

Full Length Research Paper

Determinants of antimicrobial use in diarrhoea management among under-five children in Zomba, Malawi

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Diarrhoea is one of the most common infections that under-five children suffer from across the world. Antibiotics remains one of the common measures used to treat the infection, which has led to increased usage; nevertheless, the extent to which an individual is prompted to use antibiotics in managing diarrhoea in the Malawian setting is not clearly known. This study was aimed at establishing the factors that prompt mothers/caregivers to use antibiotics in treating childhood diarrhoea. Women/caregivers with under-five children who suffered from diarrhoea two weeks before the study were recruited for the interviews (n=269). One-on-one interviews were conducted using a structured questionnaire and two focus group discussions were carried out to generate qualitative data. Quantitative data was entered in CSPro version 7 and exported to STATA version 12 for analysis. The study established that caregivers use antibiotics in managing diarrhoea due to long distances to the health facility (OR 1.93, 95% CI: 1.03-3.65; P<0.04), unavailability of drugs at the facility (OR 1.12, 95% CI: 0.60-2.10; P<.71), quality of medical care at the health facility (OR 1.11, 95% CI: 0.57-2.15; P<.75) and previous knowledge of the diarrhoea condition (OR 0.90, 95% CI: 0.49-1.66; P<.74). As a result of these findings, Government of Malawi should consider widening access to health facilities to its citizens such that citizens are encouraged to always visit the healthy facilities. Healthy professionals should always encourage caregivers to refrain from engaging in self-medicational behavior as it has devastating effects on increased drug usage which contributes to anti-microbial resistance.

Key words: Diarrhoea, under five children, anti-microbial, resistance, self-medication, over the counter, determinants, prescription.

INTRODUCTION

Diarrhoea is defined as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual (Le Doare et al., 2015). Diarrhoeal disease is the second important cause of under-five mortality, and is liable for death of around 760,000 children every year (Carvajal-Vélez et al., 2016). Despite the fact that diarrhoea related mortality has

reduced over the years in developing countries (including Malawi), morbidity as a result of diarrhoeal disease continues to remain the main cause of misery among young children (Alam et al., 2011; Munos et al., 2010). Across the globe, diarrhoea is one of the most common infections that children below the age of five suffer from (Akinnibosun and Nwafor, 2015).

Infectious diseases (including diarrhoea) are a leading cause of illness and death throughout the world. The enormous diversity of microbes combined with their ability to advance and adapt to changing environments, populations, practices, and technologies produce ongoing threats to health and repeatedly challenges researcher's noble efforts of preventing and controlling infectious diseases (Awad and Aboud, 2015). Since children are still developing immunological systems and among the parents there is a poor sense of hygiene, these children are prone to many infections, the most common among them being diarrhoea and Acute Respiratory Infection (ARI). Diarrhoeal diseases in under-five children are a source of anxiety, misery and loss of time to their parents, as compared to their older siblings in which the course of disease is mild (Unicef/WHO, 2004).

Diarrhoeal disease can be prevented by simple measures like personal hygiene and environmental sanitation; nonetheless, antibiotic therapy remains one of the common measures used to curb the disease despite the presence of less invasive solutions such as the Oral Rehydration Salts which are key remedies in treating childhood diarrhoea (Padhy et al., 2017; Mahapatra et al., 2015; Gwimile et al., 2012). This key role of antibiotics has contributed to high usage of antibiotics in management of diarrhoea which is contributing to increased cases of antimicrobial resistance (Padhy et al., 2017; Alghadeer et al., 2018). Oral Rehydration Salts (ORS) and Zinc supplementation during diarrhoea illness has been shown to reduce the duration and severity of diarrhoea episodes in many countries which in the long run reduces morbidity and mortality among under-five children (Carvajal-Vélez et al., 2016). Communities need to be encouraged to use ORS in management of diarrhoea related illnesses which has been proved to be very effective in counteracting rotavirus which in the long run will reduce overuse and misuse of antibiotics.

