

KNOWLEDGE AND PRACTICES REGARDING ANTIBIOTIC RESISTANCE AMONG NURSES AND PARAMEDICS IN PUBLIC AND PRIVATE HOSPITALS IN PARACHINAR. A DESCRIPTIVE CROSS SECTIONAL STUDY

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Abstract

Background: Antibiotic resistance (ABR) is a growing global health threat, fueled by misuse of antibiotics and insufficient knowledge among healthcare providers. Nurses and paramedics play a critical role in promoting rational antibiotic use and preventing the spread of resistant pathogens. Understanding their knowledge and practices is essential to design effective interventions.

Objective: To assess the knowledge and practices regarding antibiotic resistance among nurses and paramedics working in public and private hospitals in Parachinar, Kurram, Khyber Pakhtunkhwa.

Methods: A descriptive cross-sectional study was conducted from December 2025 to March 2026. A total of 100 nurses and paramedics with at least six months of work experience were recruited using convenience sampling. Data were collected using a structured questionnaire assessing demographic characteristics, knowledge, and practices related to antibiotic resistance. Descriptive statistics and chi-square tests were applied using SPSS version 24.

Results: Most participants were nurses (96%), aged 20–30 years (69%), and had 2–3 years of work experience (82%). The majority had received formal training on antibiotics (91%). Knowledge of antibiotic resistance was high: 72.5% understood the concept, 97.1% recognized overuse as a major cause, and 100% were aware of its public health consequences. Practices related to patient education and prescription monitoring were excellent, with over 96% consistently educating patients and checking antibiotic history. However, adherence to infection control measures was suboptimal, with only 38% always following protocols.

Conclusion: Nurses and paramedics in Parachinar demonstrated strong knowledge and generally good practices regarding antibiotics. Nevertheless, inconsistent infection control practices indicate a need for targeted training and hospital policy reinforcement to prevent the spread of resistant pathogens.

INTRODUCTION

CHAPTER 1

Antibiotics are among the most important discoveries in modern medicine and play a critical role in the

prevention and treatment of infectious diseases. Since their discovery, antibiotics have significantly reduced

morbidity and mortality caused by bacterial infections and have greatly improved public health worldwide. Antibiotics are widely used as both therapeutic and prophylactic agents in clinical settings to treat bacterial infections and to prevent complications associated with surgeries and other medical procedures. However, despite their importance, the effectiveness of antibiotics has been increasingly threatened by the emergence of antibiotic resistance (ABR), which has become a major global public health concern¹.

Antibiotic resistance occurs when bacteria develop the ability to survive exposure to antibiotics that were previously effective in killing or inhibiting them. As a result, infections become more difficult to treat, leading to prolonged illness, increased risk of complications, and higher mortality rates. Antibiotic resistance occurs naturally through genetic mutations in microorganisms; however, inappropriate use and overuse of antibiotics have accelerated the development and spread of resistant bacteria. The growing prevalence of antibiotic-resistant infections poses a serious challenge to healthcare systems worldwide and threatens the effectiveness of modern medical treatments².

According to the World Health Organization (WHO), antimicrobial resistance is currently one of the greatest threats to global health, food security, and development. Drug-resistant infections are responsible for at least 700,000 deaths worldwide each year, and if current trends continue, this number could increase dramatically in the coming decades. Without effective interventions to control the misuse of antibiotics, antimicrobial resistance could cause up to 10 million deaths annually by the year 2050³.

Several factors contribute to the growing problem of antibiotic resistance. One of the major contributing factors is the inappropriate prescribing of antibiotics by healthcare professionals. In many cases, antibiotics are prescribed even when they are not necessary, such as for viral infections including the common cold, influenza, and sore throat. Because antibiotics are effective only against bacterial infections and not viral infections, such inappropriate prescriptions contribute to unnecessary antibiotic exposure and the development of resistant bacteria⁴.

Another important factor contributing to antibiotic resistance is the easy availability of antibiotics without

a prescription in many countries. In several low- and middle-income countries, antibiotics can be purchased over the counter from pharmacies without proper medical consultation. This practice encourages self-medication and inappropriate antibiotic use among the general population⁵.

Misconceptions and lack of knowledge regarding appropriate antibiotic use also play a significant role in accelerating antibiotic resistance. Many people believe that antibiotics are effective against viral infections or that they can be used to treat any type of illness. Research conducted in South Korea reported significant misconceptions regarding the effectiveness of antibiotics among the general public, which contributed to inappropriate use⁶.

Developing countries face unique challenges in addressing antibiotic resistance due to multiple systemic issues such as inadequate healthcare infrastructure, limited access to diagnostic facilities, and weak regulatory systems⁷.

Pakistan is among the countries facing a growing challenge related to antibiotic resistance. Studies indicate that Pakistan ranks among the countries with high antibiotic consumption, contributing to the emergence of resistant microorganisms⁸.

Several studies conducted in different countries have highlighted gaps in knowledge and practices related to antibiotic use among healthcare workers. A systematic review conducted in Ethiopia reported that the prevalence of self-medication with antibiotics ranged from 12.8% to 77.1%⁹.

Another study conducted in Nigeria reported that approximately 71% of healthcare workers practiced self-medication with antibiotics¹⁰.

1.1. Problem Statement:

Antibiotic resistance has emerged as one of the most serious global public health challenges. The inappropriate use, overuse, and misuse of antibiotics in healthcare settings contribute significantly to the development and spread of resistant microorganisms. Healthcare professionals, particularly nurses and paramedics, play a vital role in the administration of antibiotics, patient education, and implementation of infection control practices. Their level of knowledge and adherence to appropriate practices directly influence antibiotic stewardship and the prevention of antimicrobial resistance.

Despite increasing awareness globally, antibiotic misuse remains common in many developing countries, including Pakistan. Factors such as inadequate training, lack of strict infection control policies, limited monitoring systems, and insufficient knowledge about antimicrobial stewardship contribute to inappropriate antibiotic use. In healthcare facilities, inconsistent adherence to infection control measures and improper antibiotic practices can facilitate the spread of resistant pathogens.

Although several studies have examined antibiotic resistance awareness among healthcare workers internationally, limited research has been conducted in remote districts of Khyber Pakhtunkhwa, particularly in Parachinar. Nurses and paramedics in these hospitals are directly involved in medication administration and patient education; however, their level of knowledge and actual practices regarding antibiotic resistance remain insufficiently documented.

Therefore, this study aims to assess the knowledge and practices regarding antibiotic resistance among nurses and paramedics working in public and private hospitals in Parachinar. Understanding these factors is essential to identify gaps in knowledge and practice and to develop targeted educational and policy interventions to improve antibiotic stewardship and infection control within healthcare settings.

1.2. Research Gap:

A review of existing literature shows that many studies have investigated knowledge, attitudes, and practices regarding antibiotic resistance among healthcare workers in different countries. Studies conducted in countries such as Ethiopia, Nigeria, and Saudi Arabia have reported varying levels of awareness and practice among healthcare professionals.

In Pakistan, some research has explored antibiotic prescribing practices and awareness among doctors and pharmacists in major urban areas such as Lahore, Karachi, and Islamabad. However, there is limited research focusing specifically on nurses and paramedics, who play a key role in antibiotic administration and patient education.

