



Knowledge of Antibiotic Resistance and Treatment of Childhood Respiratory Tract Infections among Mothers in Moshi, Tanzania

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Programme in Medicine



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Knowledge of Antibiotic Resistance and Treatment of Childhood Respiratory Tract Infections among Mothers in Moshi, Tanzania

Degree Project in Medicine

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Abstract

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“Knowledge of Antibiotic Resistance and Treatment of Childhood Respiratory Tract Infections among Mothers in Moshi, Tanzania”

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Background: Antibiotic resistance is a major threat to global health. Respiratory tract infections (RTI) are among the most common reasons for requesting antibiotics. While pneumonia, the leading cause of death in children worldwide, demands antibiotic treatment, cold and flu, caused by viruses should not be treated with antibiotics. Lack of knowledge and incorrect antibiotic use accelerate the development of antibiotic resistance. Previous studies in Tanzania have shown that there are many misconceptions about antibiotics and how they should be used.

Aim: The aim of this study was to assess the knowledge of antibiotic resistance and treatment of RTI among mothers to children under five years old in Tanzania.

Methods: A cross-sectional study was conducted during March and April in 2019, at Kilimanjaro Christian Medical Centre in Moshi, Tanzania. A total of 182 mothers of children under five were interviewed, using a questionnaire.

Results: A majority of the participants (72%) correctly answered that pneumonia should be treated with antibiotics. However, many participants (63%) also answered that cold and flu should be treated the same way. Furthermore, 89% of the mothers knew that amoxicillin was an antibiotic, but only 50% knew that penicillin was an antibiotic as well. One fifth (22%) believed that paracetamol was an antibiotic. A majority (84%) were familiar with drug resistance and about half of the mothers (57%) had heard of antibiotic resistance. The awareness of drug resistance was significantly associated with a higher educational level.

Conclusion: Misconceptions of what conditions should be treated with antibiotics are common, and the awareness of antibiotic resistance is still poor. Educational strategies have to be taken into action to increase knowledge about antibiotics and antibiotic resistance, and to ensure rational antibiotic use.

Key words: antibiotic knowledge, antibiotic resistance, respiratory tract infections

Introduction

Antibiotics are used worldwide to treat several types of bacterial infections. Unfortunately, overuse and misuse of antibiotics has led to a serious situation of antibiotic resistance (1). As the resistance of antibiotics increases, so does the risk of not being able to treat previously curable bacterial infections. Antibiotic resistance is a big threat to global health, especially in developing countries such as Tanzania. Respiratory tract infections are among the most common reasons for requesting and or prescribing antibiotics, and pneumonia is the most common cause of death in children globally (2). Children under five years is a very exposed group to these kinds of infections, and previous studies in Tanzania have shown that there is a lack of knowledge of antibiotic resistance and antibiotic use (1, 3-8). Thus, research within this field is important to conduct. According to guidelines from WHO, infections such as bronchitis and chronic recurrent cough do not require antibiotics, whereas pneumonia is much more dangerous, and hence empirical antimicrobial therapy is recommended (9). The diagnostic capabilities are however limited when it comes to respiratory tract infections such as pneumonia, which makes it even more difficult to know which therapy is indicated. Therefore, it is essential to have as much knowledge as possible about when to treat an infection with antibiotic, especially since we need to stop the development of antibiotic resistance.

Background

The discovery of antibiotics is one of the greatest accomplishments within the medical world during the 20th century. In 1928 Alexander Fleming, by mere chance, discovered penicillin and its importance to human kind. It is true that antibiotics have been a “miracle cure” and saved many people’s lives, but since the emergence of antibiotic resistance this effectiveness of antibiotics is threatened. Already in the 1930s, Alexander Fleming warned of antibiotic

resistance, but unfortunately it has become a problem that continues to increase in many countries (1). The definition of *antibiotic resistance* is when bacteria do not longer respond to an antibiotic treatment which was originally effective against the infection-caused bacteria. It has a direct relationship to the consumption of antibiotics and occurs when bacteria change their genetics in response to antibiotic treatment (10). Antibiotic resistance is a great threat to global health and our ability to cure common bacterial infections. Several infections, e.g. pneumonia, are harder to treat today because of ineffective antibiotics, which is a result of the antibiotic resistance (10).

Global Health in Tanzania

Tanzania is a low-income country, located in the mid-eastern part of Africa. The population of 57.3 million has an annual growth of 3.1 percent (11). Most of the citizens (73.6 %) live in rural areas, where education levels are lower, fertility rate is higher, and poverty more common compared to the urban areas (1). However, the country has made great progress in attempting to achieve several of the UN's Millennium Development Goals (MDG), for instance reducing infant and under-five mortality, combating HIV/AIDS, malaria, universal primary education and addressing gender equality (12). According to data from 2010, Tanzania has managed to reduce both infant mortality (45 per 1000 live births) and under five mortality (81 per 1000 live births), and the trends are continuing downwards (13). Nevertheless, there are still many challenges left; poor infrastructure, low education levels, poverty, and infectious diseases are some of the struggles the country has to face. The four leading diseases that causes illness and death in Tanzania are HIV/AIDS, malaria, pneumonia and diarrhea (1).

Healthcare in Tanzania

Healthcare in Tanzania is mostly controlled by the government, but there are private facilities as well. The health system is organized like a pyramid, with plenty of local dispensaries or clinics in the bottom and a couple of national hospitals in the top. In between, there are rural health centers, district and regional hospitals. The levels in the pyramid differ regarding knowledge, training, performance and health workforce. In urban areas, doctors tend to apply their knowledge more, have better training and performance, and a higher number of health workers per 1000 (1).

Tanzanian Health System Pyramid



Figure 1. Schematic pyramid of the health system in Tanzania



*Figure 2. Map of Tanzania and Moshi.
https://wiocc.files.wordpress.com/2011/05/tanzania_map.jpg*

This current study was conducted at Kilimanjaro Christian Medical Centre (KCMC), which is located in Moshi and one of the private hospitals in Tanzania. Moshi is a smaller city with an estimated population of 200,000 inhabitants and it is located just by the foot of Kilimanjaro, in the north eastern part of Tanzania. Although the number of citizens in Moshi town is rather low, the hospital KCMC, is one of the biggest private referral zonal hospitals in the country, covering over 15 million people in northern Tanzania (14).

Respiratory Tract Infections in Tanzania

Most respiratory tract infections are caused by viruses and do not require antibiotic treatment. In fact, antibiotics have no effect at all on infections caused by viruses. On the other hand, pneumonia can be caused by a number of bacteria, and is a life-threatening infection that needs antibiotic therapy (1). However, a problem with pneumonia is the mixed infections, where a bacterial respiratory tract infection is often preceded by a viral infection, which makes it hard to diagnose and treat. The most common bacterium causing pneumonia is *Streptococcus pneumoniae*, which is found in both children and adults as well as in high- and low-income countries. Along with antibiotics, vaccines have been very important to decrease childhood death and illnesses from many infections. Vaccines reduce the number of infections and in that way also limit the need of antibiotics. To prevent childhood respiratory tract infections, vaccines for children have been developed against *Streptococcus pneumoniae* (PCV13), *Hemophilus influenzae B* (Hib) and *Bordetella pertussis* (15). In Tanzania, both private and public facilities provide PCV13, containing 13 pneumococcal antigens free of charge to the population (15).

The Constitution of the World Health Organization (WHO) states that everyone has the right to the highest attainable standard of health, which means that health care services should be available, accessible, acceptable and also of high quality. Additionally, the government has to provide essential medicines to the population, where antibiotics are included. Even though this current research emphasizes the problematic situation of misuse of antibiotics and antibiotic resistance, it is crucial that antibiotic treatment is accessible to the entire population.

According to the Global Antimicrobial Resistance Partnership, less than 25% of children in Tanzania with pneumonia are receiving antibiotics. Despite the concern of antibiotic resistance, “no saving of antibiotic resistance is worth risking lives” (1).

Studies on Antibiotic Resistant Bacteria in Tanzania

Data on antibiotic resistance in bacteria causing respiratory tract infections is very limited in Tanzania, and few studies have been conducted among children (1). However, the Global Antimicrobial Resistance Partnership in Tanzania conducted a study in 2015 on factors that contribute to the antimicrobial resistance in humans and animals. The results of the report indicate that the bacterium *Streptococcus pneumoniae* has increased its resistance against the common antibiotic Trimethoprim/Sulphamethoxazole in children under five from 25% in 2006 to 80% in 2012 (16). The pathogen, *S. pneumoniae*, is regarded as the most important cause of life-threatening pneumonia in children, and as a result of antibiotic use and overuse, spread of resistant pathogens and self-medication, antibiotic resistance has become a serious problem both globally and in Tanzania (1).

Moreover, several studies have pointed out that there is a high rate of pneumococcal carriage in healthy children in the eastern part of Africa (17, 18). For example, a cross-sectional study in Moshi, Tanzania was conducted to determine antibiotic susceptibility and serotype distribution of *S. pneumoniae* in children (18). The study was performed after the national introduction of the 13-valent pneumococcal conjugate vaccine, PCV13. Among other things, results showed a decrease of pneumococci susceptible to penicillin using standard antibiotic dosing regimen from 69% in 2013 to 47% in 2015 (18). Carriage of bacteria, which require increased exposure to penicillin, was more common in children with many siblings. This means that pneumococcal diseases, such as pneumococcal meningitis, can become harder to treat (18). A large number of antibiotics have been produced since its first discovery several decades ago. Due to bacterial resistance, many of these older antibiotics are now worthless. *S. pneumoniae* causes respiratory tract infections, and is one of a long list of bacteria, that today is resistant against many older antibiotics (19). The pneumococci are highly non-susceptible

to trimethoprim-sulfamethoxazole and increasingly non-susceptible to penicillin. However, the pathogen is still susceptible to amoxicillin/ampicillin (18).

Antibiotic Use

The Constitution of World Health organization has identified antibiotic resistance as a global threat. Antibiotic resistance occurs naturally, but misuse and overuse will accelerate the process. According to WHO antibiotic use is higher in low-income countries than in high-income countries (20). In Tanzania, the law states that no antibiotics should be bought without a prescription. In reality, this is not the case, and many studies indicate that antibiotic are sold against the regulation in private drugstores. A study performed in Moshi, Tanzania, examines the availability of getting hold of antibiotics in both prescription-allowed pharmacies (part 1) and not prescription-allowed pharmacies (part 2) (3). Results show that antibiotics could be bought without prescription in all 15 part 2-pharmacies visited, which indicates that the system of selling antibiotic drugs is uncontrolled (3). Another study investigated the practices of antibiotic prescribing for children with diarrhea and cough in Moshi, Tanzania (4). Findings disclosed high rates of inappropriate antibiotic prescribing, 80% of the children with acute watery diarrhea and 69% with common cold received antibiotics (4). Both community and hospitals are overusing antibiotics, and hence there is a need for actions, such as control programs in order to limit the increase of bacterial resistance (19).

