

Original Research Article

Antimicrobial Sales Across Retail Medicine Outlets in the Tamale Metropolis: A Cross-Sectional Study

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Abstract: Retail medicine outlets serve as the first point of contact for most Ghanaians seeking treatment for common ailments. However, weak regulation has led to the widespread dispensing of antimicrobials without a prescription in community pharmacies and over-the-counter medicine shops (OTCMS), fueling antimicrobial resistance (AMR). This cross-sectional study assessed the sale of prescription-only antimicrobials for common self-limiting conditions that do not require antimicrobial therapy in Tamale, northern Ghana. Using the simulated patient (SP) method, adult male actors presented with symptoms of urinary tract infection, upper respiratory tract infection, and acute diarrhoea. Three escalating levels of demand were employed to evaluate dispensing practices without a prescription. A total of 35 community pharmacies and 25 OTCMS were visited three times each, resulting in 180 SP visits. In community pharmacies, pharmacists were the most frequently encountered staff (34.3%), while medicine counter assistants predominated in OTCMS (44.0%). The overall prevalence of dispensing antimicrobials without a prescription was alarmingly high at 91.7% (165/180). Antimicrobials were commonly sold at the first level of demand, 64.8% in community pharmacies and 86.7% in OTCMS. Watch group antibiotics were more frequently dispensed in pharmacies (45.8%), whereas Access antibiotics dominated in OTCMS (47.3%). The most dispensed agents were ciprofloxacin (19.6%), amoxicillin-clavulanic acid (14.4%), and doxycycline (11.0%). This study reveals widespread violations of national regulations governing antimicrobial sales, particularly in OTCMS where such sales are illegal. Urgent implementation of antimicrobial stewardship programmes, stricter enforcement of regulations, and targeted staff training are recommended to curb irrational antimicrobial use and combat AMR in Ghana.

Keywords: Antimicrobial Resistance, Antimicrobial Sales, Community Pharmacy, Over-The-Counter Medicine Shop, Simulated Patient, Common Ailments.

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INTRODUCTION

Antimicrobial use is associated with the development and spread of antimicrobial resistance

(AMR), which adversely impacts individual and population health (Murray *et al.*, 2022). AMR is an evolutionary consequence of antibiotic consumption in humans, animals, and agriculture (Ghana National

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Action Plan on Antimicrobial Use and Resistance, 2017). A major modelling research by Murray *et al.*, (2022) estimated that, in 2019, western sub-Saharan Africa had the highest all-age death rate attributable to AMR, at 27.3 deaths per 100 000. Antimicrobial use in public hospitals across Ghana has been reported by several studies (Labi *et al.*, 2018; Garcia-Vello *et al.*, 2020; Amponsah *et al.*, 2021; Labi *et al.*, 2021; Opare-Asamoah *et al.*, 2021). However, there is a paucity of literature on antimicrobial use in community pharmacies and over-the-counter medicine shops (OTCMS) in Ghana and across West Africa.

A high proportion of the population in low- and middle-income countries (LMIC), including Ghana, depends on community pharmacies and OTCMS for treatment of minor ailments, partly due to their affordability and accessibility compared to clinic and hospital visits (Akpan *et al.*, 2021; Belachew *et al.*, 2021; Sono *et al.*, 2023), as well as patients' trust in the expertise and knowledge of pharmacists. Community pharmacies and OTCMS, therefore, have a pivotal role in ensuring the appropriate use of antibiotics (Belachew *et al.*, 2021). However, available evidence indicates that community pharmacies/OTCMS in many LMICs frequently dispense and/or sell antimicrobials without prescriptions for self-limiting illnesses such as the common cold, viral diarrhoea, and urinary symptoms (Daniels *et al.*, 2019; Sono *et al.*, 2023; Lubanga *et al.*, 2024). A systematic review by Bechalew *et al.*, (2021) reported that in sub-Saharan African countries, the pooled proportion of non-prescription antimicrobial requests or consultations that resulted in the supply of antimicrobials without a prescription was 69% (95% CI 58-80).

