

## Factors Influencing Antibiotic Prescription Practices for Pneumonia among Clinicians at Mbagathi Level 5 Hospital, Kenya

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### Abstract

Although clinicians understand the importance of stewardship, inappropriate prescription of antibiotics persists in low-resource settings. This study sought to assess the factors influencing compliance for pneumonia antibiotic prescription among clinicians by focusing on the level of compliance to guidelines, socioeconomic, and health system related determinants. The study adopted cross-sectional survey design, targeting all the 171 clinicians at Mbagathi Level 5 Hospital. A census was conducted using a structured questionnaire between March 2024 and May 2024. Both descriptive and inferential statistics, including frequencies, percentages, and chi-square tests were used in analyzing data. 152 questionnaires were filled and returned, giving a response rate of 89%. Majority of the respondents were medical officers (43.4%) followed by clinical officers (36.2%) and consultants (20.4%) respectively. The findings established a moderately high compliance (68.4%) to pneumonia antibiotic prescription among clinicians. The findings also revealed significant associations between gender ( $\chi^2 = 8.05$ ,  $p = 0.005$ ), designation ( $p = 0.005$ ), presence of medical insurance ( $p = 0.005$ ), availability of diagnostic tests ( $\chi^2 = 9.13$ ,  $p = 0.010$ ), availability of drugs ( $\chi^2 = 8.96$ ,  $p = 0.011$ ), presence of staff ( $\chi^2 = 9.514$ ,  $p = 0.009$ ), knowledge and awareness ( $\chi^2 = 34.42$ ,  $p < 0.001$ ), and compliance to pneumonia antibiotic prescription practices among clinicians. These results affirm that health system factors such as staffing, availability of antibiotics and availability of diagnostic facilities influenced antibiotic prescription practices. Gender, designation as well as presence of medical insurance were determinants of antibiotic prescription practices. Therefore, National and County governments should focus on strengthening critical pillars of healthcare; namely; health workforce, service delivery, and medicines and vaccines in order to enhance compliance to antibiotic prescription guidelines. The influence of knowledge and awareness of antibiotic prescription guidelines underscored the need for health facilities to invest in continuous training on antibiotic stewardship

**Keywords:** *Prescription practice, Pneumonia, Clinicians, Determinants, Antibiotic Stewardship and antibiotic resistance*

## 1.0 Introduction

World Health Organization (WHO, 2020) defines antibiotics as medicines that are used in prevention and treatment of bacterial infections. Antibiotic resistance (AR) is a phenomenon that occurs when bacteria undergo changes as a result of utilization of antibiotics. The development of antibiotic resistance is currently one of the most significant challenges facing world health, food security, and development (Ding et al., 2023). The trends have showed increasing resistance mechanisms globally; thus, threatening the ability to treat and manage infectious diseases including pneumonia (Llor & Bjerrum, 2014). Pneumonia is an acute respiratory infection that mostly affects the lungs, causing inflammation of the tissues (Kunhikannan et al., 2021). *Streptococcus pneumoniae*, commonly referred to as pneumococcus, is a major bacterial pathogen responsible for causing pneumonia. Over time, some strains of *Streptococcus pneumoniae* have developed resistance to various classes of antibiotics, including penicillin and macrolides. Antibiotic resistance in *Streptococcus pneumoniae* is a concern, and can impact the treatment of pneumococcal infections (Jullien et al., 2020).

The presenting symptoms for pneumonia are cough, fever, difficulty in breathing, and chest pains. Pneumonia has been one of the leading public health concerns globally with approximately 2.5 million people dying annually (WHO, 2020), 30% of all the cases being children below five years (Center for Disease Control and prevention (CDC), 2022). Studies have established that most of pneumonia mortalities are associated with antibiotic resistance (Bolge et al., 2021; Hu et al., 2022). According to

Centre for disease control and prevention (CDC), pneumococcal bacteria is the most resistant type of bacteria with more than 30% of cases (CDC, 2023). Further, the most commonly reported MDR-GNB causes of pneumonia were *A. baumannii*, *K. pneumoniae*, and *P. aeruginosa*, with *A. baumannii* (Assefa, 2022). Misuse of antibiotics and poor prescribing patterns have been noted to contribute to increased risk of antibiotic resistance among pneumonia patients. A report published by CDC found that 28 percent of the antibiotics prescribed at the outpatient department were unnecessary which illustrate the poor prescribing pattern among clinicians (CDC, 2022).

