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Economic and social drivers of antibiotic dispensing practices among community pharmacies in Nepal

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Abstract

OBJECTIVE To assess economic and social drivers of dispensing antibiotics without prescription by community pharmacies in Nepal.

METHOD A survey was conducted among 111 pharmacy owners and managers in five districts. Information on demographic and economic characteristics of the pharmacies (e.g. revenue and profits from antibiotics) and their inclination to sell antibiotics without a physician's prescription under various scenarios (e.g. diarrhoea in a child) was collected. Univariate analysis was conducted to assess the demographic and economic characteristics. Bivariate analysis was conducted to examine the relationship between dispensing antibiotics without prescription and economic and social factors.

RESULTS Azithromycin and amoxicillin were the most commonly dispensed antibiotics. The proportions of pharmacies reporting that they would 'most likely' or 'likely' dispense antibiotics without prescription to adult patients ranged from 36.9% (sore throat) to 67.6% (cough). The proportions for paediatric patients ranged from 62.2% (sore throat) to 80.2% (cough or diarrhoea). There was no consistent relationship between the likelihood of dispensing antibiotics and revenues, profits or the number of patients. Instead, dispensing behaviour was influenced by the pressure from the patient; the respondents were more likely to dispense antibiotics when the patient specifically asked for 'an antibiotic' rather than for 'a medicine', and 68.5% respondents ranked 'customer satisfaction' as the most important factor motivating their work.

CONCLUSIONS In Nepal, inappropriate sale of antibiotics by community pharmacists is high, particularly for paediatric patients. Additional research is needed to establish key drivers of this behaviour and to help design effective approaches to reducing AMR.

keywords antibiotics, Nepal, economic factors, community pharmacies

Sustainable Development Goals (SDGs): Good health and well-being, strengthen capacity to manage health risks

Introduction

Antimicrobial resistance (AMR) is a public health emergency of global concern. By year 2050, an estimated ten million lives will be lost annually if the rise of resistance does not slow down [1]. The increase in antibiotic use is due to a number of factors, including rising incomes, availability of cheaper generic antibiotics, indiscriminate antibiotic use in livestock and inappropriate antibiotic use in healthcare [2].

AMR disproportionately affects low- and middle-income countries (LMICs) because of higher relative burden of infectious diseases and weaker health infrastructures. Antibiotic usage is increasing in these settings. Using data from 132 Demographic and Health Surveys and Multiple Indicator Cluster Surveys from 73 LMICs, Allwell-Brown et al. (2020) found a limited but steady increase in reported antibiotic use for sick children under five years of age between 2005 and 2017 [3]. In these settings, non-prescribed antibiotic use is common and community pharmacies are often the first point of contact for healthcare needs [4,5]. A meta-analysis conducted to calculate pooled estimates of non-prescription supply of antibiotics by community pharmacies globally found that

62% of orders fulfilled by pharmacies were without physician prescription [6].

Although dispensing of antibiotics without physician prescription is prohibited in many LMICs, regulations are frequently not enforced, and there is limited empirical evidence on the drivers of pharmacists' antibiotics dispensing behaviours. A number of studies have shown that although lack of knowledge is a concern, there are also discrepancies between knowledge and practice [7,8]. Other studies have focused on the demographic characteristics of pharmacists, such as age, gender and education level, as possible determinants of dispensing behaviour [9].

Only a few studies have examined the economic and social drivers of non-prescription sales of antibiotics. An understanding of such drivers is particularly important in LMICs where the pharmacists both provide healthcare and sell antibiotics, raising the possibility of a conflict of interest. Financial incentives, perceived customer satisfaction and competition have been described as some of the self-reported determinants of dispensing behaviour [10]. Additionally, presence of demand-side influence – patients exerting pressure on pharmacies to give antibiotics – has been shown to increase the likelihood of dispensing antibiotics without physician prescription [11,12]. However, additional evidence is required in order to design policy levers corresponding to economic and social drivers that lead to such practices.

We conducted the current study in Nepal, where pharmacists are the first and often the only point of health services for a large segment of the population [13]. In 2016, 30.6% children with a cough or a fever visited an informal sector provider, such as drug shops or pharmacies [14]. In Western Nepal, pharmacies are the most popular source of care among mothers seeking care for their children [15]. Not surprisingly, pharmaceutical costs contribute to 45% of current health expenditure and 63% of the total out-of-pocket spending on health [16].

AMR is rising in Nepal. A review article found that more than 50% of *Escherichia coli*, *Klebsiella pneumoniae* and *Streptococcus pneumoniae* isolates in Nepal were resistant to first-line antibiotics [17]. Surveillance systems to monitor dispensing and consumption of antibiotics are inadequate in health facilities, and non-existent in community pharmacies. In response, the government has recently endorsed the National Antimicrobial Resistance Containment Action Plan 2016 [18], which is based on WHO's Global Action Plan [19] and identifies interventions at community pharmacies as one of its priorities.

Despite the centrality of community pharmacies in Nepal's healthcare system, to our knowledge, there has been no study that explores the economic and social determinants of the pharmacists' dispensing practices. The primary objective of this study was to initiate work towards filling this important gap.

