Investigating influential factors on self-medication intentions among medical students

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Abstract

Background: Self-medication stands as a significant public health concern, exhibiting varying prevalence rates globally.

Objectives: This study evaluates self-medication practices and compares the intent to self-medicate among final-year and fourth-year medical students at the College of Medicine, University of Diyala, Iraq.

Methods: A cross-sectional study was carried out from January to March 2024 at the College of Medicine, University of Diyala, Iraq. Final and fourth-year students' data were collected using pre-validated, self-administered questionnaires through an online Google document form using universal sampling. Descriptive, bivariate, and multiple logistic regression analyses were conducted on the gathered data.

Results: Among the 216 participants in our study, 123 (56.9%) belonged to the fourth class, while 93 (43.1%) were from the sixth class. Predominantly, the respondents were females (71.8%), with mean age 22.6 years (SD 1.4). Almost sixty percent (59.3%, 128) exhibited a high intention to self-medicate and seventy percent (69.4%) prevalence of self-medication. Notably, sixth-class students practiced self-medication more frequently than fourth-class students, with rates of 81.7% and 60.2%, respectively, showing a significant difference (p=0.001). However, a considerable majority (83.3%, 180) showed awareness of rational drug use. Approximately three-quarters (74.5%, 161) used antibiotics for self-medication. In the multiple logistic regression students with a positive

history of past-year self-medication (OR = 3.849, 95% CI: 1.811 to 8.181, p < 0.001), female students (OR = 3.580, 95% CI: 1.770 to 7.242, p<0.001), those with a favorable attitude toward self-medication (OR = 1.211, 95% CI: 1.123 to 1.306, p < 0.001), and sixth-class students (OR = 0.477, 95% CI: 0.247 to 0.924, p=0.028) demonstrated significantly higher intentions for self-medication.

Conclusion: Despite knowledge about rational drug use and bacterial resistance, self-medication remains prevalent, especially among final-year students, females, and those with a history of past-year self-medication and a favorable attitude toward self-medication. Final-year students are more likely to self-medicate compared to fourth-year students.

Keywords: Self-medication, Medical students, consumption of over-the-counter, Iraq

Introduction

It's a common human tendency to seek remedies when feeling unwell, reflecting the desire for immediate relief and autonomy in managing one's health. Self-medication, defined as the consumption of over-the-counter (OTC). Self-medication isn't limited to OTC drugs; it can encompass prescription drugs without medical instruction like antibiotics as well [1].

Numerous factors drive self-medication practices, including medication shortages at healthcare facilities, extended wait times, distant medical facilities, and financial constraints [2]. Additionally, socioeconomic status, lifestyle choices, patient misconceptions about physicians, unregulated medication distribution, and easy access to medications due to the abundant availability of medicinal products, particularly

prevalent in developing nations, further contribute to self-medication trends [3].
On the other hand, the responsible self-medication can prevent and treat non-serious ailments, providing a cost-effective alternative for common illnesses, and even proving life-saving in acute situations [4, 5]. However, inappropriate self-medication can lead to resource wastage and pose serious health risks, including adverse side effects, addiction, and the development of pathogen resistance [6].

Individuals engaging in self-medication should possess a requisite level of knowledge, including understanding the correct dosage and duration, to ensure safe and effective outcomes. This balance between empowering individuals to manage their health and ensuring informed decision-making underscores the importance of education and awareness in self-care practices. Notably, individuals with higher levels of education and professional status are more likely to engage in self-medication [7]. These findings highlight the multifaceted nature of self-care behaviors and underscore the need for comprehensive approaches to promoting safe and informed medication use.

In Iraq, successive wars have led to the decline of the healthcare system across all levels [8]. Corruption, mismanagement, lack of strategic planning, and inadequate health regulatory bodies have facilitated illegal drug access. Previous research has indicated a significant prevalence of self-medication among undergraduate students [9] and patients in Iraq [10]. This is likely attributable to the accessibility of various medications, including antibiotics, from community pharmacies and other unofficial drug outlets without requiring a prescription. The current study aims to assess self-medication practices and compare the intention to self-medicate among final-year and fourth-year medical students at the college of medicine, university of Diyala, Iraq.

