Assessment of Rational Antibiotic Prescribing in Public Hospitals in Nasarawa State, Nigeria

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ABSTRACT

Antibiotics are the most commonly used medicines in healthcare facilities globally; and they are often misused, especially in developing countries. Periodic assessment of antibiotic prescribing practices is essential to improve prescribing standards and ensure rational use. A cross-sectional, retrospective evaluation of antibiotic prescribing in public secondary and tertiary hospitals in Nasarawa State, Nigeria was carried out. A total of 2800 case sheets of patients who accessed the hospitals under review during the period 2008-2018 were randomly sampled and evaluated. Prescribing indicators of World Health Organization (WHO) and Strengthening Pharmaceutical System/United States Agency for International Development (SPS/USAID) were evaluated and compared with published standards for each of the indicators to identify irrational antibiotic use. Percentage of hospitalization with one or more antimicrobials prescribed was 75.6%. Average number of antimicrobials prescribed per hospitalization in which antibiotics were used was 1.75 ± 0.66 . Percentage of antibiotic prescribed consistent with hospital formulary was 100.0%. Average duration of prescribed antimicrobial treatment was 5.57 ± 2.42 days. Percentage of antimicrobials prescribed by generic name was 45.8%. Percentage of injectable antibiotic used was 36.4%. Percentage of antimicrobials prescribed from the national essential medicine list was 85.7%. Average encounter with antibiotic was 0.82 ± 0.2 . Many of the prescribing indicators deviated from the WHO or SPS/USAID optimal values; and thus, were predictors of irrational antibiotic prescribing. Continuous education and re-training of prescribers in public hospitals in Nasarawa State to comply with approved standards of prescribing should be emphasized in to ensure rational antibiotic use.

Keywords: Antibiotic; periodic assessment; public hospitals; rational antibiotics.

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I. INTRODUCTION

Medicines play a vital role in healthcare delivery as drug therapy has remained the most commonly used method to manage diseases in medical practice, leading to reduction in mortality, disease burden and quality of life [1]. Seventy-four (74%) of hospital out-patient visits involve the administration of medicines [2]. Consequently, there is critical need for appropriate/rational use of medicines to ensure appropriate medical care to patients and the quality of health outcomes [3]. However, their use is often inappropriate, making the need to register the patterns of drug use essential to improve prescribing standards [2], [4]. According to the World Health Organization, over 50% of medicines prescribed, administered or vended globally are done inappropriately [5].

Rational drug use refers to the prescription of the right drug, for the right patient (indication), at the right dosage and dosing frequency, for the right duration and at the right (lowest) cost to the patients and their community [6], [7], [8]. In view of this, the use of medicines that do not meet the needs of patients in terms of disease condition, dose, frequency and duration of therapy is described as inappropriate (irrational) use of medicines [9]. Rational use

of drugs has become an indicator for measuring quality of healthcare [10], [11].

Antibiotics are a type of antimicrobial drug used to treat and prevent bacterial infection by either by killing or inhibiting the growth of bacteria [12]. Antibiotics are the most prescribed drugs worldwide in hospital settings; and play a vital role in combating bacterial infection and maintaining the health of individuals especially in developing countries [13].

The World Health Organization has defined rational use of antibiotics as 'the cost-effective use of antibiotics which maximizes clinical therapeutic effect while minimizing both drug-related toxicity and the development of antimicrobial resistance (AMR)' [14]. The rational (prudent) use of antibiotics will reduce healthcare costs and potential adverse effects to the individual taking them and also diminishes the wide ecologic effects leading to selection of antibiotic resistant bacteria [15]. The most effective strategy for combating antibiotic resistance is rational antibiotic prescription [16].

