of unknown reputation which may increase the risk to the patient. For example this problem happened in California where a shortage of betamethasone prompted an outpatient surgery center to obtain compounded betamethasone from a local pharmacy. The product turned out to be contaminated and three patients died of meningitis after getting this tainted product (Fox and Tyler, 2004).

5.7.1 The Factors which can contribute to Errors at the pharmacist stage:

5.7.2 Work Environment:

An unfavorable working environment is one of the causes which may increase the dispensing error rate. These relevant factors within the work place include: poorly designed work space-high workload-inadequate lighting-small space-humidity-distraction-noise-interruption from staff -interruptions by phone calls (Kister et al., 1994).

A major factor is a poorly design work space as this can affect the role of pharmacist in the dispensing process this and other factors will be explained below. The limitation of space is very important as it can be where explanations/consultations with patients about information about their health or on confidential matters can be exchanged. This is because a female patient may feel shy about explaining to the pharmacist in front of a queue of patients about a private problem and likewise it would be useful for a female pharmacist to be able to explain in a confidential setting matter to a male patient such is shown in as Figure 5. 1. A cluttered work space and limited area also might increase the chance of picking up the wrong drug which has the same color of packaging as other drugs – see example in Figure 5.4.

There are also many other distractions and interruptions factors which can contribute to medication error such as phone calls – talking with a friend during the preparation of a prescription in a busy pharmacy can cause a loss of concentration which can lead to errors.

Many modern pharmacies rely on specialized equipment and computers to assist in filling prescriptions. Improper maintenance of such equipment may result in unacceptable performance or having to use the manual system-with all its potential errors-when the equipment breaks down. A failure to properly maintain a physical balance could result in inaccurate measurement of drug components for a compounded prescription and ultimately a wrong dose error. Routine maintenance schedules must be followed to prevent equipment malfunction. Technicians must be trained to use equipment and maintenance operation manuals. Finally, scheduling of staff members and frequency of rotating shifts have been shown to correlate with error rates (Gold et al., 1992) So, although there are many other factors such as staffing levels, the amount of staff supervision these will not be considered in great detail in this thesis because of the limitations of space but rather the most common problems will be discussed and this will start with a consideration of the problems of workload especially when an individual is overloaded.

5.7.3 Workload and overloading

In the Armed Forces Hospital some pharmacists work under condition of high prescription volume and may have a difficult time handling the actual volume of prescriptions. For example, five pharmacists and six technicians in the outpatient pharmacy in the hospital have the responsibility to prepare and dispense more than 1500 prescriptions daily. Sometimes each prescription has more than six to ten items written by a physician for one patient. Dispensing such prescriptions is complex and needs a high attention to detail. This overloading of workload can produce errors without it being realized by the pharmacy staff. Pharmacists in both community and institutional practice setting have ranked work overload as the most significant cause of dispensing errors (Cohen, 1994). Some hospitals are short of staff and so the overloading problem is worse. Mistakes can be made by the pharmacist simply because they feel under great pressure and they cannot adequately concentrate whilst preparing medications and dispensing the prescriptions. This pressure can lead to picking up a wrong medication from the wrong shelve and because two medications may be similar to each other or are near to each other and this is the reason that pharmacist who does not have the chance to even look to the medication package or even names makes an error due to this excessive workload.

Kuwait is not alone in this problem. Pharmacists in hospital pharmacies in most countries of the world perform and dispense routinely more than a hundred prescriptions per hour. This workload can affected the pharmacists' ability to concentrate on the prescription and he cannot differentiate between two similar drugs which are written in the same hand writing. Also a Pharmacist who has not had a break for some rest every one or two hours, say for some tea, this can affect their concentration throughout the process of dispensing prescriptions. Adequate break times are very important for a pharmacist or pharmacy staff to aid relaxation and restore the powers of concentration (Abood, 1996). This can improve the dispensing medication process in the hospitals and will also encourage the staff of pharmacy to promote a high standard of safety services to the patients.

Sometimes because of the heavy workload the pharmacist can call on the help of a technician to assist him in dispensing process. This can happen if the dispensary window is too crowded such in our AFH such as, Figure 5.1 above. Sometimes this combination of pharmacist-technician is extremely useful as they can provide checks for each other. Sometimes this combination is less than useful as the pharmacist may be very apprehensive about the items dispensed by the technician. The technician must have a good knowledge about medications and have also knowledge about physicians' hand writing so as to avoid any errors occurring. The Pharmacist should be in a position to be able to check the quality of dispensing carried out by the technician so as to avoid errors occurring. Both the Pharmacist and Technician must be familiar about using all the equipment in the pharmacy so if a machine fails they can quickly repair it.

Finally in this section it is true to say that the problem of workload is not a new phenomenon. According to the Ukens survey of 1992 about work overload in the pharmacy the results suggested that 68% of pharmacist rated work overload as a major cause which can contribute to making dispensing errors (Ukens, 1992). Two years later another study re-enforced these findings when Allan in 1994 concluded that most pharmacists and experts in medication errors agree that work overload may be the most significant factor contributing to medication errors. They quantified this risk by saying that the risk of error increases when a pharmacist fills more than 10-12 prescriptions per half-hour (Allan, 1994).

5.7.4 Perception of "task tension":

Human qualities should be considered when finding ways to understand and manage medication errors. How the manager of the pharmacy communicates with their staff and how much stress and tension in the work are factors that could affect the performance of the staff of the pharmacy. Simply, being concerned about doing "well" is said not to be enough to maintain an error-free performance. Grasha (2001) suggested that pharmacists required a limited degree of increasing task tension to produce desirable results. Any pharmacy manager must be careful not to generate an atmosphere of not too much tension, because too much stress and tension can itself become a problem. Grasha (2002) also justified the adverse effect of stress on the cognitive system and consequently on the performance of the staff and here we are concerned with dispensing staff as the following:

a) Tension increases the rate at which information is processed and when capacity is exceeded, errors become more than could be expected.

b) Increasing the levels of stress may lead to various biases and shortcuts in order to meet task demands. Consequently, pharmacists then feel obligated to change work pace strategies.

c) Tension may also cause interference between past habits and more recently learned behavior.

Managers must generate a good atmosphere so that the team is free from tension and so hopefully free from errors. In my view and my experience in the AFH, if the manager of the pharmacy is “democratic” and treats the pharmacy staff equally, nicely and gives the staff time for relaxation from the dispensing process then a safe atmosphere is created. However when the manager of pharmacy is “bureaucratic” and follows the rules in a rigorous way giving staff their orders without any good interpersonal skills, such as smiling, encouraging remarks and helping them in their tasks and also fails to give staff suitable breaks for say a cup of tea, problems arise. Consequently, this tension will reflect on the work of the staff in the pharmacy and can create problems one of which may be shown in the production of more errors.

5.7.5 Distractions.

The work of both pharmacist and technicians can be affected by distractions which affect the dispensing error rate and this has been known and documented for many years (Kelly, 1994). More recently, Cohen (2007) mentioned that distractions are a major cause of error, because it prevents pharmacists focusing on their task in hand. Distractions in any hospital setting can include: ringing telephones - both landline and mobile, noise of people talking, external transport noise e.g taxis. In our AFH when pharmacists and technicians have to use the hospital telephone its location on the table of the pharmacy desk near the dispensing area can affected the other pharmacy staff as they dispense prescriptions. Also some of the staff carry and use their mobile phones and some staff actually hold conversation on them while they preparing prescriptions! This is clearly against the rules of the pharmacy and hospital ethics, but the system in our hospital fails because no action has been taken against such staff behaviors. Sometimes unnecessary conversations among pharmacy personnel while prescriptions are being processed can also be a distraction. Pharmacists and others should not be permitted to engage in idle chatter when performing critical functions such as computer data entry, reviewing prescriptions, affixing labels, and selecting proper medications (Davis & Cohen, 1995). Sometimes pharmacists can be distracted, due to a personal problem, for example one of my colleagues made a mistake in a medication he wrongly dispense to the patient. After the investigation was finished, with fortunately no harm to the patient I asked what had happened. He told me that he had fight with his wife the previous night in front of his children and did not sleep well and so came to work tired and as a result made the error.

Some pharmacists can feel distracted in their work by the attitude of their supervisor. If the manager motivates his staff well and has a democratic attitude this helps the staff to perform their tasks correctly and hopefully without any errors. However, if the manager is always punitive towards his staff this can create more stress and so more errors in their performance. So an increase in professional satisfaction and workforce can improve patient care and safety. When pharmacists suffer distraction when they are preparing prescriptions this can lead to the individual forgetting to return the medication to its proper location. This misplaced stock may cause errors when another pharmacist picks up this wrong medication from the shelf because they fail to use the ‘five rights’.

Clearly, it appears from what has been discussed above that mangers and hospital administration in the AFH are aware of and must implement and enforce rules which aid patient safety.

5.7.6 Noise:

Certain noises and sounds have been shown to affect the accuracy of the work of the pharmacist in the pharmacy whilst dispensing patients' medications(s). If the 'loudness' of sound is increased then the rate of error will also increase It has also been found the reducing the level of noise decreases the rate of dispensing errors (Flynn & Barker, 1996). This is because some noises are so distracting that adequate concentration sufficient to dispense accurately is impossible and so errors occur. To make the dispensing process safer the right environment for the pharmacist must exist so as to promote a good and accurate health care service when we control the noise and the overall sound level in the pharmacy then we can decrease the rate of dispensing errors (Flynn & Barker, 1996).

5.7.7 Lighting:

The level of light is very important for pharmacists especially when they have to differentiate between two, handwritten prescriptions on which the drug names are similar. The level of light can make such prescriptions clearer, because if the light is inadequate many problems can be created. For example there is a study which provides a clear focus as to how important the lighting level can be because it is possible kill someone by misunderstanding a drug name. In a study reported by Buchanan et al., (1991) on the effect of the lighting level on dispensing errors in a high-volume outpatient pharmacy a total of 10,889 prescriptions were evaluated. Three different lighting levels - 45-102-146 foot candles were compared and it was found when the first level 45 was raised to 102 it caused a significant decrease in the dispensing error rate of 3.9%. When the lighting level was increased from 102 to 146 foot-candles the error rate dropped to 2.6%. Most pharmacies emphasis the need for good lighting to ensure the correct dispensing of medication prescriptions as it facilitates clarity of drug names the pharmacist has to read without any ambiguity of a physician's hand writing.

5.7.8 Work Area:

A poorly designed work area can contribute to dispensing errors. The work should have good lighting (see above), an adequate counter space, a comfortable temperature and humidity both for the staff and stability of the medications in the pharmacy. Many medications can be spoilt by incorrect storage conditions. If the facilities are 'free flowing' due to there being a large space in the pharmacy then the pharmacists to move freely about during the dispensing of prescriptions and this also facilitates the easy 'pick up' of the necessary medications from their location. In some pharmacies the work area is cluttered by placing different medications in the same location. This is bad practice can lead to errors so the pharmacy work area should be kept as free of clutter as possible. When a container is no longer in use, for example, it must be returned to its proper storage area or discarded. Each medication has been allotted an adequate space and also each strength must have its own drawer. Some pharmacists however keep different strength of a medication near each other and so can easily cause errors. A way to help the process of correct selection is to have all prescription bottles stored with their labels facing forward (Cohen, 2007).

Medications should not be stored on shelves or in bins, or drawers that have an external storage label, because medications in similar packaging can easily mistaken for one to another if only the label was used only for identification (Ukens, 1997).

5.7.9 Phone calls:

Phone calls can lead to errors. It is sometimes useful to use examples from one's own experience and so the following is one such series of events about telephone calls.

One of my colleagues was processing a medication prescription for a patient who had a diabetic condition. When the phone rang, he went to answer the phone and when he came back to the prescription he forgot to give the patient one of their diabetic medications. Then the patient went home without receiving one of his medications for the regulation of blood sugar. The patient's blood sugar then increased while he was in his home and patient searched for his medicine but it was missing. One of his relatives went back to the pharmacy and they obtained the necessary medicine. The implications of this case is that all pharmacists in the AFH must double check before dispensing any medication to any patient to avoid any error which could potentially be life threatening.

5.7.10 Interruptions from the Hospital staff.

Some pharmacists whilst in the process of dispensing are interrupted by staff – from within the pharmacy and from other staff within the hospital. This can cause the pharmacist to lose their concentration as they are dispensing and this may cause errors to occur such as dispensing the wrong medication to the wrong patient.

5.7.11 Storage area.

Correct storage is very important for pharmacy staff and badly stored items can potentially lead to many errors. When medication storage areas are crowded products are more likely to be interchanged or returned to an incorrect location. Adequate space should be allotted for each medication and each strength so as to avoid any mix-up between medications which have the same name but are of different strengths. To facilitate the correct selection of a drug all prescription bottles should be stored with the label facing forward (Cohen, 2007).

5.8.1 Method for studying pharmacist dispensing for this thesis.

Before collecting the data, a ‘data collection form’ was designed and called the **pharmacy observation form** (**see 5.8.1**) as shown below and was used for data collection from the outpatient pharmacy. The form was used to record information related to patients, file number, duration of doses, descriptions of their medications and any change in medication. This observation is similar to the nurses observation carried out in Chapter 4, but it is different in the sense that only myself, the observer, checked the prescription which was dispensed with the actual physician orders.

5.8.1 Form used as the ‘pharmacy observation form’:

No of observation	File number	Time of administration doses (1x3)	Description of medication (dose-name-route strength-dosage form-shape)	Note ,changing in medication

Observations began at the medical clinic which covered all the specialties including psychiatry, cardiology, medical and endoscope (see above in Chapter 1 for a description of the hospital). Again it was agreed with the head nurses at the clinic to start by observing the medication use process at this point. Observations began at 8:00 in the morning after the physician came from the patients' round. Each patient to be seen by a physician would be given an appointment sheet by the nurse. After the physician saw the patient and wrote a prescription for him/her the nurse would place a copy of the patient's prescription in the patient file and instruct the patient to take the original to the pharmacy for filling.

The patient was then instructed to return back to the clinic in order to get the time for their next appointment. The observer randomly selected patients from the different clinics. After a patient was selected, the nurse would give the patient an appointment sheet to the observer and then observer would then start the observation process. Once the patient returned from the pharmacy with the filled prescription the observer would ask the patient to examine the filled prescriptions. The observer would start the process by matching the dispensed medications with the copy of the prescription placed in the patient file by the nurse. The observer wrote down all the dispensing errors which were found on the observation form which included the following: omissions of instructions, wrong time, wrong instructions, wrong strength, wrong dose, wrong route of administration and unordered drugs included in the patients prescription bag. At the end of the observation period, the errors found were tabulated and totaled and the error rates calculated as below.

5.8.2 Research objectives: The objectives of the study at this chapter at dispensing process was to identify the accuracy of medication dispensing system by comparing the medications dispensed with the physician actual prescription order in the files of the patients. A detailed breakdown of the errors are presented in Table (5.2). below.

Table 5.2. Detailed observation of all errors observed from pharmacy by date

Observation Number and date	Total opportunities for Error	Number of Error	Error Rate %	Accuracy Rate %
30-4-2007	70	0	0	100
1-5-2007	75	0	0	100
2-5-2007	99	7	7.0%	92.95%
5-5-2007	94	8	8.5%	91.5%
6-5-2007	81	4	4.9%	95.1%
7-5-2007	76	7	92.%	90.8%
First week total	495	26	5.2%	94.8%
8-5-2007	78	7	8.9%	91.1%
9-5-2007	139	7	5.3%	94.7%
12-5-2007	156	9	5.7%	94.3%
13-5-2007	96	8	8.3%	91.7%
14-5-2007	177	11	6.2%	93.8%
Second week total	646	42	6.5%	93.5%
15-5-2007	133	3	2.2%	97.8%
16-5-2007	162	11	6.7%	93.3%
19-5-2007	142	4	2.8%	97.2%
20-5-2007	80	3	3.7%	96.3%
21-5-2007	164	11	6.7%	93.3%
Third week total	681	32	4.6%	95.4%
22-5-2007	132	1	0.7%	99.3%
23-5-2007	141	7	4.9%	95.1%
26-5-2007	125	6	4.8%	95.25
27-5-2007	113	0	100	100
28-5-2007	139	4	2.8%	97.2%
Fourth week total	650	18	2.7%	93.3%
Grand Totals	2472	118	4.7%	95.3%

5.9.1 Results:

Table 5.3 Below summarizes the number of opportunities for errors, which were observed, and the total number of errors that occurred throughout the dispensing process. These were the total number of errors observed for the entire month period of the study. The percentage rate of errors for all observations and the accuracy rate were then calculated as previously described Chapter 4 for the nurses' observations.

Table 5.3. Error percentages and accuracy of the pharmacy dispensing process.

Opportunity for error	Number of errors	Error rate %	Accuracy rate %
2472	118	4.7%	95.2%

A total of 2472 dispensed items were observed during the one month study period. Observations were carried out for 3 hours per day for each day of the study. The study showed that there were 118 errors detected which could be categorized as:

No instructions	**52**
Wrong drug/unordered drug	**28**
Wrong strength/dose	**21**
Ignored/omission	**13**
Shortage of medication	**3**
Exceeded expiry date	**1**

In this part of the study the highest rate of error observed was of prescriptions without correct instructions while drug which had been dispensed which exceeded their expiry date had the lowest rate of error. All these categories are represented in the figure

5. 5 below to show the reader the error rate of each type of errors for all the month.