Methods

Study sample

A mixed-methods assessment was conducted with community pharmacists including qualitative structured interviews and a cross-sectional survey. The current paper focuses on the survey that centred on understanding economic and social drivers and was conducted among 111 community pharmacies in Kathmandu, Bhaktapur, Lalitpur, Kavrepalanchwok and Dhading districts. We selected these pharmacies randomly from a list of 1,281 pharmacies obtained from the Nepal Chemist and Druggist Association, an umbrella organisation of businesses involved in pharmaceutical products. Therefore, our sample is approximately representative of the pharmacies in the greater Kathmandu Valley. Appendix 1: Table A1 shows the number of pharmacies in the analytic sample by district.

Survey administration

The research team visited the pharmacies in July and August 2019 and administered a questionnaire to collect information on the demographic and education characteristics of the respondents, their knowledge of AMR, as well as information on several economic indicators relevant to the pharmacy described below. The owners of community pharmacies, or staff present at the time of the survey, were the primary respondents. For the purposes of this study, 'pharmacist' was defined as the owner, operator or supervising staff of a community pharmacy, regardless of training, degree or professional licensure/credentialing. If more than one individual was present at the pharmacy, the individuals decided who would respond to the survey. The team recorded the responses in the REDCap software [20,21]. If a pharmacy in the initial list was not open, the research team visited the next closest pharmacy in the area, obtained consent and administered the questionnaire. All of the pharmacists we approached agreed to participate in the study, thus the response rate was 100%. The list of questions asked relevant to this study is in Appendix 2.

Outcome variable

The key outcome variable is a binary measure of whether the respondent would provide antibiotics without a prescription from a physician. The respondents were asked

how likely they were to sell antibiotics without a prescription under a number of scenarios, such as 'fever in a child' and 'cough in an adult'. They were provided with four options: 'very likely', 'likely', 'not likely' and 'would not give antibiotics'. For the purpose of this analysis, we code 'very likely' and 'likely' as 1 and the remaining options as 0.

Key independent variables

Our primary interest was in understanding the economic drivers of antibiotic dispensing behaviour among pharmacists. Therefore, our key independent variables included the following: (i) number of patients per week, (ii) total monthly revenue, (iii) total monthly profits, (iv) total monthly revenues from antibiotics and (v) total monthly profits from antibiotics (in rupees *and* as a share of total profits). All of these variables were self-reported by the pharmacists. We asked questions related to each of these measures and, except in the case of the number of patients per week, provided options from which the respondents could choose. For example, for the share of monthly revenue from antibiotics, we asked: 'During the past one month, what percentage of your monthly revenue came from antibiotics'?, and provided four options: <10%, 11-25%, 26-50% and > 50%.

We measured the monthly profits from antibiotics using an additional approach, in which we asked the pharmacist for information on the per-unit buying price (i.e. the price at which they obtain various antibiotics), selling price (i.e. the price at which they sell the antibiotics to their patients) and the number of units sold per week. We obtained this information for the five most-sold antibiotics for that pharmacy. We then calculated weekly profits as the product of the units sold and the difference between the buying and selling prices.

In the analysis involving demand pressure, the key question we asked was whether the pharmacist was more likely to sell antibiotics when a customer asks for *antibiotics* than when the customer asks for a *medicine*. Here, the independent variable was 'asking for a medicine' versus 'asking for an antibiotic'.

To understand what community pharmacists value, we asked the respondents to rank key motivating factors on their work as pharmacists. These included 'profits/revenue the pharmacy makes', 'compliance with the government regulation', 'customer satisfaction' and 'reputation among peer pharmacies'.

Statistical analysis

Consistent with the study's objectives, we assessed information on the percentage of pharmacies that reported they were 'very likely' or 'likely' to sell antibiotics without a physician's prescription for cough, diarrhoea, fever and sore throat – separately for adult and children. We then described the economic characteristics of the pharmacies, followed by a description of bivariate relationships between the chances of selling antibiotics without a physician's prescription and various economic characteristics. We assessed these bivariate relationships in a regression framework, separately for the four medical conditions and for adults and children. To facilitate comparability with future studies, we used ordinary least squares (OLS) regressions and reported the coefficients. In the analysis involving demand pressure, we compared the distributions of the pharmacies' response when the patient asks for a medicine versus when the patient asks for an antibiotic using a chi-squared test. Following a previous study [12], we assumed the patient asking for an antibiotic to have exerted higher demand pressure to the pharmacist for dispensing antibiotic than the patient asking for a medicine.

Ethical aspects

The study was approved by Nepal Health Research Council (ref.: 625/2018) and the institutional review boards of the Pennsylvania State University (study ID: STUDY00010775) and Henry Ford Health System (No. 12561).