The critical step to limit the irrational use of medicines is to quantify the extent to which irrational use is occurring. The WHO, in collaboration with the International Network of

Rational Use of Drugs (INRUD), developed a set of indicators to measure the performance of healthcare facilities related to the utilization of drugs. Although the drug use indicators were originally created to measure drug use in out-patient settings in primary level facilities [14], their use has been extended to in-patients settings of tertiary hospitals [12], [17], [18], [19],[20], [21], [22],[23], [24]. Specifically, the WHO prescribing indicators are the average number of medicines prescribed per patient encounter, percentage of medicines prescribed by generic name, percentage of patient encounters with an antibiotic prescribed, percentage of patient encounters with prescribed injection and the percentage of medicines prescribed from the National essential medicines list (NEML) [15]. Apart from the WHO/INRUD drug use indicators, the USAID-funded Strengthening Pharmaceutical Systems Program developed 17 Antimicrobial Use Indicators – 5 (Indicator 1-5) are hospital-related, 9 (Indicator 6-14) are prescribing indicators, 2 (Indicator 15-16) are patient care indicators and 1 (Indicator 17) is a supplemental indicator [25]. The prescribing indicators are: Indicator 6 (Percentage of hospitalizations with one or more antimicrobials prescribed); Indicator 7 (Average number of antimicrobials prescribed per hospitalization in which antimicrobials were prescribed); Indicator 8 (Percentage of antimicrobials prescribed consistent with the hospital formulary list, which may or may not be part of national essential medicine list or formulary); Indicator 9 (Average cost of antimicrobials prescribed per hospitalization in which antimicrobials were prescribed); Indicator 10 (Average duration of prescribed antimicrobial treatment); Indicator 11 (Percentage of patients who receive surgical antimicrobial prophylaxis for cesarean section in accordance with hospital guideline); Indicator 12 (Average number of doses of surgical antimicrobial prophylaxis prescribed for cesarean section procedures); Indicator 13 (Percentage of patients with pneumonia who are prescribed antimicrobials in accordance with standard treatment guidelines); and Indicator 14 (Percentage of antimicrobials prescribed by generic name).

The extent of drug use is directly affected by the prescribing behaviour of medical doctors and other healthcare professionals (e.g. nurses, pharmacy technicians, community health workers and health assistants) who sometimes find themselves in the capacity of drug prescribers to patients [26], [27]. Consequently, studying prescribing patterns of medicines in general and antibiotic in particular aids in identifying irrational prescribing behaviors to make therapy more rational and cost effective [28].

Many studies to evaluate rational use of medicines (including antibiotics) in many countries have been reported using the WHO indicators have shown that antibiotic prescription practices vary widely between countries and healthcare facilities [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39]. In resource scarce setting where routine empirical antibiotic use, reported either in the form of self-medication or irrational use in healthcare facilities, is widespread, prescription pattern also varies widely [40].

In Nigeria, several studies on antibiotic prescribing practice has been reported [41], [42], [43]. Studies conducted by [42] and [43] reported that up to 50% of antibiotic prescriptions may be in the form of empirical prescriptions.

No study on antibiotic prescribing practice in healthcare centres in Nasarawa State, Nigeria has been reported. This study investigates antibiotics prescribing practices in public hospitals in Nasarawa State, Nigeria. The supervision of antimicrobial use has environmental, economic and clinical implications [1].

II. MATERIALS AND METHODS

A. Study Area

The study was conducted in tertiary and secondary healthcare centres in Nasarawa State, Nigeria. The healthcare centres include all general hospitals, specialist hospitals and Federal Medical Centre, Keffi, Nigeria.

B. Study Design and Outcome Variable

It was a prospective, descriptive and observational study, designed according to the objectives of the study. The outcome indicators are related to prescribing indicators.

C. Study inclusion/exclusion criteria

All patients, from both genders and all age groups, which attended secondary and tertiary healthcare centres in Nasarawa State, Nigeria, during the study period from January 2008 to December 2018, were included in our study.

D. Ethical Approval

Ethical clearance was obtained from the Ethics and Scientific Review Committee of Nasarawa State Hospital Management Board, Lafia. This was after submission and defence of the Research Protocol and Informed Consent before the Committee.

E. Sampling and Data Collection

The standard forms provided by WHO were used for data collection. The guidelines and methods were followed to ensure the reliability of all collected data [1]. The data was collected during a period of 10 years from January 2008 to December 2018.

