MEDICATION ERRORS AND CONTRIBUTING FACTORS IN INTENSIVE CARE UNIT OF JIMMA UNIVERSITY SPECIALIZED HOSPITAL, SOUTHWEST ETHIOPIA.

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Abstract

Background: Different studies indicated that prescribing medication errors in the intensive care unit are frequent and lead to attributable patient morbidity and mortality, increased length of stay and substantial extra costs. In Ethiopia, the prevalence of medication prescribing and administration errors in the intensive care unit is not studied. Thus, there is lack of data in Ethiopian intensive care units, particularly intensive care unit of Jimma University Specialized Hospital.

Objective: To assess medication errors and contributing factors during prescribing and administration of medications in the intensive care unit of Jimma university specialized hospital from February 7 to April 15, 2011.

Methods and materials: Prospective cross-sectional study was conducted in the intensive care unit of Jimma university specialized hospital from February 7 to April 15, 2011. All physician and nurse interventions to all patients admitted to the intensive care unit during the study period were included in the study. All physicians and nurses who prescribed and administered medications respectively were also included. Data regarding prescribing and administration of medications were collected from patient cards, medication documentation charts and by directly observing drug administration. Moreover, semi-structured self administered questionnaire and in-depth interview was used to collect professional related data. The data were coded, entered to SPSS windows version 16.0 and finally cleaned. Descriptive statistics and chi-square test were used.

Results: Prevalence of medication prescribing and administration errors in the intensive care unit of Jimma university specialized hospital were 209 (52.5%) and 621 (51.8%), respectively. Common prescribing errors were ascribed to wrong combination (25.7%), wrong frequency (15.5%) and wrong dose (15.1%), while administration errors were attributed to wrong timing (30.3%), omission due to unavailability (29.0%) and missed doses (18.3%) among others. Medication errors associated with antibiotics took the lion's share in both medication prescribing (32.5%) and administration (36.7%) errors. Errors related to cardiovascular drugs, analgesic/antipyretics and anticonvulsants were also common in both cases. Diclofenac was most

frequently encountered specific medication in both cases. The contributing factors associated with medication errors were multifactorial among which complexity of regimen (p=0.015), time of drug administration (p=0.000) and type of diagnosis for which medications were indicated (p=0.017) were significantly associated with medication errors.

Conclusion and recommendations: Medication errors at the prescribing and administration phases were prevalent in the intensive care unit of Jimma university specialized hospital and the contributing factors were multifactorial. With the increasing complexity of care in critically ill patients, organizational factors such as error reporting systems and routine checks can reduce the risk of such errors. Hospital managers should strive to create better awareness about medication errors and their aftermath's among health care professionals. Besides, inclusion of clinical pharmacists as member of hospital health care team in general and intensive care unit in particular might contribute a lot to diminution of medication errors.

Key words: Medication errors, intensive care unit, medication documentation charts, patient cards, patient safety

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Acronym and abbreviations

ADE	Adverse Drug Event
Adm	Administration
ADR	Adverse Drug Reaction
BID	Twice per day
CAP	Community acquired pneumonia
ED	Emergency Department
ICU	Intensive Care Unit
IM	Intra-muscular
IV	Intravenous
JUSH	Jimma University Specialized Hospital
MAE	medication administration error
MAR	Medication administration record
MDC	Medication Documentation Chart
ME	Medication Error
Mg	Milligram
Po	Per oral
OD	Every other day
PI	Principal Investigator
TID	Three Times per day
UTI	Urinary tract infection
USA	United States of America

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1. Introduction

Health care is not as safe as it should be and can be. Medication errors (MEs) are major issues in health care and are one of the most common types of medical errors. MEs can occur during prescribing; dispensing and administration of medications, and in primary, secondary and tertiary care settings. MEs are any preventable events that may cause or lead to inappropriate medication use that can cause harm to patient, while the medication is in the control of the health care professional, patient or consumer. These events may occur due to professional practice, health care products, procedures and systems including: prescribing, order communication, product labeling, and nomenclature; compounding, dispensing, distribution, administration, education, monitoring and use [1, 2, 3].

The intensive care unit (ICU) is a consolidated area of a hospital where patients with acutely life threatening illnesses or injuries receive around the clock specialized medical and nursing care, such as mechanical ventilation and intensive cardiac monitoring. The quality of care in the ICUs is strongly influenced by whether "intensivists" are providing care and the staff organization in the ICU. Intensivists are familiar with the complications that can occur in the ICU and, thus, are better equipped to minimize errors [1, 3].

MEs are more common in the ICUs probably because of poly-pharmacy, a more stressful environment and unconscious patients who cannot verbalize symptoms. These errors can cause ADEs which could be potentially life threatening in critically ill patients. The majority of errors were not the result of reckless behavior on the part of health care providers, but occurred as a result of the speed and complexity of the medication use cycle. Commonly, errors are caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them. The multiple steps in the medication use chain, from when a drug is prescribed to when a patient receives the drug, leads to significant scope for error[1, 4,5, 6].

Generally, MEs in the ICU are very common compared to other general wards of the hospital and occur at all stages of medication use cycle and are resulted from different causes [1-6].But there is no data regarding Ethiopian ICU, particularly of JUSH.

2. Statement of the problem

Medical errors are important causes of patient morbidity and mortality, 44,000 to 98,000 patients die in USA each year as a result of medical errors, a large portion of these being medication-related which could have been prevented. MEs were frequent, occurring at a rate of nearly 1 of every 5 doses in the typical hospital and skilled nursing facility. The mean error rate detected in the 36 health care facilities in Atlanta and Denver was 19%. The percentage of errors rated potentially harmful were 7%, or more than 40 per day per 300 inpatients, on the average. The error rates are likely to be understated because of the large proportion of facilities that declined to participate. But even using the lower estimate, preventable medical errors in hospitals exceed attributable deaths from such feared threats as motor-vehicle, breast cancer, and AIDS. Medical errors resulted in total costs $17 billion and $29 billion per year in hospitals nationwide. Beyond their cost, errors are costly in terms of loss of human lives, loss of trust in the health care system and diminished satisfaction by patients, and diminished satisfaction, loss of morale and frustration by health professionals [1, 7].

MEs in critical care units are frequent, serious, and predictable. Critically ill patients are prescribed twice as many medications as patients outside of the ICU. In the ICU, patients experience 1.7 errors per day and nearly all suffer from a potentially life threatening error at some point during their stay. The point prevalence of medication errors in the ICU were 10.5 per 100 patient-days, prescribing error (54%) and administration errors (46%) being the most common. But there is wide variation in the definition and rates of MEs and ADEs in the ICUs and in the methods used to detect them [1, 6, 8, 9, 10].

The rate of MEs and ADE for patients admitted to the ICU is greater than that for patients admitted to general medical wards for several reasons. This is due to the ICU patients receive more medications than patients on other hospital wards, most medications in the ICU are given intravenously, and calculation of infusion rates is often required (both of these characteristics may create more opportunities for error), most patients in the ICU are sedated (unable to identify potential errors by themselves) and patients in the ICU have little physiological reserve, potentially increasing risks of harm from medication-related errors. It is thus important to have methods to accurately measure rates of MEs and ADEs in the ICU [1, 10].

The thorough medical history is unobtainable because of the patient's condition, the unavailability of family members or close contacts, or the existence of a language barrier between the medical staff and the patient. This created management dilemmas, which may hinder the emergency department (ED) physician from executing critical time dependent decisions regarding patient management. Treatment of critically ill patients is comprised of aggressive and time-dependent management[11].

The major consequences of MEs are patient morbidity and mortality. MEs can affect patients, families, and health care providers indirectly by cost implications, prolonged hospital stays and psychological impact since errors erode public confidence to health care services. Approximately one fifth (19%) of medication errors in the ICU are life-threatening but deaths are only the tip of the iceberg [1, 6].

The data regarding medication errors in Africa, especially in Ethiopia is scarce. Information regarding medication error particularly in the ICU of Ethiopian health institutions is absent or little[12]. This study is thus initiated to fill such gaps by determining medication errors during prescribing and administering of drugs and the risk factors that contributed to these errors.

