ADHERENCE TO THE PRINCIPLES OF RATIONAL USE OF MEDICINES IN KENYATTA NATIONAL HOSPITAL

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A report submitted in partial fulfillment of the requirements for the Award of the Degree of Master of Pharmacy in Clinical Pharmacy, University of Nairobi.

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DECLARATION

I hereby declare that this is my original work and that it has not been presented to any other institution for the purpose of examination**.**

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ABSTRACT

Background: Medicines are vital in pharmacotherapy but their desired therapeutic outcome is dependent on appropriate use. Studies have revealed that medicines have been used inappropriately. Some of the consequences of inappropriate medicines use include poor patient response, increased expenditure and overall poor patient management.

Objectives: To evaluate whether pharmacological treatment given to in-patients at Kenyatta National Hospital complies with rational drug use principles.

Methodology: A cross-sectional study was adopted and the study population comprised of patients admitted at Kenyatta National Hospital's Medical, Pediatric, Surgical and Obstetrics/Gynecology wards in the months of July, August and September 2013. Systematic random sampling method was used to select 385 patients in the wards. A predesigned structured data collection tool was used to abstract data from the patient files and treatment sheets. The data obtained was analysed using Statistical Package for Social Sciences version 19 software and the Stata version 12 software.

Results: One hundred and seventy five patients (45.5%) were males and the rest were females patients. These were aged between 3 months - 86 years with a median age of 26.0 years. The 385 prescriptions contained 187 different drugs and 1597 prescribing events. The average number of drugs prescribed per patient was 4.16 (95% CI: 3.97-4.34). Thirty-six percent of all drugs prescribed were by their brand names. The overall prevalence of irrational prescribing practices was 95.6% while the prevalence of medication errors was 45%. Inappropriate duration accounted for 71.2% of the nine hundred and twenty seven (927) medication errors found and it was the most frequent error-type while inappropriate indication (1.4 %) was the least common. The odds of encountering irrational prescribing was high in surgical wards. The prevalence of drug-drug interactions was 158 (41%) and the total number of potential interaction events detected were 210. The interaction between Metoclopramide and Tramadol was the most frequent potential drug-drug. This interaction may increase the risk of seizures because of reduced seizure threshold. Six percent of patients had contraindicated medicines prescribed. The proportion of patients who experienced non – availability of medicine was 28.3%.

Conclusion and recommendations

The adherence to rational drug use prescribing principles is relatively low given the large proportion of in-patient prescriptions with medication errors (45%), the large proportion of in-patient prescriptions with potential drug interactions (41%); and to the proportion (28.3%) of patients who had not received their medications as prescribed.

Review prescriptions to check for drug interactions and contraindications to prescribed medicines should be done by trained and experienced healthcare workers. The hospital should also have periodic reviews to assess the efficiency in availing medicines to in – patients. Prescribers in the hospital should be encouraged to practice rational drug use.

OPERATIONAL DEFINITIONS

Appropriate use of medicines: The prescribing of medicines where the route of administration, the dosage form, the dose and the duration are appropriate and are correct for the patient

Drug Interaction: This is when the effects of one drug are changed because of the presence of another drug in the human body when they used concomitantly

Efficacy: The ability of a medicinal drug to produce the desired effect

Medication error: Any preventable event that may cause or lead to an inappropriate medication use or patient harm while in the control of the health care professional, patient or consumer. This term includes; inappropriate medicines prescribed for a given diagnosis, inappropriate doses, inappropriate dose duration, inappropriate routes of administration, and inappropriate frequency.

Pharmacotherapy: Treatment of disease through the use of drugs

Rational drug use: The pharmacotherapy where the right patient, receives the appropriate medicinal drug for the right diagnosis, in the appropriate dose, dosage form, in the appropriate dose frequency and for the appropriate duration.

Irrational prescribing practices – the practice of writing a prescription which has medication errors, interactions, contraindications and medicines prescribed using brand names instead of generic names.

Polypharmacy: Prescription of more than one drug.

E*ph*MRA: The E*ph*MRA is the hub for excellence in research thinking to empower healthcare market researchers to provide consultancy to the business.

***Eph*MRA/PBIRG Anatomical Therapeutic Classification**: is the system of classification put forward by the *Eph*MRA/PBIRG.

Prescription: This refers to the medicines that the Medical team documents on the treatment sheets as drugs that should be administered to an individual patient.

ACRONYMS AND ABBREVIATIONS

CSDI	:	Clinically Significant Drug Interaction
CVS	:	Cardiovascular System
INRUD	:	International Network on Rational Use of Drugs
KNH	:	Kenyatta National Hospital
PHC-EML	:	Primary health care essential medicines list
RDU	:	Rational Drug Use
WHO	:	World Health Organization
Obs/Gyn	:	Obstetrics and Gynecology
KNH/UoN-ERC and	:	Kenyatta National Hospital / University of Nairobi / Ethics Research Committee
*Eph*MRA	:	European Pharmaceutical Marketing Research Association
PBIRG Group	:	Pharmaceutical Business Intelligence and Research
WHO ATC Classification	:	World Health Organization Anatomic Therapeutic system
CME	:	Continuing Medical Education
RoA	:	Route of Administration
HCW	:	Health Care Worker(s)

CHAPTER ONE : INTRODUCTION

1.1 Introduction

This chapter contains general facts about medicines and pharmacotherapy as well as facts about rational use of drugs.

1.2 Medicinal drugs

A drug may be defined as any substance that brings about a change in biologic function through its chemical actions[2] or a chemical substance used in the treatment, cure, prevention or diagnosis of disease, or used to otherwise enhance physical or mental well-being [3]. It may also be defined as a compound used to change the physiological functions or pathophysiological conditions for the benefit of a human being or any small molecule that alters body functions by interaction at the molecular level.[2]

A medicinal drug or medicine is used to treat or prevent or alleviate the symptoms of disease[4]. Drugs bring about changes in biologic function, which are useful in addressing a disease condition. Some of the ways drug molecules do this are by either binding to specific molecules in the biologic system, interacting with hormones, or altering the movement of water molecules in body compartments across membranes.[5] Medicinal drugs are useful in prophylaxis and diagnosis of diseases.

Only about 25-60% of patients show the expected response to pharmacotherapy.[6] Various aspects of a drug directly influence its efficacy or the way it addresses a disease condition. Apart from the psychological, social and behavioral factors, [7] the patient factors such as weight, age, sex and race influence efficacy. Further still aspects of the drug product influence efficacy, for instance its pharmacokinetic properties, [8] the dosage form, and the pharmaceutical excipients[9, 10].

The aspects could be associated with the route of administration, or the patient's attributes such as the patients' condition with reference to organ function. The condition may alter absorption, distribution, metabolism and elimination of the drug. Further still, there can be patient specific variations in metabolism of drugs.[11]. Concomitantly used drugs can interact to bring about synergy or antagonism.[12, 13]

Medicines reach the hospital and other user points in various dosage forms such as oral; tablets, syrups, powders for reconstitution; parenteral dosage forms e.g. injectables, sterile powders for injection; and other dosage forms e.g. metered-dose-inhalers, ointments, creams, sterile drops. The choice of the dosage form to be used is influenced by the disease condition, the patient's condition, proximity to professional services among other factors.

The route of administration influences the outcomes of pharmacotherapy significantly. The most convenient and commonly used route of administration is the oral route. It is associated with generally less risks compared to parenteral route but has significant limitations such as varying bioavailability, dependence on the patient's condition such as state of consciousness, ability to swallow, state of the GIT and others. The parenteral route has absolute bioavailability but because it is invasive, it poses risks that are expensive to address.

Drug interactions have to be detected and avoided or addressed if pharmacotherapy is to have positive outcomes. The interactions could be between two drugs, i.e. drug – drug, or between a drug and the disease in which case, a drug is contraindicated in a particular disease state/condition. Mechanisms of drug-drug interactions may be pharmacokinetic or pharmacodynamic. These interactions occur as a result of competitive antagonism, chemical antagonism, pharmacokinetic antagonism, plasma-protein-binding displacement, antagonism by receptor block or non-competitive antagonism, i.e. blocking of receptor-effector linkage. Interactions may be a result of induction or inhibition of enzymes involved in drug metabolism, leading to changes in blood levels of concomitant drugs. Sometimes there is alteration in the elimination rate of the drug due to competition at the renal tubules. Sometimes there is increased elimination of a given drug due to presence of another. All these affect pharmacotherapy and could be used to optimize therapy or be avoided to reduce the risk of adverse out comes.[14-16]

Medicines ought to be used rationally. Rational use of medicines positively influences the healthcare and medicine use environment. It is therefore important that the principles of rational use of medicines are constantly adhered to so that the healthcare services availed to patients attain and maintain acceptable quality. The rational use of medicines requires that patients receive medications appropriate to their clinical needs, in doses that meet their own

individual requirements, for an adequate period of time, and at the lowest cost to them and their community.[17] When medicines are not rationally used, there is an increased risk of adverse drug reactions, possible emergence of resistance and poor outcomes.[18]

According to the WHO, irrational use of medicines is a major problem worldwide with more than half of all medicines being prescribed, dispensed or sold inappropriately.[19] Some of the reasons for this are the decisions taken by the prescribers on the diagnosis and on the medication to prescribe. Prescribers find diagnosing and prescribing for some illnesses problematic e.g. depression.[20-21]. The decisions are also influenced by lack of time and limitations in accessing specialist services.[22-23]

Consequences of irrational drug use are borne by the patient and they include; unnecessary adverse medicines events, rapidly increasing antimicrobial resistance, poor patient-doctor relationship, prolongation or exacerbation of illness, hospitalization or prolongation of hospitalization among others. This can increase the cost of health care to; the patient, the hospital and to the Nation.[18, 24-30]

The indicators of rational drug use are in three categories; prescribing indicators, patient care indicators and facility indicators.[31]

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter is a summary of the literature reviewed on the research topic. It contains results of studies done on prescribing and rational use of medicines; medicine availability; and drug interactions.

2.2 Prescribing habits and rational use of medicines

Medicines are a fundamental part of medical practice because they address the patients' health problems. However, no drug/medicine is inherently safe. The safety of medicines always depends on the way the medicines are used. Medicine use entails various aspects including prescribing. Errors may occur during prescribing which may result in negative pharmacotherapeutic outcomes. Rational prescribing is a fundamental part of rational use of medicines. The choices of medicines with reference to the diagnosis, the doses, duration, the route of administration and dosage form selected are part of the prescription. There may be prescription documentation practices that predispose to errors. An undetected error at this stage may be carried on to the patient who then suffers the consequences of irrational drug use.

Deaths due to medical errors are thought to be more than those from motor vehicle accidents, breast cancer, or AIDS[32]. A study carried out in Malaysia found that only 0.03% of the prescriptions sampled were totally free from errors. Ninety percent of the prescriptions were incomplete and 84.8% used abbreviations. There were cases of drug interactions and polypharmacy, wrong indication and inappropriate dosing frequency. 43.8% of prescriptions evaluated in North-West England had errors[33, 34]. Prescribing by brand name was rampant among prescribers in Nagpur, India, where prescriptions with generic names were only 7.4%, and still among these prescribers, there was polypharmacy and irrational prescription of antibiotics[35].

Errors happen because of lapses in attention and prescribers not applying relevant rules. Others contributory factors may include; work environment, workload, poor communication within the team and lack of knowledge[36]. Prescribing inadequacy may manifest when the

prescribed doses are not individualized. 33% of cancer patients who required pain control medicines received inadequate analgesic prescribing[37].

The prescribing habits of Doctors are sometimes irrational.[38-44] INRUD indicators enable country comparison of RDU and using these indicators, various countries were compared. These countries were Uganda, Indonesia, Tanzania, Malawi, Zimbabwe, Bangladesh, Nepal, Nigeria and Yemen. Prescribing of antibiotics was highest in Uganda as 56% of sampled prescriptions had an antibiotic. Prescribing of injectables was also highest in Uganda. Indonesia had an average of 3.3 drugs per prescription, which among the countries compared, was highest. Prescribing by generic name was highest in Zimbabwe (94%) followed by Tanzania (83.6%).[45]

In Yemen, it was found that a mean of 2.8 drugs were prescribed per prescription, with a low rate of prescribing drugs by generic name. The study also found the proportion of prescriptions with antibiotics to be 66.2%.[46] The mean number of drugs per prescription in a study in Jordan was 2.3 and the percentage of drugs prescribed by generic name was very low. The mean number of drugs per prescription was found to be high in a study conducted in South Africa, among public hospitals. The same study showed that generic prescribing rates were low and drug prescribing needed to be regulated.[46] Irrational prescribing of antibiotics where they are not needed, for instance in a viral infection, also occurs.[47] In Sudan, a study found that, the rates for inappropriate prescribing and dispensing practices and prevalence of self-medication with antimicrobials and herbal products were alarmingly high.[48] Adherence to the right prescribing practices depends on adequacy of training and on information availed to the health care professionals about prevailing guidance on prescribing medication.[49]

2.3 Drug interactions

Interactions between prescribed drugs may occur. The results of interactions range from effects that go unnoticed without influencing the outcome of therapy, to those that if not checked progress to significant tragic outcomes such as death or permanent disability. Various studies, internationally, nationally, in developed and undeveloped countries, have been conducted to determine the prevalence of drug-drug interactions.

In the Netherlands and New York, the prevalence of CSDIs was found to be 20–25%.[50] The prevalence of CSDI (including drug-drug interactions between antiretroviral agents) was found to be 26.3% and 40% in studies carried out in Liverpool and Switzerland respectively.[51,52] Another study in United States reported a prevalence of 41.2%.[53] Rhanna Emanuela[56] found, 70.6 % prevalence of potential drug interactions at the intensive care unit with most of the drug interactions being severe or moderate. In this study, which was among patients admitted in an intensive care unit in Brazil, it was found that after observation of patients for 120 hours, the pharmacodynamics interactions occurred at a frequency of 42.2% while the frequency of pharmacokinetic interactions was 39.6%. Further still upon analyzing the distribution of cases of potential pharmacokinetic drug-drug interactions, the metabolism process was identified as being responsible for 83.1% of the potential interactions.

In a study, carried out among psychiatric in-patients in Zurich, Switzerland, it was found that there were several dangerous interactions such as those that result in QT elongation. In addition, there were prescriptions with drugs that were contraindicated in the target patients.[55] In another study in Basel, Switzerland, among patients with heart failure, it was noted that the prescriptions which patients had upon admission (i.e. entry) had less interactions than prescriptions patient had on discharge.[56] Among cancer patients in South India, there were 6.1% CSDIs between anticancer drugs and 6.5% drug-drug interactions between anticancer drugs and other drugs prescribed for co-morbidities.[57]

Locally, in Kenya, a cohort of patients taking antiretroviral therapy was studied for CSDIs. It was found that 33.5% were at risk of a CSDI. In 12% of the patients, the interaction would potentially lower antiretroviral drug concentrations.[58]

2.4 Availability of medicines

Timely access to medication positively influences pharmacotherapeutic outcomes. There are medications that satisfy priority health care needs of the population and are relevant to the disease pattern in a given area. These are regarded as essential medicines. Patients' access to essential medicines depends on the hospital stocks, the supply chain within the hospital and the efficiency of the process of obtaining the medicine from the central pharmacy stores to the wards. Another vital factor is the financial ability of the patient to obtain the medicines and this goes hand in hand with medicine prices.

