

# Assessment of Adherence to the Core Elements of Hospital Antimicrobial Stewardship Programs: A Survey of Fourteen Hospitals in Nigeria

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DOI: <https://doi.org/10.51244/IJRSI.2023.1012063>

Received: 07 December 2023; Revised: 21 December 2023; Accepted: 26 December 2023; Published: 21 January 2024

## ABSTRACT

### Introduction

Antimicrobial resistance occurs when antimicrobial drugs are no longer effective against the target microorganism and this poses a global public health threat especially in low and middle-income countries (LMICs), including Nigeria. This study aimed to assess hospitals core elements AMS implementation in 14 secondary and tertiary hospitals in Nigeria.

### Methods

Centre for Initiative and Development (CFID) in collaboration with the Nigeria Centre for Disease Control (NCDC), employed cross-sectional intervention study across 14 target hospitals in Nigeria. The study adopted the WHO Core Elements Hospital AMS self-assessment tool. Paired-samples t-test was used and a *p*-value less than 0.05 was considered as statistically significance.

### Results

Results from the baseline assessment revealed inadequate implementation of AMS programs in most hospitals, emphasizing key deficiencies in areas such as leadership commitment, tracking antibiotic use, and reporting outcomes. However, following CFID AMS intervention, a significant positive shift in performance of hospitals AMS core elements was observed, with hospitals showing improvements in leadership commitment, accountability, and prescriber education. The paired-samples t-test demonstrated a statistically significant decrease in the measured variable, reinforcing the impact of the intervention and a substantial increase in mean scores of post-intervention.

### Conclusions

It is imperative to acknowledge the potential implications of these positive shifts, not only in the context of

individual hospitals but also in the broader landscape of public health. Addressing the challenges identified in this study is crucial for mitigating the global public health threat posed by antimicrobial resistance, particularly in resource-constrained settings. Future research and continued collaborative efforts will be essential to sustain and further improve the effectiveness of AMS interventions, ultimately contributing to the global effort to combat antimicrobial resistance.

**Keywords:** Antimicrobial Stewardship, Antimicrobial Resistance, Core elements, Hospitals, Nigeria

## INTRODUCTION

In 2014, the World Health Organization (WHO) declared antimicrobial resistance as an inescapable crisis of the 21<sup>st</sup> century that threatens human life. A study conducted by Christopher Murray and colleagues in 2019 across the globe estimated that 4.95 million deaths were associated with AMR, of which 1.27 million deaths were attributable to bacterial AMR (Murray et al. 2022). This recent study is higher than the earlier reported by O'Neill in 2016.

Antibiotic resistance is a situation in which antibiotics would no longer be effective against bacteria. These resistant bacteria make even ordinary infections more difficult to treat and surgical procedures riskier to perform. Although Nigeria does not have comprehensive data on antimicrobial resistance, a situation analysis conducted by the Nigeria Centre for Disease Control (NCDC) in 2016 revealed that multidrug-resistant organisms were discovered from common healthcare-associated infections.

There are numerous drivers that trigger antibiotic resistance, however, there exists a strong bond between the development of resistance and the overuse or over prescribing of antibiotics (Aslam et al., 2018; Blaskovich et al., 2018). These drivers as identified by Egwenu et al. 2017 include but are not limited to unregulated antibiotic sales, proliferation of unlicensed medicine stores, shortage of licensed prescribers, poor AMR awareness, and use of antibiotics.

In order to reduce the AMR burden, WHO placed the implementation of hospital-based antibiotic stewardship (AMS) programs at the heart of its Global Action Plan to curb antibiotic resistance with emphasis on healthcare facilities at distinct levels to implement AMS programs that are based on local, national or international guidelines.

Further studies have shown that many high-income countries have shifted focus by implementing AMS-related programs. Examples of such countries include; the United States Centers for Diseases Control and Prevention (CDC) chartered the Core Elements of Hospital Antibiotic Stewardship Programs (CEHASP) in 2016, updated in 2019, and demanded its implementation in all hospitals across the country (CDC, 2019).

The concept of hospital-based AMS programs has gained recent attention in LMICs, and various governments have recorded commitments to take initiatives to implement ASPs in hospitals. Nevertheless, translating national or local commitment into action represents a formidable implementation challenge (Saleem & Pethani, 2020).

Countries like Nigeria which referred to the giant of Africa belongs to the World Bank strata of LMICs with an estimated population of **220,187,987** as at Tuesday, April 4, 2023, based on Worldometer. The National Action Plan for Antimicrobial Resistance, 2017-2022, found that bad use of antibiotics was common with 42% of adults and 46.7%–71.1% of five years' children were given antibiotics without prescription, and 68.3% of adults used antibiotics following the prescription.

