Household antibiotic use in Malawi: a cross-sectional survey from urban and peri-urban Blantyre

Eleanor E MacPherson[1,2], John Mankhomwa[1], Justin Dixon[3], Raymond Pongolani[1], Mackwellings Phiri[1], Nicholas Feasey[1,2], Thomasena O'Byrne[1,2], Rachel Tolhurst[2], Peter MacPherson[1,2,3,4]

Affiliations

1. Malawi-Liverpool-Wellcome Programme, Malawi
2. Liverpool School of Tropical Medicine, UK
3. London School of Hygiene & Tropical Medicine, UK
4. University of Glasgow UK

Abstract

Background

Antimicrobial resistance (AMR) is a significant threat to public health. Use of antibiotics, particularly in contexts where weaker regulatory frameworks make informal access easier, has been identified as an important driver of AMR. However, knowledge is limited about the ways antibiotics are used in communities in sub-Saharan Africa.

Methods

Between April and July 2021, we undertook a cross-sectional survey of community antibiotic use practices in Blantyre, Malawi. We selected two densely-populated neighbourhoods (Chilomoni and Ndirande) and one peri-urban neighbourhood (Chileka) and undertook detailed interviews to assess current and recent antibiotic use, supported by the innovative "drug bag" methodology. Regression modelling investigated associations with patterns of antibiotic recognition.

Results

We interviewed 217 households with a total of 1051 household members. The number of antibiotics recognised was significantly lower among people with poorer formal health care access (people with unknown HIV status vs. HIV-negative, adjusted odds ratio [aOR]: 0.76, 95% CI: 0.77-.099) and amongst men (aOR: 0.83, 95% CI: 0.69-0.99), who are less likely to support healthcare-seeking for family members. Reported antibiotic use was mostly limited to a small number of antibiotics (amoxicillin, erythromycin and cotrimoxazole), with current antibiotic use reported by 67/1051 (6.4%) and recent use (last 6 months) by 440/1051 (41.9%).

Conclusions

Our findings support the need for improved access to quality healthcare in urban and peri-urban African settings to promote appropriate antibiotic use and limit the development and spread of AMR.

Introduction

Drug resistant infections are increasing worldwide and there is global consensus on the need for urgent action to address antimicrobial resistance (AMR).[1] Optimising the use of antibiotics is one of the central pillars of the WHO global action plan to address AMR.[2] The ramifications of AMR are being more acutely felt in low-and-middle-income countries (LMICs), where there is a higher burden of infectious diseases and health systems are weaker.[3] In low-income contexts where routine diagnostic microbiology facilities are scarce, data on the epidemiology and burden of AMR is limited.[4–6]

In the past two decades, academic and policy research has shown a substantially increased use of antibiotics in LMICs.[7,8] Due to contextual factors including weaker regulatory frameworks and more fragile health systems, antibiotics are often bought over-the-counter, or obtained through informal networks. [9–11] However, research conducted in LMICs has demonstrated that antibiotic use practices, including self-medication, are heterogeneous.[12–14] Do and colleagues (2021) undertook a survey in six countries in Asia and Africa, and found substantial differences in self-medication of antibiotics, with rates lower in Mozambique (8·0%) and South Africa (1·2%) than in Bangladesh (45·7%) and Ghana (36·1%).[14] Torres and colleagues (2020) did a systematic scoping review of self-medication with antibiotics in 10 low- and middle-income countries, and found a prevalence of self-medication in the preceding year that ranged from 8.1% to 93% across countries.[13] Both these studies found that factors shaping self-medication were complex and included access to, and cost and quality of care at health care facilities.[13,14] The diversity in the prevalence of self-medication of antibiotics in different countries underscores the need for accurate national data to guide antibiotic use and AMR policy and practice.

Global antibiotic consumption assessments have primarily relied on pharmaceutical sales records, but this data is frequently unavailable or unreliable, especially in the African region.[15–17] In LMICs, most academic research has been conducted in secondary or tertiary care facilities. While researchers are increasingly investigating antibiotic use in primary health care and community contexts,[12,16,18] there remain significant gaps in knowledge on antibiotic use practices in community settings, with knowledge particularly limited in countries in Southern and Eastern Africa.[13,14] Given the role reduction in antibiotic use (ABU) is expected to play in reducing AMR, generating robust ABU surveillance data is a necessary first step to inform context-specific interventions.[19] This paper aimed to generate data on current antibiotic use in three residential areas in Blantyre, Malawi.

Materials and Methods

Ethics statement

Ethical approval was obtained from the College of Medicine Research Ethics Committee, Malawi (approval number: P06/182429) and London School of Hygiene and Tropical Medicine Research Ethics Committee (approval number: 14617). Permission to work in the study communities was granted by the Blantyre District Health Officer. All participants provided written informed consent to participate.

