



Over-the-counter antibiotic dispensing by pharmacies: a standardised patient study in Udupi district, India

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ABSTRACT

Background Antimicrobial resistance is a global health emergency, and one of the contributing factors is overuse and misuse of antibiotics. India is one of the world's largest consumers of antibiotics, and inappropriate use is potentially widespread. This study aimed to use standardised patients (SPs) to measure over-the-counter antibiotic dispensing in one region.

Methods Three adults from the local community in Udupi, India, were recruited and trained as SPs. Three conditions, in both adults and children, were considered: diarrhoea, upper respiratory tract infection and acute fever. Adult SPs were used as proxies for the paediatric cases.

Results A total of 1522 SP interactions were successfully completed from 279 pharmacies. The proportion of SP interactions resulting in the provision of an antibiotic was 4.34% (95% CI 3.04% to 6.08%) for adult SPs and 2.89% (95% CI 1.8% to 4.4%) for child SPs. In the model, referral to another provider was associated with an OR 0.38 (95% CI 0.18 to 0.79), the number of questions asked was associated with an OR 1.54 (95% CI 1.30 to 1.84) and an SP–pharmacist interaction lasting longer than 3 min was associated with an OR 3.03 (95% CI 1.11 to 8.27) as compared with an interaction lasting less than 1 min.

Conclusion Over-the-counter antibiotic dispensing rate was low in Udupi district and substantially lower than previously published SP studies in other regions of India. Dispensing was lowest when pharmacies referred to a doctor, and higher when pharmacies asked more questions or spent more time with clients.

INTRODUCTION

Antimicrobial resistance is a global health emergency, and poor antimicrobial stewardship, which includes both overuse and misuse of these drugs, is a contributing factor.¹ Estimates suggest that 20%–50% of global antibiotic use is inappropriate,² but it is difficult to measure this in resource-constrained settings where surveillance is a challenge.

India is a leading consumer of antibiotics globally. Between 2000 and 2015, antibiotic consumption in India doubled, making India the highest-consuming low-income and middle-income country (LMIC).³ However,

Key questions

What is already known?

- The overuse and misuse of antibiotics is a contributing factor to antimicrobial resistance, and India consumes the most antibiotics of any country.
- Standardised patients (SPs) have been used to assess quality of care in India and other low-income and middle-income countries, and have shown that in India, private retail pharmacies are a source of non-prescription antibiotics.
- These studies have reported that up to 40% of pharmacies provide non-prescription antibiotics, but the most studies are limited to one or two medical conditions.

What are the new findings?

- In the district of Udupi, Karnataka, we completed 1522 pharmacy–SP interactions including three conditions in both adults and children—upper respiratory tract infection, diarrhoea and fever—and found that only 4% of pharmacies provided non-prescription antibiotics.
- Antibiotic dispensing was highest when pharmacies asked more questions or spent more time with the SP, and lowest when they referred the SP to another provider.
- Despite the low rate of antibiotic dispensing, case management by pharmacies was still poor as evaluated by adherence to international guidelines, and varied greatly according to the condition presented and whether the SP was an adult or paediatric case.

What do the new findings imply?

- In some areas of India, non-prescription antibiotic dispensing by pharmacies may not be as prevalent as previously thought, although overall quality of care remains a problem.
- In addition to provider-level variation in antibiotic dispensing, geographical and demographic factors may be relevant, though further research is required.

India also has a high infectious disease burden,⁴ and a high burden of mortality due to drug-resistant pathogens.⁵ India has a highly privatised medical system with a large informal sector, and many patients access



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antibiotics over the counter (OTC) via over 750 000 retail pharmacies across the country,⁶ and it has been documented that these pharmacies dispense antibiotics without a prescription.⁷

According to the Drugs and Cosmetics Rules Act from the Indian government,⁸ all antibiotics are designated as Schedule H, which means that pharmacies cannot dispense them without a prescription. In 2013, in an effort to regulate use of certain antibiotics such as newer cephalosporins and fluoroquinolones, carbapenems and antituberculosis drugs, the Indian government introduced a second schedule, H1. Pharmacies must maintain a register of all Schedule H1 drugs dispensed, recording the name and quantity of the drug as well as patient details.⁹ A further schedule of drugs, schedule X, requires pharmacists to also keep the original prescription on hand for 2 years; this schedule includes restricted drugs such as narcotics and sedatives.