III. RESULTS AND DISCUSSION

A. Antibiotic Prescribing Indicators

The antibiotic prescribing indicators in Nasarawa State during the 10-year period (2008-2018) are given in Table I.

Percentage of hospitalization with one or more antibiotic prescribed was 75.6%. All the hospitals had over 50% of its patients prescribed 1 or more antibiotic with the highest in General Hospital Obi (98.3%) and the lowest in General Hospital Akwanga (56.8%) and Nasarawa Eggon (56.8%).

Average number of antimicrobials prescribed per hospitalization in which antibiotics were used ($\pm$ SD) was 1.75 ± 0.66 ; with the highest in General Hospital Nasarawa Eggon (2.81 ± 0.31) and the lowest in General Hospital Keffi (0.72 ± 0.12).

Average encounter with antimicrobial ($\pm$ SD) was 0.82 ± 0.2 ; with the highest in General Hospital Awe (1.07 ± 0.63) and the lowest in General Hospital Keana (0.54 ± 0.23).

TABLE I: INDICES OF RATIONAL ANTIBIOTIC PRESCRIPTION IN TERTIARY AND SECONDARY HOSPITALS IN NASARAWA STATE, NIGERIA DURING THE PERIOD 2008-2018

S/N	Prescribing Indicator	Value (Percentage or Average Number)	*WHO/INRUD or **SPS/USAID Standard	§African Standard	Remarks
1	Percentage of hospitalization with one or more antibiotic prescribed	75.6%	20.0–26.8%	45.9%	Fail
2	Average number of antimicrobials prescribed per hospitalization in which antibiotics were used ($\pm$ SD)	1.75 $\pm$ 0.66	1.6–1.8	-	Pass
3	Average Encounter with antibiotic ($\pm$ SD)	0.82 $\pm$ 0.2	≤ 2	-	Pass
4	Percentage of antimicrobials prescribed consistent with hospital formulary	100.0%	100.0%	-	Pass
5	Average duration of prescribed antimicrobial treatment ($\pm$ SD) in days	5.57 $\pm$ 2.42	7-9	-	Pass
6	Percentage of antimicrobials prescribed by generic name	45.8%	100.0%	65.1%	Fail
7	Percentage of injectable antibiotic used	36.4%	13.4–24.1%	28.4%	Fail
8	Percentage antibiotics in an National Essential Medicine List	85.7%	100.0%	89.0%	Fail

*[8],[25],[44].

Percentage of antimicrobial prescribed consistent with hospital formulary was 100.0% in all the hospitals; with 100% in each of the hospitals.

Average duration of prescribed antimicrobial treatment ($\pm$ SD) was 5.57 $\pm$ 2.42; with the highest in General Hospital Obi (7.42 $\pm$ 0.80) and the lowest in General Hospital Nasarawa (5.1 $\pm$ 2.80).

Percentage of antibiotics prescribed by generic name was 45.8%; with the highest in General Hospital Akwanga (84.0%) and the lowest in General Hospital Nasarawa (24.1%).

Percentage of injectable antibiotic used was 36.4%; with the highest in Federal Medical Centre Keffi (62.8%) and the lowest in General Hospital Obi (21.2%).

Percentage of antibiotics used in the essential medicine list was 85.7%. The highest (100.0%) was in General Hospital Awe, General Hospital Doma, Dalhatu Araf Specialist Hospital Lafia and Federal Medical Centre Keffi; and the lowest (66.7%) in General Hospital Nasarawa Eggon, General Hospital Keana and General Hospital Karu.

Inappropriate use of antibiotics is a major cause of antibiotic resistance, treatment failure, increase in the costs of healthcare and an increased occurrence of adverse drug reactions in many countries [31],[45]. Hence, there is the need to adopt measures to promote rational use of medicines. The rational use of drugs is associated with several factors, including health care workers, patients, patient load and health care facilities [31],[46]. Factors that influence rational drug prescription by prescribing health workers include training for rational drugs, years of practice, and educational background [31], [47]. The rational drug prescription is also influenced by the characteristics of health care facilities, including the availability of treatment guidelines and the availability of drugs [31], [46].

