Antibiotic Use, Disposal and Awareness of Human Health Risk Associated With Consuming Antibiotics in Groundwater Among People Living in Informal Settlements of Kisumu, Kenya

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ANTIBIOTIC USE, DISPOSAL AND AWARENESS OF HUMAN HEALTH RISK ASSOCIATED WITH CONSUMING ANTIBIOTICS IN GROUNDWATER AMONG PEOPLE LIVING IN INFORMAL SETTLEMENTS OF KISUMU, KENYA

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Abstract

Background: Informal settlements across SSA have proliferated with increased urban population. Characterized by inadequate water supply, inhabitants resort to groundwater for domestic use. This happens oblivious of water contamination with emerging contaminants in form of antibiotics and their derivatives. Development of antibiotic resistant genes and antibiotic resistant bacteria, causes ill health, thus interventions that increase level of awareness of health effects of consuming water contaminated with antibiotics are requisite. This involves protecting human, animal and environmental in totality in a One-Health approach. This study sought to determine antibiotic use, disposal and level of awareness of health effects associated with consuming water contaminated with antibiotics.

Methods: A cross-sectional study of a random sample of 447 households in selected informal settlements of Kisumu County, Kenya was conducted in September 2019. A structured questionnaire was generated based on research questions and administered to heads of households to assess, antibiotic use, disposal and level of awareness of health effects associated with consuming water contaminated with antibiotics. Data was entered and analyzed in SPSS version 20.

Results: Level of awareness of health effects of consuming water contaminated with antibiotics was low, 35% (n=156), especially among households where a member had used an antibiotic within one month prior to the time of study; p=0.03. Groundwater was used by 99.8% (n=446) for various purposes, including drinking (9% (n=40)), cooking (18%(n=43)), washing utensils (79% (n=353)), clothes (96% (427)) and house (95% (421)). About half the households reported antibiotic use 43% (n=193). Among this, 74% (n=144) consulted a health worker in a healthcare facility for prescription. Respondents who had taken antibiotics did not always complete doses but reported to have kept the remainder for next time they would get sick (54%). About 32% disposed remainder of antibiotics in pit latrines, compost pits (10%) while 4% reported to have burnt them. **Conclusion and recommendation**: Groundwater is the major water source for domestic use in informal settlements. With low awareness of risks associated with consuming water contaminated with antibiotics, a looming public health concern due to antibiotic resistance necessitate attention to avert health effects that may lead to ill health.

Key words: human health effects, antibiotic use, antibiotic disposal, groundwater use, informal settlements

Introduction

Antibiotics are antimicrobial drugs used to kill or prevent bacteria growth and there are various classes of antibiotics used in humans and animals [1][2]. Antibiotic use is limited to persons confirmed to be suffering from a given infection and also is prescribed by a health worker in a health facility. Antibiotics have been classified as an emerging source of contaminants which need attention to prevent negative consequences to non-targeted humans, animals and ecosystems [3]. They can get into the environment through a various channels of entry including through; hospital

waste disposal, wastewater, sewage, animal waste and pit latrines adjacent groundwater sources [4][5][6].

Proliferation of informal settlements in cities in the SSA had led to increase need for housing [4]. This upsurge has led to increased demand for safe water for domestic use and sanitation [4]. While the quantity and quality of groundwater continue to be explored as source to supplement surface water sources used in most cities and towns, increased population and therefore human activity may lead to its contamination with a myriad of pollutants which include antibiotics [7][8].