One of the eight essential components of primary health care (PHC) is provision of essential medicines.[59] Essential medicines are intended to be available within the context of functioning health systems such as referral hospitals, at all times, in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individuals and the community can afford.[60]

A study in Andhra Pradesh, India, showed that all medicines included on the PHC-EML were available in the health facilities but some drugs needed frequent restocking because they were frequently prescribed.[61] In Guatemala, a study to assess the availability, prices and affordability of essential medicines for children found that, the lowest average availability was 25%. The lowest average availability in private sector was 35%.[62] Poor supply and distribution systems in developing countries negatively influence the provision of essential medicines. There is need to know whether patients actually receive the prescribed medicines and whether they do so in a timely manner.

2.5 Problem statement

Patient care involves various activities such as determining the diagnosis and therapeutic interventions including pharmacotherapy. Pharmacotherapy involves prescribing, dispensing and administration of the medicines to the patient.

Studies in Malaysia, North-West England, India and Yemen have revealed that prescriptions of medicines have compromised adherence to rational drug use. For instance; prescriptions were found to have either drug interactions, brand name-prescribing, use of abbreviations, polypharmacy, wrong indication, antibiotics prescribed unnecessarily, inappropriate doses / dosing frequency, or doses that were not individualized.[33-35, 37 and 46]

In addition, prescribing anomalies were evident in South Africa and Sudan.[48] In Khartoum, 73.9% 1750 adults studied had used antibiotics or antimalarials without a prescription, 81.8% of the study population had used medicines (including herbal remedies) without a medical consultation, and antibiotics were the most common medicine used for self-medication. (36.3%) The antibiotics were being used for cough and the common cold.[48]

Within the East Africa, some categories of irrational practices have been documented in Uganda such as, the high rate of antibiotic use, which was 56%.[68]

It is also worth noting that many RDU studies have been conducted among out patients but there are minimal studies among in-patients.

In Kenya, there is limited published data on irrational drug use; however, the picture of irrational drug use seen in some countries in East Africa may be reflected in Kenyatta National Hospital and may be a considerable factor that negatively influences service delivery in the area of medicine utilization.

2.6 Rationale

Irrational prescribing of drugs during management of patients admitted in KNH may occur. Prescriptions may have clinically significant drug interactions and there may be drugs that are contraindicated in the patients for whom they are prescribed. This may result into poor treatment outcomes, adverse drug reactions, and increased cost of medical care to the patients as well as the hospital. This calls for interventions, however, before attempting any intervention to change medicine use practices, information about the drivers of irrational use of medicines is vital. That information is what this study attempted to avail.

Rational use of drugs is vital for the in-patient setting. This study evaluated in-patient prescribing practices at KNH. The study uncovered some challenges and concerns with prescribing and issuance of medicines to in–patients, which could potentially curtail the beneficial pharmacological response.

Findings of this study may be utilized at two levels; the policy makers and the staff in various wards.

Policy makers of the hospital may identify the problem areas and make informed decisions on; the medicine delivery systems in the hospital; and on; allocation of resources so that challenges are addressed.

Staff who handle medicines include but are not limited to; prescribers, nursing teams, Pharmacy and dispensing teams. The findings of this study may increase awareness among

staff, about the extent of inappropriate documentation and irrational use. This awareness may prompt positive behavioral change.

The findings indirectly benefit the patient. If the policies made by policy makers address challenges and positive behavioral change among staff takes place, then patients will be handled in an environment devoid of irrational practices. These patients will then have increased chances of improving, moreover in a relatively short time. This might result in an overall decrease in the hospitalization time-period (i.e patient stay), and decrease in the resources expended by these patients, a phenomenon which would eventually contribute to improved satisfaction with hospital services.

2.7 Study question

Do the in-patient prescribing practices in KNH adhere to the principles of rational drug use?

2.8 Objectives

General objective

To evaluate whether pharmacological treatment given to in-patients at KNH adheres to rational drug use principles of prescribing medicines.

Specific objectives

1. To find out the proportion of in-patient prescriptions with medication errors
2. To evaluate the proportion of in-patient prescriptions with potential drug interactions
3. To determine the proportion of patients who do not receive the prescribed drugs

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter elaborates the methods that were used to achieve the objectives of the study. The section includes the study design, area, population, sample size and its determination, sampling technique, the inclusion / exclusion criteria, the data collection and analysis.

3.2 Study design

This was a descriptive study which adopted the cross section study design and involved assessment of pharmacotherapy by analyzing the prescriptions and the treatment sheets. This study design was selected because it could cost-effectively avail information on the way medicines are prescribed and issued to the patients. Based on such information other studies could be designed. While selecting patients, a sampling plan (Annex V) was drawn – up, to minimize bias.

3.3 Study area

KNH is the National public referral hospital in Kenya, with 50 wards, 22 out-patient clinics and 24 theatres. The hospital has a bed capacity of 1800. At any given day the hospital hosts between 2500 and 3000 patients in its wards. On average the Hospital caters for over 80,000 in-patients and over 500,000 out-patients annually.[63] The departments concerned with clinical services include; the Surgical department, the Medical services department, the Diagnostic services and Health Information department, the Pharmaceutical & Nutrition services and the Private wing. The Medical services department is composed of sub departments, namely Internal medicine, Pediatrics, Critical care and various specialized units.

The study was carried out in the sub-departments of internal medicine, pediatrics, surgical and obstetrics & gynecology wards. The internal medicine wards were 7A, 7B, 7C, 7D, 8A, 8B, 8C and 8D. The pediatric wards were 3A, 3B, 3C and 3D. The surgical wards were 5A, 5B, 5C, and 5D. The Obstetrics wards were GFA, GFB and 1A. Gynecology wards were 1B and 1D.

The internal medicine wards handle mainly adult patients with a variety of conditions. Some of the conditions include, cancer, HIV (and associated conditions / opportunistic infections such as Cryptococcal meningitis, toxoplasmosis, TB cases etc.), cardiovascular system (CVS) cases, Diabetes mellitus, liver diseases, leishmaniasis, respiratory diseases and various infectious diseases.

There are various conditions managed in the pediatric ward such as seizures, malnutrition, sepsis, CVS and many others. Some of the cases managed in the Obstetrics wards include hypertension in pregnancy, deep vein thrombosis (DVT) and urinary tract infections (UTIs). Some of the cases handled in Gynecology wards include, cancers (commonly cervical) and abortions. In the surgical wards various conditions requiring surgical intervention are managed. Given the wide range of conditions in the four departments, the data obtained is expected to be representative of the hospital practices.

3.4 Study population

The study population included patients admitted in the Internal medicine, Pediatric, Surgical and Obstetric/Gynecological wards in months of July, August and September 2013.

3.5 Inclusion / exclusion

Patients included in the study were those who were managed by pharmacological interventions and had a working diagnosis.

3.6 Sampling

3.6.1 Sample size calculations

The sample size was determined using Fischer's formula. (Fischer - Cochran Formula – 1977)

The formula used is $$N = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where: Z is 1.96 which is the standard normal deviate corresponding to a confidence interval of 95% confidence interval

P is 0.5 which is the estimated prevalence of irrational drug used practices taken from the WHO [19]

C is 5% degree of precision / accuracy

$$\mathbf{N} = \frac{1.96^2 * 0.5 * (1-0.5)}{0.05^2} = 384.16 \approx 385$$

The target sample size was 385.

3.6.2 Sampling technique

The systematic random sampling technique was used. The list of admitted patients was obtained from the nurses on duty. The total number of patients was determined from that list and this was divided by the target number (as mention in the sampling plan) to be recruited from the particular ward. The result was taken as the sampling interval. Then starting from any point in the list, patients were picked in accordance with the sampling interval. Where a patient was in the ward list but discharged or did not meet the eligibility criteria, the patient just next to that one, was chosen. Sampling was carried out as elaborated in annex V.

3.7 Recruitment and Data collection

The investigator gave a synopsis about the study and the activities to be done. Patients were identified based on the sampling technique. The patients expressed consent by signing the informed consent form (Annex II). For minors, the parents signed the consent forms. Some

patients expressed verbal informed consent. The patient files were reviewed and their treatment sheets were assessed.

Data was collected using a structured questionnaire (see annex II) made up of 3 parts, namely; patient biodata, prescribing practices (including; drugs and diagnosis, contraindications, interactions) and availability of drugs. The treatment sheets were reviewed to find out the drugs prescribed to the patient. The files were reviewed to determine the working diagnosis. The list of drugs being administered to the patient was evaluated for drug interactions. Treatment sheets were reviewed to ascertain if the prescribed drugs were issued / administered to the patients.

The drugs prescribed were usually listed on the treatment sheet after the ward round and each time the drug was administered to the patient, the personnel who did this, made an entry of his/her initials. The entry was made in such a way that it indicated when the medicine had been administered.

It was assumed that that the entries in the treatment sheet accurately corresponded to the issuing of medicines. Therefore, if the initials of the personnel that administered the drug appeared, the interpretation was that the patient was issued with the drug. Where no initials appeared or where the out-of-stock sign (i.e. O/S) was written, then the deduction was that the patient didn't receive the drug.

3.8 Pilot Study

Pre-testing of the research tools was done prior to the actual study to check for the relevance and ease in data collection. The questionnaire was pre-tested on 8 randomly selected patients who matched the inclusion criteria in order to ensure that the questions were clearly understood and that all information required was obtained. The questionnaire was revised accordingly. The revised questionnaire is Annex III.

Internal validity was ensured by using standard references when assessing prescribed medicines. The references used were; the, British National Formulary (BNF); the Drugs.com interaction checker and the WHO model Formulary (2008).

3.9 Data analysis and statistical analysis

This was a descriptive study and the counts of events were made. Means and modes were used to describe the study population. Percentages were used to describe the outcomes of interest. The analysis was made on the entire sample, followed by sub analysis where it was relevant and possible. SPSS software version 19 and Stata version 12 were used.

Quantitative variables were used to compute of number of medication errors, number of drugs prescribed by brand names, number of drugs per prescription, interactions, interactions and the patients who experienced non-availability of drugs. Logistic regression was used to establish the effect of change in number of drugs per prescription on irrational prescribing practices. Odds ratios were used to describe the relationships between age, sex and department with the occurrence of irrational prescribing; and the statistical significance (α) of results was stated as a p-value.

3.10 Ethical considerations

The study received written ethical approval from the Kenyatta National Hospital – University of Nairobi Ethics and Research Committee as per letter reference number **KNH-ERC/A/206**.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter elaborates the results obtained after collecting and analyzing the data. The information on the demographics of the patients, medication errors, the drug-drug interactions, contraindications and the extent of non-availability of medicines is presented in this chapter.

4.2 Demographic characteristics of the study population

A total of three hundred and eighty-five in-patients were included in this study. Almost a third (28.1 %) of the study participants were children aged 10 years and below. This age group formed the highest percentage whereas age category 81-90 years had the least proportion of patients (1.3%). The median age of the study population was 26.0 years and the range was 3 months - 86 years (Table 1).

Table 1: Distribution of participants across age groups

Age (years)	Number of patients	Percentage
0-10	108	28.1
11 to 20	36	9.4
21 to 30	92	23.9
31 to 40	67	17.4
41 to 50	32	8.3
51 to 60	17	4.4
61 to 70	18	4.7
71 to 80	6	1.6
81 to 90	5	1.3
unknown	4	1.0
Total	**385**	**100**

The number of patients obtained from each ward was determined using a sampling plan (Annex V). The majority of the patients were females at 54.5% (210) and they were from all four wards; the Obs/Gyn wards, pediatric wards, surgical wards and internal medicine wards (Table 2).

The average age in the internal medicine wards was 39.7 years which was the highest (Table 2). The distribution of patients according to the ward and gender are shown in Table 2 below.

Table 2: Participants characteristics by ward

Ward	Average Age (Years)	No and % age of females
Obs/Gyn Wards (n=97)	30.8	97(100%)
Pediatric Wards (n=96)	2.7	42(43.8%)
Surgical Wards (n=96)	33.5	22(22.9%)
Internal medicine Wards (n=96)	39.7	49(51.0%)

4.3 Types of drugs prescribed

The average number of medicines prescribed per patient was 4.16 (95% CI: 3.97-4.34). The prescribed drugs differed widely owing to the fact that the study was carried out in four different ward clusters and the medical conditions/cases among patients were different.

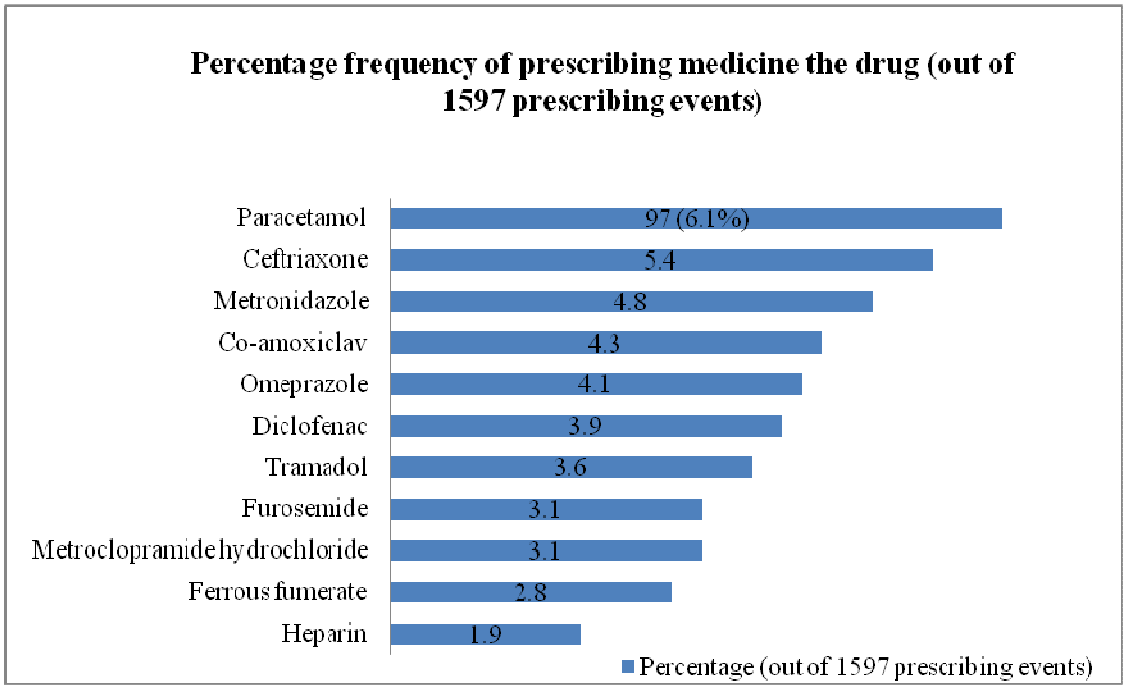


Figure 1: Frequency of prescribed drugs

187 drugs were prescribed and the total prescribing events were 1597. Figure 1 shows the frequency of prescribing of the most prescribed drugs.

