

Antimicrobial Resistance Knowledge and Practices Among Secondary School Students in Akure South Local Government Area, Ondo State, Nigeria: A Cross-Sectional Study

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Abstract

Background

Antibiotic misuse is a major contributor of antimicrobial resistance (AMR), a growing public health crisis globally, particularly in developing countries. Adolescents represent a critical group in shaping health practices, yet little is known about their knowledge and behaviours regarding AMR.

Methods

This study assessed the knowledge and practices related to AMR among secondary school students in Akure South Local Government Area, Ondo State, Nigeria, and explored factors influencing their understanding and behaviours. A cross-sectional study was conducted among 396 students aged 12–18 years, selected through multistage sampling across 10 schools. Data were collected using a structured, pre-tested questionnaire and analysed with SPSS version 23. Knowledge was categorised using a modified Bloom's cut-off, while antibiotic usage practices were classified into good and poor practices.

Results

Of the 396 respondents (response rate 96.6%), 60.6% were female, and the majority (52.3%) were aged 10–15 years. Only 34.3% had heard of AMR, with schools being the primary source of information (51.5%). Among those aware, 63.2% had fair knowledge. Regarding antibiotic use, 37.9% reported using antibiotics within the last month, and just 41.7% consistently completed prescribed doses. Notably, 57.6% stopped medication once they felt better, and 28.5% admitted to purchasing antibiotics without a prescription. Overall, 53.5% of respondents demonstrated poor antibiotic usage practices. Misconceptions were common, with 69.4% believing antibiotics are required for every fever or cold, while 61.9% acknowledged that personal behaviours could influence AMR.

Conclusion

The study revealed low awareness and suboptimal antibiotic practices among secondary school students, underscoring the urgent need for school-based health education and stricter regulation of antibiotic access. Strengthening adolescent-focused AMR interventions may help curb misuse and promote rational antibiotics use in Nigeria.

Introduction

Antibiotics are a category of drugs developed to combat bacterial infections [1]. Their introduction marked a turning point in medicine, making previously untreatable conditions manageable, improving the success of surgical procedures, and fundamentally transforming medical practice [2]. Regrettably, this

vital aspect of medical practice is increasingly undermined by the inappropriate use of antibiotics, which contributes to the emergence of antimicrobial resistance (AMR) [2, 3]. AMR arises naturally when microorganisms such as bacteria, fungi, viruses, and parasites develop the ability to withstand the effects of antimicrobial agents that were previously effective against them, typically as a result of genetic mutations [1, 2, 4]. This emerging trend has undermined the effectiveness of standard treatments, making patient management more challenging and leading to increased morbidity and mortality [3].

AMR has become a global public health challenge, with developing countries being particularly affected [5, 6]. AMR was estimated to be directly responsible for 1.27 million global deaths in 2019 [4, 5]. In Africa, the extent of AMR effects is often underestimated owing to limited surveillance data [7]. In 2019, Western sub-Saharan Africa experienced the highest burden of AMR, with an estimated 27.3 deaths per 100,000 population directly attributable to AMR and about 114.8 deaths per 100,000 associated with AMR-related complications [4]. If left unchecked, AMR is projected to further account for more than 10 million deaths each year by 2050, alongside a global economic loss exceeding 100 trillion USD [3, 7]. The rate of inappropriate antibiotic use in Nigeria is estimated to range between 20% and 50% [2], as reports from various regions of Nigeria have documented resistance to specific antibiotics, including methicillin-resistant *Staphylococcus aureus* in the southwest and the rapid emergence of fluoroquinolone-resistant *Escherichia coli* within community settings [3].

In developing countries where AMR is prevalent, it is also largely driven by the inappropriate use of antimicrobials coupled with inadequate infection prevention and control measures [1, 3, 7]. This misuse of antimicrobials is facilitated by their easy availability over the counter without prescription and the presence of poorly regulated supply chains [2]. Additionally, public awareness of the issue remains low, resulting in behaviours that contribute to its continued emergence and spread [8]. A study conducted in India among secondary school students revealed that 67% were unaware of bacterial resistance to antibiotics, 57% reported discontinuing antibiotic use once symptoms subsided, and 19% engaged in self-medication, indicating a relatively low prevalence of this practice [9]. Another study reported that 39.2% of veterinary students had self-medicated with antibiotics within the past six months, and 60.0% of these students demonstrated inadequate knowledge of AMR [7]. Furthermore, a study by Seid and Hussen [10] found that nearly 96% of participants recognized antimicrobial resistance as a serious yet preventable public health issue, while approximately 55% demonstrated a low level of knowledge on AMR [10]. Secondary school students represent a critical demographic as future decision-makers and influencers of health practices within their communities. However, there is limited evidence regarding their knowledge, attitudes, and practices concerning AMR [13, 14]. This study aims to assess the knowledge and practices related to AMR among secondary school students, examine factors influencing their understanding and behaviours, identify existing gaps, and recommend interventions to enhance awareness and promote the responsible use of antimicrobials.