Thus, OTC antibiotic dispensing is technically illegal, but enforcement of these regulations is challenging. This is concerning as overall antibiotic consumption in countries has been linked to a higher prevalence of antibiotic resistance,¹⁰ and the use of antibiotics in the individual is linked with the subsequent emergence of resistant bacteria in the body.¹¹ Thus, the practice providing antibiotics without a diagnosis may unnecessarily promote resistance.

Where prescription audits are not possible, standardised (or simulated) patients (SPs) have been used to study pharmacy practices in India and other LMICs.¹² The SP methodology is considered as the gold-standard method to assess provider practice.^{13 14} Specifically in India, this methodology has been successfully applied to provide insight on how pharmacists manage cases of tuberculosis^{15 16} or respiratory tract infection¹⁷ for adult patients and paediatric diarrhoea.^{16 18} These SP studies have found that 15% to upwards of 40% of SP visits involved the provision of a non-prescription antibiotic.

We report here the results of a cross-sectional SP study assessing OTC antibiotic dispensing in private pharmacies in the district of Udupi, located in Karnataka state, India. This study builds on previous SP studies by our team^{14 15} by extending the number of case scenarios to three common conditions: upper respiratory tract infection (URI), diarrhoea and fever suggestive of malaria.

METHODS

Objectives

This study was conducted in the district of Udupi, Karnataka, in South India. The primary objective was to assess overall non-prescription, OTC antibiotic dispensing by private, community retail pharmacies for adults and children for URI, acute, uncomplicated diarrhoea and a fever suggestive of malaria. Secondary objectives were to examine how this outcome differed between adults and children, and to determine which factors of the SP visit—history taking by the pharmacy, client volume at the time

of visit, whether the SP was referred to another provider, approximate time spent at the pharmacy and pharmacy location (urban or rural)—were associated with antibiotic dispensing.

Standardised patients

SPs are individuals recruited locally, trained to make identically scripted clinical presentations, deployed incognito to visit healthcare providers and debriefed using a structured reporting instrument. [Table 1](#) summarises the three SP case scenarios. Treatment for each condition was benchmarked against available guidelines from WHO on the management of the common cold,¹⁹ diarrhoea²⁰ and suspected malaria²¹; antibiotics are not indicated in any case. The appendix includes a description of all guidelines referenced to determine ideal management for each case.

Three adults were recruited from the local community as SPs. For the paediatric scenarios, adults were used as proxy SPs—no children were recruited. The SPs were instructed to visit the pharmacy and first request medication for a sick 2-year-old child at home and then request medication for their own illness. Thus, two cases were presented in a visit; each was considered a separate SP-pharmacy interaction.

Selection of pharmacies and SP visits

The district of Udupi has a population of approximately 1.2 million people, and, according to a list from the local pharmacists association, 350 private pharmacies were active at the time of the study. Ultimately, 279 pharmacies were included in our sample. Pharmacies were categorised as ‘urban’ or ‘rural’ according to census guidelines²²; the sample included 155 rural pharmacies and 124 urban pharmacies. Between 23 July 18 and 6 October 2018, each SP was instructed to visit each pharmacy and present their respective adult and paediatric cases. Further information on sample size calculation and pharmacy selection is available in online supplementary table S1 in the online supplementary appendix.

SPs were instructed to purchase any medications provided and place them in labelled envelopes. SPs filled out a structured questionnaire describing the visit using the EpiCollect 5 software on their mobile phones within half an hour of the interaction. In the case of the fever scenario, SPs reported whether a malaria test was recommended. Medications were then identified and classified as Schedule H or H1 by a trained research assistant. An infectious disease physician (GS) identified, coded and classified all antibiotics.

The waiver was approved because informed consent posed a threat to the scientific validity of this study, as it would increase the risk of SP detection and providers may alter their behaviour if they are aware of observation. The study posed minimal to no risk to pharmacies and their staff, as all information was kept confidential and no personal information was collected. There was also

