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An assessment of the rate, types and severity of prescribing errors in a tertiary hospital in southwestern Nigeria.

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Abstract

Background: Accurate medication prescribing is an important process in ensuring the best possible outcomes in patient care. Worldwide literature is replete with studies reporting high prevalence of prescribing error which are the most common type of avoidable medication errors and hence are an important target for improvement.

Objectives: This study assessed types and prevalence of prescribing errors, their clinical significance, when in the prescribing process they occurred and the medications commonly associated with prescribing errors.

Methods: A retrospective review of 2010 in-patients' records from medical and paediatric specialties of a tertiary hospital in South West Nigeria was undertaken. Prescriptions that met the standard as enumerated in the Nigeria Standard Treatment Guideline (STG) were assessed. Prescription error rates for potentially clinically serious and total errors were determined.

Results: The total prescribing error rate was 40.9% (95% CI 37.8 to 41.4) with 1.3% (95% CI -1.1 to 3.7) being clinically serious. Omitting to write an ending date or duration for therapy and unsafe abbreviations were the most common errors. Prescriptions involving antimicrobials produced the bulk of errant prescriptions.

Conclusion: Prescribing errors were found to be common. There was poor compliance with the Nigeria Standard Treatment Guidelines which outline the essential elements of a prescription. Continuing prescriber education on proper prescription writing and rational drug use is recommended as a way to reduce prescribing errors.

Keywords: *Prescriptions, patients, medication errors, physicians*

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Résumé

Contexte: Le précis de prescription de médicaments est un processus important pour assurer des de meilleurs résultats possibles dan les soins donnés aux patients. Les documentations de par le monde sont remplies de rapports d'études sur le haut degré de prescription erronées évitables de médicaments du type le plus souvent commun et qui sont donc une cible importante pour l'amélioration.

Objectifs: Cette étude a évalué les types et la fréquence des erreurs de prescription, l'importance de leur impact dans les cliniques, au cours du processus de la prescription erronée courante des médicaments qui leur sont associée.

Méthodes: Une étude rétrospective en 2010 des rapports de spécialités médicaux et pédiatriques de patients hospitalisés d'un hôpital de soins tertiaires du Sud-ouest du Nigeria a été faite. Les prescriptions qui répondaient à la norme telles qu'énumérées dans la directive de traitement standard au Nigeria (STG) ont été évalués. Le taux de prescription erronée pouvant être cliniquement graves et les erreurs totales ont été déterminés.

Résultats: Le taux de prescription erronée ayant de gravité médicale était au total de 40,9% (IC à 95% de 37,8 à 41,4) à 1,3% (IC 95% -1,1 à 3,7). Outre l'indication de la date d'expiration ou de la durée de la thérapie, de graves abréviations sont des erreurs les plus souvent observées. Les prescriptions sur les antimicrobiens sont pour la plus part les prescriptions courantes.

Conclusion: Les prescriptions erronées sont monnaies courante. Il y avait une faible conformité aux directives de traitement standard au Nigeria décrivant les éléments essentiels d'une prescription. La formation continue des prescripteurs sur la bonne manière bonne de prescrire et l'utilisation rationnelle des médicaments est recommandée afin de réduire des prescriptions erronées.

Introduction

A prescription is defined as an order written by a registered physician, dentist or other certified health personnel to a qualified pharmacist or appropriate personnel for the purpose of supplying the ordered medication [1]. The writing of a prescription is the

culmination of a clinical encounter with a patient. Details of this process can be found in the World Health Organization's (WHO) Guide to Good Prescribing [2]. Despite this fact however, irrational drug use and errors in the process of prescribing, dispensing and administration of medications abound in many societies [3-5].

Inappropriate prescribing can result in serious morbidity and mortality especially when infections or chronic diseases are involved. It also represents a waste of resources and as in the case of antimicrobials, may present a public health hazard by contributing to increased bacterial resistance [2]. Prescribing errors, independent of whether they cause harm, are common. Estimates of their incidence differ widely in literature. For instance, it has been estimated that 1-2% of patients admitted to both UK and US hospitals are harmed as a result of medication errors [6,7] the majority which can be attributed to prescribing errors. Though published research on the incidence and types of prescribing errors in developing countries is scarce, available studies in out-patients' setting reveal that prescribing errors are common and of varying incidence [8-10]. They include dosage errors [8], illegible prescriptions [11], medication dosage forms [12], incomplete prescribing information [13] and prescriber characteristics [14].