This study found that the percentage of hospitalization with one or more antimicrobials prescribed (Indicator 6) was 75.6%. This value is higher than both the WHO (20.0–26.8%) standard [12] and African (45.9%) standard. It however, differ from the 72% from Freetown, Sierra Leone [23], 79% observed from a tertiary hospital in Eritrea [48], 83% from Liberia [49], 82.5% from eastern Ethiopia [50] and 58.1%

from southern Ethiopia [51]. Studies from Nigeria have shown 28% [52], 42% [53], 49.2% [54], 49.5% [24], 56% [55] and 94.14% [27]. This high percentage of antibiotics being prescribed may be due to increased prevalence of infectious diseases in the developing countries necessitating increased amounts of antibiotics being prescribed, high level of routine empirical treatments seen in resource-poor countries, patient pressure on prescribers, self-medication and allowing other healthcare professionals (e.g. health assistants, associate nurses, nurses, health technicians and others) to prescribe [26], [56]. Since this indicator directly measures the extent of antimicrobial use in hospitals, it is safe to conclude that public hospitals in Nasarawa State overuse antimicrobials. Overuse of antibiotics is a common problem in healthcare, which leads to unnecessary expenditure on drugs, raised risk of adverse reactions, and the development of antimicrobial resistance [13].

The observed 1.75 $\pm$ 0.66 value for average number of antimicrobials prescribed per hospitalization in which antibiotics were used is within the WHO optimal range of 1.6–1.8. While this is commendable for the study area, studies from other parts of Nigeria have shown 1.08 [27] and 1.28 [53]. Our study finding agrees with [57] who reported a value of 1.77; but differs from [39], [58], who reported 1.29, 1.9, 2.0 and 3.5 respectively.

The average encounter with antibiotics observed in this study (0.82 $\pm$ 0.2) was in line with the WHO (≤ 2) standard [12]. Previous study elsewhere described by [58], however reported 2.1 $\pm$ 0.3. The average encounter with antibiotics observed in this study shows that too many antibiotics were not used per prescription.

The Percentage of antibiotic prescribed consistent with hospital formulary was 100.0%, a value same as the WHO (100%) standard [12]. Deviation from the WHO standard has been reported by [12] who observed 53.6% in Ghana Police Hospital. Since this indicator measures the degree of prescriber's adherence to the hospital formulary list, the value observed value suggests that the hospitals in the study area adhered to the list of medicines approved by the hospital's Drug and Therapeutics Committee for purchase and prescribing in the hospital. If such a list does not exist, it will

be necessary to refer to an NEML provided by the ministry of health. Formulary lists represent one way to optimize the use of medicines. Non-adherence to such hospital policy may be caused by prescribers not being aware of or in agreement with the list, listed antimicrobials not being available at the hospital, or prescriptions being listed with brand names while medicines are stocked and dispensed under generic names.

The average duration of antimicrobial treatment observed in this study was 5.57 ± 2.42 days, a value lower than the SPS/USAID (7-9 days) standard [25]. Previous studies elsewhere observed 5.4 days [12], 5.65 days and 6.36 days in Eritrea [39]. The optimal duration of therapy for many bacterial infections has not been determined, but the current recommendation is usually 7–10 days of treatment, with longer treatment courses for some diseases, for example, meningitis for 14 days and osteomyelitis for up to six weeks [25]. Since this indicator measures the intensity of patient exposure to antimicrobials during a hospitalization (that is, assesses the length of time antimicrobials are prescribed irrespective of routes of administration or changes in dosage, the observed value from this study indicates insufficient exposure of patients to antimicrobials during treatment. This can provide selective pressure for development of AMR as too short a course of treatment may prolong patient morbidity and promote emergence of drug-resistant organisms [25].