Materials and methods

Study Design and Area

This study employed a cross-sectional design with a quantitative approach to data collection. The design was considered appropriate as it provided a timely and cost-effective means of assessing knowledge and practices related to AMR among secondary school students. The research was carried out in selected secondary schools within Akure South Local Government Area, Ondo State, Nigeria.

Study Population

The study population comprised secondary school students aged 12–18 years who were enrolled in selected schools within Akure South Local Government Area, Ondo State, Nigeria.

Sample Size

A prevalence rate of 60% [7] was applied. The sample size was estimated using Fisher's formula, as referenced by Ekanem and Ekpenyong [11];

$$n = \frac{Z^2 pq}{d^2}$$

Where;

n = Desired sample size

Z = Confidence level

p = Prevalence rate

q = Proportion of non-occurrence (1-p)

d = margin of error

Therefore,

$$Z = 95\% (1.96)$$

$$p = 60\% = 0.60 [7]$$

$$q = (1 - 0.60) = 0.4$$

$$d = 5\% = 0.05$$

$$n = \frac{1.96^2 \times 0.60 \times 0.4}{0.05^2} \quad n = \frac{3.8416 \times 0.40 \times 0.6}{0.05^2}$$

$$n = \frac{0.9219}{0.0025} = 368.76 = 369$$

Assuming a non-response rate of 10% (0.1)

Using: $\frac{n}{1 - \text{non-response rate}}$

$$n = \frac{369}{1 - 0.10} = \frac{369}{0.9} = 410$$

Therefore, the total sample size is 410.

Sampling procedure

A multistage sampling technique was used to select secondary school students from the chosen schools within Akure South Local Government Area, Ondo State, Nigeria.

Stage 1: Selection of wards: Akure South Local Government Area consists of eleven wards, out of which five were purposively selected for the study.

Stage 2: Selection of schools: Two schools were purposively selected from each ward, resulting in a total of 10 schools.

Stage 3: Selection of respondents: From each school, 41 respondents were chosen from senior classes using simple random sampling.

Instrument for data collection

Data were collected using a structured questionnaire developed in line with the study objectives. The instrument was divided into four sections: Section A contained semi-structured items on the socio-demographic characteristics of respondents; Section B assessed students' knowledge of AMR; Section C explored practices related to the use of antibiotics and other antimicrobials; while Section D examined factors influencing students' knowledge and practices concerning AMR.

Instrument validation and reliability of data collection instruments

The questionnaire was pre-tested among 41 secondary school students in Akure North Local Government Area of Ondo State. Akure North was selected because it shares a boundary with Akure South and possesses characteristics similar to the study area. The pre-test assessed the effectiveness of the instrument in generating data relevant to the study objectives and evaluated the level of comprehension of the questions by the target population. This process helped confirm the relevance of the items and variables under investigation, eliminate ambiguities, and ensure the overall reliability of the questionnaire. Feedback obtained from the pre-test was subsequently used to refine and improve the instrument.

The reliability of the questionnaire was assessed during the pre-test using Cronbach's alpha, which produced a coefficient of 0.7, demonstrating high internal consistency and reliability.

Inclusion and Exclusion Criteria:

Secondary school students aged 12–18 years who provided informed assent were included in the study. While, students outside this age range and those unwilling to participate were excluded.

Data Analysis:

Once all the questionnaires had been completed, they were carefully reviewed to ensure that every response was accurate. The data were then recorded and cleaned before the initial analysis was carried out using Microsoft Excel. After that, they were transferred to Statistical Product and Service Solutions (SPSS) Version 23 for a more detailed statistical examination. The results were presented in tables, showing frequencies and percentages, while numerical data were summarised as averages. After the questionnaires had been completed, they were manually checked to ensure all questions were answered. Knowledge levels were evaluated using the modified Bloom's cut-off, where respondents who scored 80% or higher (5 to 6 out of 6 available points) were classified as having "good knowledge." Scores between 50% and 79% (3 to 4 points) indicated "fair knowledge," while scores below 50% (0 to 2 points) were considered to reflect "poor knowledge." Antibiotic usage was categorised into two groups: poor practice and good practice. The total possible score ranged from 0 to 14, with scores between 0 and 7 indicating poor practice and scores from 8 to 14 indicating good practice.