In a study conducted in Thailand where there was low antibiotic usage in treating diarrhoea, the decision not to use antibiotics was driven by medical professionals (Carvajal-Vélez et al., 2016). In other similar studies conducted across the globe, the decision to use antimicrobials was triggered by mother's/caregiver's knowledge of the previous medical condition without visiting a healthcare facility (Gera et al., 2016; Ocan et al., 2014a; Chalovich and Eisenberg, 2013). Other researchers established that the use of antibiotics was influenced by quality of care at the facility, attitude of the medical personnel, availability of drugs at the facility, education level and marital status of the mother (Yadesa et al., 2015; Shafie et al., 2018). It is against this background that there was a need to establish the

determinants of antimicrobial use towards management of diarrhoeal disease among under-five children in urban areas of Zomba District, which will be more specific to the Malawian setting.

METHODS

Study population

Women/caregivers having under-five children who suffered from diarrhoea two weeks before the study were recruited. Mothers/caregivers whose child did not suffer from diarrhoea two weeks before the study were excluded. For the purpose of this study, a caregiver is someone who "feeds and watches over the child, gives the child affection, communicates with the child, and responds to the child's needs. If the child is sick, the caregiver is usually the person who takes the child to a health-care provider (WHO, 2012)".

Study site

The study was conducted at four health facilities that are located in Zomba City which include; Sazi, Matawale, Police and City Clinic (Figure 1). One-on-one interviews were used to generate quantitative data and two focus group discussions were done to generate qualitative data. In some cases, the mothers/caregivers were followed in areas where an outreach clinic was conducted. The individual interviews were done on a one-on-one basis in an isolated environment to ensure that other eligible participants were not swayed by any bias.

Sampling

The sample size was 264 which was derived using the following formula:

$$n = \{z^2 (1-p) p\}/e^2$$

Where; n= required sample size; Z= level of probability that the true prevalence lies within the chosen confidence interval at 95%; P= prevalence of diarrhoea (22%) according to MDHS, 2016; e= level of precision required/margin error at 5% (standard value of 0.05). So if P = 0.22; e = + or -5% Z = 1.96 = 1.962 (1-0.22)0.22/0.052 = 263.687 \implies 264 mothers

A total of 269 (which slightly above the required sample size) mothers/caregivers were interviewed during one-on-one interactions.

Ethical consideration

Zomba City Council and Zomba District Health Office provided a signed approval to conduct the study in the district. Furthermore, ethical approval was sought from College of Medicine Research and Ethics Committee (COMREC) and a signed consent was sought from study participants before the interview.