Antibiotic Knowledge

The WHO conducted a multi-country survey to investigate public awareness on antibiotic resistance, including both questions on knowledge of antibiotics and knowledge of antibiotic resistance (20). Findings of the survey show that respondents with a higher level of education have more knowledge in both areas (20). According to WHO's summary of "Worldwide

country situation analysis: response to antimicrobial resistance”, antimicrobial resistance is one of today’s greatest challenges to global public health. When the survey was conducted, public awareness of the situation appeared to be low in all regions (21). Even in countries with national campaigns on the topic, the people still thought that antibiotics were effective against viral infections (21). In Tanzania, the knowledge about antibiotics and when they should be used is insufficient (5). Antibiotics are overused in both the urban and rural settings and this is due to both clinicians’ and drug sellers’ prescribing practices in public and private facilities (5). The study also shows prescribing of antibiotics for conditions that will not be helped by antibiotic treatment (5). The knowledge of antimicrobials and antimicrobial resistance were also investigated in a cross-sectional household survey, performed in different regions in Tanzania (6). The result revealed low levels of knowledge, for example only one third of 1200 participants had ever heard of a medicine called an antimicrobial, and some thought other medicines such as paracetamol was an antimicrobial. Furthermore, many people thought both pneumonia and common cold were to treat the same way. The level of public understanding rose with wealth status and education (6).

Misuse and overuse of antibiotics are accelerating the development of antibiotic resistance. An American study wanted to investigate if parents’ expectations and pressure might affect the patterns of antibiotic prescribing (22). Physicians from the American Academy of Pediatrics responded to a semi-structured questionnaire that later on was analyzed. It revealed that 40% of the pediatricians had experienced, ten or more times in the past month, parents that requested antibiotic when the doctor didn’t think it was indicated (22). Also, 48% reported that they very often felt pressure from the parents to prescribe antibiotics to their children even though it was not indicated. Approximately one third of the physicians had once or several times given in for these requests (22). Moreover, 78% of the pediatricians believed

that educating parents would be the best way to limit or stop this inappropriate prescribing and use of antibiotics (22). Another research, in the middle-income country Lebanon, studied the antibiotic knowledge and self-medication on a sample of the Lebanese population. Statistics showed that 61% of the participants thought antibiotics could be used for common cold, and that self-medication was significantly more common when having a lower education (23).

In an additional study where “practical” knowledge and perceptions of antibiotics and resistance among drug sellers in Tanzania are investigated, the results showed that 24% of the participants believed that antibiotics can be used for treating viral disease. Furthermore, the results demonstrated that only 72% of the drug sellers had heard of antibiotic resistance (7). Moreover, parents’ knowledge concerning antibiotics has also been shown to be insufficient. Results from a questionnaire about parents’ or physicians’ views on antibiotics, respectively, show that many parents were worried that their children were receiving too many antibiotics (8). Despite this fact, every now and then parents requested an antibiotic although their physician believed it was unnecessary. The study also showed that parents often administer antibiotics without physician knowledge, and that many parents have misconceptions about which illnesses warrant antibiotic therapy (8).

That the knowledge of antibiotics, its field of application, and antibiotic resistance is insufficient among the common population, is a problematic situation. But, the ideal of using antibiotics only when it’s needed and saves lives, is very difficult. Many infections are hard to diagnose and often suspected bacterial infections are caused by viruses or other conditions. However, the Tanzanian national aim is to try to reduce antibiotic use without affecting human or animal health. One of the six priorities at the national level is to “educate health professionals, policy makers and the public on sustainable antibiotic use.” (1) Educating the

public includes awareness campaigns that hopefully will increase the knowledge of when antibiotics are appropriate and when is not. This is especially important in areas where high levels of antibiotics are available without a prescription (1). Also, the National Action Plan in Tanzania has outlined a couple of objectives to slow the development of antimicrobial resistance, two of these are: “Improve awareness and understanding of antimicrobial resistance through effective communication, education and training”, and “Strengthen the knowledge and evidence base through surveillance and research” (16).

Aim of the study

The aim of this study was to assess the knowledge of antibiotic resistance and treatment of respiratory tract infections among mothers to children under five years old in Tanzania. The purpose was also to make a structured survey of factors that contribute to the overuse of antibiotics, which might be of value when future interventions are developed to avoid unnecessary antibiotic use. Even if it is hard to make a great impact in a short period of time, hopefully this project will shed light on the antibiotic resistance situation and contribute with a higher level of antibiotic knowledge to the common population in Moshi, Tanzania.

Research Questions

- What knowledge do mothers of children from one month to five years old in Moshi, Tanzania, have on the treatment of childhood respiratory tract infections?
- What knowledge do mothers of children from one month to five years old in Moshi, Tanzania, have of antibiotics and antibiotic resistance?
- Does the knowledge of antibiotics and treatment of childhood respiratory tract infections differ between high educated versus low educated mothers of small children in Moshi, Tanzania?

Material and Methods

This cross-sectional observational study was conducted in March and April 2019, at the Reproductive and Child Health Clinic at Kilimanjaro Christian Medical Centre (KCMC) in Moshi, Tanzania. Women included in the study attended the clinic for mainly four different reasons; antenatal care, immunization of the child, postnatal care and family planning.

Women who were mothers of children between 1-59 months were enrolled in the study.

Mothers under the age of 18 and mothers with physical or psychiatric disabilities were excluded.

The eligible mothers were collected by convenient sampling and interviewed using a semi-structured questionnaire written in both Swahili and English. The questionnaire was based on World Health Organizations' multi-country awareness survey on antibiotic resistance with some modifications, including questions constructed according to the project's specific objectives. (20) Most of the questions were quantitative, but some were qualitative with short answers demanded. The questionnaire was divided into three parts; 1. Background information, including socio-economic factors, 2. Knowledge of antibiotic and antibiotic resistance, and finally 3. Antibiotic use (see appendix nr. 1). All questions were translated from English into Swahili by the local supervisor of the project, and back translated by one of her colleagues. Before the data collection began, the questionnaire was also tested on three staff employees at the Community Health Department. Furthermore, a pilot study was done on six mothers at the Reproductive and child health clinic at KCMC.

The interviews were performed by two Swedish medical students, and assisted by one experienced local nurse and one local research assistant, helping out with the Swahili translation. One interview took approximately 20 minutes, and after finishing the

questionnaire the mothers were given opportunity to ask questions on the subject. A full written consent was obtained from every participating mother before the interviewing part started. Every day, data of total attendance, the number of participants consented and mothers who refused to participate were collected. A flow chart of the recruited study participants is shown in Figure 2.

Sample size calculation

In reference (6) the awareness of antimicrobial resistance was 40% among Tanzanian antibiotic consumers with higher formal education compared to 20% in areas with lower education. A sample size of 161 would then be able to detect a difference between the groups with a power of 80% and a statistical significance level of 0,05. The planned number of included mothers in this study was therefore 200 mothers, which was assumed to be enough to answer the research questions. In the end of the data collection we had manage to interview 182 mothers, which was more than 10% above the minimum sample size, and was therefore considered enough.

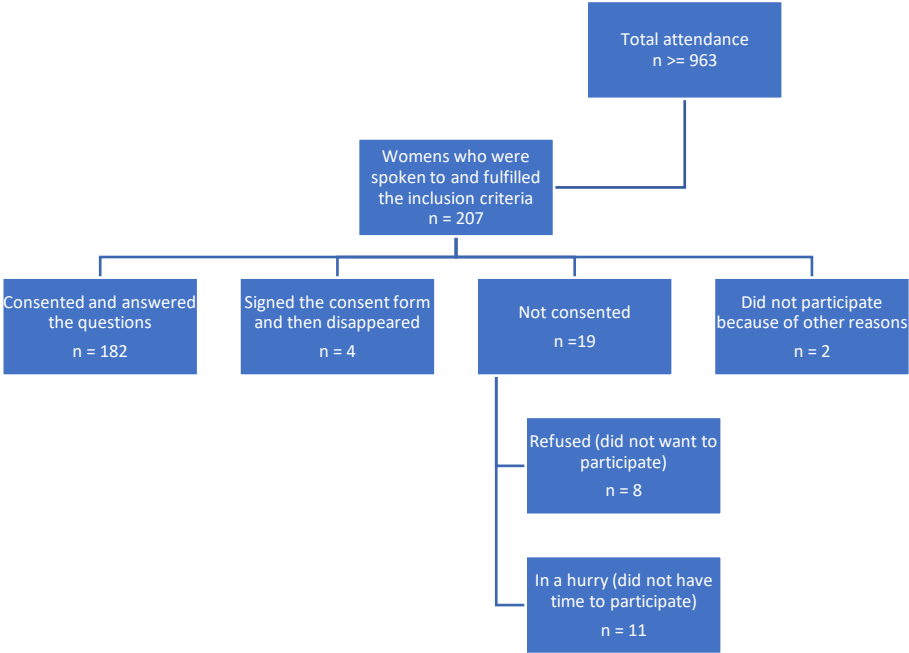


Figure 3. Schematic representation of the study participant recruitment at the Reproductive and Child Health Clinic at KCMC in Moshi, Tanzania.

Ethics

The ethics is in accordance with the Declaration of Helsinki, and follows the ethical principles for medical research involving human subjects. All participants were given an information sheet and consent form, abling them to make an informed decision as to whether take part in the study or not (see appendix 2). Moreover, the mothers had to sign a consent form before the start of the interviews (see appendix 3). An ethical approval from the local ethics committee in Moshi, Tanzania (Kilimanjaro Christian Medical University College research ethics and review committee) was committed before the study was conducted.

Statistical Methods

The collected data was analysed using the statistical program SPSS version 25. Firstly, descriptive frequency analyses were done, one for each variable in the questionnaire. Then, binary logistic regression analyses were done to see if there were any associations between socio-economic status and antibiotic knowledge. P-values under 0.05 were considered as significant.

Results

Characteristics of the study population

The study population were collected by convenience sampling at the Reproductive and Child Health Clinic. A total of 207 women fulfilled the inclusion criteria and were asked to participate in the study. Of these, 182 mothers signed the consent form and answered the questionnaire. The median age of the mothers were 31 years (range 18-46 years). The majority of the recruited mothers visited the clinic for antenatal care (37%). Most of them came from urban areas (74%) and many had studied at university or college (45%), i.e. were

high educated. Many mothers were self-employed (45%), and some had medical background (9%). The median income was 400,000 TZS (approximately 170 USD). Characteristics and socioeconomic factors of the study population are shown in table 1.

