Medication errors in the adult emergency unit of a tertiary care teaching hospital in Addis Ababa

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ABSTRACT

Background: The emergency unit is a high risk environment for inappropriate medication use due to stressors and time sensitive nature of the service. **Objective:** To assess incidence and type of Medication Errors in Tikur Anbesa Specialized Hospital. **Materials and Methods:** A prospective cross-sectional study was conducted on the interventions by prescribing physicians and attending nurses for patients seen at the emergency unit of Tikur Anbesa Specialized Hospital from May 2-20, 2011. Data about interventions were collected from the medication charts. Medication errors were identified by comparing prescriptions and administration records with standard treatment algorithms. Descriptive statistics was used to meet the objective of the study. **Results:** A total of 742 patient charts were reviewed which contained 1058 prescriptions containing 2968 orders. Medication errors were found to be 22781 (54.84%) with rate of 30.70 errors per patient and 1627.21 errors per day. Prescription errors, administration errors from recorded ones, absence of administration record were 7314 (32.11%), 991 (4.35%), and 14476 (63.54%) respectively. **Conclusion:** Incidence and types of medication errors committed in Tikur Anbesa Specialized Hospital Adult Emergency Unit were substantiated; moreover, necessary information on factors within the healthcare delivery system that predispose healthcare professionals to commit errors have been pointed, which should be addressed by healthcare professionals through multidisciplinary efforts and involvement of decision makers at national level.

INTRODUCTION

Different factors contribute to medication errors, which could be either a system or medication process factor. Of the medication process factor, the prescribing stage is believed to be the predominant point of medication errors whereas the remaining contribute to some extent.[1]

Medication errors, whether they lead to adverse consequences or not, are preventable causes of patient harm.[2] Many serious medication errors (administration of wrong drug, drug overdoses, and overlooked drug interactions and allergies) result in preventable adverse drug events (injuries resulting from medical intervention related to a drug), of which approximately 20% are life-threatening. Moreover, one adverse drug event (ADE) adds more than $2,000 on average to the costs of hospitalization in USA, which translates to $2 billion per year nationwide excluding other indirect costs.[3]

The emergency department is a high risk environment for drug misadventure that includes both adverse drug reactions (ADRs) and medication errors. Emergency

medical services personnel often work in small, chaotic, and challenging environments where there is lack of adequate human and medical resources. Physical and emotional stressors are further compounded by the time sensitive nature of emergency medical care.[4] As a result the health care professionals are under stress, which affects all cognitive processes and the individuals tend to rely on acquainted models, even if it is inappropriate, rather than using recently acquired and more appropriate models.[5]

Lack of point of care reference information, alertness of the health professional, and patient information gap are known for their role in medication error. A study in adult emergency department by Vanderbilt University, Nashville has showed that per 100 orders, 337.1 medication prescribing errors were present.[6] Moreover, a study in Civic Campus of the Ottawa Hospital identified information gaps in patient history, laboratory information, medication and imaging in visits to emergency department. Information gaps are associated with significantly longer stays in the emergency department and as a result they have significant role in causing medication errors.[7]

The situation is much intriguing in developing countries; according to one study in India, medication errors were significantly high in the emergency department, not just as the overall number of errors but also as the number of errors per patient and errors per day. Errors that potentially harm the patient, require another drug therapy or prolong patient stay in the hospital were detected in 11% of the patients.[8]

Medication errors in different African countries including Ethiopia have been reported in literatures.[9-17] So far, no study was focused on medication errors in the adult emergency units of African hospitals and thus obtaining literature is difficult. Regarding Ethiopia, no guidelines or policies pertaining to medication errors were developed except a guideline for monitoring ADRs, which was launched in 2002.[18] Furthermore, the doctor-to-population ratio (at most, 1:20,000) and the nurse-to-population ratio (1:3,000),[19] absence of clinical pharmacy service, multiple providers model of service, and types of emergency medications available in the emergency units in Ethiopia differs from other countries. Therefore, this study was initiated to determine the incidence and types of medication errors in the Adult emergency unit of Tikur Anbesa Specialized Hospital.