Figure 5.5 The error rate during a one month observation period in the AFH from the Pharmacy on prescriptions for a random number of specialities and patients.

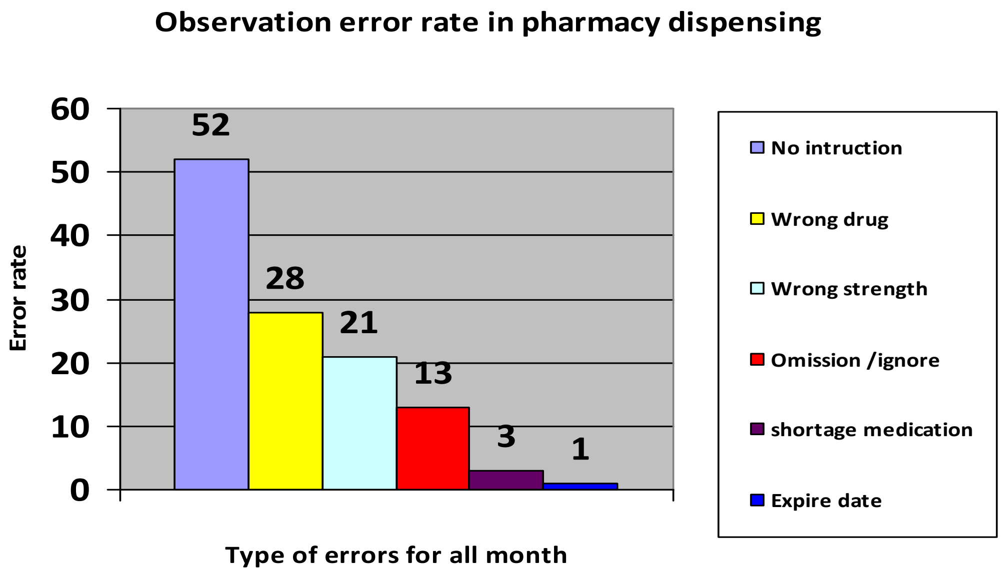


Figure 5.5 shows the number of different errors observed after the dispensing process in dispensed prescriptions for a diverse range of medical conditions. After analyzing the figure, it can be seen that from the total number of observed errors was 118, the no-instruction error achieved the highest number of occurrences, i.e. 52, this value is 44.1% of all the errors recorded. On the other hand, the shortage of medication type achieved only 3 and the least number of occurrences occurred with expired date of drug, i.e. 1. When an analysis was made of the different weeks of the study the second week in May contained the largest number of errors, i.e. 42, and the final week of the study contained the least number of error occurrences, i.e. 18 errors. That perhaps simply indicates that errors can occur any time and any stage and are not restricted to specific days or weeks.

5.10.1 Table 5. 4 A Comparisons of the number of errors and number of prescriptions with the error rate taken from a variety of published sources.

Type of pharmacy	Number of errors	Number of prescriptions	Dispensing error Rate %
Ambulatory pharmacy.	37	3227	1%
Ambulatory pharmacy.	195	5072	3%
High-volume Military ambulatory	369	10.889	3%
Ambulatory pharmacy. Pharmacists Technicians	48 44	929 1055	5% 4%
AFH Kuwait out-patient pharmacy	118	2472	4.77%
Ambulatory pharmacy.	552	9846	6%
Ambulatory pharmacy. Teaching hospital	1085	9394	12%
Outpatient pharmacy.	1229	9846	12.5%
Community pharmacy. Patient follow-up	29	223	13%
Ambulatory pharmacy.	24	100	24%

The result for the study above were then compared to published data from a number of sources where different types of pharmacies had been compared in terms of the number of errors versus the prescription items involved in each of these pharmacies (see Table 5. 4 above). This then allowed the calculation of the dispensing errors rate as a percentage of the total items. From the table it can be seen that the studies have used different number of prescriptions ranging from (100-10,889). Despite this variability in the numbers studied there were similarities in the number of errors recorded when expressed as a percentage of the total number of items dispensed. The range of such errors was huge being from 1% - 24%. However it is a cause for concern that some of the studies used very small sample sizes, namely, 100, 223, 929, 1055, to establish the error rate and this may either under or overestimates the problem. As a consequences this thesis used a sample size of 2472 which it was expected would give a more accurate assessment of the true rate of error.

5.11.1 Illustrative cases found during the study of dispensing analysis in the AFH.

Case one: My observations include patients from all the clinics within the hospital such as the medical clinic, psychotropic clinic, gastroenterology clinic and cardiology clinic. In this particular case I found one of the nurses calling out for a patient by using his first name. Unfortunately, unknown to the nurse there was another patient of the same first name also waiting for the clinic. The first patient thought he was being called and so went to see the physician. The patient was diagnosed by the physician and a prescription was written for a medication for him and he went to the pharmacy to get it dispensed. Then the second patient of the same name then was called to the clinic and the physician asked him about his blood sugar and stated that his cholesterol was high. The patient answered that he did not have any problems with blood sugar but only with cholesterol and the nurse became concerned and checked his identity and that by asking him his full name, she discovered that this was not the correct patient. The problem did not result in any harm to the patient but clearly illustrates the danger of just using a first name.

Case two: During the observational period I also found one of the patients had received from the pharmacy staff a medication, Distonix tablet which had expired. When the patient showed the medicine to the physician he said to wait and I will call the pharmacy staff to clarify this situation. Surprisingly, the pharmacy answered that there was no problem for the patient as the manufacturer had informed them it still safe to use one month after the official expiry date.

Case three: Through observation I also found one of the patients had received from the pharmacy staff one medication instead of another. The physician had written on the prescription form Zantac 150mg for the patient as they were suffering from peptic ulcer disease. The pharmacy staff changed it to Losec 20mg capsule. Although the end result of these two preparations may be similar they are very different drugs with different modes of action and could in some people on other medications cause unexpectedly drug interactions.

Case four: I also found a physician who wrote a prescription for a number of medications for a female patient but entered the items in the file of her husband as her file was not available. So, items for both the lady and her husband were dispensed together and in the process of dispensing medication in the pharmacy all the medications were put together in one bag and all were labeled with the husband's name. On questioning the lady she said that she thought she could identify which were hers and which were her husband's. This was quite a difficult task to actually do and was clearly a great risk to both patients.

Case five: As I was observing the staff of the pharmacy a pharmacist gave one patient Tenortic tablets instead of Tenormin. Here again is one of the examples of the problem of similar names which may have serious consequences.

Case six: One of the situations I noted through my observations was a physician had written a patient prescription without writing the name of the patient on it.

Case seven: I found that a patient had received a different dispensed medication when compared to actual items on the original patient's prescription I found that this change in medication dispensed was instead of Ventolin they had actually been given Serotide inhaler for the treatment of asthma.

Case eight: One of the situations I saw through my observations was when a physician wrote a patient prescription for solcosryle gel for teeth as a pain killer and the pharmacist read the name wrongly as solcosryle ointment for use on the eyes.

Case nine: Through my observation I found one prescription which had been written for an antibiotic for a paediatric patient by a medical doctor in response to a father's description of his son's condition of a throat infection. The medical doctor wrote a prescription for Amoxil without mentioning the concentration of the medication and also without mentioning the dosage form i.e. if it was to be syrup or a tablet/capsule. The father went to the pharmacy to get his prescription dispensed and because it was the 'rush time' it was done very quickly and the pharmacist received the prescription and thinking the antibiotic was for the father dispensed a 500mg tablet - the adult dose.

Through all these causes and factors listed above through the dispensing process stage can we find some solutions or suggestions to minimize these problems in the pharmacy.

5.12.1 Suggestions as to how to minimize errors at the dispensing stage:

1. Ensuring the safe dispensing procedure.

Pharmacists must make sure that to achieve safe dispensing the ‘five rights’ of dispensing prescriptions are always adhered to. These are the right patient, right label, right instruction, right counselling and right prescription for the right patient. If all these criteria are met together, then a good and accurate correct dispensing service is ensured.

Pharmacists must also double check the detail of any prescription before dispensing it. For example, the whole prescription is examined for all the relevant patient’s information in the prescription so as to ensure that any potential drug – drug interaction(s) between two or more drugs are checked before dispensing the prescription so as to avoid any error harming the patient.

2. Ensure there is a good ‘environment’ between all members the staff.

The Manager/Supervisor of the pharmacy must ensure a good ‘environment’ between members of staff so protecting staff from ‘negative feelings’ which would influence the accuracy of their dispensing. This ‘environment’ can be positively enhanced by factors such as good light-availability, easily useable space and also giving adequate break time for staff relaxation to motivate them and facilitate them to concentrate on their tasks and so work without errors.

3. Ensuring separation of the drugs which have a look-alike package from each other.

A common cause of dispensing errors is to confuse two drugs which are for different purposes but packed in virtually identical company products. Pharmacists must separate the packages of drugs that look-alike by putting each one in different shelf position so as to avoid any mix-up especially at ‘ rush time’ . Failure to do this may cause picking up one of medication, thinking this is the same strength that the physician prescribed for the patient, but was in fact the incorrect one. Pharmacists must also separate the drugs from the same company which have the same packaging color. Some ‘Alert medications’ have three strengths and great attention must be paid to these – perhaps by reading the label three times before dispensing them

Another problem of similar packaging but of different drugs is shown below in **figure 5. 8** (A- B). It can be seen that the strength of the tablets is prominently shown in red but the actual drug name is in black on the box and of a much smaller font size. Consequently it is easy to make a ‘picking error’ when dispensing during the busy the ‘rush time’. The different use of these medications could potentially lead to serious life threatening problems for example if the metoprolol was given to asthmatics it could kill them.

Figure 5.8 An example of two different drugs – metoprolol (A) and carbamazepin (B) packaged in boxes where the strength is given more prominence that the drug name.

(A) **(B)**

4.Pharmacist must try to ensure a computer system is installed in the future.

Pharmacists should try and encourage the hospital management to install a computerised system to aid the filling of prescriptions as this would help the accuracy of any dispensing process. This could avoid some problems for many conditions and may prevent allergic reactions from occurring and may also help to prevent any drug-drug-interactions and contraindications to use going unnoticed by the staff of the pharmacy.

5. Pharmacists must focus on your task-in-hand and do not interrupt your colleagues when they are dispensing.

Pharmacists must not interrupt their colleagues whilst they are preparing or after the preparation their prescriptions as errors such as writing the wrong dose or giving the wrong drug to the patient can easily occur. Pharmacists must be encouraged to concentrate on the task-in-hand so attempting to avoid errors.

6- A second person must double check all items which have been dispensed against the original prescription so as to avoid errors.

Pharmacists must always a second person to double check their work after preparing a prescription and this must be checked against the original prescription so as to the wrong drug being dispensed or to avoid any missing doses, or incorrect dose calculation or missing instructions required by the patient for the correct use of the medicine.

7- Technicians may prepare the prescription but the pharmacist is the last step in the dispensing process.

Pharmacists must not rely on the technician for carrying out the dispensing of prescriptions, even though this may be considered and efficient use of time, without adequate final checking. The pharmacist can perhaps allow the technician to dispense individual items but the pharmacist must always double check all the dispensed medications and compares them with the original prescription before giving them to the patient.

8- Pharmacist must be up-dated in medication.

Pharmacists must always keep up-to-date by reading about the new medications which become available on the market. They must also use the Internet for any new medications or alternatives which are available from different companies. The Internet is now becoming the chosen site for manufacturers to make available their drug information data. The 'Up-dated pharmacist' can give other hospital staff and patients such information which ensures that they trust him about different aspects of counselling for any new medication or for some unwanted action such as side effects or drug-drug-interactions with their old medication prescribed by their doctor.

9- Make sure that all patient information is displayed on the prescription, such as the name, age and diagnosis so as to avoid potential errors.

Pharmacists must make sure that all relevant information about the patient is on the prescription. The full name is important to avoid the error of dispensing a prescription based on only the first name to avoid simple mix up with patients (see above). It is also especially important for pharmacists to check the age of patient because if a drug is for a paediatric patient doses are clearly different from those of the adult dose. Likewise if the patient is elderly then dosage adjustments may have to be made.

Pharmacists must also use the diagnosis made by physician to ensure that the correct drugs for the patient's condition are actually those which are written on the prescription. This then acts as a double check if the clarity of handwriting is such that there may be doubts as to what drugs are actually needed. This can then avoid potential errors.

10- Being aware of 'high risk drugs' such as potassium chloride and cytotoxic agents.

Pharmacists must pay special attention to these drugs and not allow a technician to dispense such drugs. Perhaps using the procedures described in the paper free 'Introducing good housekeeping practices'(AMJ, 1999) is the most appropriate.

11-Ensure there is available space for confidential counselling for patient.

We can see from the photograph given in figure 5.1, that there can be severe crowding around the dispensary windows. This problem may cause errors to occur, simply because of people standing in a long queue in front of the window who exert 'pressure' on the pharmacist. There is also the problem that patient confidentially counselling of their medicines is impossible.

The **photograph** below, Figure 5.13.1, shows an alternative view of an outpatient pharmacy in Kuwait in another hospital than the AFH. Here only one patient at a time is at the dispensary window ensured by only one chair and the use of glass screens. The space behind the glass screens has a seating area which ensures that patients do not crowd around the window. This ensures a confidential consultation area for the patient. The system uses an electronic display system to tell patients when their prescriptions are ready and at which window to collect them. All these structures make the process more organized than the scene shown in the earlier **figure 5.1**

Figure 5.13.1 A pharmacy dispensary in a hospital in Kuwait.

5.13.1 Conclusion:

Dispensing of prescriptions is a complex task and potentially has many steps at which errors can occur. One major factor is the role of double checking the prescription before dispensing. Pharmacist must read the prescription three times for any ambiguous prescription such as, dosage form - calculation doses - incomplete information for patient and bad handwriting so as to avoid the occurrence of error. Pharmacist must minimize those factors which can affect their role in the pharmacy by using free space, organized shelves, and a suitable working atmosphere. Of major concern when high volumes of prescriptions are dispensed is to have a highly motivated and knowledgeable staff.

Chapter Six

Prescribers' errors

6.1 Introduction:

There is no system of hospital health care anywhere in the world completely free from errors. The steps whereby prescribing and writing prescription for medications are individually complex, involving a large number of people such as - the prescriber, pharmacist, nurse or carer and the patient. Each of these people should communicate with each other to ensure safe practice. Fatal drugs errors seem to be more commonly found in hospitals rather than in general practice. The general problem of medication errors has been the focus of numerous studies.

Four major studies have reported that the majority of medication errors occur in the prescribing and administration stages. (Cohen, 2007; IOM, 2007; McDowell, 2008; Naylor, 2003; Williams, 2007). It should be remembered that people work in systems and it is the responsibility of each health care professional to take every possible precaution to prevent errors occurring. Perhaps simply blaming 'systems' which is commonly done is too simplistic an approach and more consideration of the people involved is necessary.

The first individual who can take steps to prevent medication errors is the prescriber. He or she is the first to diagnose the patient's condition and write an appropriate medication prescription. Here errors can start, for example if any basic information was missing on the prescription for example, name and age as this can lead to errors occurring. Also the prescriber in busy hospitals and who has an extremely active daily routine may select the wrong drug, write the wrong strength, or verbally give the wrong route of administration to the nurses all of which can potentially cause serious harm to the patient (Ferner, 1999).

This chapter starts by reminding the reader what is the duty of physicians and then goes on to explain what are the causes of error and factors that can affect the role of physicians. There will be suggestions made as to how they can be minimized using a knowledge of the data obtained for this thesis. So, the first step is to consider the duty of a physician.

6.2 The duties of a physician should place the patient's needs at the very centre of such duties:

Patients must be able to trust doctors with their lives and well-being. To justify that trust, physicians have a duty to maintain the highest standards of practice and care and to show great respect for human life. The following apply particularly to physicians and these are modified from those given in the book entitled 'Medication errors' by Naylor (2002).

1- Make the patient care your first concern. Some physicians are concerned more with commercial considerations than medicine. Working in the government service does not attract the same remuneration and less time may be spent on each patient than in a private clinic.

2- Respect every patient politely and considerately independent of race. For example some physicians may be affected by the culture around him. If for example a problem happens against his country and is widely documented on the TV or in the newspapers and he then has to treat a citizen of the country which has caused his country problems then he may be less concerned than he should be with the individual as a patient.

3- Respect patients ‘dignity’ and privacy. Physicians must protect the privacy of any patient, especially when they need to examine them and they must not tell other physicians or their patient friends about the patient’s condition.

4- Respect patients’ view and listen to what comment they make about their lives. Some physicians do not listen to what their patients tell them and this can complicate the physician’s process of diagnosis. Some physicians also ignore patients’ opinions and think their opinion is ’right’ and this causes problems especially for patient trust which may reflected negatively on the patient’s condition.

5- Give patients information about their disease and drug therapy in a form that they can understand. Unfortunately, some physicians do not give information to the patient about their condition and how to use their medications. Patients need to know information about their drug therapy for example, the duration of their medication, so they are able to use them appropriately.