In the interest of describing the findings from this study and utilization of the information obtained following conducting this research, drugs were classified, using international classification systems, namely; the World Health Organization Anatomic Therapeutic Classification system (WHO ATC) and the E*ph*MRA/PBIRG Anatomical Classification[70]

The classes of drugs according to the WHO ATC and the E*ph*MRA/PBIRG ATC system are shown in Table 3, which also presents the proportion of the prescribing events accounted for by each class. Annex VI presents the breakdown of the drugs in each class.

Table 3: Drugs as categorized using the WHO & E*ph*MRA/PBIRG ATC

Class		Percentage (n=1597)
A	Alimentary tract and metabolism	18.9
B	Blood and blood forming organs	8.8
C	Cardiovascular system	11.2
D	Dermatologicals	0.3
G	Genito-urinary system and sex hormones	0.3
J	Anti-infectives for systemic use [including vaccines]	26.6
L	Antineoplastic and immunomodulation agents	10.6
M	Musculo-skeletal system	18.2
N	Nervous system agents	3.3
P	Antiparasitic products, insecticides and repellents	0.1
R	Respiratory system	1.9
V	Various (miscellaneous)	0.5

The anti-infectives for systemic use, contributed the largest proportion of prescribing events (26.6%).

4.4 Irrational prescribing practices

4.4.1: Prevalence of irrational prescribing

The overall prevalence of irrational prescribing practices was 95.6%. Irrational practices included medication errors, drug-drug interactions, prescribing drugs that are contraindicated in target patients, prescribing by brand names instead of generic names. The prevalence of irrational prescribing practices when prescribing by brand name was excluded was 83.3%.

4.4.2 Relationship between irrational prescribing and selected predictor variables

A logistic regression model analysis was used to assess the effect of selected variables on irrational prescribing (Table 4a). It was found that the number of drugs per prescription significantly increased the odds of irrational prescribing, 8 fold (OR=8.48, 95% CI: 3.28-20.67), and it was the variable most associated with irrational prescribing. The female

gender was twice as likely to experience irrational prescribing, but this was not significant (OR= 2.32, P – 0.39, 95% CI: 0.34-16.04). Age had no association with irrational prescribing, while being admitted in any of the wards was not a predictor of irrational prescribing.

Table 4a: Regression analysis of irrational prescribing and selected predictor variables

Predictor variable	Odds Ratio	P>z	95% Conf.	Interval
Age	1.02	0.35	0.98	1.07
No. of drugs per prescription	8.48	0.00	3.48	20.67
Gender (Female)	2.32	0.39	0.34	16.04
Internal medicine	0.05	0.09	0.00	1.52
Surgical	0.04	0.01	0.00	0.44
Paediatric	0.16	0.14	0.01	1.84
Obs/Gyn	0.01	0.02	0.00	0.50

Given that number of drugs per patient was the strongest predictor variable for irrational prescribing further assessment on how the effect of drugs per prescription differs among different wards. We found that a unit increase in the number of drugs prescribed caused the odds of irrational prescribing practices to rise by 3 in the surgical ward (OR=4.17, 95% CI: 0.37- 47.1), but the odds reduced for other wards (Table 4b).

Table 4b: Effect of increased number of drugs per prescription, in different wards

Variable	Odds Ratio	P>z	[95% Conf.	Interval]
No. of drugs per Prescription	6.61	0.00	1.87	23.38
Internal medicine	0.77	0.83	0.06	9.46
Surgical	**4.17**	**0.25**	**0.37**	**47.15**
Paediatric	0.62	0.68	0.07	5.83
*				

** The OR for Obs/Gyn was 1, the computation never yielded values for the confidence interval and p-value*

4.5 Medication errors

Medication errors were evaluated separately from the other components of irrational prescribing. They included the following; inappropriate indication, inappropriate dose, inappropriate duration, inappropriate route of administration and inappropriate frequency. Any inappropriate component of the prescription was considered as separate error. The prevalence of medication errors was 173 (44.9 %). In the 173 prescriptions there was at least one manifestation of medication error.

A total of 927 medication errors were identified, out of which 660 (71.2%) were inappropriate duration and this error type was most frequent (Figure 2). It was followed by inappropriate dose (12%), inappropriate frequency (9.1%), inappropriate route of administration (6.4%) and inappropriate indication (1.4 %).

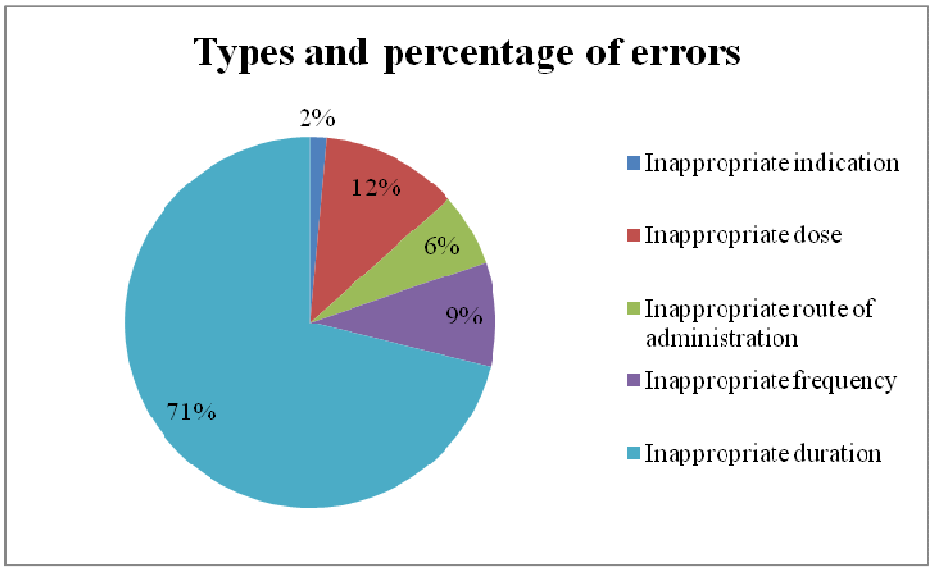


Figure 2: Proportions of the different types of medication errors

4.5.1 Distribution of errors among the different wards and drugs

Errors of all types occurred with high frequency in the internal medicine wards. The errors of inappropriate duration were 660, out of which, 315 (47.7%) occurred in the internal medicine wards, which corresponds to the highest frequency among other error-types. This

was followed by the pediatric ward, Obs/Gyn and surgical wards. Errors of inappropriate indication were the lowest and they occurred only in the pediatric and the surgical wards (Figure 4). The distribution of error by class of drugs is summarized in Table 5.

Table 5: Distribution of medication errors by type and ward

Error-type	Obs/Gyn	Pediatric ward	Surgical ward	Internal medicine	Total
Inappropriate indication	0	8	5	0	**13**
Inappropriate dose	5	84	12	10	**111**
Inappropriate RoA	14	13	12	20	**59**
Inappropriate frequency	9	43	21	11	**84**
Inappropriate duration	114	149	82	315	**660**
Total	**142**	**297**	**132**	**356**	**927**

The highest frequency of prescribing errors was noted among Anti-infectives for systemic use, with Ceftriaxone being most affected (Table 6).

Table 6: Distribution of errors among the classes of drugs

Type of error	Class with highest frequency	Particular drug(s)	Refer to annex
Inappropriate indication	Class A - Alimentary canal and metabolic disorders	Metochlopramide and multivitamins	X
Inappropriate duration	Class J - Anti-infectives	Ceftriaxone	XII
Inappropriate RoA	Class J - Anti-infectives	Metronidazole and Co-amoxiclav	IX
Inappropriate frequency	Class J - Anti-infectives	Ceftriaxone	XI
Inappropriate dose	Class J - Anti-infectives	Ceftriaxone	VIII

4.6 Prescribing by Brand name

Thirty six percent of all drugs were prescribed by their brand names. Brand name prescribing was highest in the surgical wards (27%) followed by Obs/Gyn &internal medicine wards (Table 7). The practice was lowest in the pediatric wards where 121 drugs were prescribed with brand names.

Table 7: Drugs prescribed by brand name per department

Wards	Prescribing by generic names	%age (n=1028)	Prescribing by brand names	%age (n=576)
Obs/Gyn ward	365	36	145	25
Pediatric department	278	27	121	21
Surgical	206	20	157	27
Internal medicine	365	36	145	25
TOTAL	**1028**		**576**	

4.7 Interactions and contraindications

4.7.1 Interactions

41% (158) of the 385 prescriptions had at least one potential drug–drug interaction and the total number of interaction events detected were 210. (Figure 3) Among the 158 prescriptions, 65 (41%) were from the internal medicine wards, 25% were from surgical wards, 15% from pediatric wards and 12% from the obstetrics/gynecology wards. (Figure 5) The most frequent potential interaction was the interaction between Metoclopramide and Tramadol which results in increase of the risk of seizures because of reduced seizure threshold and it was seen 28 times. (Figure 6 and Annex VII)

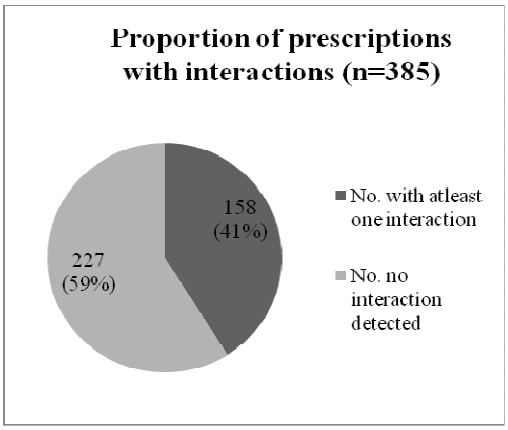


Figure 3: Proportion of prescriptions with interactions

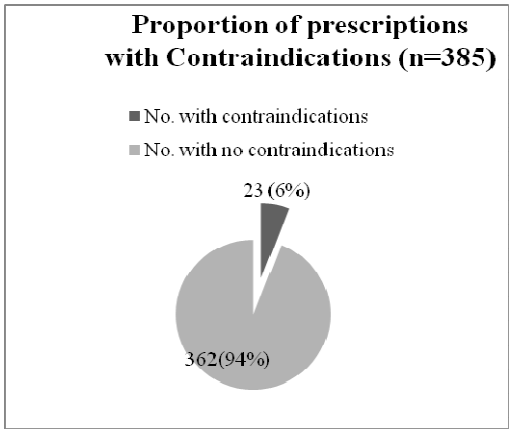


Figure 4: Drug interactions and contraindications detected

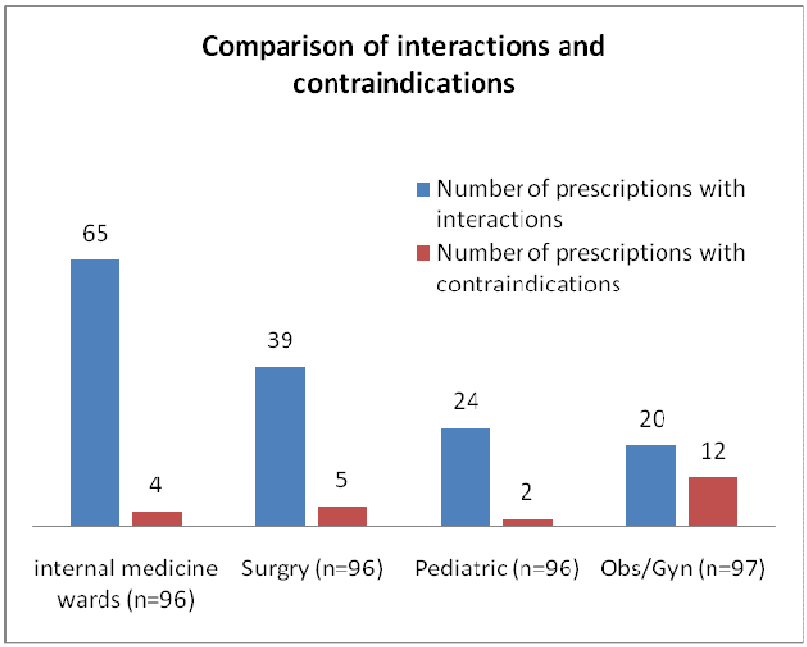
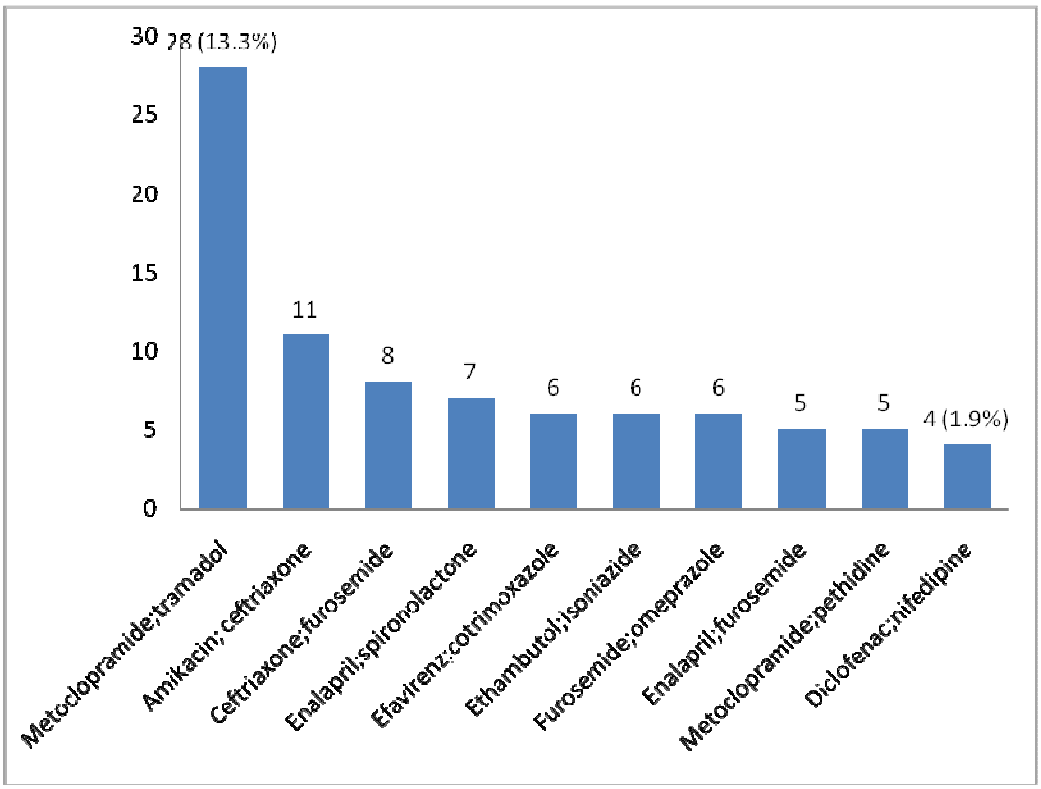


Figure 5: Comparison of drug-drug interactions and prescription of drugs that are contraindicated

Figure 6: The interactions that most frequently occurred (top ten) and percentage out of 210 interaction events



The potential drug-drug interactions were classified into pharmacodynamics and pharmacokinetic interactions. Pharmacodynamic interactions were further classified into reactions that result into antagonism and those that result in synergy. Interactions that could result in synergy occurred at the highest frequency and were found in 21.3% of the 385 prescriptions evaluated (Table7).