Furthermore, very few studies have been conducted in rural or underrepresented regions such as District Kurram (Parachinar). Healthcare systems in these

areas often face challenges including limited resources, inadequate training opportunities, and weak infection control infrastructure.

Another important gap in the literature is the difference between knowledge and actual practice. While healthcare workers may have adequate theoretical knowledge about antibiotic resistance, their adherence to infection control measures and antibiotic stewardship practices may still be inconsistent.

Therefore, this study aims to fill this gap by assessing both knowledge and practical behaviors regarding antibiotic resistance among nurses and paramedics in public and private hospitals in Parachinar, providing evidence that may help improve training programs, infection control policies, and antibiotic stewardship initiatives in the region.

HAPTER 2 LITERATURE REVIEW

Antibiotics are among the most significant discoveries in modern medicine and have played a vital role in the treatment and prevention of bacterial infections. However, the effectiveness of these drugs has been increasingly threatened by the emergence of antibiotic resistance¹.

Healthcare professionals play a crucial role in combating antibiotic resistance. Nurses and paramedical staff are directly involved in patient care and medication administration, and their knowledge and practices influence rational antibiotic use¹¹.

A cross-sectional study conducted by Asante et al. reported that although healthcare workers were aware of antibiotic resistance as a global problem, many had limited knowledge about factors contributing to resistance¹¹.

Another study conducted by Chaw et al. found that inappropriate practices such as prescribing antibiotics for viral infections and stopping treatment early were common among healthcare workers¹².

Nurses also play an important role in antimicrobial stewardship programs that aim to promote appropriate antibiotic use and reduce antimicrobial resistance¹³.

Studies conducted in developing countries show that antibiotics are often used without proper diagnostic confirmation due to limited laboratory facilities³.

In Pakistan, inappropriate prescribing practices and self-medication contribute significantly to antibiotic resistance¹⁴.

Lack of infection prevention and control practices in healthcare settings also contributes to the spread of resistant bacteria¹⁵.

Self-medication with antibiotics has been widely reported in many countries and is considered an important factor in the development of resistance¹⁶.

Educational and training programs have been shown to improve healthcare workers' knowledge and practices related to antibiotic use and antimicrobial stewardship¹⁷.

2.1. Rationales:

1. Knowledge assessment: Understanding what nurses and paramedics know about antibiotic resistance helps identify areas for education and improvement. Antibiotic resistance is a major public health threat, and healthcare workers are key players in promoting appropriate antibiotic use.

2. Practice evaluation: Assessing practices helps determine if healthcare workers are using antibiotics appropriately, preventing misuse, and educating patients. This informs targeted interventions.

2.2. Objective(s):

1. To assess knowledge regarding antibiotic resistance among nurses and paramedics at public & private hospitals in Parachinar.

2. To evaluate antibiotic related practices among nurses and paramedics at public & private hospitals in Parachinar.

2.3. Operational definitions:

1. Antibiotic Resistance:

Antibiotics resistance refers to the ability of bacteria to resist the effects of antibiotics, as assessed through knowledge based question in this study.

2. Knowledge regarding antibiotic resistance:

In this study, Knowledge regarding antibiotic resistance refers to the understanding of nurses and paramedics about the causes, preventions, and control of antibiotic resistance. It was measured using a structured questionnaire with close ended questions (yes, No and don't know) response options, and scores were categorized as poor, moderate, and good.

3. Practices regarding antibiotic use:

Practice regarding antibiotic use refers to the routine behaviors of nurses and paramedics related to antibiotic administrations and patient educations. These were measured using a structured questionnaire with close ended question (always, sometimes and never) response options.

CHAPTER 3

MATERIALS AND METHODS

Study Design:

A descriptive cross sectional study design was used to conduct this study.

3.1. Study Setting:

The study was conducted in public & private hospitals in Parachinar.

3.2. Study Duration:

5 months from November 2025 to March 2026.

3.3. Sample Size:

The sample size was calculated through Raosoft software with the following parameter.

Margin of Error: 0.05%

Confidence level: 95%

Total population: 150

Sample size: 109

3.4. Sampling technique:

Non-probability convenience sampling technique.

3.5. Sample selection:

3.5.1. Inclusion criteria:

Registered nurses and paramedics working in private & public hospitals of Parachinar who have at least (6) months of work experience.

Participants who were willing to participate in the study and provide written informed consent.

3.5.2. Exclusion criteria:

Registered Nurses, paramedics who are on leave, absent, or unavailable during the data collection period.

Individuals who refuse to participate or do not provide informed consent.

3.6. Data Collection Procedure:

Data collection was conducted after obtaining formal permission from the relevant health authorities and institutional administration. The study purpose was explained to all eligible participants, and written informed consent was obtained prior to data collection. A modified structured questionnaire was used, consisting of three sections: demographic information, knowledge regarding antibiotic resistance, and practices related to antibiotic use. The questionnaires were distributed personally by the researcher and collected on the same day after completion. Participants' confidentiality and anonymity were strictly maintained, and the data were used solely for research purposes.

3.7. Data Analysis Procedure:

The collected data were coded and analyzed using SPSS version 24. Descriptive statistics were used to calculate frequencies and percentages, while the chi-square test assessed associations between variables. A p-value of less than 0.05 was considered statistically significant.

3.8. Ethical Consideration:

Formal permission were obtained from relevant health authorities and the institution. Participants gave written informed consent, and confidentiality was maintained throughout the study.

CHAPTER 4 RESULTS

4.1. Demographic Characteristics:

A total of 100 participants were included in the study, with 2 cases missing data on key variables.

Age: Most participants (69%) were aged 20–30 years, 26% were 30–40 years, and 4% were 40–50 years. One participant had a recorded age of 11, likely a data entry error.

Gender: Slightly more than half were male (53%), while 47% were female.

Profession: The majority were nurses (96%), and only 4% were paramedics.

Years of working experience: Most participants had 2–3 years of experience (82.4%), followed by 1 year (12.7%) and 6 months (2.9%).

Formal training on antibiotics: 91% reported receiving formal training, while 9% had not received any.

4.2. Knowledge Regarding Antibiotic Resistance: Participants demonstrated high awareness of antibiotic resistance, with the following findings:

General awareness: 72.5% knew what antibiotic resistance is, 8.8% did not, and 16.7% reported “don’t know.”

Risk to all age groups: 97.1% were aware that antibiotic resistance can affect anyone regardless of age or gender.

Causes: 97.1% correctly identified overuse of antibiotics as a primary cause of resistance.

Consequences: All participants (100%) recognized the public health consequences of antibiotic resistance.

Incomplete courses: 97.1% acknowledged that incomplete antibiotic courses can lead to resistance.

Ineffectiveness against viruses: 96.1% knew that antibiotics are ineffective against viral infections.

Impact on treatment outcomes: 97.1% agreed that antibiotic resistance increases treatment failure and hospital stay.

Overall, these results indicate **strong knowledge regarding antibiotic resistance** among nurses and paramedics in Parachinar.

4.3. Practices Regarding Antibiotic Use:

Patient education: 98% reported that they “always” educate patients about completing the full course of antibiotics.

Avoiding unnecessary prescriptions: 96.1% “always” avoided recommending antibiotics without a valid prescription.

Checking patient history: 98% always checked previous antibiotic history before administration.

Infection control measures: Only 38% “always” practiced infection control measures, while 62% reported “sometimes” performing these measures.