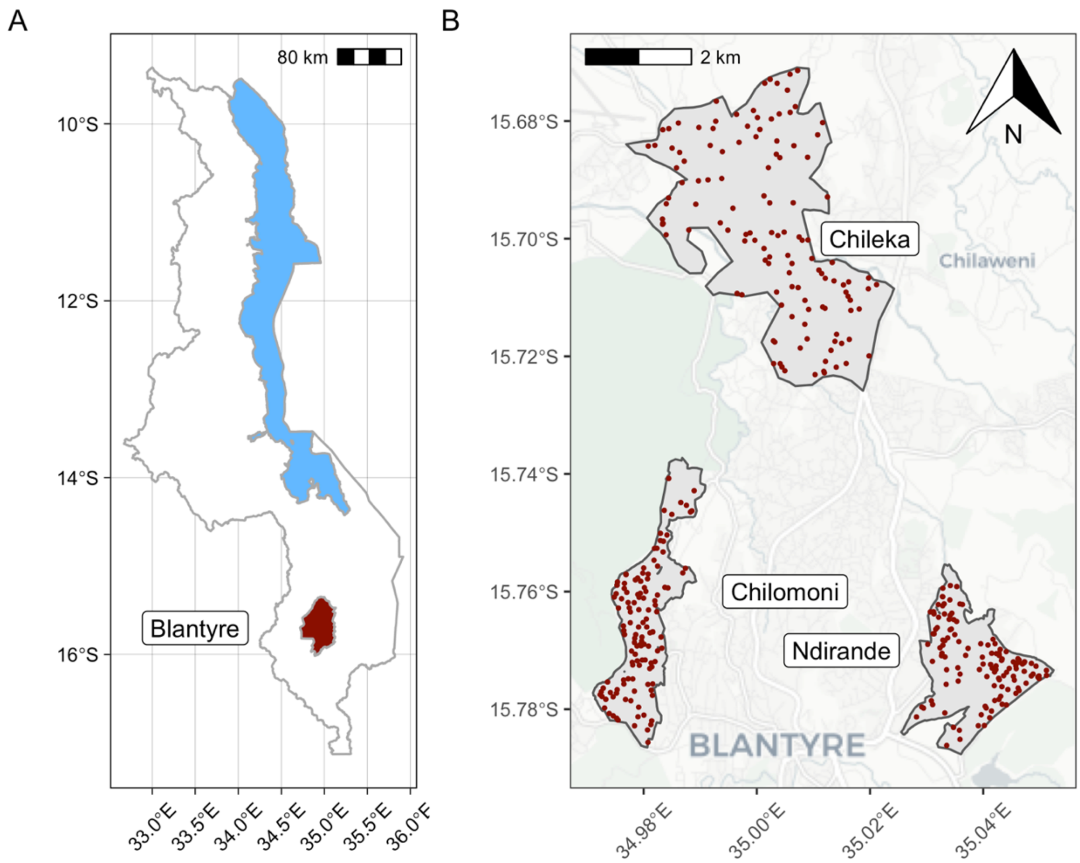
Study Design and Population

Data were collected between April and July 2021. We undertook a cross-sectional survey in two densely-populated neighbourhoods (Chilomoni and Ndirande) and one peri-urban neighbourhood (Chileka) in Blantyre, Malawi. Blantyre is a major commercial centre located in the Southern Region of Malawi. The total population of Blantyre District was estimated to be approximately 1 million people in the 2018 Malawi National Census[20], and adult HIV prevalence is estimated to be 18%[21]. Chilomoni and Ndirande are well-established urban neighbourhoods, with poor access to municipal services, and high rates of household poverty. Chileka is located on the periphery of Blantyre and is characterised by a mixture of recently established peri-urban households and households engaged in subsistence farming.

Participants eligible to take part in the survey were adults (aged 18 years or older) resident in households in either Chilomoni, Chileka, or Ndirande. We excluded households where there was no adult available to complete questionnaires, or where the household head declined consent to participate.

The unit of sampling was the household. To establish a household sampling frame for Chilomoni and Ndirande, we obtained neighbourhood boundaries and used georeferenced household data from a previous population census of these neighbourhoods conducted as part of a cluster-randomised trial of TB and HIV interventions in 2015 (Figure 1). Households were randomly selected within each neighbourhood, with a replacement list for when households declined participation or were not identified. As Chileka was not part of the 2015 trial census, we selected random sets of GPS coordinates from within the neighbourhood boundaries.

Figure 1: Location of households sampled for interview



Procedures

Using GPS coordinates of randomly-selected households in Chilomoni and Ndirande, study fieldworkers navigated to selected households; in Chileka, they navigated to selected locations using GPS coordinates, and identified the nearest household to this point. After identifying the household head and obtaining informed written consent, the fieldworker administered a questionnaire to record demographic and socio-economic characteristics of the household and household head. Data were collected using ODK Collect running on study tablets and uploaded securely in real-time to the Data Server at the London School of Hygiene and Tropical Medicine.

To evaluate household heads' understanding and use of antibiotics, the fieldworker used the "drug bag" method, which comprised of a bag of antibiotics packages and tablets assembled by the team through visiting formal and informal access points for medicines.[22] We adapted this method from anthropological studies we have undertaken exploring medicine use practices in Southern and Eastern Africa.[22] The drug bag was used to facilitate questions to the household head on which antibiotics they recognised (i.e. had ever seen or heard about before), whether antibiotics were currently being used in the household, and more generally about antibiotic use practices in the household (see Supplementary Material). The drug bag helped to overcome linguistic barriers, as 'antibiotic' is a category of medicines that is not readily understood in Malawi.

Statistical Methods

We initially set out to survey 75 households in each of two of the study neighbourhoods (Chilomoni and Ndirande), and subsequentially added the third neighbourhood (Chileka) to allow comparison with this peri-urban neighbourhood.

We summarised household, and household head characteristics by study neighbourhood using counts and percentages, and means and standard deviations, and compared between groups using Chi-square tests and Fisher's exact tests for categorical data, and Student's T test for continuous data. We used a p-value threshold of <0.05 to define a statistically-significant difference between neighbourhoods. Our main study outcomes were antibiotic use and recognition patterns. To investigate this, we summarised the number of household members who reported currently using, or having recently used (within the last 6-months) each antibiotic, and the number of antibiotics recognised by household respondents. To estimate the percentage of the total study population who used and recognised each antibiotic, we divided antibiotics within each category by the total numbers of household members, calculated binomial exact confidence intervals, and compared between study sites. We constructed a multivariable Poisson regression model to investigate associations with the number of antibiotics recognised by household respondents. Analysis was conducted using R v4.1.1 (R Foundation for Statistical Computing, Vienna).

