

Medication Errors in Patients with Enteral Feeding Tube in a Tertiary Health Care Facility in Zaria, North-West Nigeria

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ABSTRACT

Background: Medication administration to patients via enteral feeding tubes (EFTs) remains a challenge, is complex and prone to errors. Therefore, addressing the errors and incidents could guarantee the efficacy and safety of medications and improved health outcomes in patients.

Objectives: To assess the types and frequency of medication incidents and errors associated with drug administration via EFT among patients in medical wards of tertiary health care facility in northern Nigeria.

Methods: A prospective cross-sectional observational study, using a structured data collection form in 49 patients, to assess the incidence and types of medication errors occurring during drug preparation and administration via EFTs among patients in the medical ward. Data collected include demographics of patients, duration of hospital stay and use of EFTs, types and prevalence of medication errors and incidents. The list of drugs administered via EFTs, potential drug-drug, drug nutrient and drug-EFT incompatibilities.

Results: A total of forty-nine (49) patients were involved in the study with 1372 enteral drug administrations. A total of 39 different drugs were encountered, with antibacterials (28.09%), antihypertensives (18.49%), and diuretics (13.04%) as the most commonly prescribed class of drugs. Major medication errors identified include: wrong time (26.0%), wrong technique of administration (15.6%) and wrong dose preparation (14.2%). A number of potential drug-drug and drug-EFTs incompatibilities were also observed. There was no significant association $P > 0.05$, between types of medication errors and duration of enteral tube use. The common incidents identified during medication preparation were unlabeled medication (31.5%) and no hand washing (20.1%). While during medication administration, gloves not used (9.1%) and no hand washing (8.6%) were the most identified incidents.

Conclusion: Outcome of this study enumerate the various medication errors and incidents associated with drug administration via enteral feeding tube. A practice gap has been identified, as such, involvement of the pharmacists is required for evaluating and reviewing prescriptions for safety, suitability, and compatibility. Training on guidelines and recommendations, development of policies, procedures and a multidisciplinary practice is highly recommended.

Key words: Medication error, Medication incident, Enteral feeding tube, Drug administration

INTRODUCTION

Medication error or incidents is a mistake with medication, or a problem that could cause a mistake with medication. Medication error (ME) is any preventable event that has the potential to lead to inappropriate medication use or patient harm; it occurs during prescribing, transcribing, dispensing, administering, adherence, or monitoring a drug¹. Medication errors can occur during any of the three steps of the medication use process; from prescription handling, medication delivery, and dispensing to the patient.

However, medication incidents are defined as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Medication incidents may be related to professional practice, drug products, procedures, and systems, and include prescribing, order communication, product labeling or packaging or nomenclature, compounding, dispensing, distribution, administration, monitoring, and use².

In many clinical cases, adverse drug events (ADEs) and Medication Errors (MEs) are common and can occur at any point in the process of medication use. About a third to half of ADEs is typically associated with MEs³. Globally, the cost associated with medication errors has been estimated at US \$42 billion annually⁴. ADRs refer to any unexpected, unintended, undesired, or excessive response to a medicine⁵.

An enteral feeding tube enables food to be administered via a tube directly into the stomach or the small bowel⁶. It is used in individuals who have functioning guts but who are unable to meet their nutritional requirements orally. EFT is usually favoured over parenteral nutrition because of the advantage of fewer infections, complications, reduced cost and reduced length of hospital stay. Oral medication preparation and administration through EFTs in hospitals is a major challenge for nurses aiming to provide safe care. They rely primarily on their own experience and secondarily on that of their co-workers for

information and techniques on preparing and administering oral medications through feeding tubes⁷. Consequently, improper techniques are often employed, as researchers have identified wrong techniques during medication preparation and administration of enteric-coated solid drugs⁸. The crushing process destroys the coating film and promotes the immediate release of medication, which can result in toxic effects with potentially severe damages, exposing the patient to unnecessary risks⁹. The most critical issues include physicochemical incompatibilities, drug-nutrient interactions, or the use of incorrect administration techniques, increased risk of tube obstruction, increased toxicity and reduced efficacy due to alteration in drug formulation. Some drug interactions can have significant impacts on the patient's clinical state, and some dosage forms such as controlled-release tablets, enteric coated tablets, and tablets containing cytotoxic drugs cannot be crushed. Medication errors are an important cause of patient morbidity and mortality.

Enteral feeding plays a very significant part in the management of patients with poor voluntary oral intake, chronic neurological or mechanical dysphagia, or intestinal failure, and in the critically ill. However, despite the benefits and widespread use of enteral tube feeding, some patients experience complications¹⁰.

