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Antimicrobial storage and antibiotic knowledge in the community: a cross-sectional pilot study in north-western Angola

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SUMMARY

Background: Antimicrobials are drugs that were once lifesavers and mainly curative. Nowadays their value is increasingly under pressure because of the rapid and worldwide emergence of antimicrobial resistance, which, in low-resource settings, frequently occurs in microorganisms that are likely to be transmitted in the community.
Methods: This was a cross-sectional pilot study including 102 households within the 10th Health and Demographic Surveillance System round in Dande, Bengo Province, Angola.
Results: Of the total 102 households piloted, 79 (77.45%) were urban. Fifty-seven respondents were female (56.44%), and the mean age of the respondents was 39.70 ± 15.35 years. Overall, storage of antimicrobials was found in 55/102 households (53.92%). More than 66% of the antimicrobials stored were prescribed by a health professional and the majority of antimicrobials were bought at pharmacies or at a street market. Penicillin and its derivatives, antimalarial drugs, and metronidazole were the antimicrobials most frequently stored. Households with female respondents reported storing any drugs at home more frequently (82.50%; $p = 0.002$) and also storing antimicrobials more frequently (64.91%; $p = 0.016$) as compared to households with male respondents. Reported use of antimicrobials was significantly higher in urban households (60.76%, 48/79) as compared to rural households (30.43%, 7/23) ($p = 0.010$). Overall, 74 of 101 respondents (73.26%) reported having already heard about antibiotics. The common reasons given for their use were cough and other respiratory symptoms, wounds, flu and body muscle pain, fever, bladder complaints, and diarrhoea and/or presumed typhoid fever. Nearly 40% (28/74) of the respondents thought that antibiotics should be stopped as soon as the person does not feel sick anymore.
Conclusions: Community interventions for appropriate use of antibiotics should be designed with a special focus on women. This should be done through public awareness campaigns and improving access to reliable medical services. Drug prescribers are key not only to appropriate antimicrobial prescription, but also to adequate dispensing, and are strong advocates for the possible misconceptions on antimicrobial usage by lay people.

Introduction

Antimicrobials are drugs that were once lifesavers, mainly curative for meningitis, pneumonia, and other invasive infections, as well as enabling safer childbirth, surgical procedures, and, in high-resource countries, organ transplantation and oncological treatment regimens (Marston et al., 2016). Nowadays their value is increasingly under pressure because of the rapid and worldwide emergence of antimicrobial resistance (AMR).

In low-income countries, AMR frequently occurs in microorganisms that are likely to be transmitted in the community, such as the pathogens causing pneumonia, diarrheal diseases, tuberculosis, sexually transmitted diseases, and malaria (World Health

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Organization, 2017a). This complex health problem is likely associated with various factors, in particular the excessive and inappropriate use of antimicrobials (Laxminarayan and Heymann, 2012). Any antimicrobial use, whether or not appropriate, will cause selective pressure, which may lead to the selection of more resistant pathogens.

A study based on sales data from retail and hospital pharmacies in national sample surveys estimated that the worldwide consumption of antibiotics in healthcare settings over the first decade of the new millennium increased by more than one third (Van Boeckel et al., 2014). In that study, the lack of data for Sub-Saharan Africa was particularly striking. Worldwide, the large majority of antimicrobial use occurs in the community, where such drugs can readily be obtained, even without a prescription (Nga do et al., 2014; Landers et al., 2010; Hoa et al., 2009). Unfortunately in-depth information on antibiotic consumption in the communities worldwide is very scarce, especially in low-resource settings.

It has been shown that storing antimicrobials at home is related to their inappropriate use (Yu et al., 2014; Togoobaatar et al., 2010). It is also known that resource-poor healthcare systems in the developing world tend to use antimicrobials inappropriately more often (Kardas et al., 2005). Angola does not have national antibiotic treatment guidelines and has a lax regulatory system, similar to other developing countries (Laxminarayan and Heymann, 2012; Morgan et al., 2011; Holloway et al., 2016).

The purpose of this pilot study was to describe the first prevalence estimates for antimicrobial storage in the community, explore factors associated with storage, and to assess basic knowledge on antimicrobials among the general public in Bengo Province in the north of Angola. Additionally, this study served as a field test for the adequacy of the data collection tool and planning of human resources and logistics in preparation for a larger study.