Table 1. Characteristics of the recruited mothers (n = 182)

<i>Characteristics</i>	<i>n (%)</i>
Reason for attending the clinic	
Immunization of the child	37 (20.3)
Antenatal care	68 (37.4)
Postnatal care	44 (24.2)
Family planning	4 (2.2)
Other ¹	29 (15.9)
Description of living area	
Urban	134 (73.6)
Rural	46 (25.3)
Do not know	2 (1.1)
Education mother	
Never been to school	3 (1.6)
Completed primary school	41 (22.5)
Secondary school	57 (31.3)
University or college	81 (44.5)
Current occupation mother	
Employed	72 (39.6)
Self-employed ²	82 (45.1)
Unemployed	19 (10.4)
Student	7 (3.8)
Other	2 (1.0)
Medical background	
Yes	16 (8.8)
No	166 (91.2)
Household/family monthly income in TZS (10,000 TZS = 4.35 USD)	
< 200,000	30 (17.8)
200,000 – 399,999	51 (30.2)
400,000 – 599,999	31 (18.3)
600,000 – 799,999	14 (8.3)
800,000 – 999,999	8 (4.7)
>= 1,000,000	35 (20.7)

¹ Reason for attending clinic, other specify (n): check-up (14), escorting someone (6), abdominal pain (4), lab results (2), participating in study about depression (2), do not know (1)

² Current occupation mother, self-employed specify (n): entrepreneurship (3), small business (selling clothes, tailor, selling food etc.) (67), farmer/livestock keeper/taking care of animals (12)

Antibiotic knowledge

Almost all mothers asked (96%, n = 175/182) had heard of a medicine called antibiotic. Most of them did also know that antibiotics are used for fighting bacteria (68%, n = 119), and that there is more than one type of antibiotic (88%, n = 154). On the other hand, nearly 20% (n = 34) believed that conditions caused by any microbes, including viruses and fungi, could be treated by antibiotics. We further investigated the mothers' knowledge on how childhood respiratory tract infections, and other infections should be treated. When questioned the mothers of which disease or diseases they knew could be treated with antibiotics, the mothers had to suggest one or more diseases by themselves. The five most common answers were cough, urinary tract infection (UTI), flu, malaria and fungus (Figure 4). Furthermore, the next question showed that a majority of mothers thought conditions such as UTI, diarrhoea, pneumonia, cold and flu, skin or wound infection and sore throat could be treated with antibiotics (Figure 5).

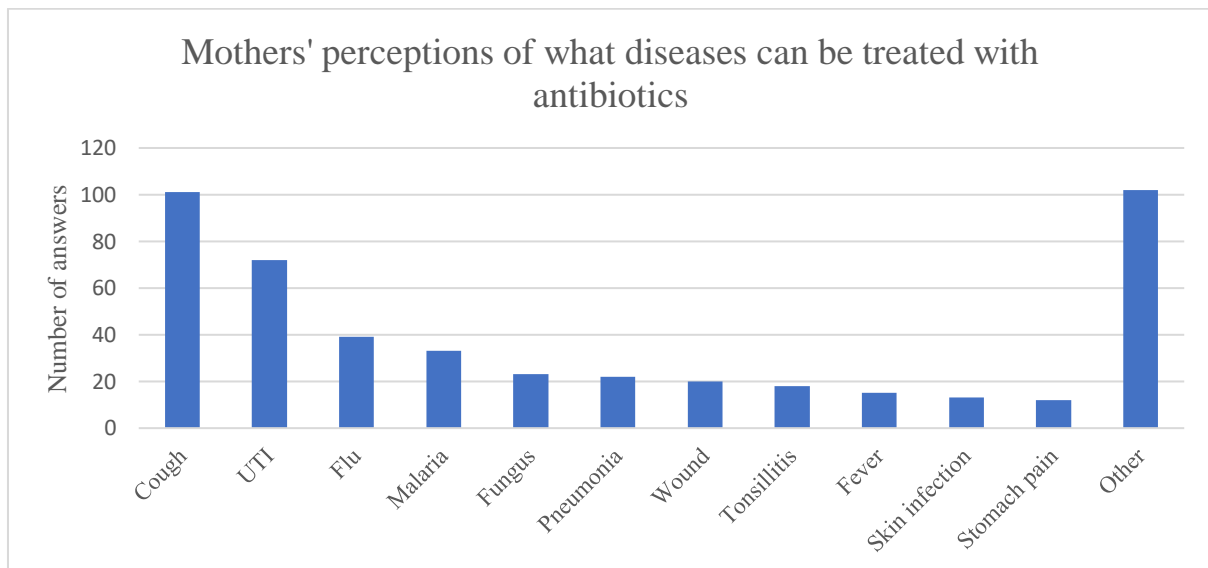


Figure 4. The most common answers, as suggested by the mothers themselves, of which disease or diseases they thought could be treated with antibiotics. Other diseases or symptoms that were less commonly listed were typhoid, diarrhoea, chest pain, amoeba, head ache, blood infection etc. UTI = Urinary Tract Infection.

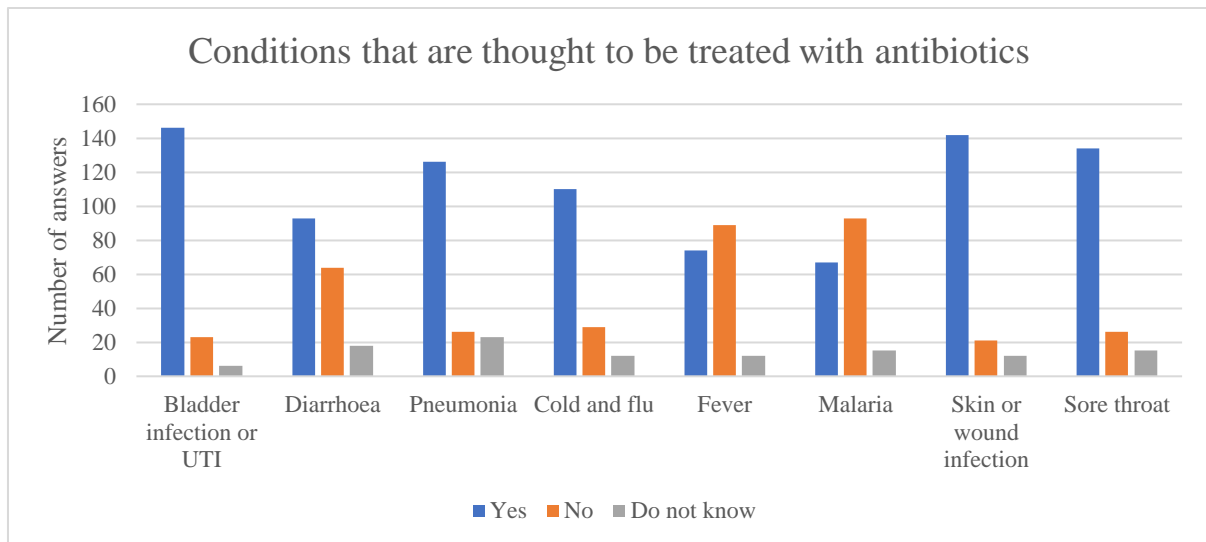


Figure 5. The number of mothers who thought a certain condition could be treated with antibiotics. UTI = Urinary Tract Infection

Two thirds of the mothers knew that antibiotics are used against bacteria (68%, n= 119), but still the majority did also think conditions such as flu and cold, diarrhea and sore throat, which are mainly viral infections, need antibiotic treatment.

When asking about how the mothers would get hold of antibiotics when their child was needing the treatment, most of them knew they were supposed to go to a health facility to get a prescription (95%, n = 167). The majority of mothers (87%, n = 152) did also know the importance of completing the whole antibiotic treatment, even if the child was feeling better after half of the treatment. Furthermore, the mothers were asked if they could recognize different types of medicines to be an antibiotic or not. Results show that 89% (n = 161) knew that Amoxicillin is an antibiotic, but only 50% (n = 90) knew that Penicillin is an antibiotic as well. On the other hand, 73% (n = 132) knew that Panadol/Paracetamol is not an antibiotic. More details are shown in Figure 6.

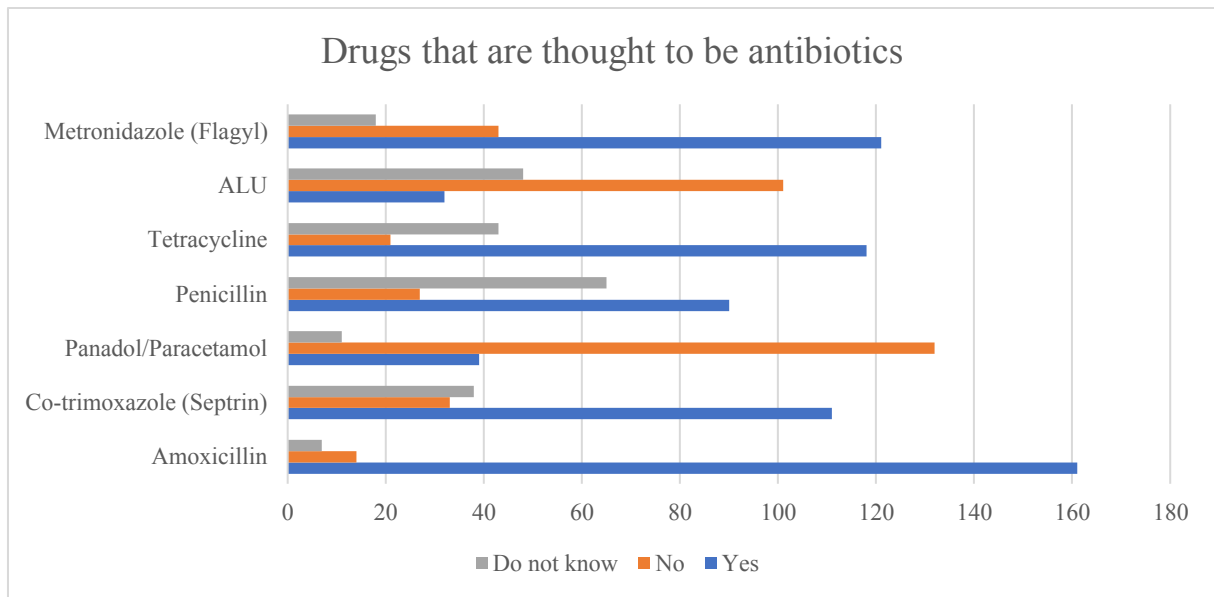


Figure 6. Frequency of mothers who thought a certain medicine was an antibiotic or not. ALU (Artemether-lumefantrine) is the first line drug for treatment of uncomplicated malaria.