Results

Out of the proposed sample size of 410, a total of 396 secondary school students participated in this study, giving a 96.6% response rate. Table 1 below shows the sociodemographic characteristics of respondents. The demographic data revealed that 240(60.6%) of the respondents were female. The majority of the participants were aged between 10–15 years, 207(52.3%). Most of the students were in SSS1 235(59.3%). Regarding school type, 152(38.4%) attended private schools. As shown in Table 2 below, only 136(34.3%) of the respondents had heard of AMR before the survey. Among the respondents aware of AMR, 89(65.4%) correctly identified that AMR can affect both humans and animals. The primary source of information on AMR was school 70(51.5%). Multiple response analysis on the causes of AMR showed that 41(30.1%) of respondents identified using antibiotics for viral infections, like a cold, as a cause. The categorization of knowledge level, as shown in Fig. 1 below, revealed that more than half, 86(63.2%) of the respondents who were aware of AMR had fair knowledge, while 45(33.1%) had poor knowledge, and 5(3.7%) had good knowledge of AMR.

Regarding the personal use of antibiotics, as shown in Table 3 below, 150(37.9%) of students had used antibiotics in the last month prior to the survey. Completion of prescribed doses was suboptimal, with only 165(41.7%) always completing their doses. Only 113(28.5%) had bought antibiotics without a

doctor's prescription before. When asked about the source of antibiotics, 366(92.4%) indicated pharmacies or medical stores. However, more than half of the respondents 228(57.6%), admitted to stopping antibiotic use when they started feeling better. Most of the respondents 249(62.9%), reported using antibiotics that were given to them by a friend or family member, as long as they were used to treat the same illnesses. Categorisation of antibiotic use revealed that more than half 212(53.5%), had poor usage of antibiotics, while 184(46.5%) had good usage (Fig. 2). On the factors influencing AMR, 233(58.8%) of the respondents reported that accessing antibiotics without a prescription was difficult. A significant proportion 121(56.6%), reported not receiving any education or awareness about AMR in school. Furthermore, 275(69.4%) believed antibiotics are necessary for every fever or cold, reflecting a misconception. However, 245(61.9%) acknowledged that their personal behaviour could contribute to AMR in the community Table 4.

Table 1
Socio-demographic characteristics of respondents

Variable	Frequency (n = 396)	Percent (%)
Gender		
Male	156	39.4
Female	240	60.6
Age		
10–15	207	52.3
16–20	186	47.0
21–25	2	.5
26 above	1	.3

Table 2
Knowledge of AMR

Variable	Frequency (n = 396)	Percent (%)
Ever heard of antimicrobial resistance (AMR)		
No	260	65.7
Yes	136	34.3
Causes of AMR		
Overuse of antibiotics	59	43.4
Incomplete antibiotic doses	29	21.3
Sharing antibiotics with others	24	17.6
Using antibiotics for viral infections like colds	41	30.1
AMR can affect both humans and animals		
No	21	15.4
Yes	89	65.4
Not sure	26	19.1
Source of AMR knowledge		
School	70	51.5
Social media	8	5.9
Internet	14	10.3
Health workers	44	32.4

Multiple responses are allowed, and Percentages do not amount to 100%

Table 3
Personal use of antibiotics

Variable	Frequency (n = 396)	Percent (%)
Last time of antibiotic usage		
In the last month	150	37.9
In the last 6 months	41	10.4
In the last year	32	8.1
More than a year ago	14	3.5
Never	50	12.6
Can't remember	109	27.5
Completed the full dose as prescribed		
Always	165	41.7
Sometimes	154	38.9
Never	77	19.4
Ever bought antibiotics without a doctor's prescription		
No	283	71.5
Yes	113	28.5
Source of antibiotics		
Medical store/Pharmacy	366	92.4
Stall/hawker	6	1.5
Friends/Family member	5	1.3
I have them saved up from previous times	11	2.8
Somewhere/someone else	8	2.0
Stop of antibiotics dosage when you start feeling better		
No	119	30.1
Yes	228	57.6
Sometimes	49	12.4
Ever used antibiotics that were given to you by a friend or family member, as long as they were used to treat the same illnesses		