Methods

Study area and site

The study was conducted in Bengo Province, about 60 km northwest of Luanda, and covered a total area of approximately 4763.6 km^2 in an area where the Health Research Centre of Angola (CISA) has run the Dande Health and Demographic Surveillance System (HDSS) since 2009. The Dande HDSS initial census covered approximately 60 000 residents living in more than 15 600 households (Sousa-Figueiredo et al., 2012), spread over 70 hamlets, 60% of them located in rural areas. The HDSS aims to provide relevant health, demographic, and socioeconomic data to inform local policies and research on endemic diseases (Fançony et al., 2012; Pires et al., 2013; Magalhães et al., 2012). Agriculture is the main economic activity, attracting some migrant workers from other parts of the country. Fishing in lakes and rivers and charcoal exploitation are also important economic activities. The existing industrial activity is linked to stone and sand extraction, which supplies the construction business. The area is holoendemic for *Plasmodium falciparum* malaria, and the prevalence of HIV among adults aged 15–49 years nationwide was about 2.2% in 2015 (UNAIDS, 2017), with higher prevalence rates in provinces with international borders.

Study design and population

Trained field workers visited a convenience sample of 102 households supervised by the principal investigator. Urban hamlets were classified according to the National Statistical Institute of Angola as agglomerations of 2000 or more inhabitants and a basic infrastructure (Ministério do Planeamento, 2011).

Study visits were performed after a 2-day training programme on the theoretical background of antimicrobials and concepts of resistance, including role-play exercises adapted to the field workers' knowledge about antimicrobials. The term 'antimicrobial' was used for any anti-infective drug (i.e., antibiotics, antivirals, antifungals, anthelmintics, and tuberculostatic drugs). 'Antibiotic' was the term used to test the participants' knowledge on this topic. A standardized questionnaire with questions on knowledge of antibiotics and resistance was filled out during the interview, and the respondents were requested to bring any medication stored at home with them. Verbal informed consent was obtained before the questionnaire was completed. The respondent was any person living in the household at that time, who was aged 16 years or above. The trained field worker collected the name of any medication (drugs themselves and/or prescriptions) and asked whether that drug had been prescribed, whether the posology had been explained, and where it had been bought. A magnifying lens was used to help field workers to retrieve the information from damaged blister strips or prescriptions.

These 102 households were used as a pilot study for an ongoing cross-sectional study through the 10th HDSS round, which started in July 2016 and which was completed at the end of January 2017.

Statistical analysis

Data were analyzed using Stata 14.0 software (StataCorp, College Station, TX, USA). Frequencies and proportions were used to describe the study population in relation to the relevant variables. Odds ratios, 95% confidence intervals, and *p*-values were computed to assess the presence and degree of association between antimicrobial storage and demographic characteristics.

The Chi-square test was used to compare proportions (sex, distance to nearest health facility, place of residence (rural/urban), and literacy) with the consumption of antimicrobials, and a *p*-value of <0.05 was considered statistically significant.

Denominators vary in the analysis because not all respondents answered every question in the survey.

Results

Socio-demographic characteristics

Of the total 102 households piloted, 79 (77.45%) were urban and 23 (22.55%) were rural. Fifty-seven respondents were female (56.44%). The mean age of the respondents was 39.70 ± 15.35 years; 72/99 (72.73%) were able to read. Among the respondents who could provide information on monthly household income, nearly 32% (61/102) declared having less than 10 000 AOA or no monthly household income (100 AOA = 0.55 EUR/0.60 USD).

Storage of antimicrobials

Seventy-two of the 102 households (70.59%) stored any medication at home, and 55 of the 102 households (53.92%) stored antimicrobials. More than 66% of the antimicrobials stored were prescribed by a health professional. More than 60% of the respondents (62/102) had bought the antimicrobials at a pharmacy and 15.68% (16/102) had bought them at a street market.

Penicillin and its derivates, antimalarial drugs and metronidazole are the most frequently antimicrobials stored respectively, 29/102 (28.43%) and 24/102 (23.53%), for antimalarial and metronidazole. Quinolones were reportedly taken in 12.75% of the households (13/102), and chloramphenicol and trimethoprim–sulfamethoxazole in 10.78% (11/102) each.

Households with female respondents reported storing any drugs at home more frequently (82.50%) ($p = 0.002$) and also

Table 1
Factors associated with the storage of antimicrobials in Bengo Province, Angola.