6- Be honest with patients and respect their privacy. Some physicians are not honest with their patients which can lose them the trust of their patient. Honesty may help him to continue their treatment without any problems occurring for the patient and the physician.

7- Respect the rights of patients to be fully involved in decisions about their care. Some physicians do not give the chance for patients to make up their own mind about say, an operation or about any course of suitable treatment

8- Act quickly to protect your patients from any of your colleagues who may not be fit to practice. Some physicians do not intervene when another physician is clearly not fit to practice. Some patient conditions need very special treatments - such as cancer, and through being ‘not fit to practice’ unsuitable medications may be prescribed.

9- Respect and protect your confidential information about patients. It is very important for physicians to protect confidential patient information such as that which involves a patient’s condition such as sexual problems so as not to lose the trust of the patients.

10- Keep your professional knowledge up to date. It is very important to keep knowledge updated by searching in the internet/journals for any new techniques which can help him in his job for the correct diagnosis or the treatment of patients.

11- Tell your patients about the purpose of their medication. Sometimes physicians forget to tell their patient about using medicines at the correct time for example before or after meals. They also forget to tell them of the potential side effects.

12- Be honest with your patients when you diagnosis their condition(s). Some physicians unfortunately lack enough experience and maybe misdiagnose which can leave a patient to suffer by prescribing unsuitable medication for this misdiagnosed condition. Sometimes a Physician because he feels ‘shame’ if he transfers the patient to another colleague the patient may be left with the wrong diagnosis.

13- Work with colleagues in a way that best serves the patient. Physicians must cooperate at work with other colleagues so as to promote good services for the patients.

14- Make sure your social life does not get ‘involved’ in you work. Some physicians unfortunately involve their ‘social life’ e.g. stress in their job which can affected their work such as when a physician may have a conflict with his wife at home that will lead the physicians not to concentrate on his tasks. (Naylor, 2002).

From all the above it can be seen that physicians have a complex tasks but if all the above conditions are adhered to then medical care would be better for the patient and many aspects of medication errors would be avoided.

6.3. Definition of prescribing errors:

A paper from 1999 written by Coleman, (1999) defined in a very concise way a prescriber error as:

“an inappropriate drug selection, dose, dosage form or route of administration”.

Examples which confirm this definition include when duplicate therapies for a single indication have been ordered, prescribing a dose that is too high or too low for a particular patient, writing a prescription illegibly, prescribing an inappropriate dosage, dosing interval or ordering a drug to which the patient is allergic. Sometimes physicians simply select the wrong strength, if there is more than one strength available, due to a lack of experience of the available drugs strengths. Some physicians do not write the full instructions on the patient prescription on the ward for example: the correct route of the medicine for nurses to follow. For example to a give patient an injection by the IM route instead of the IV route but the route is simply not written down because perhaps it was presumed it would only be given IV.

Pharmacists can also be confused if say a physician does not mention the strength and dosage of the medication on the prescription especially when there are different formulations available in different strengths. For example tablets may not be identical in strength to liquid preparations. This can clearly lead to serious dispensing errors.

Sometimes the omission of important factors by the prescriber leads to errors including a failure to comply with legal requirements for prescription writing such as the name of patient, age, sex, diagnosis and dose. In addition, the prescriber sometimes does not specify the information such as dose, strength, duration of medication or the quantity of medication, say for a month or a week. This information which both the pharmacist and nurse need to dispense/administer the drug at the correct dosage and form and directions is absolutely necessary so that the patient can take any preparation in safety.

The occurrence of medication errors can compromise patient confidence in the healthcare system and in addition, increase healthcare cost (Zellmer, 1993) Economic consequences may include the award of damages to the patient, extension of a patient's stay in hospital and the potential financial support required for long term care of a patient who suffers permanent injury (Allan & Barker, 1990). As has been mentioned above in the literature review these mistakes can be costly. In the USA, it has been estimated that the cost of adverse drug events, a proportion of which are due to medication errors, was $5.6m per year for a 700 bed teaching hospital (Bates et al., 1997)

There is also another cause of error by physicians when they prescribe the same drug to a patient simply by lacking knowledge about the medication and use both the brand name and generic names. If the physician does not have experience about both brand names and generic names they may repeat the same medication without knowing that they are the same and the effect will be to cause an overdose. For example Viracept (nelfinavir) and Viramune (nevirapine) are two antiretroviral agents used in treatment of AIDS. Both the brand and generic names are similar (Raffali et al., 1997).

Physician prescribing error rates in hospital and community setting have been reported to be 0.3 to 1.9 percent (Blum et al., 1988; Leasr et al. 1990). One study determined that almost one-third (28.3%) of the prescribing errors were potentially harmful if not followed up by a pharmacist (Rupp et al., 1992).

6.4. To study actual medication errors in practice can be done in two ways, retrospectively and prospectively.

The first type involves analysis of prescriptions which have been dispensed and are kept in the patients notes. Prospectively is to set a study specifically to monitor all prescriptions which are dispensed for a set time and determine any errors and see why such errors occur and what steps can be taken to change such errors.

For this part of the study it was decided to use the former technique as it was suitable to actual record errors which had been made and had actually been dispensed. This it was thought might be useful for both the physicians and the pharmacists as this technique monitors physician errors which have been not been detected by the pharmacist. It could be argued that this is a somewhat strange approach as it monitors errors which have already occurred but it was nevertheless thought to be a way of determining actual prescriber errors without knowledge of the physician that he was actually being monitored which may have changed his behavior. Also a large number of prescriptions could be examined and so the overall error rate could be determined.

Since the majority of errors are classically seen on prescriptions for patients taking more than one drug it was decided to examine drug charts held in the hospital medical records for patients with chronic conditions who were taking a combination of drugs.

To make the searching of the large number of records as random as possible the following procedure was used. Every tenth chart in the records was examined for prescribing of drugs during a recent, specific period of time. If the chart had 5 or more drugs then the chart was 'selected' and those charts which were examined but contained less than 5 drugs were not selected. The next tenth chart was then examined and so on.

This procedure resulted in 1000 charts being 'selected' which because of the nature of the randomisation process contained prescriptions written by a number of physicians and in a large and diverse range of specialties. The use of five drugs or more was considered to be a very powerful criteria for selection as this would severely test the prescribing skill of the physicians and it was thought provide the maximum amount of data to try and improve advice about drug prescribing to the physician and also to help the pharmacist to reduce dispensing errors by concentrating on the complicated dispensing prescriptions.

The drug–drug interactions were assessed using Micromedex DRUG-REAX system. This proven system is evidence based and provides a rating of the interaction using a four point scale namely: contraindicated, major, moderate, minor and unknown. Each prescription was assessed using this system and any interactions scored using this system.

The results from this part of the study will be described in detail later in the chapter but before that it may be useful to consider all causes and factors which may be involved in a physician making errors at the prescribing stage before real examples are examined.

6.5.1Causes of medication error at the prescriber stage:

6.5.2 Poor quality of hand writing

In 1995 the NCCMERP met to find possible solutions, which they had to report to their council, for the reduction of medication errors. The council found that the most widely recognized cause of those errors was illegible hand writing on prescriptions and on the inpatient medication records. Ambiguity in writing often leads to misreading whether by pharmacist and / or by nurse. Actually, this ambiguity in writing any of the following - drug name, dosage form, quantity, strength, and direction for use, can lead to the patient being exposed to potential error(s).

In 2007 Cohen clearly stated in his book that a pharmacist must never guess about illegible handwriting on prescriptions. They must always request more clarification from the physician, if the prescription is not clear and not complete, before the preparation process. The pharmacist must return the prescription back to the physician by writing what is needed and signed for the clarification by the prescriber. Such information is needed by the pharmacist in order to ensure the accuracy of the dispensing.

Illegible handwriting on medication orders and prescriptions has been a widely recognized cause of medication errors (Long, 1991). Such errors have resulted in patient injury and, if the staff have not enough experience or are not well trained such as a physician who writes a prescription for a drug which has a similar name to another drug then this may lead to errors or mix-ups and it is extremely difficult for both the pharmacist and the nurse to differentiate between two drugs which have similar names and strength. Also, poor handwriting can cause a delay in dispensing the and even when dispensed if there is an incorrect understanding of the intended drug or dosage and route this may cause further problems. A prescriber with poor hand writing must take full responsibility for clearly communicating any order. Through my experience in the pharmacy dispensing area (see below) I found poor physician handwriting to cause problems one of which was in the dispensing of the anti-histamine Zyrtec which was easily misread as Zantac. Another real example was when one nurse on a ward inadvertently misread the handwriting on a physician's order for a drug which is used for eye problems, Solcosryle eye gel, and instead gave dental Solcosryle gel.

6.5.3 Physicians failing in adequately diagnose a condition in a patient.

Some physicians misdiagnose a patient's condition because of a lack of experience with the disease the patient is actually suffering from or because all the relevant information about the patient is not in their file. These omissions can include data such as the name, age, and weight of patient or full drug and medical history of the patient for the last medication used or they have a history of drug allergy. Some physicians do not listen to their patients comments about their personal circumstances or illness and this will not help the physician to have an accurate overview of the history of the patient. Most physicians lack the skill to explain medical conditions to their patients in a form which can be clearly understood. This requires the use of simple and clear language that can easy be understood so as to facilitate the patient co-operating with the physician.

Some physicians neglect to update their knowledge for say a new procedure or technique to be used for newly described conditions and diseases. There is one study showing this failing in physicians (Drury, 2000). From 1988 to 1998 the number of complaints about the failure to correctly diagnose by the physician in a medical defence organization increased more than tenfold. The average cost of compensation doubled. The highest award increased from $132 000 in 1977 to $ 1.6 million in 1998 awarded to a family of a child who died after a general physician failed to diagnose meningitis. In England between 1988 and 1997 the number of complaints about doctor received by the General Medical Council (GMC) more than tripled.

6.5.4 Drug concentration:

Failure to include the concentration of a liquid formulation in a prescription could result in a wrong dose being administered from nurses or being dispensed by a pharmacist. For example, a physician wrote an order for the antibiotic suspension Augmentin ½ TSP 2.5ml TID. The dose was not specified as the concentration of suspension was missing. The lack of a dose confused both the nurse and the pharmacist and resulted in a delay of the dispensing process. Since the actual dose was unclear for the suspension and as there are three different concentrations for this suspension 156mg, 312mg & 456mg. This necessitated the nurse and/or the pharmacist clarifying the ambiguous dose before they processed the order.

6.5.5 Unavailability of information

Information transfer can cause a major challenge to knowledge-based problem solving. There is one study by Leape et al.,(1995) which analyzed adverse drug events, to determine if factors such as a physician's lack of knowledge about drugs and also a lack of the relevant patient information could cause a common systems failure. This study determined that 40% of these errors resulted in patient 'injury'. This illustrates the fact that all health care providers need to have the relevant information available about patients and their drugs when it is needed.

Some physicians also forget to weigh their patients, especially in pediatrics and the elderly where this information is vital to be able to calculate the required doses because it needs a knowledge of their body weight - in some cases their height, to be able to calculate body surface area and they also need information on the previous medication(s) which have been prescribed as well as their diagnosis and history. A lack of such detailed information can contribute to medication errors, because dose usually depends on age, indication and severity of the condition. This illustrates the fact that full information is essential for the physician.

Unfortunately in the AFH hospital reported in this thesis does not as yet have a computerised system to interface with all hospital medical information found in a patient's medical record. This information is very important for all healthcare professionals to help them see for example what previous medications have been used by the patient. Some physicians through being 'overloaded with patients waiting outside their clinics' do not always check the history of a patient to find out whether they are allergic to any medication.

6.5.6 Look-alike and sound-alike drug names:

Name mix-ups account for more than one third of medication errors that have been reported to the USP-MERP (Cousins, 1995; Davis et al., 1992) Many errors have been caused by similar drug names especially when physician handwritten prescription are used. Examples include – the prescription for a patient prescribed Losec for gastrointestinal ulcer was actually dispensed Lasix (furosemide). The diuretic effect of course would not occur with Losec and so this error could potentially cause serious problems. There are many drug names which sound-alike that have caused medication errors include the anticoagulant Coumadin and an anti-Parkinson drug such as Kemadrin. Some generic drug names can be also similar and these can be confused by a pharmacist through dispensing prescriptions such as Inocor an Inotrope used in patients with cardiomyopathy. Look-alike and sound-alike amiodarone and Cordarone, an antiarrhythmic can cause errors due to the similarity of generic names. Many case reports deal with medication errors caused by confusion surrounding drug names. (Cohen & Davis, 1993). Approximately 15% of all medication errors reported to USP have been associated with confusion regarding similar drug name. (Jt Comm Persp., 2001)

Finally, problems arise when generic names look-alike or sound-alike to brand names and these can cause errors to the patient. Also strengths on a box can also cause problems. Poor hand writing of orders may delay the administration of medication. They may also increase the potential for a serious medication error stemming from an incorrect understanding of intended drug, dosage, route of administration or frequency (Davis et al., 1992).

6.5.7 Zeroes and Decimal Points:

Quickly written orders can cause problems especially numbers containing decimal points. Decimal points are easily missed, especially on a lined order sheet, carbon and non carbon-required form and faxes. If the decimal point is missed then an overdose may occur. Some physicians as they progress through their hospital round write their orders for the nurses too quickly and this may cause errors. Physicians when they have to write a decimal point should write it with great care, even when the name of medication is clear such as examples given below.

The following is a classical case reported by Cohen (2000). An order for “vincristine 2.0mg” was misread by clinical personnel as “20mg” because the decimal point fell on a line on the order form. The patient died after receiving a massive overdose.

Some physicians in their clinics when they write prescriptions without using special care may add a zero in front of the number and/or a decimal point which can confuse the nurses which results in the administration of wrong drug. Examples include “500mg” in place of “0.5g”or “125mcg” instead of “0.125mg’ so that a decimal point is never left “naked”. Decimal expressions of less than 1 must always be preceded by a zero (0) to enhance the visibility of decimal (ASPH, 1993).

Another case occurred concerning the decimal point. An infant received 0.17mg of digoxin instead of 0.017mg because a decimal point was misplaced during dose calculation. The use of trailing zeroes frequently causes a 10-fold overdose. Lack of a zero before a decimal point can also potentially lead to a huge dosage error. For example an order for "synthroid .1" has been misread as "1mg". A space should appear between the name of the medication and the dose, as well as between the dose and the unit. Cohen & Davis (1992) cited the example of "Inderal 40mg" being easily be misread as "Inderal 140mg" instead of "Inderal 40mg".

6.5.8 Metric and Apothecary System:

Surprisingly for 2009 the apothecary system is a system of measurement that some physicians still continue to use out of habit. This system can lead to errors because it is now unfamiliar to many healthcare professionals and any such values have to be converted to the metric system "1"gr (grain) may be interpreted as 60mg or 65mg which is confusing enough, but if it is written sloppily, then it could be misread as "1 gm" (1 gram= 1000 mg). Prescribers must be discouraged from using the apothecary system as it may cause error by the process of converting one scale to another Kessler (2004). For example if a nurse needed 1/200grain (0,3mg) nitroglycerin tablets and used 2x1/100grain - 0,6mg each or 1.2mg total dose instead (Cohen, 2000). Prescribers must always remember to express all weights, volume and units by using the metric system. The apothecary system can lead to errors simply because many users are unfamiliar with the Units and their abbreviations. (Cohen |& Davis, 1992). For example, in one case study the symbol for 1 dram (3t) was mistaken for 3 tablespoons (T), leading to a theophylline overdose in a child.

6.5.9 Use Of abbreviations:

Abbreviations may appear to be a great time saver, if the physicians use them properly, but if they are not used properly then they consume other healthcare professionals' time and can increase the potential for medication errors. (Cohen & Davis, 1992; Jones et al., 1997). The use of abbreviations has recently been found to contribute to medication errors in both manual entry and computerized system (Ulrich, 2007). As 90% of the errors occur during the prescribing stage every encouragement should be given to the physicians, despite their workloads, to avoid using abbreviations whenever possible so as to avoid the errors which are known to occur.

Physicians when writing their patient prescriptions must be accurate, especially for drugs that need special care such as chemotherapy drugs, neonatal and cardiac drugs**.** Abbreviations may be easily misunderstood sometimes for different reasons. Abbreviations may have many meanings, and if the reader is not familiar with them or if the prescriber has poorly written the names of medication, it may be mistaken with another abbreviation of medications such as "mg" mistakenly by "mcg**".**

Table 6.1 Some abbreviations which can be written by physicians and misunderstood by other health care professionals..

Abbreviation /dose Expression	**Intended Meaning**	**Misinterpretation**	**Correction**
Mg	Microgram	Mistaken for "mg'' when handwritten	Use "mcg"
o.d or OD	Once daily	Misinterpreted as "right eye" OD-Oculus Dexter	Use "daily"
TIW	Three a week	Mistaken as "three time a day"	Do not use this abbreviation
Qn	Nightly or at bedtime	Misinterpreted as "qh" (every hour)	Use " nightly"
SC	Subcutaneous	Mistaken for (sublingual)	Write "subcutaneous"

Uor u	Unit	Read as a zero(0) or a four(4) causing a 10-fold overdose	Use “Unit”
q.o.d or QOD	Every other day	Misinterpreted as“q.i.d (four time daily	Use “every other day”
IU	International unit	Misread as IV (intravenous).	Use “Units”

Some of the pharmaceutical companies inadvertently contribute to problems from confusing abbreviations. For example one company used an abbreviation as part of the name for one of its oestrogen products designate “HS” because it was half the strength of the manufacturer’s full strength preparation. So when the nurses and pharmacists saw the prescription, they thought that “HS” meant ‘at bed time’ and so patients inadvertently received the full-strength product at bed time.