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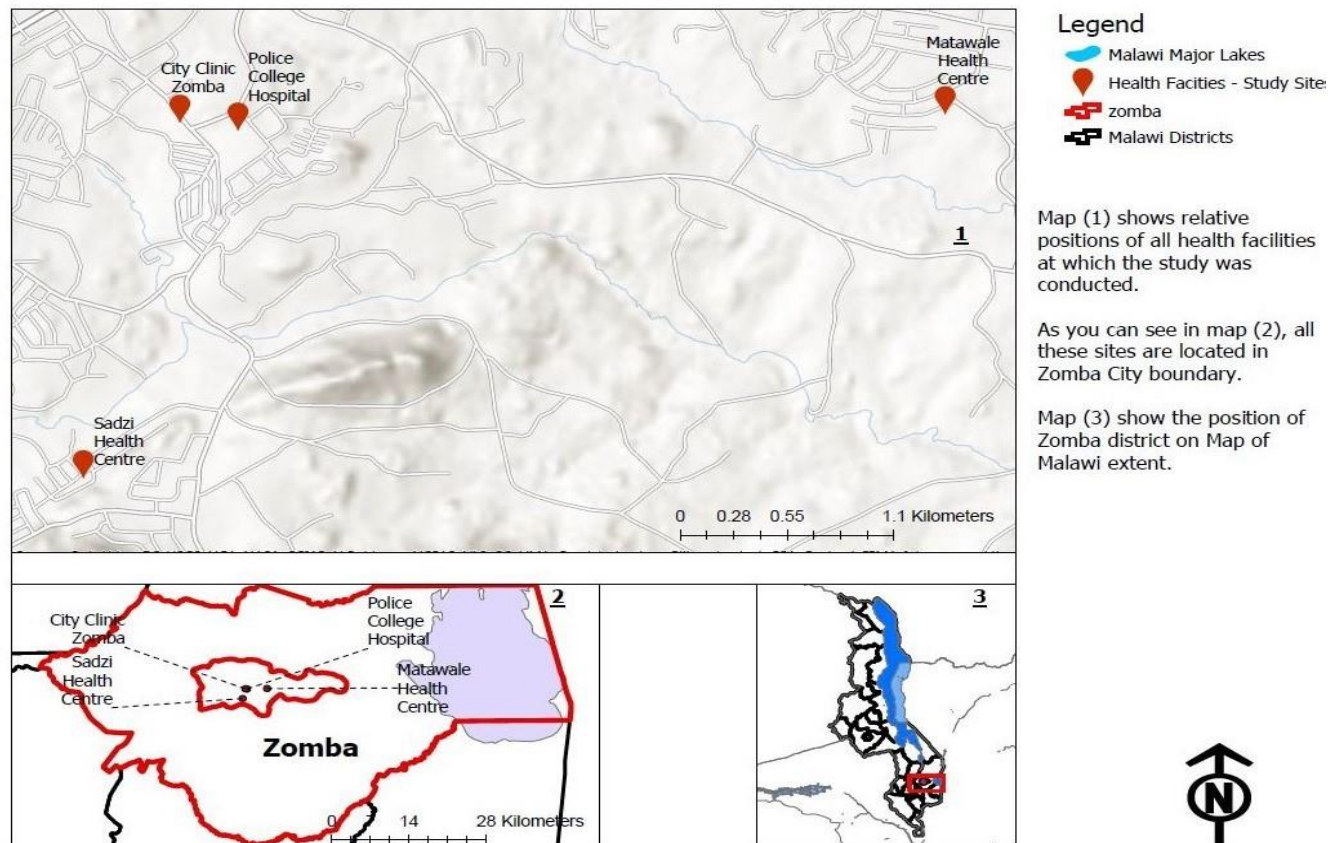


Figure 1. Map of Zomba district showing health facilities where the study was conducted.

Data analysis

Quantitative data

Data which was collected using a questionnaire was entered in CSPro version 7.0 and exported to STATA version 12 for analysis. Research Assistants were adequately trained to capture correct data and the principal investigator checked the quality of data each day and addressed all inconsistencies before passing it on to the Data Entry Clerk. The data was protected with a password to ensure that it was not altered which may affect its validity. After data entry which was entered in (CSPro which has built in checks for accuracy and validity) the principle investigator cleaned the data before analysis. Descriptive statistics were conducted in order to summarize the data set quantitatively. Multi-variate logistic regression analysis was used to establish with certainty the determinants of antimicrobial use towards management of diarrhoeal diseases.

Qualitative data

This data was generated through Focus Group Discussions (FGDs) using a checklist protocol and analysed by following the Health Belief Model (HBM). An FGD is a guided conversation or a series of interviews with a small group of 6 to 12 people who are conversant with the topic under study (Masadeh, 2012). The qualitative data was transcribed verbatim and transcriptions were re-read to get general sense of the information and reflect on the overall meaning.

A list of commonly emerged topics was made. The main topics mentioned were allocated numbers and organised into appropriate words, phrases and sentences. Main themes were generated and presented in a narrative form. The themes were analysed according to the objectives of the study using a Health Belief Model.