Data and code to reproduce analysis are available at DOI10.17605/OSF.IO/58EKN

Results

In total, 217 households were interviewed and included in this analysis (Table 1). A total of 1051 household members were identified by respondents. Numbers of household residents ranged between 1 and 13, with a median of 5 (interquartile range: 3-6). Numbers of household residents were similar between the three study sites (p=0.771).

Table 1: Characteristics of households and household respondents, by study site

	Chileka (N=74)	Chilomoni (N=67)	Ndirande (N=76)	Total (N=217)	P-value
Household residents total (median per household, IQR)	355 (4, 3-6)	321 (5, 4-6)	375 (5, 3-6)	1051	0.771
Duration residing in site					0.213
Less than one year	2 (2.7%)	6 (9.0%)	7 (9.2%)	15 (6.9%)	
More than one year	72 (97.3%)	61 (91.0%)	69 (90.8%)	202 (93.1%)	
Household respondent male	16 (21.6%)	17 (25.4%)	10 (13.2%)	43 (19.8%)	0.167
Household respondent age, Mean (SD)	38 (16)	38 (12)	37 (13)	38 (14)	0.657
Household respondent occupation					< 0.001
Paid domestic worker	0 (0.0%)	3 (4.5%)	4 (5.3%)	7 (3.2%)	
Paid employee	5 (6.8%)	4 (6.0%)	4 (5.3%)	13 (6.0%)	
Self employed	21 (28.4%)	27 (40.3%)	30 (39.5%)	78 (35.9%)	
Student	1 (1.4%)	1 (1.5%)	1 (1.3%)	3 (1.4%)	
Unemployed	32 (43.2%)	31 (46.3%)	37 (48.7%)	100 (46.1%)	
Other	15 (20.3%)	1 (1.5%)	0 (0.0%)	16 (7.4%)	
Electricity in dwelling	6 (8.1%)	50 (74.6%)	58 (76.3%)	114 (52.5%)	< 0.001
Food sufficient to meet needs	38 (51.4%)	38 (56.7%)	43 (56.6%)	119 (54.8%)	0.759
Self-rated household poverty					< 0.001
1 = poorest in neighbourhood	8 (10.8%)	5 (7.5%)	1 (1.3%)	14 (6.5%)	
2	36 (48.6%)	19 (28.4%)	24 (31.6%)	79 (36.4%)	
3	27 (36.5%)	29 (43.3%)	45 (59.2%)	101 (46.5%)	
4	3 (4.1%)	14 (20.9%)	6 (7.9%)	23 (10.6%)	
5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
6 = richest in neighbourhood	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Household respondent highest education level completed					0.044
Missing	1	0	0	1	
Never been to school	5 (6.8%)	3 (4.5%)	3 (3.9%)	11 (5.1%)	
Primary	43 (58.9%)	22 (32.8%)	29 (38.2%)	94 (43.5%)	
Secondary completed MSCE	2 (2.7%)	7 (10.4%)	8 (10.5%)	17 (7.9%)	
Secondary no MSCE	22 (30.1%)	32 (47.8%)	35 (46.1%)	89 (41.2%)	
Higher	1 (1.4%)	3 (4.5%)	1 (1.3%)	5 (2.3%)	
Household respondent literate	58 (78.4%)	61 (91.0%)	63 (82.9%)	182 (83.9%)	0.119