Methods

Study design

A cross-sectional study was conducted among a sample of the final year medical students and the fourth class at the College of medicine, University of Diyala, Iraq. The data was collected from 1st January 2024 to 15th March 2024, employing a universal sampling technique and an online self-administered questionnaire.

Inclusion and exclusion

The inclusion criteria were the medical students, in the sixth and fourth year, available at the time of study and willing to participate. Teaching staff, students from other colleges, and the absent students were excluded from the study.

Sample size

Previous research conducted in Iraq by Ali Jadoo et al. [11], and Hussien et al. [15] [12] indicated that self-medication in the past year was 84.88%. Utilizing a margin of error of ±5%, a confidence level of 95%, and a non-response correction factor of 10%, the sample size calculator determined that a sample size of 216 (196+10% non-response rate) was necessary, as per the specified formula: N= [Za2 x P XQ/(M.E.)2].

Study tool

This study recruited a pre-validated questionnaire [18,19] [13,14] having two parts. The socio-demographic variable such as age, gender, etc., were in the first part, while the second part focused on the practicing of self-medication during the past year. Self-medication considered when the respondents used POM or OTC drugs without medical consultation.

intention to self-medicate

Students' intention to self-medicate was assessed by asking the students to score three statements: "I prefer to consult a doctor," "I have the ability to diagnose and treat myself," and "Because I am a medical student, it's illegal to write a prescription." Each response was recorded on a five-point Likert-type scale, ranging from 1 for "strongly agree" to 5 for "strongly disagree." The responses were then dichotomized based on the median value. Scores of 7 and below were categorized as indicating "low intention to self-medicate" (coded as 0), while scores above 7 indicated "high intention to self-medicate" (coded as 1) among medical students.

Statistics analysis

The data was analyzed using the Statistical Package for the Social Sciences version 20 (SPSS v. 20) software. Frequency of responses was measured using numbers and percentages for categorical data. Bivariate analysis utilized chi-square tests for binary or categorical variables. Factors with a p-value <0.05 in the bivariate analysis were included in the multivariate model. Multiple logistic regression analysis (Enter technique) was employed to identify significant predictors of turnover intentions. In the "Enter technique," non-significant variables were iteratively removed until a satisfactory model was obtained. Odds ratios and 95% confidence intervals were calculated, with statistical significance set at $p < 0.05$.

Results

Descriptive analyses

Among the 216 medical students who participated in the study, 123 (56.9%) were from the fourth class, while 93 (43.1%) were from the sixth class. A majority of the respondents were female (71.8%), with an average age of 22.6 years (+/- 1.4), ranging from 20 to 28 years. Approximately ten percent (22, 10.2%) of the students reported having a chronic

disease, with the majority of chronically ill students belonging to the sixth class, comprising 15.1% of them. The vast majority (81.5%) of students stated that their decision to pursue medicine was driven by their own aspirations. Regarding their knowledge, most of the surveyed students were able to define "Over-the-counter (OTC) Medications" (83.3%) and "Prescription-only Medications (POMs)" (89.4%) successfully.

Table 1: The main characteristics of students (n=216)

No.	Variable	Categories	Total 216 N (%)	4th class 123 (56.9)	6th class 93 (43.1)	Chi	p-value
1	Age (mean ± SD)	22.60(± 1.40) (20-28)		21.74 (0.80) (20-24)	23.74 (1.21) (21-28)	-	-
2.	Gender	Male	61(28.2)	25(20.3)	36(38.7)	8.832	0.004
		Female	155(71.8)	98(79.7)	57(61.3)		
3.	Do you have Chronic Disease?	Yes	22(10.2)	8 (6.5)	14(15.1)	4.232	0.044
		No	194 (89.8)	115 (93.5)	79(84.9)		
4.	Desire to study Medicine	My desire	176(81.5)	102(82.9)	74(79.6)	0.396	0.597
		My family desire	40(18.5)	21(17.1)	19 (20.4)		
5.	Definition of Over-the- counter (OTC) Medications	True	180 (83.3)	95 (77.2)	85(91.4)	7.648	0.006

		False	36(16.7)	28 (22.8)	8(8.6)		
6.	Definition of Prescription only Medications (POMs	True	193(89.4)	105(85.4)	88(94.6)	4.771	0.043
		False	23 (10.6)	18(14.6)	5(5.4)		

Intention to self-medicate

Of the doctors surveyed, a significant majority (74.6%) expressed a preference for consulting doctors when they fell ill. Furthermore, over two-thirds (71.8%) were aware of the illegality of prescribing medication before graduation. Interestingly, a notable proportion of students (43.1%) expressed uncertainty about their capacity to diagnose and treat themselves. According to the median, a majority of the students (59.3%, 128) exhibited high intention for self-medication, whereas 40.7% (88) displayed low intention towards self-medication.