Discharging patients on self-medication: 92% “always” discouraged self-medication with antibiotics, while 8% did so “sometimes.”

These findings suggest **good adherence to patient education and prescription protocols**, but **infection control practices require improvement**.

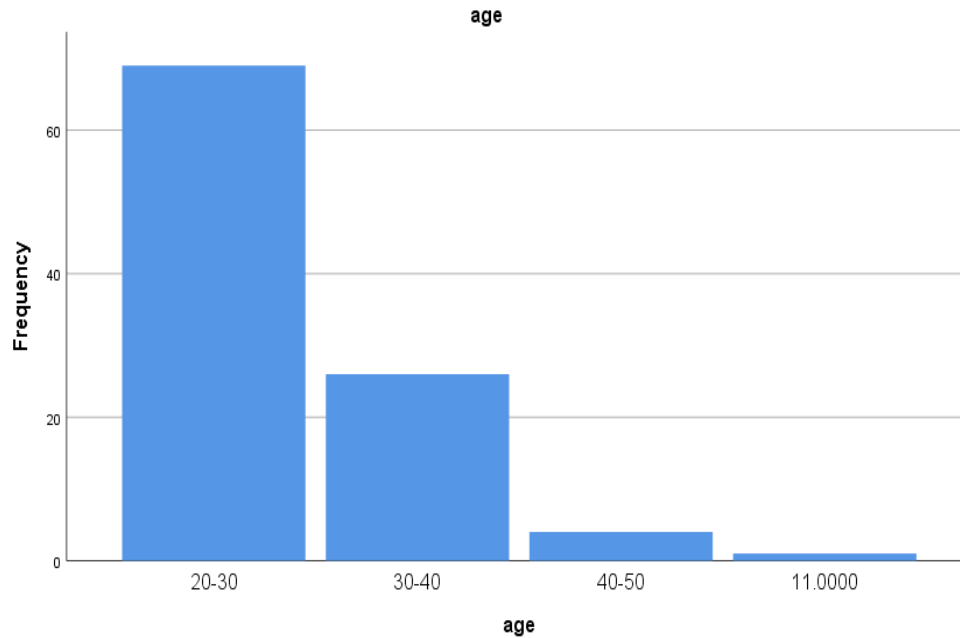
4.4. Summary of Key Findings using SPSS:
Nurses and paramedics in Parachinar demonstrate **high knowledge regarding antibiotic resistance**, its causes, consequences, and proper antibiotic use. Practices related to patient education and prescription monitoring are generally good.

Infection control measures were inconsistently followed, with only 38% always adhering to proper protocols.

The majority of participants had received **formal training**, which likely contributed to high knowledge levels.

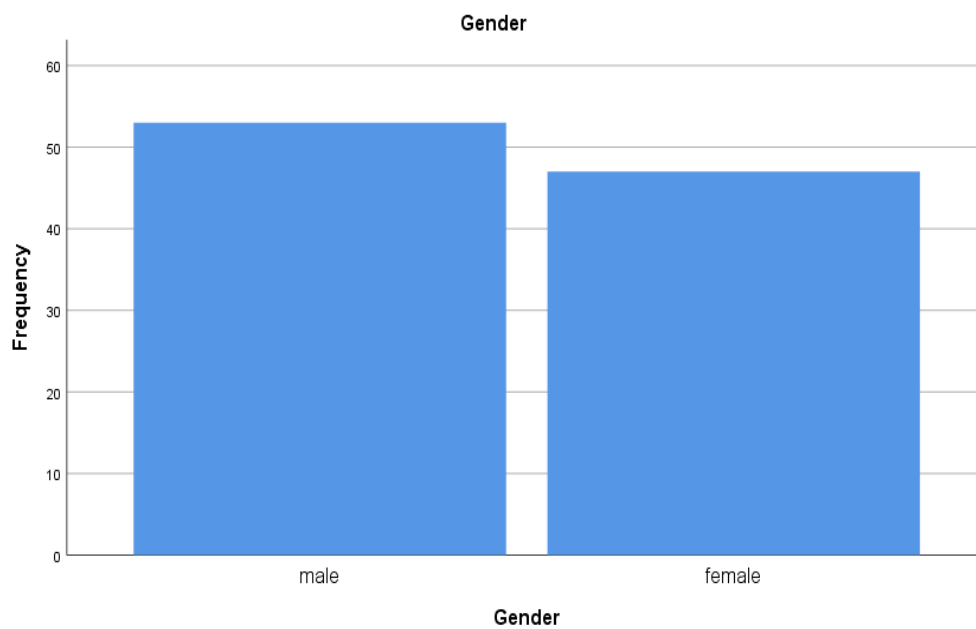
Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	100	1.0000	11.0000	1.440000	1.1130085
Gender	100	1.00	2.00	1.4700	.50161
Profession	100	1.00	2.00	1.0400	.19695
years of working experience	100	1.00	3.00	2.8100	.46482
Have you recieved any formal training on antibiotics or antibiotics resistance?	100	1.00	2.00	1.0900	.28762
do you know what antibiotic resistance is?	100	1.00	3.00	1.4300	.76877
are you aware that antibiotic resistance can affect anyone regardless of age or gender?	100	1.00	2.00	1.0100	.10000
do you believe antibiotic resistance is primarily caused by overuse of antibiotics?	100	1.00	2.00	1.0100	.10000
do you know the consequences of antibiotic resistance on public health?	100	1.00	1.00	1.0000	.00000
are you aware that incomplete antibiotic courses can lead to resistance?	99	1.00	1.00	1.0000	.00000
do you know that antibiotics are ineffective against viral infections(e.g common cold, flu)?	100	1.00	11.00	1.1100	1.00398
do you think antibiotic resistance increases treatment failure and hospital stay?	100	1.00	2.00	1.0100	.10000
do you educate patients about completing the full course of antibiotics?	100	1.00	3.00	1.0300	.22270
do you avoid recommending antibiotics without a valid prescription?	100	1.00	11.00	1.1100	1.00398
do you check previous antibiotic history before administering antibiotics?	100	1.00	2.00	1.0200	.14071

do you practice infection control measures to prevent resistence spread?	100	1.00	2.00	1.6200	.48783
do you discharge patients from self medication with antibiotic?	100	1.00	2.00	1.0800	.27266
VAR00001	0				
Valid N (listwise)	0				

