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Medication Errors among Healthcare Workers in a Major HIV treatment Centre in Nigeria.

ABSTRACT

Background: Medication errors are major challenging clinical incidents in health care settings that could jeopardize a patient's life and well being. These errors could occur at any step of the medication use process from prescribing, prescription verification, dispensing, drug administration to monitoring. This study aims to assess and classify medication errors among Doctors and Pharmacists.

Method: A prospective observational study from July to September 2018. Randomly selected prescriptions were screened for errors before and after dispensing of drugs. Errors were assessed and classified according to the NCCMERP index to determine the level of harm it posed to the patient.

Results: Out of 1529 prescriptions analyzed, 182(11.9%) medication errors were observed; 104(57.1%) and 78 (42.9%) among Doctors and Pharmacists respectively. Majority of the errors were for female patients, those on first line antiretroviral drug regimen, in the age group 41-50years and according to the NCCMERP index of the error type D. The most common medication errors among the Doctors were omission errors (36.5%) and errors in patient data (21.1%) while unsigned prescriptions (33.3%) and omitting prescribed drugs from dispensed drugs (28.2%) ranked highest among Pharmacists' errors. Doctors and Pharmacists (53.3% and 75% respectively) with < 5years HIV care experience had higher error rates.

Conclusion: Medication errors associated with cotrimoxazole therapy were most common for both categories of health workers and this has a potential for poor treatment outcome. There is need for continuous training of health workers in HIV management.

Keywords: Medication Errors, Antiretroviral therapy, HIV, Doctor's Errors, Pharmacists errors.

1. INTRODUCTION

Medication errors in health care settings are challenging and could lead to poor treatment outcomes, high mortality and adverse drug events especially among patients on lifelong therapy. They are a leading cause of adverse drug reactions in hospital settings [1, 2]. Approximately 1.5million patients are reported to have suffered harm from medication errors with about 7000 deaths annually in the United States of America alone [3].

38 Available evidence shows that medication errors are a significant problem in Australia, North America, Canada and the
39 United Kingdom [4].

40 Medication errors are defined as “unintended failure in the treatment process that leads to or has the potential to harm the
41 patient” [5]. They are classified by different schools of thought using different criteria. Some have classified errors based
42 on the psychological process, level of severity of potential harm, degree of harm or the stage of the medication use
43 process at which the error occurred [1, 6]. While others have classified errors using criteria that inform preventive
44 strategies such as knowledge- based mistakes, action-based mistakes, rule-based mistakes and lapses or slips [7].

45 According to the National Coordination Council for Medication Error Reporting and Prevention (NCCMERP) a United
46 States based council with a mission to maximize safe use of drugs and increase medication error awareness and
47 reporting, a medication error is “any preventable event that may cause or lead to inappropriate medication use or patient
48 harm while the medication is in the control of the health care professional, the patient or the consumer”. The Council has
49 classified these errors into 9 categories (A to I) on the basis of harm it poses to the patient. [8]

50 Medication errors could occur at any step of the medication use process though the steps could vary in various healthcare
51 settings such as the outpatient or inpatient units [9, 10].

52 Basically, the medication use process entails the process of drug storage, preparing, prescribing, transcribing,
53 prescription verification, dispensing, administering and monitoring. [2, 3] All these stages are prone to errors. However
54 studies have shown that the most common reported errors occur during prescribing and administration [2, 11, 12, 13].

55 A prescription is information written by a medical practitioner (the prescriber) to the pharmacist with instructions on drugs
56 administration to the patient [14]. A prescription error is said to occur during the prescription writing process when there is
57 a reduced likelihood of timely and effective treatment or increase in the risk of harm to the patient [3].

58 It is the pharmacists’ responsibility to review a prescription and also dispense accurately according to the instructions on a
59 prescription ensuring that the patient understands how to administer the drugs [15].

60 Prescription verification, also known as medication order review, is a very vital step in the medication use process that
61 should minimize prescription errors to the barest minimum. It entails cross checking patient identity, patient data and the
62 prescribed drugs for correctness, completeness and ruling out possibility of drug interactions. Drugs dispensed by the
63 pharmacist should also be checked against the prescription and where required all dosage calculations should be
64 carefully done [16]. Health workers’ medication errors could result from personal health system and organizational factors.
65 Organizational policies, heavy work load, poor working conditions and the environment are some factors related to the
66 health system.