Table 2: Intention to self-medicate among medical students (n=216)

No.	Statement	SA	A	N	SD	D
1.	I prefer to consult doctor	68(31.5)	93(43.1)	39(18.1)	6(2.8)	10(4.6)
2.	I have the ability to diagnose and treat myself	5(3.7)	45(20.8)	93(43.1)	51(23.6)	19(8.8)
3.	Because I am a medical student, it's illegal to write prescription	79(36.6)	76(35.2)	24(11.1)	20(9.3)	17(7.9)

The majority of students (69.4%, 150) reported engaging in self-medication practices within the past year. Notably, sixth-class students utilized self-medication more frequently than fourth-class students, with rates of 81.7% and 60.2%, respectively, showing a significant difference (p=0.001). However, a large proportion of students (83.3%, 180) demonstrated awareness of the rational use of drugs. Among those who practiced self-medication, over half (51.9%) reported using medications for less than one week, and a significant majority (82.9%) obtained their medicines directly from pharmacies, with sixth-class students leading in this aspect (p<0.001). Furthermore, approximately three-quarters (74.5%, 161) of students used antibiotics for self-medication, with the majority (55.6%, 120) using them for less than 7 days. Despite this, a substantial number of students (80.6%, 174) acknowledged the potential development of bacterial resistance due to antibiotic misuse.

Table 3: Practice of self-medication in the past year (n=216).

No.	Self-medication practice	No. (%)	Fourth	Sixth	Chi-	p-value
1.	The past year use of self-medication	150 (69.4)	74 (60.2)	76 (81.7)	11.60	0.001
2.	Treatment duration					
2A	Less than one week	112 (51.9)	61(49.6)	51(54.8)	1.24	0.871
2B	One week	51 (23.6)	29(23.6)	22(23.7)		
2C	Two weeks	16 (7.4)	9(7.3)	7(7.5)		
2D	One month	11 (5.1)	7(5.7)	4(4.3)		
2E	Longer	26 (12.0)	17(13.8)	9(9.7)		
3.	Medications source					

3A	Pharmacy	179 (82.9)	92(74.8)	87(93.5)	18.02	0.000
3B	Friends or relatives	8 (3.7)	4(3.3)	4(4.3)		
3C	Herb stores	6 (2.8)	6(4.9)	0(0.0)		
3D	Others sources	23 (10.6)	21(17.1)	2(2.2)		
4.	Using antibiotics as self-medication	161 (74.5)	87 (70.7)	74(79.6)	2.18	0.158
5.	Antibiotics use duration					
5A	Less than week	120 (55.6)	67(54.5)	53(57.0)	1.19	0.756
5B	One week	64 (29.6)	35(28.5)	29(31.2)		
5C	Two weeks	17 (7.9)	11(8.9)	6(6.5)		
5D	More than two weeks	15 (6.9)	10(8.1)	5(5.4)		
6.	Bacterial resistance awareness					
6A	Aware	174 (80.6)	98(79.7)	76(81.7)	0.14	0.732
6B	Not Aware	42 (19.4)	25(20.3)	17(18.3)		
7.	Rational drug use awareness					
7A	Aware	180 (83.3)	99(80.5)	81(87.1)	1.67	0.268
7B	Not Aware	36 (16.7)	24(19.5)	12(12.9)		

Primary motivations for self-medication among respondents included the desire for rapid relief (84.3%), convenience (78.7%), and the perception of minor ailments (77.8%) or the absence of serious health concerns (63.0%). Additionally, medical students viewed self-

medication as an opportunity for learning (63.0%) and a means to engage in active role-playing (56.9%). Some other factors driving medical students towards self-medication included the high cost of medical consultations, lengthy waiting times, and crowded clinics (60), as detailed in Table 4.

Table 4: Students' main reasons for self-medication (n=216).