Results

Sample characteristics

Of the 111 pharmacists surveyed, 64% respondents were male and 36% female (Table 1). More than half of the pharmacists were below the age of 40. In terms of academic qualification, 59.4% reported to have completed a pharmacy certificate (a short-term course following the Secondary School Examination (SEE)) or pharmacy diploma (a three-year course following the SEE). Close to half of the pharmacists had total work experience of more than 10 years. Forty-two of the pharmacies (37.8%) also ran a clinic for outpatient visits. Approximately 75% of the respondents were owners of the pharmacies, whereas the remaining respondents worked as managers. In terms of the medical conditions, gastrointestinal and upper respiratory tract infections constituted 86.5% of the total presentations. Azithromycin and amoxicillin together accounted for 89.2% of total pharmacy antibiotic sales.

Dispensing behaviour

When asked how likely the pharmacists were to dispense antibiotics without prescription for cough, 67.6% reported 'most likely' or 'likely' in case of adult patients and 80.2% in case of children (Figure 1). For presentation of diarrhoea, 64.9% reported that they were 'most likely' or 'likely' to dispense antibiotics without prescription in case of adults and 80.2% in case of children. For fever, 51.4% reported 'most likely' or 'likely' in case of adults and 77.5% in children to dispense antibiotics without prescription. Finally, for sore throat, 36.9% reported that they were 'most likely' or 'likely' to dispense antibiotics without prescription to adults and 62.2% to children. Overall, for all four conditions, pharmacists were more likely to dispense antibiotics to a paediatric patient than an adult patient.

Table 1 Pharmacist and pharmacy characteristics

Characteristics	Frequency (N = 111)	Percentage
Gender		
Female	40	36.0
Male	71	64.0
Age in years		
<29	24	21.6
30–39	37	33.3
40–49	31	27.9
>50	19	17.1
Highest degree		
Pharmacy certificate	23	20.7
Pharmacy diploma	43	38.7
Another pharmacy-related degree	43	38.7
Missing	2	1.8
Work experience		
Up to 5 years	33	29.7
5–10 years	22	19.8
10 + years	55	49.5
Missing	1	0.9
Pharmacy type		
Stand-alone	69	62.2
Pharmacy and clinic	42	37.8
Position		
Owner	83	74.8
Pharmacy manager	28	25.2
Customers requesting antibiotics without prescription (%)		
<10%	18	16.2
11–25%	29	26.1
26–50%	26	23.4
>50%	36	32.4
Missing	2	1.8
Common illness of patients (% reporting condition as most common)		
Gastrointestinal	72	64.9
Upper respiratory infection	24	21.6
Skin/wound	7	6.3
Urinary tract infection	6	5.4
Missing	2	1.8
Most commonly dispensed antibiotics (% reporting the antibiotic as the most common)		
Azithromycin	75	67.6
Amoxicillin	24	21.6
Cefixime	9	8.1
Cipro	2	1.8
Cephalexin	1	0.9

Economic characteristics

Of 46% of the surveyed pharmacies reported an average of fewer than 200 patients per week (Table 2), whereas 22.5% reported more than 500 patients per week. 65% of the pharmacies reported total revenues up to Nepalese rupees (NPR) 200,000 (approximately, US$ 1,650) in the month preceding the survey, whereas 7.2% reported total revenue of more than NPR500,000. 80% of the pharmacies reported a monthly profit up to NPR 50,000 and only 2.7% reported profits greater than NPR 100,000. Sales of antibiotics constituted less than 10% of total revenues for one-third of the pharmacies. Only one pharmacist reported that more than 50% of their total revenue came from antibiotics. Similarly, profits from sale of antibiotics constituted less than 10% of total profits for 35.1% of the pharmacies. Overall, antibiotics constituted less than 25% of the total revenue and less than 25% of the total profits for over 90% of the pharmacies. The low reliance of pharmacies on antibiotics for revenues and profits is consistent when profits are *calculated* using sales and purchase prices. For nearly 95% of pharmacies,

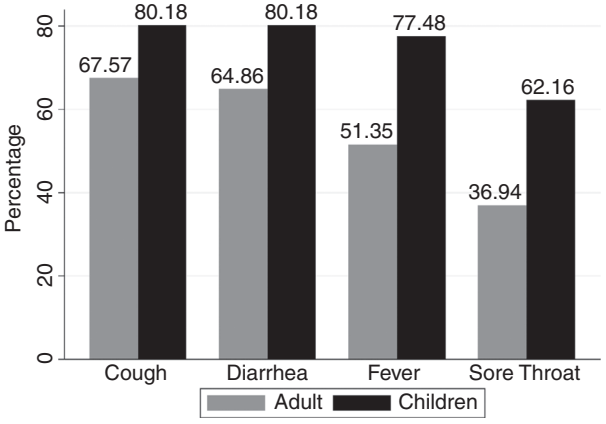

Figure 1 Proportion of pharmacists who reported that they would 'most likely' or 'likely' sale antibiotics without a doctor's prescription, by medical condition and patient's age group.