67 Personal factors such as level of experience, inadequate training, forgetfulness, carelessness, negligence, poor
68 motivation, inability to focus under pressure, wrong calculations, inadequate knowledge, defective communication style
69 and distractions have been identified to contribute to medication errors among others [11, 17].

70 Medication errors could result in devastating consequences to the patient, families, health care provider, health facility and
71 society. Although not all medications errors cause harm some could be life threatening, lead to prolonged hospital stay or
72 death [18]. The cost implication and trauma to the provider can also not be ignored. The reputation of the health facility
73 could be destroyed with very frequent occurrence of these incidents and confidence in the system is negatively affected
74 [19, 20].

75 Human immunodeficiency virus (HIV) infection is a chronic condition that requires lifelong antiretroviral therapy (ART)
76 which requires continuous monitoring and assessment for optimal outcomes. Medication errors in this instance such as
77 the wrong regimen, wrong dose or omission of a drug in the prescription or dispensing could lead to several negative
78 consequences such as treatment failure with its attendant morbidity and mortality as well as the development of drug
79 resistance and transmission of resistant virus in the community.

80 The continuous monitoring and follow up on the therapeutic outcome of treatment given to these individuals is therefore
81 of utmost importance [21].

82 The recent call especially in the developed world to reduce errors in the use of prescribed drugs by about 40-50% is
83 based on the fact that the base on which to make the comparison exists [7, 8, 12-14]. In most developing countries
84 including Nigeria these figures do not exist and needs to be established. This study was conducted to establish a baseline
85 as part of a quality improvement process in HIV/AIDS patient care. Our objectives were to estimate the incidence and
86 types of medication error and identify the prescribing process in which they occur to evaluate their clinical significance.

87 **2. METHODOLOGY**

88 **2.1 Study Setting and Design**

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91 The study was a cross-sectional survey conducted at a large HIV treatment Centre, in Lagos South western Nigeria. The
92 Centre is located in a medical research institution charged with the responsibility to conduct research into disease of
93 public health importance in the country. The Institute was among the 25 centres selected in 2002 to implement the
94 Federal Government of Nigeria antiretroviral drug access programme. It was selected principally to provide research
95 backup for the programme. Cumulatively over 24,000 HIV positive adults and children including pregnant women have
96 been enrolled into the programme.

97 Sixty five percent of the patients come from Lagos state while others are from the other 5 states of southwestern Nigeria,
98 North-central, South-south and South-eastern Nigeria. A little over 0.025% comes from the neighboring western African
99 countries. The services at the Centre are highly subsidized.

100 All patients' information is stored in the programme electronic database including details of patient's medication. All
101 antiretroviral drugs prescriptions were according to a unified patient's national HIV treatment guideline. In addition to the
102 antiretroviral drugs, other medications are prescribed to prevent or treat other co-morbidities. Prophylactic treatment are
103 also given to prevent emergence of opportunistic infections which might arise as a result of a deficient immune system
104 such as cotrimoxazole therapy given to individuals with a CD4 count less than 500 cells /mm³.

105 On typical clinic visits which are either based on scheduled appointment or event triggered, medications are prescribed by
106 the Medical practitioners using a structured prescription sheet. The prescription sheet has four sections which should be
107 completely filled. The first section captures the patient information such as the patient's name, identification number, date
108 of birth, weight, sex, visit date and allergy information. The second section captures all the names of the various
109 antiretroviral drugs available in the Centre with their corresponding codes which the prescriber selects as appropriate. The
110 third section is assigned to drugs prescribed for co-morbid conditions, while the last section is for the names and
111 signatures of the prescriber and pharmacist. The patients takes the prescription sheet to the pharmacists, who after a one
112 on one medication adherence counseling session and verification of medication by comparing the current prescription
113 with previous information on database dispenses the medication. The current prescription is thereafter used to update the
114 database. However, for the purpose of this study a second pharmacist screens the drugs handed over to the patient for
115 correctness and also checks data entry done by the first pharmacist. The medication use process in the clinic entails
116 prescribing, prescription verification, dispensing, data entry and monitoring.