Kenya like other Low- and Middle-Income Countries (LMIC) undergoing epidemiologic transition which results in a double burden of disease due to a rise in non-communicable diseases is still grappling with infectious diseases such as pneumonia (Alessa et al., 2023; Eticha & Gemechu, 2021). Momanyi et al. (2019) observed that despite 54.7% of patients having antibiotic prescription, only 37.3% had documented reason for antibiotic use. Misuse of antibiotic prescription has been a common problem in low income setting, including Kenya. Mbagathi is a level 5 hospital that draws its clientele mainly from Kibra area which comprise of low-income earners. This means that most of the people it serves are likely to have a challenge with regard to undergoing all diagnostics prior to antibiotic prescription. This challenge in turn may have implications on the clinician prescribing pattern. A previous study based on Mbagathi Level five hospital by Bii et al. (2002) found that pneumonia was a common infectious disease among patients presenting at the facility. However,

prescribing patterns were not investigated in their study, thus presenting a knowledge gap on the commitment of clinicians to follow the laid down ministry of health pneumonia treatment guidelines. There is little known information about the prescription patterns of clinicians in the management of pneumonia patients, and factors contributing to the prescription patterns.

Patients with pneumonia are more likely to experience negative outcomes when physicians and other healthcare professionals prescribe incorrectly. The prescription mistakes could result in less effective treatment outcomes, higher medical expenses, a higher risk of an antibiotic resistance, and decreased patient safety (Ghimire et al., 2023). Further, improper patient behaviors may make it more difficult to manage pneumonia patients overall and may call for corrective and improved prescribing procedures to improve patient outcomes.

### ***Statement of the problem***

It is necessary that healthcare professionals, particularly physicians, maintain a high level of compliance to the criteria for prescribing antibiotics for pneumonia. In order to provide the best possible patient care, their prescription practices should be guided by a thorough understanding of the socioeconomic and health system-related factors, as well as a thorough comprehension of the prescription practices for antibiotics used to treat pneumonia. It is estimated that resistant infections are responsible for at least 700,000 fatalities annually across the world, with multidrug-resistant communicable diseases accounting for 230,000 of the deaths (Edwards et al., 2021). A study conducted in 2019 estimated that 4.95 million deaths

are associated with bacterial AMR, with the highest mortality being in western Sub-Saharan Africa (Aslan Kayiran et al., 2020). Within the Kenyan context, Momanyi et al. (2019) noted that 54.7% of patients having antibiotic prescription do not have a documented reason for antibiotic administration. Mbagathi hospital reports the highest burden of pneumonia among patients presenting at the facility (Bii et al., 2002). However, prescribing patterns were not investigated in their study, thereby presenting a gap in the commitment among clinicians to follow the laid down ministry of health pneumonia treatment guidelines. Thus, this study sought to investigate factors influencing antibiotic prescription practices for pneumonia among clinicians at Mbagathi level 5 hospital, Kenya.

*“The paper provides compelling evidence that gender differences influence compliance, with male and female clinicians exhibiting varying adherence rates”*

### ***Theoretical review***

The Health Belief Model by Rosenstock (1974) underpins this study. This model highlights how decision-making by doctors is influenced by their perceptions of the advantages and disadvantages of antibiotic treatment, as well as its urgency and necessity. Further, the model acknowledges the interaction between socioeconomic characteristics and health attitudes, offering insights into the external factors influencing the prescription behavior of clinicians.

### **Literature review**

Antibiotics are essential tools in the treatment of bacterial infections, but their misuse and overuse contribute to the growing threat of antibiotic resistance. The prescribing patterns of physicians play a significant role in determining the appropriate use of antibiotics. However, in low resource settings, where socio-economic disparities are prevalent, various factors related to socio-economic status can influence antibiotic prescribing practices among clinicians (Servia-Dopazo & Figueiras, 2018). Kenya, just like other developing countries is faced with a growing burden of disease and resource strain which has caused competing needs. Affordability of antibiotics, insurance cover, patient and relative pressure, religion and financial incentives to clinicians to prescribe antibiotics have been identified as key determinants for prescribing patterns (Opatowski et al., 2021; Dixon et al., 2021; Liu et al., 2019).

Health system factors entails the six WHO pillars; namely, health service delivery, health workforce, health information system, access to essential medicines, leadership and governance. Prescription practices among clinicians play a crucial role in patient outcomes, medication safety, and the overall effectiveness of healthcare systems (Sibande et al., 2022). Several health system-related determinants influence physicians' prescription practices. These include, human resource factors, financial challenges, physical resources and access to health information systems. In Kenya, majority of patients access care through the National Health Insurance Fund (NHIF). Other forms of payment include out of pocket and insurance covers (Mekonnen Eticha & Gemechu, 2021). The

preference of patients with insurance covers, high prescription of close to expiry antibiotics and inability to implement antibiotic guidelines have negatively influenced prescribing practices among clinicians in Kenya. Such measures are contrary to the antimicrobial's stewardship guidelines. In countries such as Kenya where there has been limited enforcement of these guidelines, the welfare of patients has been greatly impacted. However, there is limited scholarly information about health-system related factors that influence prescribing practices among clinicians (Alowfi et al., 2023).