MATERIALS AND METHODS

Study setting and study design
The study was conducted in the Adult Emergency Unit of Tikur Anbessa Specialized Hospital (TASH). TASH is the largest specialized teaching hospital in Ethiopia that serves as training center for undergraduate and postgraduate students. TASH has a total area of 123,000 meter square with buildings holding 45,000 meter square. The main building is an 8-storey building with 1262 rooms, which includes seven x-ray, nine surgical and twelve laboratory diagnostic rooms. The hospital has 850 beds and it also provides outpatient service. TASH has 200 doctors, 379 nurses, and 115 other health professionals and various departments' faculties and residents under specialty trainings who provide patient care in the hospital.[20]

The emergency room has 3 large rooms (triage, resuscitation and stabilization) with several small exam rooms. Currently a model of multiple providers is used. The 'multiple provider model' splits patients into two different categories at triage, medical or surgical. The emergency room is typically staffed by internal medicine and surgery residents, medical interns and nurses. It has 23 beds but can quickly expand to 50 or more.

A prospective cross-sectional study was conducted on all the interventions by prescribing physicians (residents and interns) and attending nurses for all patients who were seen in the Adult Emergency Unit of TASH from May 2–May 20, 2011. Data about prescribed medications were collected from Medication charts using a pre-tested data abstraction format. Patients who were seen in the emergency unit regardless of age, gender, disease severity and state of consciousness were included in the study. Patients who were transferred to other units or those who died before being seen at the emergency unit were excluded from the study.

Data collection and management
Data was collected by final year medicine, nursing and pharmacy students who were trained on how to detect medication errors from patient chart review and direct questioning of the patients or nearby relatives to include comments using standard abstraction format in a uniform and comprehensive manner. The data collectors worked five days per week during working hours (a total of 14 data collection days). The standard abstraction format contained two parts one for the demographic information and the other for clinical

information along with a space for comments. During the study, medication orders and administrations were handwritten and medications were supplied to patients from the hospital pharmacy.

Medication errors were broadly classified as administration and prescription errors which were assessed in detail using the data. The assessment was done with the help of the Ethiopian Standard Treatment Guideline (STG) 2010 version and Lexi-Comp's Drug Information Handbook, 12th edition containing standard treatment algorithms which were used to compare the administration and prescription data collected with the standard recommendations. Data was cleaned, coded and entered into SPSS version 19 (SPSS Inc, Chicago, IL, USA). Descriptive statistics was generated and results were reported as total percent medication errors according to their types: Based on the American Society of Hospital Pharmacists (ASHP) classification scheme.

Ethical considerations

Ethical clearance was obtained from School of Pharmacy's Ethical Review Board. Prior to study initiation support of nursing, medical, and pharmacy staff and TASH administration was obtained. There was a common understanding with the concerned staff members on the importance of epidemiology and nature of medication errors; as well as a multidisciplinary approach for improvement rather than individual blame. Verbal consent of participants was obtained prior to the study. Patient and health care provider related data was confidential and was destructed after constructing database.

Operational definitions

The definition of terms used is adapted from American Society of Hospital Pharmacists (ASHP)[21] with few modifications as described below.

Medication error

Any error that occurs to a patient that arises from prescription up to administration of a drug. It includes prescription error and administration error.

Maximum possible errors

It is the maximum number of errors that can be assessed; calculated by multiplying medication orders by 14 (types of medication errors).

Prescription error

It is an error that arises from inappropriate medication, which deviates from the standards.

Administration error

This includes poor administration record on the patient chart and failure to comply with the prescription order (drug, dose, dosage regimen, dosage form and length of therapy).

Wrong drug

This includes those errors in which no drug and/or inappropriate drug are indicated for the diagnosis.

Wrong dose

It is the medication strength or quantity different from that indicated.

Wrong dosage form

This includes those errors in which no or inappropriate dosage form is indicated.

Wrong route of administration

This includes errors in which medications are prescribed or administered in a route other than the recommended.

Wrong number of dose

It is the frequency of medication per day different from that indicated.