Associated factors	% storage	*p*-Value
Sex		0.016
Female	64.9	
Male	40.9	
Age, years		0.22
≤30	66.7	
30–50	51.3	
>50	45.5	
Place of residence		0.01
Urban	60.8	
Rural	30.4	
Distance from healthcare facility		0.01
≤10 km	60.8	
>10 km	30.4	
Literacy		0.17
Yes	59.7	
No	44.4	

storing antimicrobials more frequently (64.91%) as compared to households with male respondents (Table 1).

Reported use of antimicrobials was significantly higher in urban (60.76%, 48/79) as compared to rural households (30.43%, 7/23) (Table 1). Those who lived near a healthcare facility (i.e., the nearest health facility within 10 km distance) stored antimicrobials more often (48/79, 60.76%) than those who had to travel a long distance to their health facilities (7/23, 30.43%) (Table 1).

Respondents who were able to read stored more antimalarial drugs at home (22/72, 30.56%) as compared to those who could not read (2/27, 7.41%) (Chi-square = 5.73, $p = 0.017$). This association was not statistically significant to the overall storage of antimicrobials (Table 1).

Knowledge on antimicrobial usage and resistance

Overall, 74 of 101 (73.26%) respondents reported having already heard about antibiotics. The common reasons given for the use of antibiotics were cough and other respiratory symptoms (28/74, 37.84%), wounds (22/74, 29.73%), flu and body muscle pain (23/74, 31.08%), fever (14/74, 18.92%), bladder complaints (13/74, 17.57%), and diarrhoea and/or presumed typhoid fever (10/74, 13.51%). Nearly 40% (28/74) of the respondents thought that antibiotics should be stopped as soon as the person does not feel sick anymore, and 42/74 (56.76%) thought they should only stop according to the prescription. Only 13/74 (17.57%) respondents had already heard about antimicrobial resistance, and nearly half of them (6/13) thought that it is the person taking the drugs who becomes resistant to their effects, not the microbes.

Discussion

This appears to be the first study on antimicrobial storage in Angola and one of only a few studies on antimicrobial storage in communities in low-resource settings. The overall storage of antimicrobials in this population was found to be high. Although the questionnaire did not specifically address whether the antimicrobials were used on a second occasion, this is highly probable, as shown previously in other studies performed in similar settings (World Health Organization, 2015; Lv et al., 2014; Biswas et al., 2014a; Ocan et al., 2015; Ding et al., 2015).

There are some limitations to the study findings. First, convenience sampling was applied, thus there is an important risk of selection bias, as most of the households included were located in urban areas in the vicinity of CISA, for logistical reasons. In addition, the questionnaire was applied during the morning hours when women are more frequently found at home, and thus women were more likely to be the household respondent. When asked for stored medication, women were also more likely to retrieve any stored medication, as they are much more involved in housekeeping activities. This might indicate that there are limitations in studying antimicrobial storage at home for male respondents and that a different study methodology is needed to assess the storage of antimicrobials by males. Nevertheless, female respondents and urban households were identified as those more often storing antimicrobials at home.

In contrast to a study performed in Bahir-Dar, Ethiopia (Gebeyehu et al., 2015), in the present study, urban households stored more antibiotics than rural households. This might be related to the fact that this HDSS covers a wider and more dispersed area, which leads to challenges in the exchange of information and basic knowledge on the correct use of antimicrobials, as well as the probable easier access to pharmacies and hospitals for urban households. This 'urban' storage is probably very much aligned with the health-seeking behaviour shown in the present study data, in which more than 60% of the respondents bought antibiotics with a prescription and at pharmacies or hospitals.

The effectiveness of antibiotics is threatened by the antimicrobial resistance that can arise from inappropriate self-medication and incomplete treatment courses (Hoa et al., 2009). In this pilot study, nearly 40% of the respondents thought that treatment should be stopped once the symptoms have subsided. This is a higher percentage than reported in similar studies in China (Wun et al., 2013) and Malaysia (Fatokun, 2014). Studies have shown that this discontinuation might be due to a lack of knowledge and awareness regarding antibiotic use, the nature of the health problems, and the extent of health professional advice (Fatokun, 2014; Grosso et al., 2012; Pechere et al., 2007).