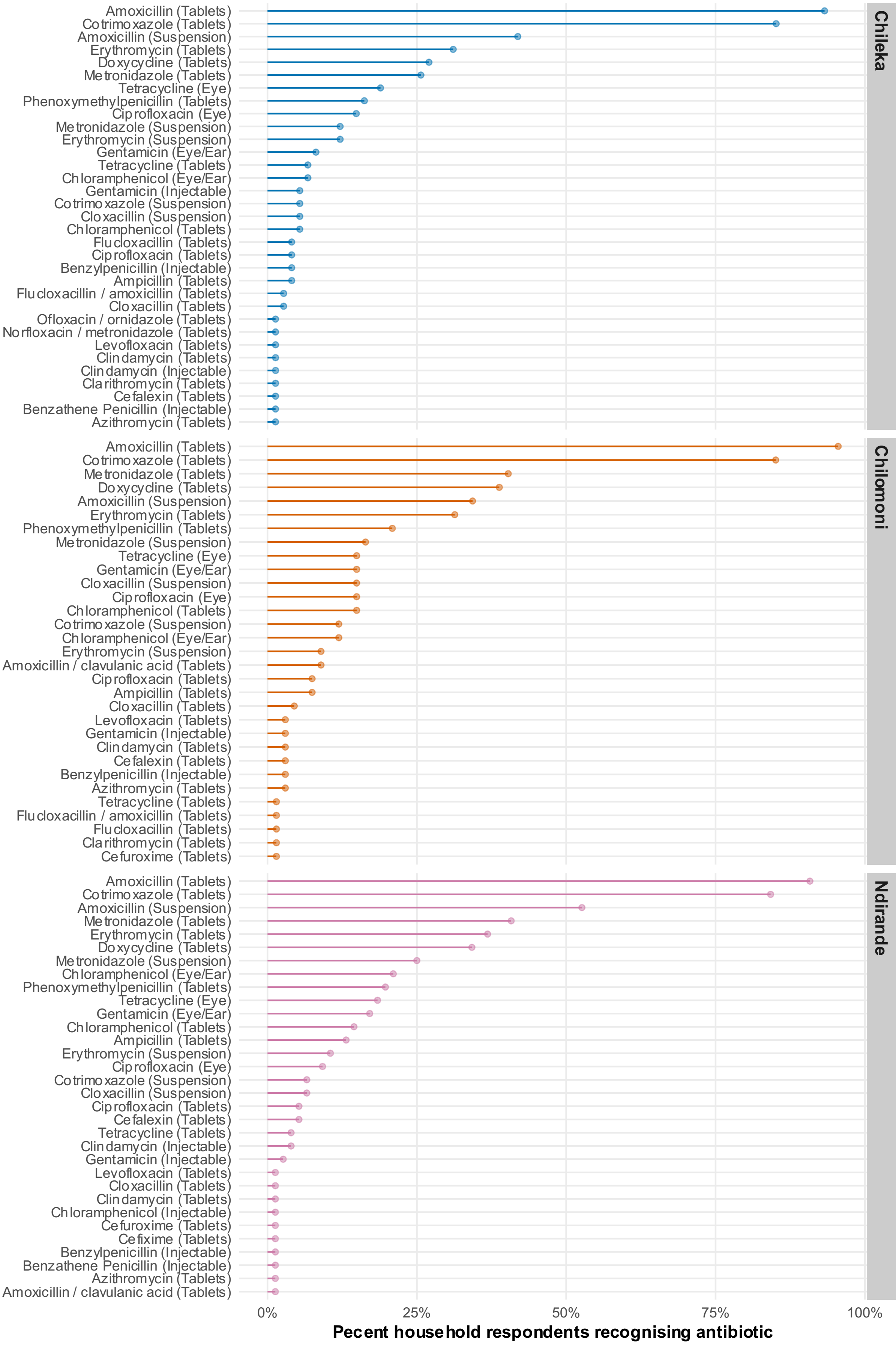
	Chileka (N=74)	Chilomoni (N=67)	Ndirande (N=76)	Total (N=217)	P-value
Household respondent self-rated general health					0.538
Missing	1	0	2	3	
Very poor	2 (2.7%)	0 (0.0%)	0 (0.0%)	2 (0.9%)	
Poor	7 (9.6%)	5 (7.5%)	5 (6.8%)	17 (7.9%)	
Fair	20 (27.4%)	19 (28.4%)	23 (31.1%)	62 (29.0%)	
Good	31 (42.5%)	27 (40.3%)	25 (33.8%)	83 (38.8%)	
Very good	13 (17.8%)	16 (23.9%)	21 (28.4%)	50 (23.4%)	
Household respondent marital status					0.307
Divorced	4 (5.4%)	3 (4.5%)	6 (7.9%)	13 (6.0%)	
Living together as if married	0 (0.0%)	1 (1.5%)	0 (0.0%)	1 (0.5%)	
Married	50 (67.6%)	49 (73.1%)	59 (77.6%)	158 (72.8%)	
Married but not living together	2 (2.7%)	0 (0.0%)	0 (0.0%)	2 (0.9%)	
Never married	7 (9.5%)	3 (4.5%)	3 (3.9%)	13 (6.0%)	
Polygamous marriage	0 (0.0%)	0 (0.0%)	2 (2.6%)	2 (0.9%)	
Separated	3 (4.1%)	2 (3.0%)	1 (1.3%)	6 (2.8%)	
Widowed	8 (10.8%)	9 (13.4%)	5 (6.6%)	22 (10.1%)	
Household respondent previously lost spouse to death					0.704
Missing	1	1	0	2	
Yes	12 (16.4%)	12 (18.2%)	10 (13.2%)	34 (15.8%)	
Household respondent ever tested for HIV previously	68 (91.9%)	64 (95.5%)	70 (92.1%)	202 (93.1%)	0.639
Household respondent HIV status					0.131
HIV-negative	62 (83.8%)	57 (85.1%)	58 (76.3%	177 (81.6%)	
HIV-positive	4 (5.4%)	7 (10.4%)	13 (17.1%)	24 (11.1%)	
Unknown	8 (10.8%)	3 (4.5%)	5 (6.6%)	16 (7.4%)	
Household respondent taking ART (if HIV-positive)	4 (100%)	7 (100%)	13 (100%)	24 (100%)	1.000

The majority of household respondents were female (80.2%), and the mean respondent age was 38 years. Household and household respondent characteristics were similar in Chilomoni and Ndirande, but there were substantial differences between these neighbourhoods and Chileka. Whereas in Ndirande (76.3%) and Chilomoni (74.6%) most households had electricity supplied to the dwelling, in Chileka only 8.1% had electricity ($p<0.001$). 78.4% of household respondents in Chileka reported that they were literate, compared to 91.0% in Chilomoni and 82.9% in Ndirande ($p=0.119$). Reported coverage of HIV testing was very high and similar across neighbourhoods, with 93.1% of household respondents reporting having ever previously tested for HIV (p=0.639 for comparison between sites). Self-reported HIV-positive status was 11.1% overall, and was substantially (but not statistically significantly) lower in Chileka (5.4%) compared to Chilomoni (10.4%) and Ndirande (17.1%), p=0.131. Antiretroviral therapy coverage was 100% among HIV-positive respondents across all three sites.

Antibiotic recognition

Using the drug bag method, household respondents recognised a median of five antibiotics (IQR: 3-6). The median number of antibiotics recognised in Chileka (4, IQR: 3-6) was slightly lower than in Chilomoni (5, IQR:3-6) or Ndirande (5, IQR: 4-6.25), but this was not statistically significant (p=0.1176). The most common antibiotics recognised overall by household respondents were: amoxicillin tablets (202/217, 93.1%, 95% CI: 88.9-96.1%); cotrimoxazole tablets (184/217, 84.8%, 95% CI: 79.3-89.3%); and amoxicillin suspension (94/217, 43.3%, 95% CI: 36.6-50.2%). Patterns of antibiotic recognition were broadly similar between the three study sites (Figure 2).

179 **Figure 2: Household respondent antibiotic recognition, by study site**



180

Associations with recognition of antibiotics

In univariable regression analysis, household respondents from Ndirande (relative risk [RR]: 1.18, 95% CI: 1.02-1.36, compared to Chileka), and from larger households (RR: 1.03, 95% CI: 1.00-1.06 per person increase in household size) recognised a significantly greater number of antibiotics (Table 2). Respondents with unknown HIV status (RR: 0.76, 95% CI: 0.58-0.98) and male household respondents recognised significantly fewer antibiotics than women (0.88, 95% CI: 0.75-1.03) although this was not statistically significant. In multivariable regression, male sex (RR: 0.83, 95% CI: 0.69-0.99) and having unknown HIV status (RR: 0.76, 95% CI: 0.57-0.99) were significantly associated with recognition of fewer antibiotics.