Table 1 SP case scenarios for both adults and children, with expected management

Description of the case scenario	Symptoms	Opening statement by the SP on entering the pharmacy	Expected management
Upper respiratory tract infection (URI), likely of viral aetiology	Individual with a 2-day history of acute-onset low-grade fever, with runny nose and non-productive cough; does not look sick. Family members have similar symptoms.	Child with URI: 'Sir/Ma'am, my niece at home has fever and cough. Can you give me some medicine for her?' Adult with URI: 'Since two days I have cough and fever. Can you help me?'	<u>Acceptable:</u> Not dispensing antibiotics, with or without referral to a doctor; dispensing symptomatic treatments according to current guidelines. <u>Unacceptable:</u> Dispensing antibiotics and/or steroids.
Uncomplicated, acute diarrhoea	Individual with 1-day history of acute onset, watery diarrhoea; no blood in the stool. No fever. Appears well hydrated.	Child with diarrhoea: 'Sir/Ma'am, my niece at home has diarrhoea. Can you give me some medicine for her?' Adult with diarrhoea: 'I have diarrhoea. Can you help me?'	<u>Acceptable:</u> Dispensing oral rehydration salts (ORS), not dispensing antibiotics, with or without referral to a doctor. For paediatric SPs, zinc should be given with ORS. <u>Unacceptable:</u> Dispensing antibiotics and restricted antimotility drugs such as loperamide.
Acute febrile illness suggestive of malaria	Individual with a 4-day history of high fever with shivering/chills, every other day; no cough or any other symptoms. No headache, fits or altered consciousness.	Child with fever: 'Sir/Ma'am, since four days my niece has fever and chills. Can you give me some medicine for him?' Adult with fever: 'I have fever since a few days that is not going away. I also get chills.'	<u>Acceptable:</u> Referral for malaria blood test without dispensing antimalarials or antibiotics. <u>Unacceptable:</u> Dispensing antimalarials, other antibiotics or steroids.

SP, standardised patient.

minimal risk to individuals recruited as SPs as they were trained to avoid detection and examinations.

Patient and public involvement

This research was done without patient involvement, particularly as this was not a clinical study. SPs cases were developed in conjunction with physicians, not patients. Individuals hired as SPs were recruited from the local public and were invited to comment on the SP case design.

Statistical analysis

The main outcome considered was the proportion of SP-pharmacy interactions resulting in the provision of an antibiotic. Secondary outcomes were the proportion of all interactions with acceptable case management and the proportion of interactions resulting in the provision of any medication, a schedule H medication, a schedule H1 medication or other medications of clinical relevance to that case. The proportions were compared for adults and children using McNemar's test for paired proportions. The adult and paediatric cases were considered paired because a single SP would present both in one interaction.

To evaluate factors associated with antibiotic dispensing, we fit a model using generalised estimating equations with a logit link to account for clustering by pharmacy. Adult and paediatric interactions were pooled for this analysis. To examine how antibiotic dispensing practices

for adults and children were correlated, we fit a second logistic generalised estimating equation with antibiotic dispensing for the paediatric SP-pharmacy interactions as the outcome. The covariate of interest was whether an antibiotic was dispensed for the corresponding adult interaction, that is, the adult SP with the same condition at the same pharmacy. All analyses were adjusted for the case presented (both condition and whether the patient was adult or paediatric). Individual SP fixed effects were not included because each case was always presented by the same person. Theoretically, it is possible that SP characteristics, such as sex, age, height or weight, could affect pharmacists' behaviour. However, as each SP case scenario was only portrayed by one individual in this study, any potential variation here will be accounted for with the case fixed effect, and SP characteristics were never included as an additional covariate in the models. A full description of the variables included, as well as the choice of model and alternate analysis, is available in the online supplementary appendix table S2, figure S1, figure S2, figure S3.

Data were collected using EpiCollect 5 and Excel (V.1901) and analysed using R (V.3.4.1).

RESULTS

Of the 837 planned visits to 279 pharmacies, 761 (91%) were successfully completed, resulting in a total of 1522 interactions including both adult and child cases. The

average cost per visit was 38 Indian rupees (IQR: INR15–INR50) (US\$0.22–US\$0.72), with a maximum cost of 158 rupees (US\$2.28). Of the 761 visits, there were no customers other than the SP present for 440 (58%). Visits were relatively short; 601 (79%) lasted less than 1 min. Pharmacy staff asked an average of 1.18 questions and dispensed an average of 0.79 drugs per interaction. In total, 1218 medications were dispensed, of which 22 (1.8%) could not be identified because the tablet strip had been cut. No loose pills were dispensed. To our knowledge, SPs were not detected, and no pharmacy staff attempted to perform any examinations on-site nor give any injections.

History taking

Adults were asked a mean of 1.04 (SD ±0.87) and a median of 1.0 questions, and paediatric cases elicited a mean of 1.31 (SD ±0.82) and a median of 1.0 questions.