Medication errors often occur because of the failure to standardize abbreviations by healthcare professionals and abbreviations have a great potential to cause problems if the physician uses them wrongly. For example patients have suffered permanent central nervous system impairment and death because of insulin overdose caused by misreading the “U” as zero or the number 4 or 6. Many abbreviations have multiple meanings or easily misread D/C is commonly used to indicate both “discharge” and “discontinue” when the physician does not clarify or specify exactly what is needed in the prescription. As an example of this problem a physician wrote three medications for a patient when he was discharged from hospital. The script was for insulin – digoxin -Tenormine. The nurse assumed that the physician’s intent was that the order was to be discontinued and so the patient went home without any medication. Three days later the error was discovered when a nurse noticed the discharge prescription clipped to the patient’s chart.

6.5.10 Course Dose vs. Daily Dose:

Using drugs for the purpose of chemotherapy is extremely complicated. To ensure their safety in use fixed schedules of drug administration are usually used. However some physicians when they write chemotherapy drug regimens instead of rigidly following the guidelines, commonly prescribed incorrect doses, combinations and strengths because they prescribe on a per course, or cycle of treatment, basis, as opposed to a per dose basis and this variability can cause confusion in the minds of both the pharmacists and the nurses. This practice increases the chances for medication errors because the orders are often difficult to interpret and these drugs can produced extremely seriously effects when given at inappropriate doses or also by the wrong route. (Cohen et al. 1996)

Many chemotherapy treatments require a patient to receive medication over several days or a week followed by a period of rest to allow the patient time to recover from side effects of the initial treatment. An example is for fluorouracil 4 g/m2 IV on days 1, 2, 3 and 4. This order might be interpreted as 4 g/m2 of fluorouracil (a cytotoxic agent) for 4 days - a total of 16 g/m2. (Kessler, 2004)

6.5.11 Drug indication:

Some physicians do not write the full drug indication on the patient prescription and this can lead to the patient using it incorrectly. Also some physicians forget to write the indication in the patient file which may confuse the nurse, and this may lead them to tell the patient something different than what physician actually intended. For example, a physician wanted a medicine to be taken three times a day, but the nurse told the patient once a day.

Confusion then occurs for everybody concerned. One of the most effective ways to prevent such prescribing errors is by writing a full indication on the patient's prescription file.

6.5.12 Ambiguous or Incomplete Orders:

Incomplete orders can cause a lot of medication errors through the 'rush writing' by the physician at end of duty time and they do not write the full indication/instructions in the patient prescription such as the route of administration, strength, dose, concentration, dosage form not being specified. For example, a physician wrote an order for a neonate for "digoxin 1.5 cc" and did not specify the concentration even though two concentrations are available - 0.5mg/2ml ampoules and 0.1mg/1ml ampoules - which are designated for pediatric patients. The nurse administered the wrong strength for a pediatric patient without double checking with the physicians or she did not check the weight of the baby before administering the dose to avoid errors (Cohen, 2000).

Some consultants at the end of a very busy ward round could delegate their tasks to a more junior staff member but only issue verbally instructions to them to continue the treatments for the patients. These verbal instructions may be wrongly understood leading to errors. Sometimes physicians neglect to actually check themselves a patient's BP and blood sugar and rely totally on a nurse, who may give him the wrong reading. Complete full information about the drug history from a casualty doctor is required by the physician who admits a patient to a ward so that the physician does not by mistake make a medication error.

6.5.13 Dose Miscalculations:

Dose miscalculations are particularly common with medication used for pediatric patients. Some physicians order doses for pediatric patients that can cause potentially serious errors through dose miscalculation. Mistakes of 10-fold or more occur up to 15% of the time (Perlstein et al.,1979).

Most of the health care professionals who work with children are very well aware of the risk of dose miscalculations. Because of the nature of drugs used in pediatric patients, even a simple computational error may have very harmful effects. Dosages of medications for infants and children may be calculated on the basis of age, status of prematurity, weight and body surface area which require weight and height to be known. But some physicians are not always aware of the consequences of wrong dose calculation through the process of writing medications for both in and out patients. Some physicians rely on nurses checking or even the patient's parents to provide the data. If a physician does not calculate the dose for a child very carefully, or adds a decimal point wrongly or does not writes the indications very clearly for other healthcare professionals this can threaten the child's life.

An example of a life threatening dose miscalculation is given in the study by Rodney & Shawn (2006). A nurse was caring for a 9-month-old child in the recovery room following surgery. For pain control, the surgeon had ordered 0.08 milligrams of hydromorphone. Two nurses independently performed the dose calculation and concluded that the dose was equivalent to 0.8 milligrams of hydromorphone. The error was detected when the infant developed respiratory suppression which fortunately was reversed and the child did not suffer actual harm.

Another study, this time by Thommas & Parkman (2005) involved a seven month old infant with a chief complain of vomiting which was brought to the triage desk for assessment and weighing. The baby's nurse told the mother the baby weighed 8KG. The baby's mother wanted to know what that equaled in pounds. So, the nurse switched the scale to display pounds and told her that the weight of baby equalled 17.6 pounds. So the nurse hurriedly documented the weight to the triage notes. There is space for weight in chart in kilograms and being distracted, she wrote 17.6. She failed to recognize that she did not switch the baby's weight back to kilograms. So when the baby was taken to the room with his mother, then physician wrote a fluid bolus of - 20ML-KG – which translated into a total volume of 352ML ordered based on the weight documented on the chart. The nurse gave the baby a bolus of 352ML, more than twice that which the baby should have received and this error was not detected. But after a physician wrote an order form for an intravenous I.V. antibiotic – the nurse noted that the dose seemed high for the baby and she checked the weight on the chart. Then the nurse again reweighed the baby, she discovered the error and corrected it for the antibiotic administration. Consequently, the physician should not rely on the nurse's calculation. He must double check before he writes any medication for the patient so as to protect them from any error. In contrast for children over twelve years of age and for adults, to reduce the potential for error, prescriber must be indicate the actual patient weight and calculate the dose, as well as the dose per weight or body surface area. Examples of such a problem are documented by (Koren et al., 1986). They described several situations involving major dosage calculation errors. Up to 10 fold errors reported in the administration of drug doses to pediatric patients, involving the drugs - digoxin, atropine, aminophyline, and gentamycin. The consequences of these errors included coma, respiratory failure and tachycardia and also transient renal failure. The most frequent computational error was a misplaced decimal point. Some physicians are careless to look in the drugs book if they are not sure about the spelling of the drug name and so it will be wrongly misinterpreted by both the nurse and/or the pharmacist (Perlstein et al., 1979).

6.5.14 Verbal orders:

Verbal orders can lead to medication errors when the orders are not transmitted clearly. Sometimes physicians use their car phones to make verbal orders and these can be very difficult for the nurse to understand especially with a number of drugs with similar-sounding names which can easily be misunderstood when given as a verbal order. In one case report, a verbal order was received by a nurse from a physician and then transmitted to a community pharmacy. The nurse inadvertently confused Ismelin (guanethidine - a potent antihypertensive agent) for Hismanal (astemizole-antihistamine) and the patient received the potent antihypertensive agent for the treatment of his allergy symptoms **(**Cohen & Davis, 1993). Some physicians during the 'rush time' in the office or in the operation theater room give the nurses some verbal order to give patients some medication by increasing or decreasing the dose and the nurse may receive the order incorrectly. For example, if a physician gave a verbal order for a drug for which there are sound-alike names for example, Losec may be give instead Lasix, these can cause errors for the patient.

6.5.15 High risk drugs: high alert medication:

Several medications or drug classes have been categorized as high alert medications such as - insulin – heparin – narcotics - because of their high risk of causing serious harm to the patient. For example when a patient is receiving unfractionated heparin the blood coagulation time must be checked at frequently intervals using the APTT test to ensure the patient is not either over or under coagulated. This is because it is impossible to know exactly what a dose of heparin will do to the clotting time without measuring it. Some physicians because of a lack of experience may increase a dose of heparin without insisting that the clotting time is checked and this can have very serious consequences. Such an error may result in serious injury or maybe the patient's death due to hemorrhaging. An overdose of heparin may be the result of needing to prescribe this drug in terms of units rather than mg quantities and the addition/omission of a zero can lead to serious consequences. In such a case the patient received 100 000 units instead of 10 000 units.

6.5.16 Drug-drug-interactions:

Some physicians through the lack of experience about drug-drug-interactions can easily cause errors by writing many types of medication for different conditions in one prescription without double checking whether the drug can interact with each other by perhaps looking in an appropriate reference text. In some cases in the AFH it is possible for a patient to see two different physicians on the same day. Sometimes the second physician fails to ask the patient about their drugs so as to avoid errors between the two treatments. The method used in this thesis found that the cause of error by prescriber by lack of knowledge of drug-drug-interaction at **page 262** with the result showing the reader how error occur through process of writing prescription by physicians without double checking and how physicians neglected to double check through reference texts before writing medication(s) for the patients to avoid any drug-drug-interaction. This problem could be addressed in AFH by perhaps installing a computer system which would facilitate the avoidance of drug-drug interactions.

6.5.17 Symbols on case notes and prescriptions:

Many health care physicians use up and down arrows to indicate “increase” and “decrease” these symbols can be confused for number or letter the nurse must always double check before administering any medication with the physician or with her colleagues or to check the patient blood pressure. An example to illustrate this point was when Vasotec (enalaprilat) 1.25mg IV was given to another elderly patient when the patient’s blood pressure was less than 180 mmHg. The order stated to hold the medication if the patient’s “SBP >180”. However, the “<” and “>” signs were confused and the medication was administered when the patient’s systolic blood pressure measured only 140 mm Hg. (PA-PSRS, 2005; Cohen, 2007)

6.5.18 Lack of patient education:

ISMP has recognized the “lack of patients understanding of their therapy” as a cause of the medication errors, so the patients should be adequately counseled (Jackson & Reines, 2005). They stated that 1 - 4% of all emergency room visit were related to the wrong use of medications. This could occur as a result of inadequate information about the drug during drug prescribing, dispensing and administration processes. Therefore, counselling the patients during dispensing could help to improve patient safety and to reduce errors. Several studies have shown that approximately 83% of dispensing errors can be discovered during patient counseling and corrected before the patient leaves the pharmacy (Ukens, 1997). Pharmacists’ reviewing the physician prescription can discover anything that does not match with the patients’ condition such as indication, dose, and directions for use.

It is also important to ensure safe medication use that all physicians educate their patients about their medications. This would consider what this drug is for, how is should be taken, how it works and what are likely to be the side effect(s) which could be expected to occur. Such advice will enable the patients to be in an excellent position to help minimize the possibility of medication errors occurring. Physicians must encourage patients to ask question about their medication and instructions to protecting them from any wrong use.

6.6.1 Factors contributing to medications errors by physicians:

6.6.2 Work Stress

Some physicians, perhaps all physicians, due to long working hours in the hospital can become tired and this can lead to them making some of the errors which occur. If break periods, during which say a cup of tea can be drunk can be taken then their powers of concentration may be restored and this will facilitate their ability to both diagnose and prescribe. Another very important consideration which concerns stress and tiredness is the one of excessive workloads which occurs when physicians have unexpectedly extremely busy clinics and have to see more than the expected number of patients. Some physicians feel discouraged by the head administration of the hospital or from the head departments discriminating between the staff, which gives a negative action on the physicians work to the patients.

6.6.3 Age:

Age of patient is very important for a physician throughout the process of diagnosing, because patients over 60 years of age change their pharmacokinetics, have a possible higher incidence of co-morbid and frailty and have a notably increased risk of serious injury and death from adverse events and medication errors as compared with younger patients (Bates et al.,1999). Furthermore the elderly are more likely to be on multiple drug therapy. The elderly people occupy about a third of hospital beds and they receive 52% of all prescriptions for different conditions**.** (Department of Health, England, 2000)

6.6.4 Work Area:

A poorly designed working area can contribute to prescribing errors by physician who can feel 'constricted' without free movement in the room which leaves the physician to fell 'psychology distracted'. Also if there is not a proper working area with proper lighting and adequate counter space or office table, a comfortable temperature and humidity these can all affect the performance of physicians for promoting good services for patient diagnosing.

6.6.5 Staff inexperience:

Errors can occur throughout the prescribing stage when there is lack experience such trainees' physician often make errors in all aspects of healthcare. In an analysis of 289411 medication orders, it was found that first postgraduate residents made four times the numbers of errors than did the four-year residents, which indicates that knowledge and experience are extremely important factor in physician performance (Leasr et al., 1990)

6.6.6 Noise:

Certain noises and sounds have been shown to affect the work of the physician in the clinic through writing medication prescription to the patients and also they found that decreasing the noise produces a decrease in the rate of prescribing errors. This is perhaps because noise sometimes leads the physician to lose concentration in the patients. To make the prescribing process safe you have to make the right environment for the physicians so as to promote a good health care service to the patients (Flynn et al., 1996). I think in my view, when we control the noise and the sound in the clinic then we can decrease the prescribing rate of errors from my experience in the hospital.

6.6.7 Lighting:

Light is very important for the physician so that he can see with clarity the full information of the patient such as the name of the patient, age, weight and history of the patient and light of a good intensity can also make the prescription clear for physician to write medications. The light level for a physician is also very important to facilitate the inspection of skin conditions such as infections or fungal conditions which can appear on the skin of the patient.

6.6.8 Number of hours worked by an individual:

This is one of the major factors which can affect the performance of physician. By seeing extra patients in a clinic without an appointment or working all day without taking any breaks. This reason leads to errors, because the physicians do not concentrate during the diagnosing stage and also afterwards when they are writing the medication prescription. The legal time for physicians working hours is seven hours a day but in some circumstances when there is a shortage of physicians in the hospital some physicians will work extra time to cover the shortage of the missing staff. This can make the physician's powers of diagnosis and prescribing less than what it would normally be.

6.6.9 Distractions:

Physicians are often distracted from one task to attend to another. Although not all distractions can be eliminated, some of them can be reduced. For example, in the AFH 'ringing telephones' may break the physician's concentration during the process of diagnosis of the patient. Also unnecessary conversation among hospital staff while the physician is undertaking a diagnosis of the patient may distract his attention during the writing of a prescription for the patient. Also, interruptions from another colleague could lead to his loss of concentration and so miss one of the medications necessary for the condition of patient. Physicians must concentrate at all stages of writing prescriptions to help to avoid any errors which may affect the patient.

6.6.10 Salary:

Salary is very important for physicians or any staff who want to promote good healthcare services for patients. A good salary gives an individual the possibility of a high living standard but if the salary is poor then the individual may feel less prone to work at the required standard. Poor remuneration for the physician is less likely to encourage him to keep his skills up to date.

6.6.11 Interruptions from staff:

Some physicians would prefer that anyone from the hospital staff does not interrupt him during the process of diagnosing the patient. This can affect his concentration while he writes the history of patient or writes the medication prescription and interruptions sometimes may cause a loss of what was intended to be written for the patient.

6.6.12 Recreation:

All of these factors given above that can affect the role(s) of physicians I conclude that from my experience without any facilities in the hospital at break time will leave the physician talking to hospital staff and only waiting for the time to arrive when they go home. In contrast, if all facilities are found such as a swimming pool or cafes and playing snooker these can give healthcare personnel a very good atmosphere for the promoting a good and safe health service.

After mentioning all the potential causes and factors which can lead to errors, through prescriber's diagnosis and writing prescription such as above, the next part of the thesis deals with the real errors found when the prescribers were checked when they manually wrote multiple medications for chronic condition in the patients prescriptions. This problem was made potentially worse by no computerized system being available which would have found errors such as, the wrong strength, wrong dose or any drug-drug-interactions. Since drug interactions are central to this part of the thesis it is appropriate to briefly consider this topic before real results are discussed.

6.7 Introduction. Drug-drug interactions at the prescriber's stage

As an indication of medication errors made by physicians it was decided to look at one aspect, namely the problems of drug interactions on prescriptions which had already been dispensed. This it was thought may give an indication of the type of errors made, albeit after the most obvious ones had been seen and corrected by the pharmacy prior to dispensing. As has been outlined above the lack of a computer system in the Pharmacy department did not allow such events to be logged or enumerated or if corrections had in fact been made but could not be recorded and as such, the actual value is lower than the prescribers really made. Nevertheless, is an indication of the more serious errors which passed through the system and perhaps reflects a combination of prescriber and pharmacist errors in spotting drug interactions. It is true that such an analysis will not spot the wrong dose, wrong drug or even the drug resulted in toxic effects but does provide a 'snapshot' of the problems of knowledge about drug - drug interactions which is one aspect of medication errors which could be studied for this thesis.