Table 2: Associations with number of antibiotics recognised by household respondent

Variable	Univariate relative risk	95% confidence interval	Multivariable relative risk	95% confidence interval
Site				
Chileka	Ref		Ref	
Chilomoni	1.15	0.99-1.34	1.10	0.94-1.28
Ndirande	1.18	1.02-1.36	1.09	0.94-1.27
Respondent sex				
Female	Ref		Ref	
Male	0.88	0.75-1.03	0.83	0.69-0.99
Respondent age (per year)	1.00	1.00-1.01	1.00	1.00-1.01
Household self-rated poverty status				
Very poor	Ref		Ref	
Poor	0.97	0.75-1.28	0.99	0.76-1.31
Somewhat poor	1.22	0.95-1.59	1.22	0.94-1.61
Somewhat rich	1.12	0.83-1.53	1.17	0.85-1.62
Respondent HIV status				
HIV-negative	Ref		Ref	
HIV-positive	1.11	0.92-1.32	1.03	0.85-1.25
HIV status unknown	0.76	0.58-0.98	0.76	0.57-0.99
Number of household members	1.03	1.00-1.06	1.02	0.99-1.05
Respondent literacy				
Respondent illiterate	Ref		Ref	
Respondent literate	1.10	0.93-1.30	1.01	0.85-1.22

Antibiotic use

Of the 1051 household members, a total of 67 (6.4%, 95% CI: 5.0-8.0%) were reportedly currently taking one of the antibiotics identified within the drug bag (Table 3). The bag included multiple versions of the same antibiotics (active ingredients) to facilitate recognition. Estimates of household members' current antibiotic use were similar between Chileka (22/355, 6.2%, 95% CI: 3.9-9.2%), Chilomoni (20/321, 6.3%, 95% CI: 3.8-9.5%), and Ndirande (25/375, 6.7%, 4.4-9.7%). Only five antibiotics (counted by active ingredient) were identified as being currently taken by household members (Table 2). The antibiotic formulation most commonly reported as currently used was cotrimoxazole tablets (39/1051, 3.7%, 95% CI: 2.7-5.0%), followed by amoxicillin tablets (13/1051, 1.2%, 95% CI: 0.7-2.1%), erythromycin tablets (5/1051, 0.5%, 95% CI: 0.2-1.1%) and amoxicillin suspension (5/1051, 0.5%, 95% CI: 0.2-1.1%).

Table 3: Antibiotic use by household members

Antibiotic	Chileka (N=355) n (%, 95%CI)	Chilomoni (N=321) n (%, 95%CI)	Ndirande (N=375) n (%, 95%CI)
Current use			
Amoxicillin (Suspension)	1 (0.3%, 0.0%-1.6%)	1 (0.3%, 0.0%-1.7%)	3 (0.8%, 0.2%-2.3%)
Amoxicillin (Tablets)	4 (1.1%, 0.3%-2.9%)	5 (1.6%, 0.5%-3.6%)	4 (1.1%, 0.3%-2.7%)
Chloramphenicol (Tablets)		1 (0.3%, 0.0%-1.7%)	
Cotrimoxazole (Tablets)	13 (3.7%, 2.0%-6.2%)	10 (3.1%, 1.5%-5.7%)	16 (4.3%, 2.5%-6.8%)
Doxycycline (Tablets)	1 (0.3%, 0.0%-1.6%)	1 (0.3%, 0.0%-1.7%)	
Erythromycin (Suspension)			2 (0.5%, 0.1%-1.9%)
Erythromycin (Tablets)	3 (0.8%, 0.2%-2.4%)	2 (0.6%, 0.1%-2.2%)	
Used last 6 months			
Amoxicillin (Suspension)	11 (3.1%, 1.6%-5.5%)	7 (2.2%, 0.9%-4.4%)	20 (5.3%, 3.3%-8.1%)
Amoxicillin (Tablets)	44 (12.4%, 9.2%-16.3%)	39 (12.1%, 8.8%-16.2%)	43 (11.5%, 8.4%-15.1%)
Amoxicillin/clavulanic acid (Tablets)		2 (0.6%, 0.1%-2.2%)	
Ampicillin (Tablets)			2 (0.5%, 0.1%-1.9%)
Benzathine Penicillin (Injectable)	1 (0.3%, 0.0%-1.6%)		
Benzylpenicillin (Injectable)		1 (0.3%, 0.0%-1.7%)	1 (0.3%, 0.0%-1.5%)
Cefalexin (Tablets)		1 (0.3%, 0.0%-1.7%)	1 (0.3%, 0.0%-1.5%)
Chloramphenicol (Eye/Ear)	1 (0.3%, 0.0%-1.6%)	2 (0.6%, 0.1%-2.2%)	4 (1.1%, 0.3%-2.7%)
Chloramphenicol (Tablets)		2 (0.6%, 0.1%-2.2%)	2 (0.5%, 0.1%-1.9%)
Ciprofloxacin (Eye)	2 (0.6%, 0.1%-2.0%)	3 (0.9%, 0.2%-2.7%)	1 (0.3%, 0.0%-1.5%)
Ciprofloxacin (Tablets)	2 (0.6%, 0.1%-2.0%)	1 (0.3%, 0.0%-1.7%)	1 (0.3%, 0.0%-1.5%)
Clindamycin (Injectable)			1 (0.3%, 0.0%-1.5%)
Cloxacillin (Suspension)	1 (0.3%, 0.0%-1.6%)		
Cloxacillin (Tablets)	1 (0.3%, 0.0%-1.6%)		
Cotrimoxazole (Suspension)	1 (0.3%, 0.0%-1.6%)	1 (0.3%, 0.0%-1.7%)	1 (0.3%, 0.0%-1.5%)
Cotrimoxazole (Tablets)	47 (13.2%, 9.9%-17.2%)	30 (9.3%, 6.4%-13.1%)	39 (10.4%, 7.5%-13.9%)
Doxycycline (Tablets)	6 (1.7%, 0.6%-3.6%)	7 (2.2%, 0.9%-4.4%)	12 (3.2%, 1.7%-5.5%)
Erythromycin (Suspension)	3 (0.8%, 0.2%-2.4%)		1 (0.3%, 0.0%-1.5%)
Erythromycin (Tablets)	9 (2.5%, 1.2%-4.8%)	11 (3.4%, 1.7%-6.0%)	8 (2.1%, 0.9%-4.2%)
Gentamicin (Injectable)		1 (0.3%, 0.0%-1.7%)	
Gentamicin (Eye/Ear)	1 (0.3%, 0.0%-1.6%)	3 (0.9%, 0.2%-2.7%)	4 (1.1%, 0.3%-2.7%)
Levofloxacin (Tablets)		1 (0.3%, 0.0%-1.7%)	
Metronidazole (Suspension)	4 (1.1%, 0.3%-2.9%)	3 (0.9%, 0.2%-2.7%)	7 (1.9%, 0.8%-3.8%)
Metronidazole (Tablets)	9 (2.5%, 1.2%-4.8%)	9 (2.8%, 1.3%-5.3%)	13 (3.5%, 1.9%-5.9%)
Phenoxymethylpenicillin (Tablets)	1 (0.3%, 0.0%-1.6%)	1 (0.3%, 0.0%-1.7%)	3 (0.8%, 0.2%-2.3%)
Tetracycline (Eye)	1 (0.3%, 0.0%-1.6%)	2 (0.6%, 0.1%-2.2%)	4 (1.1%, 0.3%-2.7%)