Antibiotics in the environments are a public health risk and an emerging global threat to health systems due to rising antibiotic resistance [9]. Health effects of exposure to antibiotics have been documented in marine environments but involuntary exposure among humans in any other environment that they may have day to day direct contact with [3]. Effect on microbes treated using the same antibiotics found in the environment have been found to be resistance [1], which results to inability to treat infections due to development of resistance, making research in the area is significant. Knowledge of health effects as a result of exposure to antibiotics through drinking water is limited in the general population [10]. Prioritizing human health should be synchronized with protection of animal health, as well as that of the environment since a complex interaction among the three occur in an interaction otherwise referred to as the One-Health triad [11]. A One-Health approach [12]to achieve optimal health for the humans, animals and the environment is key in addressing the looming global antibiotic resistance burden. This paper aims to explore antibiotic use and disposal among households as well as the level of awareness of health effects as a result of consuming water that is contaminated with antibiotics is also assessed among people living in informal settlements.

Materials and Methods

A cross-sectional study of people living in selected informal settlements of Kisumu County in Kenya was conducted in the month of September 2019. The informal settlements were selected purposively since they fall within the mapped water points within the AFRIWATSAN project site[13]. The sample of households to be included into the study was randomly selected and determined based on the population[14] of each informal settlement. Proportionate allocation of households was employed to achieve the calculated sample size of 442 households. From each household, one head was selected to be included in the study and interviewed upon giving informed consent.

Households were randomly selected around mapped water points which acted as reference points and are within the AFRIWATSAN project site[13]. Every 5^{th} household was selected and included in the sample until the determined sample size [15] of 442 households was achieved. The 442 households were proportionately distributed among five (5) informal settlements in the study area, namely Manyatta A &B, Nyalenda A&B and Obunga, based on the total populations in each of the settlements. A structured questionnaire was administered to 448 household heads. Antibiotic use, disposal and awareness of health effects associated with consuming water that is contaminated with antibiotics was sought among the household heads. Data were entered in IBM* SPSS* Statistics version 20 and checked for errors. The dataset was cleaned and analyzed. Descriptive statistics were used to summarize continuous variables whereas relationships/ associations in categorical variables were assessed using chi-square tests.

Results

A total of 447 of households were visited in the five informal settlements. The number of households in each informal settlement were as follows: Obunga 24 (5.4%), Manyatta A 143 (32.1%), Manyatta B 89 (19.9%), Nyalenda A 96 (21.4%) and Nyalenda B (21.2%) There were more female (75% (n=337)) respondents than males, majority of whom were below the age of 45 years (79% (n=354)).

Ground water use

Almost all (99.8% n=446) of the respondents used groundwater sources. Groundwater was used for various purposes in the households, including drinking (9% (n=40)), cooking (18%(n=43)), washing utensils (79% (n=353)), clothes (96% (427)) and house (95% (421)). Respondents reported to have used the groundwater sources for a period of time that extended to 32 years (94%). Others reported to have found the water in use since they were born and could have been in use for more than 32 years.

Antibiotic use

Antibiotic use among households in the past one month before the day of the interview was reported to be 43% (n=193). Antibiotics were taken following a recommendation from friends 26% (n=13) and 76% (n=36) used antibiotics based on a previous experience. Among this consuming antibiotics, 26% (n=50) did not consult a doctor for the antibiotics prescription. The level of awareness of health effects of consuming water that is contaminated with antibiotics was found to be 35% (n=158), more so in households where antibiotic use was reported p=0.003. There was however no significant association between awareness of health effects associated with consuming antibiotic in water and groundwater use.

Discussion

Antibiotic use among persons living in informal settlements of Kisumu County was found to be at 43%. The antibiotics were either prescribed by a healthcare worker in a health facility, bought based on previous experience or advice from a friend. A prescription from qualified medical personnel is required for anyone to get access to antibiotics. Predictors of antibiotic use and misuse in a given family have been prescribed by [16] as perceived behavioral control, social norms, interaction between attitudes, beliefs and knowledge as well as the presence of a healthcare practitioner in the household. Self-medication using antibiotics is a factor in development of drug resistance, more often the practice is due to convenience of the user, leading to misuse of antibiotics [17]. The Ministry of Health acknowledges lack of information on antibiotic use and/or misuse in the population [10]. To this effect, the ministry indicates that a robust data collection system on surveillance on antibiotic use and awareness of health effects as a result of exposure to the antibiotics using a One-Health approach.