History taking was highly variable according to case. Across all interactions, 86.5% (95% CI 84.7% to 88.2%) of pharmacies asked at least one question. This percentage was 74.6% (95% CI 71.3% to 77.6%) for adult scenarios and 98.4% (95% CI 97.2% to 99.1%) for paediatric scenarios. Across all paediatric scenarios, the most commonly asked question was age (97.9% of 761 interactions, 95% CI 96.5% to 98.8%), and only 22.4% (95% CI 19.5% to 25.5%) of pharmacies asked some recommended question other than age. Overall, adult SPs were asked significantly more recommended questions than paediatric SPs. Online supplementary table S3 in the supplementary appendix lists all recommended questions and how often they were asked.

Case management and medications dispensed

Table 2 shows the number and percentage of interactions for the primary and secondary outcomes and case management, overall and separated by SP case. The proportion of SP interactions resulting in the provision of any medication was 87.2% (95% CI 84.5% to 89.4%) for adult SPs and 55.5% (95% CI 51.9% to 59%) for child SPs. Antibiotics were provided in 33 adult interactions (4.34% of 761 interactions, 95% CI 3.04% to 6.08%) and 22 paediatric interactions (2.89% of 761 interactions, 95% CI 1.86% to 4.4%). A 2×2 table for overall antibiotic dispensing to adult and paediatric SPs is included in online supplementary table S4 of the online supplementary appendix.

Case management, including medication dispensing for adults versus children, is illustrated in figure 1. Case management was worst for the diarrhoea condition, with not a single pharmacy managing this case correctly. This is because ORS were never offered to adults, and while ORS were provided in 13.4% (95% CI 9.61% to 18.4%) of paediatric diarrhoea interactions, zinc was never dispensed. Fever was only managed correctly for 1.19% (95% CI 0.31% to 3.73%) of adult SPs and 3.86% (95% CI 1.97% to 7.2%) of child SPs as these were the only interactions where the SP was referred for a malaria test.

Table 2 Number of interactions, proportion and 95% CI for primary and secondary outcomes, by SP case

	Adult (percentage (95% CI))			Paediatric (percentage (95% CI))			Total (percentage (95% CI))
	URI	Diarrhoea	Fever	URI	Diarrhoea	Fever	
No of SP interactions	250	259	252	252	250	259	1522
Any medication	85 (79.8, 89)	91.1 (86.8, 94.2)	85.3 (80.2, 89.3)	51.6 (45.2, 57.9)	32.4 (26.8, 38.6)	81.9 (76.5, 86.2)	71.3 (69, 73.6)
Mean no of medicines dispensed (range)	0.89 (0, 2)	1.1 (0, 3)	1 (0, 3)	0.59 (0, 2)	1.15 (0, 3)	0.85 (0, 2)	0.79 (0, 3)
Any antibiotic	4.35 (2.3, 7.86)	4.63 (2.53, 8.16)	3.97 (2.03, 7.4)	0 (0, 1.87)	7.91 (5.02, 12.1)	0.77 (0.14, 3.06)	3.6 (2.75, 4.69)
Schedule H drug	78.7 (73, 83.4)	89.2 (84.6, 92.6)	61.1 (54.8, 67.1)	26.6 (21.3, 32.6)	20.6 (15.9, 26.2)	7.72 (4.9, 11.9)	47.3 (44.8, 45)
Schedule H1 drug	1.19 (0.31, 3.71)	0 (0, 1.82)	0 (0, 1.87)	0 (0, 1.87)	0 (0, 1.87)	0.77 (0.13, 3.06)	0.33 (0.12, 0.81)
% of interactions with acceptable management	85 (79.8, 89)	0 (0, 1.82)	1.19 (0.31, 3.73)	75.4 (69.5, 80.5)	0 (0, 1.87)	3.86 (1.97, 7.2)	33.3 (30.1, 35.7)

SP, standardised patient; URI, upper respiratory tract infection.