Illegible handwriting

Prescriptions in which the name of the drug, dose, dosage regimen, dosage form, route of administration and length of therapy are difficult to make out or read.

Wrong length of therapy

This includes those errors in which no or inappropriate length of therapy is indicated.

Omission error

This is the failure to administer dose of an ordered drug to a patient before the next scheduled dose, if any.

RESULTS

Characteristics of patients

From a total of 742 patient charts reviewed within the 14 days of data collection, 438 (59.03%) were males and majority of them (32.08%) were in the age group of 36-45 years and 658 (88.68%) were conscious upon arrival at the emergency unit as shown on Table 1.

Amount and percentage of medication error occurrence

The charts contained 1058 prescriptions having a total of 2968 orders. Total of 14 types of medication errors,

7 prescription errors (wrong drug, wrong dose, wrong dosage form, wrong number of doses, wrong route of administration, wrong length of therapy and illegible handwriting) and 7 administration errors (omission error, wrong drug, wrong dose, wrong dosage form, wrong number of doses, wrong route of administration and wrong length of therapy) were evaluated on the 2968 orders giving 41552 maximum possible errors.

Each order was evaluated for prescription and administration errors which gave an error of 22781 (54.83%) from a total of 41552 maximum possible errors with rate of 30.70 (i.e., 22781/742) errors per patient and 1627.21 (i.e., 22781/14) errors per day.

Prescription errors per total orders
The percentages for each type of prescription errors were calculated from a total of 2968 recorded prescription orders. "Wrong dosage form" holds the largest percentage (100%). Table 2 shows each types of prescription error with their respective amount and percentage.

Administration errors per total orders
The percentage for each type of error was calculated from a total of 900 recorded administrations (for the 2968 orders only 900 administrations were recorded) and a total of 991 administration errors were found for those orders in which administrations were recorded. Missing of any of the 7 type administration information was regarded as administration error of the respective group. Table 3 shows each types of administration error with their respective amount and percentage. The total administration errors in TASH Adult Emergency Unit were 15467 which include 991 errors from the recorded administrations and 14476 errors due to failure in recording administrations (out of 2968 orders for administration 2068 were not recorded).

Percentage of class errors per total errors
Of all the study participants' prescription orders (2968) containing 41552 maximum possible errors, a total of 22781 errors were found. And from these total errors: Prescription errors, administration errors from the recorded administrations, and absence of administration records were found to be 7314 (32.11%), 991 (4.35%), and 14476 (63.54%) respectively as shown in Figure 1.

Since studies indicate that injectable drugs and group of drugs such as anti-infective drugs, analgesics and sedatives are associated with medication errors, specific

drugs were taken into attention. Prescription and administration errors were high in tramadol (18.29% and 16.25%), ceftriaxone (16.41% and 24.32%) and hyosine (11.4% and 15.44%) as shown in Table 4. Examples of prescription and administration errors observed in adult emergency unit of TASH, is also presented in Table 5.

Table 1: Characteristics of patients who attended TASH Adult Emergency Unit May, 2011 (*n*=742)

Patient characteristics	Frequency (%)
Age	
≤15	40 (5.39)
16-25	45 (6.06)
26-35	76 (10.24)
36-45	238 (32.08)
46-55	106 (14.29)
56-65	142 (19.14)
≥66	95 (12.8)
Sex	
Male	438 (59.03)
Female	304 (40.97)
State of patient upon arriva	
Conscious	658 (88.68)
Unconscious	84 (11.32)

TASH=Tikur anbessa specialized hospital

Table 2: Percentage and amount of prescription errors per total orders in TASH Adult Emergency Unit, May 2011 (*n*=2968)

Types of prescription error	Amount of prescription errors	Prescription error per total orders (%)
Wrong drug	225	7.58
Wrong dose	354	11.93
Wrong dosage form	2968	100.00
Wrong route of administration	268	9.03
Wrong length of therapy	2868	96.63
Wrong number of dose	363	12.23
Illegible handwriting	268	9.03

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Table 3: Percentage and amount of administration errors per total orders in TASH Adult Emergency Unit, May 2011 (*n*=991)