Administering medications through a feeding tube can be associated with errors that occur more often than they are reported or recognized. These mistakes are often the result of administering drugs that are incompatible with the feeding tube, not preparing the medications properly, and of using faulty techniques¹¹.

Enteral nutrition support via a feeding tube is the first choice for artificial nutrition. Most patients also require simultaneous drug therapy, with the potential risk for drug-nutrient interactions which becomes a concern in clinical practice¹². Evidence also suggested that 91% of practitioners often mix solid medications in the same crushing container during medication preparation for patients in the

ward¹³. This practice is a risk factor for adverse drug interactions, contributing to tube obstruction, especially if the health care provider does not flush the tube after each medication administration. Another adverse event related to improper medication administration via feeding tubes is caused by drug interactions especially in elderly patients with a prevalence of 20 to 40% polypharmacy. This increases the complexity of clinical management and contributes to adverse medication events¹⁴.

During enteral nutrition via feeding tubes, drug–nutrient interactions are more likely to occur than in patients fed orally. However, there is a lack of awareness about its clinical significance, which should be recognized and prevented in order to optimize nutritional and pharmacological therapeutic goals of safety and efficacy. These inaccuracies can result in an occluded feeding tube, reduced drug effect, or drug toxicity. These potential adverse outcomes can lead to patient harm, resistance in the case of antimicrobial or even death, necessitating the need to assess the sources of these medication errors.

The evaluation and improvement of drug administration processes are key elements in patient safety. Therefore, the aim of the study is to assess the types and frequency of medication incidents and errors associated with drug administration via enteral feeding tubes in patients hospitalized at the medical wards.

METHOD

Study site and duration

This study was carried out at medical wards of a tertiary health care facility in northern Nigeria from September 2022 to January 2023.

Study design

A Prospective cross-sectional observational study involving 49 patients recruited from both male and female medical wards. Data was collected with a well-structured proforma adapted from a similar study¹⁵. The proforma captured the details of recommended guidelines on standards and step by step preparation and administration of

medications via ETFs by the American Society for Parenteral and Enteral Nutrition (ASPEN) in 2017. The data collection was for a period of four months from September 2022 to January 2023. The nurses were directly observed for compliance with the recommended procedures and practice during the medication preparation and administration for each of the 49 patients. Data collected include: demographics of patients, duration of hospital stay and use of ETFs, types and prevalence of medication errors and incidents. The list of drugs administered via ETFs, potential drug-drug, drug nutrient and drug-ETF incompatibilities were also recorded.

Inclusion criteria

All adult patients on enteral feeding tube admitted in the various units in both male and female medical wards of ABUTH.

Data analysis

The data obtained were analyzed using Statistical Package for the Social Sciences (SPSS) version and the result was analyzed using Chi square. A P value of less than 0.05 was considered statistically significant.

Ethical consideration

Ethical approval was obtained from the ABUTH Scientific and Health Research Ethics Committee before commencement of this study. The study was approved on the 17th October, 2022 by the Health Research Ethics Committee of ABUTH under the D-U-N-5 with clearance number 854524802.