The simulated patient ("mystery shopper") methodology utilises trained actors as simulated patients (SPs) to consistently test transactional scenarios, thereby enabling a reliable representation of interactions between healthcare providers and their patients (King *et al.*, 2019; Mokwele *et al.*, 2022). Healthcare providers do not know when they are interacting with an SP; therefore, researchers can obtain accurate measures of the management that real patients would receive when presenting with similar symptoms (Daniels *et al.*, 2019; King *et al.*, 2019). Among studies in sub-Saharan African countries that utilise the SP method to assess antimicrobial dispensing, upper respiratory tract infections (URTIs) and acute diarrhoea are the most frequently presented case scenarios (Belachew *et al.*, 2021).

In Ghana, national regulation on healthcare delivery require that antimicrobial agents be dispensed only with a valid prescription from a medical doctor, physician assistant, midwife, or nurse trained in

prescribing (Health Professions Regulatory Bodies Act, 2013), which is also emphasised in the Ghana National Action Plan on Antimicrobial Resistance. This is intended to limit antibiotic use to those patients with a relevant need for antibiotic treatment. Except for oral cotrimoxazole (frequently prescribed for the treatment of infectious diarrhoea, urinary tract infections (UTIs), and URTIs), Section 29 of the Pharmacy Act expressly forbids OTCMS from selling class A and B medications, including antimicrobials (Pharmacy Act, 1994).

Tamale is a rapidly urbanising city (estimated population of 784,420 in 2025) in northern Ghana, with a dense network of community pharmacies and OTCMS, as is typical in city centres in LMICs (Damisie *et al.*, 2019). This study aimed to assess the level of demand for the sale of antimicrobials without prescriptions across pharmacies and OTCMS in the Tamale metropolis, Ghana, with a particular focus on self-limiting infections that do not require antimicrobial therapy.

MATERIALS AND METHODS

This was a cross-sectional investigational study conducted in retail medicine outlets randomly selected within the Tamale metropolis using simulated patients (SP). The simulated case scenarios presented by the SPs were urinary tract infection (UTI), URTI and acute diarrhoea. Each community pharmacy and OTCMS was visited three times by different SPs. UTIs were chosen because of their common occurrence and the typical management with antimicrobials without proper history-taking (Abbey *et al.*, 2016; Bahta *et al.*, 2020). URTI and acute diarrhoea were also chosen due to their common occurrence and their status as well-known self-limiting conditions that can be managed without antimicrobials (Afari-Asiedu *et al.*, 2018). We calculated a total planned sample size of 180 SP visits and split this between 35 community pharmacies and 25 OTCMS. Individual sites were randomly selected from a sampling frame of all registered retail medicine outlets, provided by the northern regional branch of the Pharmacy Council in Tamale.

The SPs were four male non-professional actors aged between 24 and 30 years with prior experience of population-based research data collection. They were trained by a public health physician and a specialist pharmacist in the study methodology, including using the same language at each visit, and in providing specific responses to potential questions they might be asked. To ensure inter-actor consistency, role-play assessments were conducted daily, both before and after fieldwork, to evaluate SP's adherence to the standardised case scenarios. At the community pharmacy or OTCMS visits, the SPs presented the symptoms of UTI (burning sensation upon urination; urge to urinate frequently for the past three days) or URTI (runny nose; sore throat; dry

cough for the past three days) or acute diarrhoea (three loose stools daily; vomiting; mild fever for the past three days).

SPs were trained to use three progressive levels of demand to assess staff willingness to sell antimicrobials without a prescription. At the first level of demand, the SP asked whether there was anything that could be recommended to alleviate the symptoms presented. The second level of demand was used if an antimicrobial was not provided at the first level of demand, in which the SP asked for “something stronger” for the presenting symptoms. At the third level of demand, the SP said, “I want an antibiotic.” Where any oral antimicrobial and/or non-antimicrobial medicine(s) were offered, the SP bought them up to a maximum value of GHC100 (equivalent to US\$8.72) and noted any additional advice given or the reason (if any) for not selling the antimicrobial. The SPs always remained “in character,” and the staff was not informed that they had been subjected to scientific research. After the visit ended, the SP completed an electronic data collection form.