Generally pharmacist participation in the medication use process is the primary means of error detection and prevention. Specialization of practitioners, standardization of drug concentrations and reduction of fatigue of health care workers are among preventive measures of medication errors in generic practices[13, 22].

3. Literature review

Many researchs have been conducted on medication errors in many wards of the hospitals in the world, the ICU being the one. Among medication error researches in the ICU prescription and administration errors were the most common and most commonly performed [22].

Different researches used different research methodologies and study designs to determine medication errors. These methods were voluntarily reported, direct observation of interventions, patient medication chart review comparing medication administration record (MAR) with physicians orders, attending nursing change-of-shift report, attending medical rounds to listen for clues that an error has occurred, interviewing health care personnel to stimulate self-report, and others. Comparison of incident report review, chart review, and direct observation showed that their ability to detect medication administration errors was in reverse order , direct observation being the best method but costly followed by chart review [2, 19,23] .

Critically ill patients, unlike other hospital patients receive multiple medications through the intravenous (IV) route, either by bolus or continuous infusion due to their limited ability to participate in their medical care and lack the physiologic reserve to tolerate additional injury. Urgency, under staffing, and floor stock medication systems within an institution can potentially increase error rates due to dilution or reconstitution errors and elimination of a second check system either by pharmacists or nurses. Dose determinations for commonly used medications in the ICU are often weight based. But weight changes are fairly common early in hospitalization due to fluid balance issues, making the determination of dosing weight difficult. The ICU environment, patient characteristics and medications used can contribute to error although the medication use process is similar for all patients. But no significant correlation was found between the frequency of errors and nurses' age, sex, qualification, work experience, marital status though time of administration of drugs greatly contributed to occurrence of error, 9: am in the morning being the major cause [8, 14, 24].

According to review article on survey of nurses and physicians , on prospective cohort study 5 ICUs and 6 general care units over 6 months, in Canada, the frequency of medication errors during prescription (54%) and administration (46%), and prescribing (38%) and the administration (44%) phase of the medication process in two articles among 6 reviewed respectively. The strongest risk factors of a medication error were failure to document the patient's usual medication list, complex regimen, and type of medications used. Others potential factors were sedated patients, extremes of age, inexperience, workload, state of admission, lack of communication, difficult working condition, inadequate supervision, The most common medication associated with errors during prescribing were cardiovascular (24%), sedative or analgesic (26%), anticoagulant (20%) and anti-infective (13%). The most frequently reported administering errors were wrong infusion rate (40.1%), dose omission (14.4%), wrong dose (11.7%) and wrong time (13.9%) [8].

A Prospective study using the observation technique on medication errors at the administration stage in the ICU in Besancon, France showed that from 2009 nurse interventions 132 (6.9%) administration errors occurred. These were described as preparation errors 24 (4.2%) (Incorrect dilution 20/24 (83.3%); incorrect preparation 2/24 (8.3%); others 2/24 (8.4%)), dose related errors 41 (7.2%) (Wrong dose 38, omission 3), administration technique 10 (1.6%), physicochemical incompatibility 19 (18.6%), rate of administration 29 (6.0%) and time of administration 9 (3.7%) [15].

A prospective cohort study conducted on medication errors determined in 36 health care facilities in Georgia and Colorado by direct observational method showed that there were 605 (19%) errors: omission 183 (6%), wrong dose 103 (3%), unauthorized drug 22 (1%), wrong dosage form 20 (1%), wrong time 259 (8%) being the common but no extra dose, wrong route and technique errors were made [7].

A prospective cohort study on medication errors to compare hand-written and computerized physician order entry in the ICU in London, UK before implementation of computerized physician entry identified medication prescribing errors 71 (6.9%) from the daily pharmacist prescription chart review.

These were inadequate drug to treat patients illness 3 (4.2%), inappropriate information on how to administer the drug 8 (11.3%), dose/units/frequency omitted on prescription 22 (31%), prescription not signed or dated 10 (14.1%). About 12 (16.9%), 3 (4.2%), 5 (7%), 3 (4.2%) of drugs prescribed were wrong dose, wrong drug, incorrect route and administration errors respectively[16].

Before-and-after study to compare impact of a closed-loop electronic prescribing and administration system on prescribing errors, administration errors and staff time in Du Cane Road, London showed that medication administration errors encountered pre-intervention were 141 (8.6%). These were wrong drug 2 (0.1%), wrong dose 29 (1.9%), wrong patient 5 (0.3%), wrong route 2 (0.1%), omission due to unavailability 26 (1.6%), other omission 42 (2.6%), and fast administration of IV bolus 31 (1.9%) [17].

According to this study a total of 93 (3.8%) prescribing errors were occurred pre intervention depending on the stage of the prescribing process. These were 20 (0.8%), 2 (0.1%), 45 (1.8%), 3 (0.1%), 13 (0.5%), 10 (0.4%) patients who need drug treatment, specific drug therapy, appropriate drug dose, formulation, need instructions for supply of product and need administration instructions respectively[17].

A study involving observations of intravenous medication administration, review of medication administration records, and collection of drop-box questionnaires related to medication administration error to in five ICUs of Alabama, Birmingham determined the common medication administration errors. These have comprised of wrong dose (37%), wrong drug (27%), wrong route (22.7%), and wrong time (4%) among total errors which were 22 in number. No errors involving wrong patient were reported[18].

Retrospective evaluation of voluntarily reported medication errors in intensive care and general care units in Pennsylvania, USA showed that 541 MEs were reported from the ICU prescribing and administering errors being 311 (57.5%), 160 (29.6%) respectively based on medication use process node. Among 234 (38.7%) prescribing errors 142 (23.5%), 66 (10.9%), 64 (10.6%), 47 (7.8%) were accounted for improper dose/quantity, omissions, wrong drug and wrong patient respectively based on type of error.

This study has also identified common medications prone to error among which opioid analgesics 80 (13.2%), B-lactam antimicrobials 51 (8.4%), blood coagulation modifiers 39 (6.4%), insulin 36 (5.9%) and electrolytes 28 (4.6%) being common drug classes [19].

Observational, prospective, cross sectional study on errors in administration of parenteral drugs in 113 ICUs in 27 countries showed that about 861 (74.5%) of parenteral medication errors were detected. These were accounted for wrong time 386 (33.4%), missed medication 259 (22.4%), wrong dose 118 (10.2%), wrong drug 61 (5.3%) and wrong route 37 (3.2 %). According to this study about 857 drugs were prone to administration error. These medications were vasopressors and catecholamine 57 (8%), insulin 42 (6%), coagulation related 73 (7%), electrolytes 82 (6%), antimicrobial 179 (9%), sedation and analgesia 181 (9%) based on therapeutic category [20].

A self-reporting survey on drug administration errors by South African anesthetists in South Africa showed that about 303 wrong drug administration was reported .Among the medications prone to error were suxamethonium chloride 23%, vasoactive drugs 14%, local anesthetic agents 4%, opiates 6%, induction agent 4%, atropine 3%, antibiotics 3%, and neostigmine 2% [21].

Although there are many researches in the ICU of developed countries, data regarding medication error in the ICU of developing countries is scanty or absent. This is particularly the case in ICU of Ethiopian health institutions, especially in the ICU of JUSH. Thus this study is initiated to determine medication error and provide baseline information on existing practice.