No.	Reasons for self-medication	No. (%)	Fourth	Sixth	Chi	p-value
1	No serious health problem	136 (63.0)	67(54.5)	69(74.2)	8.83	0.004
2	Quick relief is desired	182 (84.3)	100(81.3)	82(88.2)	1.89	0.191
3	Convenience	170 (78.7)	92(74.8)	78(83.9)	2.60	0.131
4	Long waiting and crowd avoidance at clinics	130 (60.2)	74(60.2)	56(60.2)	0.12	0.894
5	Medical consultation high cost	130 (60.2)	79(64.2)	51(54.8)	1.95	0.206
6	Relative/friend suggestion	67 (31.0)	46(37.4)	21(22.6)	5.43	0.026
7	Opportunity to learn	136(63.0)	79(64.2)	57(61.3)	0.20	0.672
8	Active role-playing needs	123 (56.9)	74(60.2)	49(52.7)	1.21	0.331
9	Self-management's advice by physician	119(55.1)	66(53.7)	53(57.0)	0.24	0.679
10	No effective physician prescription	56 (25.9)	36(29.3)	20(21.5)	1.66	0.213

11	Absence of trust in the physician	47 (21.8)	30(24.4)	17(118.3)	1.16	0.320
12	Minor illness	168 (77.8)	77(82.8)	91(74.0)	2.38	0.139
13	Embarrassment of discussion own symptoms	74 (34.3)	42(34.1)	32(34.4)	0.27	0.899

Furthermore, students outlined primary determinants of self-medication, as presented in Table 5. These include concerns regarding the risk of misdiagnosis (86.6%), potential adverse effects (85.2%), the risk of drug interactions (84.7%), the possibility of consuming the wrong medication (82.4%), and the risk of drug abuse and dependence (71.3%).

Table 5: Students' reasons against self-medication (n=216).

Reasons against self-medication	No. (%)	Fourth	Sixth	Chi	p-value
Adverse effects risk	184 (85.2)	106(86.2)	78(83.9)	0.22	0.700
Wrong medication consumption risk	178 (82.4)	103(83.7)	75(80.6)	0.350	0.591
Misdiagnosis risk	187 (86.6)	103(83.7)	84(90.3)	1.97	0.226
Drug interaction risk	183 (84.7)	107(87.0)	76(81.7)	1.14	0.341
Drug abuse and dependence risk	154(71.3)	86(69.9)	68(73.1)	0.265	0.651

Medical students were surveyed regarding indicators prompting them to seek professional medical assistance, as summarized in Table 6. Top reasons included severe pain (86.6%) and worsening symptoms (83.3%). Additionally, significant factors were symptoms persisting for over one week (81.0%), perceived seriousness of the problem (81.0%), emergence of side effects (80.0%), and ineffectiveness of the medication (74.5%).

Table 6: Reasons against self-medication (n=216).

Reasons for seeking professional help	No. (%)	Fourth	Sixth	Chi	p-value
Severe pain	187 (86.6)	108(87.8)	79(84.9)	0.372	0.552
Symptoms stay more than one week	175 (81.0)	99(80.5)	76(81.7)	0.052	0.862
Worsening symptoms	180 (83.3)	100(81.3)	80(86.0)	0.850	0.461
Serious problem	175 (81.0)	98(79.7)	77(82.8)	0.335	0.603
Not effective	161(74.5)	82(66.7)	79(84.9)	9.324	0.003
Side effects	174 (80.6)	96(78.0)	78(83.9)	1.15	0.303

Over eighty percent of the students expressed agreement or strong agreement regarding the potential dangers associated with certain medication practices. Specifically, 82.9% acknowledged the risk of using medications without knowledge of their ingredients in patients with liver and kidney diseases. Additionally, 80.1% recognized the hazards of both

increasing and decreasing drug doses, while 75.5% were aware of the dangers of such adjustments. Moreover, a significant majority (75.0%) acknowledged the risks associated with the simultaneous use of multiple medications. However, opinions were divided regarding the adverse effects of all types of medications (OTC, POM, and herbal), with approximately two-thirds (67.5%) agreeing that they can cause adverse effects. Interestingly, a considerable portion (61.6%) disagreed with the notion that no drugs can be used during pregnancy, indicating a nuanced understanding of medication use in this context (table 7).

Table 7: Aspects of self-medication views by the students (n=216).