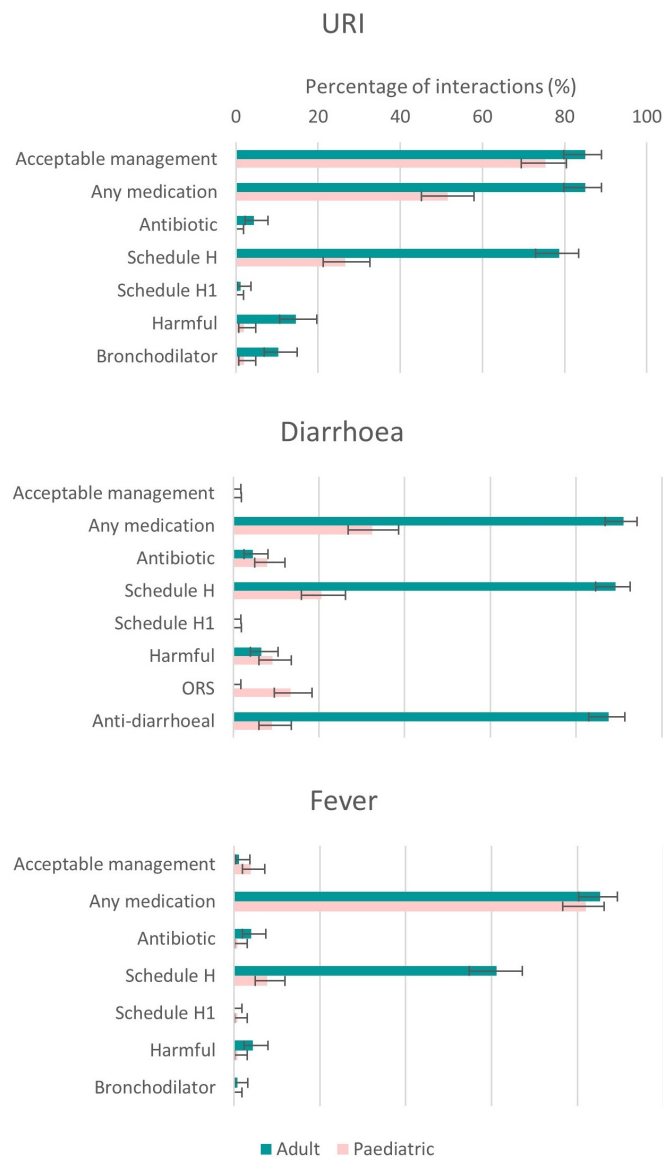


Figure 1 Management of SP cases, by condition, for adults and children. Error bars indicate 95% CI. SP, standardised patient; URI, upper respiratory tract infection.

Of all interactions, 71.6% (95% CI 69% to 73.6%) resulted in the provision of some medication. All medications provided are listed in figure 2, by active drug ingredient and separated by SP case scenario. Nearly half of SPs received schedule H medications, and a list of all non-antibiotic schedule H drugs provided can be found in online supplementary table S5 of the supplementary material. No schedule X medications were dispensed, and only five interactions resulted in the provision of a schedule H1 medication; all five were the antibiotic cefixime. The most common medications were paracetamol, loperamide for the diarrhoea, and cough and cold remedies including antihistamines and bronchodilators for the URI and fever conditions.

Of the 1218 medications provided, 55 (4.5%) were products containing antibiotics. Of these, 25 were combinations of two antibiotics. Overall, diarrhoea was the

condition resulting in the most antibiotic dispensing, accounting for 36.3% (95% CI 21% to 54.9%) of antibiotics given to adults and 90.9% (95% CI 69.4% to 98.4%) among children. As antibiotics were not indicated for any SP case by design, all antibiotic provision in this study was deemed inappropriate.

Factors associated with antibiotic dispensing

The results of the pooled model are displayed in table 3. A number of customers present at the time of the interaction and whether the pharmacy was urban or rural were both non-significant. Referral to another provider was associated with an OR 0.38 (95% CI 0.18 to 0.79), indicating that pharmacy staff referring the SP to another provider was associated with lower odds of dispensing antibiotics. Increasing number of questions asked was associated with an OR 1.54 (95% CI 1.30 to 1.84), indicating that as pharmacy staff asked more questions, the odds of dispensing an antibiotic increased. Finally, an SP–pharmacist interaction lasting longer than 3 min was associated with an OR 3.03 (95% CI 1.11 to 8.27); compared with an interaction lasting less than 1 min, an interaction of this length was associated with increased odds of antibiotic dispensing. The OR for interactions lasting 1–3 min, as compared with those lasting less than 1 min, was non-significant.

Relationships between adult and paediatric outcomes

The difference between the proportion of adults (4.3%) and children (2.9%) SP interactions resulting in an antibiotic was non-significant ($p=0.1$). However, adults received significantly more medications overall (87.4% of adult interactions vs 55.7% of child interactions) and significantly more schedule H medications (76.7% of interactions vs 18.3%), with $p<0.001$ for both.

To further investigate how adult and paediatric outcomes were related, we fit a second model to see if the treatment of the adult predicted the treatment of the child. For this analysis, only the diarrhoea condition was considered, as very few antibiotics were dispensed for the other two conditions and the model was not adequately powered for that rate of dispensing. The results of the model are shown in table 4. Dispensing of antibiotics for the corresponding adult SP interaction was associated with an OR 6.34 (95% CI 6.9 to 23.82) for paediatric dispensing.