### **2.0 Materials and Methods**

The study employed a cross-sectional survey design. Data was collected at Mbagathi level five hospital between March 2024 and May 2024. The study targeted 171 medical officers, consultants and clinical officers working at Mbagathi level five hospital. A structured questionnaire was used to collect data. Reliability was evaluated to ascertain how trustworthy the data gathering tool assessed the intended idea. A Cronbach's alpha value of 0.8 was achieved implying a high internal consistency of the research instrument. A pilot study was conducted at Mama Lucy Kibaki Hospital, using 10% of the sample as recommended by Mugenda and Mugenda (2003). Researcher permit was obtained from NACOSTI, and approval from Mbagathi level 5 hospital before data was collected. Similarly, ethical approval was sought from KEMU Ethical Review Board, and a letter of permission to carry out the study from a county facility was obtained from the county government of Nairobi. An informed consent was sought from all participants and utmost confidentiality of their responses was

assured. Data analysis was done using STATA version 17. A chi square test or Fischer’s exact test for association was used to investigate the determinants of antibiotic prescribing practices among clinicians. The level of significance was assessed at 95% significance level ( $p < 0.05$ ).

### 3.0 Results and Discussion

This section presents the results of the collected data and discussions based on the study variables, which include the level of compliance, socio-economic related factors, health system related factors,

knowledge and awareness of pneumonia antibiotic prescription practice among clinicians at Mbagathi level 5 hospital, Kenya.

#### *Demographic characteristics*

Demographic statistics describe populations and their characteristics, thus helping in conceptualizing the population of interest to research. Among the demographic characteristics of clinician at Mbagathi level-five hospital included gender, age, designation, and experience as illustrated in Table 1.

**Table 1**

*Demographic characteristics of clinicians at Mbagathi level five hospital*

	Frequency	Percent
Gender		
Male	92	60.5
Female	60	39.5
Age( years)		
21 – 30	11	7.2
31 – 40	64	42.1
41 – 50	59	38.8
>50	18	11.8
Designation		
Consultant	31	20.4
Medical officer	66	43.4
Clinical officer	55	36.2
Years of experience		
<5	17	11.2
5 – 10	62	40.8
>10	73	48.0

The findings indicate a predominantly male clinician demographic, with 60.5% of respondents being male. A significant portion of the participants, 42.1%, fell within the 31 to 40 age range, while 38.8% were aged 41 to 50, suggesting a relatively young and middle-aged workforce. The distribution of roles highlights that 43.4% of respondents were medical officers, followed by 36.2% clinical officers, and 20.4% consultants, reflecting a diverse

clinical background. Nearly half of the respondents (48%) possessed over 10 years of working experience, indicating a level of seasoned expertise within the group. This combination of experience and age suggests that respondents are well-equipped to engage with and implement non-pharmaceutical interventions in patient care, as they possess both practical knowledge and a foundational

understanding of evolving treatment options

***Level of compliance with pneumonia antibiotic prescription guidelines***

Compliance to Antibiotic Prescription guidelines requires a host of measures, including carrying out appropriate diagnostic investigations before initiation of antibiotic therapy, checking for clinical factors that could affect choice of antibiotic

in patients, as well as ensuring right dose, right duration and de escalation of antibiotic therapy. The level of compliance with pneumonia antibiotic prescription guidelines among clinicians was rated on a five-point Likert scale where 1 = Strongly disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A), and 5 = Strongly agree (SA). The higher the score, the higher the level of compliance and vice versa. The results are presented in Table 2.

**Table 2**

*Level of compliance with pneumonia antibiotic prescription guidelines among clinicians at Mbagathi level five hospital*

Statement	SD n(%)	D n(%)	N n(%)	A n(%)	SA n(%)
I follow guidelines for prescribing antibiotics in pneumonia cases on choice of antibiotics and treatment duration	2(1.3)	0	31(20.4)	90(59.2)	29(19.1)
I update my knowledge of pneumonia treatment guidelines	1(0.7)	0	25(16.4)	92(60.5)	34(22.4)
I am aware of the clinical factors in patients that influence the choice of antibiotic	0	0	19(12.5)	98(64.5)	35(23.0)
I always consult reference sources (e.g, guidelines, drug information databases) when prescribing medication	0	0	16(10.5)	101(66.4)	35(23.0)
I frequently communicate potential risks or side effects of prescribed medications to my patients	0	0	20(13.2)	105(69.1)	27(17.8)