Denominators are all reported household members, by site. Binomial exact 95% confidence intervals.
Where cells are blank, household heads reported no use/use in last 6-months of this antibiotic by household members.

Household respondents reported that 440 of the 1051 household members (41.9%) had taken an antibiotic in the last 6-months. The antibiotic formulations that had been reportedly most frequently taken in the preceding 6-months were: amoxicillin tablets (126/1051, 12.0%, 95% CI: 10.1%-14.1%); cotrimoxazole tablets (116/1051, 11.0%, 95%CI: 9.2-13.1%); and amoxicillin suspension (38/1051, 3.6%, 95% CI: 2.6-4.9%). Patterns of reported antibiotic use in the preceding 6-months were broadly similar between the three study sites.

Discussion

The main findings of this detailed cross-sectional survey of community antibiotic use practices in Blantyre Malawi were that current antibiotic use was (67/1051, 6.4%) and recent use (last 6 months) was (440/1051, 41.9%). Both current and recent antibiotic use were limited to a small number of antibiotic formualtions, with amoxicillin and cotrimoxazole being the most frequently recognised and used. Both antibiotics are classified as “access” on the WHO’s Access, Watch, Reserve (AWaRe) list, meaning they are commonly used to treat infections and should be clinically available at all times [23]. In contexts such as Malawi, cotrimoxazole is commonly used for chemoprophylaxis for people living with HIV, and with HIV prevalence in the study populations being high, it is not surprising that this was one of the most commonly used and recognised antibiotic. In contrast, the number of antibiotics recognised was significantly lower among people less likely to access formal health services (such as people with unknown HIV status, a strong indicator of delayed healthcare seeking and poor access where testing is widely available), and men, who frequently do not participate in care-seeking activities for families.

Taken together, these findings suggest that, contrary to popular narratives, use of a wide range of antibiotics and antibiotics on the watch or reserve lists was not widespread in these urban and periurban African settings; rather access to a wide range of antibiotics is likely to be limited for the majority of the population, and potentially not a major contributor to so-called “antibiotic overuse”. Nevertheless, antibiotics such as cotrimoxazole, amoxicillin, and erythromycin have broad spectrum action, and dependence on these antibiotics for community management of illness is associated with generation of resistance. Therefore, ABU and AMR guidance must recognise the healthcare and sociological context within which recommendations are made; improvements in universal healthcare access (including treatment of infection) should be accompanied by high quality surveillance and antibiotic use data, supported by interrogation of social narratives around the determinants of antibiotic use.

In Malawi and similar settings in Southern and Eastern African countries, primary health care facilities are an important source of community care, with services provided free, [24] but delivered under severe resource constraints with high rates of stockouts of many essential medicines.[25,26] International donor programmes play a significant role in funding services, and infectious diseases have received comparably more resources.[27] The provision of cotrimoxazole by the HIV programme at primary care clinics may explain why it is well recognised and used within households.[25] A multi-site study exploring household antibiotic use in Zimbabwe, Malawi and Uganda identified differences in the profile of ABU, with cotrimoxazole being the most frequently used in rural Malawi, amoxicillin in Harare, Zimbabwe, and metronidazole within informal settlements in Uganda.[28] Most differences in use reflected differences in the configuration of the health system and antibiotic supplies.

In Malawi, gender power relations shape household care seeking practices, with men often presenting at health care facilities critically ill, and having delayed diagnosis of diseases of major public health importance, particularly HIV and tuberculosis.[29] Women spend considerably more time than men seeking care and supporting household members to seek care.[30] These factors are likely to explain why women had better recognition and use of antibiotics. While government health care facilities provide care without user fees, care seeking incurs costs for transportation and loss of time from other livelihood activities.[31]

Improving access and removing economic barriers to care seeking, are likely to be important interventions to improve the community management of febrile illness, both to improve recognition of severe illness requiring antibiotics with referral to hospital where required, and to restrict unnecessary ABU.