DISCUSSION

To our knowledge, this is the first SP study to examine OTC antibiotic dispensing by pharmacies in the Indian private sector for multiple medical conditions, in both adults and children (by proxy). Antibiotics were provided without a prescription and when they were not indicated, along with other schedule H medications. Overall, antibiotics were dispensed in 4.34% of adult interactions and 2.89% of paediatric interactions, and diarrhoea was the condition resulting in the most dispensing. Adults received significantly more medications overall, but the

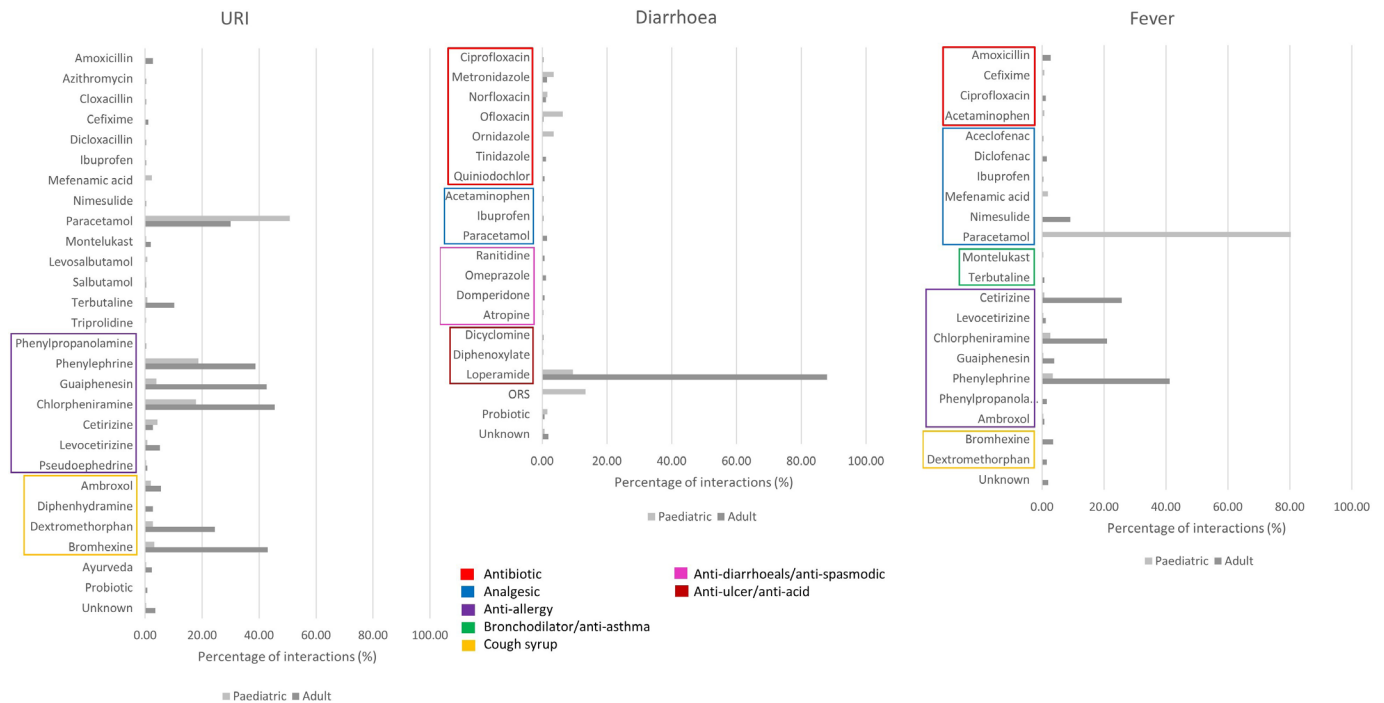


Figure 2 Active drug ingredients in medications provided to SPs by SP case, for adults and children. Percentages do not sum to 100% as one medication may have contained more than one active drug ingredient. SPs, standardised patients; URI, upper respiratory tract infection.

difference in the proportion of interactions resulting in the provision of an antibiotic was not statistically significant between adults and children.

Our results also provide moderate evidence that adult and child outcomes are correlated. For the case of paediatric diarrhoea, whether the adult SP with diarrhoea received an antibiotic was a significant predictor, suggesting that pharmacies that provided adults with antibiotics were more likely to do the same for children. This finding may in part be due to the study design, where one adult presented two cases in one visit. However, the adult SP never presented the same condition twice in one visit, and our model adjusts for correlation in outcomes at the pharmacy level.