Findings reveal that majority of respondents (59.2%) reported adherence to antibiotics prescription guidelines, indicating a strong recognition of the importance of following established protocols for antibiotic choice and treatment duration. Additionally, 60.5% acknowledged that they actively update their knowledge of pneumonia treatment guidelines, reflecting a commitment to continuous professional development and an awareness of the evolving nature of medical standards. This suggests that clinicians are not only aware of the

guidelines, but they are also proactive in ensuring their practice aligns with current recommendations, hence, optimizing patient outcomes and combating antibiotic resistance. These findings align with previous research in various regions, underscoring both the consistency and variability in adherence to pneumonia treatment guidelines globally. In Ethiopia, a study by Eticha and Gemechu (2021) reported a non-adherence rate of 36.4% to national guidelines for antibiotic use. This figure is comparable to the 31.6% noncompliance found in the current study,

suggesting similar challenges in guideline adherence despite geographical differences. The factors influencing these rates include similarities in healthcare infrastructure, clinician training, and access to up-to-date guidelines. Findings from a study in Ghana revealed that 68% of the patients with antibiotic prescription for pneumonia followed the set guidelines (Owusu et al., 2022). A study in Ghana by Sefah et al. (2021) revealed lower adherence levels, with only 33% compliance among clinicians. This finding indicates a higher rate of noncompliance compared to the present study, pointing to significant barriers to guideline adherence in the Ghanaian healthcare setting. Factors such as resource limitations, differing healthcare policies, and patient expectations may contribute to these lower adherence rates. A study conducted in China by Lui et al. (2020) also found a non-adherence rate of 25%, which is slightly lower than the current study's 31.6% noncompliance. This suggests better adherence to guidelines in China, possibly due to more robust implementation of clinical guidelines, continuous medical education, and stronger healthcare policies that support guideline compliance. Interestingly, a retrospective study in Saudi Arabia by Alessa et al. (2023) reported a higher noncompliance rate of 50%. However, it is crucial to note that this study focused on patient outcomes

rather than clinician behaviour. The divergence in findings might be attributed to differences in study design, highlighting the importance of direct assessment of clinician practices to accurately gauge compliance levels. Overall, the findings of the present study are consistent with global trends, showing significant variability in adherence to pneumonia treatment guidelines. This variability highlights the need for targeted interventions to improve compliance, such as enhancing clinician education, improving access to guidelines, and addressing systemic barriers within healthcare systems.

#### ***Socio economic factors influencing clinician's prescription patterns***

Social and economic factors, such as income, education, employment, community safety and social support were tested. Variations in these factors in both patients and clinicians may affect antibiotic prescription practices. A series of five statements were rated on five-point Likert scale to assess the social economic factors influencing clinician's prescription patterns; where 1 = Strongly disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A), and 5 = Strongly agree (SA). The higher the score, the greater the influence and vice versa. The results are presented in Table 3.

**Table 3**

*Socio economic factors influencing clinician’s prescription patterns at Mbagathi level five hospital*

Statement	SD n(%)	D n(%)	N n(%)	A n(%)	SA n(%)
Ability of patient to afford determines the type of antibiotics prescribed		27(17.8)	17(11.2)	71(46.7)	37(24.3)
Presence of medical insurance influences the choice of antibiotic prescribed		29(19.1)	20(13.2)	56(36.8)	47(30.9)
Patient and relative pressure play a role in choice of antibiotic prescribed		14(9.2)	46(30.3)	73(48.0)	19(12.5)
Incentives from drug companies have an effect on the choice of antibiotic prescribed	5(3.3)	17(11.2)	47(30.9)	66(43.4)	17(11.2)
Patients religious and cultural beliefs influence the choice of antibiotic prescribed	1(0.7)	9(5.9)	56(36.8)	65(42.8)	21(13.8)

The findings showed that 46.7% acknowledged that they consider patients' ability to afford medications when determining which antibiotics to prescribe. This suggests a recognition among clinicians of the financial constraints of patients, which could impact treatment adherence and outcomes. Additionally, 36.8% agreed, while 30.9% strongly agreed that the presence of medical insurance influences antibiotic choices. This highlights an awareness of how insurance coverage can affect access to certain medications, further emphasizing the interplay between socio-economic status and clinical decision-making. Overall, these findings suggest that clinicians are mindful of patients' financial situations and consider the impact of insurance on treatment options, which is crucial for

promoting effective and equitable healthcare.