An estimated 60% of Kisumu residents live in the informal settlements, and suffer inadequacies like lack of water and proper sanitation facilities [14]. Contamination of groundwater sources have been found to be higher in areas where population density is high [18]. Antibiotics get into groundwater through various ways that include direct dumping with garbage, excreted through feces and urine, from hospital and industrial waste[1][19] and some of the antibiotics have been detected in water [20]. Some respondents reported to have kept the remainder of antibiotics not utilized for future use whereas others disposed in a pit latrine, compost pit or burned.

Antibiotics pose a threat to human and animal health as the effect as a result of involuntary exposure are not clear. This interaction of the humans, animals in the environment comprise a complex interact otherwise referred to as the One-Health triad [11]. Any pollutant that may be

present in the environment require attention to ensure protection of the components of both humans and animals.

Level of awareness on the health effects of consuming water that is contaminated with antibiotics was low (43%) among residents of the informal settlements of Kisumu County. Antibiotic use in Kenya has not been quantified making it difficult to implement guidelines [10] on use and resistance. The situational analysis further recommends intervention by increasing awareness of antibiotic use through public forums that target the providers and consumers of antibiotics. Conversely, an assessment of awareness of human health risk associated with antibiotic use among livestock keepers in Tanzania and knowledge of the antibiotic resistance concept show revealed that farmers were not aware of antibiotic resistance [21]. Some farmers did not know diseases treatable with antibiotics and that antibiotic use among livestock had health effects among humans. Customers in a pharmacy in Norway reported a high level of knowledge of antibiotic resistance [22]. There were however, knowledge gaps on the type of infections that are treatable with antibiotics, recommending campaigns to increase level of knowledge among persons in occupations who are not familiar with the health field [22].

Conclusion and recommendations

This study explored antibiotic use, disposal and level of awareness of health effects associated with consuming water contaminated with antibiotics among people living in informal settlements. Level of awareness of health effects was generally low even with the continued use of antibiotics, bringing to perspective efforts by the World Health Organization and government of Kenya the effectiveness of the awareness creation through the 'World Antibiotic Awareness week. This is an

annual event aimed at improving awareness and understanding of antimicrobial resistance and strengthen knowledge through surveillance and research among antibiotic providers and users. To effectively provide safe water for this population that is free of contamination especially with antibiotics, efforts should be geared towards awareness creation and implementation of the Global Action Plan that guarantees prevention and treatment of infections with safe and effective antibiotics which is couples with safe disposal of the antibiotics to reduce environmental contamination which results to antibiotic resistance. The realization of this goal is possible in a multidisciplinary teams instituted in the One-Health Approach.

Declarations

Abbreviations

ARG: Antibiotic Resistant Genes, ARB: Antibiotic Resistant Bacteria, MoH: Ministry of Health: AMR: Antimicrobial Resistance, SSA: Sub Sahara Africa

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Author's contributions

KJK was involved in conception of the study, data collection, entry and analysis and interpretation of the results and drafting of the manuscript. AA, AD, MM and RA were involved in the study

design, close study supervision and in the revision of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

All data related to this study will be made available upon request.

Ethics approval and consent to participate

Ethical clearance to conduct research was obtained from three institutions as follows; the Health Research Ethic Committee of the university of the Witwatersrand (HREC. Protocol Number M190412); the Kenyatta National Hospital and University of Nairobi Ethics and Research

Committee (KNH/UoN-ERC. Ref No. P71910/2018); and the National Commission for Science, Technology and Innovation (Ref No. NACOSTI/P/19/3232/28732).

Consent to participate in the study was obtained from the study participants before the interview was conducted. The study participants signed an informed consent form.

Consent for publication

Not applicable

Competing interests

The authors declare no competing interests.

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