No.	Student's views	SA	A	N	D	SD
1	All drugs (OTC, POM, and herbal) can cause adverse effects.	50 (23.1)	96 (44.4)	43 (19.9)	13 (6.0)	14 (6.5)
2	Concomitant use of drugs can have hazards.	43 (19.9)	119 (55.1)	40 (18.5)	5 (2.3)	9 (4.2)
3	It can be dangerous to increase the drug dose.	52 (24.1)	121 (56.0)	33 (15.3)	3 (1.4)	7 (3.2)
4	It can be dangerous to decrease the drug dose.	21 (9.7)	95 (44.0)	67 (31.0)	27 (12.5)	6 (2.8)
5	Physician help must be sought, if adverse effects developed.	71 (32.9)	92 (42.6)	38 (17.6)	8 (3.7)	7 (3.2)
6	Using medications without knowing its ingredients in patients with liver and kidney	108 (50.0)	71 (32.9)	24 (11.1)	4 (1.9)	9 (4.2)

	disease is dangerous					
7	During pregnancy, no drug can be used.	14 (6.5)	30 (13.9)	39 (18.1)	93 (43.1)	40 (18.5)
8	Mild health problems do not need drug treatment.	11 (5.1)	67 (31.0)	68 (31.0)	59 (27.3)	11 (5.1)
9	Signs and symptoms of the disease can be masked by self-medication, so the physician can miss them easily	27 (12.5)	85 (39.4)	59 (27.3)	33 (15.3)	12 (5.6)

Multiple logistic regression

We conducted a multiple logistic regression analysis, as depicted in Table 8, to explore the factors influencing students' intention to self-medicate. The analysis unveiled several significant associations. Notably, students with a positive history of self-medication in the past year (OR = 3.849, 95% CI: 1.811 to 8.181, $p < 0.001$), female students (OR = 3.580, 95% CI: 1.770 to 7.242, $p<0.001$), those with a high attitude toward self-medication (OR = 1.211, 95% CI: 1.123 to 1.306, $p < 0.001$), and students in the sixth class (OR = 0.477, 95% CI: 0.247 to 0.924, $p=0.028$) demonstrated a markedly higher intention to self-medicate. The adequacy of the model was confirmed by the Hosmer and Lemeshow test, indicating a good fit ($p = 0.321$). Moreover, the overall model exhibited significance ($p = 0.001$) and explained 41.2% of the variance (Nagelkerke R square = 0.412).

Table 8: results of logistic regression on intention to self-medication (n=216)

NO.	Variables	B	S.E.	Wald	Sig.	Exp(B)	95.0% C.I. EXP(B) Lower-Upper
	Female	1.275	0.359	12.588	0.000	3.580	1.770-7.242
	Male					Reference	
	High attitude toward self-medication	0.191	0.039	24.570	0.000	1.211	1.123-1.306
	Low attitude					Reference	
	self-medication in the past year	1.348	0.385	12.280	0.000	3.849	1.811-8.181
	None					Reference	
	Finale (six) stage	0.739	0.337	4.818	0.028	0.477	0.247-0.924
	Fourth stage					Reference	

Discussion

The majority (71.8%) of our surveyed students were females, reflecting the global trend

of the feminization of medicine; often referred to extraordinary presence of female doctors. [Laurence, D., Görlich] [1]. This phenomenon aligns with personal motivations, as over eighty percent (81.5%) expressed a personal desire to pursue medicine.

Gender emerged as a significant determinant of self-medication practices. According to our logistic regression analysis, females exhibited a 3.580 times likelihood of engaging in self-medication compared to males (OR: 3.580, 95% CI: 1.770, 7.242, p-value: 0.000). These findings are consistent with prior studies []. Lukovic et al. [2] reported a 1.4 times higher likelihood of self-medication among females compared to males, while Rathod et al. [3] found this likelihood to be 2.0 times higher. Dastan et al. [4] suggested that female physicians may experience greater levels of fatigue and stress, potentially driving their inclination towards self-medication. Interestingly, our results contrast with those of Shalini A and Logaraj M. [5], who found that males were 1.5 times more inclined towards self-medication than females. The majority of students demonstrated understanding of Over-the-Counter (OTC) medications (83.3%) and Prescription-Only Medications (POMs) (89.4%), with sixth-stage students exhibiting significantly higher proficiency compared to fourth-stage students (p=0.006). This disparity suggests varying levels of knowledge and application of medical information in daily life. Previous research [2,6,7] corroborates this trend, showing that older students tend to self-medicate more than younger ones. Lukovic et al. [2] discovered that for each year of age, the likelihood of self-medication increased by about 1.13 times.