The conceptual framework of HBM

This study used the HBM as a conceptual framework to analyse themes on hygiene and sanitation practices, diarrhoea case management and determinants of antibiotic use. The fundamental principle behind HBM states that behaviour is influenced by individual beliefs or perceptions about the disease and measures available to reduce occurrence of such a disease (Tarkang and Zotor, 2015). As shown in Figure 1, the HBM is rooted among four constructs which are perceived susceptibility, perceived seriousness, perceived benefits and perceived threats/barriers. Over the years, the HBM has been modified to cover other two principles which are motivating factors to take an action and self-efficacy. In this study, the HBM was used to deduce factors that influence mothers/caregivers to use antibiotics in treating childhood diarrhoea.

RESULTS

Eighty eight percent of the study participants indicated that they wash hands at least four critical times, 75% of

Table 1. Hygiene and sanitation practices.

Parameter	Category	[n(%)]
Occasions where hand-washing is practiced	At least four times	237(88)
	Less than four times	32(12)
Hand-washing demonstration	Demonstrated correctly	202(75)
	Did not demonstrate correctly	67(25)
	Nappy	126(47)
Child defecation	Used the Diaper	11(4)
	In his clothes	27(10)
	Defecated in the house	5(2)
	Defecated outside the house	46(17)
Disposal of stool	Defecated in the common toilet	51(19)
	In the toilet	129(48)
	Washed	100(37)
Type of toilet facility	Outside the house	40(15)
	Flash toilet	16(6)
	Pit latrine	253(94)

Table 2. Access to hygiene and sanitation information.

From whom do you access information about hand washing?	Where did you receive the information?		
	At the hospital [n(%)]	Under-5 clinic [n(%)]	Home visits [n(%)]
Medical staff (nurse, clinician)	71(48.86)	66(45.21)	9(6.16)
HSA	26(21.67)	79(65.83)	15(12.50)
Extension worker	0(0.00)	2(66.67)	1(33.33)

the respondents demonstrated correctly when asked to wash hands, 47% of the study participants defecated in the nappy while 17% defecated outside the house. In terms of disposal of stool, 47% of the study participants used the toilet with 15% disposing outside the house. Ninety four had properly constructed pit latrines (Table 1).

In relation to access to hygiene and sanitation information, 49% of the study participants obtain information from the medical staff who are found at the hospital whereas 45% obtain such information from medical staff found at under-five clinic. Sixty-six of the study participants obtain hygiene and sanitation information from Health Surveillance Assistants who are usually found at under-five clinics (Table 2)

As shown in Figure 2, 71% of the study participants used ORS with only 0.2% using herbs, 10% used antibiotics to treat diarrhoea infection.

From Table 3, occupation of the respondents had a p-value of 0.007, Education level had a p-value of 0.08 and marital status had a p-value of 0.70.

As shown in the Table 4, the odds that mothers/caregivers will not go to the health facility because of lack

of drugs at the facility are 1.12 times higher than that they will go to the health facility. The odds of not going to the health facility due to long distances covered are 1.93 times higher compared to the odds of going. The odds of not going to the health facility given that they have previous knowledge of the diarrhoea condition are 10% (1-0.9×100) lower than the odds of going. Finally, yet importantly, the chances that mothers/caregivers will not go to the facility because of poor quality of services are 1.11 times higher than the chances that they will go.

DISCUSSION

Hygiene and sanitation practices

In this study, there was an increase in diarrhoea episodes among children older than 6 months of age (22% as compared to 12% in >6 months of age). Malawians who follow exclusive breast feeding programs from birth to six months were shown to have low episodes of diarrhoea.