4. Conceptual framework

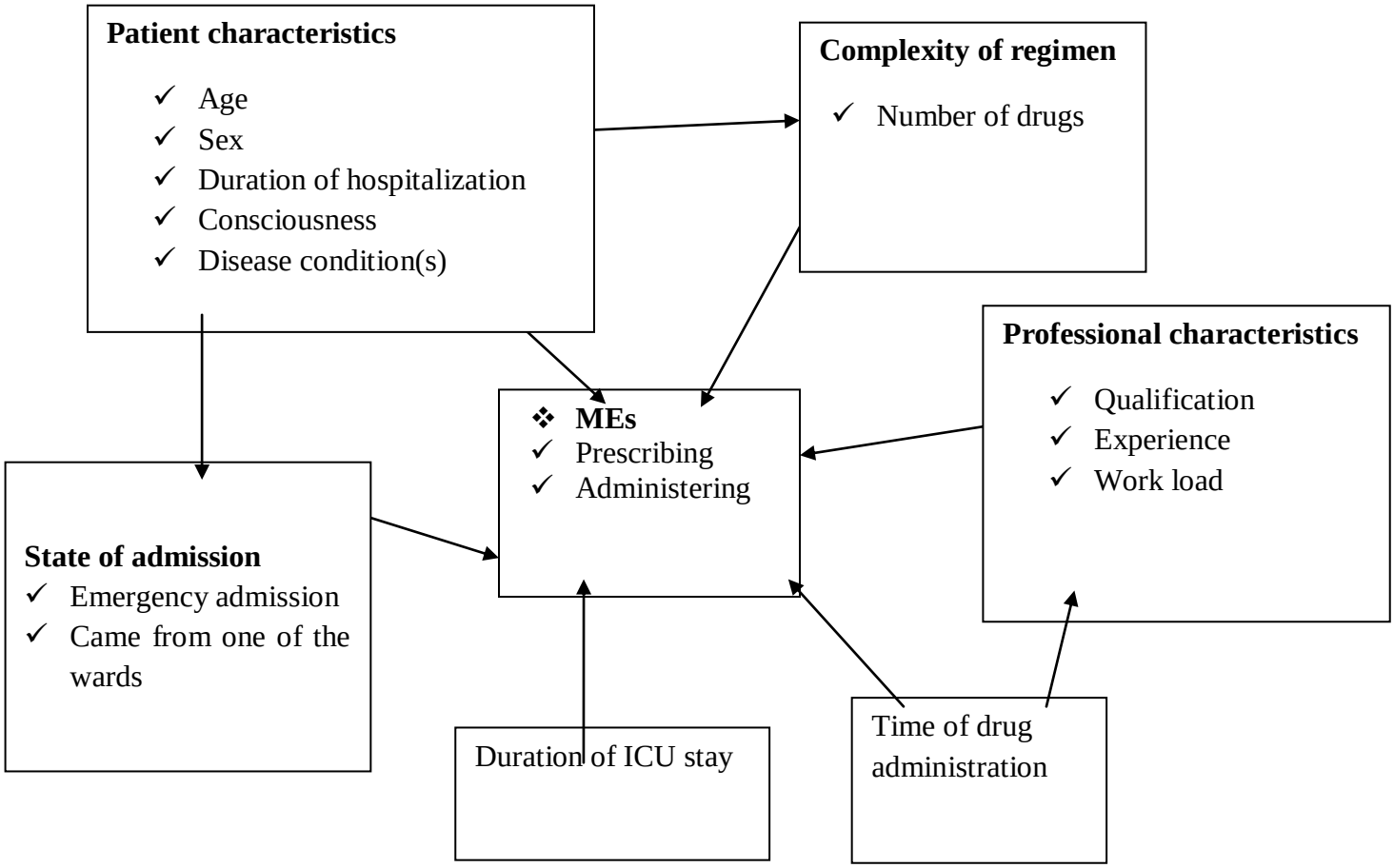

Figure 1: conceptual framework showing the relationship between factors contributing to medication errors in the ICU

5. Significance of the study

Information about medication error, particularly in ICU of Ethiopian health institutions is scanty yet. Determining medication error and providing information on existing practice has paramount importance to the hospital in general, and for patients and health care professionals working in the ICU in particular.

The rationale for conducting this study is to create awareness of health care professionals about medication errors and contributing factors, and thus to improve patient safety and the quality of medication use. It will fill existing information gap regarding medication errors in the ICU of Jimma university specialized hospital (JUSH). It will also provide base line information for further studies in the ICUs of the county and other departments of the hospital and can sensitize policy makers to formulate policy regarding medication error reporting, and possible preventive strategies by quantifying the exiting practice in the ICU of JUSH.

6. Objective of the study

6.1. General Objective

To assess medication prescribing and administering errors and contributing factors in the ICU of JUSH, Southwest Ethiopia, 2011

6.2. Specific objectives

- To determine the prevalence of prescribing errors in the ICU
- To determine the prevalence of administration errors in the ICU
- To assess category as well as specific drugs that are prone to prescribing and administration errors
- To assess contributing factors for the medication errors occurring in the ICU

7. Methods and materials

7.1 Study area and period

The study was conducted from February 7 to April 15, 2011 in the ICU of JUSH, a teaching hospital located in Jimma town, Oromia region in southwestern Ethiopia, 350 km from Addis Ababa. JUSH is the only referral hospital in southwest Ethiopia with 450 beds (6 beds in ICU, 114 beds in surgical, 76 beds in gynecology and obstetrics, 79 beds in pediatrics, 78 beds in medical, 25 beds in psychiatry and 38 beds in ophthalmology clinic) where a multidisciplinary team of diverse professionals provide a range of health care services for approximately 9000 inpatients and 80,000 outpatients each year. Among 558 health professionals are 27 specialists, 66 general practitioners, 12 anesthetists, 191 nurses (14 BSc. nurse, 161 diploma, 8 certificate and 8 mid wives), 12 pharmacists etc (information center of the hospital). The ICU is a 6 bedded, serving patients from different departments of the hospital. Medication distribution is centralized and there is no floor-based decentralized pharmacy service currently available in ICU. Since pharmacists in our institution are not given the opportunity to involve in drug preparation and delivery, all IV medications are prepared and administered by nursing staff in ICU. Anesthetist and nursing staff were among the responsible health professionals for management of the patient and drug administration respectively in the ICU [25].

7.2 Study design

A prospective cross-sectional study design was used.

7.3. Populations

7.3.1. Source Population

The source population of this study was all medication prescribing and administration interventions to all critically ill patients who were admitted to all inpatient wards of JUSH during the study period. The source population also included all health professionals who were involved in these interventions.

7.3.2. Study Population

The study populations were all medication prescribing and administration interventions to all critically ill patients who were admitted to the ICU of JUSH during the study period and all health professionals who prescribed, and administered medications to all patients in the ICU.

7.4. Sampling technique and sample size determination

All medication prescribing and administration interventions to all critically ill patients admitted to the ICU during data collection period were included. All health professionals who were prescribing, and administer medications to the ICU patients were included in the study. Data regarding prescribing and administration of medications were collected from patient cards, medication documentation charts and by directly observing drug administration. But semi-structured self administered questionnaire with in-depth interview was used to collect professional related data. Thus, no sampling technique was used.

7.5. Study variable

7.5.1. Independent variables

- Patient characteristics (age, sex, consciousness, disease condition)
- professional characteristics (qualification, experience, work load)
- complexity of regimen (number of drugs)
- State of admission
- Duration of stay in the ICU
- Time of drug administration

7.5.2. Dependant variables

- **Medication prescribing errors**: wrong combination, omission errors, wrong indication, wrong route, wrong frequency, wrong dose, wrong duration, wrong abbreviations
- **Medication administering errors**: wrong drug, wrong dose, wrong time, wrong route, wrong patient, omission of doses ,wrong rate of infusion, wrong duration

7.6. Data collection instrument

Pre-tested data collection format, designed to collect patient demographic information, prescribed and administered medications, was used to collect data. The main section was

designed to record all the data regarding the patients' medication interventions, dates and times that medications were prescribed and administered, including name of the medication, dosage forms, doses, frequency, duration of medications prescribed and administered. To collect health professional related data semi-structured self administered questionnaire with in-depth- interview guide was used. Audio tape recorder was used.

7.7. Data collection process

Prior to data collection, data collectors (One BSc. Nurse, 1 BSc. Pharmacist, and one 1st year clinical pharmacy post-graduate student), who were not working in the ICU during the data collection period, were trained on how to approach the patient and health care professionals and how to act behaviorally; to familiarize data collectors with the data collection instrument and how to used this formats; on how to abstract data from patient cards and medication documentation charts (MDC); how to observe medication administrations and thus to ease data collection process and ensure reliability of data.

Data on Medication administration was collected by directly observing medication administrations. All day time medication administrations (6:00 am to 6:00 pm) were collected by direct observation. But MDC review was used on top of direct observation to collect data on the off duty (7:00 pm till 6:00am) medication administrations. Both patient cards and MDC were used to collect medication prescribing data and review was conducted at any time of the day. Exactly what was observed and recorded in the patient card and MDC was written down during data collection including all details about the medication. Demographic information about patients was obtained from patient card and medication administration records. Laboratory and diagnostic test results were used when necessary.