A major criticism for the selection of this technique could be that is it just a proxy way of doing a study and will not determine the real incidence in actual practice. This may be true since the experience of monitoring dispensing practice of Pharmacists who were 'observed' to see how many errors they made, the Pharmacists slowed down in dispensing speed and took especial care not to make errors and so gave a result which not be actually found in day to day practice. It is a complicated problem when observation changes behaviour and one that remains to be solved. As a result of all these considerations the method which was used was thought appropriate for the situation as it was in Kuwait.

It has been determined that polypharmacy is a major cause for drug-drug interactions and adverse reactions, and the outcome may be harmful if the interaction causes an increase in the efficacy or toxicity of the drug. For example, patients already taking warfarin may begin to bleed if given azapropazone or phenylbutazone unless the warfarin dosage is reduced appropriately. There is one study which reported that the more drugs a patient takes the greater the likelihood that an adverse reaction will occur (Stockley, 1999). One hospital study found that the rate was 7% in those taking 6-10 drugs, but 40% in those taking 16-20 drugs which represents a disproportionate increase**. (**Ibrahim et al., 2005).

6.7.1 Definition drug-drug-interaction.

This occurs - when the effects of one drug are changed by the presence of another drug, food, drink or by some environment chemical agent (Stockley, 1999).

Another definition of polypharmacy:

Generally refers to the use of multiple medications by a patient. The term is used when too many forms of medication are used by a patient, more drugs are prescribed than clinically warranted (Fulton & Allen, 2005).

6.8 Objective of this part of the thesis:

To determine if the prescribers when writing a prescription for multiple medications for chronic conditions can makes potential drug interactions errors on their prescriptions.

6.9 Methods:

The hospital's Medical Records Department records was searched for charts with prescriptions with potential for drug-drug interactions. Each selected chart was examined for number of prescription drugs prescribed during a specific period. The method of selecting the charts was randomly to pick every tenth chart in the records and this was then examined for the number of drugs prescribed to the patient at the same time. If a chart had 5 or more drugs it was selected for further analysis. If there were less than five drugs prescribed the chart was not selected and selection moved on to the next 10^{th} chart. This ensured that charts were obtained from a variety of physicians for patients undergoing many different types of therapy. A total of 1000 charts were collected and these were then examined for drug-drug interactions using the Micromedex DRUG-REAX system. The Micromedex DRUG-REAX system is a proven and evidence-based system of rating interaction severity according to clinical significance.

The drug-drug interactions were rated as follows:

- Contraindicated - the drugs are contraindicated for concurrent use.
- Major - the interaction may be life-threatening and/or require medical intervention to minimize or prevent serious adverse effects.
- Moderate - the interaction may result in an exacerbation of the patient's condition and/or require an alteration in therapy.
- Minor - the interaction would have limited clinical effects. Manifestations may include an increase in the frequency or severity of side effects but generally would not require a major alteration in therapy.
- Unknown – unknown

6.9.1 For ease of use in this study a system of classification was designed, and these categories were converted into a number system as follows-

- Contraindicated 4
- Major 3
- Moderate 2
- Minor 1
- Unknown 0

6.10 Results.

The analysis of the drug-drug interactions showed that out of a total of 1000 prescriptions, 124 contained a drug-drug interaction. It was of great significance that none were found to fall into the contraindicated classification (Category 4)

However there were **21** occasions when the interactions were rated 3 (**major**), **87** when the interactions were rated 2 (**moderate**) and **15** interactions were rated 1 **(minor**) according the modified MICROMEDEX scale. If these findings are used to calculated an overall error rate and overall accuracy rate for prescribers then the following figures are obtained:

Overall error rate = 12.4% and an overall accuracy rate = 87.6%

A summary of the individual interactions rated as category 3 are shown in **Table 6.1** below.

Table 6. 1 Interactions rated as (major) – category 3, on prescription chart analysis.

Number	**Drug-drug Interaction**
1	Atorvastatin x bezafibrate

2	Atorvastatin x gemfibrozil
3	Gemfibrozil x simvastatin
4	Fluvastatin x gemfibrozil
5	Aspirin x warfarin
6	Atenolol x verapamil
7	Atorvastatin x clarithromycin
8	Captopril x spironolactone
9	Carvedilol x verapamil
10	Fosinopril x spironolactone
11	Simvastatin x verapamil
12	Atorvastatin x verapamil
13	Digoxin x verapamil
14	Atorvastatin x diltiazem
15	Celecoxib x warfarin
16	Amiodarone x metoprolol
17	Levofloxacin x metformin
18	Digoxin x Indapamide
19	Allopurinol x fosinopril
20	Allopurinol x lisinopril
21	Allopurinol x perindopril

The interactions that were rated as moderate – category 2 are shown in **Table 6.2**. below. These were interactions are classified as 'considered to potentially result in an exacerbation of the patient's condition and/or require an alteration in the patient's therapy'.

Table 6.2. Drug-drug interactions rated as 2 (moderate).

Drug-drug Interaction	Drug-drug Interaction	Drug-drug Interaction
Aspirin × glyclazide	**Atorvastatin × digoxin**	**Insulin × metoprolol**
Carvedillol × glyclazide	**Bisiprolol vs glyburide**	**Metformin × metoprolol**

Gliclazide × warfarin	**Bisiprolol vs metformin**	**Omeprazole × warfarin**
Aspirin × cilazapril	**Bisoprolol × doxazosin**	**Aspirin × fosinopril**
Amiloride x valsartan	**Bisoprolol × glimepiride**	**Aspirin × insulin**
Aspirin × celecoxib	**Bisoprolol × insulin**	**Glyburide × hydrochlorothiazide**
Carbamazepine × valproic acid	**Bisoprolol × metformin**	**Metformin × ranitidine**
Diltiazem × simvastatin	**Captopril × furosemide**	**Simvastatin × warfarin**
Hydrochlorothiazide ×perindopril	**Captopril × ndapamide**	**Aspirin × furosemide**
Aspirin × diclofenac	**Carvedilol × digoxin**	**Bisoprolol × digoxin**
Aspirin × meloxicam	**Carvedilol × glyburide**	**Aspirin × spironolactone**
Atenolol × diltiazem	**Carvedilol × insulin**	**Spironolactone × warfarin**
Bisoprolol × diltiazem	**Carvedilol × metformin**	**Atenolol × lisinopril**
Aspirin × captopril	**Celecoxib × furosemide**	**Carbamazepine × Omeprazole**
Amlodipine × atenolol	**Clopidogrel × diclofenac**	**Digoxin × simvastatin**
Amlodipine × bisoprolol	**Diclofenac × hydrochlorothiazide**	**Lisinopril × metoprolol**
Amlodipine × carvedilol	**Diclofenac × indapamide**	**Phenytoin × simvastatin**
Amlodipine × Metoprolol	**Digoxin × furosemide**	**Atenolol × warfarin**
Aspirin × glyburide	**Fosinoprikl × furosemide**	**Methydopa × metoprolol**
Aspirin × lisinopril	**Fosinopril × hydrochlorothiazide**	**Aspirin × diltiazem**
Aspirin × paroxetine	**Fosinopril × indapamide**	**Aspirin × verapamil**
Atenolol × felodipine	**Furosemide × lisinopril**	**Carbamazepine × simvastatin**
Atenolol × glimepiride	**Furosemide × meloxicam**	**aspirin × antacid (Al, Ca, Mg salts)**
Atenolol × glipizide	**Furosemide × perindopril**	**Diclofenac × digoxin**
Atenolol × Glyburide	**Gemfibrozil × rosiglitazone**	**Digoxin × omeprazole**
Atenolol × insulin	**Glimepride × ibuprofen**	**Clopidogrel × fluvastatin**
Atenolol × metformin	**Glyburide × meloxicam**	**Ranitidine × warfarin**
Atenolol × nifedipine	**Ibuprofen × indapamide**	**Aspirin × digoxin**
Atenolol × prazosin	**Indapamide × lisinopril**	**Diclofenac × glyburide**

The interactions that were of the least clinical significance are shown in **Table 6.3** below. These were considered to require minimal or no alteration in the patient's therapy and included things such as increased frequency of adverse effects.

Table 6.3 Interactions with least clinical significance rated as 1 (minor).

Number.	**Drug-drug Interaction**
1	Atenolol x antacid (Al, Ca, Mg salts)
2	Aspirin vs clopidogrel
3	Amlodipine x diclofenac
4	Bisoprolol x diclofenac
5	Bisoprolol x meloxicam
6	Celecoxib x fosinopril
7	Diclofenac x fosinopril
8	Diclofenac x lisinopril
9	Felodipine x naproxen
10	Fosinopril x Naproxen
11	Meloxicam x perindopril
12	Fluvastatin x omeprazole
13	Allopurinol x amoxicillin
14	Glucosamine x glyburide
15	Glucosamine x metformin

6.11 Recommendations to minimize medication error in prescriber stage:

From the examples which have been found in this study several recommendations can be made to minimize medication errors.

1) Prescribers must use the new technology such as Computer physician order entry system (CPOE) because it is a system that accepts the prescribers order for diagnosis and treatment services rather than using the handwritten order sheet or prescription pad. Using such system could be helpful to minimize the human errors by limiting reliance on memory (Kuchake, 2008).

2) Prescribers must provide patients with clear and complete instructions, since what is obvious to you is not obvious to your patients such as through my observation there is one patient uneducated when the physician write for him suppository for rectal use, patient think the medicine orally taking did not recognize for rectal or vaginal, because the physician did not communicate with the patient properly to give him the correct instructions.

3) Prescribers must be knowledgeable about drug-drug-interactions before writing prescriptions to the patients to avoid any error occur.

4) Prescribers must double-check drug dosing calculations before writing the prescription and also to choose the appropriate medication and dosage for individual, the prescriber must consider the patient’s age, weight, renal and hepatic function, current disease(s) states, laboratory test results, current medications.

5) Physicians must tell the patient the purpose of the medications on the outpatient prescription. This also provides pharmacists with an additional way of confirming that they have interpreted the order correctly. Also, a pharmacist should include the purpose of medication on the label. This helps patients to confirm that they have the medication ordered by their physician.

6) Prescribers must use exact metric Units vs. dosage units.

7) Prescribers must use the simple and plain words to explain the instruction to the patient by showing him or drawing some picture to explain and not to use only scientific language.

8) Prescribers must be careful about using trailing zero should not follow a whole number for drug doses to avoid any error will occur.

9) Prescribers must writing prescription more clearly, print in block letters rather than cursive; avoid using abbreviations to misinterpreted from other healthcare professionals wrongly to avoid error occurrence.

10) Prescribers must write out drug directions very clearly so as to enable the patient to understand the use of medications.

11) Prescribers must avoid the use of “take as directed” because some nurses think there is no problem in giving the drug twice a day whereas the patient can think it is safe to use the drugs more than one time or may be three times a day because he does not understand the meaning of this word.

12) Prescribers must when using a leading zero should precede a decimal point for drug doses.

13) Prescribers must not accepted patients are not written in the appointment list, that will overloaded and can affected their ability’s through diagnosing patients to not concentrate.

14) Include the patient’s weight on medication orders.

15) Prescribers must avoid use of abbreviations of drug names, acronyms, or locally termed drug names.

16) Prescribers must use updated references to have right information about drugs and disease.

17) Use prescribers computer medication order entry to alert from any error can occur.

18) Prescribers must take another opinion from another colleague if not sure (Edward & Bell 2003).

19)

6.12 Discussion:

The most common clinically significant interactions i.e. those **rated 3** (Table 6.1), were those that were considered to require interventions in therapy in order to prevent harm to the patient. These included interactions between drugs used for dyslipidaemia such as HMG-CoA reductase inhibitors and fibrates which are know to induce adverse effects such as myalgia and rhabdomyolysis which can be serious enough to kill a patient if not detected and managed early enough. Most of these interactions involved drugs used to treat or manage cardiovascular conditions such as hypertension, arrhythmias and diabetes.

The less clinically significant interactions were presented in Tables 6.2 and 6.3. These interactions, although not as serious could still potentially harm the patient or interfere with therapy e.g. increased noncompliance due to increased side effects of co-administered drugs with the same pharmacological effects such as increased hypoglycemia from co-administered oral hypoglycemic agents or an increased risk of bleeding from the co-administration of aspirin and clopidogrel due to their combined anti-platelet effects.

Many interactions could arise due to the fact that physicians do not or are not able to check for drug-drug interactions during the prescribing process. A number of solutions could be proposed to help solve this problem. Computerized dispensing with integrated drug databases could help to check for clinically significant drug-drug interactions. As well, the involvement of well-trained and knowledgeable pharmacists in triaging the prescriptions during dispensing could help to catch any potential interactions that would not have been caught by the physicians.

6.13 Conclusion

After explaining and discussing for the reader all the causes and factors which can lead to errors at prescriber's stages the factors which are responsible for such problems such as wrong diagnosing, abbreviations-incomplete order-drug-drug-interaction-verbal order-calculation of doses-incorrect drug have also been considered in great detail. From all this analysis I conclude that Physicians must double check very carefully throughout the process of writing prescription for the patient by checking full details of the patients history to avoid the occurrence potential errors.

The analytical method came at next stage where it was determined whether patients on multiple medications for chronic conditions had potential drug interactions in their prescriptions. From the results of this method of detailed chart reviews, it is obvious that some patients actually received prescriptions with potentially serious drug-drug interactions which at the very least may have affected their treatment and patient compliance and at the worst could potentially have harmed the patient resulting in the most serious cases in death or disability. This problem is thought to be due to some physicians lacking knowledge about potential drug-drug-interactions which were shown in the written patient's prescriptions.

Sometimes it was clear that they had simply neglected to double check with pharmacy staff or in the drug index which would have avoided such problems.

CHAPTER SEVEN
Patient education

Patient education is very important for all patients so as to avoid any potential error which may occur from any of the healthcare professionals who are associated with their therapy.

7.1. Definition of patient education.

Patient education is the keystone in achieving patient compliance. Fisher (1992) defined patient education as:

'the practice of increasing the knowledge and awareness of patients concerns towards their medical condition'.

In the same year, Herfindal et al. (1992) defined it as:

'an intervention designed to improve patient drug knowledge, medication compliance and therapeutic outcome'.

The most commonly used patient education methods are: oral communication and counselling, written communication, audio-visual materials, controlled therapy or self-medication before discharge from the hospital and special compliance programs. Since drug therapy issues and problems are a major part of patient education, pharmacists are becoming more involved with patient education, and can play a major role in initiating, maintaining and monitoring patient drug education. Such education will enable patients to take an important role in their own therapy so ensuring safe medication use. If patients know what a drug is for, how is should be taken, what it looks like and how it works, this will be an excellent position to help minimize the possibility of medication errors. Pharmacists must encourage patients to ask questions about their medication. For example, if any side effects are expected or any important instructions they can follow whilst they are taking their medicines. If a patient is aware of the medications they are receiving they can also alert the pharmacist to potential errors in medication dispensing. If a patient questions a dose of medication, that dose must not be dispensed unless the reason for refusal can definitely be determined to be invalid. A well educated patient is a strong defence against errors and educating patients can help any member of the health care team to discover any sort of error which could occur and will also give the patient an opportunity to explain their concerns before something actually goes wrong and so errors can be caught before they happen. An educated patient instructed by all members of the health care team/professionals is a very strong defense against errors. This educated patient will also be able to discover any potential error and will give the patient also the opportunity to understand the purpose of his medication (Cohen, 2000).

7.2. Patient request for medication information:

Patient requests for information have been identified in a number of studies. Although patients would like information about their medication, there is a discrepancy between what they require and what they receive (Whyte, 1992). A need for more information about the prescribed medicine was also supported by one major study carried out by McMahon et al. (1987) who found that although 74% of 154 patients visiting an out-patients clinic would have liked to have received written information, only 14% actually did so. Importantly, the fact that patients do not ask for information does not necessarily mean that this requirement does not exist.

7.3. A role for pharmacists in patient education:

Pharmacist involvement in patient education is a logical step to make since their undergraduate and postgraduate training enables them to have a good knowledge base about drugs and their uses. The onset of providing more advice has progressed more rapidly since the introduction of clinical pharmacy in many hospital settings. It is worth commenting that pharmacists are usually the very last health care professionals that comes into contact with the patient and so they have a very important responsibility to ensure that drug are taken both appropriately and safely. The correct use of medicines also has a potential financial benefit as expenditure on health care has been shown to be optimised by pharmacist interventions which have tried to educate patients and monitor compliance (Fisher, 1992).

In clinical practice, next to physicians, one study found that pharmacists were the most common source of drug information (Morris et al., 1987). However, in practice, pharmacist involvement in patient education is generally less than that of the physician. An interesting study to show the problems of patient education is that carried out by Hunter and Bryant in 1994**.** This study assessed pharmacists' counselling of families that included children with asthma. They identified the following as barriers to greater pharmacist involvement and effectiveness as communicators: lack of time, lack of knowledge and lack of confidence. However, in more recent studies, it was found that these barriers can be overcome and with greater emphasis being placed nowadays on communication skills and patient care skills of community pharmacists, two studies have shown that pharmacist intervention is both requested and welcomed by the majority of patients (Liu et al., 1999; Kassam et al., 2001). The importance of patient education in improving patient compliance has been shown in a number of studies. Lack of information was identified as the major factor when patients did not take their medicines as the prescriber intended (Kitching, 1990). In the study of Lin et al., (1995) compliance was assessed in 155 patients taking antidepressants and they found that 28% of patients had stopped taking medication during the first month of therapy and 44% had stopped taking their drugs by the third month of therapy. However, these authors observed that patients were more likely to comply during the first month of medication if they were given specific answers to their concerns about taking their medication and were Provided with the following key information:

1. Take the medication daily as prescribed;
2. Antidepressants must be taken for 2 to 4 weeks before any improvement in depressive symptoms will be felt;
3. Continue to take medication even if you feel better; and
4. Do not stop taking antidepressants unless your physician tells you to do so.

