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Point Prevalence Study of Antibiotics use in Paediatric Wards of a Tertiary Health Facility in Kaduna Nigeria

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Abstract:- Children often receive prescriptions for antibiotics due to their relatively high rates of infection. Overuse or inappropriate antibiotics prescription can contribute to the development of drug resistance, longer hospital stays, and higher healthcare costs. Proper regulation of antibiotic use is necessary to protect the effectiveness of these limited treatment options. This study was conducted to determine prevalence of antibiotics use to establish baseline data for audit, formulate guidelines, support prescribing initiatives and ultimately improve quality of antibiotics use.

Treatment charts in all paediatric wards were reviewed on a single day for antibiotics prescription. The names, doses, routes, duration and indications for antibiotics use were noted. Appropriateness of the antibiotic agent, doses, frequency and route of administration was determined through unanimous decision of all authors using best available evidence.

A total of 83 children were on admission and 66 (79.5%) were receiving antibiotics, 62 (93.9%) parenterally. Rates of antibiotics use in the wards were 80.0%, 70.6%, 64.3%, 93.3% and 97.7% in Emergency Paediatric Unit (EPU), Paediatric Medical Ward (PMW) and B, and out born and inborn units of Special Care Baby Unit (SCBU) respectively. The most prescribed antibiotic was Ceftrixone (74.2%). Some of the irrational antibiotic use noted are prolonged duration of antibiotic (63.6%), no microbiological requests (62.1%), incorrect doses (37.9%) and inappropriate choice of antibiotics for infection type (27.3%). In a quarter of cases antibiotics were not indicated.

Low antibiotics prescription threshold was observed with antibiotics started empirically and continued against microbiological evidence. Differences exist in antibiotic usage in the wards with high variability in dosing for same indications.

***Keywords**:- Antimicrobial stewardship; Point Prevalence study; Antibiotics; Antibiotic prescribing.*

I. INTRODUCTION

Children are more susceptible to infections due to a number of factors, including their relatively immature immune systems and the reduced level of passive immunity they receive from their mothers. They are also exposed to a wide range of microorganisms in the environment, many of which can cause illness and pose a significant threat to their existence. (1)

Consequently, childhood infections are a leading cause of illness and death among children in tropical regions, (2) and as a result, children often disproportionately receive a high number of antibiotic prescriptions to treat or prevent these infections. (1)

The overuse of antibiotics can contribute to the development of drug resistance in bacteria, which allows the bacteria to become resistant to the effects of antibiotics. (3) This occurs when the microorganisms evolve to survive exposure to the antimicrobials, leading to treatments that were previously effective becoming ineffective, causing the infections to persist, and potentially spread to others. (4) This leads to prolonged hospital stays and higher healthcare costs, including the costs of diagnostic testing. It can also result in more visits to the emergency room due to adverse reactions to the antibiotics.

The inappropriate use of antibiotics can put everyone at risk and the resulting antibiotic resistance is a major challenge for modern medicine. (5) Antimicrobial resistance is a growing global health crisis that threatens the effectiveness of treatments for infectious diseases. According to the World Health Organization (WHO), antimicrobial resistance is one of the top ten global threats to health and could lead to the spread of untreatable infections. (6)

Everyone has a role to play in addressing antimicrobial resistance. The WHO has developed a Global Action Plan on Antimicrobial Resistance, (7) which outlines a series of actions to address this issue. These actions include improving surveillance, regulating the use of antimicrobials, and promoting the development of new antimicrobials.

Rational use of antibiotics entails following guidelines and recommendations for responsible antibiotic prescribing, such as prescribing antibiotics only when necessary, selecting the most appropriate antibiotic for the specific infection, and following proper dosing and treatment duration. Additional strategies for promoting the responsible use of antibiotics include implementing antibiotic stewardship programs (8) to optimize antibiotic use and prevent resistance and regulating the sale and distribution of antibiotics. (9)

The prevalence of antibiotic use varies significantly around the world, depending on the specific population, location, and research methods employed in the studies. Generally, antibiotic prescription and usage rates are typically lower in developed countries compared to less developed countries. (12) However, even within a specific region, the rates of antibiotic use can vary significantly depending on the specific subpopulation being studied and the location of the study.