Generic prescribing was found to be 45.8%, a value lower than both the WHO (100%) standard [12] and African (65.1%) standard [44]. The observed percentage generic prescribing is lower than 83.14% in Eritrea by [48], 96%, 97% by [48], 98.14% by [58] and 98.7% by [51] but higher than 13.18% reported by [59]. The observed low percentage of generic prescription of antibiotics suggests that the public hospitals in the study area use of unnecessarily expensive drugs when cheaper effective alternatives are available. Other studies elsewhere have reported poor generic prescribing as follows: 13% in Nepal [59], 30.6% in Brazil [60], 38% in Liberia [49], 45.2% in South Africa [61], 57% in Sierra Leone [23] and 66.8% in Zaria, Nigeria [24]. Some possible reasons for this non-compliance may include: lack (or poor implementation) of policy on the procurement of antibiotics using generic names, ease of writing of common brand names as opposed to long generic names, high-powered marketing by pharmaceutical sales men, habit, empiric treatment amongst others. Prescribing with generics has notable impact on the rational use of drug with respect to cost, safety and efficacy by permitting the identification of the products by its scientific name [10],[11]. There is thus a need for refresher training for prescribers to conform to the standards in prescribing medicines for patients by generic names.

The percentage of injectable antibiotics used was 36.4%. This value is higher than both the WHO (13.4–24.1%) standard [12] and the African (28.4%) standard [11]. The percentage injectable antibiotic observed in this study was higher than 6.3% by [13], 7.8% in Eritrea [39], 11.2% in Ethiopia (Bilal *et al.*, 2016) and 26% in Sierra Leone [39]; but lower than 38% by [51] and 67.7% in Zaria, Nigeria [24]. The high percentage use of injectable antibiotics observed is not appropriate as unnecessary use of injections increases treatment costs, increases risk of infection with blood borne

pathogens if needle stick injuries arise and injections need trained health care professional to administer [31]. Prescribers are advised to prescribe non-parenteral routes of administration whenever possible since due to their safety and affordability by patients [62].

The percentage of antibiotics prescribed from the National Essential Medicine List (NEML) was 85.7%, a value lower than both the WHO (100%) standard [12] and African (89%) standard [34]. This suggests non-compliance of practices with the Nigerian National Drug Policy on EML. Previous studies have reported 95.5% in Zaria, Nigeria [24], 95.3% in Ethiopia [31], 100% in Abuja, Nigeria [27] and 100% in Eritrea [39], 32.8% in Nepal [59], 63.9% in Sierra Leone [34], 67.7% in Western China [63]. Possible reasons for deviation from WHO standard include: non-availability of the EML at the hospitals for the prescribers to get acquainted with; non-availability of such antibiotics from the drug store; and failure to strictly implement the Nigerian National Drug Policy on prescribing from the essential medicine list. Essential medicines lists promote the use of a minimum number of selected medicines with the intention of ensuring their more rational use at the least possible cost to the health system and consumers. Therefore, it is not sufficient to develop a NEML, it is more crucial to ensure its acceptance and use by the prescribers.

IV. CONCLUSION

Our study revealed that some antibiotic prescribing indicators in the public hospitals in Nasarawa State, Nigeria, deviate from WHO standard for rational prescribing while others complied with it. Compliance was observed in respect of: average number of antimicrobials prescribed per hospitalization in which antibiotics were used, average patient encounter with antibiotic and percentage of antimicrobials prescribed consistent with hospital formulary. Non-compliance was observed in respect of: percentage of hospitalization with one or more antibiotic prescribed, average duration of prescribed antimicrobial treatment, percentage of antimicrobials prescribed by generic name, percentage of injectable antibiotic used and percentage of antimicrobials on National Essential Medicine List. Concrete steps should be taken to: reduce overuse of antibiotic use, increase antimicrobial treatment period, improve generic prescribing, reduce use of injectable dosage forms and improve adherence of prescribers to the National Essential Medicine List (NEML). To achieve all these, training and extensive continuing education programmes targeting prescribers; and regular updating and wide dissemination of National Standard Treatment Guideline should be promoted.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

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