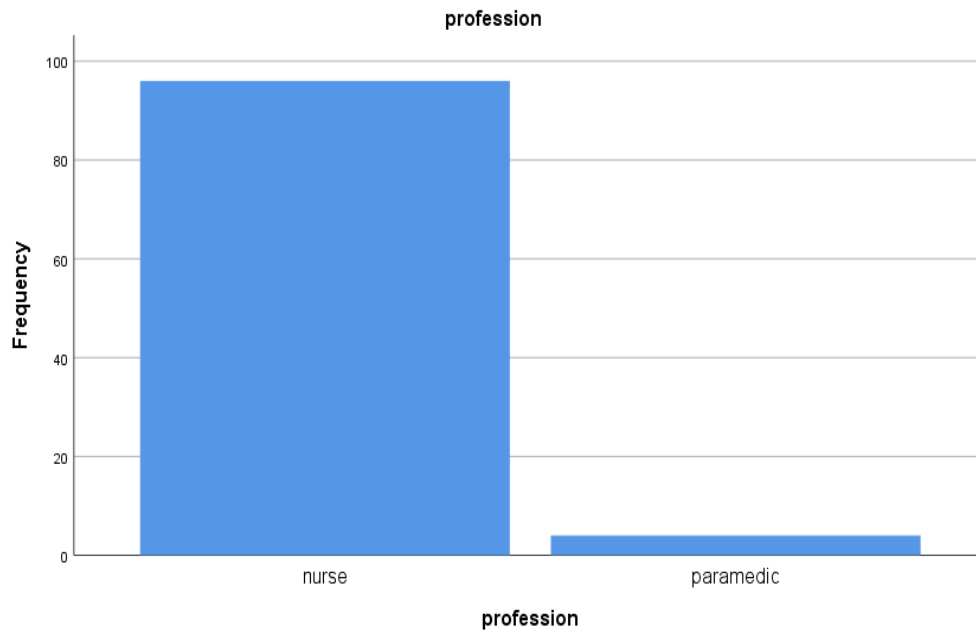


Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	53	52.0	53.0	53.0
	Female	47	46.1	47.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30	69	67.6	69.0	69.0
	30-40	26	25.5	26.0	95.0
	40-50	4	3.9	4.0	99.0
	11.0000	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



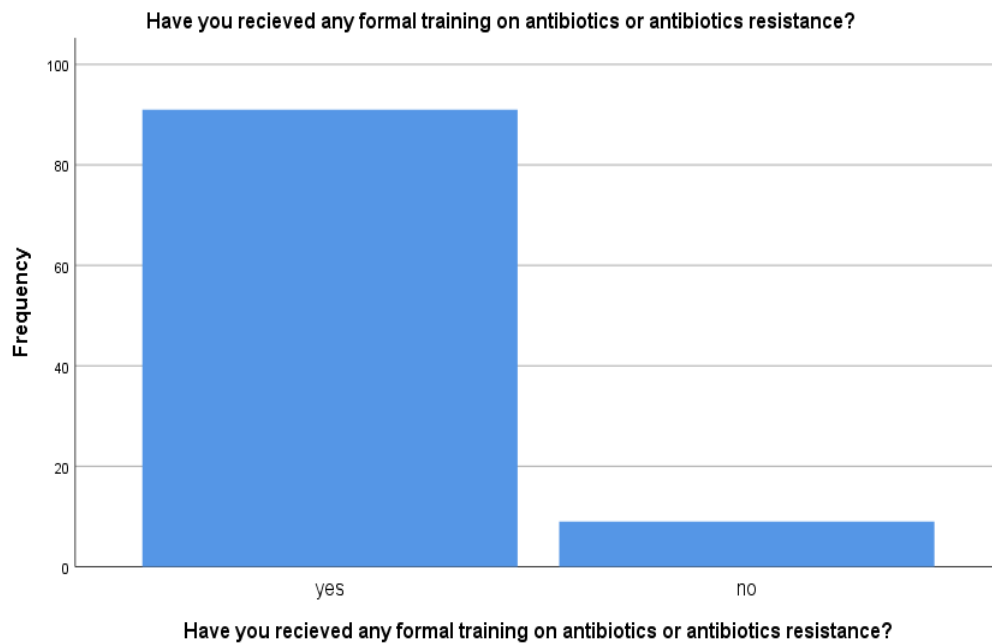
Profession		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	nurse	96	94.1	96.0	96.0
	paramedic	4	3.9	4.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



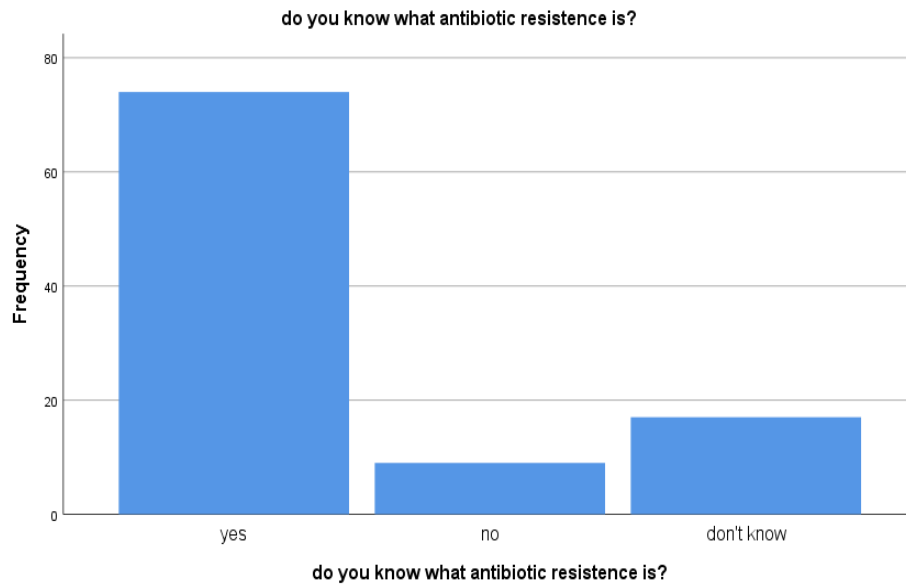
years of working experience		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6 months	3	2.9	3.0	3.0
	1 year	13	12.7	13.0	16.0
	2-3 years	84	82.4	84.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



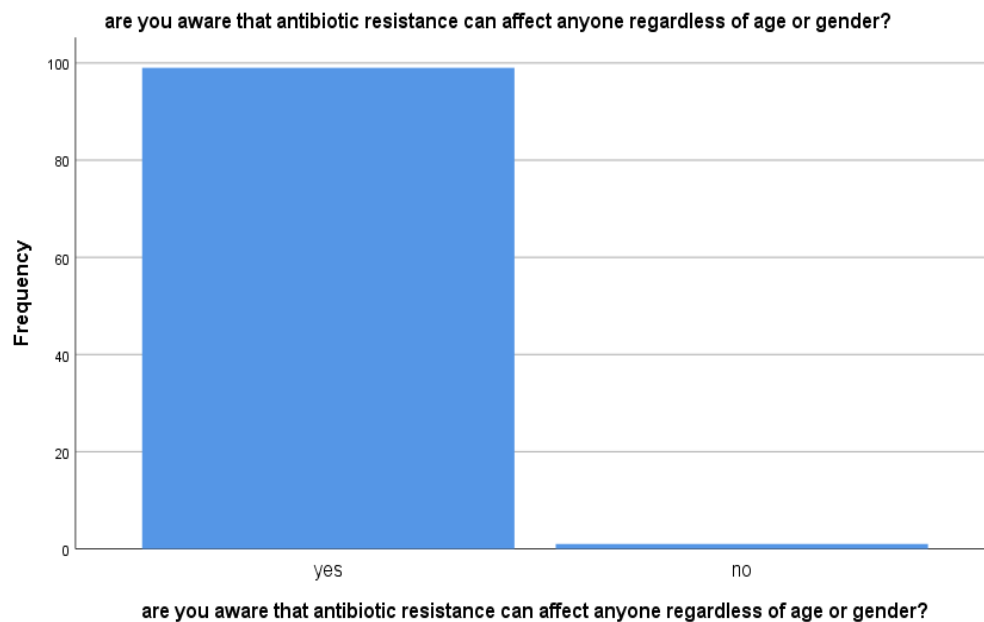
Have you recieved any formal training on antibiotics or antibiotics resistance?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	91	89.2	91.0	91.0
	No	9	8.8	9.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