Clearly the use of simple, specific information brings about favourable results.

Other studies have also shown that giving feedback to patients on their medication resulted in better compliance with therapeutic treatment. In a four-year study, Kelly et al. (1990) recruited a group of 418 male psychiatric outpatients that took part in a six-month trial. These workers reported that the introduction of two brief educational interventions intended to train patients themselves to become effective health care consumers or by engaging family members or significant others in the aftercare process, caused a significant improvement of medication compliance. In another study, Lowe et al. (1995) observed that a self-medication educational programme improved the patient knowledge of their drugs and their compliance after discharge. This improvement was found based on the use of a structured interview and 'tablet counts' i.e. counting tablets actually taken from the dispensed medicines, during home visits which were undertaken 10 days after discharge of 88 elderly hospital in-patients. The mean compliance score for patients taking part in the self-medication programme was 95% as compared with 83% for the control group. In terms of knowledge about the purpose of their drugs, 90% of the self-medication group knew the purpose of their drugs as compared with 46% for the control group. Clearly, education was a useful procedure to educate patients in a complex area such as in psychiatric outpatients.

7.4. Combined educational programme.

Many studies which have considered the elements of an effective patient education programme have concluded that a combination of educational inputs – video, leaflet, explanatory drawings, verbal instruction - as opposed to a single strategy, leads to better patient compliance outcomes in a number of conditions in the treatment of both chronic and acute illness (Haynes et al., 1987 and 1996)**.**The limitations of using a single strategy is shown by the study of Brody (1980) who found that when patients were provided with just verbal counselling. rather than a range of instructions such as those listed above, more than half made significant errors when asked to immediately recall verbal information which had been given to them about their therapy.

7.5. Patient information leaflets:

While the condition of clearly written patient information leaflets have been shown to improve patient knowledge about their medicine and decrease medication errors, its effect on compliance is less clear (Gibbs et al., 1989 and 1990).

7.6. What actual patient information is required?

Creating information leaflets is rather complex and it should be a combined effort involving all the members of the multidisciplinary health care team. Information relevant to the sociocultural aspects is extremely important if leaflets are to seem to have any relevance to the 'life style' of the patient. Although some studies have shown that patients do want to be informed about possible side-effects, there still remains some argument over what exactly they should be told. Many physicians worry that informing patients about side-effects might reduce compliance (Berry, et al., 1997; Mottram and Reed, 1997). Mottram and Reed (1997) carried out a study comparing the views of pharmacists, GPs and the general public on the value of pharmacy-generated PILs, and found that all the three groups perceived these leaflets to be useful and an aid to improve compliance. An interesting study, yet to be done, is how valuable patients think these leaflets actually are helpful.

7.7 What information is required by the patient and what information could encourage the proper use of medication

1. Knowledge of how and when to take the drug and how to store it;
2. Knowledge of how the drug is expected to help.
3. Knowledge of possible problems caused by the drug (i.e., to know the most important side-effects, adverse drug reactions and lifestyle changes) and what to do about them if they should occur (Hermann, et al., 1978; Berry, et al., 1995).

4. Patients should be able to read and understand their medication content and leaflets. This means the text has to be written in simple Arabic/English. Otherwise they become an expensive waste of resources. (Coey, 1996)

Perhaps the Association of the British Pharmaceutical Industry (ABPI) was considering such comments when it specified that ‘prescription medication inserts’ should include the following information written in clear unequivocal English (Kitching, 1990):In the context of this thesis also clear and simple Arabic.

1. Name of drug
2. Purpose and the importance of taking the drug
3. Dosage instructions
4. Methods and times of administration
5. Duration of therapy
6. Precautions
7. Interactions which are clinically significant or potentially dangerous
8. Side-effects important to patients and what to do if they occur
9. Relevant formulation details
10. Action to be taken in the case of missed doses or overdoses
11. Advice to inform the doctor if pregnant
12. What to do to get further information
13. How to recognise if a medicine is not working and what to do about it.

Finally, Patient education is very important for a patient as it can protect him from many errors which occur during his treatment which has been provided by members of the health care team.

7.8 Patient counselling:

Counselling is defined as a one-on-one, interactive session designed to modify patient knowledge or behaviour (Herfindal et al., 1992). Pharmacist-patient consultations are the means whereby pharmacists can educate patients by providing adequate information at the time medicines are dispensed (Fisher, 1992).

Deadly, in 1996 discovered that during patient counselling 83% of the potential errors could be 'sorted out' before the patient left the pharmacy and pharmacist must tell and explain technique during patient counselling by opening the container to show the patient his medication as a final look to remember it in the future and if any medication dispense wrongly from pharmacist patient can easy to catch the error. .

Pharmacists can significantly improve medication safety and can help patients to avoid medication accident or latent error at home by providing them with different advice for medication safety such as:

1. Make a list of medication you are taking
2. After any change in your medication always remember to change your list of current medications.
3. List any medication which can cause you allergies or food allergies.
4. Do not keep medication in hot temperatures which may spoil the potency of medication.
5. Keep medications in their original container.
6. Do not keep tubes of ointment anywhere near to tubes of toothpaste.

All these types of advice listed above can protect patients from suffering any medication errors occurring at home. (Jackson, 2003)

CHAPTER EIGHT

8.1 Overall conclusion from all the studies carried out for this thesis.

The surveys carried out in the earlier part of this thesis were made to establish the attitudes regarding patient safety of the nurses, physicians and pharmacists in the Armed Forces Hospital (AFH) in Kuwait. The examination of all their answers provided a very useful and interesting perspective on the state of health care in the hospital. There was a universal acceptance that safety for the patient was the priority of all types of involvement with medication – whether prescribing, dispensing or administering the medications. There was concern expressed by many of the respondents that should they report the occurrence of errors then they felt that disciplinary proceedings may be taken against them and some even thought that they would face dismissal from their jobs especially if the patients should die as a result of such an error. Such a punitive action would of course destroy their potential for future employment at the hospital.

The main aims of this thesis were threefold. The first study investigated and identified the accuracy of the administration of medication by nurses as compared with the actual prescriptions of the physician. The detailed results are given in Chapter 4 and there were found to be comparable to those of other studies in the field. The error rate of 17.3% is similar to many reported throughout the world although some studies have used far fewer, such as - 107 total opportunities for error. The validity of using 1124 doses to be examined proved that the study could be carried out in the AFH without actually influencing the staff to always be on their ‘best performance’ so ensuring an accurate value for errors was obtained. The types of errors which were found reflect those which have been reported in the literature and are comprehensively discussed in the introduction to this thesis.

Consequently, because the problems experienced in the armed forces hospital are similar to the rest of the world then if those strategies used elsewhere are used in the AFH then the error rate should be further reduced For example, if nurses can be encouraged to always following the “five rights” for safe administration medications and avoid the problems of taking verbal orders from physicians except in emergency cases then perhaps the error rate could be reduced further. If the problems of abbreviations, double checking and lack of knowledge could also be made more robust then misunderstandings involved in some types of medication administration may be further reduced. These steps could be further promoted by an enhanced educational training programme for the nursing staff.

The **second** study attempted to check the dispensing accuracy of the pharmacists in the hospital dispensary. In a preliminary study the pharmacy department was visited and the observer (myself) observed the dispensing process at a randomly chosen dispensary window. Each item which was dispensed from a prescription was observed and each error was to be logged. However it was found that simply being in the dispensary observing the process caused the pharmacists to dispense with greater accuracy than perhaps would be normally experienced as tasks that normally took 5 minutes were extended to 20 minutes in which time the pharmacists carried out their dispensing tasks with far greater time allocation than normal and as such their error rate was reduced as no errors were actually found. In addition to not seeing the actual type of normal errors which occur this process caused great inconvenience to the patients in terms of waiting for their prescriptions as well as causing problems in the dispensary window and consuming a lot of time.

As an alternative study it was decided to carry out a process in the medical clinics department (see Chapter 1 for all the departments in this specialties) to identify the accuracy of dispensing medications as compared with the physician's prescriptions in the patient file. By agreement with all the nursing staff – which proved absolutely central to the success of these studies - the observer (myself) with the nurses of clinics developed a strategy which enabled the drugs dispensed by the pharmacy to be checked against those the patients was actually prescribed. The pharmacists did not actually know that their work was being checked so it was expected that the pharmacists would work at their normal 'pace' and routines and so the 'real types of dispensing errors would be actually found. In this study the observer randomly choose a patient from clinics of different specialties after they had been seen by the physician and had been prescribed their medications. Then the nurse would ask the patient to return back to the clinic to receive their next appointment sheet which in fact would be given to them by the observer.

On their return to the clinic the observer would use an 'observation form' to write down the drugs that the patient had received in the bag from the pharmacy. When a suitable number of forms were produced, say in groups of 20 forms, the items on the observational forms were checked against those written on the actual patients file by the physician. If the items did not agree then a further form was used to list the types of errors which had been made on a form called the 'medication error form' Consequently this comparison made it possible to check the accuracy of the dispensing process This checking procedure, because it was independent of the pharmacy dispensary, was more accurate than the first study in the pharmacy dispensary which proved unsuitable.

When these results were analysed and compared with published data from a number of sources where different type of pharmacies were compared in terms of the number of errors. The studies actually cited can be seen in Chapter 4. Table 4.8 p173. From the table it can be seen that the studies have used different number of prescriptions ranging from 100-10,889. Despite this variability in the numbers studied their were similarities in the number of errors recorded when expressed as a percentage. The range of such errors has from 1% - 24%. However it is a cause for concern that some of the studies used very small sample sizes, namely, 100, 223, 929, 1055, to establish the rate of error and this may either under or over estimate the problem. As a consequences this thesis used a sample size of 2472 which it was expected would give a more accurate assessment of the true rate of error. The potential to change such rates of error may be made easier by the use of software programmes with "forcing functions" that force the entry of additional related patient information before the end of the order and dispensing the medication. These programmes activate other alerts such as drug interaction, duplication of drug writing, Look – alike and Sound – alike medications can prevent from error occurrence. This re-enforces the suggestion made above that a computer system in the AFH would be very helpful to avoid errors occurring.

The third study was to determine whether patients on multiple medications for chronic conditions have potential drug-interactions in their prescription written by physicians. The observer searching for suitable charts with prescriptions in the medical record department used a method of selecting 10 files and examining them for the number of drugs prescribed to the patient simultaneously. When the file had more than five drugs it was selected for analysis and in total 1000 files were collected and then the prescribed drugs examined for drug-drug-interactions using the Micromedex DRUG-REAX system .The Micromedex DRUG-REAX system is proven and evidence-based system of rating interaction severity according to clinical significance. Contraindicated-4, Major-3, Moderate-2, Minor-1, Unknown-o. All these cause and factors elements are making up the prescribing and giving of drugs are prone to error and writing prescription must be clear and ambiguous. Physicians must always take great care over details of dosage – diagnose- abbreviation – calculation doses- incomplete order and verbal order in consideration to avoid an occurrence of error as has been comprehensively discussed above. Physicians must always follow the “five rights” to enable safer prescribing. Physicians must be always use up to date references and using computers for medication order entry and physician using a new technology has many advantages such as simplify the work, standardize the procedure of treatment, and are helpful to minimize human error by reducing reliance on human memory. Using the software programmes with “forcing functions” that force the entry of additional related patient information before the end of the order and dispensing the medication. These programmers activate other alerts such as drug- drug- interaction- Adverse drug events and prevent form mediation error occurrence. Again this suggests a computer system for the AFH would be a very useful investment in helping to avoid errors in the future

Based on all the above analyses the key result is that all health care professional make errors and in this study the error due to physicians was 12.4%, the nurses 17.2% and the pharmacists 4.7%. I conclude that most of errors are made by the physicians and nurses and so any future focus to try and reduce the error rate should be these health care professionals.

One major step should be to encourage/enforce that the physicians to include all the relevant details on the prescriptions so that the pharmacists and nurses can dispense and administer drugs in a safe and reliable way to avoid any error can occur in the future and also all health care professional must double check before prescribing or administration or dispensing any prescription.

CHAPTER NINE

Future Work and Recommendations

9.1 Future work recommendations:

Intervention of a clinical pharmacist in the hospital. A clinical pharmacist should be included in Kuwait hospitals to work with doctors and to help supervise the nurses. He will be a link between doctors and nurses so as to ensure that the proper medication has been taken/administered by/to the patient. A survey by Cotter, (1992) found that pharmacists in 96% of NHS hospitals monitored prescriptions on the wards, usually daily on weekdays. The survey shows that hospital pharmacists can detect and prevent many errors in prescribing.

Completion of bar-coding project from patient's admission until discharge.

If bar coding could be introduced then the potential for errors should be reduced especially on the identification of patients and to avoid the dispensing of incorrect drugs. It is being used increasingly widely in other areas of healthcare such as the clinical laboratory (Brient, 1995). In addition, it has proved to be very effective in other industries, and it has the potential to nearly eliminate drug substitutions and to allow better tracking of exactly what medications are given and when they are given.

Introduction of PharmNet

Better information is central to any system of trying to make improvements to the present system but it has to be quickly available for all the staff and here a PharmNet system could be very useful to find drug names/potential drug interactions/dispensing advice/availability of drugs.

Implementation of Computerized Physician Order Entry (CPOE)

Such a system could have major implications for the reduction of errors as the problems of handwriting of medical conditions and drug names and unusual abbreviations could be avoided so enhancing the overall accuracy of the prescribing/dispensing process. The ability of such a system to alert the physician to an incorrect dose or potential interaction(s) is also a major advantage of this system. This system has ability to deliver messages in real time to the clinical decision maker (Sittig, 1994). And was found also to decrease inpatient charges per admission by 12.7% in a randomized controlled trial (Tiereny 1993). Physician order entry can also decrease the frequency of medication errors such as drug name – dose – route and frequency.

Implementation of medical administration record electronic MARs

The usefulness of a complete and comprehensive system of electronic files for any medical system is absolutely central when access to the patients' notes is needed by everybody concerned with patient care – nurses, physicians and pharmacists so if any data requires checking, for example a dose or diagnosis it can be easily done without any of the staff having to be actually contacted to explain the requirements of the patient which may be absent on the present system. The saving in time of this system as compared with the present handwritten system or manual dispensing of prescriptions could be considerable as well as being potentially safer.

Introducing outpatient robotic dispensing system

If this could be introduced in the Pharmacy department, perhaps initially for a limited number of drugs which are frequently used this would 'free up' time to spend on the more complicated drugs so that better time could be spent on the problems rather than the routine dispensing process. This would result in a combination of items dispensed robotically combined with traditionally hand dispensed items for the complex medications such as those that are used for ‘alert medication’.

Improving environmental factors by redesigning/renovating areas for all health care facilities.

It is true that if the ‘environmental factors’ such as space, privacy, light, noise and seating could be improved then there could be a benefit for the patient in terms of their ability to ask questions of a confidential type to the physician/pharmacist /nurse. The physical arrangements could also reduce the ‘pressure’ which is presently applied to staff since the increased physical space would enable patients to avoid crowding the staff during their process and help the physician to be better diagnose his patients. All these improvements of the environmental factors would help to avoid errors.

Implementing Reporting system in Kuwait:

We must implement a reporting system for medication errors in Kuwait. It is essential to share information among healthcare professionals in all hospitals in Kuwait and connect with other organizations Such as MedWatch – MERP – NCCMERP- FDA. All these reporting systems can increase the safety of patient and to minimize the error occurrence. More training programmes for all healthcare professional to help to reduce errors actually occurring should be instigated.

References

AAPM & R (2008). New Joint Commision “Do Not Use” List: Abbreviations, Acronyms, and Symbols. Available at: http:// www.aapmr.org/hpl/ pracguide/jcahosymbols.ht (Accessed on 26th July 2008.

Abood, R.R.(1996). Error in pharmacy practice. US *Pharmacy;* 21,122-32.

Al- Hameli, F (2008). AFH Kuwait, Dispensing in a high-volume, hospital-based outpatient pharmacy using direct Observation method. – Presentation at a Kuwait Pharmacists meeting

Al-Hameli, F.(2007). AFH Kuwait. Direct observation method in medical ward at Nurses. – Presentation at a Kuwait Pharmacists meeting

Allan, E.L. & Barker, J. (1990). Fundamentals of medication research . *American .J.Hospital.Pharmac,*. 47 (3), 555-71.

Allan, E.L.(1994). Relationships Among Facility Design Variables and Medication Errors in pharmacy. Aubum University Dissertation.

Allan, E.L., Barker, K.N., Malloy, M.J. et al.(1995). Dispensing errors and Counseling in community practice. *American pharmacy*, NS, 35, 25-33.