Health professionals who prescribed (27 physicians) and administered medication (9 nurses) were coded and kept till the end of the data collection period in order not to aware them about the purpose of the study, and thus to prevent bias.

At the last week of data collection semi-structured self administered questionnaire was distributed to collect quantitative and qualitative data related to professional characteristics. Interview of health professionals using in-depth interview guide was conducted to collect qualitative data on factors contributing to medication errors, their views about MEs and how to

manage them. Five nurses (two diploma and three BSc. degrees) and 2 physicians (one resident I and one resident II) were participated in interview. Interview was recorded by audio tape and finally retrieved to hard copy manually.

Finally MEs on medications administered was identified by comparing administered medications with what the prescriber ordered. When discrepancy between prescribed and administered medications existed the administration errors were identified. Prescribing errors were determined by comparing prescribed drugs with standard treatment guidelines, handbook of drugs in intensive care, text books (Harrison's text book of internal medicine, nelsons text book of pediatrics, Novak text book of gynecology, hand book of clinical drug data, hand book of critical care drug therapy, Sabiston Textbook of Surgery, dipiro-pharmacotherapy, and koda-kimble applied therapeutics) and others. Errors were determined by principal investigator in based on the existing practice.

7.8. Data quality control

To control quality of data, data collectors were trained. Supervision was carried out during data collection period on daily bases. Pre-tested data collection format was used. The collected data was cleared and checked every day for completeness and consistency before processing. The ICU medical and nursing staffs were unaware about the purpose of the study.

7.9. Data processing and analysis

Data was edited, coded, entered to SPSS windows version 16.0 and finally cleaned. Descriptive statistics was computed to determine prevalence, means, and standard deviations. Binary logistic regression and chi-square test were used to determine the association between the medication prescribing and administering errors with the independent variables. The processed data was compiled, organized and finally presented using tables, and figures. Thematic framework analysis was used for qualitative data.

7.10. Dissemination of study findings

The results of the study will be disseminated to JUSH and other responsible bodies to assist in improving practice. Publication of the findings in peer reviewed journals will also be considered.

7.11. Ethical consideration

Prior to the study ethical approval from ethical review board of Jimma University was obtained. The management of the hospital was requested by formal written letters from school of pharmacy. The head of the ICU was also informed by formally written letter from school of pharmacy. During data collection process all staff and patient-related data were kept confidential. Permission to access patient data was obtained from the attendants and care givers to access cards of unconscious patients and from patient (conscious) to access his/her card by written consent. All the information obtained from the patient was kept confidential by principal investigator only for the sake of research purpose. To ensure confidentiality the names of patients and health professionals were replaced with the code. Ethical issues were considered during data collection in order not to disclose patient and professional information to persons outside the research.

7.12. Limitations of the study

- Weight of patients, dosage forms prescribed and laboratory values were missed from patient card
- Exact dose, time, and route of medications administered was missed from MDC
- Although it was claimed that nurses were unaware about purpose the study, they might have guessed and, this could influence the rate of error

7.13. Operational definitions

- **Medication error:** implies errors committed during prescribing and administration of a particular medication to the patients in the ICU
- **Administration errors:** implies any deviation from the conventional method of administration of a particular medication as ordered by the physician excluding preparation of drugs in the ICU of JUSH
- **Complex regimen:** prescribing of more than three drugs to one patient at the same time
- **Prescribing error**: Implies medication errors that occur during prescribing excluding illegible handwriting and those drugs which were not signed and dated
- **Antibiotics:** in this study are used to mean antibacterial drugs
- **Physician:** shall mean intern, GP, resident, internist who involved in prescribing of medications

8. Results

8.1. Characteristics of interventions and respondents

This study included 1200 nursing and 398 physician interventions in the ICU of JUSH. Errors during preparation, delay in administration of medications since ordered, and dosage form errors were not included in administration errors. Those medication orders with Illegible handwriting (8.8%), failure to authenticate the medications with signature and/date (30.9%), and dosage form errors were not included in prescribing errors. Severity of errors and outcome of treatment were not included in this study.

About 69 patients were admitted to the ICU during data collection period. Majority of these patients (55.1%) were females and majority (63.8%) of them were in the age range of 18-50 years with mean age of 32.87 (± 17.03) years. About 54 (78.3%) of them were admitted to other wards before they come to the ICU. Thirty two (46.4%) of the patients were unconscious and 49 (71.0%) received complex regimen average 5(±2) drugs (Table 8.1). Patients stayed an average of 5.654 (±5.22) days in the ICU till death/transfer to other wards. Average number of co-morbid conditions per patient was 3±2 disease conditions.

Table 8.1.Characteristics of patients admitted to the ICU of JUSH, February 7-April 15, 2011 (n=69)

Characteristics		Frequency (%)
Age	<18 years	12 (17.4)
	18-50 years	44 (63.8)
	>50 years	13 (18.8)
Sex	Male	31 (44.9)
	Female	38 (55.1)
State of patient	Conscious	37 (53.6)
	Unconscious	32 (46.4)
Regimens taken	Complex	49 (71.0)
	Not complex	20 (29.0)
State of admission	Emergency	15 (21.7)
	From other wards	54 (78.3)
Length of ICU stay	<4 days	28 (40.6)
	>=4 days	41 (59.4%)

About 27 physicians were involved in prescribing medications in the ICU during the data collection period but only 21 (78.8%) returned the self administered questionnaire with non-response rate of 6(22.2%). Almost all of the prescribers were in the age range of 20-25 years and were males. Medical interns were most frequently involved in prescribing and had only 1 week of experience in the ICU practice (Table 8.2). About 13 (61.9%) physicians had duty ranging from 1 day (1 physician) to 4 days (6 physicians) per week but all of them took rest the day following duty night, and 8 (38.1%) of the physicians had part time work outside the hospital during data collection period. About 11 (52.4%) physicians had encountered at least one incident of medication error and seven of them have given self intervention and only two had reported to seniors.

Table8.2. Characteristics of physicians involved in prescribing medications in the ICU of JUSH, February 7-April 15, 2011 (n=21)

Characteristics		Frequency (%)
Age	20-25 years	17 (81.0)
	26-30 years	3 (14.3)
	31-35 years	1 (4.8)
Sex	Male	18 (85.7)
	Female	3 (14.3)
Have duty	yes	13 (61.9)
	no	8 (38.1)
Qualification	Resident I	2 (9.5)
	Resident II	1 (4.8)
	Medical interns	18 (85.7)
Experience	1 week	19 (90.5)
	2 months	2 (9.5)
Have part time work	Yes	8 (38.1)
	No	13 (61.9)

About 9 nurses, 4 BSc. degree and 5 diploma holders participated in medication administrations during the 6 weeks of data collection period. Majority of them were in the age group of 20-25 and were males. About 4 of them had practiced in the ICU more than 12 months and 4 practiced <6 months in the ICU (Table 8.3). All had duty 7 nurses 1 day/week but 2 nurses had 3, 8 days/week respectively. About 4 nurses had encountered incidence of medication errors and 2 of them reported the error to the head of ICU but 2 had given self intervention. None of the nurses had extra part time work outside hospital but seven had worked the day following duty night.

Table8.3. Characteristics of nurses involved in administration of medications in the ICU of JUSH, February 7-March 24, 2011

Characteristics		Frequency
Age	20-25 years	6
	26-30 years	2
	31-35 years	1
Sex	Male	7
	Female	2
Qualification	BSc. nurse	4
	diploma	5
Experience	3-6 months	4
	6-12 months	1
	>12 months	4

8.2. Medication errors

There were 398 drugs prescribed for 69 patients by 27 physicians (6 residents and 21 medical interns but there was no specialist intervention in the ICU) during 9 weeks of data collection on medication prescribing. More than five in ten (52.5%) prescribing errors were identified during the 9 weeks. This was rated by accounting at least one error for one drug ordered i.e. at least one error per drugs prescribed. On the other hand, there were 1200 medication administrations for 54 patients by 9 nurses during 6 weeks of data collection period.