This therefore implicates complementary food as a

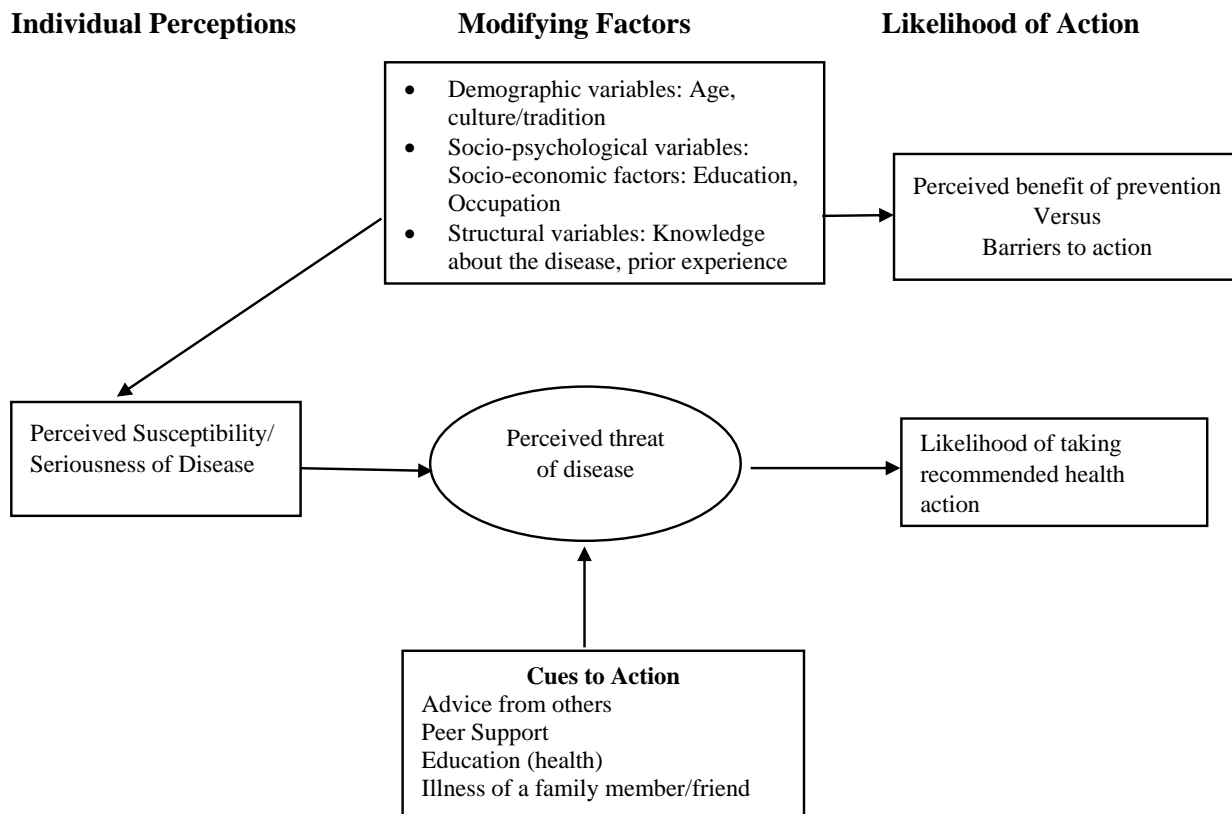


Figure 2. Conceptual Model of HBM. Adapted from Tarkang and Zotor (Shafie et al., 2018).

Table 3. Relationship between demographic characteristics (occupation, marital status, education level) and the motive behind keeping diarrhoea drugs at home.

Source	Partial SS	df	MS	F	Prob > F
Model	140.792	12	11.733	56.67	0.000
Education level	2.003	5	0.401	1.93	0.089
Marital status	0.451	4	0.113	0.54	0.703
Occupation	3.666	3	1.222	5.90	0.007

R²=0.73.

Table 4. Multivariate logistic regression on factors that influence use of antibiotics in treating childhood diarrhoea.

Predictor	Odds ratio	Std. error	z	P>z	95% CI
No drugs at the facility	1.126	0.358	0.37	0.71	0.60-2.10
Long distance to the healthy facility	1.939	0.625	2.05	0.04	1.03-3.65
Knowledge of the medical condition	0.901	0.281	0.33	0.74	0.49-1.66
Quality of care at the facility	1.110	0.374	0.31	0.75	0.57-2.15
Constant	1.639	.408	1.99	0.047	1.01-2.67

possible source of infection. In addition, the child begins to walk which poses a risk of environmental contamination through consumption of non-food items. The declining

levels of maternally acquired antibodies may cause increase in diarrhoea episodes aswell. Relatedly, in the Malawi Demographic and Healthy Survey (2015-2016)

report, children older than six months had increased episodes of diarrhoea than their younger siblings (ICF/NSO, 2017). Since the majority of study participants (82%) in this study were between the ages of 15-34 years, interventions related to hygiene and sanitation should target this age category to minimise a situation where complementary foods become a source of contamination and infection. In addition, this age group should be targeted for use of ORS campaign unlike using antibiotics to treat diarrhoea thereby reducing cases of antibiotic overuse and misuse.