Ethical approval was obtained from the Ethics Review Committee of the Ghana Health Service (GHS-

ERC:023/04/25). A waiver of informed consent was granted by the Ethics Review Committee of the Ghana Health Service to prevent the Hawthorne effect (i.e., changes in behaviour among study subjects due to their awareness of being observed). No personal information about the facility or its staff was recorded, except for the responses to SP’s symptoms and the treatment given.

RESULTS

Sociodemographic Characteristics of the Visited Facility Staff

Research was conducted in September 2025. There were 105 and 75 visits to the community pharmacies and OTCMS, respectively, over the study period. The majority of staff at community pharmacies (52.4%) and OTCMS (66.7%) were males. While most (49.5%) of the staff in the community pharmacies were visually estimated to be less than 30 years of age, slightly older staff (52.0% estimated between 30 and 50 years of age) were found at OTCMS. Pharmacists (34.3%) and pharmacy technicians (22.9%) made up the majority of staff in community pharmacies, while those of OTCMS were predominantly medicine counter assistants (44.0%; Table 1).

Table 1: Sociodemographic characteristics of the visited facility staff

Variable	Frequency (Percentage)	
	Community Pharmacy (n=105)	OTCMS (n=75)
Sex		
Male	55 (52.4)	50 (66.7)
Female	50 (47.6)	25 (33.3)
Estimated Age		
Less than 30 years	52 (49.5)	30 (40.0)
Between 30 and 50 years	49 (46.7)	39 (52.0)
Above 50 years	4 (3.8)	6 (8.0)
Profession		
Pharmacist	36 (34.3)	2 (2.7)
Pharmacy technician	24 (22.9)	7 (9.3)
Medicine counter assistant	12 (11.4)	33 (44.0)
Nurse	10 (9.5)	8 (10.7)
Physician assistant	-	1 (1.5)
Medical doctor	2 (1.9)	-
Medical student	-	1 (1.3)
Non-professional	5 (4.8)	12 (16.0)
Qualification not made known	16 (15.2)	11 (14.7)

Degree of History Taking for the Simulated Case Scenario

Overall, in 85% (153/180) of visits, the staff member asked the SPs at least one additional question after the initial description of their presenting symptoms. This proportion was similar when divided by community

pharmacies (86.7% [91/105]) versus OTCMS (82.7% [62/75]) (Table 2). The most commonly asked question across all three scenarios was “How long have you had the symptoms?” The average number of questions asked per SP visit was 3 for UTI, 4 for URTI, and 5 for acute diarrhoea.

Table 2: History taking for the simulated case scenario

Variable	Frequency (Percentage)	
	Community Pharmacy (n=105)	OTCMS (n=75)
Additional questions asked for UTI		
Yes	30 (85.7)	22 (88.0)
No	5 (14.3)	3 (12.0)
Additional questions asked for URTI		
Yes	28 (80.0)	21 (60.0)
No	7 (20.0)	4 (40.0)
Additional questions asked for acute diarrhoea		
Yes	33 (94.3)	19 (76.0)
No	2 (5.7)	6 (24.0)

UTI- urinary tract infection; URTI- upper respiratory tract infection; OTCMS- over-the-counter medicine shops

Incidence of Antimicrobial Dispensing Without a Prescription

Overall, the proportion of SP visits that resulted in the dispensing of any antimicrobial(s) without prescription was 91.7% (165/180). Specifically, in community pharmacies and OTCMS, antimicrobial dispensing without a prescription was very similar, at 91.4% (96/105) and 92.0% (69/75) of visits, respectively. The majority of the antimicrobials were

dispensed without a prescription at the first level of demand for both community pharmacies (64.8%, 68/105) and OTCMS (86.7%, 65/75). Most visits resulted in the sale of only one antimicrobial to the SPs (range: 1-3; see Table 3). On average, the SPs spent the equivalent of US\$3.94 on the recommended antimicrobials (range: US\$0.93 - 8.86).