More than half (51.8%) of the administrations were destined to errors. This was rated by accounting one error for one dose administered i.e. at least one error per dose given.

Wrong combination, frequency and dose of drugs contributed for 68 (25.7%), 41 (15.5%), 40 (15.1%) of the prescribing errors in the ICU of JUSH, respectively. For about 63 (23.8%) of medications ordered dose/frequency/route of administration and unit were omitted (Figure 8.1).

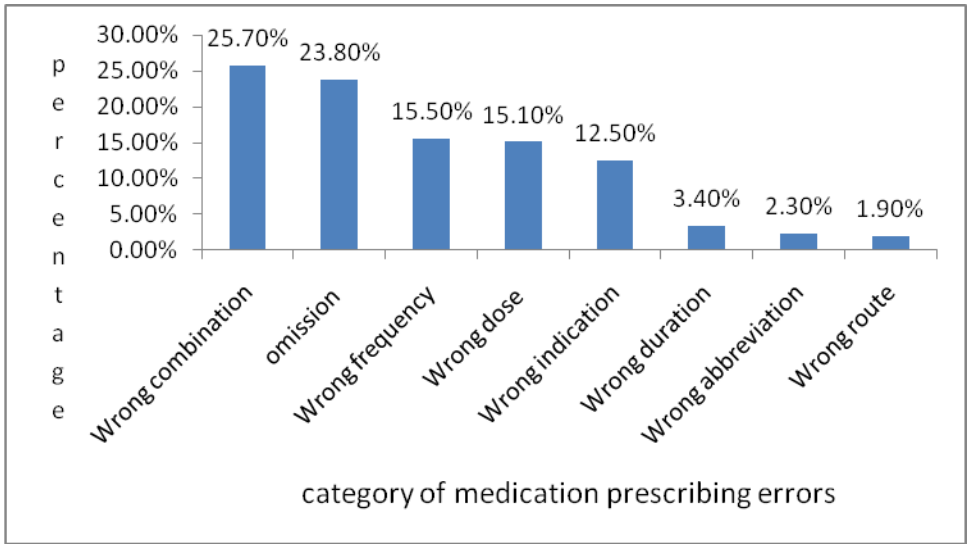

Figure 8.1: Medication prescribing error Categories in the ICU of JUSH, February 7- April 15, 2011

On the other hand, wrong timing, omission due to unavailability and missed doses contributed for 200 (30.3%), 192 (29.0%), and 121 (18.3%) of the medication administration errors, respectively. For about 26 (3.9%) of drugs dose and rate of infusion was given arbitrarily without calculation (Figure 7.2).

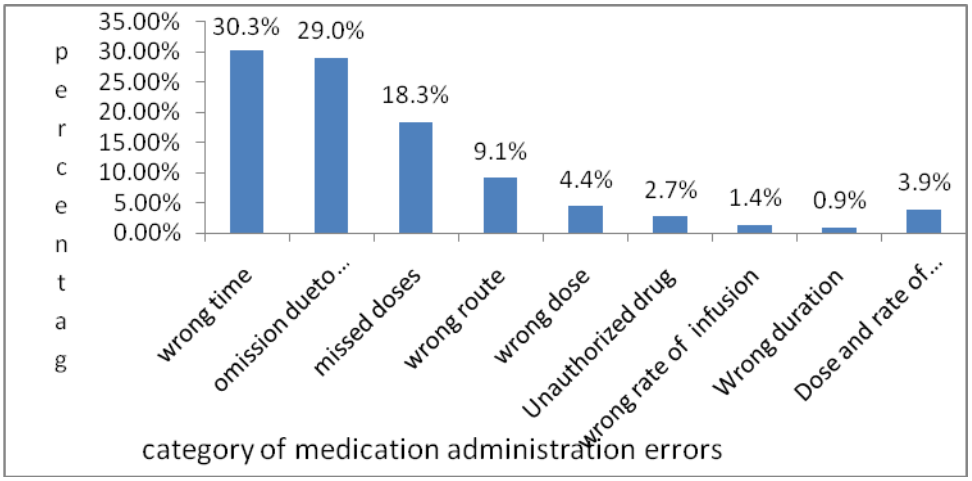

Figure 8.2. Medication administration error categories in the ICU of JUSH, February 7-March 24, 2011

Drugs involved in prescribing errors were classified according to their therapeutic category. Antibiotics (32.5%) and cardiovascular drugs (26.3%) were the most commonly encountered categories of drugs in the medication errors followed by analgesic/antipyretics (9.6%) (Table8.4).

Table8.4. Therapeutic category of medications involved in prescribing errors in the ICU of JUSH, February 7- April 15, 2011

Drug category	**Frequency (%)**
Antibiotics	68 (32.5)
cardiovascular drugs	55 (26.3)
analgesic/antipyretics	20 (9.6)
Anticonvulsants	13 (6.2)
Opioids	12 (5.7)
GI drugs	10 (4.8)
CNS drugs	9 (4.3)
Others*	22 (10.5)
Total	209 (100)

Others*: ant-parasitic, anti-coagulants, anti-thyroids, corticosteroids, electrolytes, anti-diabetics

Similarly, drugs encountered in administration errors were classified according to their therapeutic category. Antibiotics 228 (36.7%) and analgesic/antipyretics 85 (13.7%) were the most commonly involved in the medication errors followed by anticonvulsants 64 (10.3%) (Table8.5).

Table8.5. Therapeutic category of medications encountering administration errors in the ICU of JUSH, February 7 –March 24, 2011

Drug category	**Frequency (%)**
Antibiotics	228 (36.7)
Analgesic/antipyretics	85 (13.7)
Anticonvulsants	64 (10.3)
CNS drugs	62 (10.0)
Cardiovascular drugs	61 (9.8)
GI drugs	53 (8.5)
Opioids	26 (4.2)
Others*	42 (6.8)
Total	621 (100)

Others* Hematological, anesthetics, ant-parasitic, anticoagulants, anti thyroids, corticosteroids.

Taking specific drugs into consideration, in prescribing error diclofenac, ceftriaxon and furosemid 16 (7.7%), 15 (7.2%), 13 (6.2%) respectively were the commonest (Table 8.6).

Table8.6. Top ten drugs involved in medication errors during medication prescribing in the ICU of JUSH, February 7-April 15, 2011

Drug category	**Frequency (%)**
Diclofenac	16 (7.7)
Ceftriaxon	15 (7.2)
Furosemid	13 (6.2)
Chloramphenicol	11 (5.3)
Gentamycin	10 (4.8)
Ampicilline	10 (4.8)
Enalapril	9 (4.3)
Aspirin	8 (3.8)
Pethidine	8 (3.8)
Phenytoin	8 (3.8)
Diazepam	8 (3.8)
Others*	93 (44.5)
Total	209 (100)

Others* diazepam, cimetidine, dopamine, hydrocortisone, insulin, KCl, metronidazole, paracetamole, MgSO4, quinine, dioxin, tramadol, propranolol etc.

From medications involved in administration error diclofenac, metronidazole and ceftriaxon 72 (11.6%), 59 (9.5%), 58 (9.3%) respectively were the commonest (Table8.7).