Studies of antibiotic use among hospitalized patients have shown different rates compared to studies conducted among outpatient or community populations. Additionally, studies of antibiotic use in pediatric wards tend to report higher rates compared to studies of adult wards. (13-20)

In Africa, the prevalence of antibiotic use ranges from 27.8% - 74.7% among adult inpatients employing the Global Point Prevalence Survey (PPS) methodology. (12) Many studies conducted in Nigeria have used a variety of research methodologies, including descriptive retrospective design (16) and various PPS methods. (19, 22-25) There is a lack of data on antimicrobial prescription in hospitalized Nigerian children using the World Health Organization (WHO) PPS methodology in Nigeria. (16)

This study was conducted to determine the point prevalence rate of antibiotic use in the paediatric wards of Barau Dikko Teaching Hospital, to evaluate antibiotic prescribing practices in paediatric wards of the hospital, to establish baseline data for local audit, to formulate guidelines to promote prudent antibiotic prescribing, to identify targets for quality improvement and to support prescribing initiatives to ultimately improve quality of antibiotics use in the paediatric wards of our institution.

II. METHODS

A. *Study Location:*

The study was conducted in the pediatric wards of a Teaching Hospital. The pediatric wards consist of Emergency Pediatric Unit (EPU), two Pediatric Medical Wards (Wards A and B), two separate arms of the Special Care Baby Unit (Inborn and Out-born SCBU). Together these wards have a total bed compliment of 83 beds, of which 25 are for EPU, 16 and 14 for Wards A and B respectively, while 16 and 12 beds are for out born and inborn units of SCBU respectively.

B. *Study Design:*

Point prevalence study (PPS) design was employed for the survey using the WHO methodology for point prevalence survey on antibiotic use in hospitals. (26) All children hospitalized in all the paediatric wards of Barau Dikko Teaching Hospital as inpatients at or before 08:00 hours on the study date were included in this study. Treatment charts of all children enrolled for the study were reviewed for data on antibiotic use using standardised forms. The names, doses, routes, duration and indications for all ongoing antibiotics treatment as at 08:00 hours were noted. Case notes of all included children were also reviewed to identify the documented indications for the antibiotics used and to note any bacteriological tests requested and results obtained in relation to the antibiotics used. Antibiotics are reported with the written name according to the clinical notes. Each antibiotic substance was counted only once, regardless of whether different formulations were prescribed or that the same substance was prescribed more than once with interrupted treatment in between.

The duration of intravenous therapy was taken to be the time from first prescription to the day of the study date. The total duration for those continuing intravenous therapy was not taken because of the study design being a point prevalence survey. The time to oral switch from intravenous route was calculated from the time of first intravenous prescription to the time the drug was changed to oral route in patients who were initiated on intravenous therapy. Appropriateness of the antibiotic agent, doses, frequency and route of administration was determined through unanimous decision of all authors using the British National Formulary for Children (29) or any best available evidence or any national guidelines. (28) Missing or incomplete data was classified as inappropriate. If the antibiotic is used for more than one indication, it is reported as “Not assessable” and if the antibiotic is not linked to any indication, it is reported as “No information”. (26)

The authors were the team of investigators who were responsible for conducting the survey under the supervision of the lead author. A one-day special training on the PPS methodology was conducted prior to the study date. A pilot study was then conducted with each of the authors independently reviewing case notes and treatment charts of 5 patients, the results of which were then compared. This ensured uniformity in data extraction procedures and ensured internal validity.

C. *Exclusion Criteria:*

Any antibiotic use initiated after 08:00 hours or antibiotic treatment that was discontinued before 08:00 hours was excluded from the study. Ophthalmic and topical antibiotics were also excluded.