Seventy-six percent of the respondents demonstrated hand-washing practices correctly which implies that the knowledge of hand-washing with soap among the research subjects is generally high. Nonetheless, the remaining 24% is a cause of concern as it poses the potential risk of diarrhoea infection among under-five children which may endanger their general well-being. This situation calls for scale-up of interventions related to water and sanitation hygiene to ensure that the hygiene and sanitation practices are up to standard. Relatedly, the DHS 2015-2016 report found out that the prevalence rate of diarrhoea in urban areas is 24%, which is consistent with the findings of this study that 24% of the study participants did not practice sound hygiene and sanitation measures (NSO, 2015).

In terms of access to hygiene and sanitation information by mothers/caregivers, the results of cross-tabulation established that Health surveillance Assistance (HSA) just like nurses and clinicians are very instrumental in providing such information and that HSAs are very critical at all three levels that is; facility level, under-five clinics as well as during home visits (Table 2). This information is critical in the context of this study in the sense that if the households are well informed about dangers of poor hygiene and sanitation practices in relation to their child's health, they will be committed to minimise pathways for pathogens causing diarrhoea.

This will help in winning the fight against diarrhoea and its associated illnesses. The crucial role played by these HSAs in the provision of primary health care was also emphasised by Masangwi et al (2016) when establishing care-seeking behaviours among mothers/caregivers in southern part of Malawi during diarrhoea (Masangwi et al., 2016).

Management of diarrhoea cases

In relation to managing the diarrhoeal disease, the respondents indicated that Oral Rehydration Salts is mostly used to manage diarrhoea either by prescription from the health professional or through self-medication; which entails buying from drug selling points. Nevertheless, ORS on its own cannot control stomach bugs such that the need to take it concurrently with antibiotics especially during persistent diarrhoea cannot

be overemphasised (Carter et al., 2015). Relatedly, 69% of the respondents indicated that ORS is a common remedy which is used to manage the diarrhoea condition. This agrees with what Masangwi et al (2016) who established that 68% households in southern part of Malawi uses ORS in situations where their child suffers from diarrhoea (Masangwi et al., 2016).

Nonetheless, Flagile and Cotrimoxale were among the common antibiotics that were used by the respondents and mostly such drugs were bought from the shops which contributed to wrong prescription (Figure 3). According to the Health Belief Model (HBM), the perceived benefits of taking the drugs without prescription outweighed the potential cost of drug resistance in the near future as a result of indiscriminate use of antibiotics. Notwithstanding, this might be due to the potential lack of knowledge on the dangers of self-medication without prescription such that a cue to action by a well informed family member can be a recipe for behaviour change.

In terms of the ability of the respondents to notice diarrhoea condition and take an action, 42% of the participants took at least 24 hours which is very detrimental to the health well-being of the child. This delay in medication provides a leeway for faster bacterial multiplication which prolongs the time taken for the child to recover from diarrhoea and may affect its survival. This implies that their ability to detect diarrhoeal disease which in turn affects their response rate is low, such that some mothers/caregivers perceive diarrhoea as mild medical condition which does not warrant seeking medical care (Le et al., 2011; Ayalew, 2017).

During the focus group discussion, there was an indication by some mothers/caregivers (around 30%) that opening of bowels is one of the normal body processes that happens to every child especially when the child is developing teeth which does not require any medical intervention. *"Since time immemorial, children open bowels periodically especially when they are developing teeth as such there is no need for us mothers to go to the hospital to seek medication. This is my third child and the trend remains the same"* (R8). According to the HBM, a person's perceived seriousness of the disease determines the course of action to take such that it was not surprising to note that mothers/caregivers took time to take an action since they regarded diarrhoeal disease as not serious. This augurs well with what Merga and Alemayehu (2015) established that 71% of the mothers associated diarrhoea with the teething process in children such that there is no need to seek any help during diarrhoea episode.