Table 8.7: Top ten drugs involved in medication error during medication administration in the ICU of JUSH, February 7-March 24, 2011

Drug category	**Frequency (%)**
Diclofenac	72 (11.6)
Metronidazole	59 (9.5)
Ceftriaxon	58 (9.3)
Diazepam	51 (8.2)
Cimetidine	48 (7.7)
Phenytoin	45 (7.2)
Crystalline penicillin	27 (4.3)
Ampicilline	24 (3.9)
Pethidine	19 (3.1)
Levostatine	18 (2.9)
Others*	200 (32.2)
Total	621 (100)

Others*pethidine, paracetamole, hydrocortisone, methyldopa, MgSO4, gentamycin, chlorpromazine, adrenaline, cloxacillin, doxycyclin, Phenobarbital, etc

Table 8.8. Examples of prescribing medication errors in the ICU of JUSH, February 7-April 15, 2011

Ceftriaxon 2gm IV BID for 18 day to treat CAP instead of 14 days
Ceftriaxon 1gm IV BID for a child to treat sepsis instead of 400mg bid
Ciprofloxacin 2gm IV BID to treat UTI instead of 250 – 750mg Bid
Crystalline penicillin was initially prescribed on daily bases Cardiogenic shock instead of every 4 hours
Cloxacillin 625mg IV QID was prescribed for a child to treat infection 2^0 to burn instead of 6.25mg
Diclofenac 75mg QID was prescribed for head injury for pain but there was history of GI bleeding which is too high than recommended daily dose of 150mg for pain control
Diclofenac 75mg IM TID for a child to treat pain due to burn which is in too high dose and frequent
Magnesium sulfate 2.5 mg IM Q4 hr was given for Eclampsia instead of 4gmover 10 minute loading dose followed by 1gmper hour maintenance dose
Metronidazole 500mg IV TID was given for a child to treat sepsis instead of 250mg
Propranolol 40mg PO BID was prescribed with atenolol 25 mg po od to treat hypertensive encephalopathy where either of them are enough
Tramadol 50mg IM TID was prescribed with pethidin 50mg IM TID where either of them are enough

Table8.9. Examples of medication administration errors in the ICU of JUSH, February 7-March 24, 2011

Crystalline penicillin was administered 5 times a day not 6 times for all patients taking it i.e. it wasn't administered at 2:00am for all patients
Metronidazole Iv was mostly missed in the ICU because of unavailability
Quinine Iv was mostly missed because it wasn't available
Levostatine was mostly missed because of unavailability
Rate of administration of Dopamine was 80drops/min which was different from labeled i.e. 30 drops/min for 60 years male
Ceftriaxon was not given for 35 years old female because not available
Dose and rate of Metronidazole was given arbitrarily for 4 years in infusion (250mg was arbitrary determined in 500mg/100ml)
Ampicilline was given instead of cloxacillin for 8 years male patient
Methyldopa was given for 18 years female after discontinuation
Most medications in the morning were being given after 7:00am instead of 6:00am
Most medication in the afternoon (especially at the weekend) were given before 5:00pm
Ceftriaxon was not given for 8 years female child

8.3. Factors that contributed to medication errors

The quantitative data from self administered questionnaire filled by physicians showed that qualification (Medical interns 18 (85.7%)), lack of experience in ICU practice (1 week-19 (90.5)) and work load were the common causes for medication prescribing errors. This was supported by the findings of qualitative data which showed lack of responsible professional for patients from other departments except the internal medicine, inappropriate handwriting, and presence of multiple prescribers, multiple medications, professional fatigue, and poor communication between health professionals as common causes for medication prescribing errors in the ICU. Workload, misdiagnosis, hasty prescription, lack of concern of physicians, and lack of adequate knowledge were also the contributing factors for prescribing errors in the ICU. The interview results that support qualitative data from self administered questionnaire were presence of

multiple prescribers, lack of knowledge, lack of communication among prescribers, improper hand writing, and lack of concern of physicians. One physician said that inexperience, absence of attendants, unconsciousness of patients, unavailability of drugs, absence of team work, poor management system, lack of awareness about medication errors and their consequences were the most common factors for medication errors. Another physician added that lack of trained professionals, lack of adequate facility, lack of laboratory results, and lack of good team work were common factors for medication errors to occur in the ICU.

These physicians had indicated the possible solutions for preventing and reducing medication prescribing errors. These were listed as: *"... medication errors should be reported……but first there should be a team established encompassing all health professionals who have detailed knowledge on medication errors ….team members can revise patient cards, and take part in morning sessions to identify the errors……then one can report error committed by other since he/she who committee error can't report due to negligence and privacy concern...*". The second physician also believes that errors have to be reported but he has different view on to whom they have to be reported *"...it is good if there is error reporting system since it can aware health professionals and thus they can take responsibility and improve practice……it has to be reported to experienced professionals, and to managers to legalized the issue…..of course all health professionals should work in team work since medical practice is team work……. "*.

Association was not done for professional related factors since professional related data were collected at the end of data collection in order not to aware them about the purpose of study and of course it was not possible to associate since there were many interventions by one professional, and multiple prescribers. Occurrence of medication prescribing error among patients did not show statistically significant difference with the age of patient (P value- 0.879), sex of patient (P value -0.221), level of consciousness of patient (P value -0.766, number of co-morbidities (P value-0.236), type of admission of the patients (P value -0.159), and length of ICU stay (P value -0.453). However, significant difference in the occurrence of medication prescribing errors was observed according to the diagnosis (P value-0.015) and complexity of regimen (P value-0.017) when done independently. But only complexity of regimen (P value-.030) was significantly associated when done together to exclude confounding factor (Table 8.10).

Table 8.10: Binary logistic regression for complexity of regimen and diagnosis for which drugs were indicated of with medication prescribing errors in the ICU of JUSH, February 7-April 15, 2011

Factors				95.0% C.I	
		Sig.	COR	Lower	Upper
Complexity of regimen	Not Complex		1.00		
	complex	.026	1.903	.299	.925

		AOR	Lower	Upper
Complexity of regimens	.030	.534	.303	.941
Diagnosis for of drugs were indicated	.117	.911	.810	1.024

The quantitative data from self administered questionnaire filled by nurses showed that qualification (majority were diploma holders) and lack of experience in ICU practice (majority practiced <1year in the ICU) were the common causes for medication administration errors. This was supported by the findings of qualitative data which showed common causes of medication errors in the ICU as: unavailability of drugs, lack of follow up of patient, lack of knowledge, poor communication between physicians and nurse staff, and poor documentation. The interview results that support qualitative data from self administered questionnaire were unavailability of drugs, unable to sign given medications, miscommunication with physicians regarding medications prescribed, and lack of follow up of the patient. Absences of pharmacists in the ICU, miscommunication of ward nurses with ICU nurses regarding medication taking behavior of the patient in other ward, inappropriate prescribing, lack of manual and guideline for ICU were also the causes of administration errors. One nurse said that"*...perceive that physicians are knowledgeable than me ...I will administer drugs even if I knew the drug is wrong..."* But another nurse said that, *"...medication errors never occur in the ICU because they were working*

together and the staff is very careful, knowledgeable ……..and presence of medication documentation chart in the ICU unlike other words of the hospital…"

Like physicians nurses had indicated the possible solutions preventing and reducing medication administration errors. Regarding error prevention strategies most of the nurses during interview agree that "*…medication error reporting and inclusion of pharmacy professionals is the best solution for prevention of errors..."* One of them added that *"... Nurses and physicians should work in team work sprit and one should inform the other when errors are noted…"* One nurse said that *"...patients are primarily benefited from error prevention and health care professionals may satisfy indirectly..."* On the error report one nurse said that *"...errors should be reported by the person who commit the error since other may not know the error committed unless he/she told them…… error can be reported to physicians and others who can give solution…"* most of them agree that *"...error have to be reported to pharmacists…" but "...all person should have knowledge to prevent medication errors..."*, according to one nurse.

Association was not done for professional related factors since professional related data were collected at the end of data collection in order not to aware them about the purpose of study and of course it was not possible to associate since there were many interventions by one professional and sometimes nurses were administrating medications in two. Occurrence of medication administration errors showed statistically significant difference with the time of drug administration (Table 8.11). Time of medication administration is significantly associated with medication error occurrences (p value-0.000). When time of administration is compared majority were occurred at 2:00Am which is 11.6 times more than those administered at 6:00am.