American Society of Hospital Pharmacists (1993). ASHP guidelines on preventing medication errors in hospitals. *American J Hospital Pharmacy*. 50, 305-14.

Anselmi, M.L., Peduzzi, M. & C B dos Santos (2007). Errors in the administration of intravenous medication in Brazilian hospitals. *Journal of Clinical Nursing,* 16, (10), 1839 – 1847.

Armed Forces Hospital Nursing/Pharmacy/Medical Staff Questionnaires on Attitudes to Medication Errors: AHAHR & ISMP (2002). (Adapted from 2002© American Hospital Association,HealthResearch & Educational Trust, and the Institute for Safe Medication Practices *www.medpathways.info.*

Ash, J.S., Gorman, P.N., Seshadri, V. & Hersh, W.R. (2004). Computerized physician order entry in U.S. hospitals: results of a 2002 survey. *J American Medical Information Association,* 11, 95–99.

Audit Commission (2001*) A spoonful of sugar: Medicines management in NHS Hospitals*.

Audit Commission, 2001

Baker, KN & McConnell, WE (1962) The problems of detecting medication errors in hospitals. *American J of Hospital Pharmacy,* 19, 360-369

Barker, K. & Cowley, E. (2000). Liability for medication errors in expanded pharmacy practice: issues for technicians and pharmacist. Platform presentation of the American Pharmaceutical Association Annual Meeting. Washington, DC.

Barker, K. N., & McConnell, W. E. (1962). The problem of detecting medication errors in hospitals. *Am J of Hospital Pharmacy,* 19, 360-369.

Barker, K. N., Flynn, E., Pearson, R., Moss, R., & Mueller, M. (1998). Affordable observation-based method for monitoring medication error rates and reducing errors. ASHP Midyear Clinical Meeting, 33(Dec), PI-140.

Barker, K. N., Kimbrough, W. V., & Heller, W. M. (1966). A study of medication errors in a adverse drug events. *J General Internal Medicine,* 274:29-34.
Barker, K.N., Flynn, E.A., Pepper, G.A. et al.(2002). Medication Error observed in 36 health care facilities. *Archives Internal Medicine.* 162 (16): 1897-1903.

Bates, D.N., Spell, N., Cullen, D.J. et al.(1997). The cost of adverse drug events in hospitalized patients. *J American Medical Association*. 274, 29-34.
Bates, D.W., Cullen, D.J., Laird, N. et al.(1995). Incidence of adverse drug events and potential adverse drug events: implications for prevention. ADE Prevention Study Group. *J American Medical Association,* 274(1), 29-34.

Bates, D.W., Miller, E.B., Cullen, D.J., Burdick, L., Williams, L., Laird, N. et al. (1999). Patient risk factors for adverse drug events in hospitalised patients. *Archives Internal Med*icine, 159, 2553-60.

Bates, D.W., Spell, N.,Cullen,D.J., Burdic, E., Laird, N., Peterson, L. A., Small,S.D., Sweitzer, B.J. & Bell, D. (2004). Think Twice, save a life: The pharmacy's Role in Medication Safety. *Joint Commission Resources.* USA.

Bates, D.W., Teich, J.M., Lee, L., Seger, D., Kuperman, G.J., Ma'Luf, N., Boyle, D., Leape, L. (1999). the impact of computerized physician order entry on medication error prevention. *J American Medical Information Association*.6, 313-32.

Bates, D.W., Boyle, D.,Van der Vliet, M.B., Schneider, J. & Leape L. (1995). Relationship between medication errors and adverse drug events *J General Internal Medicine* 10(4), 199-205

Bates, D.W.,Spell, N.,Cullen, D.J., Burdic, E., Laird, N., Peterson, L.A., Small, S.D., Sweitzer, B.J. & Leape, L.L. (1997).The cost of adverse drug events in hospitalized patients. *Adverse Drug Events Prevention Study Group.* 277(4), 307-11.

Bell, E.A. (2003). Medication errors in pediatrics, Pediatrics, February. pp2.

Berman, A. (2004). Reducing medication errors through naming, labeling, packaging. *J Medical Systems* 28, (1) 1-21

Berry, D., Michas, I.C., Gillie, T. & Forster, M. (1997). "What do patients want to know about their medicines, and what do doctors want to tell them?: A comparative study", *Psychology and Health*, 12, 467-480.

Berry, D.C., Gillie, T. & Banbury, S. (1995). "What do patients want to know: An empirical approach to explanation generation and validation", *Expert System with Applications,* 8, 419-427.

Blum, K.V., Abel, S.R., Urbanski, C.J. et al.(1988). Medication error prevention by pharmacists. *American J Hospital Pharmacy*, 45, 1902-3.

Bontemps, H., Fauconnier. J., Bosson, J.L., Brilloit, C., Francois. P. & Calop, J. (1997). Evaluation de la qualite de la prescription des medicaments dans un CHU. *J Pharmacie Clinicale,* 16, 49-53.

Borel, J.M. & Rascati, K.L.(1995). Effects of an automated, nursing unit-based drug-dispensing device on medication errors. *American J Health-system Pharmacy*, 52,1875-9.

Brient, K.(1995). Bar-coding facilitates patient-focused care. *Health Information*, 12, 38-42.

Brody, D.S. (1980). "An analysis of patient recall of their therapeutic regimens", *J. Chronic Diseases*, 33, 57-63.

Bruce J, & Wong I. (2001). Parenteral drug administration errors by nursing staff on an acute medical admissions ward during day duty. *Drug safety,* 24 (11), 855-62

Buchanan, T.L, Barker, K.N., Gibson, J.T. et al.(1991). Illumination and errors in dispensing. *American J Hospital Pharmacy.* 148, 2137-45.

Buurma, H, de Smet, PAGM, van den Hoff, OP,& Egberts, CG (2001) nature, frequency and determinants of prescription modifications in Dutch community pharmacies. *British Journal of Clinical Pharmacology*, 52, 85 – 91.

Chiche, L., Thomas, G., Canavese, S., Rravger, S., Jean, R. and Durand, J.M. (2008). Severe hemorrhagic syndrome due to similarity of drug names *European J. of Internal Medicine*, 19, 135-136.

Coey, L. (1996). Readability of printed educational materials used to inform potential and actual ostomates, *J. Clinical. Nursing*, 5 (6), 359-366.

Cohen, J.R., Anderson, R.W., Attilio, R.M. et al.(1996). Preventing medication errors in cancer chemotherapy. *American J Health-System Pharmacy,* 53, 737-46.

Cohen, M. R. (2000). Medication Errors causes prevention and risk management, Chapter 11, pp11,2. Washington: American Pharmacists Association.

Cohen, M. R.(2007). Medication Errors. 2nd edition. Research on errors in dispensing and medication administration. Chapter 2, p23 Washington: American Pharmacists Association.

Cohen, M.R. & Davis, N.M. (1992). Who needs the apothecary system? *American Pharmacy,.* NS32, 482-84.

Cohen, M.R. & Davis, N.M. (1993) Errors caused by medical office personnel. *American Pharmacy. 1993;* NS33(7), 18.

Cohen, M.R. & Davis, N.M.(1992). Avoid dangerous Rx abbreviations. *American Pharmacy*, NS32, 112-13.

Cohen, M.R. & Davis, N.M.(1992). Expressing strengths, doses, and drug names properly. *American Pharmacy*, N32, 216-17.

Cohen, M.R. & Davis, N.M.(1993). Trademark similarities can cause problems. *American Pharmacy*, NS33, 16-7.

Cohen, M.R. & Teplitsky, B.(1992). Look-alike and sound-alike drug names: the problem and the solution. *Hospital Pharmacy*, 27, 95-110.

Cohen, M.R.(1996). Amrinone- amiodrone mix-up reported. *Hospital Pharmacy*, 31, 16.

Cohen, M.R.(1997). ISMP medication error reporting analysis. The mistake of blaming people and not the process. *Hospital Pharmacy,* 32, 1106-11.

Coleman, I.C. (1999). Medication Error: Picking up the pieces. *Drug Topic,* 14, 83-92.

Cook, R. & Woods, D. (1994). Operating at the sharp end: the complexity of human error. In: MS Bogner (ed). Human Error in Medicine. Erbaum,Hillsade,NJ.

Costa, L.A., Loureiro, S., de Oliveira, M.G.et al.(2006). Medication errors in two Brazilian hospitals. *Farm Hospital*, 30(4), 235-9. (Original in Spanish.)

Cotter, S.M., Barber, N.D.& Mckee, M.(1994). survey of clinical pharmacy services in United Kingdom National Health services hospitals. *American J Hospital Pharm*acy, 51, 2676-84.

Cousins, D.D.(1995). Prevention of errors. *US Pharmacist.* August;70-75.

Cummings, J., Bush, P., Smith, D. & Matuszewski, K. (2005) Bar-coding medication administration overview and consensus recommendations. *American J Health System Pharmacy,* 62, 2626–2629.

Davis, N.M. & Cohen, M.R. (1995) Changing how pharmacist think about errors. *American Pharmacy,* NS35, 11 & 45.

Davis, N.M. & Cohen, M.R.(1994) Ten steps for ensuring dispensing accuracy. *American Pharmacy,* NS34(7):22-23.

Davis, N.M. (1994). A well- informed patient is a valuable asset. *American J Nursing*, 94:16.

Davis, N.M., Cohen, M.R. & Teplitsky, B.(1992) Look-alike and sound-alike drug names: the problem and the solution. *Hospital Pharmacy*, 27, 95-110.

De Michele, D.(1995). preventing medication errors. *US pharmacy*, 20, 69-75.

Dean, B., Schachter, M., Vincent, C. and Barber, N. (2002) Prescribing errors in hospital inpatients: their incidence and clinical significance. *Quality Health Car,.* 11, 340-44.

Dean, B.S., Barber, N.D. & Schachter, M.(2000). What is prescribing error? *Quality Health Care*, 9, 232-237.

Deans, C. (2005). Medication errors and professional practice of registered nurses. *Collegian*. 12(1):29-33. [Royal College of Nursing, Australia]

Dearden, C.H. & Rutherford, W.H. (1985). The resuscitation of the severely injured in the accident and emergency department-a medical audit. *Injury,* 16, 249.

Department of health (2000). Prescription dispensed in the Community statistics for 1989-1999, England. Department of Health: London.

Department of Health UK (2000) Building a safer NHS for patients - implementing an organisation with a memory Department of Health 2001

Drury, M (2000). Cause and effect. In: M Drury (ed.) *Clinical Negligence in General Practice*. Radcliffe Medical Press, Oxford, 1-12.

Editorial (2001).Code of ethics revision. *Pharacuetical Journal,* 266, 325-32.

Ferner, R. E. (1999). Error in prescribing, supplying and giving medicine. *Prescribers Journal,* 39, 51-58

Ferner, R.E. & Aronson, J.K.(2004). Clarification of terminology in medication errors: definitions and classification. *Drug Safety,* 29(11), 1011-22.

Fisher, R.C. (1992) “Patient education and compliance: A Pharmacist’s perspective”, *Patient. Education Counselling*, 19, 261-271.

Fisher, R.C. (1992). “Patient education and compliance: A Pharmacist’s perspective”. *Patient. Educational. Counselling*, 19, 261-271.

Fitzgerald, W.L., Wilson, D.B. (1998). Medication errors. *Lessons in Law. Drug Topics,* 142, 84-93.

Flynn, E.A. & Barker, K.N. (2006). Research on dispensing errors and medication administration errors. In: *Medication Errors*. (ed: Cohen). APA, Washington DC, 1-76.

Flynn, E.A., Barker, K.N., Gibson, J.T. et al.(1996). Relationships between ambient sounds and the accuracy of pharmacists' prescription-filling performance. *Human Factors*, 38, 614-22.

Flynn, E.A., Barker, K.N., Gibson, J.T., Pearson, R.E., Berger, B.A. & Smith, L.A.(1999). Impact of interruptions and distractions on dispensing errors in an ambulatory care pharmacy. *American J Hospital Pharmacy,* 56, 1319-1325.

Flynn, E.A., Pearson, R.E. & Barker, K.N. (1997). Observational study of accuracy in compounding IV admixtures at five hospitals. *American J Hospital Pharmacy,* 54, 904-912.

Fox, E. R. & Tyler, L.S. (2004). Measuring the impact of drug shortage. *American Journal of Health System Pharmacy*, 61(19), 2015-2022.

Fulton, M.M. & Allen, E.R.(2005). Polypharmacy in the elderly: a literature review. *J American Academy Nurse Practioner,* 17,123-32.

Gandhi, T.K. et al. (2000). Drug Complications in Outpatients. *J General Internal Medicine,* 15, 149-54.

Gibbs, S., Water, W.E. & George, C.F. (1989).”The benefits of prescription information leaflets(1)”, *British. J. Clinical. Pharmacology*, 27 (6), 723-739.

Girotti, M.J., Garrick, C., Tierney, M.G., Chesnick, K. & Brown, S.J.(1987). Medication administration errors in an adult intensive care unit. *Heart Lung,* 16, 449–53.

Gold, D.R., Rogacz, S., Bock, N. et al.(1992). Rotating shift Work, sleep, and accidents related to sleepiness in hospital nurses. *American J Public Health,* 82(7), 1011-4.

Grasha, A. (2001). Understanding Medication Errors: A Cognitive System Approach. American Pharmaceutical Association 148th Annual Meeting, March 16-20 San Francisco California.

Grasha, A. (2002). Psychosocial Factors, Workload, and Risk of Medication Errors. *US Pharmacist*, 27, 32HS-52.

Haw, C., Stubbs, J. & Dickens, G. (2007). An observational study of medication administration errors in old-age psychiatric inpatients. *International. J. for quality in Healthcare*, 19 (4), 210-216.

Haw, C.M., Dickens, G. & Stubbs, J.(2005). A review of medication administration errors reported in a large psychiatric hospital in the United Kingdom. *Psychiatric Services,* 56, 1610- 3.

Hawksworth, GM, Corlett, AJ, Wright DJ & Chrystyn, H. (1999) Clinical pharmacy interventions by community pharamciasts during the dispensing process. British J Clinical Pharmacology, 47, 695 – 700.

Haynes, R.B., McKibbon, K.A. & Kanani, R. (1996). Systematic review of randomised trials of interventions to assist patients to follow prescriptions for medications. *The Lancet*, 348 (9024), 383-386.

Haynes, R.B., Wang, E. & Gomes, M.D. (1987). "A critical review of interventions to improve compliance with prescribed medications"**.** *Patient Educationa. Counselling*, 10, 155-166.

Hepler, C.D. & Strand, L. (1990). Opportunities and responsibilities in pharmaceutical care, *American J of Hospital Pharmacists*, 46, 533-43.

Hepler, C.D. & Strand, L. (1990b), Integrated patient-specific model of pharmacy practice, *Am J of Hospital Pharmacists* 46

Herfindal, E.T., Gourley, D.R. & Lloyd Hart, L. (1992). Editors. *Clinical Pharmacy and Therapeutics.* Chapter 6: Patient education and chronic disease monitoring. Carter, B.L. and Helling, D.K.: East Preston, Baltimore, Maryland, USA. 5th edition.

Hermann, F., Herxheimer, A. & Lionel, N. (1978). Package inserts for prescribed medicines: What minimum information do patients need? *British Medical Journal* 2, 1132-1135.

Hunter, K.A. & Bryant, B.G. (1994). Pharmacist provided education and counseling for managing pediatric asthma, *Patient Educationa. Counselling*, 24, 127-134.

Hussain, E. & Kao, E. (2005). Medication safety and transfusion errors in the ICU and beyond. *Critical Care Clinics***,** 21**,** 91–110.

Ibrahim, I.A., Kang, E. & Dansky, K.H.(2005). Polypharmacy and possible drug-drug interactions among diabetic patients receiving home health care services. *Journal Home Health Care Services Quarterly,* 24(1-2), 87-99.

Institute for Safe Medication Practices (1999) The "five rights" Aug17 Availablefrom:http/www.ismp.org/MSArticles/FiveRights.html.

Institute for Safe Medication Practices. Mosby's Nursing (2005) PDQ for Medication Safety. St Louis: Mosby.

ISMP (2000). May 3 Medication safety Alert. 5 (9). FDA has approved LANTUS (insulin glargine [rDNA origin]). Concern is mounting that oral or written orders for Lantus may be mistaken as "Lente"**.**

ISMP, (2000) Institute of Medicine. To Err Is Human: Building a Safer Health System. National Academy of Sciences :www.nap.edu/openbook/0309068371/html/1.html.

Jackson, M. A. & Reines, W. G. (2005). A systematic approach to preventing medication errors. *US Pharmacist*, 28(6), 6976.

Jackson, M. A.(2004). A systematic approach to prevent Medication errors, *For the Record,* 16(4), 27–9.

Jessee, W.F. (1981). Medication errors noted as major source of incident reports. *Hospital Peer Review*, 39 (1), 141-144.

Jick, H. (1984). Adverse drug reactions: the magnitude of the problem. *J Allergy Clinical Immunol*ogy, 74, 555-7.

Johnson, J.A. & Bootman, J.L. (1995). Drug-related morbidity and mortality. A cost of illness model. *Archives Internal Medicine,* 155, 1949 -56.