D. *Data analysis*

Data related to the ward such as ward type and number of patients present or eligible for the survey was noted. Patient data consisting of demographic variables and variables related to risk factors for receiving antibiotics were taken. Collects information on each antibiotic prescribed and/or dispensed to the patient. When the antibiotic was a combination product, the combination product was recorded as one antibiotic. Conversely, if two or more single products were prescribed to replace a combination product, each single product was entered independently. Proportions of patients receiving antibiotics were calculated. Results are given as numbers, percentages and proportions as appropriate, and presented in prose, graphs and tables where appropriate.

III. RESULTS

All available beds in the paediatrics wards were occupied as at 08:00 hours on the study date, giving a bed occupancy rate of 100%. All children who were receiving at least one antibiotic were eligible and included.

A. Prevalence of antibiotics use

A total of 66 children were receiving antibiotics treatment as at 08:00 hours on the study date, giving the point prevalence rate of 79.5%. (Fig I).

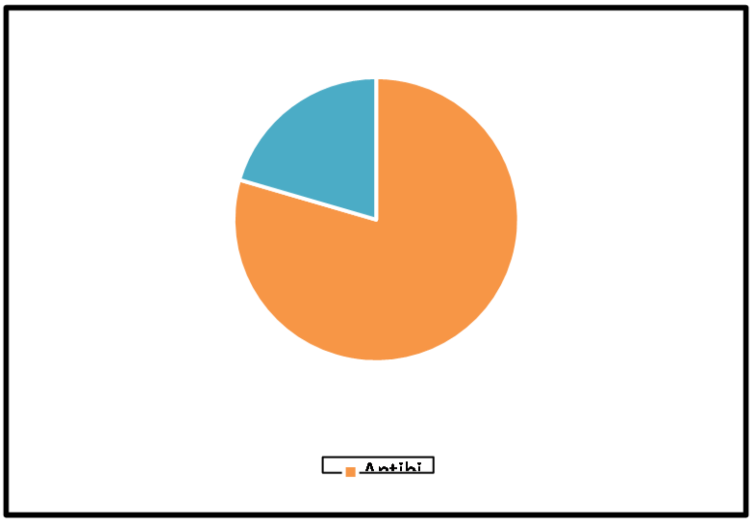

Fig 1: Point prevalence of antibiotics use

B. Prevalence of antibiotic use by wards:

Differences between wards in antibiotics use were noted. The relative contribution of each of the wards is presented in 1. In the EPU, 20 of the 25 children on admission (80.0%) were on antibiotics. Similarly, out of the 17 and 14 children on admission in wards A and B, 12 (70.6%) and 9 (64.3%) were on antibiotics respectively. In the out-born and inborn wings of the SCBU, 14 (93.3%) and 11 (97.7%) of the 15 and 12 neonates on admission were on antibiotics respectively. (Table 1).

C. Sex prevalence:

There was a slight female preponderance with a male-female ratio of 1:1.2 with more males on antibiotics (84.2%) than females (75.6%) respectively. However, these observed differences were not statistically significant (p = 0.74.)

Characteristics	On Admission	On Antibiotics	%
Wards:			
EPU	25	20	80.0
Ward A	17	12	70.6
Ward B	14	9	64.3
Out-born SCBU	15	14	93.3
Inborn SCBU	12	11	97.7

Table 1: Antibiotics use by wards

D. Routes of antibiotics:

The routes of antibiotics used in the pediatrics wards are shown (Fig 2). An overwhelming proportion of those on antibiotics (84.8%) were receiving it via the intravenous route and only 6.1% had oral antibiotics. `