Determinants of antimicrobial use in diarrhoea management

This study found out a number of factors are responsible for use of antibiotics in managing diarrhoeal diseases that

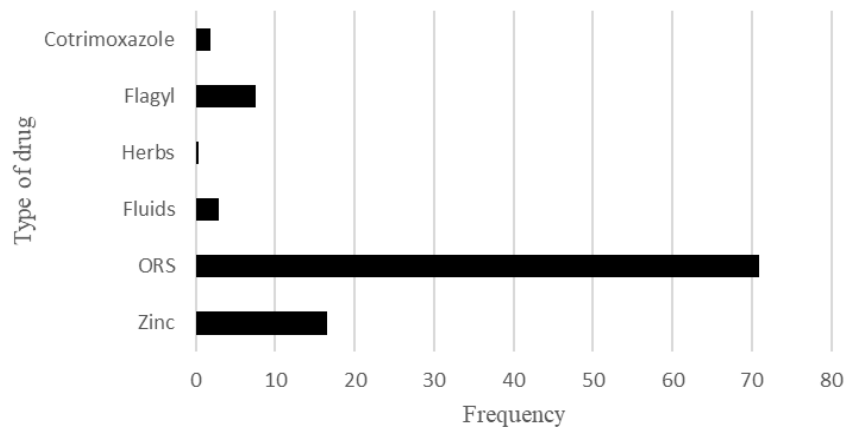


Figure 3. Type of drug used to treat diarrhoea.

were established during one-one-interviews and FGDs. These factors are shortage of drugs at the health facility, previous knowledge of the medical condition, long distance to the health facility, quality of care at the health facility and transportation related challenges.

Furthermore, the study assessed the effect of demographic characteristics which include occupation, marital status and education level on use of antibiotics. On this, a linear regression analysis was computed and that an R^2 value of 73% was found implying that only 27% of the effect independent variables cannot be explained by the dependent variable leading to a statistically significant relationship. Occupation was found to affect self-medication behaviour much more than other demographic factors with a p-value of 0.007 which is less than 0.005 hence significant at 95% confidence interval (Table 3). This implies that employed women were more likely to engage in the purchasing of drugs over the counter than their unemployed counterparts which can be attributed to their high purchasing power.

The shortage of drugs at a health facility was another factor responsible for haphazard use of antibiotics to treat under-five diarrhoea in this study. As shown by the results of multivariate logistic regression above (Table 4), the likelihood that a mother/caregiver will engage in self-medication as a result of shortage of drugs at the facility was 1.12 greater than that of not engaging. This implies that mothers/caregivers were likely not going to visit the health facility despite observing sickness on their child knowing fully that they will not find any medication at the healthy facility. As a result, alternative ways of acquiring drugs like purchasing over the counter which is a form of self-medication were inevitable.

Long distances to the health facility is another factor that significantly influenced caregivers' behavior of using antibiotics without prescription. As observed in the logistic regression model above (Table 4), the likelihood that mothers/caregivers will not visit the health facility as a result of long distance was 1.93 higher than that of

going to the clinic. This implies that mothers/caregiver's will likely not visit the clinic despite their child being presented with diarrhoea. In addition, a p-value of 0.04 (Table 4) which is less than 0.05 is significant at 95% confidence interval confirming that indeed long distance is critical towards illogical use of antibiotics among the study participants. This augers well with responses that were given by the participants when asked "How long does it take for them to travel to the healthy facility" of which 47% indicated having to walk more than one hour to the health facility. This is in support with what other researchers established in similar studies that mothers/caregivers who had to travel more than 10KM to seek medical care mostly resort to self-medication behaviour (Masangwi et al., 2016; Ocan et al., 2014b).