Types of administration error	Amount of administration errors	Administration error per order (%)
Omission error	230	23.21
Wrong drug	53	5.35
Wrong dose	19	1.92
Wrong dosage form	19	1.92
Wrong route of administration	19	1.92
Wrong length of therapy	498	50.25
Wrong number of dose	153	15.44

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Documentation and source of drug information

Documentation in the unit was not complete; 46.5% and 4.3% of the patient charts had incomplete patient history and laboratory information, respectively. Moreover, documents were not standardized to contain patient name, generic drug name, route, site and time of administration, dosage form, dose, strength, quantity, frequency of administration, and prescriber's and administrator's name. The contents of some charts were illegible and not clear. In addition drug information resources like guidelines, medical handbooks and books were not easily accessible.

DISCUSSION

Medication incidents such as giving the wrong dose or wrong medicine exist in emergency units and can inflict unintended harm on patients; epidemiological figures also confirm this. The total prescription errors in this study were 7314 from 2968 orders i.e., 246.43 prescribing errors per 100 orders. A study of Vanderbilt University, Nashville showed that there were 337.1 prescription errors per 100 orders in the

Figure 1: Percentage of class errors per total errors in TASH Adult Emergency Unit, 2011 (*n* = 22781)

Table 4: Top drugs with prescription (*n*=7314) and administration (*n*=991) errors in TASH Adult Emergency Unit, May2011

Drugs	Frequency (%)	
	Prescription error	Administration error
Adrenaline	752 (10.28)	25 (2.52)
Ceftriaxone	1200 (16.41)	241 (24.32)
Cimetidine	761 (10.41)	82 (8.27)
Diazepam	600 (8.20)	100 (10.09)
Diclofenac	154 (2.11)	54 (5.45)
Hydrochlorothiazide	468 (6.40)	106 (10.70)
Hyosine	834 (11.40)	153 (15.44)
Lidocaine	746 (10.20)	45 (4.54)
Tramadol	1338 (18.29)	161 (16.25)
Others	461 (6.3)	24 (2.42)

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adult emergency department.[6] In this study at TASH, allergy to medications was excluded because patients were not familiar with the allergies they might incur and the patient charts do not state allergies. Possibly exclusion of allergy to medication from prescription errors could have led to a fewer number of prescription errors.

Despite this, failure to record administrations spurred to a more alarming administrations error, increasing the total medication errors observed in this study to over half the number of maximum possible errors and increasing the number of errors per patient and per day. Even though the studies conducted in Ethiopia and other African countries do not focus on emergency units; similar medication errors types were observed in other hospitals' wards. [16,17] But a similar study done in emergency department of a hospital in India revealed that medication errors were significantly high, not just as the overall number of errors but also as the number of errors per patient and errors per day.[22]

In the emergency unit of TASH, documentation was not complete. About 46.5% and 4.3% of the patient charts had incomplete patient history and laboratory information; the papers within charts were also missing. Moreover, documents were not standardized and some of the charts were illegible and not clear.
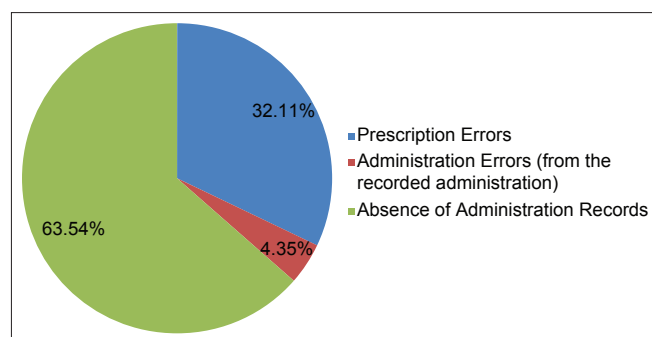
Table 5: Examples of medication prescription and administration errors committed in TASH adult Emergency Unit, May 2011