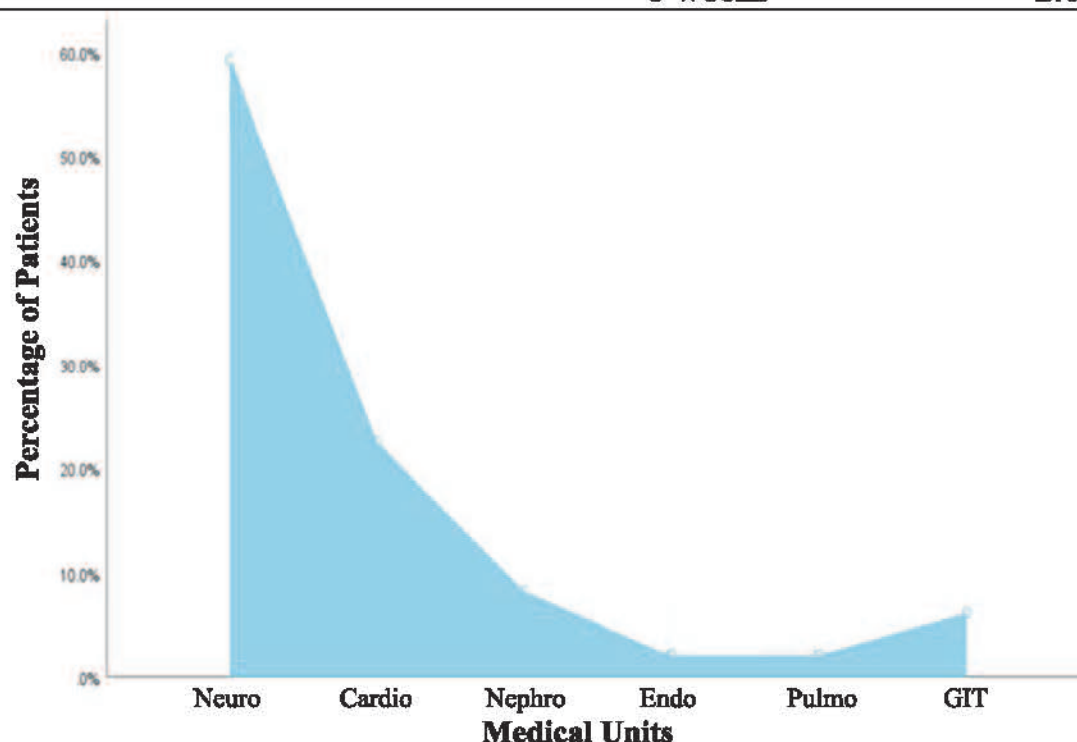
RESULTS

Characteristics of patients on enteral feeding tube

A total of 49 patients (male 65.3% and female 34.7%) with age range of 21 to above 60 years were recruited for the study. The length of hospital stay ranged from <2 weeks to > 8 weeks and the length of enteral tube feeding varied from 5 to 56V days (Table 1). The main diagnoses were diseases from neurology (59.2%), cardiology (22.4%), nephrology (8.2%), endocrinology (2.0%), pulmonology (2.0%) and gastrointestinal (6.1%) units (Figure 1).

Table 1: Characteristics of Participants

Parameters	Category	Values (%)
Gender	Male	65.3
	Female	34.7
Age	21-25	6.1
	26- 30	4.1
	31- 35	12.2
	36-40	12.2
	41-50	20.4
	51-60	22.4
	>60	22.4
Duration of disease	<1 year	53.1
	1- 5 years	36.7
	6-10 years	10.2
	11-15 years	0.0
	>15 years	0.0
Duration of hospital stay	<2 weeks	36.7
	2 - 4 weeks	40.8
	5 - 6 weeks	8.2
	7 - 8 weeks	10.2
	> 8 weeks	4.1
Duration of use of enteral tube feeding	<2 weeks	69.4
	2 – 4 weeks	18.4
	5 – 6 weeks	4.1
	7 – 8 weeks	6.1
	> 8 weeks	2.0

**Figure 1: Patients on Enteral Feeding Tubes in Various Medical Units**

Key: Neuro: Neurology, Cardio: Cardiology Nephro: Nephrology Endo: Endocrinology Pulmo: Pulmonology GIT: Gastroenterology

Drugs administered capsule and torsemide tablet. The most prescribed Totally, thirty-nine (39) different drugs were class of drugs were antibacterials (26.09), administered. Six commonly encountered drugs antihypertensives (18.49%) and diuretics include clindamycin capsule, furosemide tablets, (13.04%) (Table 2). aspirin tablets, cefuroxime capsule, amoxiclav

Table 2: Classes of Drugs Administered

Drugs	% Frequency of Administration
Antibacterials	26.09
Antihypertensives	18.49
Diuretics	13.04
Vitamins	10.86
Analgesics	9.78
Antipsychotics	6.52
Antilipidaemics	3.26
Antiplatelets	3.26
Electrolyte replacements	3.26
Anticonvulsants	2.17
Proton Pump Inhibitors	1.09
Antifungal	1.09
Antimalaria	1.09

Prevalence of medication incidents Whilst with respect to incidents during medication Prepared medication, not labeled (31.5%), was the administration, lack of gloves had the highest most prevalent incident during medication occurrence (9.10%), followed by no hand washing preparation followed by absence of hand washing (8.6%) and the least (1.1%), was administering (20.10%), liquid medications with a high tablet in different position of the optimal site for osmolality incorrectly diluted or not diluted absorption (Table 4). (3,4%), the least occurring (Table 3).