Variable	Frequency (n = 396)	Percent (%)
Last time of antibiotic usage		
No	249	62.9
Yes	147	37.1

Table 4
Factors Influencing AMR

Variable	Frequency (n = 396)	Percent (%)
Ease and accessibility of getting antibiotics without a prescription		
Very easy	110	27.8
Somewhat easy	53	13.4
Difficult	233	58.8
Ever received any education or awareness on AMR in your school		
No	224	56.6
Yes	172	43.4
Believe antibiotics are necessary for treating every fever or cold		
No	121	30.6
Yes	275	69.4
Your behaviour can contribute to AMR in the community		
No	151	38.1
Yes	245	61.9

Discussion

This study provides a comprehensive overview of antimicrobial resistance knowledge and practices among secondary school students in Akure, Ondo State. According to the sociodemographic characteristics data, respondents were largely female. A meaningful portion of the respondents were aged between 10 and 15 years.

Knowledge of AMR among respondents indicates a divided pattern. Respondents demonstrated a limited understanding of AMR, with only a few showing a good grasp of the topic. This suggests the

presence of AMR knowledge gaps among secondary students, consistent with previous findings [15, 16, 17, 18]. Respondents, according to their knowledge of AMR, highlighted the following as causes of AMR: overuse of antibiotics, Incomplete antibiotic doses, sharing antibiotics with others, and using antibiotics for viral infections such as colds. Previous studies have also identified these factors as contributing to AMR in both developing and developed nations [12, 19]. The respondents strongly agreed that AMR can not only affect humans, but also highlight that it can affect animals. This level of knowledge shows a good understanding of AMR among respondents who have previously heard of AMR. Schools proved to be the main source of AMR knowledge. This study revealed that the knowledge level of secondary school students in Akure, Ondo State, was 34.3%. Categorisation under this proportion, the majority of the respondents had fair knowledge of AMR.

On practices of AMR among secondary school students, a meaningful number of respondents used antibiotics in the last month, and a large number can't remember when they last used antibiotics. A suboptimal number of respondents completed their doses of antibiotics, signifying their good practice level of preventing AMR. This is similar to another study among non-medical students in Nigerian universities; almost half the respondents (42.0%) always completed prescribed doses of antibiotics [20]. More than half of the respondents don't buy antibiotics without a doctor's prescription, as also outlined in a previous study, where Antibiotics were usually obtained by the respondents on a doctor's prescription (68.3%) [20]. Almost all the respondents get antibiotics from a medical store/Pharmacy. More than half the respondents (57.6%) stopped taking antibiotics once the symptoms had resolved, which is greatly higher compared to a similar study among non-medical students (28.5%) [20]. Only 37.1% respondents take leftover antibiotics from friends. Generally, respondents exhibited poor practices of antibiotic use, 53.5%.

Factors that influence AMR among secondary school students, a large number of respondents revealed that it was difficult to access antibiotics with a doctor's prescription, 58.8%. However, this finding is the opposite of a previous study in Greece and Turkey. Only 15.6% of Greek citizens thought it was either difficult or extremely difficult to obtain antibiotics without a prescription, while this figure was 40.6% in Turkey [21], indicating a much stricter enforcement of the rules in Akure. 69.4% of respondents thought that antibiotics can be used to treat a cold. Strikingly, from a previous study, 22.1% construed that antibiotics cured their cold/sore throat faster, while 27.9% agreed that using leftover antibiotics was permissible when they had a cold or similar symptoms [22]. The majority 56.6% of the respondents, had never received AMR education in their schools, which highlights the health educational gaps in secondary schools in Akure, Ondo State. This is similar to the result found in a review conducted among the WHO African Region [23].

Conclusion

This study reveals a low level of awareness and misconceptions regarding antimicrobial resistance among secondary school students in Akure, Ondo State, Nigeria. While some students demonstrate appropriate knowledge, a significant number engage in risky practices such as early discontinuation of

antibiotics, self-medication, and misunderstanding the appropriate use of antibiotics. Health authorities, NGOs, and educators should collaborate to launch AMR-focused campaigns using engaging tools such as drama, storytelling, and interactive sessions.

Declarations

Acknowledgement

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Contributions

The authors' contributions to the article are as follows: IMC, KPA & IM played key roles in the study conception, data acquisition, analysis, and interpretation. IMC, KPA, OGM, and OJY were involved in manuscript preparation. EEB and JOF critically reviewed the research content. All authors read and approved the final manuscript draft.