Antibiotic consumption rate is alarmingly high and reportedly Nigeria is regarded as one of the countries with high antibiotic consumption in LMICs. Recent needs assessment survey conducted across 14 hospitals

in Nigeria also depict a gloomy situation with absent of most hospital AMS structures (Danjuma et al., 2022). Furthermore, various studies have reported pervasive infections caused by multidrug resistant and extensively drug resistant bacteria (NCDC 2017). Rampant inappropriate prescribing requires systematic interventions to change the physician's attitude, and, in this context, ASPs can play a formidable role to optimize the antibiotic use in hospitals.

Nigeria's National Action Plan (2017-2022) recognizes antibiotic resistance as a key challenge in Nigeria and urges hospitals nationwide to develop and implement AMS programs in order to reduce the spread of resistant infections. However, to what extent standardized AMS programs have been instituted in hospitals remains unknown, and there is a paucity of key implementation data and facts on the roll out of AMS programs, especially across tertiary and secondary hospitals in Nigeria.

In the light of the above, Center for Initiative and Development (CFID) in collaboration with the Nigeria Centre for Disease Control (NCDC) conducted PPS and core elements hospital AMS assessment before and after CFID Quality Improvement AMS interventions across seven target hospitals in Nigeria. The purpose of the baseline assessment was to determine data and gaps on AMS to be addressed while the post assessment was performed to measure progress (change) of AMS intervention across 14 target hospitals in Nigeria. It is with the belief that evidence base data generated from this study may potentially contribute to the formulation of national or local policies to implement AMS programs across hospitals.

## **MATERIALS/METHODS**

### **Study Design, Survey Instrument, and Setting**

This was an intervention study across 14 hospitals in Nigeria (Taraba State Specialist Hospital, Jalingo; Federal Teaching Hospital, Gombe; Benue State University Teaching Hospital, Makurdi; General Hospital, Gembu, Abubakar Tafawa Balewa University, Bauchi; State Specialist Hospital Yola; General Hospital, Takum; Dalhatu Araf Specialist Hospital Lafia; Federal Medical Centre Jalingo; Federal Medical Centre Makurdi; Khalifa Sheikh Rabiu Paediatric Hospital Kano; Plateau State Specialist Hospital Jos; Limi Children Hospital Abuja; Usman Danfodiyo University Teaching Hospital Sokoto). Core elements assessment tool was adopted from the WHO which was again reviewed by CFID/NCDC research teams.

### **Data Collection and Statistical Analysis**

Data were collected across all the Fourteen intervention hospitals from 3 January 2023 to 15 February 2023. Data were independently collected from the Antimicrobial Stewardship team, Medical Superintendent, Deputy Medical Superintendent, Assistant Medical Superintendent, Manager/Head of Pharmacy, or Chief Pharmacist and collated in every hospital.

The tools were administered by a well-trained staff of CFID and NCDC and the aim was to reach both tertiary and secondary care hospitals located in all the target states of Nigeria. Statistical Package for Social Sciences (SPSS) (version 26 IBM, Armonk, NY,, USA) was used to manage and analyze while descriptive statistics were used to evaluate the extent of adherence, also, mean difference between the baseline assessment and current assessment was analyzed using paired sample *t*-tests with a *p* value < 0.05 considered significant.

### **Data Management and Statistical Analysis**

Statistical Package for Social Sciences (SPSS) (version 26 IBM, Armonk, NY,, USA) was used to manage and analyze data. Descriptive statistics were used to evaluate the extent of adherence, while mean difference between the baseline assessment and current assessment was analyzed using paired sample *t*-tests for each

of the core elements mentioned earlier with a  $p$ - value  $< 0.05$  considered significant.

### Ethical Consideration

The ethical approval was granted by the Research Ethics Committee, with NHREC Protocol Number NHREC/01/01/2007-11/10/2021 and NHREC Approval Number NHREC/01/01/2007-01/11/2022B. Before taking consent, project information was shared with the representative of all participating hospitals to detail the background, aims, and how the data would be utilized. To ensure the anonymity of hospitals, an individual identification number was allocated to each participating hospital. Data were stored in a password protected computer.