Table 8: Categorized interactions

Interaction		**n**	**% (N = 385)**
Pharmacodynamic interactions	- Antagonism	10	2.6
	-Synergy	82	21.3
Pharmacokinetic interactions	- Absorption	13	3.4
	- Metabolism	28	7.3
	- Elimination	3	0.8
Other (increased risk of an adverse event)		66	17.1

4.7.2 Contraindications

Six percent of the prescriptions had drugs contraindicated in the patients for whom they had been prescribed (Figure 4). The obstetrics/gynecology wards had 12 prescriptions with drugs contraindicated in the target patients and this was the highest followed by the surgical wards, internal medicine wards and pediatric wards (Table 9).

Table 9: Distribution of contraindications among different wards

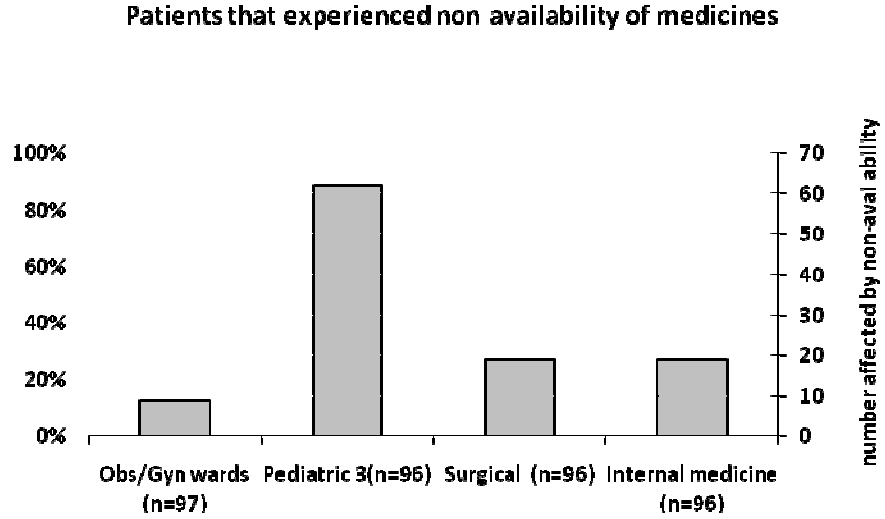
Wards	Prescriptions with contraindications	Prescriptions without contraindications
Obs/Gyn wards (n=97)	12(12.4%)	85(87.6%)
Pediatric wards (n=96)	2(2.1%)	94(97.9%)
Surgical wards (n=96)	5(5.2%)	91(94.8%)
Internal medicine (n=96)	4(4.2%)	91(95.8%)

4.8 Availability of Drug to the Patient at the Right time

109 (28.3%) patients experienced non-availability of medicines out of which 62 (56.8%) were from the pediatric wards. The proportion of patients that experienced non - availability of medicines was highest in the pediatric wards followed by the surgical & internal medicines wards and was least in the obstetrics/gynecology wards (Figure 7). Administration of some medicines was in such way that the dose frequency deviates from the prescribed frequency. For instance, where a Medical officer prescribes 8-hourly but the medicines are administered at a 12-hourly frequency, on some days.

Further still, there was a time lag between the prescription of medicines and actual start of administering the medicine. The time lag ranged between 1 day and 3 days. The extent of this was not studied because it was outside the scope of this research. The factors influencing the timeliness of the administration of drugs were also not evaluated.

Figure 7: Proportion of patients that experienced non-availability of medicines



CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS.

5.1 Introduction

This chapter discusses the findings by comparing results of similar studies. It also presents the conclusions drawn from the findings and outlines recommendations for policy, practice and further research.

5.2 Discussion

There were more females than males probably because the obstetrics/gynecology wards which are exclusively for female patients, were part of the study. Most participants were children aged below ten years. The prevalence of irrational prescribing practices was 95.6% and medication errors was 44.9%. The findings are comparable to a study done in North-West England which reported a prevalence of 43.8% of medication errors [34] but contrasts with the studies done in Malaysia, Morocco and Washington, where 90%, 30 % and 28%, of prescriptions were found to contain medication errors[33,64,69]. Factors that may influence medication errors include; absence of personnel that have been trained to handle and use of pharmaceutical products , absence of clinical pharmacists in the ward, the small ratio of health-worker to the number of patients and inadequate supplies of contemporary references on medicines. These factors may have influenced the study sites in Malaysia, North East England, Washington and Morocco. The extent to which these factors influenced the results in the KNH study are not known. However, inappropriate dose duration was the most common error type, which was frequently manifested by; absence of duration or denotation of the duration with an arrow (→). This may be as a result of low commitment to rational prescribing practices.

The frequency of inappropriate prescribing was highest among Anti-infectives. This might have been because Ceftriaxone, Metronidazole and Co-Amoxiclav were frequently prescribed, and each event of prescribing increased the possibility of having a detectable error.

Thirty six percent of drugs were prescribed by their brand names which was better compared to Nagpur, India, where only 7.4% of drugs were prescribed by their generic

names [35]. Prescribing by brand names was used for preparations that contained multiple ingredients such as hematinics which normally contain minerals and vitamins in addition to iron. These preparations were more common in the surgical wards and in the obstetrics/gynecology wards probably because the patients go through procedures that predispose them to substantial loss of body fluids rich in vital body components.

The use of brand names while prescribing may have been influenced by drug promotion. In addition, brand names may have been used because they are relatively shorter. The size of the space on the treatment sheet where the prescribed medicine is to be written is small and therefore long generic names, fixed dose combination (FDC) products such as some antiretroviral agents, and preparations of mineral/iron products, cannot be well written in the space without abbreviating or using shortened brand names.

The proportion of patients (or prescriptions) with potential drug-drug interactions was forty-one percent (41%), six percent of the patients were prescribed for, drugs that were contraindicated.

These findings are comparable with those in other studies around the globe. The prevalence of clinically significant drug interactions was found to be 40% in a study carried out in Switzerland, and 41.2% in United States. In Liverpool, interactions were 26.3%. In Brazil, it was 71%[51-54]

In India, one of the studies conducted among cancer patients noted 6.1% drug interactions between anticancer drugs and 6.5% drug-drug interactions between anticancer drugs and other drugs prescribed for co-morbidities.[57] Further still, Vijayakumar, et al (2011) in India (East Godavari District, Andhra Pradesh), detected twenty-six drug-drug interactions in eighteen prescriptions and fifteen (83%) of the 26 interactions were potentially hazardous. [67]

A study conducted in Kenya, found that 33.5% of the patients were at risk of a drug interactions and that in 120 patients, the interactions would potentially lower antiretroviral drug concentrations. The findings of the study are comparable to those found by this KNH study.

A study conducted in Malaysia found 0.5% among 386 patients[32] to have contraindications while in UK, it was found that Metformin was contraindicated in 54% of the patients that were taking it.[65] The studies are not comparable to our KNH study.

The study participants who experienced non – availability of medicines were one hundred and nine (28.3%) out these, sixty-two patients (56.8%) were from the pediatric department. Akshaya, et al (2013), found that 46.7% of their study patients evaluated in a prospective study on the use of drugs at prescriber, dispenser and patients level in Ethiopia, experienced challenges in obtaining the prescribed medicines. According to this study, 35.8% prematurely discontinued prescribed medicines. [66]

The results from this KNH study might be so because medicines are not administered in a timely way to patients.

The relevance of the possible consequences of delays in administering the prescribed drugs depends on the drug in question, the nature of the illness and (or) the patient's condition. When antibiotics are erratically issued the result may range from developing resistance, to worsening infections and even death. When analgesics are issued erratically, the patient may experience inadequate pain control, on the other hand for a patient with a condition that is expected to improve with time, the missed doses may not cause much apprehension as the patient improves and becomes pain free. There is however, need for prescribers to adjust prescriptions accordingly.

5.2 Conclusions

This study has shown that there is relatively low adherence to rational drug use prescribing principles owing to the large proportion of in-patient prescriptions with medication errors (45%), the large proportion (41%) of in-patient prescriptions with potential drug interactions; and to the proportion (28.3%) of patients who had not received their medications as prescribed. The prevalence of medication prescribing errors was found to be moderate in some evaluated parameters but significantly high in others, which may suggest that the in-patient prescribing practices in the hospital have low adherence to the principles of rational drug use.

5.3 Recommendations

5.3.1 Recommendations for policy and practice

Trained and experienced healthcare workers should constantly review drug interactions and contraindications to prescribed medicines and take appropriate measures to minimize the deleterious consequences. The hospital should also have periodic reviews to assess the efficiency in availing medicines to in – patients. Prescribers in the hospital should be encouraged to practice rational drug use.

5.3.2 Recommendations for further research

1. The Hospital management should compare the efficiency and effectiveness of the unit dosing system to that of the ward-stock because the latter is being phased out in KNH.

2. A study focusing on assessment of the results of non-adherence to the prescription should be carried out. For example, studies on the consequences of some potential interactions should be carried out. The suggested studies include but are not limited to; incidence of bleeding when ceftriaxone and heparin are concomitantly used; Cotrimoxazole and Efavirenz associated liver injury; occurrence of seizures with the concomitant use of Tramadol and Metoclopramide; kidney damage from Amikacin and Ceftriaxone, and from furosemide and Vancomycin.

3. The reasons for high prevalence of irrational prescribing found in this KNH study need to be investigated and addressed

5.4. Study Limitations

a) The method was susceptible to information bias and selection bias. The measures to address this were; adherence to sampling technique and plan; and using standard materials as references when evaluating the drugs and the interactions.

b) The information on the treatment sheets might have been misleading with reference to administration of medicines, especially whether or not patients received the drugs. The study could not unequivocally establish whether all the drugs issued to patients were documented in a timely manner.

c) The factors that could influence the levels of non-adherence to rational practices were not studied

d) The factors that could influence timeliness of drug-administration were not studied.

e) Abbreviations were not considered during data collection

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Annex I - Tables

Table 10: Drugs on the in-patient prescriptions

Name of Drug	**n**	**%**
Paracetamol	97	6.1
Ceftriaxone	86	5.4
Metronidazole	77	4.8
Co-amoxiclav	69	4.3
Omeprazole	66	4.1
Diclofenac	62	3.9
Tramadol	57	3.6
Furosemide	50	3.1
Metoclopramide hydrochloride	50	3.1
Ferrous fumerate	44	2.8
Heparin	31	1.9
Multivitamin	30	1.9
Co-trimoxazole	27	1.7
Pethidine (Meperidine)	26	1.6
Cefuroxime	25	1.6
Flucloxacillin	24	1.5
Spironolactone	23	1.4
Lactulose	23	1.4
Nifedipine	22	1.4
Pyridoxine	22	1.4
Dihydrocodeine tartarate	20	1.3
Gentamicin	19	1.2
Ranitidine	18	1.1
Enalapril	17	1.1
Amikacin	17	1.1

Ciprofloxacin	17	1.1
Benzylpencillin	16	1
Phenytoin	15	0.9
Prednisolone	15	0.9
Rifampicin/Isoniazid/Pyrazinamide	15	0.9
Erythromycin	15	0.9
Zinc sulphate	14	0.9
Dexamethasone	13	0.8
Fluconazole	12	0.8
Tranexamic acid	12	0.8
Phenobarbital	11	0.7
Methyldopa	11	0.7
Enoxaparin	11	0.7
Warfarin sodium	11	0.7
Ibuprofen	11	0.7
Ceftazidime	11	0.7
Vincristine	11	0.7
Folic acid	10	0.6
Acyclovir	9	0.6
Salbutamol inhaler	9	0.6
Bisacodyl	9	0.6
Granisetron	9	0.6
Digoxin	8	0.5
Meropenem	8	0.5
Cyclophosphamide	8	0.5
Iron sucrose	8	0.5
Aluminum hydroxide	8	0.5
Tenofovir/Lamivudine/Efavirenz	7	0.4
Ferrous and folic acid	7	0.4
ORS	7	0.4
Esomeprazole	7	0.4

Allopurinol	7	0.4
Atenolol	6	0.4
Carvedilol	6	0.4
Amlodipine	6	0.4
Insulin intermediate	6	0.4
Vitamin D3	6	0.4
Chlopheniramine (Piriton)	6	0.4
Carbamazepine	5	0.3
Sildenafil	5	0.3
Rifampicin/isoniazid	5	0.3
Clarithromycin	5	0.3
Vancomycin	5	0.3
Methotrexate	5	0.3
Gabapentin	4	0.3
Propranolol	4	0.3
Aspirin	4	0.3
Morphine	4	0.3
Efavirenz	4	0.3
Zidovudine/lamivudine	4	0.3
Azithromycin	4	0.3
Actinomycin D	4	0.3
Doxorubicin	4	0.3
Saline nasal drops	4	0.3
Cetirizine	4	0.3
Sodium valproate	3	0.2
Trihexyphenidyl	3	0.2
Losartan	3	0.2
Atorvastatin	3	0.2
Nevirapine	3	0.2
Amoxicillin	3	0.2
Levofloxacin	3	0.2

Albendazole	3	0.2
Calcium salts	3	0.2
Ambroxol	3	0.2
Haloperidol	3	0.2
Nystatin oral drops	3	0.2
Clotrimazole pessaries	3	0.2
Pregabalin	2	0.1
Clonazepam	2	0.1
Oxytocin	2	0.1
Hydralazine	2	0.1
Captopril	2	0.1
Abacavir	2	0.1
Lamivudine	2	0.1
Tenofovir disopropoxil	2	0.1
Rifampicin/Isoniazid/Pyrazinamide	2	0.1
Clindamycin	2	0.1
Dapsone	2	0.1
Artemether/Lumefantrine	2	0.1
Quinine	2	0.1
Etoposide	2	0.1
Mercaptopurine	2	0.1
Epoetin	2	0.1
Filgastim	2	0.1
Vitamin D	2	0.1
Vitamin A	2	0.1
Vitamin K	2	0.1
Ursodeoxycholic acid	2	0.1
Betamethasone sodium	2	0.1
Zinc oxide	2	0.1
Artificial tears	2	0.1
Neurobion	2	0.1

Diazepam	1	0.1
Dydrogesterone	1	0.1
Goserrelin	1	0.1
Nimodipine	1	0.1
Clopidogrel	1	0.1
Acetazolamide	1	0.1
Hydroclothiazide	1	0.1
Carbimazole	1	0.1
Insulin (short acting)	1	0.1
Metformin hydrochloride	1	0.1
Meloxicam	1	0.1
Indomethacin	1	0.1
Hydrocortisone	1	0.1
Abacavir/Lamivudine	1	0.1
Isoniazid	1	0.1
Pyrazinamide	1	0.1
Rifampicin	1	0.1
Cefazolin	1	0.1
Chloraphenicol	1	0.1
Neomycin	1	0.1
Nitrofurantoin	1	0.1
Amphotericin B	1	0.1
Itraconazole	1	0.1
Griseofulvin	1	0.1
Cytarabine	1	0.1
Azathioprine	1	0.1
Cocovit oil	1	0.1
Vitamin B1	1	0.1
Vitamin B2	1	0.1
Albumin	1	0.1
Resonium	1	0.1

Ipratropium	1	0.1
Terbutaline	1	0.1
Sodium picosulfate	1	0.1
Chlorpromazine hydrochloride	1	0.1
Amitriptyline hydrochloride	1	0.1
Domperidone	1	0.1
Ofloxacin drops	1	0.1
Calamine lotion	1	0.1
Soap enema	1	0.1
Manitol	1	0.1
Tetanus toxoid	1	0.1
Butylscopolamine	1	0.1
Glevoma	1	0.1
Gelopril	1	0.1
AZT/3TC/EFV	1	0.1
Lamivudine/Tenofovir/TDF/3TE	1	0.1
Colchicine	1	0.1
Zinocovir	1	0.1
Doxycycline	1	0.1
Cisplatin	1	0.1
*Others	3	0.2

*these drugs were not legible and identifiable

TOTAL number of drugs - **187**

Annex II - Consent/assent explanation and consent form

Introduction

My name is Huldah Nassali, a Clinical Pharmacy Postgraduate student in the Pharmacy School, University of Nairobi. I am carrying out an evaluation of the way the medicines are prescribed and issued to the patients who are admitted in selected wards in KNH.