Table 3: Incidence of antimicrobial dispensing without a prescription

Variable	Frequency (Percentage)		
	Community Pharmacy (n=105)	OTCMS (n=75)	Total (N=180)
Antimicrobial dispensed at			
First level	68 (64.8)	65 (86.7)	133(73.9)
Second level	15 (14.3)	3 (4.0)	18(10.0)
Third level	13 (12.4)	1 (1.3)	14(7.8)
No antimicrobial dispensed	9 (8.5)	6 (8.0)	15(8.3)
Any level of demand			
UTI	32 (91.4)	25 (100.0)	57(31.7)
URTI	33 (94.3)	23 (92.0)	56(31.1)
Acute diarrhoea	31 (88.6)	21 (84.0)	52(28.9)
Number of antimicrobials dispensed			
One antimicrobial	81 (84.4)	52 (75.4)	133(73.9)
Two antimicrobials	10 (10.4)	12 (17.4)	22(12.2)
Three antimicrobials	5 (5.2)	5 (7.2)	10(5.6)

WHO AWaRe Classification of Antimicrobials Dispensed Without a Prescription

Overall, 209 oral antimicrobials were dispensed during the 180 SP visits. Most of the antimicrobials dispensed at the community pharmacies were WHO *Watch* antibiotics (45.8%), while those from OTCMS were mainly WHO *Access* antibiotics (41.6%). No WHO *Reserve* antibiotics were dispensed in this study. The

most commonly dispensed prescription-free antimicrobials were ciprofloxacin (19.6%), amoxicillin-clavulanic acid (14.4%), and doxycycline (11.0%). The fixed-dose combination formulation, ciprofloxacin plus tinidazole, was also commonly dispensed (8.1%); this combination is not classified under the WHO AWaRe system (Table 4).

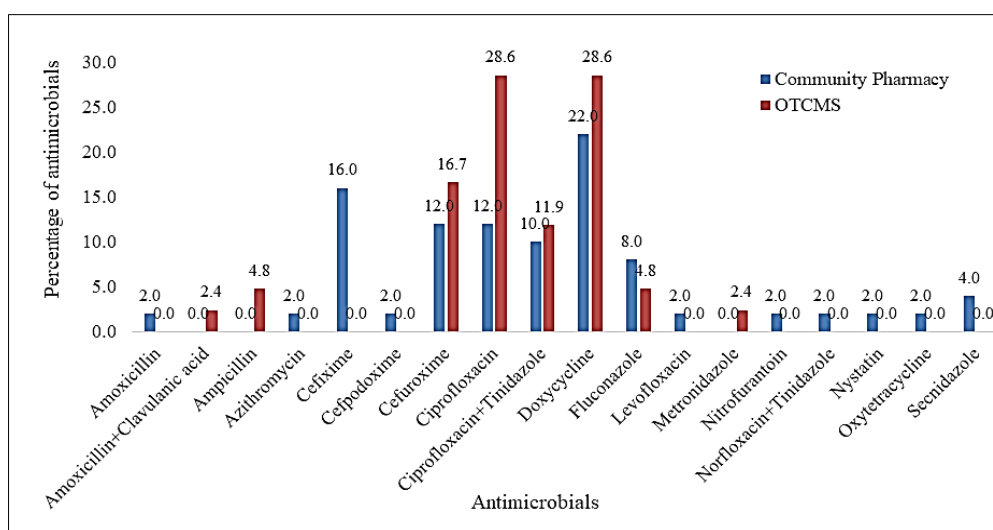
Table 4: WHO AWaRe classification of antimicrobials dispensed without a prescription