The Nigeria's Standard Treatment Guideline (STG) [15] outlines the essential elements of a prescription. Despite this effort, lapses in the writing of prescriptions are rife in the hospital setting. In developing specific strategies to improve prescribing in our environment, it is important to first understand the nature of prescribing errors that frequently occur and the scale of the underlying problem, with a view to formulating and assessing the effectiveness of interventions.

This paper describes a study of prescribing errors in the in-patient setting at the University College Hospital (UCH), a tertiary hospital in southwestern Nigeria. The objectives were to determine the prevalence and types of prescribing errors, to describe when in the prescribing process they occur frequently, to evaluate their severity and to identify medicines commonly associated with these errors.

Methods

Design

This is a retrospective study which involved the review of in-patient medication records (ward treatment sheets / prescriptions, medical notes and discharge prescriptions) covering the period between January – December 2010.

Setting

The study was undertaken at the University College Hospital (UCH), an 850-bed tertiary hospital in southwestern Nigeria which operates the usual pharmacy service. Briefly, this entails prescribers handwriting in-patients medication orders into the patient's medical notes as well as onto pre-designed treatment sheets during their various ward rounds. Pharmacists check that the orders are clear, clinically appropriate (to avoid ambiguity in terms of name of medication, dose, dosing interval, route and quantity) and valid before initiating the supply of any drugs to patients in the wards [16]. These same documents are used by the nursing staff to determine the doses due at each medication round and to record their administration.

Data collection

Prescriptions, from specialties such as internal medicine, family medicine, psychiatry, ophthalmology, urology and paediatrics were screened for prescribing errors that met the study definition. Data collection forms were used to extract information such as: ward type, dates of admission and discharge, patient demographic characteristics, prescribing stage, number and type of medications ordered, number and types of prescription errors, and the medications involved.

The sample size was calculated using the Raosoft Sample size calculator [17]. The calculated sample size of 400 in-patient records allowed estimation of the prevalence of prescribing errors to within 1.4 percentage points either side of the estimated prevalence using a 95% confidence interval, assuming that the prevalence is approximately 50%.

Error definition and types

Medication prescribing errors have been described as any type of deviation from a complete, accurate and legible prescription, as it pertains to errors on the prescription and not the prescribing decision or dispensed medicines [11]. The Nigeria STG 2008 enumerates the essential features of a prescription. They are: (1) identity of prescriber: including name and signature; (2) identity of patient: including age and gender; (3) elements specifying the medication such as medication name, strength, dosage, frequency, route, duration, direction for use, and additional labeling instructions; (4) abbreviations: only standard official abbreviations are acceptable. Any deviation from the above specifications was considered a prescribing error. Error types / classification used in this study were based on this requirement. In-patient prescriptions hand-

written by doctors within the study period were included and screened.

Medications ordered or prescribed while a patient was on admission at the accident & emergency / casualty unit were categorized as prescriptions generated at admission. The in-patient stay was regarded as the time the patient was transferred to the ward (either from the emergency unit or by direct admission into the wards) and throughout the period the patient was hospitalized as an in-patient. Medications written at the end of hospitalization, at the point of patient discharge, were categorized as prescriptions generated at discharge.

Grading of errors

The error severity classification scheme grading, developed by some researchers [17] (Appendix A) was used as a guide to clinical significance. For the purposes of this evaluation "potentially lethal, serious and significant" errors were grouped as 'serious' and "minor" as 'non-serious'. Serious and non-serious prescribing error rates were calculated. One of the researchers (AAA) grouped similar errors together and classified each group as either "serious" or non-serious". The other clinical pharmacists (MKO and WOE) reviewed these classifications independently. Any disagreements were resolved together.

Data management and analysis

Data collected was stored using Microsoft Office Excel 2007 and analysed using the Statistical Package for the Social Sciences (SPSS) software version 15.

Nominal variables were analyzed using descriptive statistics which consisted of frequency distribution and percentages.

The outcome of primary interest was the percentage prescribing error rate, stage of patient care and clinical significance. Prescribing error rate was calculated as the number of medication order errors divided by the total number of medication orders examined. Secondary outcome was the medications associated with the errors. Chi-squared statistics was used to test association. Results were given in terms of a 95% CI. Values of $p < 0.05$ for a two-sided test of proportions was considered as statistically significant.

The UI/UCH Ethics committee gave approval for the study.