Antibiotic resistance

Some medicines that used to work in the past for fighting bacteria are no longer working. This problem is called drug resistance. When asking the mothers if they had heard of drug resistance, a majority (84%, n = 152) was familiar with the phrase. Additionally, more than half of the mothers (57%, n = 103) had heard of antibiotic resistance, and almost as many mothers (55%, n = 100) had heard of antimalarial resistance. Furthermore, most of the mothers who knew about antibiotic resistance had heard the term from a doctor or a nurse (52%), or from a family member or a friend (44%) (Figure 7).

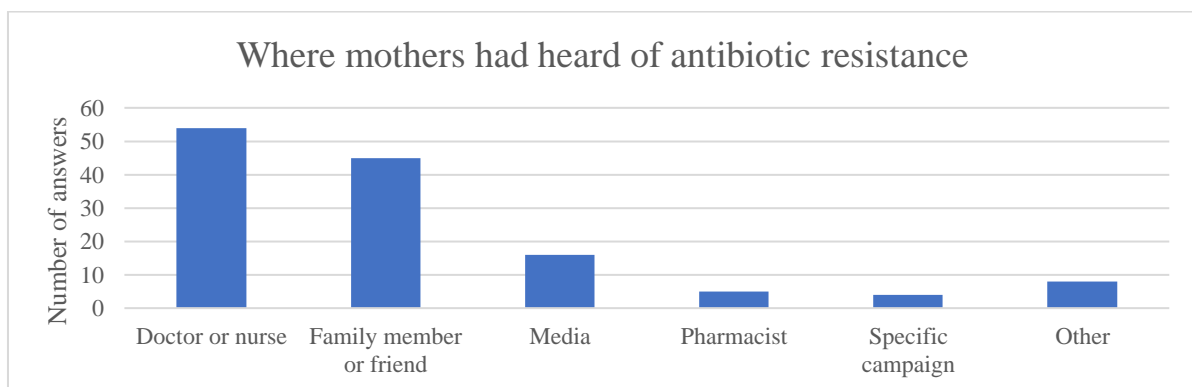


Figure 7. Illustrates where the 103 mothers, who knew about antibiotic resistance, had heard of the term. Other, specify: poster or leaflet at hospital, in school, learned from own experience.

Mothers who had heard of the antibiotic resistance were also questioned about the meaning of the term. They were given a couple of statements about antibiotic resistance and had to confirm if it was true or false. Although more than fifty percent of the mothers knew about the term antibiotic resistance the knowledge of its meaning was quite diverse. For example, 65% (n = 67) thought that antibiotic resistance is only a problem for people who take antibiotic regularly, and 41% (n = 42) did not think that antibiotic resistant bacteria could be spread from person to person. Figure 8 shows the different conceptions of what the mothers thought antibiotic resistance meant.

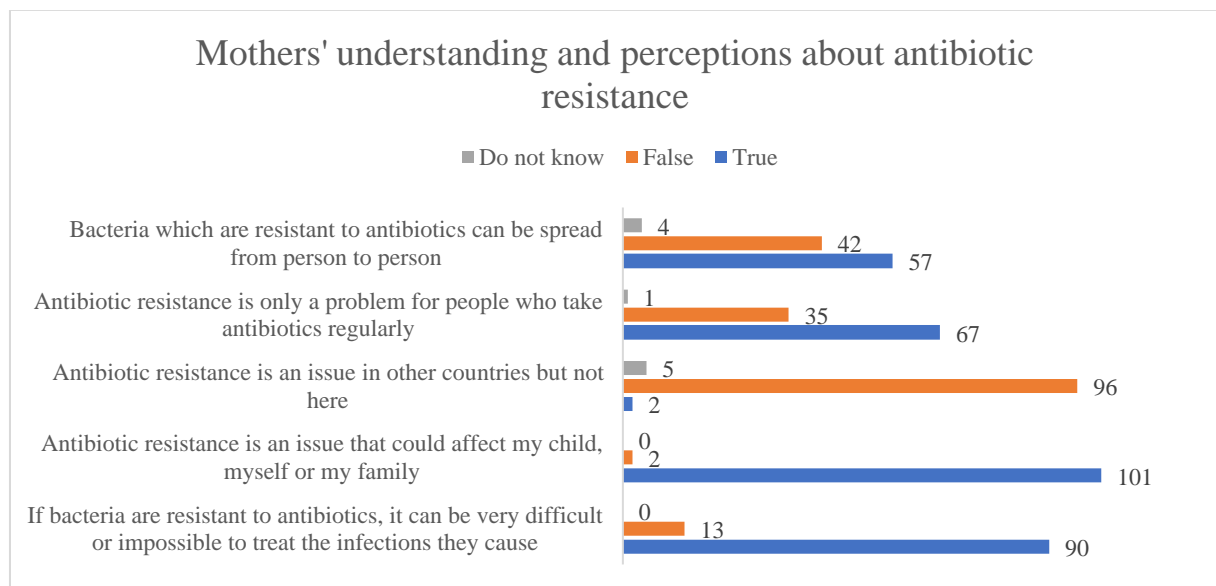


Figure 8. Statements about antibiotic resistance. A total of 103 mothers were asked to confirm whether the statement was true or false.

Socioeconomic status

Differences in the knowledge of antibiotics and treatment of childhood respiratory tract infections between high educated versus low educated mothers were investigated, however, no significant differences could be shown.

Different levels of education were also analyzed in relation to what medicines the mothers thought were antibiotics or not. Those mothers who had been to college or university were

more likely to know that amoxicillin was an antibiotic, and less likely to believe that paracetamol was an antibiotic, compared to mothers with lower education (p -value < 0.05 for both) (Table 2).

Moreover, mothers with education from college or university had to a higher extent heard of the term drug resistance, compared to mothers with no education or only from primary school (OR = 5.07, CI 1.63-15.74, p -value = 0.005) (Table 2).

Table 2. Knowledge of antibiotic and antibiotic resistance in relation to educational level

QUESTIONS ¹		OR	95% CI	P-value
<i>Have you ever heard of a medicine called an antibiotic?</i>	None or Primary (ref.)	1.00		
	Secondary school	2.75	0.48-15.76	NS
	University	8.00	0.87-73.95	0.067
<i>Do you think pneumonia could be treated with antibiotics?</i>	None or Primary (ref.)	1.00		
	Secondary school	0.50	0.20-1.23	NS
	University	1.24	0.51-3.02	NS
<i>Do you think cold and flu could be treated with antibiotics?</i>	None or Primary (ref.)	1.00		
	Secondary school	0.60	0.24-1.51	NS
	University	0.60	0.25-1.45	NS
<i>Do you think amoxicillin is antibiotic?</i>	None or Primary (ref.)	1.00		
	Secondary school	1.80	0.65-5.03	NS
	University	7.65	1.98-29.55	0.003
<i>Do you think penicillin is an antibiotic?</i>	None or Primary (ref.)	1.00		
	Secondary school	0.87	0.40-1.93	NS
	University	1.58	0.75-3.30	NS
<i>Do you think Panadol/paracetamol is an antibiotic?</i>	None or Primary (ref.)	1.00		
	Secondary school	0.95	0.42-2.15	NS
	University	0.37	0.16-0.85	0.019
<i>Some medicines that used to work in the past for fighting infections are no longer working. This problem is called drug resistance. Have you heard of this problem?</i>	None or Primary (ref.)	1.00		
	Secondary school	1.02	0.41-2.55	NS
	University	5.07	1.63-15.74	0.005
<i>Have you ever heard of antibiotic resistance</i>	None or Primary (ref.)	1.00		
	Secondary school	1.22	0.55-2.68	NS
	University	1.96	0.93-4.14	0.076

¹In case the mother answered "do not know" to any question, this was considered as incorrect answer.
NS = Non-Significant.

To see if knowledge of antibiotics and antibiotic resistance correlates to other socioeconomic factors, the same analyses were also done for different occupations and household income groups. Results of these analyses are found in table 3 and 4. The findings imply that mothers

who are employed have better knowledge of antibiotic and antibiotic resistance compared to mothers who are unemployed. For instance, employed mothers were significantly more likely to know that pneumonia should be treated with antibiotics, and that cold and flu do not require antibiotic treatment, compared to unemployed mothers (Table 3). Likewise, there was a significant difference between mothers with employment and mothers without an occupation in knowing that paracetamol was not an antibiotic (Table 3). In similarity to educational level, employed mothers were more likely to have heard of both drug resistance and antibiotic resistance, compared to mothers without employment (Table 3).

Table 3. Knowledge of antibiotics and antibiotic resistance in relation to different occupations

QUESTIONS ¹	OCCUPATION	OR	95% CI	P-value
<i>Have you ever heard of a medicine called an antibiotic?</i>	Unemployed (ref.) ²	1.00		
	Self-employed ³	1.56	0.27-9.03	NS
	Employed ⁴	5.68	0.49-65.39	NS
<i>Do you think pneumonia could be treated with antibiotics?</i>	Unemployed (ref.)	1.00		
	Self-employed	2.21	0.88-5.56	0.093
	Employed	3.76	1.41-10.00	0.008
<i>Do you think cold and flu could be treated with antibiotics?</i>	Unemployed (ref.)	1.00		
	Self-employed	0.22	0.48-1.20	0.053
	Employed	0.13	0.03-0.61	0.009
<i>Do you think amoxicillin is antibiotic?</i>	Unemployed (ref.)	1.00		
	Self-employed	0.66	0.17-2.54	NS
	Employed	1.68	0.37-7.55	NS
<i>Do you think penicillin is an antibiotic?</i>	Unemployed (ref.)	1.00		
	Self-employed	1.20	0.50-3.00	NS
	Employed	2.83	1.13-7.80	0.026
<i>Do you think Panadol/paracetamol is an antibiotic?</i>	Unemployed (ref.)	1.00		
	Self-employed	0.43	0.18-1.05	0.063
	Employed	0.15	0.06-0.41	0.0001
<i>Some medicines that used to work in the past for fighting infections are no longer working. This problem is called drug resistance. Have you heard of this problem?</i>	Unemployed (ref.)	1.00		
	Self-employed	0.95	0.33-2.69	0.919
	Employed	3.83	1.10-13.83	0.04
<i>Have you ever heard of antibiotic resistance</i>	Unemployed (ref.)	1.00		
	Self-employed	1.25	0.52-3.00	NS
	Employed	2.66	1.08-6.60	0.034

¹In case of the mother answered "do not know" to any question, this was considered as incorrect answer.