117 **2.2 Study population**

118 HIV positive adults aged 18 years and older seen at the center for monthly antiretroviral drug refill and 6 monthly physician
119 consults over a 3months period from July 1st to September 2018 were invited to participate in the study. Prescribers were
120 unaware of the study, and Pharmacists were not aware of the second pharmacist review in order to avoid changes in
121 behavior

122 **2.3 Study sample size determination and sampling procedure**

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124 Raosoft online sample size calculator was used to calculate the sample size for the study.
125 (<http://www.raosoft.com/samplesize.html>)[RaosoftIncorporated:RaosoftSamplesize calculator. 2004, Available from URL:
126 <http://www.raosoft.com/samplesize.html>].

127 Given that there were approximately 24,000 adults on the programme, on the basis of the most conservative error
128 distribution of 50%, since no previous data in our environment and allowing 2.5% margin of error at 95% confidence
129 interval, the required minimum sample size was calculated to be 1448.

130 **2.4 Study Sample selection**

131 A systematic random sampling technique was used to select the patients whose prescriptions were used for the study.
132 On the average 350-400 patients requiring drug prescription are seen in each of the three clinic days in a week. For every
133 ten patients one was selected from the daily clinic attendance list during the study period for the study. Effort was made
134 to ensure patients were not sampled for more than once in the study

135 **2.5 Ethical Issues**

136 Ethical approval for the study was obtained from the Ethics committee of the Institution. Information about the study was
137 given to the patients who were selected from the sample frame by the lead researcher as part of the informed consent
138 process before signing the consent form. The prescriptions were reviewed by trained research assistants who were all
139 pharmacists. Thereafter the lead researcher and another setting of research assistants re reviewed the prescription after it
140 was dispensed.

141 **2.6 Data Collection**

142 The prescriptions of selected patients were screened for prescribing errors and information was collected in three stages.
143 The initial information collected were errors observed on the prescription sheet, then entry errors obtained by checking the
144 electronic record entered for each patient by the pharmacist in comparison to the information on the prescription sheet
145 and finally dispensing errors obtained by physical assessment of drugs handed over to the patients and the assessment
146 of directions given on drug administration.

147 Patient parameters such as age, gender and drug information were also obtained from the prescription sheet. All collected
148 data were entered into an excel spread sheet. Two pharmacists independently classified the observed errors and in cases
149 of discrepant classifications the lead researcher's classification was the tie breaker.

150 **2.7 Definition of terms and classification of medication error**

151 The National Coordination Council for Medication Error Reporting and Prevention, USA definition and classification of
152 medication error was adopted for this study.

153 **2.7.1 Category / Description Event**

154 **A** Circumstances or events occur that have the capacity to cause error.

- 155 **B** An error occurred but the error did not reach the patient.
- 156 **C** An error occurred that reached the patient, but did not cause patient harm.
- 157 **D** An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm, and /or
158 required intervention to preclude harm.

159 **Cases in which harm reaches patient**

- 160 **E** An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention.
- 161 **F** An error occurred that may have contributed to or resulted in temporary harm to the patient and required an initial or
162 prolonged hospital stay.
- 163 **G** An error occurred that may have contributed to or resulted in permanent harm.
- 164 **H** An error occurred that required intervention necessary to sustain life.
- 165 **I** An occurred that may have contributed to or resulted in patient death.

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167 **2.8 Data Management**

168 The obtained information were coded, entered into the computer and analyzed using the SPSS version 22.0 (SPSS Inc.
169 Chicago, IL) statistical packages. The main outcome variable was presence of medication error. Results were presented
170 using descriptive statistics.

171 **3. RESULTS AND DISCUSSION**

172 **3.1 RESULTS**

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174 A total of 1529 prescription were selected and analyzed during the study period of which 182(11.9%) had errors consisting
175 of doctor's (104; 57.1%) and pharmacists errors (78; 42.9%). Table 1 shows the characteristics of patients whose
176 prescriptions had errors and these were segregated into doctors' and pharmacists' errors.

177 Majority of the patients with doctors' and pharmacists' errors were females (58.6% and 56.4% respectively), aged 41-
178 50years (40.3% and 39.7% respectively), were on the first line antiretroviral drug regimen (60.6% and 66.7% respectively)
179 had errors of category D.