Information on the medicines issued to the patients when admitted is essential for the evaluation. I would therefore like to obtain some information from your file and which would facilitate my study.

O*bjectives of the study*

In this study I intend to find out if medicines have been used appropriately.

Confidentiality

The information picked from your file and treatment sheet is confidential. It will be accessed by the investigator or any other authorized person. It shall not be divulged to any person or body except in circumstances where is required for legal purposes or required by the hospital administration.

Benefits

The immediate benefit is the corrective actions that I will recommend towards improving your management while admitted in hospital, for instance, when I find any clinically significant interactions among the medicines that you are receiving concurrently. Other benefits that are long term, are that the information from this study will help the health professionals to know if medicines are appropriately used. According to this information, health professionals may then improve the way they manage the patients. This will in turn improve treatment outcomes and improve patients' satisfaction.

Risks

In this study, I will review your file and treatment sheet. I will not carry out any invasive procedures such as withdrawal of blood. It is therefore considered to be a minimal risk study.

Compensation mechanism

There will be no compensation given to you for participation.

Voluntarism

Your participation in this study is not obligatory and you are at liberty to withdraw or to terminate your participation in the study at any time. Kindly note that your decision on whether to or not to participate in the study shall not at all influence the level or quality of care you receive while on the ward in KNH.

For further information on this activity you may contact any of the following:

1) The principal investigator, Huldah Nassali on 0735821710; or
2) The study supervisors: Dr. David Nyamu, Dr. Peter Karimi or Dr. Eric Guantai, P.O. Box 30197–00400. School of Pharmacy, University of Nairobi; or
3) The secretary, Kenyatta National Hospital / University of Nairobi / Ethics and Research Committee, P.O. Box 20723-00100 Nairobi, Tel No. 2726300/2716450 ext. 44102.

I kindly request you to sign the attached consent form. Thank you for your co-operation.

Respondent's statement

The nature of the study has been explained to me by the principal investigator. I have been explained to that participation in this study is purely voluntary which means that I can withdraw any time and my treatment will not be jeopardized.

I …… being the patient / guardian to the patient, hereby do consent to voluntarily participate/to have my patient participate, in this study.

Signature: …… Date: …….....

Researcher's statement

I HULDAH NASSALI confirm that I have explained to the study participant the nature and purpose of the study, including; its benefits, ensuring of confidentiality and the fact that it is voluntary.

Signature: …… Date: ……..…...

Annex III – Tool for data collection from files and treatment sheets

Study Title: 'Adherence to the principles of rational use of medicines in Kenyatta National Hospital'

Instructions: Tick the appropriate, write where required

Part 1 – PATIENT BIODATA									Date of Data collection:			
Patient identification code		Age		Height*		BSA	Sex	F	M			
Patient Number: (on the file)		Weight		Admission date:								
Part 2 – Prescribing practices 2 a) Drugs and Diagnosis												
State diagnosis: 1 -		2 -		3 -								
List of Drugs prescribed												
Drug	Appropriate indication		Appropriate Dose		Appropriate ROA		Appropriate Frequency		appropriate Duration		Generic (G) or Brand (B) name?	
1												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
2												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
3												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
4												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
5												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
6												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
7												

	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
8												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G
9												
	Y	N	Y	N	Y	N	Y	N	Y	N	B	G

2 b) Contraindications (CIs)			
Are there contraindications?	Y	N	How many?
State the CIs			
1.			
2.			
3.			

2 c) Interactions				
Are there interactions? Y or N		Potential consequence of interaction	Clinically significant?	Precaution taken?
Interacting drugs				
			Y or N	Y or N
			Y or N	Y or N

Part 3 Availability of the prescribed medicines		
Have the drugs been issued to the patient according to the prescription?	Y	N
If no why?		

* For patients on chemotherapy

Annex IV- Criteria for deciding on clinical significance of an interaction

Interactions once identified were assessed on their clinical significance based on the criteria below;

a) Effect on any of these organs –
    i. The liver (where the interaction increases risk of damage)
    ii. The brain (where the interaction increases the risk of malfunctioning)
    iii. The heart (including electrolyte imbalances that could result in distortion of the ECG)
    iv. the kidney
    v. the reproductive organs (where the germ cells are or may be destroyed)
b) where the interaction consequences alter the concentration of a drug, which phenomenon is associated with possible (even when not confirmed or when not yet evident) clinically negative results.
c) Where another factor may potentiate the risk of an interaction (e.g. Age)
d) Where an interaction calls for patient monitoring that is practically impossible in our setting

Interaction considered to be non-clinically significant interactions were those;.

a) Where the interacting drugs are formulated into a fixed dose combination product, even when major organs are affected;
b) Where the two drugs are concomitantly used with the aim of benefiting from synergy e.g. anti-hypertensive drugs (including scenarios where both drugs should be used as preparation for discharge e.g. the concomitant use of heparin and warfarin when changing the anticoagulant from heparin (injectable) to warfarin (oral).
c) Where effects of the interaction can be monitored and the drugs a rather necessary

Annex V – Sampling plan

Stepwise sampling was done. First, out of all KNH departments, four were selected because they are Clinical departments and handle large numbers of patients who are managed with pharmacological interventions. Secondly, within each ward attached to a clinical department, selection of patients was random. A procedure was followed to ensure that the selection is random. The procedure is explained below.

Preamble

The departments from which data was to be collected were 4 (four) namely; Internal medicine, Pediatric, Obstetrics/Gynecology and Surgical. The total sample size (385) would be constituted by study participants from each of the 4 departments.

1 – Obtaining the number of study participants to be picked from each department.

This is done by dividing the total number of participants by four to yield **96**

2 - Identifying the number of wards that make up each of the four departments, where data is to be obtained.

In this case; 8 internal medicine wards, 4 pediatric wards, 8 surgical wards, and 5 Obs/Gyn wards.

3 – Determining the number of study participants to be recruited from each ward.

This is obtained when 96 (obtained from step 1 above) is divided by the number of wards in a given department. For Internal medicine - $^{96}/_{8\ \text{(internal medine wards)}\ -}$ yields 12; for pediatric ward - $^{96}/_{4\ \text{(pediatric wards)}}$ yields 24; Surgical wards - $^{96}/_{8\ \text{(surgical wards)}}$ yields 12; likewise, for Obs/Gyn, $^{96}/_{5}$ yields approximately 19.

4 - Consolidating.

The number of participants to be obtained from each ward adds up to 383 yet the required sample size is 385. The extra two participants were randomly picked from 1A and GFA. These were both Obs/Gyn wards. The numbers obtained after this process are in the table below. These were the number of participants picked from the wards.

Table 11: Number of patient files / treatment sheets reviewed from each ward

Distribution Ward	**Number of files with treatment sheets**
Internal medicinewards	
7A	12
7B	12
7C	12
7D	12
8A	12
8B	12
8C	12
8D	12
Pediatric wards	
3A	24
3B	24
3C	24
3D	24
Obs/Gyn wards	
GFA	20
GFB	19
1A	20
1B	19
1D	19
Surgical wards	
5A	12
5B	12
5C	12
5D	12
6A	12
6B	12
6C	12
6D	12
	385

Annex VI Drugs that were prescribed to patients

Table 12: Drugs that were part of the prescriptions reviewed

Drugs that were part of the prescriptions reviewed						
Code	**Class**	**SN**	**Drug**	**Number of prescriptions with the drug**	**% out of 1597 prescription events**	**% out of 385 (the sample size)**
A	Alimentary tract and metabolism	1	Aluminum Hydroxide	8	0.5	2.08
		2	Bisacodyl	9	0.6	2.34
		3	Butyl scopolamine	1	0.1	0.26
		4	Calcium salts	3	0.2	0.78
		5	Cocovit oil	1	0.1	0.26
		6	Domperidone	1	0.1	0.26
		7	Esomeprazole	7	0.4	1.82
		8	Granisetron	9	0.6	2.34
		9	Insulin intermediate	6	0.4	1.56
		10	Insulin short acting	1	0.1	0.26
		11	Lactulose	23	1.4	5.97
		12	Metformin hydrochloride	1	0.1	0.26
		13	Metoclopramide hydrochloride	50	3.1	12.99
		14	Multivitamin	30	1.9	7.79
		15	Neurobion	2	0.1	0.52
		16	Omeprazole	66	4.1	17.14
		17	ORS	7	0.4	1.82
		18	Pyridoxine	22	1.4	5.71
		19	Ranitidine	18	1.1	4.68
		20	Soap enema	1	0.1	0.26
		21	Sodium picosulfate	1	0.1	0.26
		22	Ursodeoxycholic acid	2	0.1	0.52
		23	Vitamin A	2	0.1	0.52
		24	Vitamin B1	1	0.1	0.26
		25	Vitamin B2	1	0.1	0.26
		26	Vitamin D	8	0.5	2.08

		28	Vitamin K	2	0.1	0.52
		29	Zinc Sulfate	14	0.9	3.64
	SUB TOTAL			**297**	**18.8**	**77.14**
B	Blood and blood forming organs	30	Heparin	31	1.9	8.05
		31	Ferrous Fumerate	44	2.8	11.43
		32	Albumin	1	0.1	0.26
		33	Enoxaparin	11	0.7	2.86
		34	Epoetin	2	0.1	0.52
		35	Ferrous And Folic Acid	7	0.4	1.82
		36	Filgrastim	2	0.1	0.52
		37	Folic Acid	10	0.6	2.60
		38	Iron Sucrose	8	0.5	2.08
		39	Manitol (B05B C solutions producing osmotic diuresis)	1	0.1	0.26
		41	Tranexamic Acid	12	0.8	3.12
		42	Warfarin Sodium	11	0.7	2.86
	SUB TOTAL			**140**	**8.8**	**36.36**
C	Cardiovascular system	43	Acetazolamide	1	0.1	0.26
		44	Hydroclothiazide	1	0.1	0.26
		45	Nimodipine	1	0.1	0.26
		46	Clopidogrel	1	0.1	0.26
		47	Furosemide	50	3.1	12.99
		48	Spironolactone	23	1.4	5.97
		49	Nifedipine	22	1.4	5.71
		50	Hydralazine	2	0.1	0.52
		51	Losartan	3	0.2	0.78
		52	Atorvastatin	3	0.2	0.78
		53	Sildenafil	5	0.3	1.30
		54	Propranolol	4	0.3	1.04
		55	Aspirin	4	0.3	1.04
		56	Enalapril	17	1.1	4.42

		57	Digoxin	8	0.5	2.08
		58	Atenolol	6	0.4	1.56
		59	Carvedilol	6	0.4	1.56
		60	Amlodipine	6	0.4	1.56
		61	Methyldopa	11	0.7	2.86
	SUB TOTAL			**174**	**11.2**	**45.19**
D	Dermatologicals	62	Betamethasone Sodium	2	0.1	0.52
		63	Zinc Oxide	2	0.1	0.52
		64	Calamine lotion	1	0.1	0.26
	SUB TOTAL			**5**	**0.3**	**1.30**
G	Genito-urinary system and sex hormones	65	Dydrogesterone	1	0.1	0.26
		66	Goserrelin	1	0.1	0.26
		67	Oxytocin	2	0.1	0.52
	SUB TOTAL			**4**	**0.3**	**1.04**
H	Systemic hormonal preparations, excluding sex hormones and insulins					
J	Anti-infectives for systemic use	68	Neomycin	1	0.1	0.26
		69	Nitrofurantoin	1	0.1	0.26
		70	Amphotericin B	1	0.1	0.26
		71	Itraconazole	1	0.1	0.26
		72	Griseofulvin	1	0.1	0.26
		73	AZT/3TC/EFV	1	0.1	0.26
		74	Lamivudine/Tenofovir (TDF/3TF)	1	0.1	0.26

		75	Zinocovir	1	0.1	0.26
		76	Doxycycline	1	0.1	0.26
		77	Ofloxacin drops	1	0.1	0.26
		78	Abacavir / Lamivudine	1	0.1	0.26
		79	Isoniazid	1	0.1	0.26
		80	Pyrazinamide	1	0.1	0.26
		81	Rifampicin	1	0.1	0.26
		82	Cefazolin	1	0.1	0.26
		83	Chloraphenicol	1	0.1	0.26
		84	Co-amoxiclav	69	4.3	17.92
		85	Metronidazole	77	4.8	20.00
		86	Ceftriaxone	86	5.4	22.34
		87	Captopril	2	0.1	0.52
		88	Abacavir	2	0.1	0.52
		89	Lamivudine	2	0.1	0.52
		90	Tenofovirdisopropoxil	2	0.1	0.52
		91	Rifampicin/ Isoniazid/ Pyrazinami	2	0.1	0.52
		92	Clindamycin	2	0.1	0.52
		93	Dapsone	2	0.1	0.52
		94	Nevirapine	3	0.2	0.78
		95	Amoxicillin	3	0.2	0.78
		96	Nystatin oral drops	3	0.2	0.78
		97	Clotrimazole pessaries	3	0.2	0.78
		98	Rifampicin/Isoniazid	5	0.3	1.30
		99	Clarithromycin	5	0.3	1.30
		100	Levofloxacin	3	0.2	0.78
		101	Efavirenz	4	0.3	1.04
		102	Zidovudine/Lamivudine	4	0.3	1.04
		103	Azithromycin	4	0.3	1.04
		104	Vancomycin	5	0.3	1.30
		105	Rifampicin/Isoniazid / Pyrazinamide	15	0.9	3.90
		106	Erythromycin	15	0.9	3.90
		107	Benzylpencillin	16	1	4.16
		108	Acyclovir	9	0.6	2.34