***Socio-economic determinants of pneumonia antibiotic prescription practice among clinicians***

The clinicians were also asked about the socio-economic factors influencing their prescription patterns. Pearson chi-square and Fischer’s exact tests were used to establish whether or not there was association between demographic as well as socio economic factors under study, and the compliance to antibiotic prescription guidelines as illustrated in table 4.



**Table 4**

*Demographic and Socio-economic related determinants of pneumonia antibiotic prescription practice among clinicians at Mbagathi level five hospital, Kenya*

	Compliance		$\chi^2$	Df	P value
	High	Low			
Gender					
Male	55(59.8)	37(40.2)	8.05	1	0.005
Female	49(81.7)	11(18.3)			
Age					
21 – 30	7(63.6)	4(36.4)		3	0.439
31 – 40	46(71.9)	18(28.1)			
41 – 50	34(57.6)	25(42.4)			
>50	17(94.4)	1(5.6)			
Designation					
Consultant	28(90.3)	3(9.7)		2	<0.001
Medical officer	51(77.3)	15(22.7)			
Clinical officer	25(45.5)	30(54.5)			
Years of experience					
<5	13(76.5)	4(23.5)		2	0.719
5 – 10	41(66.1)	21(33.9)			
>10	50(68.5)	23(31.5)			
Ability of patient to afford influence my decision to prescribe					
Agree	69(63.9)	39(36.1)		2	0.405
Disagree	25(92.6)	2(7.4)			
Neutral	10(58.8)	7(41.2)			
Presence of medical insurance influence my decision to prescribe					
Agree	63(61.2)	40(38.8)		2	0.005
Disagree	27(93.1)	2(6.9)			
Neutral	14(70.0)	6(30.0)			
Patient and relative pressure influence my decision to prescribe					
Agree	66(71.7)	26(28.3)		2	0.207
Disagree	11(78.6)	3(21.4)			
Neutral	27(58.7)	19(41.3)			
Presence of financial incentive in prescribing antibiotics influence my decision to prescribe					
Agree	57(68.7)	26(31.3)		2	0.997
Disagree	15(68.2)	7(31.8)			
Neutral	32(68.1)	15(31.9)			

The findings from the Pearson chi-square and Fischer's exact tests indicate significant associations between various factors and compliance with pneumonia antibiotic prescription practices. A strong relationship was found between gender and compliance, with a chi-square value of  $\chi^2(1) = 8.05$  and a p-value of 0.005, suggesting that gender may influence adherence to prescription guidelines. Additionally, the results revealed a significant association between clinicians' designation and their compliance with these practices, a p-value of 0.005. Further, the assertion regarding the influence of medical insurance on prescribing decisions showed a significant association ( $p = 0.005$ ). The findings also indicated that the cadre of clinician was significantly associated with compliance in prescription practice. Higher cadre of clinicians such as consultants had a higher level of compliance compared to lower cadre, such as clinical officers. The findings suggest that the professional role or cadre of the clinician plays a crucial role in adherence to guidelines. These findings align with those from a study in Ghana which established that higher-ranking clinicians, such as consultants and specialists, were more likely to adhere to pneumonia prescribing guidelines compared to junior doctors and general practitioners (Sefah et al., 2021). The study attributed this to the extensive training and experience of higher-ranking clinicians. Lui et al. (2020) in a study done in China also revealed that compliance rates were higher among senior physicians compared to junior staff. It suggested that seniority and specialization in respiratory medicine contributed to better adherence, emphasizing the role of advanced clinical knowledge and experience.

The study found that clinicians are significantly influenced by the socioeconomic status of patients, especially their medical insurance status, when deciding on antibiotic prescriptions. This means that clinicians need to balance between optimal clinical practice and the realities of patient access to medications. These findings align with those from a study in Ethiopia which noted that lower socioeconomic status often led to deviations from standard antibiotic guidelines as a result of financial constraints. Clinicians sometimes prescribe less expensive, but not necessarily first-line, antibiotics to accommodate patients' economic limitations (Eticha & Gemechu, 2021). Findings from a study in Ghana also revealed that patients without insurance covers were less likely to receive the recommended antibiotics, as clinicians opted for more affordable alternatives that might not align with best practice guidelines (Sefah et al., 2021).

Financial constraints are a significant barrier to adherence to clinical guidelines. Patients without insurance or with lower socioeconomic status may not afford the recommended treatments, prompting clinicians to deviate from guidelines. The impact of socioeconomic status on compliance varies significantly across different healthcare systems. In countries with universal healthcare or comprehensive insurance coverage, adherence to guidelines is higher compared to regions where patients bear more of the healthcare costs directly.