WHO AWaRe Index	Antimicrobial	Frequency (Percentage)		
		Community Pharmacy	OTCMS	Total
Access	Amoxicillin	4 (3.4)	2 (2.2)	6 (2.9)
	Amoxicillin+Clavulanic acid	15 (12.7)	15 (16.5)	30 (14.4)
	Ampicillin	-	2 (2.2)	2 (1.0)
	Doxycycline	11 (9.3)	12 (13.2)	23 (11.0)
	Metronidazole	7 (5.9)	11 (12.1)	18 (8.6)
	Nitrofurantoin	1 (0.8)	-	1 (0.5)
	Secnidazole	6 (5.1)	-	6 (2.9)
	Sulfamethoxazole+Trimethoprim	-	1 (1.1)	1 (0.5)
	Total	44 (37.3)	43(47.3)	87(41.6)
Watch	Azithromycin	16 (13.6)	4 (4.4)	20 (9.6)
	Cefixime	8 (6.8)	-	8 (3.8)
	Cefpodoxime	1 (0.8)	-	1 (0.5)
	Cefuroxime	7 (5.9)	10 (11.0)	17 (8.1)
	Ciprofloxacin	19 (16.1)	22 (24.2)	41 (19.6)
	Erythromycin	1 (0.8)	-	1 (0.5)
	Levofloxacin	1 (0.8)	-	1 (0.5)
	Oxytetracycline	1 (0.8)	1 (1.1)	2 (1.0)
	Total	54 (45.8)	37 (40.7)	91 (43.5)
Unclassified	Ciprofloxacin+Tinidazole	9 (7.6)	8 (8.8)	17 (8.1)
	Fluconazole	4 (3.4)	2 (2.2)	6 (2.9)
	Metronidazole+Furazolidone	5 (4.2)	1 (1.1)	6 (2.9)
	Norfloxacin+Tinidazole	1 (0.8)	-	1 (0.5)
	Nystatin	1 (0.8)	-	1 (0.5)
	Total	20 (16.9)	11 (12.0)	31 (14.8)

Antimicrobials Dispensed for Treating Urinary Tract Infection

Overall, 92 antimicrobials were dispensed for simulated urinary tract infection (UTI), 50 at community pharmacies and 42 at OTCMS. The most dispensed antimicrobials for UTI in community pharmacies were doxycycline (22.0%, 11/50), cefixime (16.0%, 8/50), cefuroxime (12.0%, 6/50), and ciprofloxacin (12.0%, 6/50), while those of OTCMS were ciprofloxacin (28.6.0%, 12/42), doxycycline (28.6%, 12/42), and

cefuroxime (16.7%, 7/42). The antifungal agent fluconazole (8.0%, 4/50) and nystatin (2.0%, 1/50) were sometimes added to antibiotic regimens to treat UTIs in community pharmacies (Figure 1). Three community pharmacies and two OTCMS offered to administer an immediate (“stat”) dose of ceftriaxone by injection, followed by oral antimicrobials. In 15.8% (9/57) of visits in which antimicrobials were dispensed for UTI, over-the-counter medicines such as alkalinising agents, analgesics, and antihistamines were also recommended.

**Fig. 1: Antimicrobials dispensed for simulated UTI (n=60 visits)**

Antimicrobials Dispensed for Treating Upper Respiratory Tract Infection

Overall, 56 antimicrobials were dispensed for simulated upper respiratory tract infection (URTI), 34 at community pharmacies and 22 at OTCMS. Amoxicillin+clavulanic acid (44.1%, 15/34) and azithromycin (44.1%, 15/34) were both commonly dispensed in community pharmacies. Similarly, in

OTCMS, amoxicillin+clavulanic acid (63.6%, 14/22) and azithromycin (18.2%, 4/22) were also commonly dispensed (Figure 2). In 16.1% (9/56) of visits in which antimicrobials were dispensed for URTI, over-the-counter medicines such as antihistamines, cough remedies, cold remedies, and demulcents were also recommended.