Table 8.11: Time of drug administration at which medication administration errors occurred in the ICU of JUSH, February 7-march 24, 2011

Time of drug administration	Sig.	OR	95.0% C.I	
			Lower	Upper
6:00am		1.00		
6:00pm	.337	.884	.879	1.455
2:00am	.001	11.673	.020	.366
2:00pm	.248	1.270	.525	1.181
10:00pm	.587	.809	.576	2.651
10:00am	.117	.424	.807	6.880
12:00pm	.581	.800	.567	2.755
12:00am	.087	3.113.	.087	1.181

9. Discussion

According to this study the frequencies of medication prescribing and administration errors were 209 (52.5%) and 621(51.8%) respectively. Although prescribing error is relatively lower, the administration error in current study is higher when compared to an earlier finding involving 205 ICUs in 29 countries (8). Conversely, a much lower administration and slightly higher frequency of prescribing errors were reported in our study compared to the intensive care and general care units in Pennsylvania, USA (19). Illegible handwriting (8.8%) and failure to authenticate the prescription with signature and/dated (30.9%) were not considered as prescribing error in our study. These might contribute the gaps between the current study and previously reported ones. Unavailability and costliness of the ordered medications could also contribute to the difference. However, the frequency of both prescribing and administration errors in this study were extremely higher than the findings reported from London (17). This implies that the higher frequency of errors in the JUSH ICU is likely related to lack of trained staff and the medical facilities available in the ICU. Generally these medication errors might have resulted to death to patient and eroded public confidence to ICU admission since most patients and attendants, even health care givers considered ICU as temporary place for dying patient.

In this study the common types of medication prescribing errors were wrong combination of drugs (25.7%), dose/frequency/route/unit omitted (23.8%), wrong frequency (15.5%), wrong dose (15.1%), wrong indication (3.4%), wrong abbreviations (2.3%) and wrong route (1.9%). Although frequency of dose/frequency/route/unit omitted, wrong indication and wrong dose was extremely higher than a study reported in London, the percentage was lower (16) probably due to low number of total errors in other study. Frequencies of wrong dose and indication were higher than findings in a study from London while they were lower than those of Pennsylvania, USA (17, 19). Since wrong combinations were common error categories in our case patients might suffered from toxicities incase of inhibitors and disease in case of inducers in our case which lack therapeutic drug monitoring.

In this study the common medication administration errors were wrong timing (30.3%), omission due to unavailability (29.0%), and missed doses (18.3%). These were higher when compared with a research done in London (17) but lower when compared with study in Alabama, Birmingham (18). As compared to the findings reported from France, wrong time of administration was higher in this study while the frequency of wrong rate of administration was lower (15). Improper timing might result in low plasma concentration of medications which were given after scheduled time interval and increased concentration for those drugs which were given before recommended time.

According to this study the three most common categories of drugs encountered in prescribing errors were antibiotics (32.5%), cardiovascular drugs (26.3%), and analgesic/antipyretics (9.6%). This was different from what was reported from Pennsylvania, USA, where opioid analgesics (13.2%) were the first ones followed by β-lactam antimicrobials (8.4%) and blood coagulation modifiers (6.4%). The percentage error of the top rating drug category, i.e. antibiotics, cardiovascular drugs and analgesic/antipyretics in our study is much higher than that of Pennsylvania. Errors associated with opioid analgesics (5.7%) in our case are quite lower; moreover errors related to blood coagulation modifiers is even insignificant (19). The difference observed might be attributable to the variation in the prevalence of diseases that cause ICU admission and co-morbid conditions that lead to prescribing antibiotics in the two geographic locations. The errors attributed to antibiotics and cardiovascular drugs might lead drug resistance in case of antibiotics, and aggravate the condition and result in disease progression in case of cardiovascular drugs even to death.

On the other hand, in this study the three most common categories of medications associated with administration errors were antibiotics (36.7%), analgesic/antipyretics (13.7%) and anticonvulsants (10.3%). This was not the case in a study involving intensive care units in 27 countries where cardiovascular drugs (9.0%), antimicrobial (8.0%), coagulation related (7.0%), diabetic drugs (6.0%) took the leading shares (20). Unlike other study reported from South Africa, antibiotics, analgesic/antipyretics and anticonvulsants were highly prone to administration errors in this study (21). This might be related to the difference in the prescribing pattern, availability and affordability of drugs, and time of administration of drugs in the ICU (i.e. those drugs most frequently prescribed and administered might be related with higher levels

of administration errors). Such level of error associated with antibiotics is a concern as this might result in drug resistance and ADEs, treatment failure and death in the worst scenario.

According the present study diclofenac (11.6%), metronidazole (9.5%), ceftriaxon (9.3%) and diazepam (8.2%) were the four common specific drugs prone for administration errors. A similar study reported that vasopressors and catecholamine (8%), insulin (6%), coagulation related (7%), electrolytes (6%) were associated with administration errors (20). This difference might be due to difference in drugs available in the study hospitals and pattern of prescribing.

In this study cause of medication errors were multifactorial, the common factors that led to medication prescribing errors being professional related (inexperience, qualification and work load), complexity of regimen ($p=0.017$), and disease conditions for which drugs were indicated ($p=0.015$). Lack of responsible professional for patients from other departments except the internal medicine, inappropriate handwriting, and presence of multiple prescribers, multiple medications, professional fatigue, and poor communication between healths professionals were also reported to be the major causes for medication prescribing errors in the ICU. Similar to an article review in Canada the causes for prescribing errors were multifactorial (8).

According to present study the common factors that lead to medication administration errors were professional (nurses) related (experience, qualification) and time of medication administration ($p=0.000$). The time at which medication errors occurred was different from a study from Australia (24). Unavailability of drugs, lack of follow up of patient, lack of knowledge, poor communication between physicians and nurse staff and poor documentation were also reported to be the factors for medication administration errors in the ICU.

9. Conclusions and recommendations

10.1. Conclusions

Medication errors were frequent in intensive care unit of JUSH. Medication prescribing and administration errors were almost equivalent (52.5%) and (51.8%) respectively. Antibiotics were most commonly encountered drug categories in both prescribing and administration errors in the ICU. Causes of medication error in ICU were multifactorial among which complexity of regimen (p=0.015), time of drug administration (p=0.000) and type of diagnosis for which medications were indicated (p=0.017) were significantly associated with medication errors.

10.2. Recommendations

Based on the findings of the study the following recommendations are forwarded to the hospital management and other relevant organs.

To hospital management and other responsible bodies

- The hospital management body should work to raise awareness of health professionals regarding the possibilities of medication errors even in the best set ups
- Inclusion of the clinical pharmacist in the process of patient care in ICU and elsewhere in the hospital could be one of the measures to tackle the problem of frequent medication errors
- Guidelines, manuals and standard operating procedures for patient care in the ICU has also been one of the means to avoid both prescribing and administration errors.
- The staff of the ICU should be trained on how to prevent and detect medication errors
- There should be a means for medication error reporting, and computerized physician order entry should be initiated to prevent error and reduce error rates in the ICU
- Ministry of health should work towards preventing medication errors in the ICUs of the country, and there should be policy on medication error prevention, and preventive strategies

To health care professionals

- All health professionals including clinical pharmacists should work in team sprit to prevent medication errors, in the ICU
- Pharmacy professionals should avail drugs in inpatient pharmacy
- All relevant information for patient management including laboratory values should done for each patients and be evaluated thoroughly

To researchers

- Further studies are recommended to reveal medication errors elsewhere in the hospital and other ICUs in the country

11. Annexes

Annex I: References

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Annex II: Informed Consent

1. **For patients to get access to their card/if unconscious/children to care givers or attendants caring them**

Dear participant, I'm clinical pharmacy student in Jimma university college of public health and medical sciences and currently conducting my thesis on: Medication error and associated factors in ICU of JUSH. The study will be conducted by reviewing your cards. Your card is only accessed if you are voluntary and you have the right not to give your card in the study or to take your card at any time you feel uncomfortable. The output of this research will be greatly helpful to the patient, community and health professionals by creating awareness and recommending possible solutions. The information obtained from your card will be kept confidential by avoiding using of your names and securing from access to others other than principal investigator. After the research is over, the information obtained from your card will be discarded. Thank you in advance for your cooperation.