The study revealed a prevalent practice of self-medication (69.4%) among final-year and fourth-year medical students over the past year, particularly for minor ailments requiring quick relief. This finding resonates with similar observations in both local and international studies. In Iraq, Tikrit Medical College [8] reported a rate of 81.3%, while Anbar and Fallujah Medical College [9] recorded 73.0%. Internationally, rates were observed at Private Medical Institutes in India (71.7%) [10], Iran (44.8%) [11], Egypt (52.8%) [12],

Ethiopia (68.1%) [13], Saudi Arabia (55.9%) [14], and 79.9% of surveyed medical students in Serbia [2]. These findings underscore the widespread nature of self-medication practices among medical students across various regions. In our study sample, medical students are expected to possess a strong medical education and awareness of the risks associated with medication misuse. However, the tendency of sixth-year students to engage in self-medication based on their own judgment and experience suggests a belief among older students that they possess adequate knowledge to self-diagnose and self-medicate without requiring further examination. This inclination may stem from a sense of confidence in their accumulated expertise over the years of study, leading them to bypass additional consultations.

Additionally, when assessing students' self-medication intentions, 74.6% preferred consulting doctors when ill, while 71.8% were aware of illegal prescribing before graduation. Notably, 43.1% doubted their ability to self-diagnose. Median analysis showed 59.3% leaned towards self-medication, contrasting with 40.7% preferring otherwise. Comparing self-medication practices between different academic years reveals a consistent trend of higher self-medication rates among senior students. For instance, in a study by Lukovic et al. [2], Serbian sixth-year medical students exhibited higher rates of self-medication compared to first-year ($\chi 2 = 26.9$, $p < 0.001$) and third-year students ($\chi 2 = 29.6$, $p < 0.001$). Similarly, Daanish and Mushkani [15] observed increased self-medication and prescription-only medicine use among fifth-year students compared to their first-year counterparts. Ameel et al. [9] found that the fifth-year medical students had higher prevalence of self-medication than students in earlier stages. Kasulkar and Gupta [10] reported a higher prevalence of self-medication among final-year students relative to first-year students, consistent with findings from other studies demonstrating a progressive increase in self-medication with advancing years of medical education. This suggests a potential correlation between clinical exposure and self-medication practices

among medical students.

More than half of surveyed students (51.9%) engaged in self-medication for less than a week, while a minority (12.0%) extended their self-medication period to over one month. Bennadi D. [16] outlined various factors contributing to prolonged self-medication, including potential misdiagnosis, incorrect medication consumption, improper route of administration, and inadequate or excessive dosage, all of which may underlie severe underlying health issues.

Our findings align with prior research [17], indicating that pharmacies are the primary source of medications for students. This trend can be attributed to the inclusion of a pharmacology training program as part of the students' curriculum in medical college, ensuring their familiarity and accessibility with pharmacy services.

Although most students (80.6%) are aware of the risks associated with bacterial resistance, this knowledge didn't deter about sixty percent of them from resorting to self-medication with antibiotics, without a prescription. Our findings align with numerous studies [17,18]. Despite strict guidelines from the Iraqi Ministry of Health (MOH), pharmacies in Iraq often dispense medications, including antibiotics, without adhering to regulations. This laxity contributes to the prevalent self-medication practices [17]. This study has certain limitations that should be acknowledged. Firstly, due to its cross-sectional design, it cannot determine causal relationships. Secondly, the findings are specific to the final and fourth stages of the College of Medicine at the University of Diyala, which may restrict the generalizability of the results to a national level.

Conclusion

Despite being aware of the risks, there was a high prevalence of self-medication and antibiotic usage among final-year medical students, surpassing that of fourth-year students. Approximately sixty percent displayed high intention for self-medication. While students demonstrated moderate knowledge regarding the pros and cons of self-medication and generally held appropriate views on the subject, promoting responsible self-medication necessitates enhancing educational courses on drug safety and efficacy. Additionally, authorities should enforce stringent regulations and oversight on pharmacies to combat the illicit use of medications, particularly antibiotics.