²Unemployed: unemployed, student, other

³Self-employed: entrepreneurship, small business (selling clothes, tailor, selling food etc.), farmer/livestock keeper/taking care of animals

⁴Employed: i.e. teacher, nurse, doctor, accountant

NS = Non-Significant

When monthly household/family income was related to antibiotic knowledge, similar results were found. Women who had a high monthly family income were significantly more likely to know that cold and flu do not need antibiotic therapy and that amoxicillin was an antibiotic, compared to groups with lower household income (Table 4). Wealthier women were also more likely to have heard of antibiotic resistance compared to mothers with low monthly family income. These results raise the question if it is the same women who meet all three categories of high socio-economic status. After analyzing this, it appears to not be the case. Only 26 mothers had all three; university education, high income and employment.

Table 4. Knowledge of antibiotics and antibiotic resistance in relation to different economic status

QUESTIONS ¹	MONTHLY HOUSEHOLD INCOME	OR	95% CI	P-value
<i>Have you ever heard of a medicine called an antibiotic?</i>	Low income (ref.) ²	1.00		
	Middle income ³	5.22	0.83-32.87	0.078
	High income ⁴	4.67	0.46-47.21	NS
<i>Do you think pneumonia could be treated with antibiotics?</i>	Low income (ref.)	1.00		
	Middle income	1.05	0.41-2.67	NS
	High income	1.19	0.41-3.48	NS
<i>Do you think cold and flu could be treated with antibiotics?</i>	Low income (ref.)	1.00		
	Middle income	1.28	0.45-3.27	NS
	High income	0.35	0.12-1.00	0.05
<i>Do you think amoxicillin is antibiotic?</i>	Low income (ref.)	1.00		
	Middle income	7.50	2.44-23.04	0.0001
	High income	6.67	1.65-26.97	0.008
<i>Do you think penicillin is an antibiotic?</i>	Low income (ref.)	1.00		
	Middle income	1.63	0.71-3.75	NS
	High income	1.43	0.56-3.68	NS
<i>Do you think Panadol/paracetamol is an antibiotic?</i>	Low income (ref.)	1.00		
	Middle income	1.06	0.44-2.59	NS
	High income	0.45	0.15-1.40	NS
<i>Some medicines that used to work in the past for fighting infections are no longer working. This problem is called drug resistance. Have you heard of this problem?</i>	Low income (ref.)	1.00		
	Middle income	1.35	0.47-3.86	NS
	High income	1.29	0.38-4.30	NS
<i>Have you ever heard of antibiotic resistance</i>	Low income (ref.)	1.00		
	Middle income	4.07	1.68-9.85	0.002
	High income	3.94	1.45-10.66	0.007

¹In case the mother answered "do not know" to any question, this was considered as incorrect answer.

²Low income: < 200 000 TZS

³Middle income: 200 000-799 999 TZS

⁴High income: >= 800 000 TZS

NS = Non-significant

Discussion

This study investigated knowledge among mothers of children from one month to five years old in Moshi, Tanzania, on antibiotics – including treatment of respiratory tract infections and antibiotic resistance. The results showed that most mothers included in the study had heard of a medicine called an antibiotic. A great portion of mothers (72%) did also know that pneumonia needs antibiotic therapy, which is important knowledge. This is actually more than was observed in another study in Tanzania, where only 21% of the participants believed that antibiotics were useful against pneumonia (6). Furthermore, the majority of participants in the present study (83%) correctly identified both bladder infection/UTI and skin/wound infection as conditions that can be treated with antibiotics. This is a similar frequency as the findings in the multi-country public awareness survey about antibiotic resistance from WHO, where 72% of the respondents knew that both bladder infection and skin/wound infection should be treated with antibiotics (20).

However, there are also a couple of obvious gaps regarding knowledge of antibiotics and antibiotic treatment. For instance, the majority of mothers incorrectly thought that cold and flu and sore throat were conditions which could be treated with antibiotics (63% and 77%, respectively). In addition to this, nearly 20% of the participants believed that antibiotics could be used for infections caused by any microbes, including bacteria, viruses and fungi. These two misconceptions of when antibiotic therapy is needed, seem to be common when comparing with other studies which have been investigating the same objectives. In WHO's multi-country awareness survey about antibiotic resistance, similar large proportions of respondents mistakenly thought that viral conditions can be treated with antibiotics, particularly sore throats (70%) and colds and flu (64%) (20). In a cross-sectional study performed in Lebanon, parents' perceptions and knowledge of antibiotics used for upper

respiratory tract infections in children were examined (24). Significant findings on misconceptions and malpractices were revealed. Almost 34% of the parents believed that antibiotics could be used for treating common cold in their children, and about 38% of the respondents thought that antibiotics could be used to treat viral infections (24). In another study from Singapore where knowledge and practices towards antibiotic use in upper respiratory tract infections among patients, the majority agreed to the statement: “antibiotics are effective against viruses” (78%, n = 715/914) (25). One additional study that aimed to examine the knowledge about upper respiratory tract infections and antibiotics among pharmacy consumers in Brisbane, Australia, did also find similar knowledge gaps (26). The study concealed that more than one third of all 252 participants believed that antibiotic could help them recover faster when suffering from a cold or a flu, and almost 20% thought that viral infections were to be cured by antibiotics. (26).

Other interesting findings on antibiotic knowledge were what drugs the mothers thought were antibiotics or not. A large proportion (89%) knew that amoxicillin is an antibiotic, but less than half of the participants knew that penicillin is an antibiotic as well. Furthermore, about 22% of the mothers believed that panadol/paracetamol was an antibiotic. This is a high number compared to another household study in Tanzania, where approximately 8% of the participants thought paracetamol were antimicrobial medicines (6).

The final part of the questionnaire in this study addressed the mothers’ knowledge of antibiotic resistance. Are they aware of the issue and do they understand what antibiotic resistance means? The results revealed that many mothers had heard of drug resistance, but only about half of the mothers were familiar with the term antibiotic resistance. This is a low number compared to WHO’s multi-country awareness survey about antibiotic resistance,

where 70% had heard of antibiotic resistance (20). But when comparing the different countries included in the mentioned survey, there were some significant differences in the findings. Mexico and Indonesia had high proportions of respondents that were familiar with the term (89% and 84%, respectively), but countries such as Nigeria and Egypt were not very aware of the term antibiotic resistance (38% and 22%, respectively) (20). This emphasis with that the awareness of antibiotic resistance mothers in Moshi, Tanzania, is still pretty low but similar or even higher compared to other countries in Africa. Though some mothers had heard of antibiotic resistance it did not mean that they had high levels of understanding the issue. Many of those who were familiar with the term had misconceptions about its meaning.

Furthermore, analyses showed that some questions on antibiotic knowledge were associated to higher socio-economic status. For example, awareness of drug resistance significantly rose with education level. Other socio-economic factors such as family income and occupation, were also significantly associated with the awareness of antibiotic resistance. Mothers with higher family income or who were employed, were more likely to have heard about antibiotic resistance than mothers with low family income or who were unemployed. Other studies have also concealed a relation between education and other socioeconomic factors and good antibiotic knowledge (6, 20, 24, 25). For instance, in WHO's multi country awareness survey on antibiotic resistance, respondents with a higher level of education were more likely to have heard of the term antibiotic resistance (77%) compared to those with basic (60%) or no education (49%) (20). Moreover, a cohort study in Lebanon examined misconceptions and malpractices toward antibiotic use in childhood upper respiratory tract infections among parents.(24) It was found that significant factors associated with poor knowledge and misuses were parents' lower educational level and socioeconomic levels (24). Similarly, in a study performed in Singapore on knowledge, attitudes and practices towards antibiotic use in upper

respiratory tract infections, the same conclusion was drawn, and lower educational level significantly correlated to more misconceptions about antibiotics.(25) Additionally, a household survey on knowledge of antimicrobials and antimicrobial resistance performed in different regions of Tanzania, did also find that the level of public understanding rose with wealth status and education (6).

To conclude, there are some valuable findings. Most mothers in Moshi, Tanzania, had heard of a medicine called an antibiotic, and more than expected did also know pneumonia was to be treated with antibiotics. On the other hand, many had misconceptions about antibiotic therapy against cold and flu and other viral infections. However, this seems to be the case in many other parts of the world as well. Furthermore, amoxicillin was a well-known antibiotic to most participants. This is, in one manner a good result, since it is the first-line treatment against pneumonia, and a rather narrow spectrum antibiotic. Finally, good knowledge of antibiotic resistance seems to be associated with higher level of education, and related socioeconomic factors. This is important to be aware of so future interventions can be done in the right direction.

Although many questions were answered, some remains and new ones arose. Many mothers had misconceptions about what conditions should be treated with antibiotics. Anyway, it is not the mother's responsibility to know what condition her child is suffering, if it is bacterial or viral, and if antibiotic therapy is needed. This is up to the prescribing doctor or nurse. However, it would have been interesting to investigate what knowledge different health care workers have on antibiotic treatment and antibiotic resistance. In future studies, it would also be interesting to examine if parents' expectations affect the pattern of antibiotic prescribing. Many people in Tanzania have to travel far to visit a health facility, and therefore require

something that makes it worth it. Does the doctor feel the pressure of parents' expectations and prescribe antibiotics even if it is not needed? In addition, could a better knowledge of antibiotics and antibiotic resistance help this situation?

Furthermore, it would be interesting to do the same study on mothers from more rural areas of Tanzania. Since the majority of the Tanzanian population live in rural parts of the country, it would be more representative to this study. Future studies would also be interesting to carry out on mothers' or parents' antibiotic knowledge in Sweden. What knowledge about antibiotic treatment towards childhood respiratory tract infections do Swedish parents have? For example, do mothers know that amoxicillin is an antibiotic? And what do they know about antibiotic resistance? Does the knowledge differ between mothers and fathers and does it correlate to different socio-economic status? A Norwegian study investigated the knowledge of antibiotics and antibiotic resistance among pharmacy customers. They found out that more than 90% knew that bacteria could become resistant against antibiotics and that unnecessary use could make the antibiotics less effective (27). But interestingly, about one third incorrectly thought that viruses, colds or flu could be treated with antibiotics (27). Factors such as health professional background and high educational level had a positive effect on antibiotic knowledge (27). Although Norway is a high income-country there were still some important knowledge gaps. The country is comparable to Sweden and it would be interesting to know what knowledge and misconceptions Swedish parents have on antibiotics.