		109	Tenofovir/Lamivudine/Efavirenz	7	0.4	1.82
		110	Meropenem	8	0.5	2.08
		111	Ceftazidime	11	0.7	2.86
		112	Fluconazole	12	0.8	3.12
		113	Amikacin	17	1.1	4.42
	J07 - Vaccines	114	Tetanus toxoid	1	0.1	0.26
	SUB TOTAL			**415**	**26.6**	**107.79**
L	Antineoplastic and immunomodulating agents	115	Cytarabine	1	0.1	0.26
		116	Azathioprine	1	0.1	0.26
		117	Cisplatin	1	0.1	0.26
		118	Hydrocortisone	1	0.1	0.26
		119	Etoposide	2	0.1	0.52
		120	Mercaptopurine	2	0.1	0.52
		121	Co-trimoxazole	27	1.7	7.01
		122	Ciprofloxacin	17	1.1	4.42
		123	Gentamicin	19	1.2	4.94
		124	Flucloxacillin	24	1.5	6.23
		125	Cefuroxime	25	1.6	6.49
		126	Methotrexate	5	0.3	1.30
		127	Actinomycin D	4	0.3	1.04
		128	Doxorubicin	4	0.3	1.04
		129	Dexamethasone	13	0.8	3.38
		130	Cyclophosphamide	8	0.5	2.08
		131	Vincristine	11	0.7	2.86
	SUB TOTAL			**165**	**10.6**	**42.86**
M	Musculo-skeletal system	132	Colchicine	1	0.1	0.26
		133	drops	1	0.1	0.26
		134	Indomethacin	1	0.1	0.26
		135	Tramadol	57	3.6	14.81
		136	Diclofenac	62	3.9	16.10

		137	Paracetamol	97	6.1	25.19
		138	Pethidine	26	1.6	6.75
		139	Dihydrocodeinetartarate	20	1.3	5.19
		140	Morphine	4	0.3	1.04
		141	Ibuprofen	11	0.7	2.86
		142	Allopurinol	7	0.4	1.82
	SUB TOTAL			**287**	**18.2**	**74.55**
N	Nervous system	143	Chlorpromazine hydrochloride	1	0.1	0.26
		144	Amitriptyline hydrochloride	1	0.1	0.26
		145	Pregabalin	2	0.1	0.52
		146	Carbimazole	1	0.1	0.26
		147	Diazepam	1	0.1	0.26
		148	Sodium valproate	3	0.2	0.78
		149	Trihexyphenidyl	3	0.2	0.78
		150	Haloperidol	3	0.2	0.78
		151	Phenobarbital	11	0.7	2.86
		152	Phenytoin	15	0.9	3.90
		153	Carbamazepine	5	0.3	1.30
		154	Gabapentine	4	0.3	1.04
	SUB TOTAL			**50**	**3.3**	**12.99**
P	Antiparasitic products, insecticides and repellents	155	Quinine	2	0.1	0.52
		156	Artemether/Lumefantrine	2	0.1	0.52
		157	Albendazole	3	0.2	0.78
		158	Prednisolone	15	0.9	3.90
	SUB TOTAL			**22**	**1.3**	**5.71**
R	Respiratory system	159	Saline nasal drops	4	0.3	1.04
		160	Salbutamol inhaler	9	0.6	2.34

		161	Terbutaline	1	0.1	0.26
		162	Ambroxol	3	0.2	0.78
		163	Cetirizine	4	0.3	1.04
		164	Chlopheniramine (Piriton)	6	0.4	1.56
	SUB TOTAL			**27**	**1.9**	**7.01**
S	Sensory organs	163	Artificial tears	2	0.1	0.52
V	Various (Including alergy medication,		Glevoma	1	0.1	0.26
			Resonium	1	0.1	0.26
			Gelopril	1	0.1	0.26
			Others	3	0.2	0.78
	SUB TOTAL			**6**	**0.5**	**1.56**

Annex VII – Interacting drugs

Table 13: Interacting drugs

Interacting Drug	**n**	**%**	
Amikacin; Ceftriaxone	11	5.2	**Other**– This may increase the risk of nephropathy
Ceftriaxone;Furosemide	8	3.8	**Other** - May potentiate the nephrotoxicity of cephalosporins (Ceftriaxone)
Omeprazole;Phenytoin	1	0.5	**Metabolism** - Omeprazole may increase phenytoin serum concentrations and the risk of toxicity
Erythromycin;Lactulose	1	0.5	**Other –** Lactulose, being a laxative may cause electrolyte loss and increase the risk of torsade de pointes ventricular arrhythmia in patients treated with drugs that prolong the QT interval.
Pethidine;Tramadol	2	0.9	**Additive effect (negative) –** increased risk of developing seizures in patients taking other opioids. These agents are often individually epileptogenic and may have additive effects on seizure threshold during coadministration. CNS- and respiratory-depressant effects may also be additive.
Amitriptyline;Haloperidol	1	0.5	**Additive effect** a) Metabolism (Haloperidol may increase the serum concentrations of tricyclic antidepressants by inhibiting their metabolism via CYP450 2D6) b) Additive effect prolongation of QT

Cefuroxime;Ranitidine	1	0.5	Decreased **absorption** of cefuroxime Ranitidine, by reducing stomach acid, can decrease the absorption and blood levels of cefuroxime.
Tramadol;Warfarin	1	0.5	**Metabolism** (increased effect of one drug) Potentiation of the hypoprothrombinemic effect of warfarin manifested in elevated prothrombin time or INR and bleeding in warfarin patients taking tramadol.
Cefuroxime;Omeprazole	1	0.5	Decreased **absorption** of cefuroxime Omeprazole, by reducing stomach acid, can decrease the absorption and blood levels of cefuroxime.
Cefuroxime;Furosemide	1	0.5	**Other** - May potentiate the nephrotoxicity of cephalosporins (Cefuroxime)
Cetirizine;Dihydrocodeine	1	0.5	**Additive** side effects (dizziness, drowziness)
Chlorpheniramine;Pethidine	1	0.5	**Additive** side effects (dizziness, drowziness)
Chlorpheniramine;Dihydrocodeine	1	0.5	**Additive** side effects (dizziness, drowziness)
Ciprofloxacin;Diclofenac	3	1.4	**Other - N**onsteroidal anti-inflammatory drugs (NSAIDs) may potentiate the risk of central nervous system toxicity sometimes associated with fluoroquinolone use. Possible mechanism- the piperazine ring of fluoroquinolones may inhibit the binding of gamma-aminobutyric acid (GABA) to brain receptors. NSAIDs may

			synergistically add to this effect. Patients with a history of seizures may be at greater risk. (poorly documented)
Ciprofloxacin;Iron(Oral)	1	0.5	Decreased **absorption** of quinolone (chelation)
Dihydrocodeine;Metoclopramide	1	0.5	**Antagonism** a) Narcotics diminish gastrointestinal motilityandmay antagonize the pharmacologic effects of gastrointestinal prokinetic agents. b) Additive side effects – use of the agents concomitantly may increase central nervous system effects such as sedation, dizziness, confusion, and mental depression
Amikacin;Ceftazidime	2	0.9	**Other** – possible increase in the risk of nephrotoxicity. The risk may be greatest in the elderly or patients with preexisting renal impairment, when large doses are used, and during prolonged treatment.
Dactinomtcin;Etoposide	2	0.9	**Additive toxicity** - potentiated risk and severity of additive toxicities, such as immunosuppression and myelotoxicity.
Dexamethasone;Rifampicin	2	0.9	Induced **metabolism** leading to decreased dexamethason
Dexamethasone;Erythromycin	1	0.5	**Metabolism** (inhibition resulting into decreased clearance of dexamethasone) Erythromycin inhibits CYP450 3A4 and affects dexamethsone clearance. This could at worst result in adrenal insufficiency and cushing syndrome

Dexamethasone;Phenytoin	1	0.5	**Metabolism** (enzyme induction) Phenytoin may induce the CYP450 3A4 hepatic metabolism of corticosteroids and increase their clearance and decrease their half-lives, possibly reducing their therapeutic efficacy.
Diclofenac;Enoxaparin	1	0.5	**Other** – this combination may create a risk of developing an epidural or spinal hematoma. It is significant if a patient is receiving neuraxial anesthesia or spinal puncture. The development of epidural and spinal hematoma can lead to long-term or permanent paralysis
Diclofenac;Warfarin	1	0.5	**Additive toxic effect** Nonsteroidal anti-inflammatory drugs (NSAIDs) may potentiate the hypoprothrombinemic effect and bleeding risk associated with oral anticoagulants. - This has occurred according to some studies, while some have not demonstrated any effect of the combination. The risk may be increased in the elderly
Diclofenac;Heparin	1	0.5	**Additive toxic effect** This combination may create a risk of developing an epidural or spinal hematoma. It is significant if a patient is receiving neuraxial anesthesia or spinal puncture. The development of epidural and spinal hematoma can lead to long-term or permanent paralysis
Diclofenac;Nifedipine	4	1.9	**Antagonism-** This may contribute to attenuation of

			antihypertensive effects of Nifedipine owing to alteration of vascular tone, which is dependent on prostacyclins (inhibited by diclofenac)
Dogoxin;Furosemide	2	0.9	**Additive toxic effect** Diuretic-induced hypokalemia and hypomagnesemia may predispose patients on digitalis to arrhythmias.
Digoxin;Nifedipine	1	0.5	**Additive toxic effect** Nifedipine may decrease digoxin clearance however data is limitedon this. This could result in increased serum digoxin levels and risk of toxicity
Efavirenz;Cotrimoxazole	6	2.8	**Additive toxic effect** - Increased risk of liver damage
Efavirenz;Lamivudine	4	1.9	**Additive toxic effect** - Increased risk of liver damage
Efavirenz;Tenofovir	3	1.4	**Additive toxic effect** - Increased risk of liver damage
Efavirenz;Zidovudine	1	0.5	**Additive toxic effect** - Increased risk of liver damage
Enalapril;Prednisolone	1	0.5	**Antagonism** Corticosteroids may antagonize the effects of antihypertensive medications by inducing sodium and fluid retention.
Enalapril;Spironolactone	7	3.3	**Additive toxic effect** - May increase the risk of hyperkalemia
Enalapril;Furosemide	5	2.4	**Additive effect** – Increased blood presure lowering tendency
Enalapril;Heparin	1	0.5	**Additive toxic effect** May increase the risk of hyperkalemia
Erythromycin;Sidenafil	1	0.5	**Metabolism** (enzyme

			inhibition) Erythromycin may CYP450 3A4, an iso enzyme that metabolises sildenafil, which may result in prolongation of and/or increase in pharmacologic effects of sildenafil.
Ethambutol;Isoniazide	6	2.8	**Additive toxicity** The increased risk of peripheral neuropathy especially in patients >60 yrs
Ferrous Fumerate;Methyldopa	2	0.9	**Decreased oral bioavailability** Owing to chelation of methyldopa by the iron cation, and forming an insoluble complex that is poorly absorbed from the gastrointestinal tract, the oral bioavailability and pharmacologic effects of methyldopa may be decreased
Fluconazole;Methotrexate	1	0.5	**Additive toxic effect** Possible risk of liver injury Methotrexate, especially at higher doses or with prolonged treatment, has been associated with hepatotoxicity including acute hepatitis, chronic fibrosis, necrosis, cirrhosis, and liver enzyme elevations.
Furosemide;Hydrocortisone	1	0.5	**Additive toxic effect** increased risk of hypokalemia.
Furosemide;Insulin	1	0.5	**Antagonism** Diminished efficacy of insulin by furosemide
Furosemide;Omeprazole	6	2.8	Additive effect - Increased risk of hypomagnesemia
Furosemide;Vancomycin	1	0.5	**Additive** toxicity Increased risk of nephrotoxicity
Ibuprofen;Warfarin	1	0.5	**Other** (increased risk of

			bleeding) - Potentiation of hypoprothrombinemic effect and bleeding risk associated with oral anticoagulants.
Iron(Oral);Omeprazole	4	1.9	**Reduced absorption** hypochlorhydria induced by proton pump inhibitors (PPIs) may impair the gastrointestinal absorption of nonheme iron,
Iron Fumerate;Iron Sucrose	1	0.5	**Absorption** reduced Parenteral iron therapy may reduce the absorption of concomitantly administered oral iron preparations.
Isoniazide;Phenytoin	1	0.5	**Metabolism** (induction of enzyme) : Rifampin may induce the CYP450 hepatic metabolism of phenytoin. Plasma concentrations and clinical effects of phenytoin may be decreased
Isoniazide;Refampicin	1	0.5	**Additive** toxicity risk Increased risk of hepatotoxicity
Isoniazide;Paracetamol	3	1.4	**Additive** toxicity risk Increased risk of hepatotoxicity
Methotrexate;Vincristine	3	1.4	**Additive** toxicity risk Increased risk of hepatotoxicity
Metoclopramide;Tramadol	28	13.3	**Other** (risk) The risk of seizures may be increased because of reduced seizure threshold
Aspirin;Enoxaparin	2	0.9	**Other** (risk) This combination may create a risk of developing an epidural or spinal hematoma. It is significant if a patient is receiving neuraxial anesthesia or spinal puncture. The development of epidural and

			spinal hematoma can lead to long-term or permanent paralysis
Metoclopramide;Pethidine	5	2.4	**Antagonism** a) Narcotics diminish gastrointestinal motilityand may antagonize the pharmacologic effects of gastrointestinal prokinetic agents. b) Additive side effects – use of the agents concomitantly may increase central nervous system effects such as sedation, dizziness, confusion, and mental depression
Metronidazole;Rifampicin	2	0.9	Metabolism (induced enzymes) Decreased metronidazole concentration because of rifampicin induction of enzymes which metabolism metronidazole.
Metronidazole;Isoniazide	2	0.9	Additive effect risk - Risk of peripheral neuropathy
Metronidazole;Hydralazine	1	0.5	Additive effect risk - Risk of peripheral neuropathy
Metronidazole;Warfarin	1	0.5	**Metabolism** (increased warfarin effect) Possible increase the plasma concentrations and hypoprothrombinemic effect of warfarin due Metronidazole inhibition of CYP450 2C9, the isoenzyme responsible for the metabolic clearance of the more active S(-) enantiomer of warfarin. Manifestation - significant bleeding and elevation of