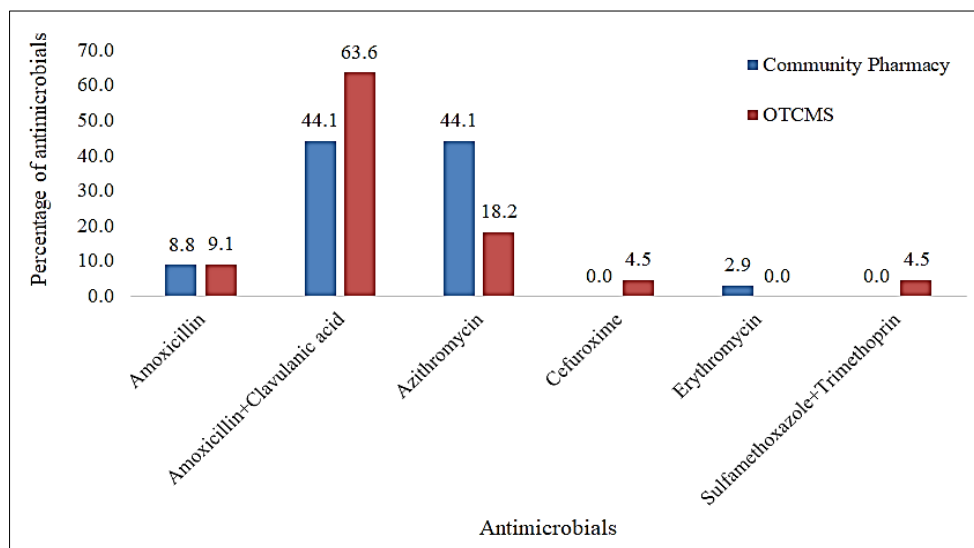


Fig. 2: Antimicrobials dispensed for simulated URTI (n=60 visits)

Antimicrobials Dispensed for Treating Acute Diarrhoea

Overall, 61 antimicrobials were dispensed for simulated acute diarrhoea, 34 at community pharmacies and 27 at OTCMS. Community pharmacies commonly dispensed ciprofloxacin (38.2%, 13/34), metronidazole (20.6%, 7/34), and metronidazole+furazolidone (14.7%, 5/34) for treating acute diarrhoea, while antimicrobials

dispensed by OTCMS were mainly ciprofloxacin (37.0%, 10/27) and metronidazole (37.0%, 10/27) (Figure 3). In 42.3% (22/52) of the visits where antimicrobials were dispensed for acute diarrhoea, over-the-counter medicines such as anti-diarrheal medicines, oral rehydration medicines and nutritional supplements were recommended.