Given the results of previous SP studies^{15–18} and qualitative data demonstrating that retail pharmacists are willing to provide antibiotics for common ailments,²³ it is not surprising that antibiotics were dispensed. The rate of antibiotic dispensing in our study, however, is lower than that seen in other Indian studies; for example, two previous SP studies reported that over 30% of pharmacies provided antibiotics for paediatric diarrhoea.^{16 18}

Regions within India are not only culturally different, but vary in their degree of development, enforcement of regulations and awareness about antimicrobial stewardship. It is, thus, plausible that pharmacy practice varies geographically, and this has been observed. A study conducted by Satyanarayana *et al* in pharmacies in Patna and Mumbai, two major cities located in different states, found that approximately 15% of interactions in Mumbai resulted in the provision of an antibiotic, compared with approximately 39% in Patna.¹⁵

The district of Udupi, where our study was conducted, is well developed. The literacy rate is 86.24%, 10% above the state average.²⁴ In 2014, Udupi had the third greatest per capita income in the state, and less than 1% of the population lived in slums.²⁵ The district also performs well on many health indicators: the percentage of deliveries that are institutional births is 19% above the national average and the prevalence of stunting in children under age five is 17% lower than the national average.²⁶ This may reflect better healthcare coverage and access to doctors, in which case pharmacists may not be motivated to step into the role of a de facto medical care provider. As studies have only included one or two cities, further research would be required to determine if, and to what extent, demographic and geographical characteristics affect OTC antibiotic dispensing.

History taking and case management varied according to case, and management was particularly poor for fever and diarrhoea. Improved history taking did not necessarily result in better case management, as 100% of adults were asked at least one question for the fever condition but only 1% were referred for a malaria test. Further, bronchodilators and antiallergy medications were frequently provided for this condition (online supplementary figure 2, table S5), although the SP presentation did not involve symptoms of respiratory illness. The poor case management for fever is concerning, as a study in the city of Mangaluru, a district adjacent to our study site, found that over 30% of surveyed patients with a malaria diagnosis first visited a pharmacy.²⁷

In contrast to diarrhoea and fever, the rate of correct case management for URI was over 80% for both adults

Table 3 Results of model fit using generalised estimating equations with a logit link for all interactions (n=1522)

	OR* (95% CI)	P value
History taking		
No of questions asked	1.54 (1.30, 1.84)	0.00009
Pharmacy location		
Urban pharmacy	Reference	
Rural pharmacy	0.94 (0.52, 1.68)	0.82
Referral		
Patient not referred	Reference	
Patient referred to another provider	0.38 (0.18, 0.79)	0.0035
Client volume at the pharmacy		
No of customers present	Reference	
One to three customers	0.97 (0.48, 1.97)	0.93
More than three customers	1.18 (0.39, 3.59)	0.78
Length of interaction		
Less than 1 min	Reference	
1–3 min	0.93 (0.41, 2.08)	0.85
More than 3 min	3.03 (1.11, 8.27)	0.03
Case		
URI	Reference	
Diarrhoea	2.83 (1.47, 5.45)	0.0046
Fever	0.83 (0.37, 1.83)	0.66
Patient age		
Child	Reference	
Adult	1.65 (0.92, 2.96)	0.099

ORs are for the outcome of antibiotic dispensing by the pharmacy.
 *All ORs are adjusted for case and age of SP (adult/child).
 URI, upper respiratory tract infection.

and children, although only 28% of children were asked a recommended question. This level of questioning would not be enough to differentiate a common cold from a serious condition such as pneumonia. Additionally, schedule H medications were still widely dispensed. The provision of unnecessary medications is concerning not only from a medical standpoint; it also reflects unnecessary financial costs to the individual patient. This is particularly unfortunate given that Indians with low income commonly rely on pharmacists, partly to save costs associated with visiting private providers.²⁸ However, it is encouraging that very few schedule H1, and no schedule X, medications were dispensed.