Medication prescription error	Medication administration error
Ceftriaxone 3g BID for 5 days was prescribed for community acquired pneumonia	Ampicillin, 1 g IV QID for 7-10 days plus gentamicin, 3 mg/kg IV as a loading dose, followed by 1.5 mg/kg/day TID for 7 days was ordered for sepsis but the loading dose and maintenance dose of gentamicin was not given
Tramadol 50 mg IM TID was prescribed with pethidine 50 mg IM TID where either of the two would suffice	Cimetidine, 400mg IV, every 4-6 hours was prescribed for a sever burn injury but Cimetidine 200mg was given every 8 hours
Adrenaline 1:10000, 3-5 ml was ordered for a patient with anaphylactic shock. Route of administration was not mentioned; it could be given via unintended route (SC) that might negatively affect the patient or brings no benefit to the patient instead of IV	Diclofenac 50mg IM TID was given instead of prescribed Tramadol 50mg TID

IM=Intramuscular, IV-Intravenous, SC=Subcutaneous, BID=Two times a day, TID=Three times a day, QID=Four times a day, TASH=Tikur anbessa specialized hospital

Drug information resources such as guidelines, medical handbooks and books were not available let alone electronic services. According to a study in Civic Campus of Ottawa Hospital, the most common types of information gaps in the emergency units were patient history (57.9%) and laboratory information (23.3%). Almost half of the gaps were rated by the attending emergency physicians as very essential to patient care. The visits in which information gaps were identified were associated with significantly longer stays in the emergency department.[7]

In the emergency unit of TASH, pharmacists were not involved in prospective review of medication orders prior to dispensing and administration. On the contrary, many institutions in most developed countries have pharmacists to review orders prospectively and this function provides significant safety benefits in the emergency department.[23] Furthermore, another study identified 7.8 medication errors per 100 patients and 2.9 per 100 medication orders were recovered by the emergency department pharmacists. Most of the recovered medication errors were intercepted potential ADEs (90.3%), with fewer mitigated ADEs (3.9%) and ameliorated ADEs (0.2%). The potential severities of the recovered errors were most often serious (47.8%) or significant (36.2%).[24]

All health care providers, involved in the drug use process, should get easy access to drug information resources. In order to prevent medication errors, verbal orders should be minimized whenever possible and health personnel should have continuing medical education about types of errors that occur in the use of high alert medications. Moreover, well designed workflow within the emergency unit (in a manner that improves communication, minimizes interruptions, and disturbance and provides double check mechanism as well) plays a great role in preventing occurrence of medication errors.[25] Some authors recommend automated approaches like the use of e-prescriptions, which avoid mistakes that accompany handwritten prescription; check for drug allergy, dug-drug interaction, and high doses; and avoid 'hand-off errors' to prevent medication errors.[26] However, technologies like this are very expensive specially for developing countries like Ethiopia; as a result standardization of prescription and administration sheets, standardization of treatment protocols and systematic review of prescriptions and transcriptions by emergency unit based clinical pharmacists are solutions of a paramount importance in a resource-limited settings.

The presence of clinical pharmacists on work rounds may lead to more informed clinical decisions by physicians, interception of errors before medication orders are finalized as well as development of education programs and drug therapy protocols. The role of patient centred pharmacy services in Ethiopia to promote rational use of medications has been confirmed by a study conducted in Jimma University Specialized Hospital, which resulted in well-documented and optimized medication use.[27]

Even though this study is more descriptive and fails to evaluate the impacts and severity of the errors due to time and budget limitations, it has clearly depicted the incidence and types of medication errors committed in TASH Adult Emergency Unit. Errors occurred mostly due failure to record administrations followed by common types of prescription errors and administration errors. Errors were very common among drugs given in an injection form and drug groups such as anti-infective agents, analgesics, and sedatives. Therefore, this study provides necessary information on factors within the healthcare delivery system (poorly designed service providing system, poor teamwork, unstandardized prescription and administration sheets, poor record keeping habit, and lack of standardized treatment protocols) that predispose healthcare professionals to commit errors; which should be addressed through rigorous root cause analysis and development of corrective action plans, guidelines, regulations and policies that prevent errors, make errors visible, and assuage the effects of errors in multidisciplinary approach.

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