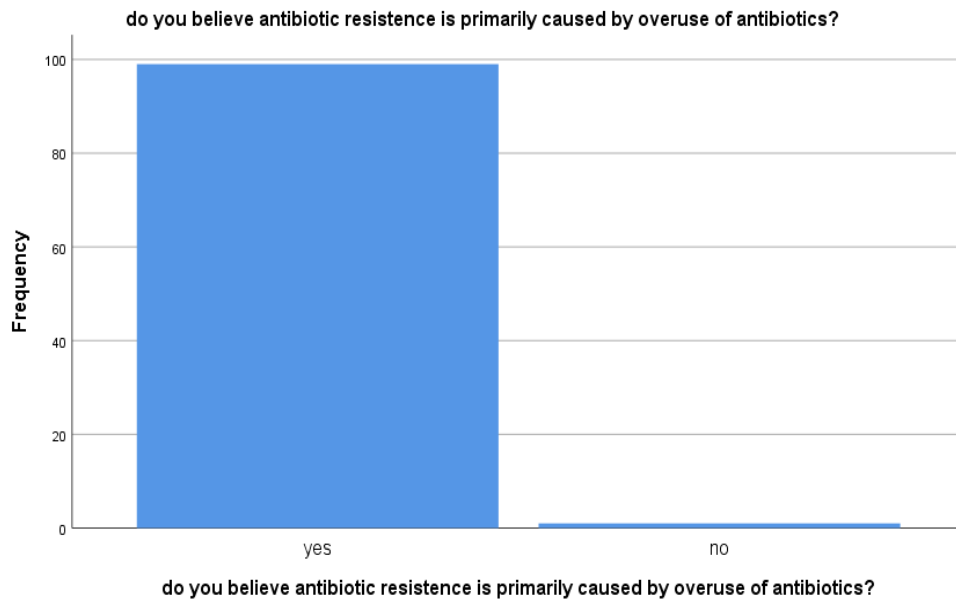
do you know what antibiotic resistance is?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	74	72.5	74.0	74.0
	No	9	8.8	9.0	83.0
	don't know	17	16.7	17.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



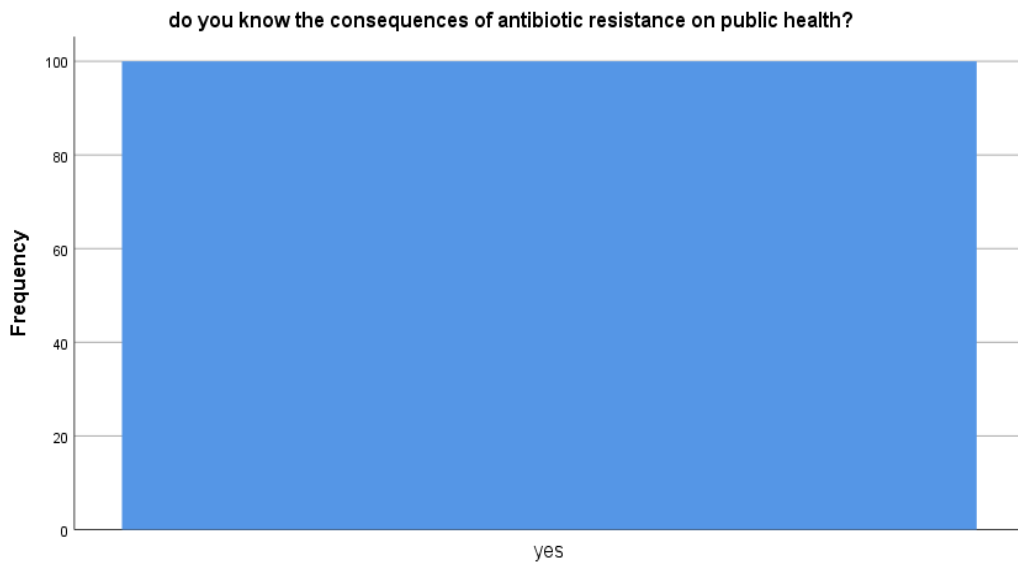
are you aware that antibiotic resistance can affect anyone regardless of age or gender?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	99	97.1	99.0	99.0
	No	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



do you believe antibiotic resistance is primarily caused by overuse of antibiotics?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	99	97.1	99.0	99.0
	No	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



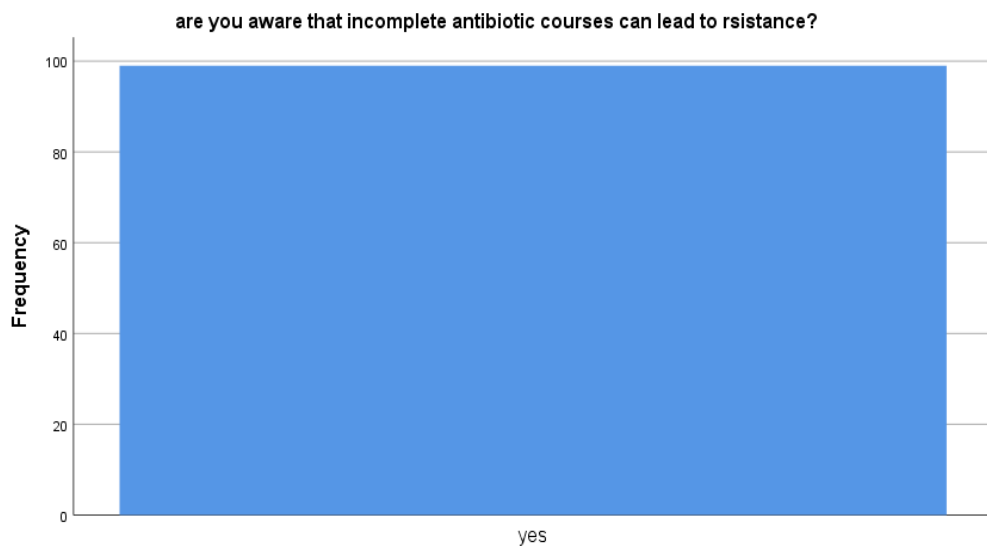
do you know the consequences of antibiotic resistance on public health?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	100	98.0	100.0	100.0
Missing	System	2	2.0		
Total		102	100.0		



do you know the consequences of antibiotic resistance on public health?