180 Table 2 describes the doctors and pharmacists who attended to the prescriptions with errors of which majority were
181 females (66.7% and 75% respectively) and in the 21-30years age group (40% and 75% respectively). Over 50% of the
182 doctors and the pharmacists in this cohort have less than 5 years of HIV management experience and no post graduate
183 qualification a greater percentage of the pharmacist (75%) have had less than three antiretroviral therapy training.
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A description and pattern of the doctors prescribing errors is displayed in table 3. Omission error (36.5%) was the most prevalent error with omission of cotrimoxazole from an eligible patient's prescription ranking highest. Errors in patient's data accounted for a total of 21.1% of the errors while prescription of wrong drug regimen and unsigned prescription occurred in close ranges of 14.4%, and 12.5% respectively.

Other observed errors of note were allergy status errors (5.8%), wrong dosage (3.9%) and blank prescriptions (5.8%).

Among the pharmacists' errors displayed in table 4, unsigned prescription (33.3%) and omission of drugs from dispensed drugs to patients for whom it was prescribed (28.2%) were of the highest occurrence. Other observed errors were data entry errors (15.3%), verification error (15.3%) and labeling errors (7.7%).

Table 1: Characteristics of patients whose prescriptions had errors

<i>S/N</i>	<i>Variables</i>	<i>Doctor's Errors</i> <i>n=104 (57.1)</i> <i>n=182 (11.9%)</i>	<i>Pharmacist's Errors</i> <i>n=78 (42.9)</i>
1	Sex		
	Male	43(41.4)	34(43.6)
	Female	61(58.6)	44(56.4)
2	Age		
	21-30	5(4.8)	4(5.1)
	31-40	34(32.7)	19(24.4)
	41-50	42(40.3)	31(39.7)
	51-60	16(15.4)	19(24.4)
	61-70	6(5.8)	5(6.4)
	>70	1(1.0)	0(0)
3	Antiretroviral Regimen		
	First Line	63(60.6)	52(66.7)
	Second Line	41(39.4)	26(33.3)
4	Error Category		
	Type B	23(22.1)	12(15.4)
	Type C	13(12.5)	26(33.3)
	Type D	68(65.4)	40(51.3)

Table 2: Characteristics of Doctors and Pharmacists who attended to the Prescriptions

<i>Variable</i>	<i>Doctors</i> <i>n=15(%)</i>	<i>Pharmacists</i> <i>n=8(%)</i>
Sex		
Male	5(33.3)	2(25)
Female	10(66.7)	6(75)

Age		
21-30	6(40)	6(75)
>30	9(60)	2(25)
Years of HIV Mgt Experience		
1-5	8(53.3)	6(75)
>5	7(46.7)	2(25)
Post Graduate Qualification		
Yes	7(46.7)	1(12.5)
No	8(53.3)	7(87.5)
No of ARV Training		
<3	7(46.7)	6(75)
>3	8(53.3)	2(25)

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Table 3: Doctors Prescription Errors

Types of Prescribing Errors	NCCMERP Classification	Frequency (%) , n =104
Omission Error	D	38(36.5)
Omission of cotrimoxazole		33
Omission of Isoniazid		2
Omission of one ARV Drug		3
Wrong drug regimen	D	15(14.4)
1 st line regimen prescribed instead of 2 nd line		5
Prescription of previous drug regimen		6
Wrong drug combination		4
Unsigned Prescriptions	C	13(12.5)
Failure to indicate name		3
Failure to sign Prescription		1
Failure to indicate name and signature		9
Allergy Issues	D	6(5.8)
Prescription of Cotrim to a patient with sulpha allergy		6
Blank Prescriptions	B	6(5.8)
No ARV drugs prescribed		6
Wrong dosage	D	4(3.9)
Full dose of ARV prescribed instead of reduced dose in patients with renal impairment		4
Error in Patient Data		22(21.1)
Wrong patient identification number	B	10
Error in weight	D	5
Error in visit date	B	3
Wrong date of birth	B	2
Gender Errors	B	2

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Table 4: Pharmacists' Dispensing, Verification and Entry Errors.