Pharmacist knowledge is also a factor in pharmacists' behaviour and antibiotic dispensing.^{7 29} Knowledge was not specifically evaluated in our study, but referral, a potential indicator of better practice, was associated with lower provision of antibiotics. However, history taking had the opposite effect: as pharmacists asked more questions, the odds of dispensing increased. This is unexpected as the scripted responses to questions were designed to rule out the possibility of severe illness and discourage the provision of antibiotics. A possible explanation for

Table 4 Results of model fit using generalised estimating equations with a logit link with antibiotics dispensed for paediatric SPs with diarrhoea as the outcome (n=233)

	OR (95% CI)	P value
History taking		
No of questions asked	1.34 (0.94, 1.93)	0.29
Pharmacy location		
Urban pharmacy	Reference	
Rural pharmacy	2.54 (0.90, 7.20)	0.11
Referral		
Patient not referred	Reference	
Patient referred to another provider	0.07 (0.02, 0.25)	0.00002
Client volume at the pharmacy		
No customers present	Reference	
Customers present	1.23 (0.41, 3.70)	0.98
Length of interaction		
Less than 1 min	Reference	
1–3 min	1.37 (0.42, 4.48)	0.25
Antibiotic dispensed for adult		
Not dispensed	Reference	
Dispensed	6.34 (1.69, 23.82)	0.0062

'Antibiotic dispensed for adult' refers to dispensing for an adult SP with the same condition at the same pharmacy.
 SPs, standardised patients.

this could be a situation of reverse causality: it is possible that pharmacy staff first decided to dispense antibiotics and then asked more questions, perhaps to identify the type of antibiotic or dosing, or to justify provision of the medication.

We also included the length of the SP–pharmacy interaction in our model. We found that particularly long interactions had greater odds of antibiotic dispensing. This is also unexpected; similar to history taking, it is plausible that pharmacy staff who spend more time with an SP would identify that the SP's symptoms are not severe and do not warrant the use of antibiotics. However, the number of questions asked was not highly correlated with length of interaction, indicating that long interactions were not because of increased history taking. This may indicate that the decision to dispense antibiotics is not only motivated by a perception of the drug's necessity. Patient demand—real or perceived—and financial incentives likely drive pharmacies to provide antibiotics even when they do not suspect bacterial illness, because retail pharmacies are primarily driven by business.²⁹

Some strengths of our study are worth mentioning. Using SPs is an ideal method for studying OTC antibiotic dispensing, as it measures actual pharmacy practice rather than what they know (ie, knowledge) or say they would do (ie, self-reported practices). Standardising cases across individuals ensures that specific patient characteristics are unlikely to influence provider behaviour. Our study had a limited risk of poor recall, as few questions

were asked and SPs filled out a questionnaire soon after their pharmacy visit. We build on the results generated from previous SP studies by extending the number of medical conditions assessed and by providing a comparison between adults and children. We additionally report how factors of the SP visit affect dispensing to better understand sources of variation. Lastly, our study covered 80% of registered pharmacies in the district. To our knowledge, no unregistered drug shops exist in Udupi district, though such informal sellers are known to exist in South Asia.⁷

However, this study has some limitations. It was conducted at a single site, meaning that the results are not generalisable to the rest of the country or even the state, and the SP study design does not allow us to determine why fewer antibiotics were dispensed in this setting. Additional qualitative and ethnographical research is required. Second, only male SPs were used in this study, and it is possible that patient gender affects provider practice. However, our choice was motivated by safety considerations, as some pharmacies were located in isolated areas and all SPs were unaccompanied. Third, our study was based on a single SP visit from an individual that has not visited the pharmacy before, so we cannot evaluate the effect of an existing relationship with a patient. We also cannot be sure that the staff member the SP interacted with was the pharmacist; a review of community pharmacy practice in India found that medications were often sold by non-qualified employees.³⁰ Although our study captures the real experience of individuals visiting a pharmacy in the district, dispensing by untrained staff poses a problem for the development of antimicrobial stewardship programme, as training pharmacists alone may not be sufficient. A further limitation is that we were not able to analyse the financial burden of unnecessary antibiotic dispensing: though we collected data on the amount of money spent by each SP, receipts were never provided by pharmacies, so it is unclear how much was spent for the paediatric case versus the adult case. Also, a single adult SP presented both an adult and a paediatric case in the same interaction; this has been done before,¹⁶ and we do not believe that this would have a significant effect, particularly as all cases involved common symptoms. However, we cannot rule out the possibility that the results would be slightly different if the cases were presented separately.

CONCLUSION

Non-prescription antibiotic dispensing by pharmacies in Udupi was low, although prescription-only medications were frequently provided. However, even when antibiotics were not dispensed, case management was poor, with a lack of adequate history taking and referrals, and the dispensing of other unnecessary medications. Both dispensing and case management varies according to symptoms and the age of the patient. Additional research is required to understand the low rates of antibiotic

dispensing by pharmacies in this area and use the knowledge to inform antibiotic stewardship interventions.

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