Global public engagement campaigns to improve awareness of antimicrobial resistance have focused predominantly on communicating the need to stop people from indiscriminately using antibiotics with insufficient attention paid to the issues of access.[32] Our findings demonstrate frequent use of a very limited number of antibiotic formulations in the preceding six months, however in a context where febrile illness is common and presentation to health care facilities is late, and diagnostics are few, this may represent appropriate prescribing. Indeed, this may instead speak to the need to improve access to and quality of health care services, not limit access, particularly for the most economically disadvantaged groups.

The limitations of this study include the potential for social desirability bias, whereby household respondents may state that they recognised or used antibiotics to meet interviewer's expectations. We mitigated against this by using our innovative and previously validated "drug bag" methodology and experienced field interviewers. The drug bag uses a wide range of antibiotics available in the community; however it is possible that we did not include some important formulations, or that packaging designs have changed, limiting recognition. The concept of an "antibiotic" is not well understood in Malawi and has no specific Chichewa word, potentially hindering accurate recall of use and recognition. We randomly sampled households from a community sampling frame to minimise sampling bias; nevertheless, women were over-represented, perhaps because men may not have been available for interview, or at work. We may therefore have underestimated antibiotic use and recognition.

In conclusion, we found patterns of current and recent antibiotic use and recognition among randomly-sampled household members in Blantyre, Malawi to be limited to a small number of broads-spectrum antibiotic formulations. People known to have poorer access to healthcare reported recognising fewer antibiotics. So-called “antibiotic overuse” – specifically of antibiotics on the watch list – is unlikely to be a major driver of antimicrobial resistance and drug resistance infections in this and similar settings. Rapidly reducing generation of antibiotic resistance and drug resistant infection in low-income settings in Africa will require a shift of focus, away from narratives that blame people in precarious living conditions for “antibiotic overuse” and instead towards holistic approaches that address the underlying systemic drivers of AMR, whilst recognising and supporting antibiotic access within well-functioning health systems.

Acknowledgements

We are grateful to all study participants who took part in this study and to the DRUM Consortium.

Funding

This study was funded by AMR Cross-Council Initiative through a grant from the Medical Research Council MR/S004793/1. MLW is funded by Wellcome Asia and Africa Programme Grant 206545/Z/17/Z. PM is funded by Wellcome (206575/Z/17/Z). For the purpose of open access, the author has applied a CC BY public copyright licence to any Author Accepted Manuscript version arising from this submission.

References

1. WHO,. New report calls for urgent action to avert antimicrobial resistance crisis. World Health Organization. Published 2019. Accessed July 27, 2021. https://www.who.int/news/item/29-04-2019-new-report-calls-for-urgent-action-to-avert-antimicrobial-resistance-crisis

2. WHO,. *WHO: Global Action Plan on Antimicrobial Resistance*. World Health Organization; 2015. Accessed August 11, 2020. http://www.who.int/antimicrobial-resistance/publications/global-action-plan/en/

3. Cox JA, Vlieghe E, Mendelson M, Wertheim H, Ndegwa L, Villegas MV, Gould I, Levy Hara G. Antibiotic stewardship in low- and middle-income countries: the same but different? *Clinical Microbiology and Infection*. 2017;23(11):812-818. doi:10.1016/j.cmi.2017.07.010

4. Jasovský D, Littmann J, Zorzet A, Cars O. Antimicrobial resistance—a threat to the world's sustainable development. *Upsala Journal of Medical Sciences*. 2016;121(3):159-164. doi:10.1080/03009734.2016.1195900

5. Laxminarayan R, Duse A, Wattal C, Zaidi AKM, Wertheim HFL, Sumpradit N, Vlieghe E, Hara GL, Gould IM, Goossens H, Greko C, So AD, Bigdeli M, Tomson G, Woodhouse W, Ombaka E, Peralta AQ, Qamar FN, Mir F, Kariuki S, Bhutta ZA, Coates A, Bergstrom R, Wright GD, Brown ED, Cars O. Antibiotic resistance-the need for global solutions. *Lancet Infect Dis*. 2013;13(12):1057-1098. doi:10.1016/S1473-3099(13)70318-9

6. Iskandar K, Molinier L, Hallit S, Sartelli M, Hardcastle TC, Haque M, Lugova H, Dhingra S, Sharma P, Islam S. Surveillance of antimicrobial resistance in low-and middle-income countries: a scattered picture. *Antimicrobial Resistance & Infection Control*. 2021;10(1):1-19.

7. Klein EY, Van Boeckel TP, Martinez EM, Pant S, Gandra S, Levin SA, Goossens H, Laxminarayan R. Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. *Proceedings of the National Academy of Sciences*. 2018;115(15):E3463-E3470.

8. Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, Laxminarayan R. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. *The Lancet infectious diseases*. 2014;14(8):742-750.

9. WHO,. Antibiotic resistance: Key facts. World Health Organization. Published 2020. Accessed June 24, 2020. https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance

10. Sartelli M, C Hardcastle T, Catena F, Chichom-Mefire A, Coccolini F, Dhingra S, Haque M, Hodonou A, Iskandar K, Labricciosa FM. Antibiotic use in low and middle-income countries and the challenges of antimicrobial resistance in surgery. *Antibiotics*. 2020;9(8):497.

11. Wilkinson A, Ebata A, MacGregor H. Interventions to Reduce Antibiotic Prescribing in LMICs: A Scoping Review of Evidence from Human and Animal Health Systems. *Antibiotics*. 2018;8(1):2. doi:10.3390/antibiotics8010002

12. Yeika EV, Ingelbeen B, Kemah B, Wirsiy FS, Fomengia JN, Van der Sande MA. Comparative assessment of the prevalence, practices and factors associated with self-medication with antibiotics in Africa. *Tropical Medicine & International Health*. 2021;26(8):862-881.