Table 2 Economic characteristics of the pharmacies

Characteristics	Frequency (n = 111)	Percentage
Average patients per week		
<50	14	12.6
50–200	37	33.3
201–500	35	31.5
500+	25	22.5
Total revenues in past month		
<NPR 50,000	21	18.9
NPR 50,001–NPR 200,000	51	45.9
NPR 200,000–NPR 500,000	31	27.9
NPR 500,000+	8	7.2
Total profits in past month (self–reported)		
<NPR 20,000	45	40.5
NPR 20,001–NPR 50,000	44	39.6
NPR 50,000–NPR 100,000	19	17.1
NPR 100,000+	3	2.7
Total profits from antibiotics in past month (calculated)		
<NPR 1,000	29	26.1
NPR 1,001–NPR 2,000	43	38.7
NPR 2,000–NPR 5,000	32	28.8
NPR 5,000+	7	6.3
Percentage revenues from antibiotics		
<10%	37	33.3
11–25%	63	56.8
26–50%	10	9.0
>50%	1	0.9
Percentage profits from antibiotics		
<10%	39	35.1
11–25%	63	56.8
26–50%	7	6.3
>50%	0	0.0
Missing	2	1.8

the profits calculated by the researchers using the buying and selling prices of antibiotics reported by the pharmacies were less than NPR5000 (approximately, US$50).

Bivariate relationship

In case of cough, diarrhoea or sore throat in an adult patient, the pharmacist's decision to dispense antibiotics without prescription does not seem to depend on any of the economic factors we evaluated (Table 3 a). For fever, compared to pharmacies with fewer than 50 patients per week, the chances of dispensing antibiotics without prescription were higher for pharmacies with more than 50 patients per week. There was also no clear relationship between the economic factors we evaluated and the chances of dispensing antibiotics when the patient was a child (Table 3 b).

Demand pressure

Table 4 shows results from comparing the distributions of pharmacists' inclination to provide antibiotics without a prescription based on whether the patient asks for a 'medicine' or for an 'antibiotic'. As mentioned before, previous studies have used this distinction as a measure of pressure from the patient on the provider. The table shows that pharmacists were more likely to dispense antibiotics without a prescription when the patient asked for antibiotics. This was true when the patient was adult male, adult female, a child or an elderly, although the difference in the distributions in case of adult male patient was statistically significant only at the 10% significance level.

Motivating factors

Among the key motivating factors we evaluated, 76 (68.5%) pharmacists ranked 'customer satisfaction' as the most important motivating factor in their work as a pharmacist, 17 (15.3%) ranked 'compliance with government regulation' as the most important factor, 10 (9%) 'reputation as a good pharmacist' and 8 (7.2%) 'revenue and profit.'

Discussion

Despite rising challenges from AMR, there is limited social science research in the area [22]. The research is particularly lacking in LMICs or in community pharmacy settings. In this study, we aimed to document the economic and social factors that lead to inappropriate antibiotics dispensing by community pharmacies in Nepal. In summary, our findings first indicated that the proportion of pharmacies who sell antibiotics without prescription is high – and as high as 80% in case of paediatric patient with cough or diarrhoea. These findings are generally in agreement with those in other LMICs [23,24]. Secondly, across conditions, pharmacies were more likely to sell antibiotics to a paediatric patient than an adult patient. Thirdly, revenue and profits from antibiotics seemed insufficient to fully explain inappropriate dispensing. Instead, the pharmacies' behaviour seems to be driven by customer satisfaction. Consistent with the pharmacies' focus on patients, across all demographic groups of the patients (adult male, adult female, child, and elderly), the pressure from the patients mattered significantly on whether pharmacies sold antibiotics.

The lack of an association between dispensing and economic factors such as revenue and profits is surprising and contradicts findings from qualitative interviews we

Table 3 (a) Bivariate relationship between non-prescription dispensing and economic factors (patient: adult) (b) Bivariate relationship between non-prescription dispensing and economic factors (patient: child)