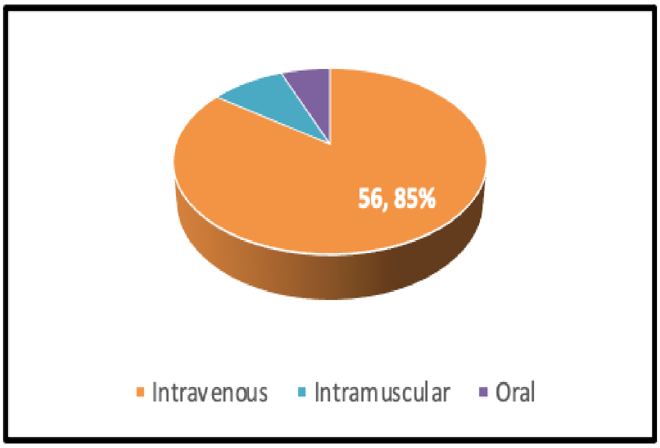

Fig. 2: Routes of antibiotics

Table 2 shows the routes of antibiotics segregated by wards and the average time to switch from intravenous route to the oral route in days. Overall, 23 (92.0%) of all neonates on antibiotics in the two units of the SCBU were on intravenous antibiotics. However, there is no statistically significant difference between the pediatric wards (EPU, wards A and B) and neonatal wards (Out born and inborn SCBU) with respect to the routes of antibiotics (parenteral versus oral). ($X^{2=}$ 2.8 p = 0.09)

The average time to change from the intravenous to the oral route for all the wards was 2 days. It was longest in the EPU (3 days).

E. *Indications for antibiotics by ward according to routes of administration:*

Table 3 shows the reported indications for the prescribed antibiotics according to the source of infection. Community acquired infections was overall recorded as the indication in 39 (59.1%) of the prescribed antibiotics.

This was followed by medical prophylaxis recorded as the indication for antibiotic use in 14 (21.2%) and hospital:

Route	EPU	Ward A	Ward B	Out-born SCBU	Inborn SCBU n (%)	Total n=66
Parenteral						
IM	2	1	1	0	2 (33.3%)	6 (9.1%)
IV-C	0	0	1	2	1 (33.3%)	3 (4.5%)
IV-B	16	7	5	12	8 (16.7%)	48 (72.7%)
IV-E	1	0	0	0	0 (0.0%)	3 (4.5$)
O	-	-	-	-	-	-
Oral	1	1	2	0	0	4
Oral switch (days)	3	2	1	0	0	2

Table 2: Antibiotics use by wards according to routes of administration

Key: IM: intramuscular IV-B: intermittent intravenous
IV-C: continuous intravenous IV-E: extended intravenous
O: Oral

associated infections in 9 (13.6%). Community-acquired infections were reported as an indication for antibiotic use all the wards, while a case of surgical prophylaxis was recorded in the EPU, and another case had no documentation in the inborn SCBU.

Indication	EPU	Ward A	Ward B	Out-born SCBU	Inborn SCBU	Total n (%)
CAI	10	9	8	12	0	39 (59.1)
MP	5	2	1	0	6	14 (21.2)
HAI	2	1	0	2	4	9 (13.6)
SP	1	0	0	0	0	1 (1.5)
Others	0	0	0	0	1	1 (1.5)

Table 3: Indications for antibiotics by ward

HAI: hospital-associated infection CAI: community-acquired infection SP: surgical prophylaxis MP: medical prophylaxis O: Other

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F. Medical devices and antibiotics use:

Majority of those who had either a peripheral or vascular intravenous line (89.4%) were on antibiotics. However, only 4 out of 13 (30.8%) children with intubation in situ were on antibiotics at the time of the study (Figure 3).

G. Most Frequently prescribed antibiotics:

The most prescribed antibiotic was Ceftrixone across all the paediatric wards, being a component of therapy in 49 (74.2%) of children. This was closely followed by Genticin (47.0%), Ampiclox (22.7%), Amoxiclav (21.2%), Crystalline Penincilline (13.6%) and Cotrimoxazole (10.6%) (See table 4). Other antibiotics used for children include Ampicilline, Cefuroxime, Erythromycine, Clindamycine and metronidazole.