Types of Error	NCCMERP Classification	Frequency (%) n=78
Unsigned Prescription Failure to indicate name Failure to sign prescription Failure to indicate name & signature	C	26 (33.3) 7 8 11
Omission Errors among dispensed drugs Omission of Cotrimoxazole Omission of Isoniazid	D	22 (28.2) 20 2
Data Entry Errors Entry totally not made for drug pick up Entry not done for months of drug supplied Wrong months of drug supply entry Entry not done for cotrimoxazole dispensed Entry not done for isoniazid dispensed Wrong ARV Drug entry	B	12 (15.3) 4 1 3 2 1 1
Verification Error Failure to detect wrong ARV was prescribed Failure to detect omission of cotrim Failure to detect patient data not filled Failure to detect omission of Isoniazid Failure to detect wrong patient data filled	D	12 (15.3) 3 4 2 1 2
Labelling Error No dosage direction given Wrong dosage direction	D	6 (7.7) 4 2

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3.2 DISCUSSION

The overall frequency of medication error observed in this study was 11.9% which is similar to that reported by Al-khani and his colleagues [3] in Saudi Arabia (10%) whose research work was also carried out in the specialist clinic of a Research Institute. However these findings are much lower than reports from several other studies and this could be attributed to the fact that our study and that of Al Khani *et al* were conducted among a cohort of patients in a specialized clinic while other studies were conducted in hospital settings where patients are treated for varying diseases thus probably

226 a contributing factor to the observed higher error rates recorded by Sapkota *et al* (53%), Agalu *et al* (51.8%), Seden *et al*
227 (43.8%) and Sheikh *et al* (20%) [9 - 11, 19].

228 The most common error among the doctors in this study was medication omission error (36.5%) which occurred at the
229 prescribing stage. The pharmacists were also observed to have omitted prescribed medications from drugs dispensed to
230 the patients (28%). This pattern is in tandem with another study conducted in Wales and England by Harken and
231 colleagues [22] who reported omission errors as the most common error category (31.4%), from their work on medication
232 error incidents that resulted in death. Seden *et al* and Agalu *et al* [11, 19] have similarly reported omission error rates of
233 29.6% and 29.0 % respectively.

234 Majority of the patients whose prescription had errors in our study were of the age group 41-50 years. This is in contrast to
235 several studies that have observed high level of medication errors among geriatrics or critically ill patients in general
236 hospital settings [9, 20]. This high prevalence of medication error among this group of patients is attributed to poly
237 pharmacy which is quite common in their care. The observed prevalent age group in our study could be a reflection of the
238 age group with the highest burden of HIV/AIDS infection and the fact that the study is in an outpatient facility.

239 Pharmacists have a major role to play in preventing prescribing errors which could be averted at the stage of prescription
240 verification. The observed verification error rate of 15.3% in our study is worrisome because the doctor's errors ought to
241 be detected by the pharmacist and should not slip by as much as possible.

242 In this study a second pharmacist was engaged to screen the pharmacists' error and this helped identify some slips in the
243 verification process as well dispensing errors. The process of reviewing the pharmacy verification and dispensing
244 procedure by another pharmacist could be tedious and will ultimately prolong patient's waiting time especially in a large
245 treatment centre with limited number of Pharmacist. However, its effectiveness cannot be undermined.

246 The errors observed were mainly of the NCCMERP category D classification which represents errors that reached the
247 patient but requires monitoring to ensure no harm has been done to the patient. Intensified patient monitoring of treatment
248 outcome should be generally enforced to enable early detection of the aftermath medication errors.

249 Medication errors were most observed in doctors and pharmacists with less than 5 years of HIV care experience or less
250 than three antiretroviral therapy trainings. This emphasizes the need for training and retraining of healthcare workers, in
251 this case doctors and pharmacist to ensure accurate knowledge and skill in the conduct of their professional duties. There
252 is also need for occasional review or audit of the prescription and dispensing processes to ensure that errors are nipped in
253 the bud and that preventive strategies are instituted or maintained.

254 Organizational and personal factors contribute to medication errors in health care settings. Identifying these factors which
255 are specific to individual health care settings and developing strategies to ameliorate their occurrence and impact should
256 be the goal of every organization.

257 **4. CONCLUSION**

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260 Omission error was common among doctors and pharmacists in this study and it was principally associated with the drug
261 cotrimoxazole which is a very important part of therapy for people living with HIV/AIDS. Continuous training of health care
262 workers in HIV/AIDS management is recommended. Factors that contribute to medication error in this setting should be
263 investigated and strategies devised to address them.

264 **COMPETING INTERESTS**

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267 Authors have declared that no competing interests exist.
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270 **CONSENT**

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272 All authors declare that written informed consent was obtained from patients for use of their data for study and those who
273 declined to give consent were excluded from research.

274 **ETHICAL APPROVAL**

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278 Ethical approval for the study was obtained from the ethics committee of the Nigerian Institute of Medical Research.
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