(a) Patient: adult	Cough	Diarrhoea	Fever	Sore throat
Proportion reporting 'very likely' or 'likely' to dispense antibiotic without a prescription	67.57%	64.86%	51.35%	36.94%
Average customers per week				
<50 (Reference)				
50 – 200	−0.002 [−0.291, 0.288]	−0.127 [−0.420, 0.166]	0.479** [0.177, 0.780]	0.120 [−0.183, 0.423]
201 – 500	−0.186 [−0.478, 0.106]	−0.343* [−0.638, −0.047]	0.343* [0.039, 0.647]	0.143 [−0.162, 0.448]
500+	−0.226 [−0.534, 0.082]	−0.257 [−0.569, 0.055]	0.457** [0.136, 0.778]	−0.006 [−0.328, 0.317]
Total revenues in past month				
<NPR 50,000 (Reference)				
NPR 50,001–NPR 200,000	−0.182 [−0.420, 0.056]	−0.056 [−0.300, 0.188]	−0.227 [−0.482, 0.028]	−0.258* [−0.505, −0.010]
NPR 200,000–NPR 500,000	−0.068 [−0.327, 0.192]	−0.246 [−0.512, 0.020]	−0.006 [−0.284, 0.272]	−0.249 [−0.518, 0.021]
NPR 500,000+	−0.435* [−0.816, −0.053]	−0.262 [−0.653, 0.129]	0.006 [−0.403, 0.415]	−0.196 [−0.593, 0.200]
Total profits in past month (self – reported)				
<NPR 20,000 (Reference)				
NPR 20,001–NPR 50,000	−0.120 [−0.312, 0.073]	−0.233* [−0.432, −0.034]	0.078 [−0.128, 0.285]	−0.059 [−0.265, 0.147]
NPR 50,000–NPR 100,000	0.056 [−0.192, 0.304]	−0.071 [−0.329, 0.186]	0.292* [0.026, 0.559]	−0.032 [−0.298, 0.235]
NPR 100,000+	−0.733** [−1.274, −0.193]	−0.089 [−0.649, 0.472]	−0.444 [−1.025, 0.136]	−0.067 [−0.647, 0.513]
Total profits from antibiotics in past month (calculated)				
<NPR 1,000 (Reference)				
NPR 1,001–NPR 2,000	−0.153 [−0.374, 0.068]	−0.223 [−0.448, 0.002]	−0.051 [−0.291, 0.189]	0.039 [−0.193, 0.272]
NPR 2,000–NPR 5,000	−0.234 [−0.470, 0.002]	−0.234 [−0.474, 0.006]	−0.117 [−0.373, 0.138]	−0.098 [−0.346, 0.150]
NPR 5,000+	−0.399* [−0.786, −0.012]	−0.399* [−0.793, −0.005]	−0.300 [−0.721, 0.120]	0.049 [−0.358, 0.457]
Percentage revenues from antibiotics				
<10% (Reference)				
11–25%	−0.079 [−0.272, 0.114]	−0.122 [−0.316, 0.072]	−0.033 [−0.241, 0.175]	−0.083 [−0.284, 0.117]
26–50%	−0.030 [−0.362, 0.303]	−0.357* [−0.690, −0.023]	−0.041 [−0.398, 0.317]	−0.132 [−0.477, 0.212]
>50%	−0.730 [−1.676, 0.216]	−0.757 [−1.705, 0.191]	−0.541 [−1.558, 0.477]	−0.432 [−1.413, 0.548]

Table 3 (*Continued*)

(a) Patient: adult	Cough	Diarrhoea	Fever	Sore throat
Percentage Profits from Antibiotics				
<10% (Reference)				
11–25%	−0.192* [−0.379, −0.004]	−0.223* [−0.414, −0.033]	−0.062 [−0.267, 0.142]	−0.160 [−0.354, 0.034]
26–50%	−0.081 [−0.459, 0.297]	−0.366 [−0.750, 0.017]	0.033 [−0.379, 0.445]	−0.176 [−0.566, 0.215]
(b) Patient: child	Cough	Diarrhoea	Fever	Sore throat
Proportion reporting 'very likely' or 'likely' to dispense antibiotic without a prescription	80.18%	80.18%	77.48%	62.16%
Average Customers per Week				
<50 (Reference)				
50-200	−0.081 [−0.318, 0.156]	−0.091 [−0.338, 0.156]	0.025 [−0.230, 0.281]	0.104 [−0.202, 0.410]
201-500	−0.371** [−0.610, −0.133]	−0.243 [−0.492, 0.006]	−0.157 [−0.415, 0.100]	0.000 [−0.308, 0.308]
500+	−0.240	−0.089	0.134	0.069
[−0.492, 0.012]	[−0.351, 0.174]	[−0.137, 0.406]	[−0.257, 0.394]	
Total Revenues in Past Month				
<NPR 50,000 (Reference)				
NPR 50,001– NPR 200,000	−0.140 [−0.342, 0.062]	−0.042 [−0.244, 0.160]	−0.151 [−0.367, 0.065]	−0.134 [−0.385, 0.116]
NPR 200,000–NPR 500,000	−0.034 [−0.254, 0.186]	−0.227*[−0.447, −0.007]	−0.051 [−0.286, 0.185]	−0.214 [−0.487, 0.060]
NPR 500,000+	−0.405* [−0.728, −0.082]	−0.280 [−0.603, 0.044]	0.018 [−0.328, 0.364]	−0.262 [−0.663, 0.139]
Total Profits in Past Month (Reported)				
<NPR 20,000 (Reference)				
NPR 20,001–NPR 50,000	−0.094 [−0.264, 0.075]	−0.252** [−0.415, −0.089]	0.017 [−0.154, 0.188]	−0.144 [−0.348, 0.061]
NPR 50,000–NPR 100,000	−0.002 [−0.221, 0.216]	−0.069 [−0.279, 0.141]	0.267* [0.046, 0.487]	0.070 [−0.194, 0.334]
NPR 100,000+	−0.178 [−0.654, 0.298]	0.089 [−0.369, 0.547]	−0.400 [−0.881, 0.081]	0.000 [−0.575, 0.575]
Total Profits from Antibiotics in Past Month (Calculated)				
<NPR 1,000 (Reference)				
NPR 1,001–NPR 2,000	−0.141 [−0.331, 0.049]	−0.233* [−0.421, −0.046]	−0.002 [−0.203, 0.199]	−0.132 [−0.365, 0.102]
NPR 2,000–NPR 5,000	0.013 [−0.190, 0.216]	−0.087 [−0.287, 0.113]	−0.012 [−0.226, 0.203]	−0.065 [−0.314, 0.185]
NPR 5,000+	−0.148 [−0.481, 0.185]	−0.217 [−0.545, 0.112]	−0.222 [−0.574, 0.131]	0.025 [−0.385, 0.434]