Jones, E.H. & Speerhas, R.(1997). How physicians can prevent medication errors: practical strategies. *Cleveland Clinical J Medicine,* 64, 355-59.

Kaushal, R., Barker, K.N. & Bates, D.W. (2001). How Can Information Technology Improve Patient Safety and Reduce Medication Errors in Children's Health Care? *Archives Pediatric Adolescent Medicine,* 155, 1002-1007.

Kaushal, R., Bates, D.W., Landrigan, C et al., (2001). Medication Errors and adverse drug events in pediatric inpatients. *J American Medical Association*, 285, 2114 - 2120.

Kelly, G.R., Scott, J.E. & Mamon, J. (1990). "Medication compliance and health education among outpatients with chronic mental disorders", *Medica. Care*, 28 (12), 1181-1197.

Kelly, W.N.(1994). Pharmacy contribution to adverse medication events. Presented of the Conference on Understanding and Preventing Drug Misadventures, Chantilly, Va, October 21-23.

Kennedy, AG & Littenburg, B (2004) Medication error reporting by Community Pharmacists in Vermont. *J American Pharmacy Association*, 44 (4), 434-8

Kessler, J. Z. (2004). Medication Errors, 3rd Edition, Chapter 15. pp323 & 324

Kistner, U.A., Keith, M.R., Sergeant, K.A. et al.(1994). Of accuracy of dispensing in a high-Volume, hospital-based out patient pharmacy. *American J Hospital Pharmacy,* 51:2793-97.

Kitching, J.B. (1990). Patient information leaflets - the state of art**.** *J. Royal Society. Medicine*, 83, 298-300.

Knudsen, P., Herborg, H., Mortensen, A.R., Knudsen, M. and Hellebek, A.(2007). Preventing medication errors in community pharmacy: frequency and seriousness of medication errors. *Quality and safety in Health care*, 16, 291-96.

Kohen, L.T., Corrigan, J.M., Donaldson, M.S., Editors.(1999) To error is human. Building a safer health system. National Academy press. Washington, D.C;. Available at www.nap. Edu/ lakolog/9728. html,accessed july 3,2002.

Kohn, L.T., Corrigan, J.M. & Donaldson, M.S.(2000). To Err Is Human: Building a safer Health System. Institute of Medicine: National Academy Press. Washington, DC

Koren, G., Barzilay, Z. & Greenwald, M.(1986). Tenfold errors in administration of drug doses: a neglected iatrogenic disease in pediatrics. *Pediatrics*, 77, 848-49.

Kuchake, V. G., Ingle, P. V., Patil, P. H. et al. (2008). Review on Medication Errors. Pharmainf. net. Available at: http:// www.pharmainfo. Net/ reviews/review-medication errors (Accessed on 10th August 2008).

Kuiper, S.A.,McCreadie, S.R., Mitchell, J.F. & Stevenson, J.G. (2006). Medication Errors in Inpatient Pharmacy Operations and Technologies for Improvement *American Journal of Health-System Pharmacy,* 64(9), 955-959.

Leape, L.L, Bates, D.W., Cullen, D.J., Clapp, M.D et al. (1999). Pharmacist participation on physician round and adverse drug events in the intensive care unit. *J American Medical Association,* 282, 267-270.

Leape, L.L. (1995). Preventing adverse drug events. *American J Health Systems Pharmacy,* 52, 379-382.

Leape, L.L. (1999). *A systems analysis approach to medical error.* In, Cohn M.R,Ed; Medication errors. Jones and Bartlett, Sudbury, MA, p37.

Leape, L.L., Bates, D.W., Cullen, D.J., Cooper, J., Demonaco, H.J., Gallivan, T. et al. (1995). System Analysis of adverse drug events. *J American Medical Association,* 274, 35-43.

Leaser, T.S., Briceland, L.L., Delcoure, K. et al. (1990). Medication prescribing errors in a teaching hospital. *J American Medical Association,* 263, 2329.

Lesar, T.S. (2007). Medication Errors Related To Dosage Formulation Issues. Medscape, Medline and drug reference.

Lesar, T.S., Briceland, L.& Stein, D.S.(1997). Factor related to errors in medication prescribing. *J American Medical Association,* 277:312-317.

Levandoski, L.A. (2005) Medication errors involving “L Insulin”. *Hospital physician*. 19, 4.

Liu, M.Y., Jennings, J.P., Samuelson, W.M. & Sullivan, C.A. (1999). “Asthma patients’ satisfaction with the frequency and content of pharmacist counselling”, *J. American. Pharmacists. Association*, 39 (4), 493-498.

Locke, J. (1632-1704). in - An essay concerning Human Understanding , Book 4, Chapter 20, Section 17.

Long, K.J. (1991).The need for obligatory printing in medical records (letter). *Hospital Pharmacy,* 26, 924.

Look-alike, Sound-alike drug names. *Jt Comm persp*. (2001); 19:10-11.

Lowe, C.J., Raynor, D.K., Courtney, E.A., Purvis, J. & Teale, C. (1995). “Effects of self medication programme on knowledge of drugs and compliance with treatment in elderly patients”, *British Medical Journal*, 13 (310), 1229-1231.

Maidment, I., Lelliott, P., & Paton, C. (2006). Medication errors in mental healthcare: a systematic review. *Quality and Safety in Health Care*, 15, 409-413.

Malone, P. M., Kier, K.L. & Stanovich, J.E. (1999). *Drug information,* 1999, A guide for pharmacists, Third edition. Chapter 17. p613.

Manasse, H.R. (1989). Medication use in an imperfect world: drug misadventuring as an issue of public policy, part 1. *American J. Hospital Pharmacy*, 46, 929-944.

Mc Ghan, W.F., Smith, W.E. & Adams, D,W.(1983), A randomized trial comparing pharmacists and technicians as dispensers of prescriptions for ambulatory patients. *Medical care*, 21, 445-53.

Mc Guckin, M et al.(1997). Hand washing: the Effect of patient Education program presented at Society for Healthcare Epidemiology in America annual meeting. St Louis, Mo, April.

McMahon, T., Clark, C.M. & Bailie, G.R. (1987). "Who provides patients with drug information?", *British Medical Journal*, 294, 355-356.

McPhillips, H.A., Stille, C.J., Ralph, D.S. et al.(2005). Potential Medication Dosing Errors in out patient pediatrics. *J Pediatrics,* 147, 961.

Meichenbaum, D. & Turk, D.C.(1987). Facilitating treatment adherence: a practioner's handbook. New York: Plenum Press.

Milles, M. & Sweeng, S. (2001). Insulin dose interpretation errors. *Pharmaceutical Journal*, 267, 193.

Monette, J., Gurwitz, J.H. & Avom, J.(1995). Epidemiology of adverse drug vents in the nursing home setting. *Drugs & Aging*, 7(3), 203-11.

Morris, L.A., Grossman, R., Barkdoll, G. and Gordon, E. (1987)."A segmentational analysis of prescription drug information seeking". *Med. Care*, 25, 953-964.

Mottram, D.R. & Reed, C. (1997). "Comparative evaluation of patient information leaflets by pharmacists, doctors and the general public". *J. Clinical. Pharmacology. Therapeutics*, 22 (2), 127-134.

National Center for Health Workforce Analysis (2002). Projected supply.(Heinz, D. Hospital 2001).

Naylor, R. (2002). *Medication Errors: Lessons for education and healthcare* Chapter 7 and 9,pp 81, and 281 Radcliffe Medical Press Ltd.

NCCMERP (2008). The National Coordinating Council for Medication Error Reporting and Prevention, About Medication Errors: What is medication error. Available at: http://www.nccmerp.org/aboutMed Errors. html(Accessed on 19th June 2008).

NCGNP (2006). Highlights of the National Conference of Gerontological Nurse Practioners 25th Annual Meeting.

O' Neal, D.J. (2000). Nurses' Role in Reducing Adverse Drug Events, Chapter 10, pp 147.

O’ Neal. D J. (2000). *Nurses’ Role in Reducing Adverse Drug Events,* Chapter 10, pp 147.

O’Hare,M., Bradley,A., Gallacher, T. & Shield, M. (1995). Errors in administration of intravenous drugs. *British Medical Journal,* 310,1536-1537.

O'Brodovich, M. & Rappaport, P.(1991). A study pre and post unit dose conversion in pediatric hospital. *Canadian J Hospital Pharmacy*, 44, 5-15 and 50.

Omoria, D.M., Potyk, R.P. & Kroenke, K.(1991). The adverse effects of hospitalization on drug regimens *Archives Internal Medicine,* 156, 2-4.

Osborne, J., Blaisk, H. & Hayes J. (1999). Nurses’ perceptions: When is it a medication error? *JONA*, 29 (4) , 33-38.

Paoletti, R.D.,Suess,T.M., Lesko, M.G., Feroli, A.A., Kennel, J.A., Mahler, J.M.& Saunders, T. (2007). Bar-code Technology and Observation for Safer Drug Administration: Implementation of EMAR and BCMA System *American journal of health-system pharmacy* 64(5), 536-543,

PA-PSRS Patient Safety Advisory Abbreviations: a shortcut to medication errors. PA-PSRS Patient Safety Advisory. March 2005;2(1):19-21. Available at:www.psa.state.pa.us/psa/lib/psa/Advisories/march.2005_advisory_v2_n1 pdf.Accessed May31,2005. cited Cohen 2007.

Perlstein PH, White CC, Barnes B, et al.(1979) Errors in drug Computations during newborn intensive care *Am J Dis Child;* 133:376-9.

Perrowe (1984) *Normal accidents*. Basic Book KS, New York.

Peterson, A.M.(2004). *Managing pharmacy practice, Principles, Strategies, and system*. Pharmacy education. Chapter 16. Book- pp 262.

Philip, E.J. & Gregory, G.H.K. (1999). Medication Misadventures: Adverse Drug Reactions and Medication errors. Chapter 16, p505 and Chapter 17, 613

Phillip, J., Beams, B.A., Holquist, C., Honig, P., Lee, L. et al. (2001). Retrospective analysis of mortalities associated with medication errors. *American J Health System pharmacy*, 58 (19), 1824-9.

Phillips, D.P., Christenfeld, N. & Glynn, L.M.(1998). Increase in U.S. medication error deaths between 1983 and 1993. *Lancet*, 351, 643-44.

Raffali, J., Nowakowski, J., Wormser, G.P. (1997)”Vira something”: a taste of the wrong medicine. *Lancet,* 350: 887. Letter.

Raju, T., Kecskes, S., Thornton, J., Perry, M. & Feldmen, S. (1989). Medication errors in neonatal and pediatric intensive care units. *Lancet* , 2, 374-376.

Reason, J. (1990). Human Error. Cambridge University Press, Cambridge.

Reitberg, D.P., Miller, R.J. & Bennes, J.F.(1982). Evaluation of two concurrent drug-delivery systems in a skilled-nursing facility. *American J Hospital Pharmacy*, 39, 1316-20.

Report on Radiology Medication (2006) Error Provokes alarms, Responses and Recommendations, *Journal of Nuclear medicine,* 47 (3). March.

Rodney, W., Hicks, J. & Baker. S.C. (2006). An Overview of intravenous-related medication administration Errors as reported to MEDMARX, a National medication Error reporting program. *Journal of infusion Nursing,* 29 (1), 24.

Rogers, A.E., Hwang, W.T., Scott, L.D. et al. (2004). The working hours of hospital staff nurses and patient safety. *Health Affairs* (Millwood), 23(4),202-12.

Rowe, C., Koren, T. & Koren, G. (1998). Errors by pediatric residents in calculating drug doses. *Archives Diseases in Children,* 79, 56-58.

Roy, V., Gupta, P. and Srivastava, S. (2005). Medication Errors: Causes and Prevention. *Health Administrator*, 19 (1), 60-64.

Rupp, M.T., De Young, M., & Schondelmeyer, S.W.(1992). Prescribing problems and pharmacists interventions in community practice. *Medical Care*, 30, 926-40.

Santell, J. P. (2006). Report on radiology medication errors provokes alarms, responses, and recommendations. *Journal of Nuclear Medicine*, 47, 3 .

Santell, J.P., Cousins, D.D. and Hicks, R. (2003). Top 10 drug-products involved in medication errors. *Drug Topics,* 23-24.

Schneider, P.J., Gift, M.G., Lee, Y.P. et al. (1995). Cost of Medication - related problems at a university hospital. *American J Health System Pharmacy*, 52 , 2451-8.

Schnell, B.R. (1976). A study of unit dose drug distribution in four Canadian hospitals. *Canadian J Hospital Pharmacy,*. 29, 85-90.

Sender, J.W. (1993). Theory and analysis of typical error in a medical setting. *Hospital Pharacy,* 28, 505-8.

Shulman, R., Singer, M., Goldstone, J. & Bellingan, G. (2005). Medication errors: a prospective cohort study of handwritten and computerized physician order entry in ICU. *Critical Care*, 9, R516-R521.

Simbrog, D.W. & Derewiez, H.J. (1975). A high automated hospital medication system: five years, experience and evaluation. *Annals Intereral Medicine,* 83, 342-6.

Sittig, D.F. & Stead, W.W. (1994). Computer-based physician order entry: the state of the art. *J American Medical Information Association,* 1, 108-23.

Spader, T.J. (1994). Dispensing Errors and Detection at an outpatient pharmacy. Chapel Hill, NC: University of North Carolina - Thesis.

Stockley, I.H. (1999). General Consideration and an outline survey of some Basic drug Interaction Mechanisms, 5nd edition, Chapter 1,pp1.

Taxis, K. & Barber, N.(2003). Causes of intravenous medication errors; an ethnographic study. *Quality Safety Health Care*, 12(5), 343-7.

Thomas, D. & Henderson, D.P. (2005). Basic Evidence-Based Advice for Preventing Medication Error in Children, *Journal of emergency Nursing*, 31(15), 490.

Thomas, M.R., Holquist, C. &Phillips, J.(2001). MED WATCW. Drug Topics, October 1.

Tisdale, J.E.(1986). Justifying a pediatric critical-care satellite pharmacy by medication error reporting. *American J Hospital Pharmacy,* 43, 368-71.

Tissot, E, Cornette C, Limat S et al. (2003). Observational study of potential risk factors of medication administration errors. *Pharmacy World Science*.; 25(6): 264-8.

Tissot, E., Cornette, C., Demoly, P., Jacquet, M., Barale, E. and Capellier, G. (1999). Medication errors at the administration stage in an intensive care unit. *Intensive care Medicine*, 25, 353-359.

Townsend, A. (2000). The role of the General Medical Council. In: M Dury (ed.) *Clinical Negligence in General Practice.* Radcliff Medical Press, Oxford, 27-42.

Trinkoff, A, Geiger-Brown J, Brady B, et al.(2006) How long and how much are nurses now working? *American J Nursing,* 106(4), 60-71, quiz 2.

Ukens, C. (1997). Deadly dispensing: an exclusive survey of Rx errors by pharmacists. *Drug Topics,* 41(5), 100-10.

Ukens, C. (1997). Deadly dispensing: an exclusive survey of Rx errors by pharmacists. *Drug Topics*, 141, 100–11.

Ukens, C.(1992). Breaking the Trust: Exclusive survey of dispensing errors. *Drug Topics*, 136, 58-69.

Ulrich, B. (2007). Preventing errors by eliminating mistake – prone abbreviations. *Nephrology Nursing Journal,* 34(6), 593.

United States Pharmacopoeia. Distractions contribute to medication errors. USP Patient Safety CAPSLink. September 2003;2-4.

Van den Bemt, P.M.L.A., Egberts, T.C.G., de Jong-van den Berg, L.T.W., Brouwers, J.R.J.B., (2000). Drug-related problems in hospitalized patients. *Drug Safety* 22(4), 321-333.

Vere, D.W. (1965) Errors of complex prescribing. *Lancet* , 1:370-373.

Waleed M.S. Al-Shaqha, Mohamed Zaiir,(2000*),* Re-engineering pharmaceutical care: towards a patient-focused care approach *International Journal of Health Care Quality Assurance* 13 (5) 208-217

Werthemier AL, Ritchko C, Dougherty DW.(1973) Prescription accuracy. Room for improvement. *Med care*;11:68-71.

White J.R. (2003) How can pharmacists help avoid medication errors in the use of insulin glargine (Lantus) *US Pharmacist* 2003; 28:5.

Whyte, L.A. (1992) "Medication card for elderly people: a study", *Nursing Standard*, 8(48), 25-28.

Williams, D.P. (2007). Medication Errors. *J Royal College of Physicians of Edinburgh*, 37,343-346.

Winslow E., Neestor, V., Davidoff, S., Thompson, P., Borum, J. (1997) Legibility and completeness of physician's hand-written medication orders. *Heart Lung* ,26, 158-164.

Wolf Z.(1989) Medication errors and nursing responsibility. *Holistic Nursing Practice*, 4(1), 8-17.

Wou, K. (1994) Letter - Cost associated with recurred hypoglycemia caused by dispensing error. *Annals Pharmacotherapy.* 28, 965-6.

Zellmer, WA. (1993) Medication error versus medication misadventure- what's in name.*American Society of Hospital Pharmacists*, 50(2), 315-8.