Strengths and weaknesses

Mothers who were interviewed in the study visited the hospital for maternal healthcare. There were mostly routine check-ups, meaning they were healthy women participating. This is a strength in two manners. Firstly, it is good in an ethical point of view, as the mothers

interrupted with an interview were neither sick nor bringing a sick child to the hospital.

Secondly, these mothers were perhaps more likely to participate, giving more of their time to the interview, answer the questions more carefully, and were more curious to learn something on the topic meanwhile. Another strength in this study was the questionnaire as a whole, including the structure and content. It contained many validated questions, and it had also been piloted, back-translated and revised several times in order to make it work as good as possible. Furthermore, a number of 182 mothers were included in the study which is well enough according to the sample size calculation.

However, there are some methodological considerations. Even if the questionnaire was validated and had been tested several times, there seemed to be some misinterpretation on a couple of questions. For instance, there might be possible misunderstandings between symptoms and diseases. “Cough” was the most common reply to the question about what diseases that can be treated with antibiotics. Did the mothers think of pneumonia when answering “cough”, or did they really think that cough as a single symptom needed antibiotics? The same issue appeared regarding the symptom “sore throat” and the disease tonsillitis. Many mothers thought both conditions were to be treated with antibiotics, but did the mothers really understand the difference between the two? Furthermore, one could also discuss how truthful the mothers answered the questions during the interview. For example, when the mothers were asked whether they had heard of antibiotic resistance, some might have replied yes even if they never had heard of the term. This could be because of feeling pressure or loss of interest.

The study population is also discussable. Mothers who visit the reproductive and child health clinic at KCMC were mostly living in urban areas (74%). A majority of the Tanzanian

population live in rural parts of the country, and therefore it would have been more representative if the study population included more mothers from rural areas. Data from the World bank states that 33% of the Tanzanian population was urban in 2017 (28). Additionally, the educational level of this study was very high compared to the average level in Tanzania and the Kilimanjaro region. According to the Basic Demographic and Socio-Economic Profile of the Kilimanjaro region from 2016, primary education was the most dominant level of education (81%) attained among population aged five and above (29). Only 2.4% of the population attained education from university level, which is much less than the frequency in this study (29). Almost half of the mothers who participated had been to university or college (45%), which presumably affected the results. Furthermore, the study population of this project was very rich compared to the general population in Tanzania, which may also affect the findings. The median of monthly household income was 400 000 TZS for the participating mothers in this study. In an analysis of household income and expenditure in Tanzania, findings from 2007 state that the mean monthly household income for the Tanzanian mainland is around 51 000 TZS (30). It also states that mean monthly incomes in rural household are much lower than incomes among urban households (30). All this implies that the study population of this study is not representative for the general population of Tanzania. Future studies on more similar population, regarding living area, educational level and economical status should be conducted.

Furthermore, women were collected by convenient sampling to participate in the study. Lack of time and resources made it not possible to do randomized sampling, which would have been more preferable. Parts of the interview performances are also good to take into consideration. Mothers were interviewed in the same area as the waiting room, where all the other women were present as well. Even if the interviews took place in a closed circle aside

from the bigger group of people, there were still opportunities for mothers to listen underhand and talk to each other about the topic, which could affect the results of the study. In order to translate the questions and replies, the interviews were held together with interpreters, in most ways a strength, but the risk for misinterpretations and misunderstandings will always exist.

Conclusion and Implications

In conclusion, results suggest that there is a lack of knowledge of antibiotics and antibiotic resistance, especially among mothers with lower levels of education. Misconceptions of what conditions should be treated with antibiotics are common and the issue of antibiotic resistance is still unknown to many. This is meaningful information and of medical relevance. Future studies should be done in order to address the problem further. Antibiotic resistance is a great threat to global health and incorrect use of antibiotics is accelerating the development.

Therefore, multiple strategies are needed to improve the public awareness and understanding of antibiotics, the effects of irrational use, and the dangers of antibiotic resistance. Since lower educational levels seem to be associated with poorer antibiotic knowledge, strategies such as public education and communication should be taken into action. To emphasize the conclusion, good knowledge and rational antibiotic use are crucial to fight the problem of antibiotic resistance.

Populärvetenskaplig sammanfattning

Kunskaper om antibiotikaresistens och hur man behandlar luftvägsinfektioner hos barn bland mödrar i Moshi, Tanzania

Antibiotika är läkemedel som bekämpar eller dödar bakterier. Därav används olika typer av antibiotika till att behandla infektioner som är orsakade av bakterier. Antibiotikaresistens innebär att bakterier genomgår genetiska förändringar och utvecklar en motståndskraft mot antibiotika. Tidigare botbara sjukdomar kan därmed vara svåra, eller rent utav omöjliga, att behandla när bakterier blivit resistenta och inte längre är känsliga mot den tidigare verksamma antibiotikan. Bristande kunskap samt felaktig användning av dessa läkemedel står i direkt relation till utvecklingen av antibiotikaresistens. Luftvägsinfektioner är bland de mest vanliga tillstånden som behandlas med antibiotika, och lunginflammation är den sjukdom som orsakar flest dödsfall bland barn i världen. På grund av antibiotikaresistensen riskerar många infektioner, däribland lunginflammation, att inte svara på tidigare botande behandling. Studier i Tanzania har visat på bristfälliga kunskaper bland allmänheten om antibiotika och antibiotikaresistens, hur och när dessa läkemedel ska användas samt att resistenta bakterier är utbredda i samhället. Antibiotikaresistens är idag ett stort hot mot den globala hälsan, då det leder till ökad dödlighet, förlängda vårdtider och högre sjukvårdskostnader. God kunskap inom ämnet samt rationell användning av antibiotika spelar en avgörande roll för att kunna bromsa utvecklingen av antibiotikaresistens.

Syftet med denna studie var att undersöka småbarnsmödrars kunskaper om antibiotikabehandling vid luftvägsinfektioner hos barn under fem år, samt deras kunskaper om antibiotikaresistens. Till syftet hörde även att kartlägga vilka orsaker som leder till överkonsumtion av antibiotika och om det fanns någon skillnad i kunskap om antibiotika

mellan olika utbildningsnivåer. Målsättningen med projektet var dessutom att belysa problematiken kring antibiotikaresistens samt öka kunskaperna hos befolkningen inom detta område. För att uppfylla ovannämnda syften genomfördes en tvärsnittsstudie under mars och april månad, 2019, på sjukhuset "Kilimanjaro Christian Medical Centre" i Moshi, Tanzania. Med hjälp av ett frågeformulär intervjuades totalt 182 mammor om deras kunskaper om antibiotika och antibiotikaresistens.

Resultaten visade att nästan alla mammor som var inkluderade i studien (96%) hade hört talas om antibiotika. En majoritet av dessa (72%) trodde helt korrekt att lunginflammation skulle behandlas med antibiotika, men många (63%) trodde även att tillstånd som förkylning och influensa skulle behandlas på samma sätt, vilket inte stämmer. Vidare hade merparten av deltagarna kännedom om att amoxicillin var en typ av antibiotika, men endast omkring hälften visste att penicillin var en annan sort av antibiotika. En femtedel trodde dessutom att det smärtstillande och febernedsättande läkemedlet paracetamol var ett antibiotikum.

Huvuddelen av alla inkluderade mammor (84%) var bekanta med läkemedelsresistens och runt hälften (57%) hade hört talas om begreppet antibiotikaresistens. Resultaten visade även på att hög socio-ekonomisk status hade ett samband med bättre kunskap om antibiotika och antibiotikaresistens. Mödrar med universitetsutbildning visade sig veta mer om antibiotika och läkemedelsresistens jämfört med mödrar med låg utbildning.

Sammanfattningsvis, visade denna studie på bristande kunskaper om antibiotika och antibiotikaresistens. Missuppfattningar om vad antibiotika är samt hur och när det ska användas, existerade hos flertalet deltagare i studien Detta innebär att insatser i utbildningssyfte av den allmänna befolkningen skulle kunna öka förståelsen om antibiotikaresistens och därmed minska olämplig användning av antibiotika.

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Appendices

Participant Questionnaire

DODOSO LA MSHIRIKI

BACKGROUND INFORMATION

STUDY ID NUMBER:.....

TAARIFAZAAWALI

<p>1. NAME OF HEALTH CENTRE <i>JINA LA KITUO CHA AFYA</i></p>		
<p>2. DATA COLLECTION DATE <i>TAREHE YA KUCHUKULIWA TAKWIMU</i></p>	YYYY/MM/DD:	
<p>3. NAME OF VILLAGE/STREET /WARD AND THE DISTRICT WHERE YOU LIVE <i>JINA LA KIJJI/MTAA NA KATA UNAPOISHI</i></p>	Go straight to question number 5.	
<p>4. WHICH OF THESE BEST DESCRIBES WHERE YOU LIVE? NI YAPI KATI YA YAFUATAYO YANA ELEZEA VEMA UNAPOISHI?</p>	<p>A) Urban B) Suburban C) Rural</p>	<p><i>A) Mjini B) Mchanganyiko C) Vijijini</i></p>
<p>5. MOTHER DATE OF BIRTH <i>TAREHE ALIYOZALIWA MAMA</i></p>	YYYY/MM/DD:	
<p>6. AGE OF MOTHER IN YEARS <i>UMRI WA MAMA KWA MIAKA</i></p>		
<p>7. EDUCATION MOTHER <i>ELIMU YA MAMA</i></p>	<p>A) Never been to school B) Some primary school C) Completed primary school D) Secondary school E) College or University</p>	<p><i>A) Hajawahi kwenda shule B) Hakumaliza shule ya msingi C) Amemaliza shule ya msingi D) Elimu ya Sekondari E) Chuo au Chuo Kikuu</i></p>
<p>8. CURRENT OCCUPATION MOTHER <i>KAZI YA MAMA KWA SASA</i></p>	<p>A) Employed B) Self-employed, specify..... C) Unemployed D) Student E) Other</p>	<p><i>A) Nimeajiriwa B) Nimejiajiri, ainisha:..... C) Sina ajira D) Mwanafunzi E) Nyingineyo</i></p>
<p>9. DO YOU HAVE A MEDICAL BACKGROUND?</p>	<p>A) Yes B) No</p>	<p><i>A) Ndio B) Hapana</i></p>

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<i>JE, WEWE NI MTUMISHI WA AFYA?</i>	
10. CHILD DATE OF BIRTH <i>TAREHE ALIYOZALIWA MTOTO</i>	YYYY/MM/DD:

IF THE MOTHER HAS BROUGHT TO THE CLINIC MORE THAN ONE CHILD BETWEEN ONE MONTH AND FIVE YEARS OLD, REFER TO THE YOUNGEST CHILD.