Table 3 (*Continued*)

(b) Patient: child	Cough	Diarrhoea	Fever	Sore throat
Percentage Revenues from Antibiotics				
<10% (Reference)				
11–25%	−0.135 [−0.297, 0.028]	−0.071 [−0.234, 0.091]	−0.108 [−0.281, 0.066]	−0.136 [−0.333, 0.061]
26–50%	0.135 [−0.144, 0.415]	−0.165 [−0.444, 0.115]	−0.038 [−0.336, 0.260]	0.224 [−0.115, 0.564]
>50%	0.135 [−0.659, 0.930]	−0.865* [−1.660, −0.070]	0.162 [−0.685, 1.010]	0.324 [−0.640, 1.289]
Percentage Profits from Antibiotics				
<10% (Reference)				
11–25%	−0.167* [−0.328, −0.006]	−0.151 [−0.313, 0.010]	−0.132 [−0.302, 0.038]	−0.178 [−0.374, 0.018]
26–50%	−0.040 [−0.365, 0.284]	−0.183 [−0.509, 0.142]	0.011 [−0.332, 0.354]	−0.004 [−0.399, 0.391]

These tables show coefficients from linear regressions of dispensing antibiotic without a prescription (binary) on economic variables, separately for each variable and by medical condition. Table (a) shows the results for adult patients, while Table (b) shows the results for pediatric patients. R from 24 different regressions (6 variables by 4 conditions). 95% confidence intervals in brackets. $*P < 0.05$, $**P < 0.01$, $***P < 0.001$. The coefficients, multiplied by 100, should be interpreted as the percentage point change in the chances of dispensing antibiotic without a prescription associated with the change in the economic variable relative to the reference group.

Table 4 Differences in the probability of selling antibiotics based on what the patient asks for (a measure of demand pressure), by age group

	Asking for a medicine	Asking for antibiotics	*P*-value from chi-2 test
Adult male			
Would not give	77 (69.37%)	14 (12.61%)	0.071
Not likely	29 (26.13%)	37 (33.33%)	
Likely	5 (4.50%)	60(54.05%)	
Adult female			
Would not give	74 (66.67%)	13 (11.71%)	0.034
Not likely	27 (24.32%)	31 (27.93%)	
Likely	10 (9.01%)	67 (60.36%)	
Child			
Would not give	44 (39.64%)	11 (9.91%)	0.004
Not likely	48 (43.24%)	15 (13.51%)	
Likely	19 (17.12%)	85 (76.57%)	
Elderly			
Would not give	61 (55.45%)	8 (7.27%)	0.015
Not likely	35 (31.82%)	32 (29.09%)	
Likely	14 (12.73%)	70 (63.64%)	

This table shows the proportion of pharmacies reporting whether they would not give, likely not give, likely give or most likely give antibiotics, by what the patient asks for ('antibiotic' versus 'a medicine'). *P*-values reported in the final column are from a chi-squared test of the difference in the distributions. 'Likely' and 'Very Likely' were included together as 'Likely' because of low number of respondents in the 'Very Likely' category in 'Asking for medicine' for an 'adult male'. Recall that chi-squared test requires the expected number of cases to be at least 5.

conducted as part of a larger study. From the interviews with pharmacists, we identified several key factors which seemed to underlie antibiotic dispensing practices. Among economic factors, respondents reported that they were concerned about maintaining their business to support their families and that there existed a level of competition whereby if one pharmacist did not provide an antibiotic, the client went elsewhere [25]. These qualitative findings are also consistent with studies in neighbouring India where intense competition between pharmacies and staff's desire to maximise profits has been documented [26,27]. In terms of social factors, respondents discussed the ethical and moral obligation to provide medications for people who are sick and their experience in terms of determining appropriate treatments. Consumer pressure was often mentioned, which ties into their recognition of competition and personal financial needs [25].

It is difficult to pinpoint the reason for the inconsistency between our quantitative findings and those from interviews and the wider literature. Here, we offer a few methodological explanations, which illustrate the limitations of the current study and point to the need for additional research on this topic. First, the information we used was all self-reported by the pharmacists, making it vulnerable to social desirability bias and reporting error. Specifically, revenues and profits from antibiotics as well as the likelihood of dispensing may have been under-reported, leading to an overall weak association. Relatedly, for the purpose of this study, we have characterised any dispensing without physician's prescription as 'over-dispensing'. In the vignettes, we attempted to make the scenarios sufficiently clear that pharmacists should not be selling antibiotics without a prescription under those scenarios. However, it is possible that the pharmacists would have responded differently to the vignettes if they had a more complete picture of the patient's health condition including the severity of symptoms and underlying conditions. With the vignettes, we were unable to assess the clinical reasoning of the pharmacists. Third, what we have characterised as a social consideration – pressure from patient which we found to be an important determinant of dispensing – may be a guise for economic motive. In fact, there are three ways to maximise profits: maximising the number of customers, maximising the revenue from each customer and minimising costs [8]. It is possible that the underlying reason for attempting to ensure customer satisfaction is in fact profit maximisation. Finally, pharmacists may have a rationale that extends beyond social or economic considerations. For example, they may view themselves as filling an important gap in healthcare delivery – particularly towards patients who would not afford to visit a doctor to get a prescription – and may be modelling their dispensing behaviour on the practices of local doctors [8]. In that sense, over-dispensing may be reflective of the local need and doctors' practices.