### SUMMARY OF RESULTS ACROSS 14 HOSPITALS

Table 3: Summary Scores of AMS Hospital Core Elements Before and After Intervention (CFID Quality Independent AMS programs)

Hospital	Cumulative Scores Before	After
1	46	100
2	76	111
3	118	151
4	58	91
5	58	71
6	21	58
7	11	65
8	78	116
9	78	141
10	90	96
11	42	77
12	41	70
13	42	117
14	86	106

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Before	60.3571	14	29.05858	7.76623
	After	97.8571	14	28.11476	7.51398

		N	Correlation	Sig.
Pair 1	Before & After	14	.783	.001

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Before – After	-37.5000	18.86287	5.04131	-48.39109	-26.60891	-7.439	13	.000

Table 3.0 shows summary of data analyzed from the implementation of Antimicrobial Stewardship (AMS) interventions in various healthcare facilities, evaluating the effectiveness of AMS programs based on WHO Hospitals core element checklist. As seen on the summary table, before the AMS intervention across hospitals, most facilities were at Basic or Inadequate AMS core element levels. After intervention, improvements were observed across facilities, with many reaching Intermediate or even Advanced levels. For example, Abubakar Tafawa Balewa University Teaching Hospital and Benue State University Teaching Hospital both progressed from Basic to Intermediate AMS core element levels. However, Federal Teaching Hospital Gombe saw a slight decrease in score while remaining at the Intermediate level. The results indicate positive impacts of AMS interventions on antimicrobial practices in diverse healthcare settings.

The paired-samples test conducted on a dataset consisting of 14 hospitals, as detailed in Table 3.1, revealed substantial changes in the measured variable before and after the intervention. Prior to the intervention, the mean measurement stood at 60.36, accompanied by a standard deviation of 29.06 and a standard error mean of 7.77. Following the intervention, a noticeable increase was observed, with the mean rising to 97.86, and the standard deviation and standard error mean reaching 28.11 and 7.51, respectively, indicative of a notable shift in the central tendency of the variable.

The paired-samples correlations presented in Table 3.2 further elucidate the relationship between the measurements before and after the intervention. The correlation coefficient of 0.783 denotes a robust positive correlation, signifying higher values after the intervention. Moreover, the significance level of underscores the statistical significance of this correlation, providing confidence in the strength and reliability of the observed relationship.

Results from paired-samples test in Table 3.3, shows the calculated mean paired difference of -37.50, along with a standard deviation of 18.86 and a standard error mean of 5.04, attests to a consistent and notable decrease in the measured variable across hospitals. The 95% confidence interval of the difference, ranging from -48.39 to -26.61, reinforces the robustness of this observed change. The t-value of -7.439, associated with 13 degrees of freedom, is indicative of a highly significant difference between the before and after measurements, as corroborated by the exceedingly low p-value of 0.000. Thus, the intervention emerges as a statistically significant catalyst, leading to a substantial reduction in the measured variable.

Based on results from paired sampled t-test presented On Tables 3.1, 3.2 & 3.3, it can be seen that when core elements hospitals AMS assessment baseline result was compared with the post implementation result, there was a significance change in mean difference of the two groups. The paired-samples t-test results indicate a statistically significant difference between the before and after measurements (*p-value* = 0.000). The negative mean of -37.50 suggests that, on average, there was a decrease in the measured variable after the intervention. The 95% confidence interval of the difference does not include zero, further supporting the evidence of a significant change the data therefore suggests that the intervention led to a statistically significant decrease in the measured variable, and this change is consistent across the sample.

This indicates the impacts of implementing AMS across the target hospitals.

## DISCUSSION

In this study, the current state of implementation of the Antimicrobial Stewardship Program is examined across 14 secondary and tertiary level hospitals in Nigeria. The healthcare system in Nigeria can be categorized into three different levels namely; primary, secondary, and tertiary healthcare system (Danjuma *et al.*, 2022). Recall that this study focuses on comparing baseline assessment of Core Element Hospitals Antimicrobial Stewardship programs with that of post-implementation of AMS programs across 14 secondary and tertiary level hospitals in Nigeria with the sole objective of measuring change in the implementation of AMS programs across hospitals. Based on the overall findings, the majority of the Core Element Hospitals AMS Programs were yet to be implemented across most hospitals at the baseline for example, the formation of AMS teams including patient representatives and performing Hospital AMS interventions such as *Reporting and Tracking of Antibiotic Use and Outcomes across hospitals* which are considered as key in the implementation of Antimicrobial stewardship programs were completely absent. Possible reasons for this implementation failure across hospitals could be the general absence of AMS structures as the core national health priority to convince the political. Similarly, responses to the four statements that cover *Tracking Antibiotic Use and Outcomes* revealed that preauthorization and prospective audits were evidently absent in an overwhelming majority of the hospitals, especially in secondary hospitals. Many studies have reported the impact of prospective audits and formula as being the most effective measurer in AMS programs (Hayat *et al.* 2019). Nevertheless, these two core elements implied two major gaps in practice for any future intervention and may be taken as a top priority. Similarly, *Hospital Leadership Commitment* was notably lacking and indicated another gap in practice across 14 hospitals in Nigeria at the baseline however, when results were compared with the baseline data, a significant improvement was noticed. Leadership commitment in a hospital is actually a direct function of the extent of implementing Antimicrobial stewardship programs in hospitals. *Hospital Leadership Commitment* was evaluated at both phases' pre-implementation and post implementation of AMS programs. Based on the results, responses for this particular core element at the baseline received low scores but high scores were recorded at the post intervention assessment. Two encouraging findings of this study are related to the two core elements *Accountability* and *Education* of the prescribers, which received the highest mean score in both secondary and tertiary levels hospitals after a successful implementation of AMS across hospitals. This result agrees with recent studies conducted in Punjab by and McKnight *et al.* (2019) whose findings shows that a small investment on these basic core elements can substantially improve the outcome. One way to improve this AMS activities across hospitals is to engage hospital pharmacists in the stewardship teams. The addition of pharmacists in AMS programs has shown to improve the outcomes of antibiotic stewardship interventions, and a recent example may be cited from Africa (Gebretekle *et al.* 2018 & McKnight *et al.* 2019). This is of particular relevance for LMICs like Nigeria, where only a few physicians are available for a huge population of patients, and therefore dissemination of a meaningful education to patients is often compromised.