KAMA MAMA AMELETA MTOTO ZAIDI YA MMOJA, TAFADHALI ZUNGUMZIA KUHUSU MTOTO ALIE MDOGO KWA UMRI

11. AGE OF THE CHILD <i>UMRI WA MTOTO</i>	
12. GENDER OF THE CHILD <i>JINSIA YA MTOTO</i>	A) Female <i>A) Mwanamke</i> B) Male <i>B) Mwanaume</i>
13. HOUSEHOLD/FAMILY MONTHLY INCOME <i>KIPATO CHA KAYA KWA MWEZI</i>	
14. HOW MANY CHILDREN DO YOU HAVE? <i>UNA WATOTO WANGAPI?</i>	
15. HOW MANY CHILDREN IN THE HOUSEHOLD ARE UNDER FIVE YEARS OLD? <i>NI WATOTO WANGAPI KWENYE KAYA YAKO WANA UMRI CHINI YA MIAKA MITANO?</i>	
16. HOW MANY ROOMS ARE THERE IN YOUR HOME? <i>NYUMBA YAKO INA VYUMBA VINGAPI KWA UJUMLA?</i>	
17. HOW MANY ROOMS ARE USED FOR SLEEPING? <i>VYUMBA VINGAPI VINATUMIKA KWA KULALA?</i>	
18. DOES YOUR FAMILY HAVE A HEALTH INSURANCE? <i>JE, KAYA AU FAMILIA YAKO INA BIMA YA AFYA?</i>	A) Yes <i>A) Ndio</i> B) No <i>B) Hapana</i>

Appendix 1

ANTIBIOTIC KNOWLEDGE

UELEWA KUHUSU DAWA ZA ANTIBIOTIC

<p>19. HAVE YOU EVER HEARD OF A MEDICINE CALLED AN ANTIBIOTIC? <i>JE, UMEWAHI KUSIKIA AINA YA DAWA INAYOITWA ANTIBIOTIKI?</i></p>	<p>A) Yes B) No</p> <p>If No, go to question 26</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i></p>
<p>20. AGAINST WHICH ORGANISMS ARE ANTIBIOTIC USED? <i>ANTIBIOTIKI ZINATUMIKA KUUWA/KUSHAMBULIA WADUDU GANI?</i></p>	<p>A) Virus B) Bacteria C) Fungi D) Any microbes E) Do not know</p>	<p>A) <i>Virusi</i> B) <i>Kimela cha bakteria</i> C) <i>Fangasi</i> D) <i>Kimelelea chochote kile</i> E) <i>Sijui</i></p>
<p>21. WHICH DISEASE OR DISEASES DO YOU KNOW THAT CAN BE TREATED BY ANTIBIOTICS? <i>NI MAGONJWA GANI UNAYAFHAMU YANAYOTIBIWA KWA ANTIBIOTIKI?</i></p>		
<p>22. DO YOU THINK THESE CONDITIONS COULD BE TREATED WITH ANTIBIOTICS? <i>JE, UNAFIKIRI HIZI HALI ZINAWEZA KUTIBIWA NA ANTIBIOTIKI?</i></p>	<p>A) Bladder infection or urinary tract infection (UTI) Yes No</p> <p>B) Diarrhoea Yes No</p> <p>C) Pneumonia Yes No</p> <p>D) Cold and flu Yes No</p> <p>E) Fever Yes No</p> <p>F) Malaria Yes No</p> <p>G) Skin or wound infection Yes No</p> <p>H) Sore throat Yes No</p>	<p>A) <i>Bladder infection or urinary tract infection (UTI)</i> Ndio/Hapana</p> <p>B) <i>Diarrhoea</i> Ndio /Hapana</p> <p>C) <i>Pneumonia</i> Ndio/Hapana</p> <p>D) <i>Flu/mafua</i> Ndio/Hapana</p> <p>E) <i>Homa</i> Ndio/Hapana</p> <p>F) <i>Malaria</i> Ndio/Hapana</p> <p>G) <i>Infekishen ya ngozi au kidonda</i> Ndio/Hapana</p> <p>H) <i>Koo kuuma anapomeza</i> Ndio/Hapana</p>

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<p>23. WHEN YOUR CHILD NEEDS ANTIBIOTICS, HOW WOULD YOU GET HOLD OF THEM? PINDI MTOTO WAKO ANAHITAJI DAWA YA ANTIBIOTIKI, UTAIPATAJE?</p>	<p>A) Go to a health facility to get prescription B) Go directly to a drugstore/ pharmacy C) Get from a friend or a family member D) Get from a neighbour who is a health care professional E) Other, specify:..... F) Do not know</p>	<p>A) <i>Nenda Kituo cha Afya kupata.</i> B) <i>Nenda moja kwa moja duka la dawa/famasi</i> C) <i>Pata toka kwa rafiki au ndugu katika familia</i> D) <i>Pata kutoka kwa jirani ambae ni Mhudumu wa Afya</i> E) <i>Mengineo, ainisha:.....</i> F) <i>Sijui</i></p>
<p>24. ARE THERE MORE THAN ONE TYPE OF ANTIBIOTIC? KUNADAWA ZA ANTIBIOTIKI ZAIDI YA MOJA?</p>	<p>A) Yes B) No</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i></p>
<p>25. IF YOUR CHILD WAS FEELING BETTER AFTER HALF OF THE TREATMENT WITH ANTIBIOTICS, WOULD YOU STOP THE TREATMENT? KAMA MTOTO WAKO ANAPATA NAFUU KABLA YA KUMALIZA DOZI YA ANTIBIOTIKI, JE UTAACHA KUTUMIA HIZO ANTIBIOTIKI?</p>	<p>A) Yes B) No</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i></p>
<p>26. ANTIBIOTICS ARE MEDICINES THAT KILL OR FIGHT BACTERIA. WHICH OF THE FOLLOWING DRUGS DO YOU THINK ARE ANTIBIOTICS? ANTIBIOTIKI NI DAWA ZINAZOUA AU KUSHAMBULIA BAKTERIA. NI ZIPI KATI YA DAWA ZIFUATAZO NI ANTIBIOTIKI?</p>	<p>A) Amoxicillin B) Co-trimoxazole (Septrin) C) Panadol/ Paracetamol D) Penicillin E) Tetracycline F) ALU G) Metronidazole (Flagyl)</p>	<p>A) <i>Amoxicillin</i> B) <i>Co-trimoxazole (Septrin)</i> C) <i>Panadol/Paracetamol</i> D) <i>Penicillin</i> E) <i>Tetracycline</i> F) <i>ALU</i> G) <i>Metronidazole (Flagyl)</i></p>
<p>27. SOME MEDICINES THAT USED TO WORK IN THE PAST FOR FIGHTING INFECTIONS ARE NO LONGER WORKING. THIS PROBLEM IS CALLED DRUG RESISTANCE. HAVE YOU EVER</p>	<p>A) Yes B) No</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i></p>

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<p>HEARD OF THIS PROBLEM?</p> <p><i>BAADHI YA DAWA ZILIZOKUWA ZINATUMIKA MIAKA YA NYUMA KUPAMBANA DHIDI YA MAGONJWA AMBUKIZI HAZIFANYI TENA KAZI KWA SASA. HII SHIDA INAJULIKANA KAMA USUGU WA DAWA. JE, UMEWAHI KUSIKIAUSUGU WA DAWA?</i></p>		
<p>28. HAVE YOU EVER HEARD OF ANTIBIOTIC RESISTANCE?</p> <p><i>JE, UMEWAHI KUSIKIA USUGU WA DAWA ZA ANTIBIOTIKI?</i></p>	<p>A) Yes B) No</p> <p>If no, go to Question 31</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i></p>
<p>29. WHERE DID YOU HEAR THE TERM ANTIBIOTIC RESISTANCE?</p> <p><i>JE, NI WAPI ULISIKIAUSUGU WA DAWA ZA ANTIBIOTIKI?</i></p>	<p>A) Doctor or nurse B) Pharmacist C) Family member or a friend D) Media E) Specific campaign F) Other, specify: G) Do not remember</p>	<p>A) <i>Daktari au Muuguzu/Nesi</i> B) <i>Mfamasia</i> C) <i>Mwanafamilia au rafiki</i> D) <i>Vyombo vya habari</i> E) <i>Kampeni maalum</i> F) <i>Mengineyo, ainisha:.....</i> G) <i>Sikumbuki</i></p>
<p>30. PLEASE INDICATE WHETHER YOU THINK THE FOLLOWING STATEMENTS ARE “TRUE” OR “FALSE”</p> <p><i>TAFADHALI ONYESHA KAMA UNAFIKIRI SENTENSI ZIFUATAZO NI KWELI AU SIO KWELI</i></p>	<p>A) If bacteria are resistant to antibiotics, it can be very difficult or impossible to treat the infections they cause True False</p> <p>B) Antibiotic resistance is an issue that could affect my child, myself or my family True False</p>	<p>A) <i>Kama vimelea vya bacteria vinakuwa sugu dhidi ya antibiotiki, inaweza kuwa ngumusana au kushindikana kutibu maambukizi yanayosababishwan avyo</i> Kweli/Sio</p> <p>B) <i>Usugu wa dawa za antibiotiki ni kitu kinachoweza kumdhuru mtoto wangu, mimi mwenyewe au familia yangu</i></p>

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Kweli/Sio

C) Antibiotic resistance is an issue in other countries but not here
True False

C) *Usugu wa dawa za antibiotiki ni kitu chachi nyingine na sio/hapa*
Kweli/Sio

D) Antibiotic resistance is only a problem for people who take antibiotics regularly
True False

D) *Usugu wa dawa za antibiotiki ni shida tu kwa wale watu wanaotumia dawa za antibiotiki mara kwa mara*
Kweli/Sio

E) Bacteria which are resistant to antibiotics can be spread from person to person
True False

E) *Vimelea vya bacteria vilivyo sugu dhidi ya dawa za antibiotiki vinaweza kusambaa kutoka mtu mmoja kwenda kwa mtu mwingine*
Kweli/Sio

31. HAVE YOU EVER HEARD OF RESISTANCE TO MALARIAL DRUGS OR ANTIMALARIAL RESISTANCE?

UMEWAHI KUSIKIA USUGU WA DAWA ZA MALARIA?