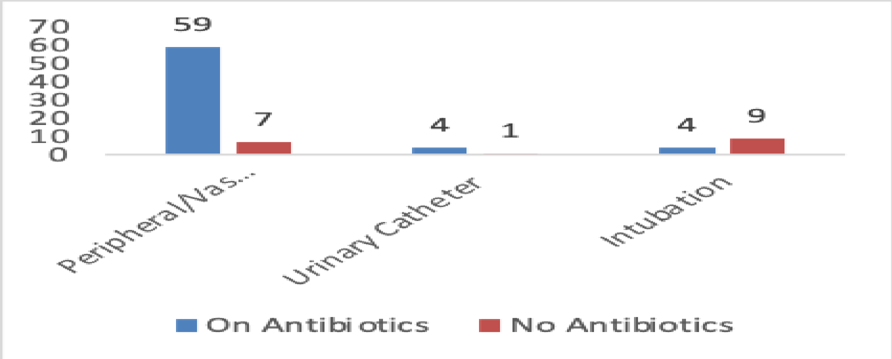

Fig. 3: Antibiotics use by children on medical devices

H. Irrational Antibiotics Use:

Table 5 depicts the types of irrational prescribing noted in the paediatrics wards. The most irrational antibiotic use of antibiotics in the pediatric wards noted was prolonged use of parenteral routes without switching to the oral route. This was evident in 63.6% of all antibiotic prescriptions. Most of the prescriptions for antibiotics were found to have been prescribed empirically and 62.1% of these antibiotics were started without taking appropriate samples for microbiological tests. Incorrect doses was noted in 37.9% of all antibiotic prescriptions. Inappropriate antibiotics for infection type was found in 27.3% of all prescriptions. In 25.8% of all antibiotics use, there was lack of clear-cut indication for the antibiotics for the diagnosis supposedly being treated or antibiotic was not recommended. Other irrational use of antibiotics observed are incorrect dosage intervals (19.5%) and continuation of antibiotics against negative microbiological culture results (4.5%).

Wards	**EPU**	**Ward A**	**Ward B**	**Out-born SCBU**	**Inborn SCBU**	**Total n (%)**
Cefriaxone	20	7	8	5	9	49 (74.2)
Genticin	13	3	2	6	7	31 (47.0)
Ampiclox	2	1	2	5	5	15 (22.7)
Amoxiclav	9	3	2	0	0	14 (21.2)
Crystalline Penincilline	7	0	2	0	0	9 (13.6)
Cotrimoxazole	4	2	1	0	0	7 (10.6)
Ampicilline	0	0	1	2	3	6 (9.1)
Cefuroxime	0	2	1	0	0	3 (4.5)
Erythromycin	1	1	0	0	0	2 (3.0)
Clindamycine	1	0	0	0	0	1 (1.5)
Cloxacilline	0	0	1	0	0	1 (1.5)
Metronidazole	0	1	0	0	0	1 (1.5)
Others	3	4	2	1	2	12 (18.2)

Table 4: Antibiotics used in the paediatric wards

Type of Irrational Antibiotic Prescription	**Total (%)**
Inappropriate duration	63.6
No microbiological tests	62.1
Incorrect doses of antibiotics	37.9
Inappropriate antibiotics	27.3
Antibiotics not indicated	25.8
Incorrect dosage intervals	19.5

Table 5: Types of irrational prescription noted

IV. DISCUSSION

This study is the first to assess the prevalence of antibiotic use in this hospital since it became a tertiary referral center. It is also the first time an effort has been made to establish a baseline for implementing an antibiotic stewardship program in the facility. The study revealed a high prevalence rate of 79.5% for antibiotic use in the pediatric wards of this hospital. This high rate is not surprising given that the hospital is in the process of transitioning from a secondary health facility to a tertiary referral center, where specialists in infectious diseases, microbiology, and pharmacy are available to promote antimicrobial stewardship. Antimicrobial stewardship programs have been shown to improve prescription patterns and microbial outcomes, including institutional resistance patterns. (9) Antibiotic prescribing rates among pediatric inpatients have been found to be higher in lower levels of care than in tertiary teaching settings,(15,29) as well as between general hospitals and tertiary referral hospitals. (19) The lack of institutional policies and guidelines regulating antibiotic prescription at lower levels of care may explain the low rates of antibiotic prescribing threshold.

Differences in the prevalence of antibiotic use were observed among different pediatric wards, which is consistent with findings from other studies that reported variations in antibiotic use between different wards based on the type of pediatric patients admitted. (21) Wards providing highly specialized care to children and those with a high rates of intubations or indwelling catheters, or where invasive procedures are being performed, may have higher rates of antibiotic use. In our study, we found higher rates of antibiotic use in both wings of the Special Care Baby Unit (SCBU) and the Emergency Paediatric Unit (EPU), where invasive procedures are commonly performed.