			prothrombin time
Metronidazole;Phenytoin	1	0.5	**Metabolism** (decreased clearance of phenytoin)
Morphine;Tramadol	1	0.5	Other (risk of seizure) **Other -** Increased seizure risk **and Additive** side effects (dizziness, drowziness)
Paracetamol;Phenobarbital	1	0.5	**Additive toxicity and metabolism**– increased risk of Hepatotoxicity Barbiturates may increase the hepatotoxic potential of acetaminophen and decrease its therapeutic effects. The mechanism may be related to accelerated CYP450 metabolism of acetaminophen with consequent increase in hepatotoxic metabolites. This interaction is of greatest concern in cases of *acetaminophen overdose.*
Phenytoin;Phenobarbital	2	0.9	**Metabolism** resulting in varying target concentration of phenytoin
Phenytoin;Tramadol	2	0.9	**Additive side effects** Central nervous system and/or respiratory-depressant effects may be additively or synergistically increased in especially in elderly or debilitated patients.
Atenolol;Insulin	1	0.5	**Other –** Masking the hypoglycemia by the Beta-blockers.
Rifampicin;Pyrazinamide	1	0.5	**Additive toxic effect** liver injury, both agents are individually hepatotoxic and may have additive effects on the liver during coadministration.
Spironolactone; Sildenafil	1	0.5	**Addititve effect** Sildenafil, a phosphodiesterase-5 (PDE5) inhibitor may potentiate the

			blood pressure-lowering effect of spironolactone, an antihypertensive
Spironolactone; Heparin	1	0.5	**Other** - Increased risk of hyperlaemia
Augmentin;Efavirenz	1	0.5	**Additive hepatotoxic effect** Rifampin may decrease the anticoagulant effect of warfarin by enhancing CYP450 hepatic microsomal enzyme metabolism of warfarin.
Rifampicin;Warfarin	2	0.9	**Metabolism** (decreased concentration of one drug) Rifampin may decrease the anticoagulant effect of warfarin by enhancing CYP450 hepatic microsomal enzyme metabolism of warfarin.
Omeprazole;Warfarin	1	0.5	**Metabolism** (increase in effect of warfarin) Coadministrationof both these drugs has occasionally been associated with enhanced hypoprothrombinemic effect of warfarin.
Lumefantrine;Quinine	1	0.5	Additive toxic effect Artemether-lumefantrine may cause prolongation of the QT interval.Quinine antimalarial agents that can prolong the QT interval
Clarithromycin;Efavirenz	1	0.5	Enhanced **metabolism** -: Efavirenz enhances the metabolism of clarithromycin leading to decreased concentrations of the same
Warfarin;Heparin	3	1.4	**Additive effect** Potential for additive anticoagulant effects
Cotrimoxazole;Rifampicin	2	0.9	**Metabolism** Increase in rifampicin concentration and decrease on concentration of contrimoxazole.

Bisacodyl;Ondansetron	1	0.5	**Other –** Laxatives may cause electrolyte loss and increase the risk of torsade de pointes ventricular arrhythmia in patients treated with drugs that prolong the QT interval. Hypokalemia and hypomagnesemiawhich may occur with laxatives abuse. These are known risk factors for torsade de pointes associated with QT interval prolongation.
Atorvastatin;Nifedipine	1	0.5	**Metabolism**; Nifedipine is one of the inhibitors of CYP450 3A4 yet atorvastatin is metabolized by this enzyme. Concomitant use may increase the plasma concentrations of Artovastatin. There is then increased risk of musculoskeletal toxicity and rhabdomyolysis.Symptoms such as muscle pain and/or weakness associated with elevated creatine kinase exceeding ten times the upper limit of normal has been reported occasionally.
Dihydrocodeine;Gabapentin	1	0.5	**Additive**side effects on the respiratorysystemespecially in elderly or debilitated patients.
Dihydrocodeine;Tramadol	2	0.9	**Other -** Increased seizure risk **and Additive** side effects (dizziness, drowziness)
Atenolol;Furosemide	2	0.9	**Additive effect** on blood pressure lowering
Omeprazole;Methotrexate	1	0.5	Increased serum concentration of Methotrexate (due to PPI inhibition of the active tubular secretion of MTX and 7-hydroxymethotrexate via renal H+/K+ ATPase pumps)
Clarithromycin;Nimodipine	1	0.5	**Metabolism** (deceased

			clearance) Inhibition of CYP450 3A4 by clarithromycin results in decreased clearance of Nimodipine with an accompanying increase the plasma concentrations and blood pressure lowering effect.
Ceftriaxone;Heparin	2	0.9	**Other– increased risk of bleeding** This combination may result in enhanced effect of heparin and manifest by bleeding tendency
Metronidazole;Ethambutol	1	0.5	**Additive toxicity –** Increased risk of peripheral neuropathy following concomitant administration. Risk is increased in patients with diabetes, and with age older than 60 years.
Clarithromycin;Warfarin	1	0.5	**Metabolism –** enhanced hypoprothrombinemic effect of warfarin possibly because of inhibition of CYP450 3A4 by clarithromycin
Ciprofloxacin;Tramadol	2	0.9	**Other**- increased risk of seizures when tramadol and ciprofloxacin are co-administered. Both drugs can reduce the threshold for seizures.
Carbamazepine;Phenobarbital	1	0.5	**Metabolism** (increased clearance)
Nifedipine;Omeprazole	1	0.5	Increased **absorption** of Nifedipine
Chlorpromazine;Metoclopramide	1	0.5	**Additive** side-effects
Chlorpromazine;Tramadol	1	0.5	**Other** - The risk of seizures may be increased during coadministration of tramadol with any substance that can reduce the seizure threshold such as opioid
Omeprazole;Rifampicin	2	0.9	**Metabolism** – (decreased omeprazole concentration)

Paracetamol;Phenytoin	1	0.5	a) **Additive** Hepatotoxic effect b) **metabolism** leading to decreased paracetamol effect
Furosemide;Gentamicin	1	0.5	**Additive** nephrotoxic and ototoxic effect
Fluconazole;Prednisolone	1	0.5	Decreased **Metabolism**– inhibition of CYP450 3A4 by fluconazole may result in increased plasma concentration of Prednisolone which is one of the CYP450 3A4 substrates.
Fluconazole;Vincristine	1	0.5	**Metabolism** – inhibition of CYP450 3A4 by fluconazole may result in increased plasma concentration of vincristine which is one of the CYP450 3A4 substrates
Amlodipine;Aspirin	1	0.5	**Antagonism** – Possible attenuation of antihypertensive effects of calcium channel blockers by cyclooxygenase inhibitors. The mechanism - alteration of vascular tone, which is dependent on prostacyclins (this was considered as a non-clinically significant interaction)
Total	210	100	

Annex VIII - Error in dose by drug and Ward

Table 14: Error on dose by drug and ward

Drug \ Ward		Obs/Gyn wards	Pediatric wards	Surgical wards	Internal medicine wards	TOTAL
Class A	Aluminum hydroxide	0	2	0	1	3
	Bisacodyl	1	0	0	2	3
	Esomeprazole	0	3	0	0	3
	Granisetron	0	3	0	0	3
	Lactulose	0	7	0	1	8
	Metoclopramide hydrochloride	0	0	5	5	10
	Omeprazole	3	2	1	6	12
	Ranitidine	0	0	5	0	5
	Ursodeoxycholic acid	0	2	0	0	2
	Vitamin D	0	3	0	0	3
	Vitamin D3	0	15	0	0	15
	Vitamin K	0	1	0	0	1
	Zinocovir	0	1	0	0	1
	Insulin intermediate	0	0	0	2	2
	Zinocovit	0	1	0	0	1
	Multivitamin	0	20	0	0	20
	Zinc sulphate	0	15	0	0	15
	Pyridoxine	0	2	0	1	3
	Calcium salts	0	6	0	0	6
	Cocovit oil	0	1	0	0	1
	TOTAL	**4**	**84**	**11**	**18**	**117**
Class B	Heparin	1	0	0	1	2
	Epoetin	0	4	0	0	4
	Warfarin sodium	0	1	0	0	1
	Tranexamic acid	1	0	0	1	2
	Ferrous fumerate	1	7	0	0	8
	Epoetin	0	4	0	0	4
	Filgastim	0	1	0	0	1
	Folic acid	0	6	0	0	6
	TOTAL	**3**	**23**	**0**	**2**	**28**
Class	Atenolol	0	0	0	1	1

C						
	Carvedilol	0	0	0	1	1
	Methyldopa	0	0	0	1	1
	Captopril	0	1	0	0	1
	Enalapril	0	0	0	1	1
	Amlodipine	0	0	0	1	1
	Nifedipine	0	4	0	0	4
	Spironolactone	0	3	0	1	4
	Sildenafil	0	3	0	0	3
	Digoxin	0	1	0	0	1
	Furosemide	0	12	0	2	14
	TOTAL	**0**	**24**	**0**	**8**	**32**
Class J	Nevirapine	0	2	0	0	2
	Tenofovir/Lamivudine/Efavirenz	0	0	0	2	2
	Acyclovir	0	13	0	0	13
	Rifampicin/Isoniazid/Pyrazinami	0	1	0	0	1
	Rifampicin/Isoniazid	0	1	0	0	1
	Amikacin	0	17	0	0	17
	Amoxicillin	0	2	0	0	2
	Benzylpencillin	0	7	0	0	7
	Ceftazidime	0	10	0	0	10
	Ceftriaxone	1	32	0	1	34
	Cefuroxime	0	1	5	0	6
	Chloramphenicol	0	1	0	0	1
	Ciprofloxacin	0	0	2	0	2
	Clarithromycin	0	0	0	1	1
	Co-amoxiclav	0	8	1	2	11
	Co-trimoxazole	0	9	0	2	11
	Erythromycin	0	18	0	0	18
	Flucloxacillin	0	10	2	1	13
	Gentamicin	0	6	0	0	6
	Levofloxacin	0	0	0	1	1
	Meropenem	0	15	0	0	15
	Metronidazole	2	8	2	4	16
	Neomycin	0	1	0	0	1
	Vancomycin	0	6	0	0	6
	Fluconazole	0	9	0	1	10
	Doxycycline	0	0	0	1	1
	TOTAL	**3**	**177**	**12**	**16**	**208**
Class L	Mercaptopurine	**0**	**1**	**0**	**0**	**1**

Class M	Allopurinol	0	5	0	2	7
	Dihydrocodeine tartarate	0	7	0	1	8
	Pethidine	0	0	1	0	1
	Tramadol	1	0	5	1	7
	Paracetamol	1	16	7	3	27
	Diclofenac	2	0	3	0	5
	Ibuprofen	0	1	1	0	2
	Prednisolone	0	5	0	0	5
	TOTAL	**4**	**34**	**17**	**7**	**62**
Class N	Phenytoin	0	1	3	0	4
	Phenobarbital	0	9	0	0	9
	Carbamazepine	0	5	0	0	5
	Sodium valproate	0	6	0	0	6
	Clonazepam	0	1	0	0	1
	Trihexyphenidyl	0	1	0	0	1
	Haloperidol	0	0	0	1	1
	TOTAL	**0**	**23**	**3**	**1**	**27**
Class P	Artemether/Lumefantrine	0	1	0	0	1
	Quinine	0	0	0	1	1
	Albendazole	0	8	0	0	8
	TOTAL	**0**	**9**	**0**	**1**	**10**
Class R	Chlopheniramine (Piriton)	0	4	0	3	7
	Salbutamol inhaler	0	8	0	0	8
	Cetirizine	0	0	0	1	1
	Chlopheniramine (Piriton)	0	4	0	3	7
	TOTAL	**0**	**16**	**0**	**7**	**23**
Class S	Zinc oxide	0	3	0	1	4
	Nystatin oral drops	0	4	0	0	4
	Saline nasal drops	0	7	0	0	7
	Ofloxacin drops	0	0	0	1	1
	TOTAL	**0**	**64**	**0**	**18**	**82**

Annex IX - Error in ROA

Table 15: Error in Route of Administration

Drug \ Ward		Obs/Gyn wards	Pediatric wards	Surgical wards	Internal medicine wards	TOTAL
Class A	Insulin intermediate	0	0	0	5	5
	Insulin short acting	0	0	0	3	3
	Calcium salts	0	2	0	0	2
	ORS	0	2	0	0	2
	Vitamin D	0	1	0	0	1
	Multivitamin	0	3	0	0	3
	Zinc sulphate	0	2	0	0	2
	Pyridoxine	0	1	0	3	4
	Vitamin D3	0	2	0	0	2
	Sodium picosulfate	0	1	0	0	1
	Zinocovit	0	1	0	0	1
	Lactulose	0	2	0	2	4
	Aluminum hydroxide	0	0	0	4	4
	Ranitidine	1	0	1	0	2
	Omeprazole	1	0	1	12	14
	Bisacodyl	2	0	0	2	4
	Granisetron	0	3	0	0	3
	Metoclopramide hydrochloride	1	0	1	7	9
Class B	Heparin	0	0	0	8	8
	Warfarin sodium	0	0	0	2	2
	Iron sucrose	0	0	0	5	5
	Ferrous fumerate	2	0	2	1	5
	Epoetin	0	0	0	1	1
	Ferrous and folic acid	0	0	0	1	1
	Tranexamic acid	1	0	1	0	2
Class C	Hydralazine	0	0	0	3	3
	Atenolol	0	0	0	2	2
	Carvedilol	0	0	0	3	3
	Captopril	0	1	0	0	1
	Enalapril	0	0	0	5	5
	Amlodipine	0	0	0	1	1
	Nifedipine	0	0	0	3	3
	Nimodipine	0	0	0	1	1

Class J	Acyclovir	0	2	0	0	2
	Rifampicin/isoniazid/pyrazinamide	0	1	0	2	3
	Rifampicin/isoniazid	0	0	0	1	1
	Amikacin	0	1	0	0	1
	Benzylpencillin	0	1	0	0	1
	Ceftazidime	0	1	0	0	1
	Ceftriaxone	0	3	1	2	6
	Cefuroxime	1	0	3	0	4
	Clarithromycin	0	0	0	1	1
	Clindamycin	0	0	2	0	2
	Co-amoxiclav	5	1	3	3	12
	Co-trimoxazole	0	1	0	0	1
	Dapsone	0	0	0	1	1
	Erythromycin	0	3	0	3	6
	Flucloxacillin	0	0	5	0	5
	Gentamicin	0	1	0	0	1
	Meropenem	0	3	0	0	3
	Metronidazole	6	1	3	4	14
	Neomycin	0	1	0	0	1
	Vancomycin	0	1	0	0	1
	Fluconazole	0	2	0	0	2
	Albendazole	0	1	0	0	1
Class L	Doxorubicin	0	1	0	0	1
	Methotrexate	3	1	0	0	4
	Mercaptopurine	0	1	0	0	1
	Vincristine	3	1	0	0	4
	Azathioprine	0	0	0	1	1
	Etoposide	3	0	0	0	3
	Actinomycin D	3	0	0	0	3
	Cyclophosphamide	3	1	0	0	4
Class N	Phenytoin	0	0	1	1	2
	Phenobarbital	0	1	0	0	1
	Carbamazepine	0	1	0	1	2
	Sodium valproate	0	1	0	0	1
	Aspirin	0	0	0	2	2
	Clopidogrel	0	0	0	1	1
	Atorvastatin	0	0	0	1	1
	Sildenafil	0	1	0	0	1
	Furosemide	0	1	0	6	7
	Spironolactone	0	1	0	4	5