For designing effective policy, it will be important to better understand the drivers of dispensing practices, including socio-cultural motivations and dynamics, for which more rigorous studies are needed. There is already a critical threshold of such studies from other settings [11,12,28], which are worth replicating in Nepal by extending the analyses to pharmacists (many of the studies mentioned earlier focus on physicians). Additional research is also needed from outside Kathmandu, where the sale of antibiotics without a prescription is likely higher given weaker supervision by the government, lower education levels among patients as well as pharmacists, and scarcer qualified physicians [29]. All the pharmacies in our survey were within or in the vicinity of Kathmandu Valley. Therefore, the study can be categorised as a 'critical case' [30] – one that reflects the best of circumstances in Nepal.

In the meantime, the study's findings point to a number of general directions for future interventions on AMR reduction. First, the large share of pharmacies who sale antibiotics without prescription suggests the need for aggressive awareness campaigns on AMR. It is critical that the key messages in awareness campaigns are supported by evidence and targeted to conditions for which inappropriate use is highly prevalent; a recent survey in 55 countries suggests that this is currently not the case [31]. In Nepal's context, the messages should speak directly to the overuse of antibiotics in children, as pharmacies were more likely to sell antibiotics to paediatric patients. Relatedly, promoting non-antibiotic alternatives as a part of the information campaigns may simultaneously improve patient satisfaction and reduce AMR.

Second, although we are unable to rule out economic factors conclusively, it is clear that the pharmacies value social factors, such as whether they are seen as complying with the government regulation and whether they are respected as good pharmacies. Future interventions targeted to change pharmacies' behaviour on selling antibiotics should capitalise on these social considerations.

Third, while the focus of the current study was pharmacists, the findings imply that a holistic approach that caters to multiple stakeholders – patients, pharmacists and physicians – is needed to address AMR. Educating the patients on AMR so that they do not ask for antibiotics may provide the pharmacists greater autonomy in determining whether antibiotics are necessary for a particular patient without the fear of losing a customer. A WHO review in 2016 shows that information campaigns

targeted to the general public and parents of young children are substantially lower in LMICs than in high-income countries [32]. A recent study using nationally representative data from eight LMICs, including Nepal, found that a large proportion of *prescriptions* for children below the five years of age was unnecessary [14], suggesting that interventions targeted to physicians are also needed in order to arrest the rising AMR.

The above policies can complement those aimed at reducing the *need* for antibiotics (such as proper handwashing in healthcare settings, which can reduce infections and the need for antibiotics [33]) and ensuring that, when antibiotics are necessary, correct dosage is sold and consumed.

Conclusion

In our study setting in Nepal, inappropriate dispensing of antibiotics by community pharmacists is common, particularly when the patient is a child. Additional research is needed to understand the drivers of this behaviour. In the meantime, our findings speak to the significance of improving awareness and understanding of AMR, including among patients.

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Appendix 1

Table A1 Number of pharmacies by district

District	Total number of pharmacies	Sample	
		Urban	Rural/peri-urban
Kathmandu	947	34	8
Lalitpur	249	30	2
Bhaktapur	85	15	1
Dhading	51	0	10
Kavrepalanchwok	62	4	7
Total		83	28

The table shows the number of pharmacies by district. We aimed to survey 108 pharmacies. At the time of the sample selection, we added three additional pharmacies. All of these pharmacies either agreed to participate in the study or we were able to find a replacement pharmacy nearby. The total number of pharmacies is based on the list available from the Nepal Chemist and Druggist Association.