Competing interests

The authors reported no potential conflicts of interest concerning the research, authorship, or publication of this article.

Ethics approval

A letter of introduction was obtained from the Director of the Department of Health Planning, Research and Statistics, Ondo State Ministry of Health, prior to data collection. Ethical approval was obtained from the Ministry of Health (NHREC/Ondo SMH-HREC/02/01/2025). The study was conducted in accordance with the ethical principles governing research involving human participants in Nigeria.

Consent to participate

The study adhered to the ethical principles outlined in the Declaration of Helsinki. Participants were fully informed about the purpose of the study, and written informed consent was obtained prior to their involvement. Confidentiality was guaranteed, and respondents were informed of their right to withdraw from the study at any time.

Consent to publish

Not applicable.

Data availability

The data sets that were utilized and examined in this study can be obtained from the corresponding author upon a reasonable request.

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Figures

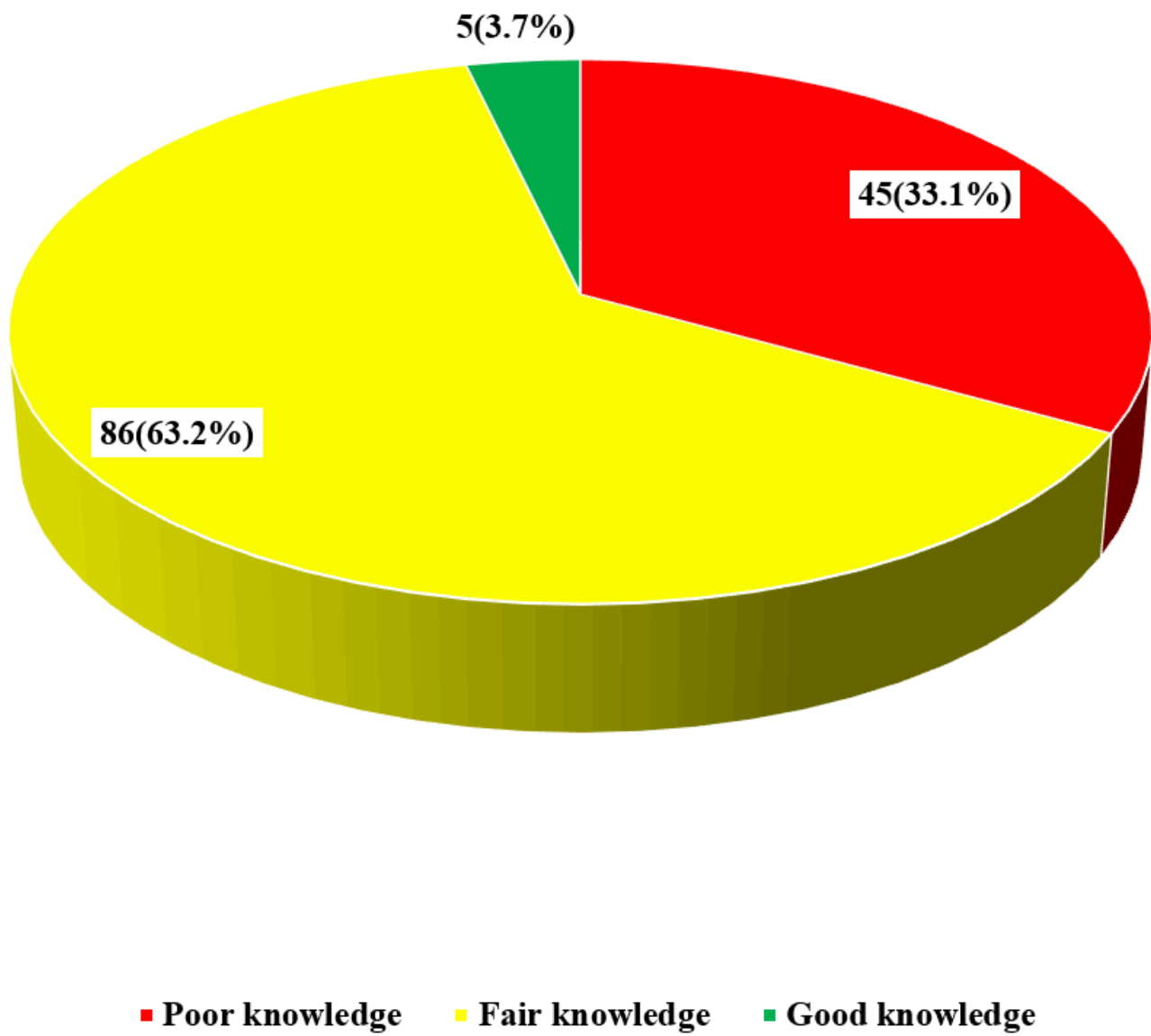


Figure 1

Knowledge level of AMR

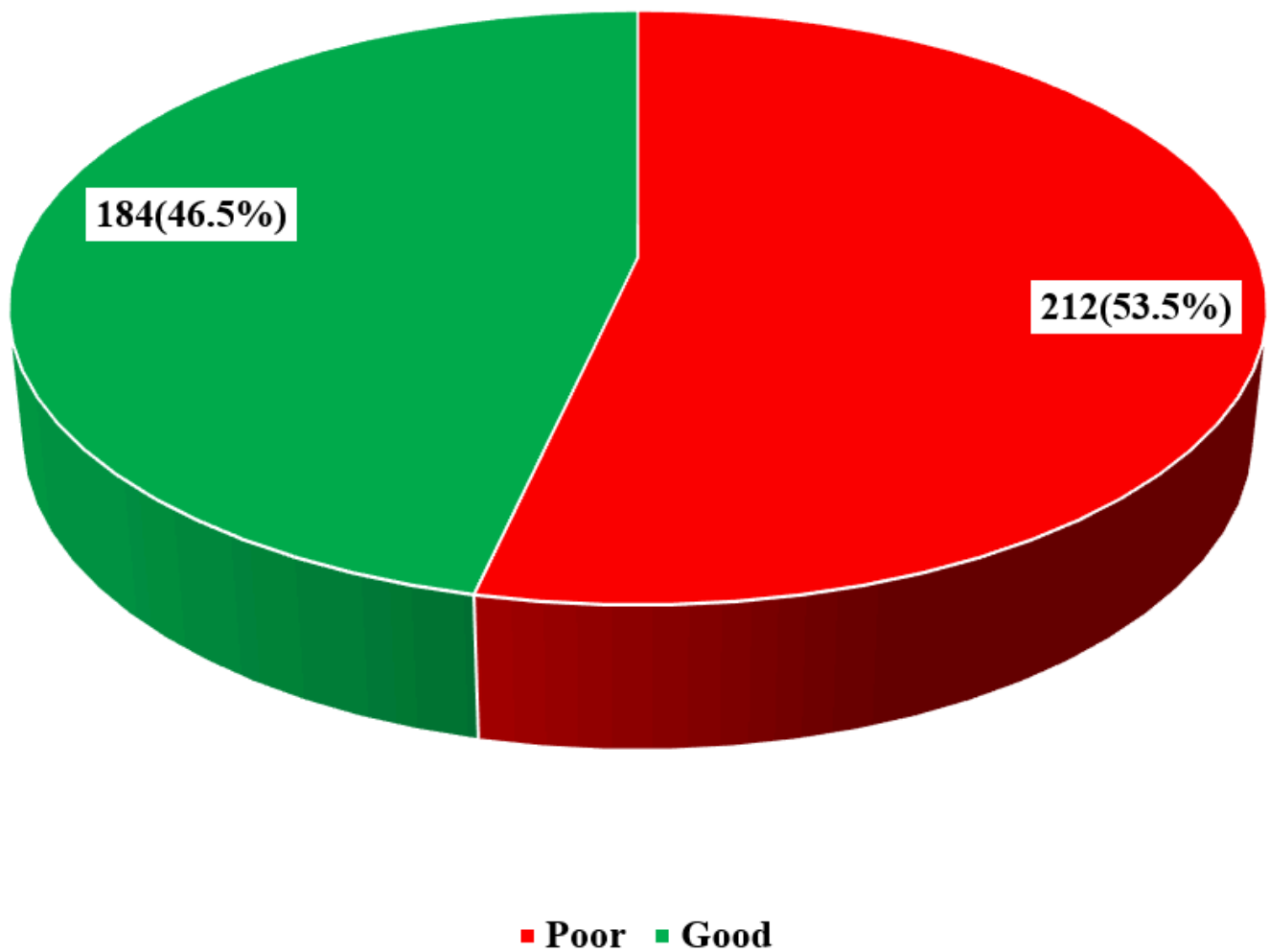


Figure 2

Antibiotic use

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