This study has identified the pattern of antibiotic use in the pediatric wards of this hospital, which can be used to promote prudent antibiotics use. The most commonly prescribed antibiotics in this study were cephalosporins, which is similar to the findings of other studies involving hospitalized children in tertiary hospitals, (16) but contrasts with other studies that reported aminoglycosides as the most commonly prescribed antibiotics. (11)

One reason we found the use of third-generation antibiotics is the lack of laboratory diagnostic support. Many of the antibiotics were prescribed without initially taking microbiological samples for testing, so the clinician had no choice but to prescribe antibiotics with a wide enough coverage and to extend the therapy.

Overuse of Ceftrixone, a third-generation cephalosporin, often commenced empirically without taking any microbiological specimens or recourse to results when available could lead to antibiotic pressure and antimicrobial resistance, reducing the number of therapeutic options available.

The most common reason for using antibiotics in the pediatric wards was for the treatment of community-acquired infections, accounting for almost two-thirds of cases. This is not surprising given the high prevalence of infections as a significant cause of morbidity and mortality in our environment. Other authors have reported similar findings.[18, 22-24] A cause for concern is the relatively large proportion (nearly 10%) of those receiving antibiotics for the treatment of hospital-acquired infections (HAIs), which are often associated with the development of multi-drug resistance. This places selective pressure on the hospital and leads to use of antibiotics for prolonged period, exposing the children to increased side effects and prolonging their hospital stay. HAIs are usually associated with use of tubes and invasive devices as well as the prescription of antibiotics as prophylaxis. While close to 90% of all those on antibiotics had an intravenous access, 6% additionally had catheter in situ and a further 6% had intubations. All these give room for the development of HAIs.

Closely tied to the choice of antibiotics class to use is the choice of dose and route of administration, which are dependent on the indication and site of the infection. About 85% of antibiotics were given via the intravenous routes in this study. This rate compares favorably with rates reported in other parts of the developing world such as Asia and Latin America, but higher than rates reported in Europe. (13, 18) Prolonged duration of antibiotic use and delayed switching to oral drug found in this study is suggestive of irrational antibiotic prescription and it is against the principles of rational antibiotic prescription. (5, 30)

Overall, the study has established a robust baseline antibiotic use data in the paediatric population and a starting point for quality improvement activities in the hospital, by providing target places for improvement. Although we have provided evidence to guide formulation of antibiotic use guidelines in the paediatric wards of our institution, more studies are needed across the entire hospital to guide hospital antibiotic use policy and make any meaningful impact to prevent antimicrobial resistance (AMR) within the hospital. In the same vein, more studies to describe and compare the antibiotics use in children in hospitals across the state and nationwide using the same methodology are very much needed.

V. LIMITATION OF THE STUDY

Our study has some limitations. First, data about prior antibiotic use by the children, which might have influenced the initial choice of antibiotic by the managing team was not provided. Moreover, the characteristics of involved institutions may have affected at least in part the reliability of some results.

VI. CONCLUSIONS

Low antibiotics prescription threshold was observed with antibiotics started empirically and continued against microbiological evidence. High variability in dosing for same indications was noted. There were also differences in antibiotic use in the wards. The study may be an important target for antibiotic use reduction through antibiotic stewardship program in the hospital.

AUTHORS' CONTRIBUTIONS

- **Musa S:** Concept and design of the study, supervising the conduct of the survey, analysis and interpretation of the results. Reviewed and approved the draft.
- **Aliyu-Zubair R:** Conducting the survey, analysis of the results, interpretation of results and contributed to the discussion. Reviewed and approved the draft.
- **Muhammad SB:** Conducting the survey, analysis of the results, contributed to discussion and writing of the initial draft
- **Haliru L:** Conducting the survey, analysis, and interpretation of the results, contributed to discussion and critical review of the initial draft for important intellectual input

All authors contributed to the discussions and the final draft of this work was jointly approved by all the authors.

- ***Conflict of interest:*** None

- ***Funding:*** None

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