Most of the stored antimicrobials were penicillin and derivatives, metronidazole, and antimalarials. Penicillin consumption is frequently mentioned in other similar studies, including studies from Ethiopia (Gebeyehu et al., 2015; Desalegn, 2013; Fenta et al., 2013; Getachew et al., 2013), Uganda (Ocan et al., 2014), Indonesia (Widayati et al., 2011), and Guatemala (Ramay et al., 2015).

Cough and other respiratory symptoms (37.84%), flu and body muscle pain (31.08%), wounds (29.73%), and fever (18.92%) were the disease symptoms/conditions for which antibiotics were more commonly reported to be used. Respiratory tract infection was also found to be the main driving force for antibiotic usage in Ethiopia (Gebeyehu et al., 2015), Bangladesh (Biswas et al., 2014b), and other Asian countries (Okumura et al., 2002; Bi et al., 2000).

A striking finding was that more than a quarter of the households interviewed reported the usage of antibiotics to combat flu and body muscle pain, signs and symptoms typical of viral diseases. This reinforces the lack of knowledge and awareness of antimicrobial use and the origin of health problems.

Interestingly, those households in which the respondent was more literate stored more antimalarials. Although other studies have found that a lower educational status is associated with inappropriate overall use of antibiotics (Gebeyehu et al., 2015; Awad et al., 2005; Sapkota et al., 2010; Chowdhury et al., 2009; Osemene and Lamikanra, 2012), a statistically significant difference in overall storage of antimicrobials according to the level of literacy was not found in the present study.

The misunderstanding of the participants about antimicrobial resistance is based on their perception that resistance is an attribute of people and not of microbes. Research published by the World Health Organization (WHO) in 2015 showed that three-quarters of people in poor and middle-income countries misunderstood the problem that way (World Health Organization, 2015).

This study was planned as a pilot test. By the time a full assessment HDSS round is complete, it is expected that a clearer

picture of overall antimicrobial storage in this community will be obtained, and associations with certain factors such as household income, number of family members per household, literacy, and age will be performed. It is also intended to determine any associations between knowledge on antimicrobials and their storage. The current study is part of a larger project that aims to assess and improve knowledge, attitudes, and practices towards antimicrobial use, using sales data from pharmacies, hospital-based point prevalence studies, in-depth interviews at markets, and focus group discussions with doctors, nurses, and teachers, leading to a broader assessment of this public health problem.

As a cross-sectional study, it was not possible to check for temporal or geographical trends. The recall period, which was placed within the context of the recent yellow fever outbreak and high all-cause mortality in Angola (World Health Organization, 2017b), as well as the methodology used, probably allowed for a higher percentage of antimicrobial storage than WHO reports for similar settings. Nevertheless, it is believed that this figure may be reliable as a benchmark for antimicrobial storage in low-resource settings. Additionally, storage of antimicrobials at home may end in self-medication at any time. Access to health services, in particular the feeling of satisfaction/dissatisfaction, was not assessed. This variable has been shown as one of the predictors of inappropriate antibiotic use (Gebeyehu et al., 2015; Fernandes et al., 2014; Spellberg, 2014). Before this pilot study, a theoretical background was given to the field workers, routine meetings were held with the field workers during the HDSS round, a structured questionnaire was developed, and a magnifying lens was provided to improve information gathered from damaged blisters. Nevertheless, the use of medical jargon was inevitable, which might have made it difficult to retrieve the correct names for these medications.

In spite of these limitations, it is believed that this pilot study followed by the ongoing study of the 10th Dande HDSS round will provide information of unique significance regarding the prevalence of antimicrobial storage in Angolan communities, which could boost research in inter-related areas. It could also help the drug regulatory authorities in Angola to implement restrictions for the supply and demand chain of these drugs, as well as be helpful in the design and setting up of targeted education campaigns.

In conclusion, this pilot study revealed a high proportion of antimicrobial storage in households in Dande, Bengo Province, in particular in urban households and households where women were responsible. A high discontinuation rate of the treatment course was also found, as well as a high proportion of prescription and pharmacy-driven health-seeking behaviour and an almost unacknowledged concept of antimicrobial resistance. The ongoing 10th HDSS round study will hopefully give a clearer picture of the situation.

Community interventions for the appropriate use of antibiotics should be designed with a special focus on women, through public awareness campaigns and improving access to reliable medical services. Drug prescribers are key not only to appropriate antimicrobial prescription, but also to adequate dispensing, and are strong advocates for the possible misconceptions on antimicrobial usage by lay people.

Conflict of interest

The authors declare that they have no competing interests.

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