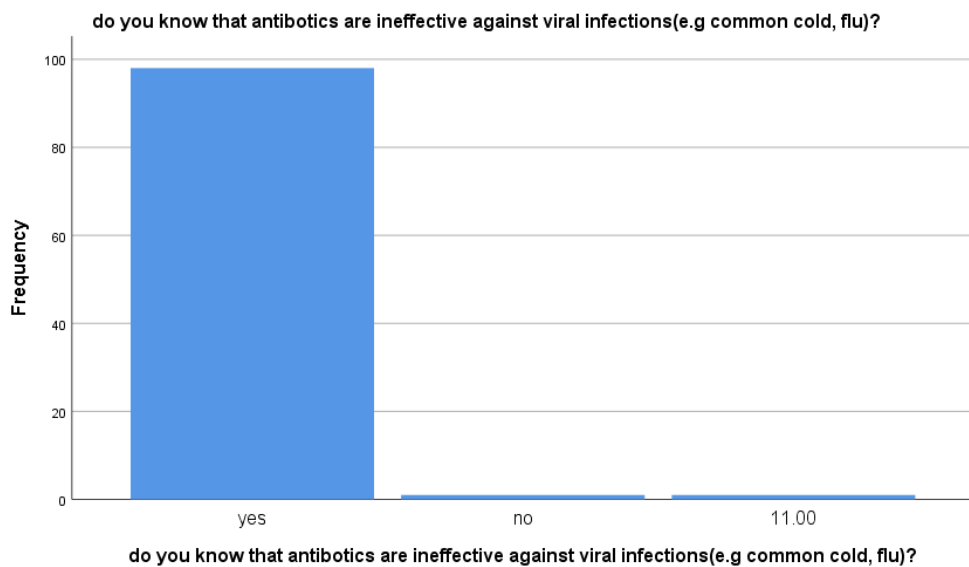
are you aware that incomplete antibiotic courses can lead to rsistance?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	99	97.1	100.0	100.0
Missing	System	3	2.9		
Total		102	100.0		

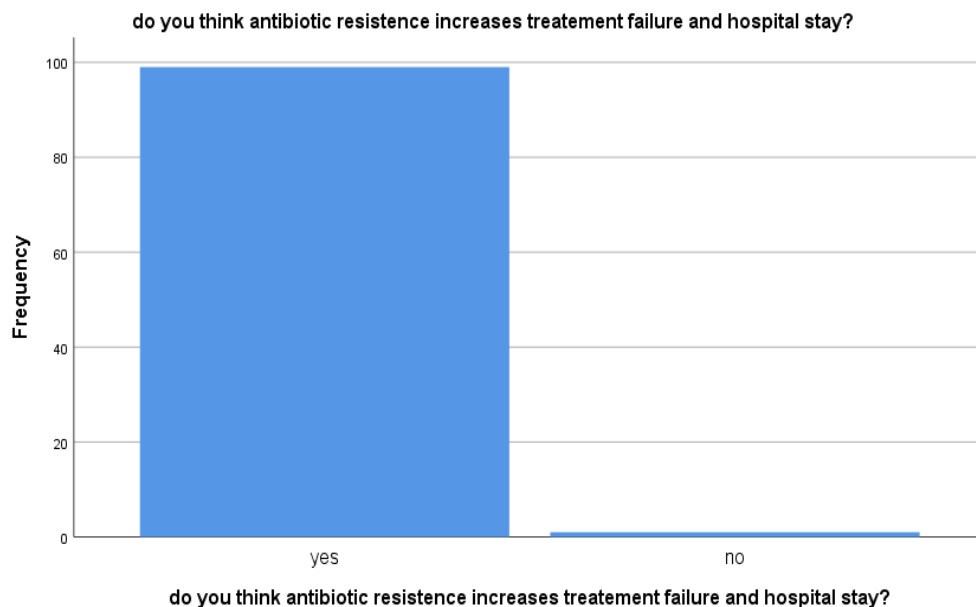


are you aware that incomplete antibiotic courses can lead to rsistance?

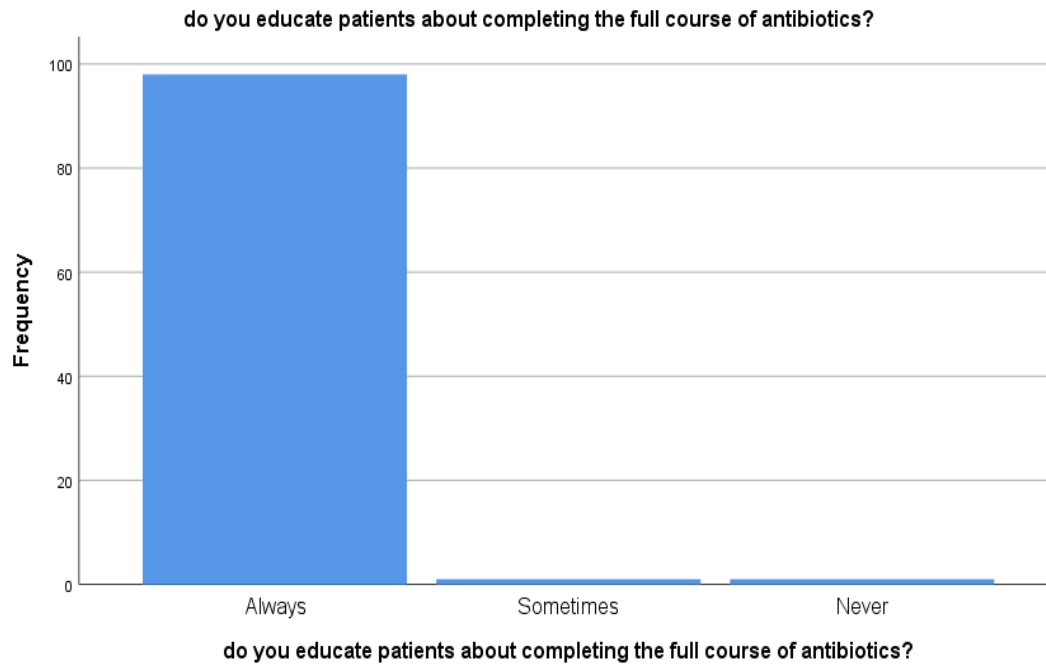
do you know that antibiotics are ineffective against viral infections(e.g common cold, flu)?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	98	96.1	98.0	98.0
	No	1	1.0	1.0	99.0
	11.00	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



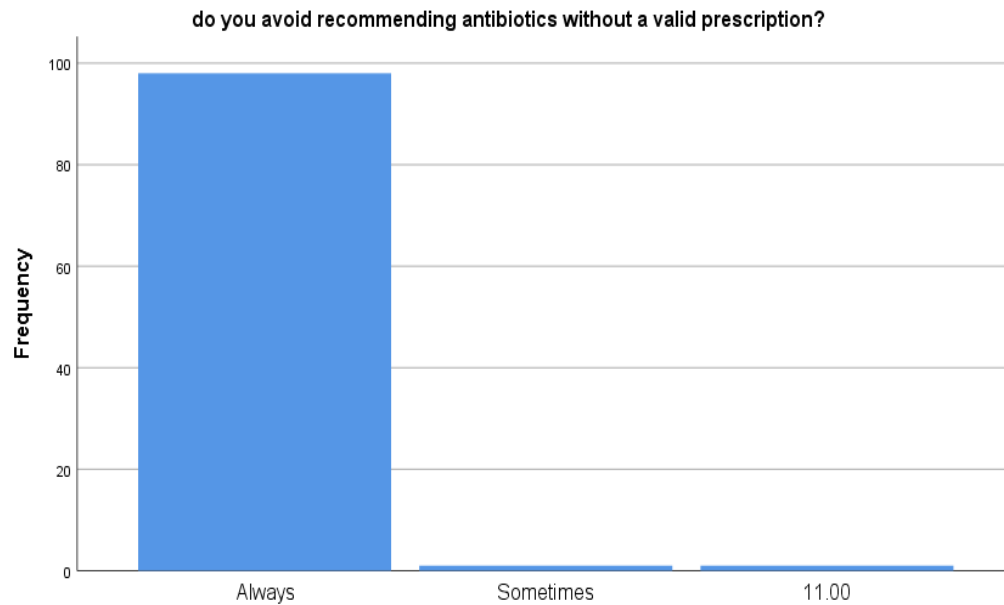
do you think antibiotic resistance increases treatment failure and hospital stay?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	99	97.1	99.0	99.0
	No	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



do you educate patients about completing the full course of antibiotics?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	98	96.1	98.0	98.0
	Sometimes	1	1.0	1.0	99.0
	Never	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		