The study participants during the FGD cited lack of money for transport as one of the factors behind irrational use of antibiotics without prescription. This lack of money for transport was exacerbated by long distances that the mothers/caregivers have to cover in order to reach the health posts. "*The distance to the health facility is long so we find it difficult to carry our baby and walk there. This force us to use other methods of treating diarrhoea other than going to the health facility like buying from shops*"(R2). As per the HBM, this transportation issue is a perceived barrier which may hinder a positive health behaviour of always visiting the clinic and may promote usage of drugs bought from shops contributing to antibiotic resistance.

Another factor responsible for use of antibiotics in the face of childhood diarrhoea is knowledge of the medical condition by the mother/caregiver. As seen in Table 4, the likelihood that mothers/caregivers will engage in self-medication behaviour due to their knowledge of the medical condition was 10% (1-0.9x100) lower than that of going. Despite this being the case, the results of the FGD and findings from other researchers revealed that previous knowledge of the diarrhoea condition which was obtained from the health facility, pharmacist and from

family and friends had a greater influence on the ability of the mothers/caregivers to administer drugs on their own (Masangwi et al., 2016; Mahapatra et al., 2015).

As per the Health Belief Model, a cue to action by mothers/caregivers influenced by the medical personnel, family and friends contributed to use of antibiotics without prescription which may contribute to antibiotic resistance. Other researchers established that these drugs are mostly bought from drug-retail outlets under the prescription of a pharmacist or a friend (Shafie et al., 2018; Ayalew, 2017; Bachrach and Gardner, 2002). These findings are in agreement with available published literature which indicated that intentions for self-medication with antibiotics result from the need to save money and the desire to act promptly to treat suspected or confirmed bacterial infections (Carvajal-Vélez et al., 2016; Chalovich and Eisenberg, 2013; Le et al., 2011). This knowledge of the condition is obtained from the health facility after the initial visit and knowledge of the exact medication that was provided (Viberg et al., 2010; Alghadeer et al., 2018).

Another determinant of antibiotic use is the quality of care rendered by health facility staff. As observed in Table 4, the likelihood that mothers/caregivers will engage in irrational use of antibiotics due to the nature of service rendered to them whenever they visit the facility was 1.11 higher than that of not engaging. This implies that study participants were less likely to visit the health facility in a situation where the quality of service rendered to them during their previous visit was poor. The quality of care at the health facility is associated with the expectations of the caregivers. Caregivers who receive antibiotics regard health facilities as more caring and responsive than those that do not provide antibiotics. This situation forces medical practitioners to provide broad-spectrum antibiotics even without proper diagnosis and justification contributing to drug resistant (Sharma et al., 2015).

Policy makers developing cost effective local interventions should pay attention to issues related to shortages of drugs at the health facility, previous knowledge of the medical condition, long distances to the health facility, quality of care at the health facility and transportation challenges if the battle against antibiotic resistance is to be won in Malawi.

CONCLUSION AND RECOMMENDATIONS

These findings add new knowledge on the determinants of antimicrobial use in diarrhoea management in the Malawian setting. Based on the findings of this study, investment in relieving distances traveled by mothers/caregivers in need to medical care is key to improving the quality of primary health care. Deliberate efforts by the Government of Malawi (GOM) such as the promotion of closely monitored mobile clinics and the construction of more health care posts in areas with critical distance challenges can go a long way in challenging the status quo.

Policy makers should focus on promoting interventions that lessen indiscriminate use of antibiotics to treat diarrhoea among households by encouraging local councils through decentralisation to include by-laws stopping the malpractice as well as targetted mass awareness campaigns. More also, communities should be encouraged to use ORS and Zinc supplements as they are critical towards reducing rotavirus which mostly cause childhood diarrhoea. There is a strong need to improve accessibility of medical facilities across the nation to ensure that the general citizenry irrespective of social-economic status are motivated to visit the government-owned health facilities.

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CONFLICT OF INTERESTS

The researchers had no conflicts of interest.

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