13. Torres N, Chibi B, Middleton L, Solomon V, Mashamba-Thompson T. Evidence of factors influencing self-medication with antibiotics in low and middle-income countries: a systematic scoping review. *Public health*. 2019;168:92-101.

14. Do NT, Vu HT, Nguyen CT, Punpuing S, Khan WA, Gyapong M, Asante KP, Munguambe K, Gómez-Olivé FX, John-Langba J. Community-based antibiotic access and use in six low-income and middle-income countries: a mixed-method approach. *The Lancet Global Health*. 2021;9(5):e610-e619.

15. Hamers RL, van Doorn HR. Antibiotic consumption in low-income and middle-income countries. *The Lancet Global Health*. 2018;6(7):e732.

16. Sulis G, Adam P, Nafade V, Gore G, Daniels B, Daftary A, Das J, Gandra S, Pai M. Antibiotic prescription practices in primary care in low- and middle-income countries: A systematic review and meta-analysis. Kruk ME, ed. *PLoS Med*. 2020;17(6):e1003139. doi:10.1371/journal.pmed.1003139

17. Allwell-Brown G, Hussain-Alkhateeb L, Sewe MO, Kitutu FE, Strömdahl S, Mårtensson A, Johansson EW. Determinants of trends in reported antibiotic use among sick children under five years of age across low-income and middle-income countries in 2005-17: a systematic analysis of user characteristics based on 132 national surveys from 73 countries. *International Journal of Infectious Diseases*. Published online 2021.

18. Frost I, Kapoor G, Craig J, Liu D, Laxminarayan R. Status, challenges and gaps in antimicrobial resistance surveillance around the world. *Journal of Global Antimicrobial Resistance*. Published online 2021.

19. Kirchhelle C, Atkinson P, Broom A, Chuengsatiansup K, Ferreira JP, Fortané N, Frost I, Gradmann C, Hinchliffe S, Hoffman SJ, Lezaun J, Nayiga S, Outterson K, Podolsky SH, Raymond S, Roberts AP, Singer AC, So AD, Sringernyuang L, Tayler E, Rogers Van Katwyk S, Chandler CIR. Setting the standard: multidisciplinary hallmarks for structural, equitable and tracked antibiotic policy. *BMJ Glob Health*. 2020;5(9):e003091. doi:10.1136/bmjgh-2020-003091

20. National Statistics Office. 2018 Malawi Population and Housing Census. Accessed September 22, 2021. http://www.nsomalawi.mw/index.php%3Foption%3Dcom_content%26view%3Darticle%26id%3D226:2018-malawi-population-and-housing-census%26catid%E2%80%89%3D%E2%80%898:reports%26Itemid%E2%80%89%3D%E2%80%896

21. Ministry of Health of Malawi. Malawi Population-based HIV Impact Assessment 2015-2016. Published online 2018.

22. Dixon J, MacPherson E, Manyau S, Nayiga S, Khine Zaw Y, Kayendeke M, Nabirye C, Denyer Willis L, de Lima Hutchison C, Chandler CI. The 'Drug Bag'method: lessons from anthropological studies of antibiotic use in Africa and South-East Asia. *Global health action*. 2019;12(sup1):1639388.

23. WHO,. WHO | WHO releases the 2019 AWaRe Classification Antibiotics. WHO. Published 2019. Accessed November 19, 2020. http://www.who.int/medicines/news/2019/WHO_releases2019AWaRe_classification_antibiotics/en/

24. Makwero MT. Delivery of primary health care in Malawi. *Afr j prim health care fam med*. 2018;10(1). doi:10.4102/phcfm.v10i1.1799

25. MacPherson EE, Reynolds J, Sanudi E, Nkaombe A, Phiri C, Mankhomwa J, Dixon J, Chandler CIR. Understanding antimicrobial resistance through the lens of antibiotic vulnerabilities in primary health care in rural Malawi. *Global Public Health*. Published online December 21, 2021:1-17. doi:10.1080/17441692.2021.2015615

26. Wild L, Cammack D. The supply and distribution of essential medicines in Malawi. Published online 2013.

27. Page S. The Development Aid Situation in Malawi. In: *Development, Sexual Cultural Practices and HIV/AIDS in Africa*. Springer; 2019:43-60.

28. Dixon J, MacPherson EE, Nayiga, S, Manyau S, Nabirye C, Kayendeke M, Sanudi E, Nkoambe, A, Mareke, P, Sithole, K, de Lima Hutchison C, Bradley, J, Yeung S, Ferrand R, Lal S, Roberts C, Green, E, Denyer Willis, Laurie, Staedke, S, Chandler CIR. A Mixed-Methods, Multi-Country Analysis of Household Antibiotic use in Malawi, Uganda and Zimbabwe. *BMJ Global Health*. 2021;6(e006920).

29. Chikovore J, Hart G, Kumwenda M, Chipungu GA, Corbett L. 'For a mere cough, men must just chew Conjex, gain strength, and continue working': the provider construction and tuberculosis care-seeking implications in Blantyre, Malawi. *Global Health Action*. 2015;8(1):26292. doi:10.3402/gha.v8.26292

30. Yeatman S, Chamberlin S, Dovel K. Women's (health) work: a population-based, cross-sectional study of gender differences in time spent seeking health care in Malawi. *PLoS One*. 2018;13(12):e0209586.

31. Abiiro GA, Grace, MB, De Allegri M. Gaps in universal health coverage in Malawi: A qualitative study in rural communities. *BMC Health Serv Res*. 2014;14(1):234. doi:10.1186/1472-6963-14-234

32. Glover R, Chandler C, Manton J. The benefits and risks of public awareness campaigns: World Antibiotic Awareness Week in context. *The BMJ Opinion*. Published online 2019.