Finally, a promising finding of the study is revealed in the results from paired sample t-test which shows a significant change of many hospitals from inadequate to basic and of course intermediate. This shows that an increasing number of hospitals (intervention hospitals) have been sensitized on the need to drive AMS in their hospitals, hence the reason for the actions taken.

The gaps identified in this study are more relevant as a broader outline to refine the plan into action. Based on the findings, the current study suggests following implications for policy, practice and further research:

1. Hospitals should take a step forward and enforce a low hanging intervention. Here, the concept of low hanging intervention refers to interventions that require least resources but yield high outcomes, for instance, *Education* of the prescriber is directly correlated with improved prescribing habits and

- patient education.
2. The deficiency areas highlighted in this study, such as the core elements of *Tracking and Reporting of Antibiotic Use*, should be prioritized in any future policy shift and must be given due weight with the results of PPS.
  3. Key Healthcare professionals such as doctors, pharmacists, Microbiologists, IT experts should be engaged in antibiotic stewardship activities in the hospitals
  4. Similar studies need to be conducted in other states and hospitals in Nigeria to draw a holistic picture of the AMS situation.

## CONCLUSIONS

Findings from this study imply that adoption of the AMS programs in the secondary and tertiary care hospitals in Nigeria is key. Based on the results from this study, it can be seen that at the baseline, most hospitals have inadequate AMS structures such as the stewardship committees and teams that comprises a patient, religious or community representative. With the implementation of CFID QI AMS across fourteen hospitals, there was a significance change of the mean score of hospitals AMS core elements from inadequate to intermediate and some to advance. This implies that AMS interventions across fourteen hospitals have attain some levels of change based on core element of hospitals AMS assessment. The majority of the core elements of hospital antibiotic stewardship point out areas which hospitals focuses on such as *Tracking and Reporting of Antibiotic Use and Outcomes* in hospitals. These priority areas should be given special emphasis in the Nigerian future policy for hospital-based antibiotic stewardship programs. This study urges relevant stakeholders to expediate the implementation of antibiotic stewardship programs in hospitals to curb the growing antibiotic resistance and optimize antibiotic therapy. A significant impact is only possible majority of the hospitals in Nigeria implement uniform stewardship programs. We are running our time out for antibiotics, and if implementation of stewardship interventions is further delayed, the resistant infections will have disastrous impact on the healthcare sector and the country's economy.

**Author Contributions:** Conceptualization, Dr. Abiodun E., Ridwan Y., Obed T. J; methodology: Obed T. J. Danjuma K.A and Rijimra Ande: formal analysis; Obed T.J., Dr. Ochi, Ridwan Y.,and Y.H.J.; data curation, Obed T. John and Ochi T; writing original draft preparation, Obed T.J., Elkanah S; Abiodun E., Oscar F.K. writing—review and editing, Abiodun E. Ridwan Y., Josphine G., Mohammed U., Rijimra A, funding acquisition, CFID, Danjuma K. A., Elkanah S., and Barnabas T., All authors have read and agreed to the published version of the manuscript.

**Conflicts of interest:** – none to declare.

**Funding:** Financial support for this study was provided by Pfizer Independent Quality Improvement grant to Centre For Initiative and Development (CFID) NGO in Nigeria. Pfizer had no role in the study design or data collection, analysis, or interpretation. The authors have access to all study data and have final responsibility for the writing and decision to submit for publication.

**Acknowledgment:** The authors acknowledge the support of all hospitals where the survey was conducted.

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