Appendix 2

Survey Questionnaire

1. Demographics	
1.1 Gender	Male [1] Female[2]
1.2 Age	
1.3 Education	Pharm Certificate [1] Pharm Diploma [2] Other [98]
1.4 Education other (Pharmacy)	
1.5 Education other (non-Pharmacy)	
1.6 Year completed education	
1.7 Years working as pharmacist	
2. Pharmacy	
2.1 Type of pharmacy	Stand-alone [1] Pharmacy + Clinic [2]
2.2 Position at pharmacy	Owner [1] Pharmacy Manager [2] Pharmacy Staff [3] Other [98]
2.3 Position other	
2.4 Number of persons working at the pharmacy	
2.5 Average number of customers / week	
2.6 What percentage of monthly income is from non-pharmaceutical products (e.g. diapers, shampoo, toothpaste)	< 10% [1] 11% to 25% [2] 26% to 50% [3] > 50% [4]
2.7 Common illnesses of customers (rank from 1 [most common] to 5 [least common])	2.7a. Upper Respiratory Infection 2.7b. Gastrointestinal 2.7c. UTI 2.7d Skin/Wound 2.7e STI
3. Dispensing Practices	
3.1 What percentage of your customers requesting antibiotics have a prescription?	<10% [1] 11% to 25% [2] 26% to 50% [3] >50% [4]
3.2 Antibiotics commonly dispensed (rank from 1 [most common] to 6 [least common]	3.2a. Cefixime 3.2b. Ampicillin 3.2c. Azithromycin 3.2d. Cipro 3.2e. Amoxicillin 3.2f. Cephalixin
3.3 How likely is it that you would dispense an antibiotic for the following conditions without a physician's prescription?	
3.3a. Fever in a child	< 10% [1] 11% to 25% [2] 26% to 50% [3] > 50% [4]
3.3b. Fever in an adult	< 10% [1] 11% to 25% [2]

	26% to 50% [3]
	> 50% [4]
3.3c. Cough in a child	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
3.3d. Cough in an adult	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
3.3e. Sore throat in a child	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
3.3f. Sore throat in an adult	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
3.3g. Diarrhoea (lasting more than a day) in a child	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
3.3h. Diarrhoea (lasting more than a day) in an adult	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
4. General Financial Considerations	
4.1 What was the pharmacy's total revenue (note: not profit) this past month?	
	Rs _____ (amount)
4.2 What was the pharmacy's total profit this past month?	
	Rs _____ (amount)
4.3 During the past one month, what percentage of your monthly revenue came from antibiotics? (If the pharmacist does not know, ask for an approximation.)	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
4.4 What percentage of your monthly profits comes from antibiotics? (If the pharmacist does not know, ask for an approximation.)	< 10% [1]
	11% to 25% [2]
	26% to 50% [3]
	> 50% [4]
4.5 Antibiotics that generated the most profits during the preceding one month (rank from 1 [highest amount of profits] to 6 [least amount of profits]	9.5a. Cefixime
	9.5b. Ampicillin
	9.5c. Azithromycin
	9.5d. Cipro
	9.5e. Amoxicillin
	9.5f. Cephalixin
5. Prices and Volume	
5.1 We would now like to ask a few questions about prices. For how much do you sell a tablet of the following antibiotics?	
5.1a. Cefixime	10.1a Rs_____
5.1b. Ampicillin	10.1b. Rs_____

5.1c. Azithromycin	10.1c. Rs_____
5.1d. Cipro	10.1d. Rs_____
5.1e. Amoxicillin	10.1e. Rs_____
5.1f. Cephalixin	10.1f. Rs_____
5.2 How much do you have to pay the supplier for a tablet of the following antibiotics (approximately)?	
5.2a. Cefixime	10.2a Rs_____
5.2b. Ampicillin	10.2b Rs_____
5.2c. Azithromycin	10.2c Rs_____
5.2d. Cipro	10.2d Rs_____
5.2e. Amoxicillin	10.2e Rs_____
5.2f. Cephalixin	10.2f Rs_____
5.3 In the past one month how many tablets of the following antibiotics did you sell from this pharmacy?	
5.3a. Cefixime	10.3a. _____
5.3b. Ampicillin	10.3b. _____
5.3c. Azithromycin	10.3c. _____
5.3d. Cipro	10.3d. _____
5.3e. Amoxicillin	10.3e. _____
5.3f. Cephalixin	10.3f. _____
6. Demand Pressure	
6.1 We would now like to ask a few questions about hypothetical scenarios. How likely is it that you would provide antibiotics to a patient under the following scenarios? (In all cases, assume that the patient has not been to a doctor for this condition and does not have a prescription)	
6.1a. An adult male patient comes to the pharmacy and says, 'I have had a fever and sore throat for two days. Can you sell me some medicine'?	Very likely [4] Likely [3] Not likely [2] Would not give AB [1]
6.1b. An adult brings a child to the pharmacy and says, 'He has had a fever and sore throat for two days. Can you sell us some medicine'?	Very likely [4] Likely [3] Not likely [2] Would not give AB [1]
6.1c. An adult male patient comes to the pharmacy and says, 'I have had a fever and sore throat for two days. Can you sell me antibiotics'?	Very likely [4] Likely [3] Not likely [2] Would not give AB [1]
6.1d. An adult brings a child to the pharmacy and says, 'He has had a fever and sore throat for two days. Can you sell us antibiotics'?	Very likely [4] Likely [3] Not likely [2] Would not give AB [1]

6.1e. An adult female patient comes to the pharmacy and says, 'I have had a fever and sore throat for two days. Can you sell me some medicine'?	Very likely [4] Likely [3] Not likely [2] Would not give AB [1]
6.1f. An adult female patient comes to the pharmacy and says, 'I have had a fever and sore throat for two days. Can you sell me antibiotics'?	Very likely [4] Likely [3] Not likely [2] Would not give AB [1]

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