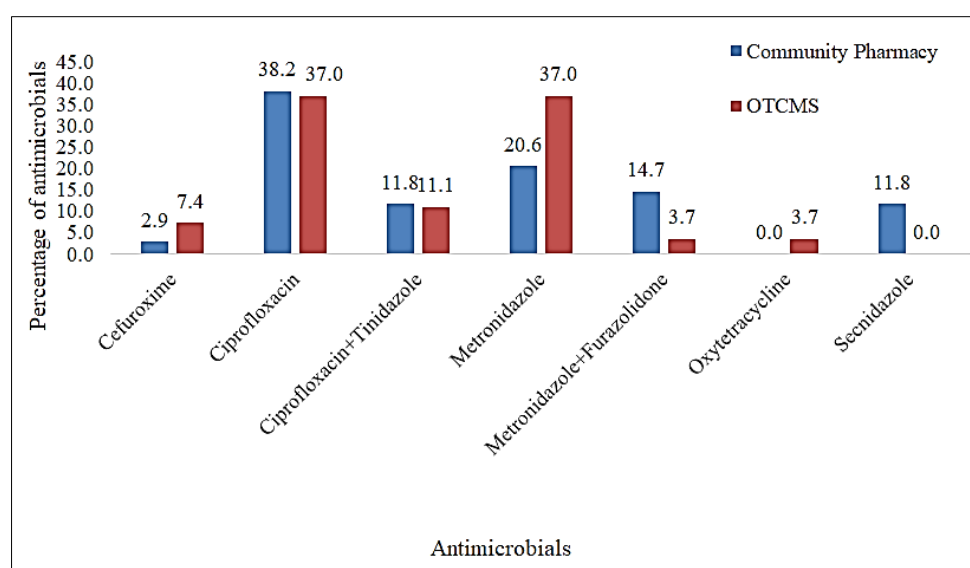


Fig. 3: Antimicrobials dispensed for simulated diarrhoea (n=60 visits)

Incidence of Antimicrobial Non-Dispensing Without a Prescription

In only 8.3% (15/180) of the visits, antimicrobials were not dispensed to SPs, occurring in 8.6% (9/105) of community pharmacies and 8.0% (6/75) of OTCMS visits. Among visits to community pharmacies, reasons given for not recommending antimicrobials to the SPs included: the symptoms presented did not require an antimicrobial agent (n=9); the symptoms had lasted less than 5 days (n=1); and the absence of abdominal pain and blood or mucus in stool (n=1; more than one reason given per visit). In OTCMS, the staff referred the SPs to a medical doctor for further clinical examination on three visits. A further three were refused antibiotics because the condition was deemed not to require them, and one each was denied antimicrobials due to the risk of antimicrobial resistance and the requirement for a valid prescription.

DISCUSSION

This study sought to measure the proportion of community pharmacies and OTCMS in the greater Tamale metropolitan area in northern Ghana that dispense antimicrobials without a prescription for self-limiting infections that typically do not require antimicrobials. We found a very high prevalence of antimicrobials dispensed without a prescription (92%), with a similar level observed in OTCMS, which are excluded by law from dispensing antimicrobials (Damisie *et al.*, 2019).

The use of antimicrobials for self-limiting infections, often of viral origin, promotes the development and spread of antimicrobial resistance in the community, wastes limited resources, and leads to adverse drug reactions (Abbey *et al.*, 2019). The prevalence seen in Tamale, Ghana was higher than that reported by similar SP studies in Nigeria (86.5%) (Sono *et al.*, 2023), Eritrea (87.6%) (Abbey *et al.*, 2019), Catalonia, Spain (45.2%) (Llor & Cots, 2009), Gauteng Province, South Africa (80.0%) (Mokwele *et al.*, 2022), and the average level across sub-Saharan Africa countries (69.0%) (Belachew *et al.*, 2021), but lower than that reported in Mizan-Aman town, Ethiopia (94.4%) (Bahta *et al.*, 2020), Punjab, Pakistan (96.6%) (Saleem *et al.*, 2020), Moshi municipality, Tanzania (92.3%) (Horumpende *et al.*, 2018), and Lusaka district, Zambia (100%) (Kalungia *et al.*, 2016; Sono *et al.*, 2023). Although some of these differences might be due to variations in study procedures, we believe the SP methodology provides a high degree of reproducibility and, hence, comparability, meaning these studies are likely to reflect true variations in dispensing patterns.

The principle of pharmaceutical care requires comprehensive history taking to optimise pharmacotherapy (Blenkinsopp *et al.*, 2014). We found

that in both community pharmacies and OTCMS (Table 2), some questions were typically asked of the SP, but the interaction typically concluded with the dispensing of an antimicrobial agent, despite our construction of scenarios (especially acute diarrhoea and URTI) that would not normally be considered to require antibiotic treatment. Nonetheless, in a few visits (8.3%), the SPs were denied antimicrobials even at the highest demand. Our finding of increasing antimicrobial sales as our SP enacted the three progressive levels of simulated demand indicates that at least some of the tendency to dispense antimicrobials in Tamale is due to practitioners' response to patient pressure. All three scenarios presented resulted in frequent dispensing of antimicrobials, suggesting that the form of infection was not a major factor in the decision to dispense in this setting.