Results

Demographic characteristics of population

Table 1 reveals the age distribution and sex of the patients involved. Of the 400 patients' record evaluated, 76.5% were females and 77.3% were between 15 and 65 years. Three (0.8%) patients' ages were not recorded. Of the patients records assessed, 77% were medical cases.

Table 1: Demographic characteristic of the study population.

Age	N (%)
Not specified	3(0.8)
< 5yrs	0(0.0)
6-14 yrs	5(1.3)
15- 65 yrs	309(77.3)
> 65 yrs	83(20.8)
Total	400(100)
Sex	
Females	306(76.5)
Males	94(23.5)
Total	400(100)

Table 2: Prescribing errors according to stage of patient stay, expressed as percentages of the number of orders.

Stage of patient stay	No. of medication orders	Serious errors (%)	Other errors (%)	Total errors (%)	95% Confidence Interval		
					Serious errors	Other errors	Total errors
Medication orders written on admission.	3050	45 (1.5)	1221 (40.0)	1266 (41.5)	-2.05 to 5.05	37.25 to 42.75	38.79 to 44.21
Medication orders written during remainder of patients' stay.	2988	37 (1.2)	587 (19.7)	625 (20.9)	-2.31 to 4.71	16.48 to 22.92	17.71 to 24.09
Medication orders written at discharge.	781	5 (0.6)	893 (114.3)	898 (115.0)	-6.17 to 7.37	107.81 to 120.79	108.53 to 121.47
Total	6819	87 (1.3)	2701 (39.6)	2788 (40.9)	-1.08 to 3.68	37.76 to 41.44	37.78 to 41.42

Table 3: Examples of errors identified

Potentially serious prescribing errors	Less serious prescribing errors
Serious drug interaction occurring from co-prescribing Amiodarone and Digoxin tablets; warfarin and carbamazepine.	An adult male patient was prescribed Anthelmintics without specifying which one, and dose
Azithromycin 500mg tabs prescribed as tds instead of once daily for a patient with Steven-Johnson syndrome.	IV Ceftazidime 750mg daily was ordered in a patient's medical notes, but was transcribed in the treatment sheet as IV Ceftriazone 1g daily
IV Ciprofloxacin 500mg q12h prescribed for a child less than 3years, resulting in overdose.	A 5-year old child with bronchopneumonia was prescribed oral cefuroxime without specifying dose, frequency and duration.
Potassium chloride (Slow K) 600mg qds tabs prescribed for a two and a half year old child (inappropriate dose).	Co-prescribing a bacteriostatic and bacteriocidal antibacterial.
Fersolate ™ (ferrous sulfate) 500mg tablets tid prescribed for a 16-year old male.	IV Fluid 250mls stat ordered for a child without stating which one.
	Tab ceftriazone 1g bd (wrong formulation) prescribed for demyelinating disease in an adolescent.

IV= Intravenous.

Table 4: Types and rates of prescribing errors.

Error description	N	(%)
Incomplete Information		
Duration/stop date omitted	2398	(86.0)
Direction for use omitted	13	(0.5)
Route of administration omitted	7	(0.3)
Drug Name omitted	13	(0.5)
Dosing		
Dose/Frequency omitted	81	(2.9)
Dose Inappropriate (Under)	20	(0.7)
Dose Inappropriate (Over)	9	(0.3)
Dose adjustment in liver impairment	5	(0.2)
Dose adjustment in renal impairment	2	(0.1)
Interaction		
Serious drug interaction	32	(1.2)
Ambiguous		
Ambiguous order	85	(3.1)
Abbreviation		
Unsafe Abbreviation	115	(4.1)
Others		
Wrong drug name	3	(0.1)
Therapeutic duplication	2	(0.1)
Wrong route of administration	2	(0.1)
Wrong formulation	1	(0.0)
Total	2788	(100)

2. *Proportion of prescriptions written per point of care*

A total of 6819 medication orders were written during the study period of which 2788 errors were identified, giving an overall prescribing error rate of 40.9% (95% CI 37.8 to 41.4). The highest proportion of medication ordered was at the point of admission (44.7%) while the lowest was at the point of discharge (11.5%). The time of discharge was associated with the highest error rates i.e. 115% (95% CI 108.5 to 121.5) (Table 2).

3. *Severity of errors*

It was determined that 87 (3.1%) of the total errors were potentially serious, equivalent to 1.3% of all medication orders written. Examples of potentially serious and less serious errors are given in Table 3.

Table 5: The top ten classes of drugs involved in errors.