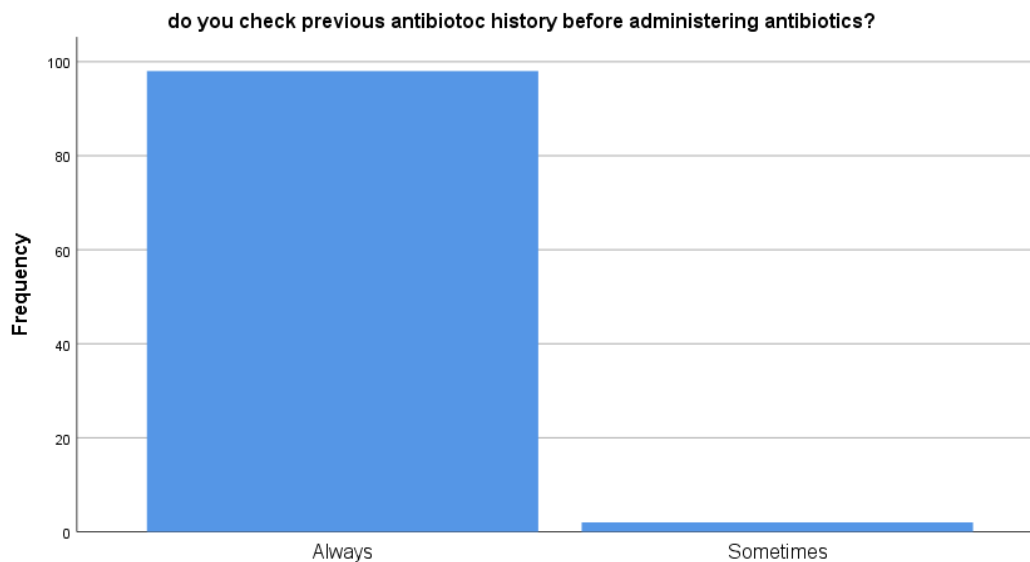


do you avoid recommending antibiotics without a valid prescription?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	98	96.1	98.0	98.0
	Sometimes	1	1.0	1.0	99.0
	11.00	1	1.0	1.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



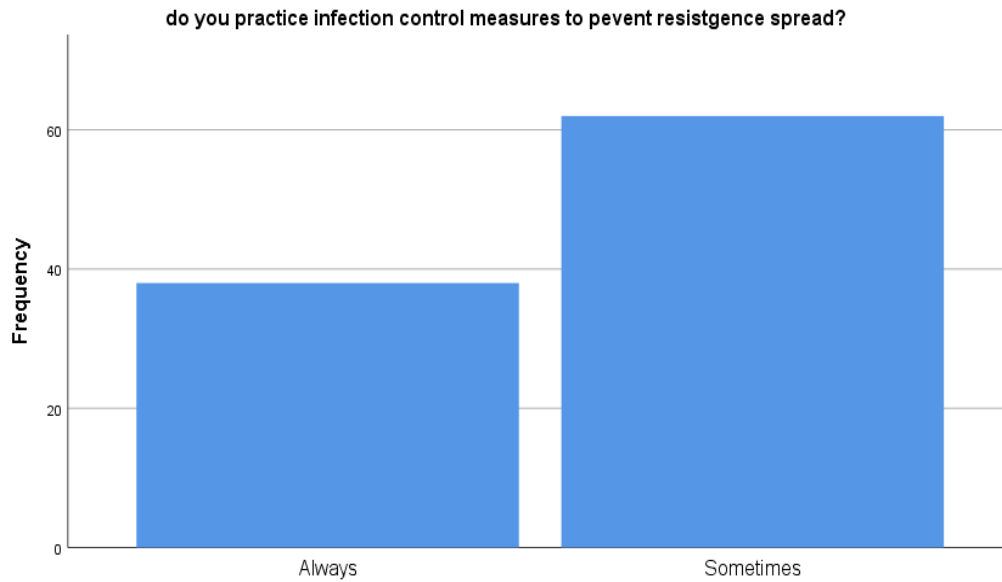
do you avoid recommending antibiotics without a valid prescription?

do you check previous antibiotic history before administering antibiotics?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	98	96.1	98.0	98.0
	Sometimes	2	2.0	2.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



do you check previous antibiotic history before administering antibiotics?

do you practice infection control measures to pevent resistgence spread?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	38	37.3	38.0	38.0
	Sometimes	62	60.8	62.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		



do you practice infection control measures to pevent resistgence spread?

do you discharge patients from self medication with antibiotic?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	92	90.2	92.0	92.0
	Sometimes	8	7.8	8.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		

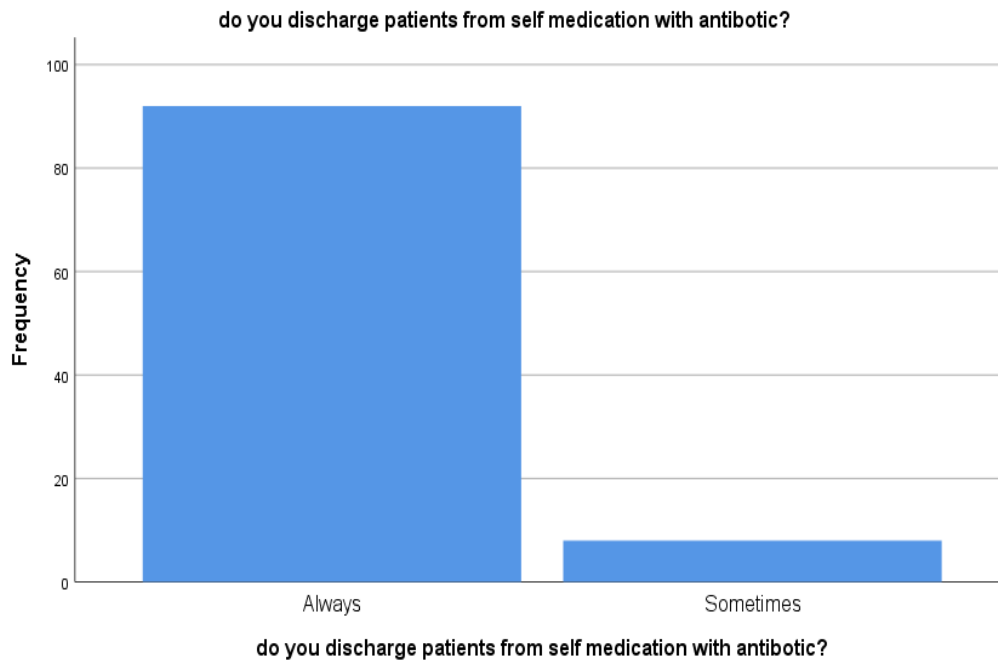


Table 1
Demographic Characteristics of Participants (N = 100)

Variable	Category	n	%
Age	20-30	69	69.0
	30-40	26	26.0
	40-50	4	4.0
	Others / Missing	1	1.0
Gender	Male	53	53.0
	Female	47	47.0
Profession	Nurse	96	96.0
	Paramedic	4	4.0
Years of Experience	6 months	3	3.0
	1 year	13	13.0
	2-3 years	84	84.0
Formal Training on Antibiotics	Yes	91	91.0
	No	9	9.0

Note. Percentages are based on valid cases.