#### ***Health system related determinants of pneumonia antibiotic prescription practice among clinicians***

Health system factors that were investigated in this study included hospital

leadership and governance, service delivery, health workforce, medical products, vaccines and technologies as well as Health information system. Pearson chi square and Fischer’s exact were used to

establish association between health system-related factors under investigation, and compliance to antibiotic prescription guidelines. The findings are shown in Table 5.

**Table 5**

*Health system related determinants of pneumonia antibiotic prescription practice among clinicians at Mbagathi level five hospital, Kenya*

Health system	Level		$\chi^2$	Df	P value
	High n(%)	Low n(%)			
<b>Diagnostic tests are readily available.</b>					
Agree	33(84.6)	6(15.4)	9.13	2	0.010
Disagree	61(66.3)	31(33.7)			
Neutral	10(47.6)	11(52.4)			
<b>Guidelines or protocols on antibiotic prescribing are readily available.</b>					
Agree	94(70.7)	39(29.3)	2	0.115	
Disagree	5(71.4)	2(28.6)			
Neutral	5(41.7)	7(58.3)			
<b>Drugs are readily available.</b>					
Agree	25(80.6)	6(19.4)	8.946	2	0.011
Disagree	69(70.4)	29(29.6)			
Neutral	10(43.5)	13(56.5)			
<b>Staff are readily available.</b>					
Agree	25(80.6)	6(19.4)	9.514	2	0.009
Disagree	72(69.9)	31(30.1)			
Neutral	7(38.9)	11(61.1)			
<b>Prescription monitoring is readily available.</b>					
Agree	25(78.1)	7(21.9)	2.573	2	0.276
Disagree	60(63.8)	34(36.2)			
Neutral	19(73.1)	7(26.9)			

Pearson chi square or Fischer’s exact established that there was significant association between respondent perception of diagnostic tests availability and compliance with pneumonia antibiotic prescription practice,  $\chi^2 (2) = 9.13$ ,  $p = 0.010$ . Availability of drugs was also significantly associated with compliance with pneumonia antibiotic prescription

practice,  $\chi^2 (2) = 8.96$ ,  $p = 0.011$ . Presence of staff was also associated with compliance with pneumonia antibiotic prescription practice,  $\chi^2 (2) = 9.514$ ,  $p = 0.009$ . Generally, there was a notable relationship between respondents' perceptions of the availability of diagnostic tests and their compliance, with a chi-square value of  $\chi^2(2) = 9.13$

9.13 $\chi^2(2)=9.13$  and a p-value of 0.010. This suggests that clinicians who believe diagnostic tests are accessible are more likely to adhere to antibiotic prescription guidelines. Similarly, the availability of drugs was significantly associated with compliance, as indicated by a chi-square value of  $\chi^2(2)=8.96$  and a p-value of 0.011, highlighting the critical role that drug availability plays in prescribing practices. Additionally, the presence of medical staff was also significantly linked to compliance, with a chi-square value of  $\chi^2(2)=9.514$  and a p-value of 0.009. These findings emphasize the importance of adequate health system resources—such as diagnostic tests, medication availability, and staffing—in promoting adherence to antibiotic prescription guidelines for pneumonia treatment. These findings align with those of Sefah et al. (2021) who found that the lack of diagnostic facilities was a major barrier to guideline adherence in Ghana. Clinicians often had to rely on clinical judgment alone, which increased the likelihood of non-compliance to antibiotic prescribing. Liu et al. (2020) also revealed that availability of advanced diagnostic tests, such as PCR and rapid antigen tests, significantly improved compliance with antibiotic guidelines in China. This was due to the precise identification of bacterial versus viral pneumonia, reducing unnecessary antibiotic use.

Further, the availability of essential antibiotics is another critical determinant of compliance. When recommended antibiotics are not available, clinicians may be forced to prescribe alternatives that may not align with guidelines. Eticha and

Gemechu (2021) established that drug shortages were a common issue that led to non-compliance. Ensuring a consistent supply of recommended antibiotics was identified as a key factor in improving adherence. Alessa et al. (2023) in a study done in Saudi Arabia affirmed that drug availability was a significant factor in Saudi Arabia. Hospitals with well-stocked pharmacies and efficient supply chains demonstrated better adherence to pneumonia treatment guidelines.

The present study highlights the significant impact of laboratory resource availability on compliance with pneumonia antibiotic prescription guidelines. Access to comprehensive laboratory resources, including pathogen culturing and sensitivity testing, allows clinicians to tailor antibiotic treatments to specific pathogens and their susceptibilities (Taube et al., 2023). This precision in treatment not only improves patient outcomes but also enhances adherence to clinical guidelines. Ecker et al. (2013) affirmed that the availability of such laboratory resources enables clinicians to prescribe antibiotics that are specifically effective against the identified pathogens, thereby improving treatment efficacy and compliance with guidelines. Pallavi et al. (2012) also highlighted the importance of pathogen-specific antibiotic therapy, noting that laboratory resources are essential for accurate diagnosis and tailored treatment plans.