Table 3: Prevalence of Medication Incidents During Medication Preparation

Medication Incidents	Occurrence (%)
No hand washing before medication preparation	20.10
Tablets not crushed to fine powder mixture	14.10
Crushing an enteric-coated tablet	7.40
Crushing a sustained release tablet	8.40
Mixing tablet with other drug(s) during medication preparation	9.40
Liquid medications with a high osmolality incorrectly diluted or not diluted	3.40
Prepared medication not labeled	31.50
Prepared medication did not correspond to the prescribed drug	5.40

Table 4: Prevalence of Medication Incidents During Medication Administration

Medication Incidents	Occurrence (%)
Route of administration did not correspond to the prescribed route	3.50
No hand washing before medication administration	8.60
Patient not called by name before medication administration	7.30
Procedure not explained to the patient prior to medication administration	5.90
Gloves not used	9.10
No testing of the correct placement of the feeding tube prior to medication administration	2.10
Administering tablet in different position of the optimal site for absorption	1.10
No flushing of the tube prior to medication administration	6.70
Administering medications together	5.90
No flushing of the tube between medications	5.10
No flushing of the tube after medication administration	4.03
Administering medication that adsorbs or interact with enteral nutrition, without observing the minimum recommended interval between ingestion	4.03
Enteral feeding flow not re-established after medication administration	4.03
Patient not monitored after medication administration	8.30

Prevalence of medication errors (14%) are the most frequently encountered Wrong time (26%), Wrong administration medication errors and wrong formulation been the technique (15.6%) and Wrong dose preparation least (0.35%) (Table 5).

Table 5: Prevalence of Medication Errors

Medication errors	Percentage (%)
Omission	8.90
Unordered drug	0.75
Wrong drug	3.75
Wrong formulation	0.35
Wrong dose preparation	14.20
Wrong administration technique	15.60
Wrong route of administration	8.90
Wrong time	26.00
Drug-drug Incompatibility	12.70
Drug-enteral tube incompatibilities	2.90

Duration of use of enteral feeding tubes and medication errors patients on enteral drug administration after less than 2 weeks, 2-4 weeks, 4-6weeks, 7-8weeks and more than 8 weeks respectively (Table 6). No Wrong drug, wrong formulation, more than 8 weeks respectively (Table 6). No Incompatibilities due to drug-enteral feeding tube, significant association between the incidence of wrong dose preparation, and wrong drug are the medication errors and the duration of use of EFTs. most significant medication errors observed in

Table 6: Duration of Use of Enteral Feeding Tube and Medication Errors

Medication error types	<2weeks (%)	2-4 weeks (%)	4-6 weeks (%)	7-8 weeks (%)	>8 weeks (%)	P value
Omission	26.9	21.5	12.1	15.8	23.7	0.506
Unordered drug	26.9	23.1	11.5	15.4	23.1	0.338
Wrong drug	27.1	21.1	12.0	15.8	24.1	0.956
Wrong formulation	23.1	23.1	15.4	15.4	23.1	0.904
Wrong dose preparation	27.0	21.2	12.0	16.0	23.8	0.266
Wrong technique of administration	27.0	21.4	12.0	15.8	23.8	0.185
Wrong route of administration	26.9	21.5	12.0	15.8	23.7	0.660
Wrong time	27.0	21.5	11.9	15.9	23.9	0.054
Incompatibilities due to drug-drug	27.0	21.4	11.8	15.9	23.9	0.213
Incompatibilities due to drug-enteral feeding tube	24.6	19.3	24.6	10.5	21.0	0.334

No Significant difference $P > 0.05$ (Chi-Square test) between Types of medication error and duration of use of enteral feeding tubes

DISCUSSION

Problems related to enteral feeding and drug administration, is a growing concern to physicians, pharmacists and nurses and requires urgent attention by all stakeholders. This study assessed the types and frequency of medication incidents and errors associated with drug administration via enteral tube in hospitalized patients. The most common medical diagnosis with enteral tube feeding was seen in patients in neurology and cardiology units. Antibacterials, Antihypertensives and diuretics ranked high as administered drugs, similar to a study conducted in Brazil¹⁵. Clindamycin capsules was the antibiotic most encountered as part of management therapy for aspiration pneumonia (a major complication associated with stroke due to dysphagia). This probably explains why majority of patients were recorded from neurology units and antibiotics also been the most encountered medication. However, the two most prescribed medications (clindamycin capsules and frusemide tablets) for EFT administration recorded in this study are available as parenteral dosage forms. The difference in cost between the oral and parenteral dosage forms, probably suggests why the medications were given via EFTs.

The study recorded a number of medication incidents during medication preparation and administration through feeding tubes. Unlabeled prepared medication was the most common incident associated with medication preparation followed by no hand washing, in agreement with a study in Brazil¹⁵ which also identified, not labelling the prepared medication, mixing tablets with other drugs and no hand washing before medication preparation as the most frequently encountered medication incidents. In addition, as regards medication incidents associated with medication administration, no usage of gloves nor washing of hands also ranked highest. Hygiene remains paramount as the key to prevention of infection and incidents of nosocomial infections amongst hospitalized patients.