Therapeutic class	N=2788	(%)
Antibacterials (oral and parenteral)	1013	(36.3)
Fluid and electrolyte Replacement (parenteral)	425	(15.2)
Diuretics	221	(7.9)
HTN and HF (CVS)	193	(6.9)
Vitamins	159	(5.7)
Haematinics	130	(4.7)
Anti-diabetics (Insulin)	113	(4.1)
Antiplatelet	58	(2.1)
Analgesics (opioid)	57	(2.0)
Drugs used in diabetes (OAA)	53	(1.9)

OAA= Oral anti-diabetic agents; CVS= Cardiovascular system; HTN & HF= Drugs for Hypertension and heart failure.

4. *Types and rates of prescribing errors from in-patients prescription records*

The types and frequency of prescribing errors assessed is shown on Table 4. The most common prescribing fault was omission of duration of therapy

or stop date of prescribed medicines of which majority involved drugs given via the intravenous route. Errors relating to dosage (over or under dose) were 3.9% while about 4.1% were related to the use of unsafe abbreviations.

5. Medications associated with errors

The medications most commonly involved in prescribing errors are shown in Table 5. Foremost are antibacterials (36.3%), intravenous (IV) infusions for fluid and electrolyte replacement (15.2%) and diuretics (7.9%). Others are medicines used for managing hypertension and heart failure (6.9%) and Vitamins (5.7%).

Discussion

The incidence of prescribing errors of 40.9% (95% CI 37.8 to 41.4) determined in this study was fairly high. This however, was comparable with other studies of diverse in-patient settings which determined prescribing error rates of 32.9% [11], 40% [16], 43.8% [5] and 53% [19]. Prescribing error rates were determined using the same methods applied in this study. Nevertheless, only 1.3% (95% CI -1.1 to 3.7) of these errors was judged serious. It is important to note that severity ratings relate to the potential severity had the error been allowed un-intercepted. These results have noted that prescribing errors are not uncommon in the in-patient medical and paediatric setting at the University College Hospital, Ibadan independent of whether they caused harm or not.

It was found that the highest rates of both serious and less serious errors were medication orders written at patient's discharge (overall error rate 115%; serious error rate 0.6%). It is of concern that writing discharge prescriptions, tasks based mainly on transcription, were associated with such rates. Errors were also more likely to occur on admission prescriptions than orders made during the in-patient period. Other studies identified highest error rates during the in-patient stay when new medicines were written [16], or at point of admission to the hospital [19].

The most frequent error encountered was incomplete prescribing information or omission errors. The tendency to omit necessary information (viz date of stopping a drug or duration of therapy especially for antibiotics administered via the parenteral routes), omission of route of administration for a drug (e.g. furosemide, diazepam and phenytoin which can be administered through more than one route), or dose of drug to be taken or frequency of administration as seen in this study is not uncommon among prescribers but are critical for prescription completeness. Sapkota *et al* [18], Seden *et al* [5] and other researchers [21,22] have reported similar findings. A medication order is valid only if the prescriber enters all the required information. Omitted vital information may result in delays in administration or occurrence of more serious errors. Pharmacists' more active participation in the in-patient medication process may help in reducing prescribing errors by their role in performing routine checks on all prescriptions issued. This will likely provide the defense against these errors in clinical areas associated with highest risk such as at discharge or admission.

Another important prescribing error was the use of unsafe abbreviations in prescriptions. Although use of abbreviations may seem a time saving convenience, a prescription may be misinterpreted leading to patient harm. The failure of a small number of prescribers to write a drug name in full is serious as it could be argued that a ward with regular personnel (nurses, nursing attendants, doctors and others) all know what correct practice is or what is meant by an abbreviation. But this may not always apply as staff change jobs and new staff or staffs from other wards are used. If a word or abbreviation is misinterpreted, a serious incident can occur.

Failure to attend to drug-drug interactions can cause important problems/injuries and affect the process of treatment or even cause serious or fatal problems to patients' health. This underscores the need for evaluating prescriptions in order to prevent them. Again, Pharmacists can contribute to this.

Prescriptions involving antimicrobials (oral and parenteral) produced the bulk of errant prescriptions. This was consistent with other reported studies [21-23]. Antimicrobial prescribing should include essential information on dose, route and duration of therapy as well as the appropriate selection of the antimicrobial agent. Worldwide, antimicrobial management is now a key component of infection prevention and control, and prudent antimicrobial prescribing is important in reducing the prevalence of resistant microbes [24]. Availability of local guidelines for antimicrobial prescribing which specify the above criteria should be ensured.