#### ***Knowledge and awareness of pneumonia antibiotic prescription practice among clinicians***

Knowledge and awareness of antibiotic prescription guidelines for pneumonia is a requisite for proper antibiotic use. A series

of seven statements were used to assess the level of knowledge and awareness of antibiotic prescription guidelines among clinicians on five-point Likert scale; where 1 = Strongly disagree (SD), 2 = Disagree

(D), 3 = Neutral (N), 4 = Agree (A), and 5 = Strongly agree (SA). The higher the score, the higher the level of awareness and vice versa. The findings are shown in Table 6.

**Table 6**

*Knowledge and awareness of pneumonia antibiotic prescription practice among clinicians at Mbagathi level five hospital, Kenya*

<i>Statements</i>	<i>SD n(%)</i>	<i>D n(%)</i>	<i>N n(%)</i>	<i>A n(%)</i>	<i>SA n(%)</i>
I am familiar with the national prescription guidelines and protocols in Kenya	2(1.3)	5(3.3)	11(7.2)	107(70.4)	27(17.8)
I am very confident in my knowledge of the appropriate prescribing practices according to the guidelines		4(2.6)	46(30.3)	79(52.0)	23(15.1)
I know many factors that influence my decision to prescribe medication differently from the recommended guidelines, such as patient preferences, resource limitations		7(4.6)	17(11.2)	101(66.4)	27(17.8)
I always involve patients in a shared decision-making when prescribing medications		4(2.6)	46(30.3)	79(52.0)	23(15.1)
I understand and I have received adequate training and updates on prescription guidelines		18(11.8)	20(13.2)	95(62.5)	19(12.5)
I usually attend training on antibiotic diagnostic	1(0.7)	8(5.3)	17(11.2)	104(68.4)	22(14.5)
I think there should be stricter monitoring or enforcement of prescription guidelines in Kenya		16(10.5)	20(13.2)	92(60.5)	24(15.8)

Findings indicate a strong familiarity among clinicians with the national prescription guidelines and protocols in Kenya; with 70.4% (107 respondents) agreeing that they are well-acquainted with these standards. Additionally, more than half of the respondents, 52% (79 clinicians), expressed confidence in their knowledge of appropriate prescribing practices according to these guidelines. This level of awareness and confidence

suggests that clinicians are generally prepared to implement the antibiotic prescription guidelines effectively, which is crucial for ensuring optimal patient care and adherence to best practices in antibiotic prescription. However, continued education and support may still be beneficial to further enhance their confidence and compliance with these protocols. The seven items were summed up and converted into percentages. The

results indicated that a significant majority of respondents, 74.3% (113 clinicians), demonstrated a high level of knowledge and awareness regarding the relevant guidelines and practices, as they achieved scores of 80% or higher. This suggests that a substantial portion of clinicians are well-informed and equipped to apply their knowledge effectively in their prescribing roles. The strong level of knowledge among the respondents indicated positive patient care outcomes, reinforcing the importance of ongoing education and training in maintaining and enhancing clinical competencies. Findings from Pearson chi-square analysis indicated a significant association between clinicians' knowledge and their antibiotic prescription practices, with a chi-square value of  $\chi^2(1) = 34.42$  and a p-value of less than 0.001. This strong correlation suggests that higher levels of knowledge among clinicians are associated with more appropriate and compliant antibiotic prescribing practices. The results underscore the importance of knowledge as a critical factor in influencing clinical decision-making, highlighting the need for ongoing education and training to enhance prescribing behaviors and ultimately improve patient outcomes. These findings are comparable to those from Opatowski et al. (2021) who emphasized that clinician knowledge, supported by access to continuing education and resources, was a significant determinant of guideline adherence in France. Knowledgeable clinicians were more likely to prescribe antibiotics appropriately. Sefah et al. (2021) affirmed these findings highlighting that the

regular training and updates on pneumonia treatment guidelines were crucial for improving adherence. Clinicians who participated in such training sessions were more likely to comply with prescription practices. Knowledgeable clinicians are better equipped to make informed decisions regarding antibiotic prescriptions, understanding the nuances of different cases and the importance of adhering to guidelines (Eticha & Gemechu, 2021).