Drug-drug, drug-enteral tube incompatibilities were among significant medication errors observed in patients on drug administration via EFTs for the 8 weeks period of the study. Drug-drug, drug-nutrient and drug-EFT incompatibilities are a major concern, as a number

of patients that are critically ill are usually on multiple medications (polypharmacy) that require spacing during administration, but these medications are all mixed and pounded together as observed in this study. Polypharmacy increases the complexity of clinical management and contributes to adverse medication events. Interactions of significance could compromise efficacy and safety in patients. Phenytoin, ciprofloxacin and carbamazepine are examples of drugs recorded in this study with drug-EFTs incompatibilities. Drug-nutrient interactions can lead to formation of precipitates and change in viscosity, hindering nutrient or drug absorption¹⁶. Also of concern, is the compromise of the pharmacokinetics of enteric coated (EC) modified release (MR) and sustained release (SR, XR) formulations because of the bypass of several natural levels of the GIT. These dosage forms are unsuitable for administration through an EFT^{17,18} and could lead to detrimental consequences due to exposure of the patient to high doses of the drug at one time leading to excessive peak plasma concentrations and side effects. A case report from the United States of America has linked the death of a patient to haemodynamic instability, resulting from the improper use of labetalol and crushed nifedipine XR through an EFT¹⁹. These EC and SR formulations do exist as uncoated oral dosage forms and could have been used as alternatives. The lack of information on appropriate and available alternatives continue to compound the problems enumerated, however, interventions and adherence to guidelines that prevents other harmful medication incidents as observed in this study can reduce the complications associated with medication administration via EFTs.

No flushing of tubes prior to medication adherence, and wrong technique of drug administration also ranked high as medication incidents and errors in this study. Both of them have been implicated in enteral tube obstruction, reduced drug efficacy and increased drug toxicities²⁰. A major reason for loss of feeding tubes have been associated with tube obstruction (38%) related to wrong medication preparation and administration technique²¹. A study in Brazil¹⁵ had recorded a greater than 80% medication incident of not flushing the tube between medications and over 60% of administering

medications together. The very high percentage observed in the latter study can be attributed to the large number of patients and long duration of the study. Another wrong practice is the flushing of EFTs with enteral formula and not water after drug administration which can provide a favorable environment for bacterial growth leading to an increase risk of infection.

Placing the EFT correctly i.e. whether in the stomach or duodenum, prior to medication administration is vital especially for medications requiring acidic or alkaline PH environment for absorption. The study recorded wrong placements of the EFTs prior to drug administration for some medications. Such medications will readily precipitate in unfavorable conditions leading to hindered absorption and consequent therapeutic failure¹⁶.

Wrong timing of medication was also largely observed as a medication error, this is especially for medications that produce undesirable gastrointestinal effects. When administering medication that adsorbs or interact with enteral nutrition, the minimum recommended interval between ingestion should be observed. The procedure is to interrupt nutrition 1h before or 2h after administration of the drugs such as phenytoin and ciprofloxacin, which were medications recorded as been administered via EFT in this study. However, some other medications are more tolerable when administered with enteral nutrition such as furosemide and spironolactone acetylsalicylic acid and amlodipine¹⁶, which incidentally rank as part of medications mostly encountered in this study. Gastro intestinal side effects such as vomiting and diarrhoea can be minimized with appropriate timing of medication administration.

The incidences of the various medication errors observed over these periods was not associated with the length of use of enteral tube. These errors were observed from the very onset of placing the EFTs all through the stay of the patients on admission. It invariably means that it was a practice reflective of the attitude of the health care practitioner which have been largely documented to be due to lack of adequate education and training²² and also a reflection of a practice devoid of multidisciplinary team approach. A

comprehensive guide (ASPEN Safe Practices for Enteral Nutrition Therapy)²³ has been developed by an interdisciplinary task force and is instructive on step by step procedures which prevents medication errors and incidents following drug administration via EFTs.

The incorporation of pharmacists in drug preparation and administration via EFTs, is of fundamental importance. They have a role to play in evaluating and reviewing the prescriptions for safety, suitability, and compatibility as ordered, prevention of adverse effect, detection and management of interactions and provision of vital and necessary information to prevent and solve medication related problems^{22,23}.

CONCLUSION

The outcomes of this study enumerate actions and events that impair the appropriateness, efficacy and safety of medications during preparation and administration through EFTs, which can significantly compromise the quality and safety of therapy provided for patients. A practice gap was identified in this study, as such, training on guidelines and recommendations, development of policies, procedures and a multidisciplinary practice is recommended.

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