This study has drawn attention to the need for improvement in the writing of orders especially to including the duration or ending date of initiated medication orders, appropriate dosing and use of abbreviations for drug names. These are important prescription elements as enumerated in the Nigeria STG. Prescribers may benefit from reminders, re-education/training on proper prescription writing and

rational drug use. Prescriptions can then be re-audited at a later time to measure impact of intervention. Improvement in prescription writing will advance the efficiency of the system resulting in pharmacists, nurses and other clinicians being able to do their job quickly, with more appropriate use of drugs and less time spent sorting out problems. Patients will ultimately benefit from this.

Limitations of this study

This study had some limitations. The study evaluated in-patient prescriptions in specific wards (medical and paediatric) and the results may be different for other wards in the hospital or other prescribers in other specialties. As the study involved a tertiary hospital located in the southwestern region of the country, the findings may not be representative of prescribers in other parts of the country or other types of hospital settings. The study did not consider factors that could be associated with or responsible for these errors which could shed light in designing appropriate interventions for their mitigation.

Despite these limitations, this study gives some insight into the incidence and types of prescribing errors and offers openings for further research in this area.

Conclusion

This study reported that prescribing errors were not uncommon in the study wards. The overall error rate of all types of prescribing errors at the selected wards at the University College Hospital Ibadan was 40.9%. However, only a fraction of these errors were judged to be clinically serious. Antibacterials, parenteral fluids for electrolyte imbalance and diuretics were the drug categories most commonly associated with prescribing errors in this study while omission of duration of therapy of these medications was the most frequent lapse. The point of discharge was associated with the highest error rate even though this was the point at which the least number of medications were ordered.

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Appendix A: Error Severity Classification Scheme

Potentially lethal error

An error is defined as potentially lethal if it could have one or more of the following consequences:

- The serum level resulting from such a dose is likely to be in the severe toxicity range based on common dosage guidelines, e.g. serum theophylline concentrations greater than 30 micrograms per ml. More than 10 times the dose of chemotherapy agent
- The drug being administered has a high potential to cause cardiopulmonary arrest in the dose ordered.
- The drug being administered has a high potential to cause a life threatening adverse reaction, such as anaphylaxis, in light of the patient's medical history.
- The dose of a potentially life-saving drug is too low for a patient having the disease being treated
- The dose of a drug with a very low therapeutic index is too high (ten times the normal dose)

Serious error

An error is defined as serious if it could have one or more of the following results:

- The route of drug administration ordered is inappropriate, with the potential of causing the patient to suffer a severe toxic reaction.
- The dose of the drug prescribed is too low for a patient with serious disease who is in acute distress
- The dose of a drug with a low therapeutic index is too high (four to ten times the normal dose)
- The dose of the drug would result in serum drug levels in the toxic range, e.g. theophylline levels 20-30 micrograms per mL.
- The drug orders could exacerbate the patient's condition, e.g. drug-drug interaction or drug-disease interaction.
- The name of the drug is misspelled or illegible creating a risk that the wrong drug might be dispensed including errors in decimal points or units if the error could lead to the dose being given
- High dosage (ten times) normal of a drug without a low therapeutic index

Significant error

An error is defined as significant if it could have one or more of the following results:

- The dose of the drug with low therapeutic index is too high (half – four times the normal dose)
- The dose of the drug is too low for a patient with the condition being treated

- The wrong laboratory studies to monitor a specific side effect of a drug are ordered e.g. CBC and reticulocyte counts are ordered to monitor gentamicin toxicity
- The wrong route of administration for the condition being treated is ordered e.g. the inadvertent change from IV to oral therapy for the treatment of bacterial meningitis.
- Errors ordering fluids are made e.g. specific additives needed for complete therapy are omitted or incompatible fluids are ordered
- Errors of omission whereby patient's regular medication is not prescribed either on admission, during a rewrite and on discharge

Minor error

An error is defined as minor if it could have one or more of the following results:

- Duplicate therapy was prescribed without potential for increased adverse effects
- The wrong route was ordered without potential for toxic reactions or therapeutic failure
- The order lacked specific drug, dose, dosage strength, frequency, route or frequency information
- Illegible, ambiguous or non-standard abbreviations
- An errant order was written that was unlikely to be carried out given the nature of the drug, dosage forms, route ordered, missing information etc

Examples include, simvastatin prescribed in the morning rather than at night. Bisoprolol – two puffs four times a day.

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