A) Yes
B) No

A) *Ndio*
B) *Hapana*

Appendix 1

ANTIBIOTIC USE
MATUMIZI YA DAWA ZA
ANTIBIOTIKI

<p>32. HAS YOUR CHILD RECEIVED ANTIBIOTICS FOR RESPIRATORY TRACT INFECTIONS IN THE PAST 12 MONTHS? <i>JE, MTOTO WAKO AMEWAHI KUTUMIA DAWA YA ANTIBIOTIKI KUTIBU MAGONJWA AMBUKIZI YA MFUMO WA HEWA KATIKA MIEZI 12 ILIYOPITA?</i></p>	<p>A) Yes B) No C) Can't remember</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i> C) <i>Sikumbuki</i></p>
<p>A) IF YES, HOW MANY TIMES? <i>KAMA NDIO, NI MARA NGAPI?</i></p>		
<p>33. WHEN DID YOUR CHILD LAST TAKE ANTIBIOTICS AGAINST A RESPIRATORY TRACT INFECTION? <i>NI LINI MARA YA MWISHO MTOTO WAKO AMEPEWA DAWA YA ANTIBIOTIKI KWA AJILI YA MAAMBUKIZI YA MFUMO WA HEWA?</i></p>	<p>A) In the last week B) In the last month C) In the last 6 months D) In the last year E) More than a year ago F) Never G) Can't remember</p>	<p>A) <i>Wiki iliyopita</i> B) <i>Mwezi uliopita</i> C) <i>Miezi 6 iliyopita</i> D) <i>Mwaka uliopita</i> E) <i>Zaidi ya mwaka mmoja uliopita</i> F) <i>Hajawahi</i> G) <i>Sikumbuki</i></p>
	<p>If more than a year ago, never or can't remember, go directly to question 42.</p>	
<p>THE FOLLOWING QUESTIONS ARE ABOUT THE LAST TIME YOUR CHILD WAS GIVEN ANTIBIOTICS <i>MASWALI YAFUATAYO YANAHUSU MARA YA MWISHO MTOTO WAKO ALIPEWA DAWA YA ANTIBIOTIKI</i></p>		
<p>34. WHICH SYMPTOMS DID YOUR CHILD HAVE THE LAST TIME HE OR SHE RECEIVED ANTIBIOTICS FOR A RESPIRATORY TRACT INFECTION? <i>NI DALILI ZIPI MWANAO ALIKUWA NAZO MARA YA MWISHO ALIPEWEWA DAWA ZA ANTIBIOTIKI KWA AJILI YA MAAMBUKIZI KWENYE MFUMO WA HEWA?</i></p>	<p>A) Fever B) Rapid or difficult breathing C) Cough D) Stuffy or runny nose E) Sore throat F) Chest indrawing G) Other symptoms, specify.....</p>	<p>A) <i>Homa</i> B) <i>Kushindwa au kupumua haraka haraka</i> C) <i>Kikohozi</i> D) <i>Pua kuziba</i> E) <i>Koo kuuma anapomeza</i> F) <i>Kifua kuingia ndani</i> G) <i>Dalili nyinginezo, ainisha:.....</i></p>

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35. WHERE DID YOU GET THE ANTIBIOTICS?

ULIPATA WAPI ANTIBIOTIKI?

- | | |
|--|--|
| A) Medical store or pharmacy | A) <i>Duka la dawa au famasi</i> |
| B) Health facility (dispensary, hospital etc.) | B) <i>Kituo cha Afya (Zahanati, Hospitali, n.k.)</i> |
| C) Market | C) <i>Sokoni</i> |
| D) The internet | D) <i>Mtandaoni</i> |
| E) Family member or friend | E) <i>Kwa mtu wa familia au rafiki</i> |
| F) I had them saved up from a previous time | F) <i>Nilikuwa nazo za akiba toka mara ya mwisho</i> |
| G) Somewhere/someone else | G) <i>Mahali/kwa mtu mwingine</i> |
| H) Can't remember | H) <i>Sikumbuki</i> |

36. DID YOU GET A PRESCRIPTION FROM A DOCTOR OR A NURSE?

ULIPATA KARATASI YA KUNUNULIA DAWA KUTOKA KWA DAKTARI AU MUUGUZI/NESI?

- | | |
|-------------------|---------------------|
| A) Yes | A) <i>Ndio</i> |
| B) No | B) <i>Hapana</i> |
| C) Can't remember | C) <i>Sikumbuki</i> |

37. DID YOU GET ADVICE FROM A DOCTOR, NURSE OR PHARMACIST ON HOW TO TAKE THE ANTIBIOTICS?

ULIPATA USHAURI KUTOKA KWA DAKTARI AU MUUGUZI/NESI?

- | | |
|-------------------|---------------------|
| A) Yes | A) <i>Ndio</i> |
| B) No | B) <i>Hapana</i> |
| C) Can't remember | C) <i>Sikumbuki</i> |

38. DID A DOCTOR OR A NURSE PERFORM A PHYSICAL EXAMINATION OF YOUR CHILD BEFORE YOU RECEIVED ANTIBIOTICS?

JE, DAKTARI AU MUUGUZI/NESI ALIMFANYIA MTOTO WAKO UCHUNGUZI KWA KUMPIMA KABLA YA KUPEWA DAWA ZA ANTIBIOTIKI?

- | | |
|-------------------|---------------------|
| A) Yes | A) <i>Ndio</i> |
| B) No | B) <i>Hapana</i> |
| C) Can't remember | C) <i>Sikumbuki</i> |

39. DID YOUR CHILD COMPLETE THE LAST PRESCRIBED ANTIBIOTIC TREATMENT?

JE, MTOTO WAKO ALIMALIZA DOZI YOTEALIYOANDIKIWA?

- | | |
|-------------------|---------------------|
| A) Yes | A) <i>Ndio</i> |
| B) No | B) <i>Hapana</i> |
| C) Can't remember | C) <i>Sikumbuki</i> |

Appendix 1

<p>40. HAS YOUR CHILD EVER RECEIVED ANTIBIOTICS THAT BELONG TO SOMEONE ELSE? <i>JE, MTOTO WAKO AMEWAHI KUPEWA DAWA YA ANTIBIOTIKI ILIYOKUWA YA MTU MWINGINE?</i></p>	<p>A) Yes B) No C) Can't remember</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i> C) <i>Sikumbuki</i></p>
<p>41. HAS YOUR CHILD EVER RECEIVED LEFTOVER ANTIBIOTICS? <i>MTOTO WAKO AMEWAHI KUPEWA DAWA ILIYOBAKIZWA?</i></p>	<p>A) Yes B) No C) Can't remember</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i> C) <i>Sikumbuki</i></p>
<p>42. DO YOU KEEP ANTIBIOTIC STOCKS AT HOME? <i>JE, HUWA UNAHIFADHI DAWA ZA ANTIBIOTIKI NYUMBANI?</i></p>	<p>A) Yes B) No C) Can't remember</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i> C) <i>Sikumbuki</i></p>
<p>43. DO YOU CHECK THE EXPIRE DATE OF THE ANTIBIOTIC BEFORE YOU USE IT? <i>JE, HUWA UNAANGALIA TAREHE YA KUJARIBIKA YA DAWA YA ANTIBIOTIKI KABLA YA KUITUMIA?</i></p>	<p>A) Yes B) No C) Can't remember</p>	<p>A) <i>Ndio</i> B) <i>Hapana</i> C) <i>Sikumbuki</i></p>



UNIVERSITY OF
GOTHENBURG

Participant Information Sheet

This Informed Consent Form is for mothers with children under five years that we are inviting to participate in research on knowledge of antibiotic resistance and experiences of antibiotic treatment to children with respiratory tract infections.

We are..... from the Kilimanjaro Christian Medical College in Moshi, Community Health Department, in collaboration with University of Gothenburg in Sweden, supervised by Dr Florida Muro (PI Sia Msuya).

Fever and respiratory tract symptoms are common in children under five years of age. Some of these conditions can be treated with medicines called antibiotics. It is important to know what antibiotics are and their use, which can be challenging for parents and health care workers.

You as a mother are invited to participate in an interview because you are the sole taker of the child, therefore your experience will inform our findings. You may not receive any payment from participating, and you and your child may not benefit directly however, results from this study will benefit the society as a whole in the future.

You and your child's participation will be kept confidential, neither you nor your child's name will be recorded. Instead, a unique identification number will be used. We appreciate if you answer all the questions honestly and to the best of your knowledge. If there is any question you do not want to answer you are free to say so. You are also free to ask any questions.

Participating in this study may take some of your time (about half an hour), however, you are free to withdraw from this study at any time, and you do not need to give a reason. If you decide to withdraw, you can inform the interviewer/study coordinator and no new information will be collected about you or your child, other than that needed to keep track of your withdraw.

Your participation in this research is entirely voluntary. You are free to participate or not to participate in this study. Your and your child's right to receive care in this facility will not be affected if you chose not to participate. You will be provided a copy of this consent form for your references.

Appendix 2

Contact details

Local Principal investigator:

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College
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Appendix 3

CONSENT FORM

The purposes of this study and the study procedures, risks and benefits have been explained to me. I have been allowed to ask questions and my questions have been answered to my satisfaction. I have been told that I may contact the KCMC Ethics committee if I have questions about my rights as a research subject.

I confirm that I have read the participant information sheet/the participant information sheet has been read to me. I understand that my participation is voluntarily, and that I am free to withdraw at any time, without my legal rights being affected. I agree to take part in this study.

Name of participant..... Signature

Date.....

Name of researcher taking consent..... Signature

Date.....

Witness (if applicable).....Signature.....

Date.....

Appendix 4

CRERC FORM 07



TUMAINI UNIVERSITY MAKUMIRA

**KILIMANJARO CHRISTIAN MEDICAL UNIVERSITY COLLEGE
P. O. Box 2240, MOSHI, Tanzania**

RESEARCH ETHICAL CLEARANCE CERTIFICATE

No. 2415

Research Proposal No. 1162

Study Title: Health care workers' experiences of antibiotic prescription in children under five years presenting with fever or respiratory tract symptoms and the perspective of the caring parent. A qualitative study carried out in Moshi.

Study Area: Moshi Urban District

P. I Name : Matilda Emgård

Coinvestigators: Sia E.Msuya, Celina Mayo, Rose Mwangi, Florida J.Muro, Cecilia Rosenlind, Lovisa Svensson, Magret Lepp, Sussann Skovbjerg, Rune Andersson

Institution (s): Kilimanjaro Christian Medical University College

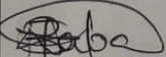
The Proposal was approved by CRERC on: 14th March 2019

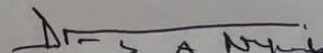
Duration of Study: One year

From: 14th March 2019 to 14th March, 2020

Name: BEATRICE Z. TEMBA

Name : PROF.MRAMBA NYINDO


Secretary - CRERC


Chairman - CRERC

Note: Final approval must be sought from NIMR