Class M	Dihydrocodeine tartarate	0	1	0	2	3
	Morphine	0	0	0	1	1
	Pethidine	0	0	2	0	2
	Tramadol	1	0	1	7	9
	Paracetamol	2	4	6	2	14
	Diclofenac	1	0	4	0	5
	Dexamethasone	1	0	0	0	1
	Prednisolone	0	1	0	1	2
	Allopurinol	0	2	0	0	2
Class P	Quinine	0	1	0	0	1
Class R	Salbutamol inhaler	0	1	0	0	1
	Ambroxol	0	0	1	0	1
	Chlopheniramine(Piriton)	0	0	1	0	1
Class S	Saline nasal drops	0	2	0	0	2
	Nystatin oral drops	0	1	0	0	1
	Clotrimazole pessaries	2	0	0	0	2
Class V	Glevoma	0	0	0	1	1

Annex X – Drugs with errors in indication per ward

Table 16: Drugs with errors in indication per ward

DRUG \ WARD		Obs/Gyn wards	Pediatric wards	Surgical wards	Internal medicine wards	TOTAL
class A	Cocovit oil	0	1	0	0	1
	Granisetron	0	1	0	0	1
	Insulin intermediate	0	1	0	0	1
	Lactulose	0	2	0	0	2
	Metoclopramide hydrochloride	0	0	4	0	4
	Multivitamin	0	4	0	0	4
	Omeprazole	0	2	0	0	2
	ORS	0	2	0	0	2
	Ranitidine	0	0	4	0	4
	Ursodeoxycholic acid	0	1	0	0	1
	Vitamin K	0	1	0	0	1
	zinc sulfate	0	2	0	0	2
	TOTAL					25
Class B	None					0
Class C	Atenolol			2	0	2
	Amlodipine			1	0	1
	TOTAL					3
Class D	None					0
Class G	None					0
Class H	None					0

Class J	Benzylpencillin		2	0		2
	Cefazolin		0	1		1
	Ceftazidime		1	0		1
	Ceftriaxone		1	1		2
	Cefuroxime		0	3		3
	Chloramphenicol		2	0		2
	Ciprofloxacin		2	0		2
	Erythromycin		1	0		1
	Griseofulvin		2	0		2
	Meropenem		1	0		1
	Neomycin		1	0		1
						18
Class L	None					0
Class M	Tramadol		0	4		4
	Prednisolone		2	0		2
	Paracetamol		1	1		2
						8
Class N						
Class R	Salbutamol inhaler		1	0		1
	Terbutaline		1	0		1
	Ipratropium		1	0		1

Annex XI – Error in frequency per drug class per ward

Table 17: Error in frequency per drug class per ward

Drug \ Ward		Obs/Gyn wards	Pediatric wards	Surgical wards	Internal medicine wards	TOTAL
Class A	ORS	0	2	0	0	2
	Vitamin D	0	3	0	0	3
	Multivitamin	0	12	0	0	12
	Zinc sulphate	0	6	0	0	6
	Pyridoxine	0	0	0	2	2
	Vitamin D3	0	5	0	0	5
	Lactulose	0	3	2	1	6
	Aluminum hydroxide	0	0	1	0	1
	Omeprazole	0	4	2	3	9
	Esomeprazole	0	0	2	1	3
	Bisacodyl	1	0	1	0	2
	Domperidone	0	1	0	0	1
	Granisetron	0	12	0	0	12
	Metoclopramide hydrochloride	0	0	6	3	9
Sub total		**1**	**48**	**14**	**10**	**73**
Class B	Heparin	0	0	0	3	3
	Warfarin sodium	0	1	0	0	1
	Iron sucrose	0	0	0	1	1
	Ferrous fumerate	0	6	2	1	9
	Epoetin	0	1	0	0	1
	Folic acid	0	3	0	0	3
Sub total		**0**	**11**	**2**	**5**	**18**
Class C	Carvedilol	0	0	0	2	2
	Methyldopa	3	0	0	0	3
	Enalapril	0	1	0	2	3
	Nifedipine	0	1	0	0	1
	Sildenafil	0	1	0	0	1
	Digoxin	0	0	0	1	1
	Furosemide	0	3	0	3	6
	Spironolactone	0	1	0	3	4

sub total		**3**	**7**	**0**	**11**	**21**
Class J	Abacavir	0	0	0	1	1
	Efavirenz	0	0	0	1	1
	Lamivudine	0	0	0	1	1
	Acyclovir	0	6	0	0	6
	Rifampicin/isoniazid/ pyrazinamide	0	0	0	2	2
	Amikacin	0	11	0	0	11
	Amoxicillin	0	2	0	0	2
	Azithromycin	0	0	0	3	3
	Cefazolin	0	0	1	0	1
	Ceftazidime	0	3	0	0	3
	Ceftriaxone	0	16	7	4	27
	Cefuroxime	0	1	4	0	5
	Ciprofloxacin	0	0	0	1	1
	Co-amoxiclav	5	1	6	4	16
	Co-trimoxazole	0	1	0	3	4
	Dapsone	0	0	0	1	1
	Erythromycin	1	4	0	1	6
	Flucloxacillin	0	4	3	1	8
	Gentamicin	0	0	1	0	1
	Meropenem	0	6	0	0	6
	Metronidazole	2	7	5	1	15
	Neomycin	0	1	0	0	1
	Vancomycin	0	2	0	0	2
	Amphotericin B	0	0	0	1	1
	Fluconazole	0	1	0	1	2
Sub total		**8**	**66**	**27**	**26**	**127**
Class M	Dihydrocodeine tartarate	0	2	2	0	4
	Morphine	0	0	1	0	1
	Pethidine	1	0	4	0	5
	Tramadol	3	0	5	1	9
	Paracetamol	1	11	10	5	27
	Diclofenac	5	0	6	0	11
	Ibuprofen	0	1	5	0	6
	Dexamethasone	0	1	0	0	1
	Prednisolone	0	4	0	1	5

	Allopurinol	0	8	0	0	8
	Actinomycin D	0	1	0	0	1
Sub total		**10**	**28**	**33**	**7**	**78**
Class L	Cyclophosphamide	0	10	0	0	10
	Doxorubicin	0	6	0	0	6
	Methotrexate	0	1	0	0	1
	Cytarabine	0	3	0	0	3
	Mercaptopurine	0	1	0	0	1
	Vincristine	0	10	0	0	10
	Azathioprine	0	0	0	1	1
	Cisplatin	0	5	0	0	5
Sub total		**0**	**36**	**0**	**1**	**37**
Class N	Phenytoin	0	1	0	1	2
	Phenobarbital	0	1	1	0	2
	Trihexyphenidyl	2	0	0	0	2
	Haloperidol	2	0	0	0	2
	Amitriptyline hydrochloride	2	0	0	0	2
sub total		**6**	**2**	**1**	**1**	**10**
Class R	Chlopheniramine(Piriton)	0	1	0	1	2
Class S	Betamethasone sodium	0	2	0	0	2
	Ofloxacin drops	0	0	0	1	1
	Saline nasal drops	0	1	0	0	1
	Nystatin oral drops	0	2	0	0	2
	Calamine lotion	0	1	0	0	1
	Zinc oxide	0	1	0	0	1
Sub total		**0**	**7**	**0**	**1**	**8**

Annex XII - Error in Duration per drug per ward

Table 18: Error in Duration per drug per ward

Drug \ Ward		Obs/ Gyn wards	Pediatric wards	Surgical wards	Internal medicine wards	Total
Class A	Lactulose	16	20	22	39	97
	Ursodeoxycholic acid	0	8	0	0	8
	Aluminum hydroxide	3	1	0	18	22
	Ranitidine	2	0	16	5	23
	Omeprazole	26	21	32	154	233
	Esomeprazole	0	5	6	6	17
	Bisacodyl	13	0	3	10	26
	Insulin intermediate	0	0	9	24	33
	Metformin hydrochloride	0	0	9	0	9
	Zinocovit	0	1	0	0	1
	Domperidone	0	3	0	0	3
	Granisetron	0	16	0	0	16
	Metoclopramide hydrochloride	1	0	34	76	111
	Butylscopolamine	0	0	0	4	4
	Vitamin D	0	7	0	0	7
	Vitamin A	0	6	0	0	6
	Vitamin B1	0	0	1	0	1
	Vitamin K	0	5	2	0	7
	Multivitamin	1	63	6	23	93
	Zinc sulphate	0	18	0	0	18
	Pyridoxine	0	7	1	69	77
	Vitamin D3	0	13	0	0	13
	Calcium salts	0	7	0	7	14
	Cocovit oil	0	5	0	0	5
	ORS	0	12	0	0	12
Class B	Heparin	4	0	0	92	96
	Enoxaparin	16	0	12	9	37
	Warfarin sodium	11	2	0	32	45
	Aspirin	4	0	0	25	29
	Iron sucrose	9	0	0	19	28
	Ferrous fumerate	40	28	1	28	97
	Epoetin	0	5	0	6	11
	Filgastim	1	3	0	0	4
	Ferrous and folic acid	6	0	4	0	10

	Folic acid	4	12	0	7	23
	Tranexamic acid	4	0	0	24	28
	Albumin	0	0	0	6	6
Class C	Clopidogrel	0	0	0	7	7
	Atorvastatin	0	0	9	11	20
	Sildenafil	0	8	0	6	14
	Digoxin	14	6	0	14	34
	Furosemide	18	26	5	112	161
	Spironolactone	6	4	5	63	78
	Carbimazole	0	0	0	6	6
	Hydralazine	5	0	0	0	5
	Propranolol	0	2	5	6	13
	Atenolol	4	5	0	18	27
	Carvedilol	0	0	9	19	28
	Methyldopa	23	0	0	8	31
	Captopril	0	3	0	0	3
	Enalapril	5	3	0	51	59
	Losartan	0	0	11	5	16
	Amlodipine	0	9	0	25	34
	Nifedipine	27	5	21	17	70
	Nimodipine	0	0	0	2	2
Class J	Abacavir	0	0	0	8	8
	Efavirenz	0	7	1	15	23
	Lamivudine	0	0	0	14	14
	Nevirapine	0	1	0	10	11
	Tenofovir/Disopropoxil	0	0	0	8	8
	Abacavir/Lamivudine	0	7	0	0	7
	Tenofovir/Lamivudine/Efavirenz	5	0	0	20	25
	Zidovudine/Lamivudine	0	0	1	16	17
	Acyclovir	0	11	0	1	12
	Isoniazid	0	1	0	0	1
	Pyrazinamide	0	1	0	0	1
	Rifampicin	0	0	6	0	6
	Rifampicin/Isoniazid	0	6	0	18	24
	Amikacin	0	10	0	0	10
	Amoxicillin	0	3	0	0	3
	Azithromycin	0	0	0	13	13
	Benzylpencillin	2	16	0	7	25
	Ceftazidime	0	19	0	1	20
	Ceftriaxone	17	44	18	50	129

	Cefuroxime	14	0	8	3	25
	Ciprofloxacin	0	0	2	18	20
	Clarithromycin	2	0	0	11	13
	Clindamycin	0	0	0	6	6
	Co-amoxiclav	27	11	4	46	88
	Co-trimoxazole	0	13	7	79	99
	Dapsone	0	0	0	12	12
	Erythromycin	0	18	0	10	28
	Flucloxacillin	0	21	4	0	25
	Gentamicin	3	14	1	14	32
	Levofloxacin	0	0	0	6	6
	Meropenem	0	17	0	2	19
	Metronidazole	30	18	23	31	102
	Neomycin	0	2	0	0	2
	Vancomycin	0	0	0	3	3
	Amphotericin B	0	0	0	2	2
	Fluconazole	0	4	0	20	24
	Itraconazole	0	0	0	7	7
	Griseofulvin	0	0	5		
	Doxycycline	0	0	0	3	3
	Lamivudine/Tenofovir/TDF/3TE	0	0	0	4	4
Class L	Doxorubicin	0	8	0	0	8
	Methotrexate	0	0	0	7	7
	Mercaptopurine	0	1	0	0	1
	Vincristine	0	9	0	1	10
	Azathioprine	0	0	0	6	6
	Cisplatin	0	8	0	0	8
	Cyclophosphamide	0	8	0	0	8
Class M	Dihydrocodeinetartarate	16	12	16	31	75
	Morphine	0	0	0	13	13
	Pethidine	7	0	1	0	8
	Tramadol	14	0	34	70	118
	Paracetamol	20	21	53	77	171
	Diclofenac	43	0	20	0	63
	Ibuprofen	0	2	2	2	6
	Indomethacin	3	0	0	0	3
	Dexamethasone	0	4	0	12	16
	Hydrocortisone	2	0	0	0	2
	Prednisolone	0	15	0	34	49
	Colchicine	0	0	0	1	1

	Allopurinol	0	20	0	11	31
Class N	Phenytoin	5	4	2	15	26
	Phenobarbital	0	23	1	0	24
	Carbamazepine	0	6	0	18	24
	Gabapentine	0	0	12	9	21
	Diazepam	0	0	1	0	1
	Sodium valproate	0	13	0	0	13
	Pregabalin	0	0	0	3	3
	Clonazepam	0	7	0	0	7
	Trihexyphenidyl	4	4	0	5	13
	Dydrogesterone	2	0	0	0	2
	Oxytocin	1	0	0	0	1
	Haloperidol	4	0	0	8	12
	Amitriptyline Hydrochloride	4	0	0	0	4
Class P	Artemether/Lumefantrine	0	1	0	0	1
	Quinine	0	3	0	0	3
	Albendazole	0	3	0	0	3
Class R	Salbutamol Inhaler	7	12	0	4	23
	Ambroxol	0	0	11	0	11
	Cetirizine	0	0	0	12	12
	Chlopheniramine(Piriton)	0	5	0	12	17
Class S	Nystatin oral drops	0	5	0	0	5
	Calamine Lotion	0	2	0	0	2
	Zinc Oxide	0	5	0	7	12
	Betamethasone Sodium	0	6	0	0	6
	Saline nasal drops	0	6	0	0	6
Class V	Artificial tears	0	0	0	3	3
	Resonium	5	0	0	0	5
	Glevoma	0	0	0	3	3
	Gelopril	2	0	0	0	2
	Soap enema	0	0	6	0	6