Sriram et al. (2011) notes that lack of continuous medical education is a barrier to compliance. Clinicians with regular access to updated guidelines and training exhibited higher adherence rates. Anderson et al. (2018) found that educational interventions targeting antibiotic stewardship improved compliance with guidelines. Clinicians who attended training sessions showed significantly higher adherence levels to recommended practices. The ability to refer to the latest information ensures that clinicians are well-informed about the best practices for treating pneumonia. This is supported by studies by Lui et al. (2020) which found that clinicians with access to updated guidelines through professional development programs exhibited better adherence in China.

#### ***Multivariable analysis of factors influencing prescribing practices***

Binary logistic regression analysis was conducted to establish key factors influencing compliance with antibiotic prescription guidelines among clinicians. The results are illustrated in Table 7.

**Table 7**

*Multivariable analysis of factors influencing prescribing practices*

	<b>aOR(95%CI)</b>	<b>P value</b>
<b>Gender</b>		
Male	Ref	
Female	3.74(1.29 - 10.86)	0.015
<b>Designation</b>		
Clinical officer	Ref	
Medical officer	6.74(2.11 - 21.50)	0.001
Consultant	11.48(2.36 - 55.94)	0.003
<b>Medical insurance</b>		
Agree	Ref	
Neutral	0.13(0.03 - 0.59)	0.008
Disagree	3.27(0.40 - 26.82)	0.27
<b>Drug availability</b>		
Agree	Ref	
Neutral	5.97(0.66 - 54.10)	0.112
Disagree	1.65(0.35 - 7.75)	0.525
<b>Diagnostic test available</b>		
Agree	Ref	
Neutral	2.11(0.32 - 3.11)	0.451
Disagree	3.21(0.21 - 3.22)	0.211
<b>Staff availability</b>		
Agree	Ref	
Neutral	2.21(0.28 - 17.65)	0.455
Disagree	2.97(0.54 - 16.39)	0.212
<b>Knowledge</b>		
Inadequate	Ref	
Adequate	9.72(3.24 - 29.16)	<0.001

Findings from binary logistic regression analysis highlight several key factors influencing compliance with antibiotic prescription practices among clinicians. Notably, female clinicians were found to be significantly more likely to demonstrate high compliance compared to their male counterparts, with an adjusted odds ratio (aOR) of 3.74 (95% CI: 1.29 - 10.86, p = 0.015). Additionally, designation played a

crucial role; medical officers had an aOR of 6.74 (95% CI: 2.11 - 21.50, p = 0.001), and consultants had an aOR of 11.48 (95% CI: 2.36 - 55.94, p = 0.003), indicating they were significantly more compliant than clinical officers.

The perception of medical insurance status also influenced compliance; clinicians who were neutral about insurance had an aOR of 0.13 (95% CI: 0.03 - 0.59, p = 0.008),

indicating a much lower likelihood of high compliance compared to those who agreed they had insurance. Furthermore, adequate knowledge emerged as a strong predictor of high compliance, with clinicians possessing sufficient knowledge having an aOR of 9.72 (95% CI: 3.24 - 29.16,  $p < 0.001$ ). This suggests that those with adequate knowledge were nearly ten times more likely to adhere to appropriate antibiotic prescription practices than those with inadequate knowledge. These findings underscore the importance of gender, designation, insurance perception, and knowledge in promoting compliance with antibiotic prescribing guidelines.

#### 4.0 Conclusion

The study examined factors affecting clinicians' compliance with pneumonia antibiotic prescription guidelines. Findings indicated a 68.4% high compliance rate, and a 31.6% low compliance rate. Gender differences influenced compliance, with male and female clinicians exhibiting varying adherence rates. Higher-ranking clinicians adhered better than juniors, indicating that professional status impacts compliance. Medical insurance significantly influenced antibiotic prescribing, highlighting the role of socioeconomic factors in clinical decisions. Access to diagnostic tests and drugs, as well as adequate staffing were crucial for higher compliance. Clinicians with more

knowledge adhered better to guidelines, emphasizing the need for ongoing medical education and professional development programs on antibiotic stewardship and pneumonia treatment.

#### 5.0 Recommendations

Health workforce, service delivery and medicines, vaccines and technology are devolved functions. As such, county governments should ensure availability of adequate clinical personnel, availability of required diagnostic services for evidence-based decision making, as well as availability of quality, safe, cost effective and scientifically sound antibiotics.

Health financing is a function of the national government through the ministry of health. In this regard, the Ministry of health should ensure that all citizens are members of the Social Health Authority regardless of their socio-economic status as this will guarantee them access to scientifically sound antibiotics.

All medical colleges should incorporate antibiotic stewardship in their course work. The ministry of health should also make it mandatory for all health facilities to have antibiotic stewardship programs encompassing core elements such as leadership commitment, accountability, stewardship expertise action, tracking, reporting and education.

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