Shall I use your card? Yes----------No ---------

በመጀመሪያ እንደምን አደረ/ሯሱ የተከበረ የጥናታችን ተሳታፊ::እኔ በጅማ ዩኒቨርስቲ የህብረተሰብ ጤናና የህክምና ኮሌጅ የድህረ ምረቃ ት/ቤት የክሊኒካል ፋርማሲ ተማሪ ስሆን በስሁኑ ጊዜ ምረቃ ፁህፌን የመዴሃኒት ስህተትና ምክንያቱ በሚል ርዕስ እየሰራሁ ነዉ::ስለሆነም ስጥናቱ መሳካት ካርድዎ ስለሚያስፈልገን ካርድዎን እንዲፈቅዱልን ስል የእርስዎን ትብብር በትህትና እጠይቃለሁ:: ካርድዎን መዉሰድ የምንችለዉ በእርስዎ ፈቃድ ብቻ ነዉ:: ካርድዎን የመስጠትም ሆነ ያለመስጠት መብት የእርስዉ ነዉ::እንዲሁም በማንኛዉም ሰዓት ካርድዎን የመዉሰድም ሆነ የማስቆም መብትዎ የተጠበቀ ነዉ::በዚህ ጥናት ተገኝ ዉጤት ስበሽተኛ፤ስህብረተሰብ እንዲሁም ስጤና ባለሙያዎች ይጠቅማል::ከእርስዎ ካርድ የተገኘ መረጃ ሚስጥራዊነቱ የተጠበቀ ነዉ::ስዚህም ሲባል ስምዎ አይጠቀስም፤መረጃዉ በሌላ አካል እንዳይገኝ ስስፈለገዉ ጥንቃቄ ይደረጋል::ጥናቱ ካለቀ በሆላ መረጃዉ ይወገዳል::ስለትብብርዎ ከልብ እናመሰግናለን!

ካርድዎን መጠቀም እችላለሁ? አዎ----------አይቻልም----------

Duraan dursee kabajamoo hirmaatota qu'annoo keenyaa akkam bultan/oltanii? Ani Asrat Agalu kanan sedhamu uniiveersitii jimmaatti kuta barnootaa kiliniikaal faarmaasii tii,barnoota digirii lammaffaa warkaa eebaa koo mata duree dogogora qoorichafi sababa ka'umsa isaa jedhu irratti hojiiechu irrati argama. kanaaafuu galma gahuu qo'annoo kanaaf kaardiin yaalaa keesan babaachisaa waanta'eef nuti agarsiisuun akka nugargaartan kabajaan isin qaafadha.kaardii keessan eeyama keesan yoo ta'l qofadha kan faya dammu dardeenyu. Kanaafuu kaardii kardii keesan nutli aqarsiisuufista'ee, dhorkachuuf mirqa qabdu. Qo'annoo kanaan firiin argamu yaalamtootaaf, uummataa fi beektota yaalaattif baay'ee barbaachisaadha. Firiin kardii keessanii icitiin niqabama. Kanafis maqaan keessan asirratt, hinbarreeffamu, firiin kardii kessanii qaamni biroon akka itti hin fayyada mni ofeeqanoon cimaan ni qodhama.qu'annoo kun erqa raawatee booda firiin kardii kessanii ni dhabamsiifama.

Harqarsa nuuf qootaniif qudda isin qaala teefana

Kardii kessan itti fayyadamuu nau dada'aa?

Eyyeen_____

hin ta'u_____

2. For health professionals (both for nurses and physicians)

Dear participant, I'm clinical pharmacy student and currently conducting my thesis on: Medication error and associated factors in intensive care unit (ICU) of JUSH, South West Ethiopia. I'm here searching for your help. I will kindly request you to fill the questionnaire and to participate in the interview.

The purpose of this study is to explore medication errors during prescribing and administering drugs and associated factors at the ICU in JUSH, Southwest Ethiopia. The study will be conducted by reviewing patient cards, medication chart, observing your intervention and interviewing you. Thus, as you were involved in prescribing and administration of medications, you are requested to get interviewed and to fill self-administered questionnaire. Your information will be secured from access to others other than principal investigator. The information obtained is used for only study purpose.

Your participation in the study is entirely based on your full voluntary consent and you have the right not to participate in the study or to withdraw from the study at any time you feel uncomfortable with study. The output of this research will be greatly helpful to the patient, community and health professionals by creating awareness and recommending possible solutions. During the patient card review, medication card review, observing your name, identity and all your other records will be kept confidential and will only be identified by code designation.

Shall I proceed?

- Yes _____
- No _____

Annex III: Data collection format

A. Self-administered questionnaire to be filled by prescribers

I, GENERAL INFORMATION

1. Age: a) 20-25 b) 26-30 c) 31-35 d) 36-40 e) >40
2. Gender : male □ female □
3. Marital status a) single, never married b) single, separated c) married d) widowed
4. Qualification:
   A. Specialist
   B. Resident a) RI b) RII c) RIII
   C. Intern a) medical b) HO
   D. Others, specify _____

II. ICU practice pattern

5. How long have you been practicing/ working in the ICU?
   a) 1 week b) 4 weeks c) 8 weeks d) >4weeks
6. Do you have duty/night time work in the ICU? Yes □ No □
   If yes, how many days do you have per week? _____
7. Do you work the day following your duty? Yes □ No □
8. Do you have other part time work out side hospital? Yes □ No □
9. Have you ever encountered the incidence of medication error during your work in the ICU? Yes □ No □
   If yes, what have you done?
   a) Reported to senior b) intervention was given c) nothing was done
10. Why do you think medication errors occur in the ICU?

B. Self-administered questionnaire to be filled by nurses

I, GENERAL INFORMATION

1 Age: a) 20-25 b) 26-30 c) 31-35 d) 36-40 e) >40

2 Gender : male □ female □

3 Marital status a) single, never married b) married c) widowed

4 Qualification:

1 BSc in Nursing

2 MSc in Nursing

3 Diploma

4 Practicing students

5 Others, specify _____

II. ICU practice pattern

5 How long have you been practicing/ working in the ICU?

b) < 1 month b) 1-3 moths c) 3-6 months d) 6-12 months e) >12 months

6 Do you have duty/night time work in the ICU? Yes □ No □

If yes, how many days do you have per week? _____

7 Do you work the day following your duty? Yes □ No □

8 Do you have other part time work out side hospital? Yes □ No □

9 Have you ever encountered the incidence of medication error during your work in the ICU? Yes □ No □

If yes, what have you done?

a) It was Reported to head of ICU b) intervention was given c) nothing was done

10 Why do you think medication errors occur in the ICU?

C. In-depth interview guide

Introduction

We are aware that medication error is one of the common health issues in the ICU. We are interested in knowing your views about this problem and how it is managed. It will be appreciated if we could spend some time together to discuss this issue. All the information you provide here will be confidentially kept and used for the purpose of the study alone. You have the right not respond to any of the questions to follow or stop the interview at any time if you feel you have to.

Shall I proceed?

- Yes _____
- No _____

1. Do you have any information about medication errors that could occur in the health care setting?

   Follow up: How did you come to know about these?
2. Do you think medication error should be a concern to health professionals and/or managers in this hospital? Why?
3. What types of medication errors have you heard of or observed in this hospital? How about the ICU?
4. Why do you think medication errors occur in the ICU?

   Follow up: Which of the causes are preventable? How? By whom?
5. Have you ever heard or observed medication errors in the ICU reported? If no, Why?

   Follow up: Do you think medication errors have to be reported? If no, Why?

   If yes, to which body and how?

D. Prescribing data collection format

Bed no_____

Name of the patient (initials) _____age ____sex ____card no_____body weight____kg

Date of admission _____Date of prescribing_____

Type of admission (emergency/from ward) _____

Number of health professionals caring the patient_____

State of the patient (alert/unconscious)

Drug prescribing information

Diagnosis (including co-morbidities)

_____

_____

Laboratory data

RFT_____

LFT_____

CBC_____

others_____

_____

_____

Abbreviations _____

Legibility of hand writing _____

Prescription order signed/not _____

Date of Prescribing		Drug Prescribing documentation protocol			
		Full Regimen of drug therapy	Added/regimen change/revised order/ discontinuation including date		
1st order	date of data collection				
			date		

Name of Prescriber (initials) _____qualification_____

Name of data collector_____signature_____

E. Medication administration data collection format

Bed no____

Name of the patient (initials) _____age _____sex _____card no _____body weight_____

Date of adm.	Name of drug	Drug administration documentation protocol					
		Time of drug adm		frequency	Rate of infusion	Dose of the drug	Route of admin
		Current	Last given				

Name of drug administrator _____qualification_____

Name of data collector _____signature_____