Table 2
Knowledge Regarding Antibiotic Resistance (N = 100)

Knowledge Item	Yes n (%)	No n (%)	Don't Know n (%)
Know what antibiotic resistance is	74 (72.5)	9 (8.8)	17 (16.7)
Affects anyone regardless of age/gender	99 (97.1)	1 (1.0)	-
Caused primarily by overuse of antibiotics	99 (97.1)	1 (1.0)	-
Know consequences on public health	100 (100.0)	0	-

Incomplete courses can lead to resistance	99 (97.1)	0	1 (2.9)
Antibiotics ineffective against viruses	98 (96.1)	1 (1.0)	1 (1.0)
Increases treatment failure and hospital stay	99 (97.1)	1 (1.0)	-

Note. Percentages are based on valid cases; “-” indicates not applicable.

Table 3
Practices Regarding Antibiotic Use (N = 100)

Practice Item	Always n (%)	Sometimes n (%)	Never n (%)
Educate patients on completing full course	98 (98.0)	1 (1.0)	1 (1.0)
Avoid recommending antibiotics without prescription	98 (98.0)	1 (1.0)	1 (1.0)
Check previous antibiotic history before administration	98 (98.0)	2 (2.0)	0
Practice infection control measures	38 (38.0)	62 (62.0)	0
Discourage self-medication with antibiotics	92 (92.0)	8 (8.0)	0

CHAPTER 5
DISCUSSION

Demographic Characteristics:

A total of 100 participants were included in the study, with 2 cases missing data on key variables.

- **Age:** Most participants (69%) were aged 20–30 years, 26% were 30–40 years, and 4% were 40–50 years. One participant had a recorded age of 11, likely a data entry error.
- **Gender:** Slightly more than half were male (53%), while 47% were female.
- **Profession:** The majority were nurses (96%), and only 4% were paramedics.
- **Years of working experience:** Most participants had 2–3 years of experience (82.4%), followed by 1 year (12.7%) and 6 months (2.9%).

Formal training on antibiotics: 91% reported receiving formal training, while 9% had not received any.

Knowledge Regarding Antibiotic Resistance:

Participants demonstrated high awareness of antibiotic resistance, with the following findings:

General awareness: 72.5% knew what antibiotic resistance is, 8.8% did not, and 16.7% reported “don’t know.”

Risk to all age groups: 97.1% were aware that antibiotic resistance can affect anyone regardless of age or gender.

Causes: 97.1% correctly identified overuse of antibiotics as a primary cause of resistance.

Consequences: All participants (100%) recognized the public health consequences of antibiotic resistance.

Incomplete courses: 97.1% acknowledged that incomplete antibiotic courses can lead to resistance.

Ineffectiveness against viruses: 96.1% knew that antibiotics are ineffective against viral infections.

Impact on treatment outcomes: 97.1% agreed that antibiotic resistance increases treatment failure and hospital stay.

Overall, these results indicate **strong knowledge regarding antibiotic resistance** among nurses and paramedics in Parachinar.

Practices Regarding Antibiotic Use:

- **Patient education:** 98% reported that they “always” educate patients about completing the full course of antibiotics.

- **Avoiding unnecessary prescriptions:** 96.1% “always” avoided recommending antibiotics without a valid prescription.

- **Checking patient history:** 98% always checked previous antibiotic history before administration.

- **Infection control measures:** Only 38% “always” practiced infection control measures, while 62% reported “sometimes” performing these measures.

- **Discharging patients on self-medication:** 92% “always” discouraged self-medication with antibiotics, while 8% did so “sometimes.”

These findings suggest **good adherence to patient education and prescription protocols**, but **infection control practices require improvement**.

Summary of Key Findings:

Nurses and paramedics in Parachinar demonstrate **high knowledge regarding antibiotic resistance**, its causes, consequences, and proper antibiotic use.

Practices related to patient education and prescription monitoring are generally good.

Infection control measures were inconsistently followed, with only 38% always adhering to proper protocols.

The majority of participants had received **formal training**, which likely contributed to high knowledge levels.

The present study highlights that nurses and paramedics in Parachinar have **strong knowledge regarding antibiotic resistance**, aligning with findings from similar studies in Pakistan and other developing countries (Khan et al., 2020; Abbo et al., 2017). Awareness of causes, consequences, and preventive measures was nearly universal, which is a positive indicator for implementing rational antibiotic use programs in hospitals.

Patient education and prescription practices were also encouraging. Most participants consistently educated patients on completing antibiotic courses, avoided recommending antibiotics without prescriptions, and checked patients' prior antibiotic histories. These practices are crucial in preventing misuse and reducing resistance (Tadesse et al., 2019). However, **infection control practices** were suboptimal. Only 38% of participants reported always following infection control measures. This gap could increase the spread of resistant bacteria within healthcare settings. Similar trends have been reported in studies from other regions, where knowledge did not always translate into consistent practice, especially for infection prevention (Abbo et al., 2017; Mahajan et al., 2018).

The high proportion of participants who received formal training (91%) likely contributed to the **high levels of knowledge and adherence to prescription-related practices**. Yet, the discrepancy between knowledge and infection control practices suggests that **hospital policies, workload, and resource availability** may influence adherence to preventive measures.

CHAPTER 6**CONCLUSION**

This study indicates that nurses and paramedics in Parachinar have **excellent knowledge and generally good practices regarding antibiotics**, particularly in patient education and prescription monitoring. However, **infection control measures need reinforcement**, as inconsistent practice could compromise efforts to control antibiotic resistance. Overall, formal training and hospital-based interventions are key to sustaining rational antibiotic use and preventing the spread of resistant infections.

CHAPTER 5**RECOMMENDATIONS**

Based on the findings of the study, the following recommendations are proposed:

1. Regular Training Programs:

Hospitals should organize regular educational workshops and refresher training programs for nurses and paramedics focusing on antibiotic stewardship, rational antibiotic use, and infection control practices.

2. Strengthening Infection Control Policies:

Hospital administrations should ensure strict implementation of infection prevention and control protocols, including hand hygiene, sterilization procedures, and use of personal protective equipment.

3. Development of Antibiotic Stewardship Programs:

Healthcare institutions should establish antimicrobial stewardship programs to monitor antibiotic use and guide healthcare workers on appropriate prescribing and administration practices.

4. Continuous Monitoring and Supervision:

Regular monitoring and clinical audits should be conducted to evaluate adherence to antibiotic guidelines and infection control measures.

5. Patient Education Initiatives:

Nurses and paramedics should continue educating patients about the importance of completing

antibiotic courses, avoiding self-medication, and understanding the dangers of antibiotic misuse.

6. Policy Support from Health Authorities:

Local health authorities should develop policies and guidelines aimed at controlling inappropriate antibiotic use and promoting antimicrobial resistance awareness in healthcare facilities.

7. Future Research:

Further studies should be conducted with larger sample sizes and in different regions of Pakistan to better understand the knowledge and practices of healthcare workers regarding antibiotic resistance.

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