The inappropriate dispensing of antimicrobials for self-limiting infections in community pharmacies and OTCMS, as observed in this study (Table 3), increases treatment costs for patients and promotes antimicrobial resistance (Merrett *et al.*, 2016; Akpan *et al.*, 2021; Sono *et al.*, 2023). The broader factors driving high levels of non-prescription antimicrobial sales in LMIC are complex. These include a weak regulatory framework for antimicrobial sales and dispensing, high community demand (coupled with difficulty accessing health services), and inadequate professional training for pharmacists and other paramedical staff in the rational use of antimicrobials (Afari-Asiedu *et al.*, 2018; Damisie *et al.*, 2019; King *et al.*, 2019; Sono *et al.*, 2023). To this end, we recommend that regulatory bodies assign key performance indicators to pharmacists and other pharmaceutical support staff in Ghana and that these indicators be monitored more closely to reduce inappropriate dispensing. Primary professional training for practitioners, alongside patient education and awareness-raising, should promote appropriate antibiotic dispensing and, consequently, reduce AMR levels (Merrett *et al.*, 2016; Sono *et al.*, 2023). In-service training of retail pharmaceutical professionals should be routinely emphasised to further mitigate these problems (Abbey *et al.*, 2016; Damisie *et al.*, 2019). Any further restriction on access to antimicrobials will need to be balanced by improved access to healthcare professionals, so that patients who do require antibiotics can access them. The high rate of dispensing antimicrobials observed in our study may be due to community pharmacies and OTCMS being typically privately owned in Ghana, mostly by non-pharmaceutical professionals; hence, proprietors might put undue pressure on licensed pharmaceutical professionals for economic gain, which may compromise their professional decision-making (Damisie *et al.*, 2019).

The study found that the most frequently dispensed antimicrobial was ciprofloxacin, a WHO

Watch-category antibiotic (WHO, 2019), consistent with findings from another Ethiopian study (Zawahir *et al.*, 2019). Since ciprofloxacin is a fluoroquinolone, the potential for cross-resistance to other fluoroquinolones among microorganisms is a concern, particularly because fluoroquinolones are used as second-line anti-TB treatments (Daniels *et al.*, 2019). Ciprofloxacin and doxycycline were both commonly dispensed for UTI in community pharmacies and OTCMS, while amoxicillin+clavulanic acid and azithromycin were commonly dispensed together for URTI in community pharmacies. We note that for the UTI visits, our young male actors were often dispensed an antibiotic (doxycycline), typically used for the treatment of chlamydia (causing sexually transmitted urethritis) (Merrett *et al.*, 2016), which was unexpected. Some of the UTI visits had antifungals (fluconazole and nystatin) dispensed - presumably for suspected candida infection. This pattern of prescribing has also been seen in previous studies (Abbey *et al.*, 2016; Afari-Asiedu *et al.*, 2018; Saleem *et al.*, 2020; Akpan *et al.*, 2021; Ngyedu *et al.*, 2023). In the case of acute diarrhoea, ciprofloxacin and metronidazole were both commonly dispensed. Local guidelines, such as the Ghana Standard Treatment Guidelines (GSTG) (Ghana Standard Treatment Guidelines, 2017), and international guidelines, such as the WHO AwaRe Antibiotic Book, make it clear that the vast majority of watery diarrhoea, with or without fever, does not require antibiotics (WHO, 2021).

CONCLUSION

There was a high prevalence of dispensing antimicrobials to adults without prescriptions for self-limiting infections in community pharmacies and OTCMS in Tamale, Ghana. Going forward, enhanced awareness-creation campaigns on AMR, continuing education and training for community pharmacists and pharmaceutical support staff and strengthening of existing regulations in community pharmacies and OTCMS in Ghana are all needed. These same conclusions apply across most of sub-Saharan Africa and other countries with equivalent community health sector conditions.

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Conflict of Interest: All authors have none to declare.

Data Availability: The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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